Sukkur IBA Journal of Computing and Mathematical Sciences (SJCMS) is the bi-annual research journal published by **Sukkur IBA University**, Sukkur Pakistan. **SJCMS** is dedicated to serve as a key resource to provide practical information for the researchers associated with computing and mathematical sciences at global scale.

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Mission Statement

The mission of **Sukkur IBA Journal of Computing and Mathematical Sciences (SJCMS)** is to provide a premier interdisciplinary platform to researchers, scientists and practitioners from the field of computing and mathematical sciences for dissemination of their findings and to contribute in the knowledge domain.

Aims & Objectives

Sukkur IBA Journal of Computing and Mathematical Sciences aims to publish cutting edge research in the field of computing and mathematical sciences.

The objectives of **SJCMS** are:

1. to provide a platform for researchers for dissemination of new knowledge.
2. to connect researchers at global scale.
3. to fill the gap between academician and industrial research community.

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The research focused on but not limited to following core thematic areas:

Computing:
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- Formal Methods
- Human Computer Interaction
- Information Privacy and Security
- Computer Networks
- High Speed Networks
- Data Communication
- Mobile Computing
- Wireless Multimedia Systems
- Social Networks
- Data Science
- Big data Analysis
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- Crowdsource Management
- Ubiquitous Computing
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- Cloud Computing
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- Security, Privacy and Trust in Computing and Communication
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- Genetic Algorithms
- Robotics
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Mathematics:
- Applied Mathematical Analysis
- Mathematical Finance
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- Stochastic Processes

Patron's Message

Sukkur IBA University has been imparting education with its core values merit, quality, and excellence since its inception. Sukkur IBA University has achieved numerous milestones in a very short span of time that hardly any other institution has achieved in the history of Pakistan. The university is continuously being ranked as one of the best university in Pakistan by Higher Education Commission (HEC). The distinct service of Sukkur IBA University is to serve the rural areas of Sindh and also underprivileged areas of other provinces of Pakistan. Sukkur IBA University is committed to serve targeted youth of Pakistan who is suffering from poverty and deprived of equal opportunity to seek quality education. Sukkur IBA University is successfully undertaking its mission and objectives that lead Pakistan towards socio-economic prosperity.

In continuation of endeavors to touch new horizons in the field of computing and mathematical sciences, Sukkur IBA University publishes an international referred journal. Sukkur IBA University believes that research is an integral part of modern learnings and development. Sukkur lBA Journal of Computing and Mathematical Sciences (SJCMS) is the modest effort to contribute and promote the research environment within the university and Pakistan as a whole. SJCMS is a peer-reviewed and multidisciplinary research journal to publish findings and results of the latest and innovative research in the fields, but not limited to Computing and Mathematical Sciences. Following the tradition of Sukkur IBA University, SJCMS is also aimed at achieving international recognition and high impact research publication in the near future.

Prof. Nisar Ahmed Siddiqui
(Sitara-e-Imtiaz)
Vice Chancellor, Sukkur IBA University
Patron SJCMS

Editorial

Dear Readers,

It is a pleasure to present to you the fifth issue of (volume 3, issue 1) of Sukkur IBA Journal of Computing and Mathematical Sciences (SJCMS).

The stunning advances in various fields of science and technology have a profound impact on our lives in almost every sphere of our activity, such as health, agriculture, communication, transportation, and defense. These advances have been driven by an ever-growing volume of exciting discoveries, largely emanating from research community. In order to highlight the future technology challenges, the SJCMS aims to publish cutting-edge research in the field of computing and mathematical sciences for dissemination to the largest stakeholders. SJCMS has achieved milestones in very short span of time and is indexed in renowned databases such as DOAJ, Google Scholar, DRJI, BASE, ROAD, CrossRef and many others.

This issue contains the double-blind peer-reviewed articles that address the key research problems in the specified domain The SJCMS adopts all standards that are a prerequisite for publishing high-quality research work. The Editorial Board and the Reviewers Board of the Journal is comprised of renowned researchers from technologically advanced countries. The Journal has adopted the Open Access Policy without charging any publication fees that will certainly increase the readership by providing free access to a wider audience.

On behalf of the SJCMS, I welcome the submissions for upcoming issue (Volume-3, Issue-2, July-December 2019) and looking forward to receiving your valuable feedback.

Sincerely,

Ahmad Waqas, PhD
Chief Editor

Contents

A Priority Based Intelligent Transportation (IT) Assistance Model for Victims in Incident Environment Using Drone and eCall Technology

Sana Ullah [1]

Abstract:

With the advancement in information technology (IT), transportation sector has been evolved remarkably. Numerous technologies have been deployed to assist and manage transportation systems in emergency and incident situations. Assisting the serious injured in road accidents is extremely important on time and a little delay in medical assistance leads to huge lives loss. In this connection, a model "A Priority Based Intelligent Transportation (IT) Assistance Model for Victims in Emergency/Incident Environment Using Drone and eCall Technology" has been proposed which assist victims/accident injured on priority basis. The main breakthroughs of the proposed model are inclusive of diminished/minimized lives losses, saving time, speed up rescuing process; maximize efficiency, improving the transport results like traffic resilience, travel reliability, environment protection and road safety. For the validation of the proposed research model, a quantitative research approach (Survey) has been utilized. The expert opinions are gathered from field experts in different rounds through questionnaire. The hypotheses are assessed based on chi-squared test statistical method.

Keywords: *Intelligent Transportation System (ITS), Artificial Intelligence, Transportation, IT, Drone Technology, Mobile Technology, Incident environment, Emergency environment, Intelligent Transportation System (ITS), Incident detection*

1. Introduction

With the rapid increase in world population, road traffic is increasing rapidly. It ultimately boosts up business activities and as well vehicles and cars for transportation. City planning is an important phase to plan transportation routes well to decrease transportation issues. Proper transportation systems management can lead to attract foreigner investors, economy, social well-being and nation progress. Furthermore, the integration of technology plays a vital role in enhancing transportation [1]. Transportation is a legal sector which involves carrying of things. Due to more congestion in transportation, diverse issues have been faced which are inclusive of injuries in crash, high accidents rate, air pollution, traffic congestion. The integration of virtual technologies has diminished such faced problem up to some limit. The technological integrated transportation system is termed as Intelligent Transport System (ITS) [2].

The deployment of different technological systems in Intelligent Transport System (ITS) plays an important role in decreasing different traffic faced problems. The integrated information systems are including Traveler Information Systems, Regional Multimodal Systems, Electronic Toll Collection (ETC), Emergency Management Systems, Incident Management Systems, Transit Management Systems (ITS), Freight and Intelligent Transportation Management Systems. The integrated technologies play a vital role in control methods, policies and infrastructure. The Emergency Vehicle Preemption

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[1] *University of Electronic Science and Technology of China (UESTC).*
Corresponding Email: Sanaullah.cs@fuuast.edu.pk

1

(EVP), Transit Signal (ITS), Vehicle Data Collection (VDC) and Intelligent Transportation System (TMS) have significant role in reducing risks. Different technologies which can be integrated in Intelligent Transport System (ITS) are listed in Table-1 [3]. Different enabled technologies have been integrated in ITSs which is shown in the Table I.

Table I: ITS Enabled Technologies

S. No	Technologies	Systems
1	Communication	Wireless (Cellular or Wide Area) Wire line (Coaxial or Fiber Optic)
2	Data Storage and Processing	Compact Disc, Magnetic storage, Media Magnetic stripe cards, hard disks and data cartridges, smart cards.
3	Database Management Systems	Data Warehousing, Expert Systems,
4	Information Display	Cathode ray Tubes (CRTS), LCDs, Variable message sign.
5	Location	Dead reckoning, Map matching, GPS, Beacon based Vehicle Location
6	Sensors	Inductive Loops, Infrared Beams, Microwave (RADAR), LIDAR, Vision-based Sensors, Acoustic scanning Laser
7	Actuator	Gates and Displays

1.1. Major categories of Intelligent Transportation System (ITS)

The intelligent transportation system (ITS) is sub divided in six categories [4].

I. Advanced Traffic Management Systems (ATMS): The main aim of ATMS is to reduce traffic jam and as well to enhance quality of traffic services. It operates with ramp meter timing schedules, network signals, variable message signs, roadway loop detectors and video. There are around three elements of ATMS which include collection team members, support systems and real time traffic control systems.

II. Advance Travelers Information Systems (ATIS): In this, real time traffic information is sent to travel.

III. Commercial Vehicles Operation (CVO): It integrates diverse ITS technologies to improve efficiency and safety of commercial vehicles.

IV. Advanced Public Traffic Transmissions (APTS): It integrates different electronic technologies to improve efficiency and operations of large vehicles such as trains and buses.

V. Advanced Vehicles Control Systems (AVCS): It utilizes control systems, computers and sensors technologies to generate alerts for drivers in any unconditional situations. The core aim is boosting safety decreasing congestion on road [5].

VI. Advanced Rural Transports Systems (ARTS): Its main purpose is to handle problems of rural areas traffic. Road infrastructures differ by different attributes such as few alternative routes, mix of users, few navigational signs, curves, blind corners and steep grades [6].

1.2. Incident Management Systems

In Intelligent Transport System (ITS), incident management systems play an important role. It is best utilized whenever different incidents happened. It is helpful in incidents such as 9/11 attacks, 2018 Sichuan earthquake and SARS epidemic. The disaster assistive teams, ambulances and vehicles can track the suitable safe route to the affected regions. The World Health Organization (WHO) reported that in Europe accidents and injuries were around thirty-one thousand per year. The deaths due to transportation incidents will become fifth foremost reason by 2030 [15]. The integration of technologies in incident management areas is like prototype recognition, calculation, storage, data gathering make incident information exploration,

processing more efficient [7]. Incident management system is further divided into sub systems which are traffic management, incident detection, emergency response management and roadway incident management system. Diverse systems and models have been proposed for managing incident management which are inclusive of cyber physical system (CPS), critical incident management (CIMS) and many more. The details of systems are shown in Table II and Table III shows Regional Multimodal and Traveler Information Systems/ Information Management systems [8-11]

Table II: Incident Management Systems

Author (s)	Title	Problem	Solution
Jin Ki Kim November 2007	Efficiency of critical incident management systems: Instrument development and validation	A poor assessment of CIMS efficiency	CIMS efficiency model
Yaodong Wang November 2012	Perceptual control architecture for cyber-physical systems in traffic incident management	Problem of unified modeling for incompatible approaches of Cyber-Physical Systems (CPSs)	Perceptual Control Architecture of CPSs
S. Akhtar Ali ShahJune 2008	System architecture of a decision support system for freeway incident management in Republic of Korea	Inefficient freeway network in the post-incident scenario	FIAS - Freeway Incident Analysis System
Choi, E.H.C. March 2007	Multimodal user interface for traffic incident management in control room	Collection of critical data	Advanced MMUI systems for emergency management

Table III: Traveler Information Management & Regional Multimodal systems

Author (s)	Title	Problem	Solution
Natvig, M.K. December 2010	Flexible organization of multimodal travel information services	Inefficient and flexible establishment and provision of new and improved travel information services	Generic and multimodal ITS framework
Jianwei Zhang 2011	A multimodal transport network model for advanced traveler information systems	Delay time for data reading and compiling	Generic multimodal transport network model for ATIS applications
Zhong-Ren Peng September 1997	A methodology for design of a GIS-based automatic transit traveler information system	Inefficient system of trip planning for transit customers	GIS)-based automatic transit traveler information system (ATTIS)
Gerhard Schilka 2012	Use of ITS Technologies for Multimodal Transport Operations - River Information Services (RIS) Transport Logistics Services	Deficiency in transport planning and management processes	Next generation of multimodal transport management and information systems

1.3. Emergency Management Systems

The emergency management system is the discipline deals with risk avoidance and risks [12]. It is mostly related to natural hazards which are danger for human life such as mass movement, volcanic, geological, seismic, meteorological and hydrological. The emergency management system emergency management system monitors and the collected information is provided to transportation system for dealing with emergencies on priority. Incident management techniques and models changed with time, and new technological systems are proposed like optimal models, prototype models, Multi-commodity stochastic humanitarian inventory management model (MC-SHIC) which are utilized for efficiency, decision support and security purpose. The Table IV shows emergency management systems, while the Table V shows Vehicular Communication application and characteristics [13-16].

Table IV: Summarized literature of Emergency Management System

Author (s)	Title	Problem	Solution
James H. Lamberta January 2013	Understanding and managing disaster evacuation on a transportation network	Harmful performance of the region's transportation system	Analyze transportation system demand and system and its performance for emergency management
Eren Erman Ozguven April 2013	A secure and efficient inventory management system for disasters	Inefficient usage and distribution of emergency supplies	Multi-commodity stochastic humanitarian inventory management model (MC-SHIC)
S.W. Yoona, December 2008	Transportation security decision support system for emergency response: A training prototype	Challenging Task of decision making in emergencies	The emergency training prototype
Deng Chunlin 2012	Sample Average Approximation Method for Chance Constrained Stochastic Programming in Transportation Model of Emergency Management	Problem of the chance constrained stochastic programming	Optimal model for the transportation of emergency resource

Table V: Vehicular Communication application and characteristics

S. No	Application Name	Communication	Messaging Type	Message Period	Latency	Other Requirements
1	Emergency Electronic Break Lights	Ad hoc V2V	Event-triggered, time-limited broadcast	100 ms	100 ms	Range:300 m, high priority
2	Intersection Collision Warning	Ad hoc, infrastructure V2V,V2I	Periodic permanent broadcast	100 ms	100 ms	Accurate positioning on a digital map, high priority
3	Intersection Collision Warning	Ad hoc, infrastructure V2V,V2I	Event-Triggered time-limited Geo Cast	100 ms	100 ms	High priority
4	Hazardous Location Warning	Ad hoc, infrastructure V2V,V2I	Event-Triggered time-limited Geo Cast	100 ms	100 ms	High priority
5	Traffic Signal Violation Warning	Ad hoc, infrastructure I2V	Event-Triggered time-limited broadcast	100 ms	100 ms	Range:250 m, High priority
6	Pre-Crash Sensing	Ad hoc V2V	Periodic broadcast, unicast	100 ms	50 ms	Range: 50 m, high/mid priority for beaconing/unicast
7	Lane Changing Warning	Ad hoc V2V	Periodic broadcast	100 ms	100 ms	Relative positioning accuracy: < 2 m; range :150 m
8	Cooperative forward collision warning	Ad Hoc V2V	Periodic, event-triggered broadcast, unicast	100 ms	100 ms	Relative positioningaccuracy: <1m; range:150 m
9	Intersection Management	Infrastructure, ad hoc V2I,V2V	Periodic broadcast, unicast	1000 ms	500 ms	Positioning accuracy: < 5 m
10	Limited Access and Detour Warning	Infrastructure, I2V, other broadcast network	Periodic Broadcast	100 ms	500 ms	Mid/Low priority
11	Cooperative Adaptive cruise control	Ad hoc V2V	Unicast Broadcast	500 ms	100 ms	Mid priority
12	Electronic Toll Collect	Infrastructure, ad hoc V2I, Cellular	Periodic broadcast,unicast	1000 ms	200 ms	CEN DSRC
13	Remote Diagnosis/ JIT Repair Warning	Infrastructure, ad hoc V2I,V2V, Cellular	Unicast, broadcast, event-triggered	N/A	500 ms	Internet access Service availability
14	Media Download	Infrastructure; cellular, other broadcast network	Unicast, broadcast, on –demand	N/A	500 ms	Internet access Digital rights management
15	Map Download/ update	Infrastructure, ad hoc V2I,V2V, cellular, other broadcast network	Unicast, broadcast, on –demand	1000 ms	500 ms	Internet access Digital rights management Services availability
16	Ecological Drive assistance	Infrastructure, ad hoc V2I,V2V, cellular	Unicast, broadcast, on-demand	1000 ms	500 ms	Internet access service availability

The AIDER project was introduced for optimization of rescue management system with the main aim of reduction in road accidents. It is equipped with vehicles to detect post and pre-crashed situations. A specific box "black box" is used which holds different factors like terrain, speed, etc. to calculate all factors after and before accident happened. At the same time, it generates an automatic call to rescue center with the details which were assessed during and after accident. It helps in quick rescuing victims/injured [17]. Due to technological advancements, different intelligent transportation systems solutions have been introduced. The Japan, Europe and USA are on top in ITS technologies. In Europe, Smartway was developed, in Europe the, eSafety and in USA the Connected Vehicle Research (CVR) [18], [19], [20]. The prediction of road incidents duration is an important parameter in assisting the accident management system. In Korea, the Freeway Systems were introduced which can predict accident duration for large accident data set. Furthermore, the said model is helpful in mitigating congestion due to road accidents [21]. With the advancement in ITS technologies, the integration of new technologies in ITS is extremely important with the passage of time due to new environmental demands. A little deficiency may cause a huge lives loss, a huge waste of nonrenewable fossil energy, and degradation of quality of life, high pollution, pedestrians and vehicles. Three functionalities have been jointly integrated to manage safety and traffic. The functionalities are including the functionality of cognitive management is integrated in vehicle for exchanging traffic relevant information through knowledge inferring [22].

1.4. Drone Technology/Unmanned Aerial Vehicle (UAV) and Applications

Unmanned Aerial Vehicle (UAV) utilized by the logistics industry to provide transference of package, payload, food, drug, blood or other goods. A UAV based delivery allows quick delivery times, decrease response time, enhanced accuracy and decrease human cost and time. UAV makes the delivery service quicker and more convenient without human labor [23] [24]. In the recent trend, the market for delivery goods is high. The logistics industry introduces the UAV based delivery system for fast and efficient delivery. [25] [26] [27]. In previous eras, UAVs were only used for commercial, surveillance, military, police and other government agency's purpose, but UAVs is

currently in use as children's toys, delivering payloads, crop monitoring [28] and spraying, mapping [29] [30], search & rescue [31] [32], social coverage [33] etc.

In the field of medical, UAV plays a vital role to supply medicine, first aid kits, and different medical accessories of patient need and provide rescue service also [34] [35]. In the field of agriculture [28] [29] [30], UAVs used for automated planting, crop health monitoring, mine surveys, agriculture monitoring, groundwater discharge monitoring, plume tracking, air quality monitoring, avalanche patrols, wildlife surveys, forest inventory and fire mapping applications, monitoring of sport activity. Here, UAV survey delivers field data in less time to increase yields, provide assistive help of farmers and reduce costs, resources, etc. UAV technology has been used for observing forest along with the monitoring of deforestation, monitoring and assisting of highways. In addition, it is also being utilized in the field of transportation as payload delivery service in a professional way [36-41].

2. Proposed Model

2.1. Proposed Model Description
Figure 1 Model diagram has been described on details below.

2.1.1. *ITS Rescue Emergencies Services Center (IRESC)*
It is the core module of the proposed model. It controls all the activities such as receiving accident/emergency situation ubiquitously. After confirmation of accident, it provides an urgent first aid facility through UAV based on the received coordinates of the accident point. Along with this, for full medical assistance, it informs emergency services module to provide ambulances and police, etc.

2.1.2. *UAVs Based First Aid Services*
The UAVs Based First Aid Services module main responsibility is to get coordinates of the accident/demand point from ITS Rescue Emergencies Services Center (IRESC) to provide first aid medical services to seriously injured people.
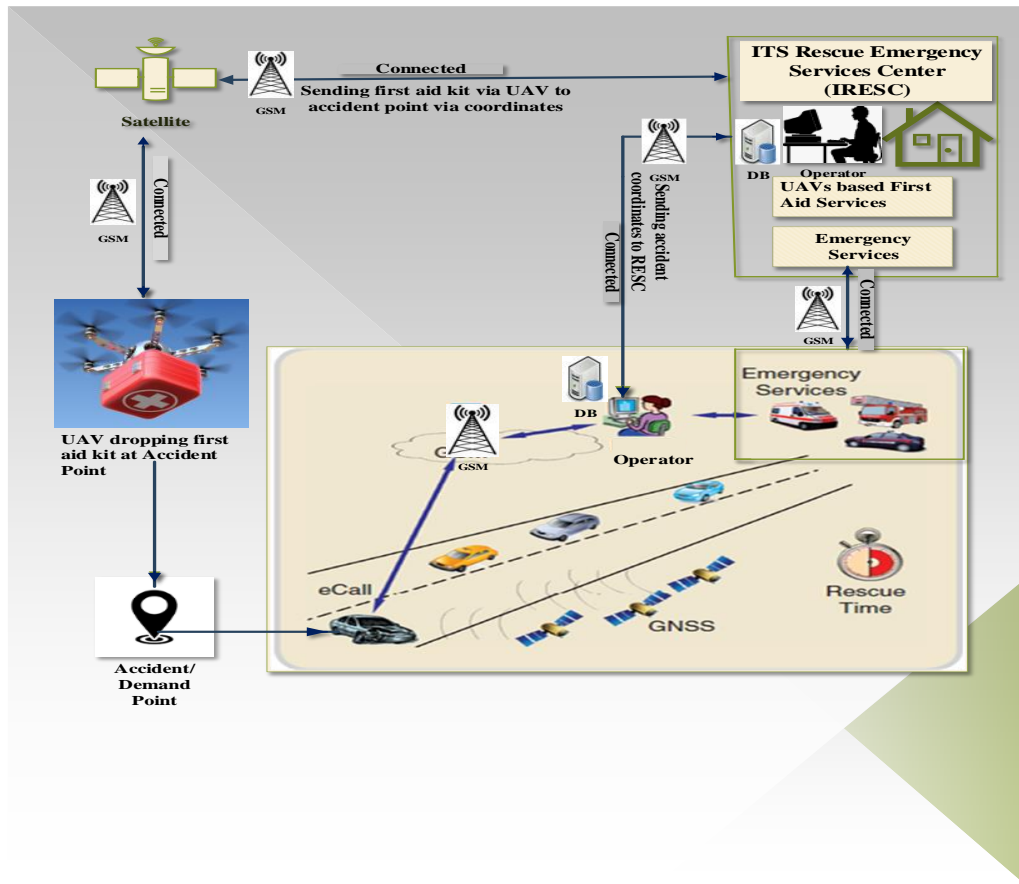
Figure 1: Model Diagram

2.1.3. Emergency Services

This module contains ambulance services and as well is connected with police department to assist accident/emergency situation in proper way. According to the coordinates received by IRESC, it reached the destination by following short root to assist victims appropriately.

2.1.4. Unmanned Aerial Vehicle (UAV)

The core component of the proposed framework is UAV which is used for the delivery of first aid medical assistance in emergency on urgent basis. It contains systems inclusive of meteorological events to obstacle avoidance, central control, Flight control system (FCS), emergency response system,

weather response system, on-board GPS, gyroscope, accelerometer and barometer, payload dropping and payload dropping mechanism and flyaway protection system. It should be fully programmable and customizable flight platform which can be controlled remotely around in the distance of a range of more than l5km. UAV should have the capability and flexibility for the additional attachment of required components. During the flight, all relevant data (UAV details, mission details, and real-time data) should be shared with the ITS Rescue Emergencies Services Center (IRESC). Two TB48D batteries used which are connected in the parallel system.

2.1.5. eCall

It is security and in-vehicle safety system mainly used for assistance in on-road travel. Whenever, vehicles collide with

some body or other vehicle then embedded sensors are automatically activated and generate an emergency voice call to the centralized database server of ITS Rescue Emergencies Services Center (IRESC). In addition, it also transmits the necessary information of accident with IRESC.

2.1.6. *Global Navigation Satellite System (GNSS)*
The short term used for Global Navigation Satellite System is GNSS. The main function of the proposed research model is to provide an autonomously geo-spatial position of the accident/emergency situation to IRESC for urgent assistance.

2.1.7. *Accident/Demand Point*
It is the actual accident/emergency area where accident happened and victims need to be assisted. Whenever accident happened, then through the eCall system embedded in the vehicles generates a call alert to the centralized database server. The centralized database server gets coordinates and proceeds rescue assistance process accordingly.

2.1.8. *Satellite*
Through the connected satellite, first aid medical assistance UAV can get coordinates of the accident area and handover the required kit to the emergency/demand point consequently. The centralized database server can feed coordinates and land UAV according to the demand in a ubiquitous mode.

2.1.9. *Centralized Database Server*
The centralized database server is maintained and controlled by IRESC operator. It maintains all information during road accident rescuing.

2.1.10. *Global System for Mobile (GSM)*
The Global System for Mobile communications stands for GSM. This standard describes protocols for mobile devices for second-generation (2G) digital cellular networks.

3. Research Methodology
In the proposed research work, the Delphi method has been used for validation. It is a quantitative research approach to collect expert opinions from different field experts about the proposed model through questionnaire. For final conclusion from the gathered experts' observations, the goodness of fit in chi-square test has been applied. The model is used to test hypotheses about the research model [42], [43].

3.1. Survey Population
For the validation and verification of the proposed model, around 60 participants were involved. The involved participants were selected based on professional accomplishments and technical awareness of the field. Table VI shows the characteristic of practitioner in which random sampling method was used for the selection of participants' panel.

Table VI:

Category of Responder	Gender		Age	Academic Level			Technology User	Non-Technology User
	M	F		Under Graduation	Post-Graduation	Master		
UAVs Delivery companies' employees	10	05	30-50	9	6	-	Yes	-
ITS Departmental Technologies experts	12	07	35-60	-	11	08	Yes	-
ITS Research experts	16	10	20-45	08	13	05	Yes	-
Total	38	22	-	-	-	-	-	-

3.2. Statement of the Hypotheses

The proposed intended to inspect the impact of adopting UAV
in ITS, through the hypotheses shown in Table VII.

Table VII: Hypotheses Statement

HYPOTHESES	STATEMENT
1	H_{01}: Proposed model is not reliable for the end user/rescue management authority. H_{11}: Proposed model is reliable for the end user/ rescue management authority.
	$H_{01.1}$: Proposed model does not provide virtual visiting of the road accident area. $H_{11.1}$: Proposed model provides virtual visiting of the road accident area.
2	H_{02}: UAVs not provide quick service than traditional one. H_{12}: UAVs provides quick service than traditional one
	$H_{02.1}$: Proposed model does not provide great assistive service to rescue management authority. $H_{12.1}$: Proposed model provides great assistive service to rescue management authority.
3	H_{03}: In proposed model, the rescue management authority cannot deliver first aid kit to the accident/demand point. H_{13}: In proposed model, rescue management authority can deliver first aid kit to the accident/demand point.
	$H_{03.1}$: Proposed model does not provide facility to road accident management authority. $H_{13.1}$: Proposed model provides facility to road accident management authority.
4	H_{04}: UAV legislation, chance of stolen, mishandling of UAV navigation create hurdles during the delivery process. H_{14}: UAV legislation, chance of stolen, mishandling of UAV navigation does not create hurdles during the delivery process.
5	H_{05}: Road accident management authority does not utilize control of UAV ubiquitously. H_{15}: Road accident management authority uses control of UAV ubiquitously.
6	H_{06}: Proposed model does not save time for the road accident management authority. H_{16}: Proposed model saves time for the road accident management authority.
7	H_{07}: Proposed model does not labor cost for UAV road accident management authority. H_{17}: Proposed model saves labor cost for UAV road accident management authority.
8	H_{08}: Participants don't support the proposed system H_{18}: Participants supports the proposed system.
9	H_{09}: Proposed model is not economically expensive. H_{19}: Proposed model is economically inexpensive.
10	H_{010}: Road accident management authority don't satisfy from the proposed system H_{110}: Road accident management authority satisfies from the proposed system because it assists seriously injured people during road accident on priority.

3.3. Analyzing Factors

This study presents results on ten tested null hypotheses. These hypotheses are tested on 0.05 level of significance using goodness-of-fit (Chi-square) test based on the above-mentioned hypotheses. The data is analyzed to check the efficiency and impact of the adopted features in the proposed model on the following observation factors which are shown in Table VIII.

Table VIII:

S.No	Analyzing Variable
1	Reliability.
2	Flexibility.
2	Impact of service efficiency.
3	Efficiency impact of Security.
4	Ease-of-use.
5	Efficiency impact of management authority time & cost reduction.
6	Efficiency impact of labor cost.
7	Efficiency impact of traceability & supports.
8	Efficiency impact of implementation cost.
9	Efficiency impact of management authority satisfaction.

3.4. Reliability of the Proposed System

RQ1: Proposed model is reliable for the end user/ rescue management authority.

Table-IX shows result of the chi-square test of goodness-of-fit shows that there is a significant difference in the frequencies at 0.05 level of significance $X^2 (60, 4) = 15.833$, $p = .003$. Therefore, the first null hypothesis has been rejected.

RQ2: Proposed model provides virtual visiting of the road accident area

Table-X the result of the chi-square test of goodness-of-fit shows that there is a significant difference in the frequencies at 0.05 level of significance $X^2 (60, 4) = 57.167$, $p = .000$.

Table IX: a. 0 cells (. 0%) have expected frequencies less than 5. The minimum expected cell frequency is 12.0.

	Observed N	Expected N	Residual	Chi-Square	df	Asymp. Sig.
Strongly Agree	19	12.0	7.0	15.833[a]	4	.003
Agree	20	12.0	8.0			
Neutral	6	12.0	-6.0			
Disagree	7	12.0	-5.0			
Strongly Disagree	8	12.0	-4.0			
Total	60					

Table X: a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 12.0.

	Observed N	Expected N	Residual	Chi-Square	df	Asymp. Sig.
Strongly Agree	34	12.0	22.0	57.167[a]	4	.000
Agree	14	12.0	2.0			
Neutral	5	12.0	-7.0			
Disagree	2	12.0	-10.0			
Strongly Disagree	5	12.0	-7.0			
Total	60					

RQ3: UAVs provides quick service than traditional one.
Table XI: The result of the applied test shows there is a significant difference in the frequencies at 0.05 level of significance $X^2 (60, 4) = 12.500$, $p = .014$. Therefore, the null hypothesis has been rejected

Table XI a. 0 cells (. 0%) have expected frequencies less than 5. The minimum expected cell frequency is 12.0.

	Observed N	Expected N	Residual	Chi-Square	df	Asymp. Sig.
Strongly Agree	18	12.0	6.0	12.500^a	4	.014
Agree	17	12.0	5.0			
Neutral	14	12.0	2.0			
Disagree	5	12.0	-7.0			
Strongly Disagree	6	12.0	-6.0			
Total	60					

RQ4: Proposed model provides great assistive service to rescue management authority.

Table-XII: The result of the applied test shows that there is a significant difference in the frequencies at 0.05 level of significance X^2 (60, 4) = 50.800, p =.000. Therefore, the null hypothesis has been rejected

RQ5: In proposed model, rescue management authority can deliver first aid kit to the accident/demand point.

Table XIII: The chi-square test statistics confirm that the number of participants who were agreed is significantly higher than those who were disagreed, X^2 (60, 2) = 12.100, p =. 002.

RQ 6: Proposed model provides facility to road accident management authority.

Table XIV: The result of this null hypothesis shows that there is a significant difference in the frequencies on 0.05 level of significance. X^2 (60, 5) = 67.600, p =. 000.

Table XII: a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 20.0

	Observed N	Expected N	Residual	Chi-Square	df	Asymp. Sig.
Yes	46	20.0	26.0	50.800^a	2	.000
No	6	20.0	-14.0			
I don't know	8	20.0	-12.0			
Total	60					

Table XIII: a. 0 cells (. 0%) have expected frequencies less than 5. The minimum expected cell frequency is 20.0.

	Observed N	Expected N	Residual	Chi-Square	df	Asymp. Sig.
Yes	31	20.0	11.0	12.100^a	2	.002
No	20	20.0	.0			
I don't know	9	20.0	-11.0			
Total	60					

Table XIV: a. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 20.0.

	Observed N	Expected N	Residual	Chi-Square	df	Asymp. Sig.
Yes	50	20.0	30.0	67.600^a	2	.000
No	4	20.0	-16.0	2		
I don't know	6	20.0	-14.0			
Total	60					

RQ7: UAV legislation, chance of stolen, mishandling of UAV navigation does not create hurdles during the delivery process.

Table XV: The statistics approve that the number of participants who were agreed is significantly higher than those who were disagreed, X^2 (60, 2) = 10.900, p =. 002. In this case, the null hypothesis has been rejected.

RQ8: Road accident management authority uses control of UAV ubiquitously.

Table XVI: The result of this null hypothesis show that there is a significant difference in the frequencies at 0.05 level of significance. X^2 (60, 5) = 48.600, *p* =. 000.

RQ9: Proposed model saves time for the road accident management authority.

Table XVII: There is a significant difference in the frequencies at 0.05 level of significance X^2 (60, 2) = 14.700, *p* =. 001.

Table XV: a. 0 cells (. 0%) have expected frequencies less than 5. The minimum expected cell frequency is 20.0.

	Observed N	Expected N	Residual	Chi-Square	df	Asymp. Sig.
Yes	32	20.0	12.0	10.900[a]	2	.004
No	13	20.0	-7.0			
I don't know	15	20.0	-5.0			
Total	60					

Table XVI: a. 0 cells (. 0%) have expected frequencies less than 5. The minimum expected cell frequency is 10.0.

	Observed N	Expected N	Residual	Chi-Square	df	Asymp. Sig.
Much more user friendly	29	10.0	19.0	48.600[a]	5	.000
Somewhat more user-friendly	2	10.0	-8.0			
Not more or less user-friendly	6	10.0	-4.0			
Somewhat less user friendly	5	10.0	-5.0			
Much less user-friendly	12	10.0	2.0			
I don't know	6	10.0	-4.0			
Total	60					

Table XVII: a. 0 cells (. 0%) have expected frequencies less than 5. The minimum expected cell frequency is 20.0.

	Observed N	Expected N	Residual	Chi-Square	df	Asymp. Sig.
Yes	34	20.0	14.0	14.700[a]	2	.001
No	13	20.0	-7.0			
I don't know	13	20.0	-7.0			
Total	60					

RQ 10: Proposed model saves labor cost for UAV road accident management authority.

Table XVIII: The result shows that the number of participants who were agreed is significantly higher than those who were disagreed on said hypothesis, X^2 (60, 4) = 30.400, *p* =. 000. Therefore, the seventh null hypothesis has been rejected.

RQ 16: Participants support the proposed system.

Table XIX: Result shows that the number of participants who were agreed is significantly higher than those who were disagreed in the said hypothesis. X^2 (60, 4) = 32.500, *p*=. 000. In this situation, the null hypothesis is rejected.

RQ 12: Proposed model is economically inexpensive.

Table XX: There is a significant difference in the frequencies at 0.05 level of significance. X^2 (60, 2) = 36.400, the *p*=.000.

RQ 13: Road accident management authority satisfies from the proposed system because it assists seriously injured people during road accident on priority.

Table XXI: shows there is a significant difference in the frequencies at 0.05 level of significance. X^2(60, 5) = 42.167, *p* =. 000.

Table XVIII: a. 0 cells (. 0%) have expected frequencies less than 5. The minimum expected cell frequency is 20.0.

	Observed N	Expected N	Residual	Chi-Square	df	Asymp. Sig.
Yes	40	20.0	20.0	30.400[a]	2	.000
No	12	20.0	-8.0			
I don't know	8	20.0	-12.0			
Total	60					

Table XIX: a. 0 cells (. 0%) have expected frequencies less than 5. The minimum expected cell frequency is 20.0.

	Observed N	Expected N	Residual	Chi-Square	df	Asymp. Sig.
Yes	40	20.0	20.0	32.500[a]	2	.000
No	5	20.0	-15.0			
I don't know	15	20.0	-5.0			
Total	60					

Table XX: a. 0 cells (. 0%) have expected frequencies less than 5. The minimum expected cell frequency is 20.0.

	Observed N	Expected N	Residual	Chi-Square	df	Asymp. Sig.
Yes	42	20.0	22.0	36.400[a]	2	.000
No	8	20.0	-12.0			
I don't know	10	20.0	-10.0			
Total	60					

Table XXI: a. 0 cells (. 0%) have expected frequencies less than 5. The minimum expected cell frequency is 12.0

	Observed N	Expected N	Residual	Chi-Square	df	Asymp. Sig.
Strongly Agree	32	12.0	20.0	42.167[a]	4	.000
Agree	9	12.0	-3.0			
Neutral	7	12.0	-5.0			
Disagree	6	12.0	-6.0			
Strongly Disagree	6	12.0	-6.0			
Total	60					

3.5. Descriptive Statistics Discussion

Table XXII associates all null hypothesis variables in single tabular. It collects all variables of null hypothesis and shows that the number of participants who were agreed is significantly higher than those who were disagreed in all hypothesis case.

Table XXII:

S.No	Variable	N	Mean	Std. Deviation
1	Reliability.	60	2.40	1.278
2	Flexibility.	60	2.42	1.394
2	Impact of service efficiency.	60	1.63	0.736
3	Efficiency impact of Security.	60	1.72	0.846
4	Ease-of-use.	60	2.78	1.941
5	Efficiency impact of road accident management authority time & cost reduction.	60	1.65	0.820
6	Efficiency impact of labor cost.	60	1.47	0.724
7	Efficiency impact of tractability & supports.	60	1.58	0.869
8	Efficiency impact of implementation cost.	60	1.47	0.769
9	Efficiency impact of road accident management authority satisfaction.	60	2.08	1.406

The analyzing of overall results shows that reliability and flexibility have a maximum mass of agreement from participants respectively which are shown in the table XXIII.

Table XXIII:

Hypotheses	α	P-value	Null Hypotheses	Conclusion
RQ-1		.003		Proposed UAV based first aid kit delivery model is reliable for the road accident management authority.
RQ-2		.000		Proposed model provides virtual visiting of accident/demand point.
RQ-3		.014		UAV based delivery service faster, safer and more cost-effective than traditional one.
RQ-4		.000		Proposed model provides great assistive service to visit accident/demand point.
RQ-5		.002		In proposed model, road accident management authority can deliver first aid kit to accident/demand point.
RQ-6	0.05	.000	Rejected	Proposed model provides facility to road accident management authority
RQ-7		0.004		UAV legislation, chance of stolen, mishandling of UAV navigation not create hurdles during the delivery process.
RQ-8		.000		Road accident management authority controls the UAV ubiquitously.
RQ-9		.001		Proposed model saves time for the road accident management authority.
RQ-10		.000		Proposed model saves time and labor cost for UAV based first kit delivery in road accident management authority.
RQ-11		.000		Participants support the proposed UAV based delivery system for road accident management.
RQ-12		.000		Proposed model is economically inexpensive.
RQ-13		.000		Road accident management authority is satisfied from the proposed system because it provides UAV based first kit delivery in road accident on priority based in emergency.

Table XXIII represents a summary of the results of the all null hypotheses. The table shows all null hypotheses are rejected at the 0.05 level of significance.

4. Conclusion

Different research projects have worked on accident/emergency situations to assist properly. In the proposed drone technology and eCall technology to assist seriously injured in road accident in intelligent transportation system (ITS). In the first emergency situation, first aid kit or needed medical assistance are provided to more needed injured to whom urgent medical assistance is required on priority basis through drone technology. In the second phase, proper ambulance and other services are provided. The main aim of the model is to provide on time medical assistance to road accident injured whose lives can be lost with a little bit delay in urgent medical assistance. Furthermore, the other advantages of the proposed model are including to diminished/minimized lives losses, saving time, speed up rescuing process; maximize efficiency, improving the transport results like traffic resilience, travel reliability, environment protection and road safety.

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Exploring the Impact of Mathematics Perception on Students' Performance

Bakh Rani[1], Sher Muhammad Daudpota[1]

Abstract:

The aim of this study is to analyze students' attitude and interest in Mathematical courses. Additionally, students' perception on teaching methodology adopted by the teachers is also analyzed in this study. This study investigated a relationship between students' perception and their Mathematics results. There were 330 students selected using random sampling, from different departments who were taking Mathematics course in fall 2017 at Sukkur IBA University. A survey was conducted through questionnaire and data were collected. Using inferential statistics (Pearson correlation, One-way ANOVA test and Independent t-test), data analysis was performed through statistical package (SPSS) version 19.0. The results specify that the level on students' perception towards Mathematics subject is good among all departments and there is a negative non-linear relationship between students' perception and their Mathematics courses results. Furthermore, it was concluded that male and female contain good and same level of perception about the subject.

1. Introduction

Some factors are considered important in learning process of a subject at educational institutes. They can highly influence students' performance in the subject positively or negatively. The factors that can affect students' performance can be their interest and attitude towards the subject, their learning strategies towards the subject, teacher's teaching methodology and so on. So, the student's performance in the subject depends on student's perception about the subject. Different subjects are being taught at Sukkur IBA University, Mathematics is one of them. It is applicable to many educational fields for example Engineering, Business, Computer Science. The subject of Mathematics needs thinking and logical reasoning while solving different problems. Most of the times it is being heard that Mathematics is a difficult subject, and some reply it as that nothing is difficult, it is all about our perception.

According to the study [1], one's attitude towards a subject plays a key role in the subject understanding. Attitude is an expression of showing favorableness or un-favorableness towards any object whether it is a person or a thing. Attitude in a person can be developed from a persons' past or present experiences and that results in positive attitude or negative attitude.

Interest is the emotional level that causes a person to be attentive towards an object that is when object attraction becomes high, an interest is developed towards that object. In study [4], It has been analyzed that performance in mathematics is highly influenced by one's interest towards the subject. A student's efforts and enthusiasm in learning a subject show their level of interest towards the subject.

Teaching methods of a teacher shows a teachers' ability of teaching a subject. So, teaching methodology of a teacher's is a crucial factor in the perception model to determine students' achievement in a subject [7]. It is very important to know that what teaching methods and strategies a teacher is applying during the teaching process. The study [8], believes that throughout the teaching process, a teacher's appearance, teaching strategies and his/her style of declaring the lecture can have a high influence on students' understanding towards the

[1] *Department of Computer Science, Sukkur IBA University Sukkur, Pakistan*
Corresponding Email: engr.bakh@gmail.com

subject. The teacher should make some efforts to provide the effective material to students and other teaching aids for example providing help after lecture scheduled times, in order to make learning process easy for them.

In this paper, in Section II Literature review is provided. Problem Definition is stated explicitly in Section III. section IV consists of Methodology for solving the Problem, section V discusses the results and finally Conclusion and Future Directions are explained in section VI.

2. Literature Review

Positive or negative perception of a student in a subject can highly impact students' performance. Perception of a student can be measured by many factors like attitude, interest, motives, cognitive structure, expectations, teachers' teaching methodology and so on. This study intends to find the relation between students' perception and students' perception about subject. Three factors are considered for this study, they are attitude, interest and teachers' teaching methodology. A person with a positive attitude can learn the subject in a better way as compared to a person with negative attitude. So, this negative attitude during the subject learning needs to be changed to achieve satisfactory results, [2]. The mathematics subject needs a lot of thinking and it is impossible with a negative attitude. According to [3], only positive attitude can make a student think in a creative style and to be active in learning process. The study further states that positive attitude can motivate student to participate in the group study and discussions which can have beneficial effect on his/her communication skills.

Along with positive attitude, student should also develop some interest towards the subject. Study [5] analyzed the difference between general interest in Mathematics and an interest to participate in the Mathematical activities, students with the latter are beyond the level of simple calculations and algorithms. The study [6] found that high interest towards a subject can increase the students' performance level in a subject and students will want to understand the subject in depth.

There is a significant role of teacher or his/her teaching style in developing the interest and positive attitude among students towards the subject. The study in [9], analyzed that if a student's perception about the subject teacher is not good because of his/her teaching methodology, then it will cause a negative attitude towards the subject. There should be good communication and cooperation among students and teacher during learning process.

The inferences from the study [11] showed that students' perception can have significant impact on students' performance in Mathematics subject. According to the study

[12], some myths about the mathematics are widespread among students can cause the students' negative perception towards the subject, which leads to the poor student performance in class and poor mathematics results. The study [15] provides an overview of past research that has investigated the association between math anxiety and math achievement, factors that can cause math anxiety, characteristics of students that can increase their susceptibility to math anxiety, and efforts that educators can take to remedy math anxiety. A study presented in [16] analyzed that teachers' role influenced students' interest and their mathematics achievement. The teacher's role as a motivator was factored as the delivery of learning goal and learning comfort and the author came up with some effective results.

3. Problem Identification

As stated earlier, Mathematics is one of the challenging subjects and considered difficult among students of each level and they believe that Mathematics is just for talented and extraordinary students. This assumption and bad perception cause lack of confidence and thus affects students' results. So, the study aims to investigate whether students' perception effect on their Mathematics performance.

Sukkur IBA University, a public-sector university in Pakistan, offers different Mathematical courses to engineering, business and computer science students. During previous years, a high failure rate and low scores/GPA in Mathematics related courses has been observed in each department. It can be further illustrated from the students' performance chart given below:
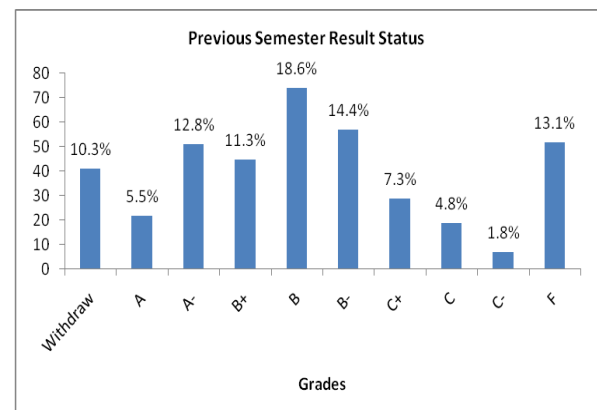

Figure 1: Previous Semester Result Status

From figure it can be observed that 13.1% failed the subject and 10.3% withdrew from final exam. 44% students passed the

subject in B category, only 18.4% students passed the subject in A category and nearly 14% students passed in C grade category. Hence students with good grades are less.

To achieve the cause behind this high failure rate and low grades, the study aims to explore the perception of students regarding the teaching methods of their Mathematics lecturer, their attitude and interest towards Mathematics subject.

4. Methodology

4.1. Hypothesis of the Problem

The main objective of the study is to investigate whether the students' perception about the subject effects on students' performance in Mathematics. Whereas four hypotheses are derived to investigate the study based on research question. Because data should be tested in every perspective before stating any results.

- Hypothesis-1: Whether there is any difference in students' level of perception among all departments?
- Hypothesis-2: Analyzing the Perception level of both gender categories i.e. male and female.
- Hypothesis-3: Is there any positive or negative relation between gender discrimination and students' performance in Mathematics subject.
- Hypothesis-4: Examining the relationship of students' perception among all departments with their performance in Mathematics subject.

4.2. Data Collection

The data was collected through a questionnaire from undergraduate students of Business Administration Department (BBA), Department of Computer Science (BCS) and Electrical Engineering Department of Sukkur IBA University during their fall semester 2017. The purpose of this analytical study is to describe the level of students' perception towards Mathematics.

4.3. Perception Model

The concept of the study is taken from a previous study [4] that is done recently [4]. Fig 2. represents the model of Students' perception towards Mathematics. According to the model, student's Interest and Attitude and Teacher's teaching ability play an important role in the Mathematics performance of student.

There are many components which can be included in students' perception towards Mathematics as specified by [12] which has presented a Mathematical Perceptions development model.
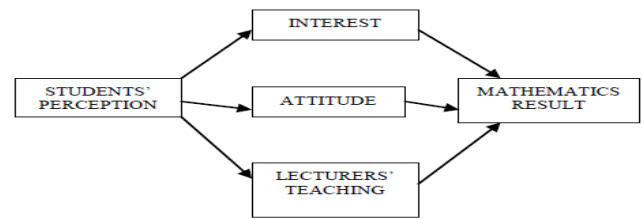

Figure 2. Perception Model for Students Towards Mathematics

4.4. Data Sampling Procedure

The target population for this study consists of undergraduate students of Sukkur IBA University. A sample of three hundred and three (303) students was taken from the target population. The undergraduate students of the three-targeted departments of the institute which offers Mathematical courses in fall semester 2017. Sampling procedure for this study consists of two stage sampling, stratified sampling and Simple random sampling technique.

- **Stratified Sampling:** In first step Stratified sampling was performed. The stratification covered three departments of the Institute which are Business Administration (BBA), Computer Science (BCS) and Engineering (BEE). The final year students are not included in these strata as they didn't have any Mathematics Course in fall semester 2017.

- **Simple Random Sampling:** After doing stratification, in second step, students were randomly selected from each stratum through simple random sampling technique. There were 330 students from which 190 students from BBA department, 60 from BEE department and 80 from BCS department were included in the sample.

- **Sample Size:** Eight hundred (800) students were enrolled in Business Administration (BBA), Computer Science (BCS) and Engineering (BEE) departments. The sample size was calculated using sampling calculator available at this [14] website. So, a sample size of 330 is obtained using population size of 800 with 95% Confidence level.

4.5. Research Instrument

Data collection was performed through a questionnaire based on 4-point Likert scale. Data collected was of qualitative type and then was converted into quantitative data. One part of the questionnaire consists of some demographic information such as field and year of the study whereas other one included 30 questions based on three domains that is 11 for Attitude Domain, 8 for Interest Domain and 11 for students' perception

on teachers' teaching methodology. In questionnaire, 1-19 items were based on endorsement scale rated as strongly agree (4), agree (3), disagree (2), strongly disagree (1) and reverse was considered for negative items and for remaining 10 items, 20- 30 items were based on frequency scale rated as Always (4), Often (3), Rarely (2), Never (1) and reverse scale was considered for negative items.

The reliability index of the instrument was determined by the Cronbarch Alpha test. The Alpha value for the instrument is 0.81 which is a satisfiable value and shows the consistency and reliability of items in the instrument [13]. Also, the Alpha values of each domain was described which are satisfiable values and given in the Table I.

Table I. Distribution of Items based on Domain

Domain	No. of Items	Alpha Values, α
ATTITUDE	3,5,6,8,9,10,11,24, 25,26,27	0.81
INTEREST	1,2,4,7,20,21,22,23	0.85
TEACHERS' TEACHING	12,13,14,15,16,17, 18,19,28,29,30	0.52

4.6. Mathematics Result

Students' performance indicator for Mathematics was taken as their Mathematics scores (out of 100) based on results of fall 2017. The score of failed students was zero 0. Students' Mathematics result was gathered from academic records in the University.

5. Data Analysis

5.1. Data Preprocessing

The collected data from the research instrument was first preprocessed that is, non-serious responses of students and missing answers were removed. The remaining 318 responses out of 330 were then, measured for further data analysis.

5.2. Questionnaire Visualization

The figures given below are giving a complete visualization of questions with students' responses that are used in survey to collect the data. Figure 3a and 3b are representing the students' attitude and interest towards Mathematics Subject. Figure 4a and 4b are visualizing perception of students about teachers' teaching methodology.
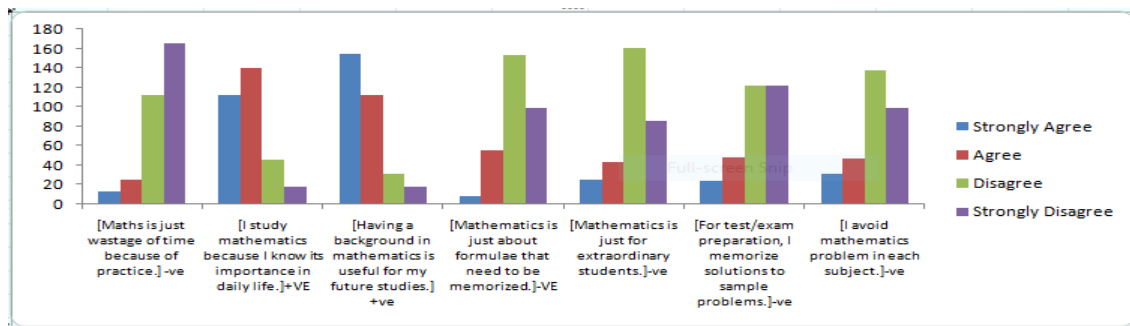

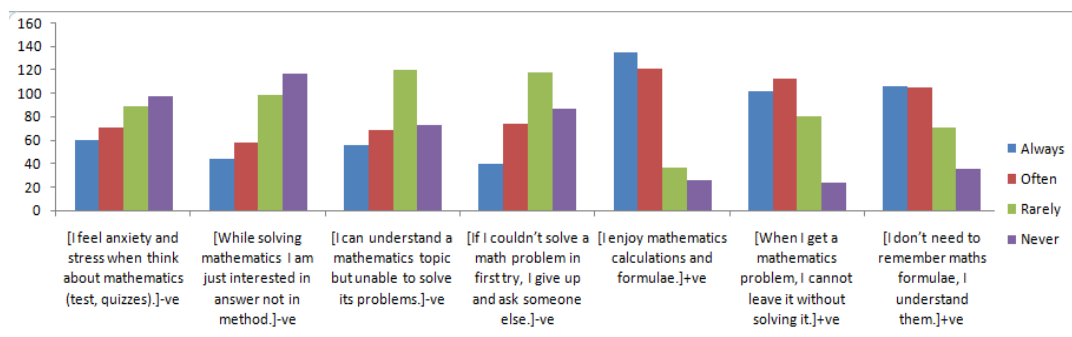Figure 3a. Students' response showing attitude and interest

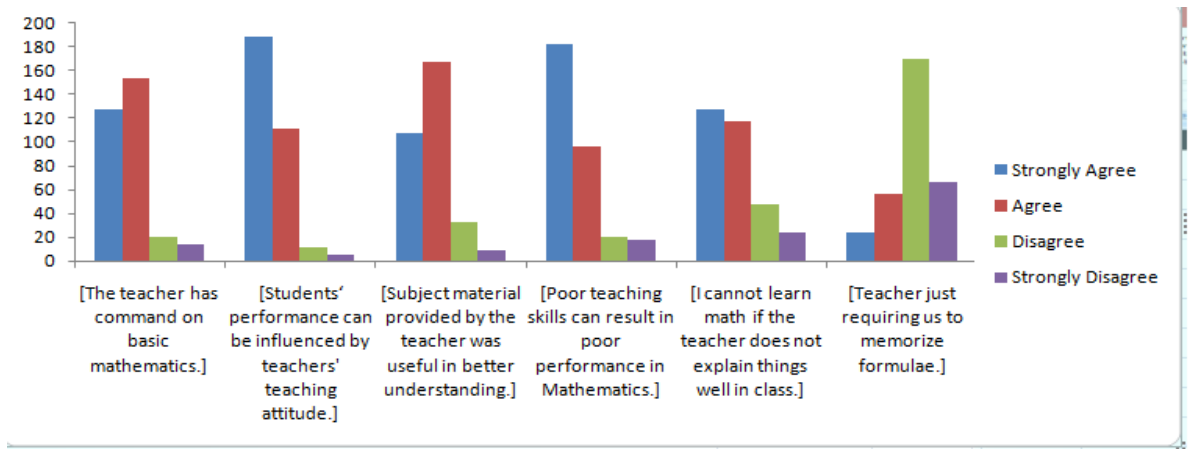Figure 3b. Students' response showing attitude and interest

Figure 4a. Students' response representing Teachers' teaching ability according to students
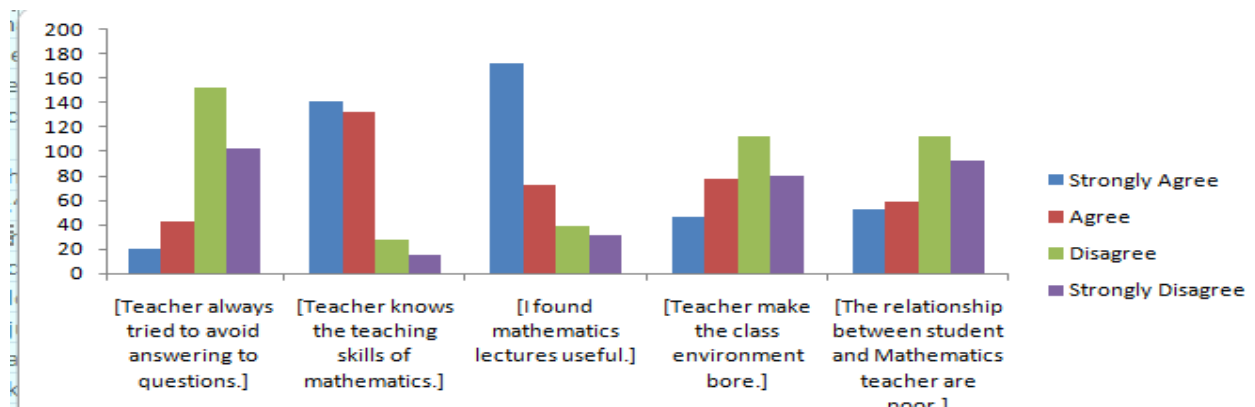

Figure 4b. Students' response representing Teachers' teaching ability according to students

Before analyzing the data, it can be inferred from the bar charts of questions, that students have good perception level towards the Mathematics subject in the three mention aspects that are attitude, interest and perception about teaching methodology.

5.3. Testing of Hypothesis-1: Comparing perception level

This hypothesis is about measuring the students' level of perception of all departments.

Ho: All means are equal that is students from the three departments have the same level of Perception towards mathematics Subject.

Ha: At least one mean is different.

Dependent Variable: Students' Attitude, Students' Interest and Students' perception towards Teaching Methodology).

Independent Variable: The three departments i.e. BBA, BCS and BEE.One-way ANOVA test was used to prove this hypothesis because this test compares the means among three groups on the same variable. Here One-way ANOVA test was performed on one independent variable with more than two categories to check the level of variance among students of three groups (departments): Business Department, Computer Science Department and Department of Electrical Engineering. One-way Anova test was performed for each dependent variable individually.

One-way ANOVA analysis comes up with following assumptions:

5.3.1. Assumption of independence: All groups or departments have unique participant.

5.3.2. Assumption of absence of Outliers: There should be no significant outliers in the collected data. The box plot for outlier detection is generated and then detected outliers are deleted from the data. The box plots for each dependent variable are shown in figure 5, figure 6 and figure 7.
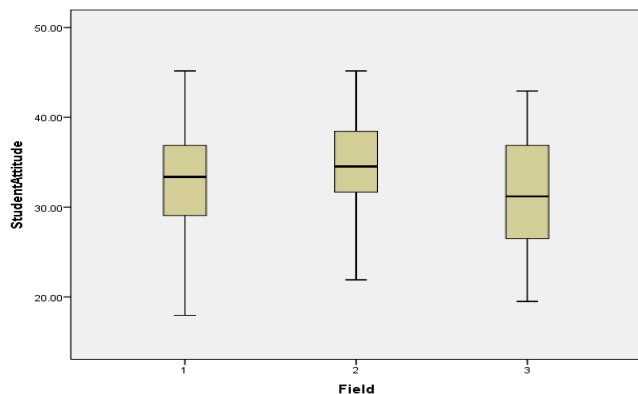

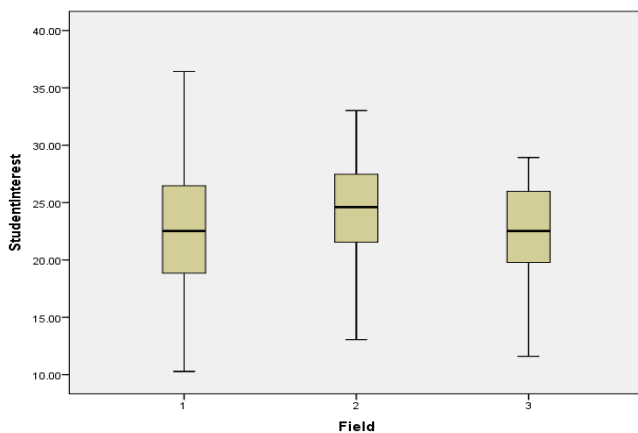Figure 5. Box plot representing Attitude of students of BBA (1), BCS (2) and BEE (3) departments

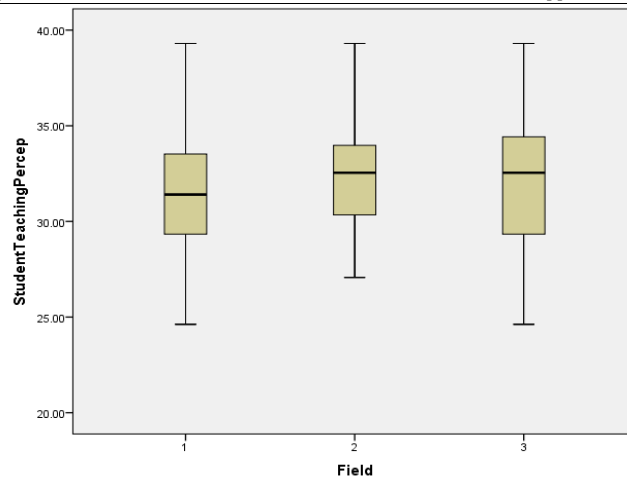Figure 6. Box plot representing Interest of students of BBA (1), BCS (2) and BEE (3) departments

Figure 7. Box plot representing students' Teaching ability perception of BBA (1), BCS (2) and BEE (3) departments

5.3.3. Assumption of normality: The dependent variable should be approximately normally distributed from each group of independent variables. Normality of data is checked through Shapiro-Wilk and Kolmogorov-Smirnov test, as shown in Table II.

Table II. Normality test results

	Field	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	Df	Sig.	Statistic	Df	Sig.
Attitude	BBA	.050	186	.200[*]	.990	186	.252
	BCS	.070	68	.200[*]	.984	68	.512
	BEE	.126	50	.047	.961	50	.102
Interest	BBA	.055	186	.200[*]	.990	186	.225
	BCS	.092	68	.200[*]	.982	68	.419
	BEE	.096	50	.200[*]	.949	50	.052
Teaching Percep	BBA	.078	186	.057	.985	186	.06
	BCS	.128	68	.048	.965	68	.053
	BEE	.105	50	.200[*]	.984	50	.727

*. This is a lower bound of the true significance.

As the Significant (p-value) value is greater than α value which is 0.05 for each dependent variable which verifies the normality of data distribution of dependent for each independent variable category.

5.3.4. Assumption of homogeneity of variance: The variances of the distributions in the populations are equal. A Levene's test verified the homogeneity of variances. The table III below shows the Leven's test results.

Table III. Levene's test results

	Levene Statistic	Df1	Df2	Sig p
Attitude	2.194	2	302	.113
Interest	2.105	2	302	.124
Teaching Ability	1.411	2	302	.245

The significances value (p-value) of all variables is greater than alpha (α=0.05). So, it can be concluded that there is not a significant difference between the three department's variances.

Now the data is prepared for One-way Anova test as all the assumptions for one-way Anova have not been violated.

- ***The Level of Students' Attitude and Interest towards Mathematics***

Table IV. shows the One-way ANOVA results and mean values of attitude and interest among BBA, BCS and BEE.

Table IV. Level of Attitude and Interest among BBA, BCS and BEE

Domain	Mean-Score	SD	F-value	p-value
Attitude				
BBA	3.18	0.84	4.772	0.009
BCS	3.43	0.71		
BEE	2.97	0.86		
Interest				
BBA	2.91	0.79	2.962	0.053
BCS	3.16	0.63		
BEE	2.90	0.69		

Mean value Indicator
Very high:– 4.21 until 5.00
High:– 3.41 until 4.20
Moderate:– 2.61 until 3.40
Weak:– 1.81 until 2.60
Very weak:– 1 until 1.8
Source: Quek Miow Leng (2006), [3]

From results given in Table 4, it can be inferred that mean values for attitude of BBA, BCS and BEE students was 3.18, 3.43 and 2.97 respectively with standard deviation of 0.84 for BBA, 0.86 for BEE students and 0.71 for BCS students. Means that the level of the students' attitude is Moderate for

BBA and BEE programs and high for BCS department according to the mean indicator taken from [3].

There is statistically significant difference between departments according to One-way Anova results (F (2,302) =4.772, p= .009). A Tukey post hoc test was performed to reveal the departments whose students Attitude level differs. Table V given below presents the results of Tukey Post hoc test for dependent variable Attitude.

Table V. Tukey post hoc test results for dependent variable Attitude

(I) Field	(J) Field	Mean Difference (I-J)	Std. Error	Sig.
BBA	BCS	-.25270	.11611	.077
	BEE	.20801	.12951	.245
BCS	BBA	.25270	.11611	.077
	BEE	.46071*	.15178	.007
BEE	BBA	-.20801	.12951	.245
	BCS	-.46071*	.15178	.007

A Post hoc comparisons using the Tukey HSD test indicated that the mean score for Attitude of BCS department students (M = 3.43, SD = 0.71) was significantly different than the students of BEE department (M = 2.97, SD = 0.86) as p=0.007. However, mean score of students of BBA department (M = 3.18, SD = 0.84,) did not significantly differ from the BCS and BEE department students where significance value is greater than 0.05.

Further, the results specify that the mean score for interest of BBA, BCS and BEE students was 2.91, 3.16 and 2.90 respectively with standard deviation = 0.79 for BBA students, 0.63 for BCS students and 0.69 for BEE students. From the mean score indicator, it can be stated that level of the students' interest is moderate for all programs. The results are not showing any significant difference in students' interest level among all departments, as p-value=0.090 that is p> 0.05.

From the findings of students' attitude and interest, it can be concluded that the students' level of attitude and interest towards Mathematics for all departments is good. The reason can be a group study, because at that time students solve Mathematics problem more confidently as compared to exams.

- *The level of Students' Perception of Teachers' Teaching Methodology*

Table VI shows the One-way ANOVA results that is F- values and mean values of students' perception of their teachers' teaching methodology among BBA, BCS and BEE.

Table VI. Students' Perception on Teachers' Teaching Methodology

Domain	Mean-Score	SD	F-value	p-value
Teaching Ability				
BBA	2.92	0.82	1.727	0.180
BCS	3.12	0.73		
BEE	3.06	0.89		

Mean value Indicator
Very high: – 4.21 until 5.00
High:– 3.41 until 4.20
Moderate:– 2.61 until 3.40
Weak:– 1.81 until 2.60
Very weak:– 1 until 1.8
Source: Quek Miow Leng (2006), [3]

According to Table 6, the results specify that the mean value for BBA, BCS and BEE students' perception of their teachers' teaching methodology was 2.92, 3.12 and 3.06 respectively with standard deviation = 0.82 for BBA, 0.73 for BCS and 0.89 for BEE students. It can be inferred from the results that the students' perception level about teaching methodology of their teachers is moderate for all departments' students according to mean score indicator. There is no significant difference shown in the results among students' of all departments as (p-value=0.18 that is p> 0.05).
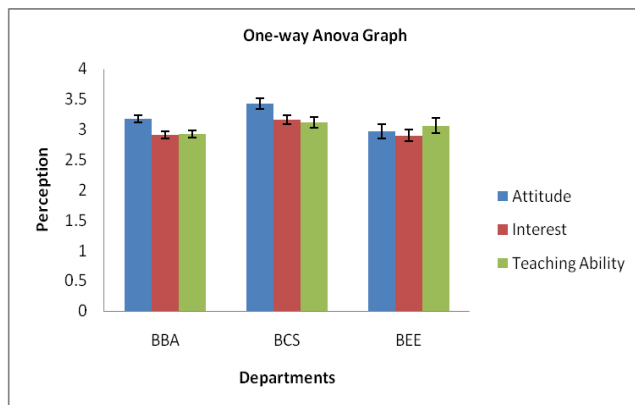

Figure 8. One-way Anova results

Figure 8 presents the graph for One-way Anova results. From the graph, it is clear that Attitude level of students of BCS department is different as compared to BBA and BEE department, as the standard error bars of BCS students attitude level are not overlapping.

5.4. Hypothesis-II Testing: Comparing *Perception level of gender Categories*

This hypothesis compares the perception level of male and female students. Here students from all three departments are divided in two groups male and female.
Ho: two populations i.e. Male and female students have same means.

Ha: Atleast one mean is different.

Independent Variable: Gender categories (Male and Female)
Dependent Variable: Total Perception

where,
Total Perception = Students' Attitude + Students' Interest + Students' perception towards Teaching Methodology

Independent t-test is used to prove this hypothesis because this test compares the means between two unrelated groups that are male and female on the same dependent variable i.e. Total Perception.
To test the hypothesis that the male students' perception (N=185, M=2.89, SD=0.85) and female students' perception (N=120, M=2.86, SD=0.73) means were equal, an independent sample t-test was performed. Prior to conducting the analysis, the assumption of normality distributed differences was examined. The assumption was considered satisfied. Furthermore, the assumption of homogeneity of variances was tested and satisfied based on Levene's test for equality of variances F=4.07, p=.055.

Table VII. shows the Independent t-test results and mean values of total perception among male and female group of students.

Table VII. Independent t-test results

Domain	Mean-Score	SD	F-value	p-value
Total Perception				
Male	2.89	0.85	4.07	0.78
Female	2.86	0.73		

Mean value Indicator
Very high: – 4.21 until 5.00
High: – 3.41 until 4.20
Moderate: 2.61 until 3.40
Weak: – 1.81 until 2.60
Very weak: – 1 until 1.8
Source: Quek Miow Leng (2006), [3]

According to Table III, It can be inferred from the results that the students' total perception level is moderate for both groups of independent variable according to mean score indicator. There is no significance difference shown in the results between male and female groups as (p-value=0.78 that is p> 0.05).

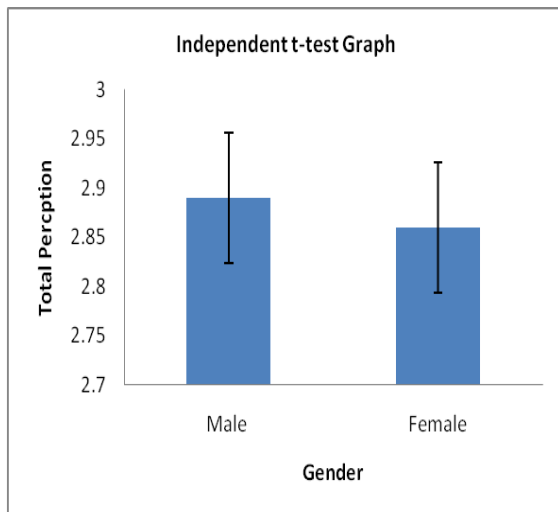A bar chart is presented in figure 9 to visualize the t-test results.

Figure 9. Independent t-test bar chart

Again from the t-test it can be inferred that male and female students have same and significantly moderate level of perception as the standard error bars for both male and female are overlaping. Hence, null hypothesis is accepted as there is no dffrence in means between both groups.

5.5. Hypothesis-III Testing: Investigating performance relevance with gender discrimination

This hypothesis will investigate that how much subject performance is affected by gender discrimination. Do female students perform better than male students?

Ho: Both Male and Female students of all departments performed equally well in Mathematics Subject.

Ha: Male students perform better than female or vice versa.

Independent Variable: Gender i.e. Male and Female categories

Dependent Variable: Subject Performance

A point-biserial correlation will be used to measure the strength of the association that exists between one dependent variable and one dichotomous variable, which is gender in this case. It is a special case of Pearson product moment correlation.
All the assumptions for the biserial correlation are checked and no assumption is violated.
The biserial correlation (r) results are given in Table VIII.

Table VIII. Relationship B/W gender variables(male/female) And Mathematics' Scores

Correlation Results		
Perception	Pearson Correlation, r	0.037
	Sig. (2 tailed)	0.519

*p<0.01

Strength Indicator
Very high: – 0.91 until 1.0
High :– 0.71 until 0.9
Moderate :– 0.41 until 0.7
Weak :– 0.21 until 0.4
Very weak :– 0.00 until 0.2
Source: Quek Miow Leng (2006), [3]

The resulting value (r = 0.037, p > 0.01) represents a positive and a very weak but a significant relationship between students' perception and Mathematics result. The correlation value of 0.037 is very low which shows a negligible relation of students' performance in the subject with gender discrimination.
So, we can reject the null hypothesis that is no correlation between students' perception towards the subject and their Mathematics results. From the strength indicator, it is cleared that the relationship's strength is very weak.

5.6. Relationship between Students' Perception and Mathematics result

The objective of the study is to identify the relationship strength and direction between students' perception towards the Mathematics subject and students' performance that is their scores in Mathematics subject of BBA, BCS and BEE students in Institute of Business Administration, Sukkur University.
This hypothesis will investigate the strength of relationship between students' perception and students' performance in mathematics subject.
Ho: There is no correlation between students' perception and student's performance in the Mathematics Subject.

Ha: There is a significant and strong relation between students' perception and their scores in the Mathematics Subject.

Independent Variable: Students of three departments
Dependent Variable: Subject Performance

The correlation results based on the formula of Pearson Product Moment Correlation (r) are given in Table IX.

Table IX. Relationship B/W Student's Perception and Mathematics 'Scores

Correlation Results		
Perception	Pearson Correlation, r	-0.059
	Sig.(2 tailed)	0.308

*p<0.01

Strength Indicator
Very high:– 0.91 until 1.0
High :– 0.71 until 0.9
Moderate :– 0.41 until 0.7
Weak :– 0.21 until 0.4
Very weak :– 0.00 until 0.2
Source: Quek Miow Leng (2006), [3]

The resulting value (r = -0.059, p > 0.01) represents a negative and a very weak but a significant relationship between students' perception and Mathematics result.

So, null hypothesis can be rejected, which implies that there is no correlation between students' perception towards the subject and their Mathematics results. From the indicator, it is cleared that the relationship's strength is very weak and negative. The correlation value (r= -0.059) specifies that there is a negligible impact of students' perception on performance in mathematics subject and it is further described from the scatter plot given in figure 10.
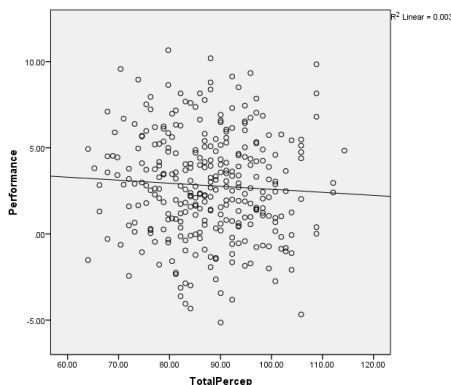

Figure 10. One-way Anova results

6. Conclusion and Future Work

The study found that there is no impact of student's perception students' performance in Mathematics. It can be analyzed from the results that students' perception level that is attitude, interest and teachers' teaching methodology; is good and encouraging. Male and female students' perception does not differ, and their perception does not have any effect on their mathematics performance. There is a very weak relationship between students' perception and Mathematics' result.

The low performance can be caused by other factors such as no parental support, and inconsistent assessment and weak Mathematics foundation. Students solve mathematics problem more confidently while working in groups by confirming the solutions and answers than solving those in examination hall. The study removes certain misconceptions and myths regarding mathematical courses. Teaching methodology and student's perception were widely considered as major setback for students' poor performance in mathematics. However, the numbers suggest that there may be some factors that can be identified by other researchers in future.

The study is applied only to the Sukkur IBA University. Therefore, the results may vary for other institutes.

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Current Status of Urdu on Twitter

Saqib Muhammad Ghulam[1] Tariq Rahim Soomro[2]

Abstract:
Language is the medium of communication and interaction in words or sign format. Easy access to mobile held devices and popularity of social media has revolutionized the way people used to communicate with each other in the past. The information generated in the past two years is many times greater than the information generated since data storage technology inceptions. The Urdu language has emerged since the 6th century from other languages like Arabic, Hindi, Persian, Prakrit and Sanskrit, and it is the national language of Pakistan. Even after being used widely in all public, official and media use of this language is limited to speaking and reading. The study to analyze the use of Urdu language on social media was conducted during the general elections of Pakistan, 2018. With the expansion of the internet, a new colony of the digital world has come into existence which communicates. This study utilized Twitter as a source of information to assess how Urdu as a language has flourished over this Social Media platform. The results showed the varying use of Urdu and Roman Urdu. The study was able to prove that the language had evolved and integrated even into Social Media and its usage is mostly during occasions and varying durations.

Keywords: Twitter, Semantics, Sentimental Analysis, Urdu, Social media data

1. Introduction

Like Facebook, Twitter [1] is one of the most popular social media networking services that began in 2006. Any registered Twitter user can use this platform to post 140-character information called tweet. This tweet has the potential to generate a large number of retweets that can help reach the target audience. Twitter helps registered user to post in any format like audio, video or text. Also, the practice of sharing information from different platforms has added a new format of posting tweets. According to the study [2] researchers analyze these tweets for sentiment analysis whereas another study [3] has tried to predict suggest an appropriate mechanism in predicting election results.

Every registered user communicates in a common understandable language to make his/her tweet reach masses. The medium of communication the registered user uses is known as the language. Every user on twitter if free to post information in any language. The Urdu language is not only the national language of Pakistan but also an official language of

India. More than 60.6 million people speak the language, Twitter does not bind them to use their native language thus giving birth to social media language learning (SMLL) [4]. The Urdu language evolved from Arabic, Hindi, Persian, Prakrit and Sanskrit, during 6th to the 13th century. Urdu [5] is also the official language of Pakistan. Urdu uses Arabic writing script, known as 'Nastalique' and resembles Arabic, Persian, and Turkish [6]

As per official statistics of Pakistan, six percent (6%) of the population of Pakistan speaks Urdu language. Urdu started impacting subcontinent when the British Empire in early 1837 abolished the Persian language along with other northern emirates' languages and declared Urdu and English languages as official languages of India [7].

This study was conducted during the Pakistan general election 2018, which was the perfect time to evaluate how much this 18th century language has integrated into digital society and people use this language to express their sentiments as other languages like Arabic has shown during 2012 Egypt uprising

[1] *SZABIST Dubai Campus, United Arab Emirates*
[2] *CCSIS, Institute of Business Management (IoBM), Karachi, Pakistan*

28

[8] and Turkish during an attempted coup to oust the Turkish president.

Twitter tweets corpse were used as sample in this research to study and develop the required information. However, the major challenge during this study remained as most people prefer Roman Urdu over traditional Urdu in all digital mediums which will make identification of tweets corpse difficult. Selection of common words strategy helped us identify these words in the sample data.

2. Literature Review

During the 1980's social media known as Bulletin Board System (BBS) started its development. The first social media site was SixDegrees.com whose model was later adopted by sites such as Friendster, Myspace and Facebook. Social Media sites have transformed how people communicated over the internet [9]. The term user generated content was first used to describe the matter social media audience create [10]. Twitter came into existence in 2005. Addition of audio and video format played a significant role in transforming text-based internet communication into an interactive and robust format of communication [10]. The interaction happening within social media has created a global village of collective dialogue [11]. To examine the inner sights known as emotions with the dialogues resulted due to events such as political, social, marketing campaigns has led emergence of computing and sentiment analysis [12]. Recently, sentiment analysis or opinion mining is employed to identify the public opinion about people's thought [10]. The purpose of the sentimental analysis is to distinguish between positive, negative or neutral sentiment words [9].

Unavailability of linguistic features of Urdu makes sentiment analysis of social media difficult. However, due to advancement in mobile technology, Urdu-enabled keyboards are becoming common. Following are a few common challenges researchers face:
- Handing Urdu language skill to be upgraded
- Roman Urdu is using English Character set – it is difficult to recognize the language.
- The majority of Tweets consist of English language.

This study also faced major challenges, such as:
a) Dialect Spectrum. Urdu language using four possible dialects, other than Roman-Urdu (using English alphabets to write Urdu). These four dialects are Dakhini, Hyderabadi Urdu, Rekhta, and Urdu. All these four dialects are the same in writing style and script as shown in Table I below.

Table I: Different dialects of Urdu with Respective spellings

Text in Dakhini Hyderabadi Urdu Rekhta Urdu	Roman Urdu	English
پاکستان ایک امن پسند ملک ہے	Pakistan ek aman pasand mulk hay	Pakistan is a peace-loving country

b) Idioms. Interestingly many of the idioms have no place in lexicon dictionary, but are very common words used in the Urdu language; they are occasion/event based and exists within the common community and make their place among them. For example, "دے گھماکے" (De Ghoma-ky) – has no meaning, but commonly referred in Cricket for scoring (hitting).
c) Sentimental Analysis and Subjective
  a. Sometimes names in the Urdu language are adjectives; this issue is very critical to distinguished; for example, "شیر" (sheer or tiger) is an animal, whereas sheer "شیر" in Urdu used to indicate bravery.
  b. Negation handling in the Urdu language is also difficult to distinguish.
d) Twitter specific challenge
  a. Using Roman Urdu on Twitter
    i. Main Qamyab Ho Gaya
  b. English along with Roman Urdu
    i. Main Pass Ho Gaya
  c. Infirmity of language
    i. Hashtags, Uniform Resource Locators, etc.
e) Hashtags. The term tags refer to the characterized topic of interest mainly used to indicate in the social media tools including Twitter, while hashtags allow, for example, for easy analysis of trending topics. Hashtags in Twitter plays a vital role in recognizing the sentiments of people and trends. It also helps specify the interest of the community and showing what is going on by finding the top 10 hashtags [14].
f) Links. These are the pointers to link with other pages and/or applications. Technically speaking tweets are

made of limited lengths, so it may contain compressed hyperlinks.

g) Mentions. They are represented in Twitter by using "@" followed by the username. This pattern is the same as the Facebook tagging pattern.

h) Conversation: It allows direct interaction with the user as a reply to other user's tweets. These replies are only seen by the users; who either follow them or the user to whom reply is sent.

i) Known methods. Twitter with more than 261 million users and a penetration rate of 31.9% is considered to be a high speed growing social media network [15]. More than 300 billion tweets are already shared online till today. Twitter has been more likely being used by mobile users with data package than on any other device. The research found that the English language accounted for more than 50% of social media use on the Internet [16]. Other than English language support was the huge milestone announced by Twitter; they announce 34 language support platform to accommodate non-English language speakers; however, due to the advancement of operating systems, Twitter allows their users to write tweets in their native language along with the English language [17].

3. Material and Methods

Urdu is the commonly spoken language of the sub-continent and national language of Pakistan. This study will explore use of Urdu in the digital world.
Research Instrument

1) Python. *It is no denying fact that Python is mainly used for data analysis and it is a very powerful programming language. Python language constitutes a rich library and used for this study to monitor the status of Urdu language tweets on Twitter. In this study python version, 3.5 has been used.*

2) *Tweepy API. It is an open-sourced API, freely available at GitHub. Tweepy API enables Python to communicate easily with the Twitter platform. Tweepy version 3.6.0 was used at the time of this study.*

The Urdu language sentimental analysis using Twitter is also part of this study. This analysis yields three results as:

• Positive: Completed my graduation.
• Negative: Didn't perform well in Exams
• Neutral: Schools are closed due to heavy rain

As of 2018 World Bank, the population of Pakistan was 220 million and as per Internet World Statistic (2018), it has 44.6 million Internet users and the Internet penetration rate is 22%. There are 35 million active social media users with penetration rate is 18%. There are 109.5 unique mobile users and penetration rate is 55%, while there are 32 million Active mobile social media users and the penetration rate is 16%. Gender wise 77% of Pakistani users are male and 23% are female. According to tribune 72% of users 'log on' on a daily basis. In Pakistan there are about 3.1 million Twitter users [18].

Table II: Keywords selected for testing in twitter streaming API

English word	Urdu word
Pakistan	پاکستان
Imran Khan	عمران خان
Nawaz Sharif	نواز شریف
Bhutto	بھٹو
Justice	انصاف
Dam	ٹیم
Pakistan	پاکستان
Imran Khan	عمران خان

4. Results and Findings

If compared with international languages, Urdu shares a very minimal share in the digital world.

A. Research Instrument

Twitter was chosen as the source of information and three tools were developed for this research. The first tool in Python was developed to download filtered tweets. The second tool was developed for sentiment analysis and displaying bar chart in percentage for the use of common words. Finally, a third tool was developed to view the location of active Urdu users around the world. Common words used during data collection are shown in Table II.

Table III below depicts the result of sentimental analysis of English words commonly used in Pakistan. Here in this study keyword "Pakistan" strength was highest i.e. 42%, whereas keyword "Justice" strength was lowest i.e. 14%. People were more positive about "Dam" with 25%, whereas, the keyword "Imran Khan" shows sentiments of 9:7; here 9 means positive and 7 means negative.

Table III: Sentimental analysis of English tweets

S. N o	Search Term	strength	sentiment	passion	reach	Sentiment Analysis		
						Positiv	Neutral	Negativ
1	Pakistan	42 %	9:1 0	6	43	9	18 2	1 0
2	Imran Khan	17 %	5:2	12	18	15	20 3	6
3	Nawaz Sharif	22 %	9:7	9	23	9	21 8	7
4	Bhutto	20 %	11: 8	26	20	11	22 8	8
5	Justice	14 %	1:1	9	15	14	15 7	1 4
6	Dam	22 %	25: 8	0	23	25	22 7	8

Table IV:Sentimental Analysis of Urdu Tweets

S. No	Search Term	strength	sentiment	passion	reach	Sentiment Analysis		
						Positiv	Neutral	Negativ
1	باکستان	13%	11:3	0	14	11	202	3
2	عمران خان	2%	5:8	3	3	5	267	8
3	نواز شریف	0%	2:1	0	0	4	77	2
4	بھٹو	11%	1:0	0	12	7	138	0
5	انصاف	17%	4:3	26	18	20	316	15
6	ڈیم	20%	1:1	3	20	7	173	7

Table IV depicts the result of sentimental analysis of Urdu words commonly used in Pakistan. Here in this study keyword "ڈیم" strength was highest i.e. 20%, whereas keyword " نواز شریف" strength was lowest i.e. 0%. People were more positive about "انصاف", whereas, keyword "Imran Khan" shows sentiments of 11:3; here 11 means positive and 3 means negative.

Figure 1, below depicts the most popular hashtags, which reflects the thinking of Pakistani people. This figure depicts that people are twitting 'Pakistan' and more concerned than anything else.
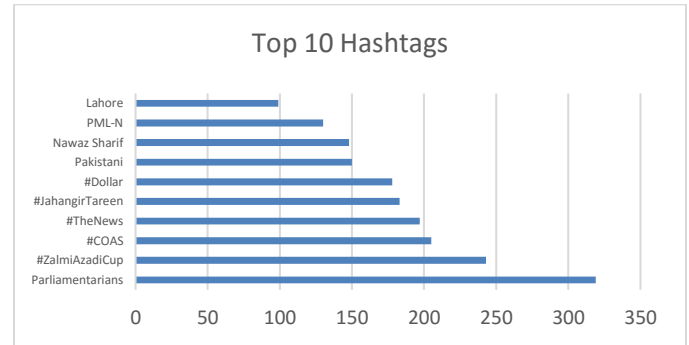

Figure 1: Top 10 keywords from 2000 tweets

Figure 2 depicts the top 10 keywords collected, where Urdu stands tops of the list for three hours, from 6:00 am to 9:00 am. The Urdu word (دہشت گردی) "terrorism" shows a strange of 7 positives; on the other hand, the English word "Terrorism" for the same meaning given 7 negatives.
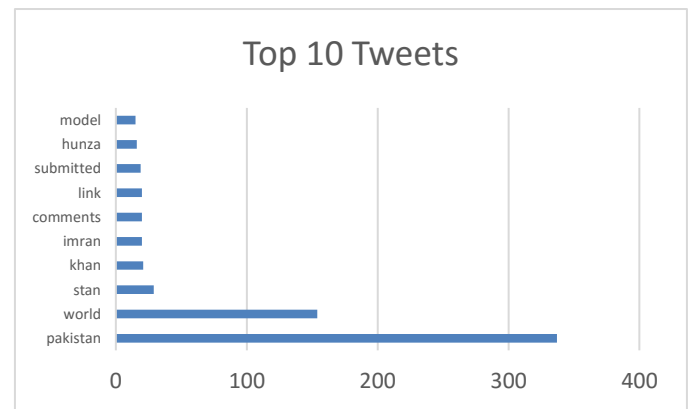

Figure 2: Top 10 keywords from 1200 tweets

Figure 3 below, depicts the running filter only on Urdu tweets mentioning Pakistan in Urdu and English without location restriction; revealed 93.27% users use English text and 6.73% use Urdu.
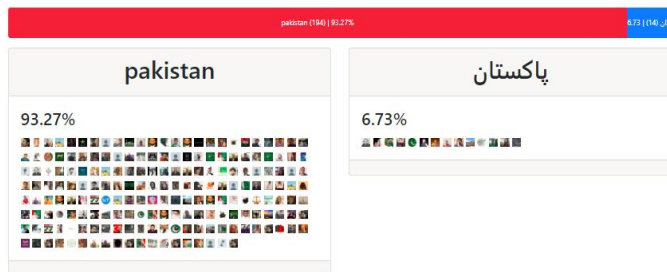
Figure 3: Shows the percentage of mentions of two similar words in different language between 21:00 and 00:00 UAE ST

The Figure 4 below depicts the running filter only on Urdu tweets mentioning Pakistan in Urdu and English, with location restriction (set as Pakistan), revealed that less 34.89% users use Urdu text and 65.11% use English.
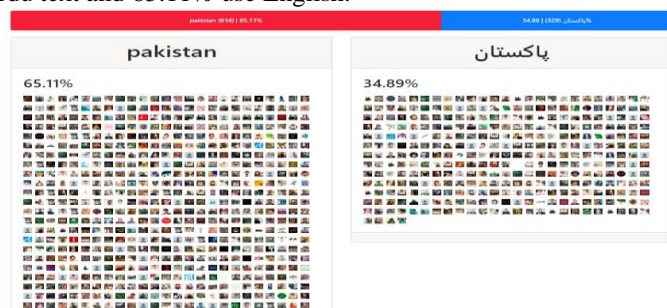

Figure 4: Shows the percentage of mentions of two similar words in different language (21:00 UAE ST)

The Figure 5 depicts the running filter only on democracy in Urdu and English language, with location restriction (set as Pakistan); found that English users scored 96.7% while Urdu users scored 3.3% (14:00 UAE ST).
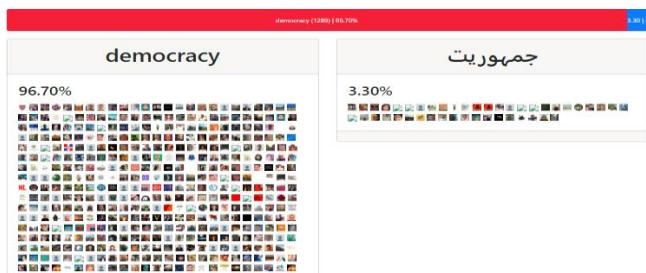

Figure 5: Shows the percentage of mentions of hashtags of two similar in different language (21:00 UAE ST)

5. Discussion & Future Work

People all around the world speak in their native language and with the popular use of social media tools, people tend to communicate in English as English is the native language of social media. Urdu is one of the popular languages, which deserves to be used on social media along with the English language. This study was conducted to identify where Urdu stands along with social media language English? Twitter was used as a social media tool to confirm findings. The study was not able to identify the exact number of tweets generated in Pakistan and was restricted by privacy control policy of Twitter. Therefore, this study assumes that there are possibly more users than the number Twitter claims. Information on the Internet in the Urdu language must be verified using a content credibility measuring system, which makes sure that the information posted is in the Urdu language. This can be accomplished using a rank or scoring system on information, which is being collected and forwarded. Currently, research on Urdu sentiment analysis is limited and the language is still trying to intercept itself in this growing digital field.

This study depicts the initial step towards Urdu sentiment analysis using Twitter. The retrieved tweets during this study were analyzed to provide their sentiments polarity (positive or negative). Urdu has also issues with Lexicon based sentimental analysis and this is the possible future area, where researchers can start their work. Thus this study concludes based on findings that the Urdu language is not strange to social media tools, such as Twitter. The Urdu language used infrequently on social media along with English. Urdu language users use Urdu on certain normal or abnormal events occurrence while happening in their lives, but commonly these users use English more than Urdu.

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Aspects Based Opinion Mining for Teacher and Course Evaluation

Sarang Shaikh[1], **Sher Muhammad Doudpotta**[1]

Abstract:

Teacher and course evaluation by students at the end of each term is an important task in almost every academic institution worldwide. It helps in assessing faculty performance and suitability of the course in any academic program. The data collected from evaluation comprises of two parts, Likert Scale and open-ended feedback. Computationally, the Likert Scale form can be handled easily as it is numerical in nature but to handle open-ended feedback is a challenging task. Presently, in most of the organizations it is processed manually, which contains many problems like it is error-prone, tedious and full of human biases. The objective of this study is to solve these problems, using two-step rule-based strategy from Machine Learning and Natural Language Processing (NLP) techniques. The first step is to extract overall topic of the feedback text using supervised machine learning followed by exploitation of NLP rules to find out specific aspect and related opinion word about which the feedback is given along with orientation of the opinion either positive, negative or neutral. Using, this two-step strategy combining with NLP, machine learning techniques and data from past seven years of real feedback at a public sector university in Pakistan, we are able to achieve a recall and precision of 83.89% and 84% on topic identification i.e. to classify a feedback in teacher and course category. The system is able to extract different aspects of teacher and course with a precision of 83% and recall of 80%, whereas overall sentiment classification accuracy is 90%. To the best of our knowledge, this is the first rule-based approach for such problem with quite satisfactory results.

1. Introduction

Student feedback/ evaluation about teacher and course at the end of every term is an important integral part of any academic organization. The impact of this evaluation can be understood from its outcomes which most of the times highlights teacher's positive areas and identifies areas of improvement. Also, this evaluation helps to find out the impact of course regarding specific degree program. The evaluation is also helpful for the annual progress of faculty members [1]. Mainly, this evaluation involves student's feedback regarding different aspects of teacher and course. For Example: teacher's behavior, methodology, teaching pace, course contents, etc. Student feedback helps in most of the areas where there is a need of any improvement. Ultimately, this evaluation process using student's feedback assists top-level management to make decisions for further continuation of those faculty members or courses. [3].

The student's feedback collected during evaluation process consists of mainly two types, Quantitative Feedback and Qualitative Feedback. The quantitative feedback is taken from a student using Likert Scale whereas the qualitative feedback is in form of open-ended textual comments regarding teacher and course [1]. Processing quantitative feedback is an easier task as performance can be represented in terms of percentages which are easy to comprehend. On the other hand, the textual feedback is hard to represent in numbers, consequently, it is mostly processed manually, which means human involvement. The task of processing text is tedious, especially when student population is high, just imagine 5000 students in a university, more than 200 faculty members and 100s of courses, the

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[1] *Department of Computer Science, Sukkur IBA University Sukkur, Pakistan*
Corresponding Email: sarang.msse17@iba-suk.edu.pk

amount of data to process simply requires an army of readers, even then, it would be an error-prone and full of human biases. Ironically, a university with mentioned population is considered a small university, medium and large universities population is many folds of this definition.

Considering this major issue, the research community is working towards the machine-based evaluation of these open-ended comments. This machine-based evaluation of unstructured textual data lies under the category of natural language processing (NLP), text mining and more specifically opinion mining / sentiment analysis [2]. In recent years, many attempts have been made under the umbrella of opinion mining including variety of approaches using machine learning classification models and lexical approaches [5]. Liu et al. in [6] and Moraes et al. in [12] have defined opinion mining problem as general document classification problem which considers single review as single subjective document classified as either negative, positive or neutral.

This paper proposes two-step strategy based on natural language processing and machine learning techniques. In the first step, we use supervised machine learning to identify the topic of feedback, either teacher or course, followed by employing natural language rules to extract specific aspect of the teacher or course which is being discussed in the text. Finally, classification of the text in positive, negative and neutral classes. Furthermore, using this approach a standard corpus has been developed for teacher/course evaluation domain using data from past seven years from a public sector university in Pakistan as a training model. The corpus consists of important aspects in this domain for which most of the time students discuss their possible opinion words with desired sentiment classes. The proposed solution works for automatic sentiment classification for opinions collected during evaluation task at universities. Rest of the paper is organized as: section 2 discusses related work, section 3 explains methodology, section 4 explains results and section 5 explains conclusion & the future work.

2. Related Works

There are many recent attempts to automate sentiment analysis in general and students' opinions in particular. This section, describes opinion mining, its basic concepts followed by opinion mining application on teacher / course evaluation using students' feedback. [3]

a. Opinion Mining

Esuli et al. in [4] define opinion mining as a sub discipline of the two major disciplines --- information retrieval and computational linguistics, which doesn't explain topic of text but expression / meaning of text. Mishra et al. in [5] define opinion mining is a technique which takes some of data mining techniques to identify speaker's / writer's attitude towards particular topic and overall sentiment orientation of particular block of text. Liu et al. in [6] define term opinion as a quintuple in Eq. 1. For a text, which contains subjective opinion for different aspects the quintuple is defined by:

$$e_i, a_{i,j}, oo_{ijkl}, h_k, t_l \qquad (1)$$

where

e_i is entity name
a_{ij} is the attribute of entity
oo_{ijkl} is sentiment orientation of attribute
h_k is opinion holder
t_l is time when opinion was expressed.

Considering this definition of opinion, Cambria et al. in [7] define opinion mining as a process to apply different tasks by discovering all quintuples from opinion texts.

b. Existing Approaches

Below are some major approaches which literature suggests regarding opinion mining as this research area has recently got a lot of attention.

i. *Document Sentiment Classification:*

This approach can also be termed as machine learning based opinion mining. The important discussion under this approach is that it considers each opinion, piece of text as single document so according to this approach every document represents subjectivity regarding only single entity. i-e. it considers a single review about a product or service. The major drawback of this approach is that it works for general aspect of feedback text. As this is machine learning based approach so it is divided into two types:

- Supervised Document Sentiment Classification
- Unsupervised Document Sentiment Classification

The authors of [8] applied this approach for student's feedback text by using different classifiers including Naive Bayes, Maximum Entropy and Support Vector Machine (SVM). The author got maximum accuracy of 94% for their dataset on SVM
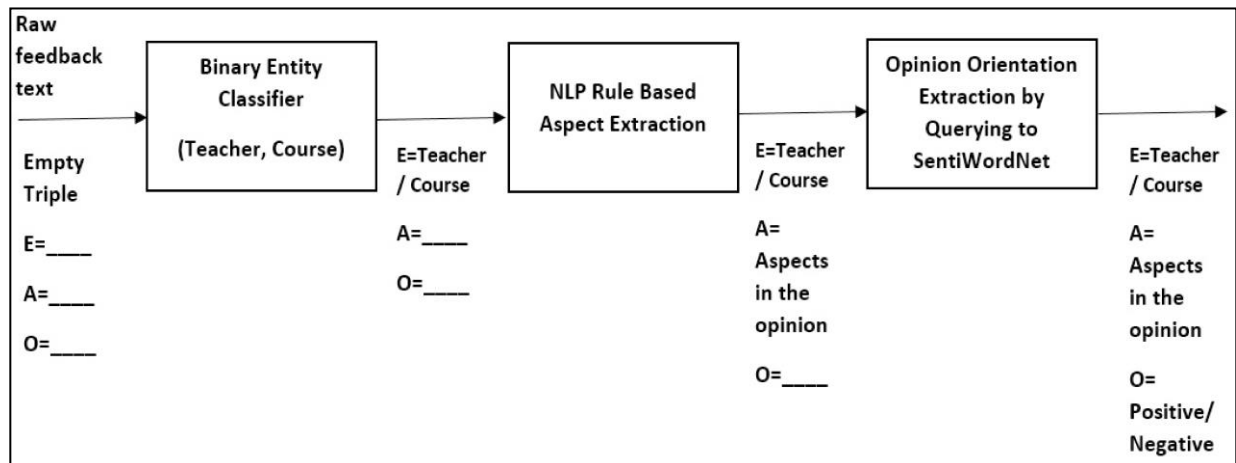
Figure 1:Proposed System Overview

classifier. On the other hand, Turney et al. in [9] applied this approach on movie reviews dataset and got overall accuracy of 84%.

ii. *Opinion Lexical Approach:*

Taboada et al. in [10] define this approach as to calculate sentiment orientation of document using polarity scores of words or phrases in the document using some pre-built dictionaries or corpus. Lexical approach consists of two methodologies. [3]

- Dictionary Based Approach
- Corpus Based Approach

Liu et al. in [6] explained dictionary-based approach to create small opinion words seed list, then use an online dictionary like WORDNET [11] to query limited opinion words for finding their synonyms and antonyms and the process continues until no new word is found from dictionary. [10]

Liu et al. in [6], explain corpus-based approach works same as dictionary-based approach defined above but major difference is involvement of some sentiment consistency inference rules to avoid domain inconsistency. Particularly, if two opinion words are combined with each other using conjunction "and", if first opinion word is positive oriented so inference rules suggests second opinion word to be positive oriented too. This approach supports most of these inference rules. [10]

iii. *Aspect Based Sentiment Analysis Approach:*

Pontiki et al. in [14] define this approach as finding sentiments about specific entities and their aspects for which feedback is provided. The previous literature suggested two major approaches but major drawback in those approaches is they provide overall sentiment of specific text but this is not necessarily that if feedback is overall positive then it cannot have any negative aspect. The feedback is always combination of different positive and negative opinions regarding different aspects or attributes of entities [6]. For example, students give positive opinion regarding course content but give negative opinion regarding teacher methodology. Mubarok et al. in [15] applied this approach using Naive Bayes Classifier on restaurant domain customer reviews data set and got accuracy of 78.12%.

iv. *Spam Feedback Detection:*

Opinions/reviews available over the web for different products or items have gained major attention from different users before buying any item. This practice is widely used to identify major aspects of products or items. These reviews mainly explain reputation of product. More the positive reviews, more the product is likely to be accepted otherwise rejected. Liu. et al. in [6] has explained spam feedback as false or fake reviews which are used to mislead readers to increase or decrease chances of item selection. Jindal & Liu. et al. in [21], [22] had proposed the idea of detecting fake opinion, first time. They define spam feedback detection using below methods:

- Spam Detection Based on Supervised Learning
- Spam Detection Based on Abnormal Behaviors

Spam detection based on supervised learning is a classification-based approach which contains two classes, spam and non-spam. Duplicate reviews or near-to-duplicate reviews are classified as spam reviews, whereas the rest were classified as non-spam reviews. Jindal. et al. in [24] have defined another technique which identifies unusual reviewer behavior using unexpected rule discovery.

v. *Existing Approaches for Teachers Evaluation:*

Rajput Q. et al. in [3] used corpus-based approach and got 91.2% accuracy on real data of their university. The work is limited only on sentiment orientation classification, whereas extraction of different aspects of course and teacher have not been considered in this work. Altrabsheh et al. in [8] used machine learning based approach using Naive Bayes, SVM classifier and got accuracy of 94%. Chee. in [26] used sentiment analysis on (SMS) texts in teacher evaluation. The authors have proposed models-based approach which leads to the base model, corrected model and sentiment model. Altrabsheh. et al. in [27] have applied sentiment analysis in education domain for teacher's evaluation. Inspite of using data from stored files,they have used social networks like Facebook, twitter to get data and perform sentiment analysis. There are many other authors who have worked on sentiment analysis for teacher's evaluation domain but to analyze feedback in this domain using aspect-based approach is an active research problem and same is the problem addressed in this paper.

3. System Overview

Fig. 1 shows the abstract model of the proposed system. The proposed system accepts raw opinionated text at the input to extract entity, aspect and opinion orientation. The first step based on supervised learning is a binary classifier that takes the input text and classifies it in either teacher or course entities. Once the entity has been extracted, the next step is to use natural language processing rules to learn relationship between words and different part of speeches to extract aspect of the entity. For example, behavior, contents knowledge, experience and assessment are aspect for teacher entity, whereas pace, market acceptability, suitability in curriculum are some aspect for the course entity. Finally, we use different part of speech words to query SentiWordNet to extract orientation of an opinion. Suppose, following raw text is input,

"Teaching methodology of this teacher is excellent, he teaches in a way that \indent difficult topics become easy"

For this text, following triple would be generated,

(E, A, O) = (Teacher, Teaching Methodology, Positive)

Similarly, for following text,

"I don't know why they are still teaching this course, job market no more \indent require graduate to know GWBasic"

Here, the triple would be,

(E,A,O) = (Course, Market Acceptability, Negative)

In next few sections, we describe working of each of these components of the proposed system.

3.1. Binary Entity Classifier

We have used major text pre-processing techniques (See Section 3.1.1) and applied text features engineering (See Section 3.1.2) combined with classification algorithm (See Section 3.1.3) to classify text as whether it belongs to teacher or course entity. We have used 10,000 manually annotated feedback for teacher / course category. The annotation has been done by the domain experts. We divided feedback into training and test instances with 70% 30% ratio. Fig. 2 shows samples taken from training data.

For teacher	good teacher
For teacher	awesome teacher and we love to be taught by him again
For teacher	always my favorite.
For teacher	This teacher is quite well who try that students learn something helps us generate our analytical skills
For teacher	never seen that like teacher of finance in my academic life. he is expert in his field.
For Course	a helpful course for beginners.
For Course	informative course
For Course	good course.
For Course	good teacher and good teaching ,methodology.
For Course	Course rating is normal

Figure 2: Manual Labelled Input Raw Text for

It has been observed that usually noun, adjective and verbs differentiate well between entities of two different domains, namely teacher and course. All other words present in the raw text are considered stop words and removed during pre-processing step, this reduces vocabulary of the text and also improves efficiency. Algorithm 1 shows main steps involved in entity extraction.

```
Algorithm 1 Entity Classification
INPUT : Raw Feedback Text
OUTPUT : Target Class/Entity {Teacher, Course}
Pre Processing for Input Raw Text
    while INPUT ≠ NULL do
        sentences ← extractSentences(INPUT)
        while sentences ≠ NULL do
            tokens ← extractTokens(sentences)
            while tokens ≠ NULL do
                posTag ← posTAG(tokens)
                if posTag = NN||posTag = JJ||posTag = VB then
                    x ← lowerCase(tokens)
                end if
            end while
            trainingInstance ← x  Concat  ManualClassLabel
        end while
    end while
Applied String2WordVector on Training File
Created Training Model Using Naive Bayes Classification Algorithm
Evaluated Training Model Using 10-Fold Cross Validation
Supplied Test Data Set Using Same Pre Processing Done for Training Data Set
```

3.1.1. Text Pre-Processing

As given in Algorithm 1, we have performed 04 pre-processing steps. [16]

We have used default Apache OpenNLP models to perform preprocessing tasks. Finally, the extracted words for each sentence are stored as training instance with their desired manual class label (see Fig. 3). Any classification task expects features in numerical format, therefore, we need to convert our training data, which is in text format, to numbers.

3.1.2. Feature Extraction

We use String2WordVector to create features/attributes from text to be used for classification. String2WordVector uses concepts from language modeling called Term Frequency-Inverse Document Frequency (TF*IDF). In [17] Zhang et al. has defined TF*IDF in detail. (See Eq.2)

For a term i in a document j, the weight $W_{i,j}$ of term i in document j is given by:

$$W_{i,j} = tf_{i,j} * \log(\frac{N}{dfi}) \qquad (2)$$

where

- $tf_{i,j}$ is the number of occurrences of i in document j.
- df_i is the number of documents containing the term i.
- N is the total number of documents in the corpus.

Figure 3: Sample Training Instances File

3.1.3. Naive Bayes Multinomial Classification

Xu. et al. in [18] has explained this classification algorithm as one variation of Naive Bayes classifier, best for multinomial distributed data which in case of text classification is best suited. As compared to other algorithms this is faster and accurate specifically for text classification. The author has discussed complete mathematics and procedure of this classification algorithm as defined in Fig.4

For each document $m \in \{1, …, M\}$:
(a) Draw a class c_m from Multinomial($\vec{\vartheta}$);
(b) For each word $n \in \{1, …, N_m\}$ in document m:
   i. Draw a word $w_{m,n}$ from Multinomial ($\vec{\phi}_{c_m}$).

Figure.4: The mathematical form of Naïve Bayes Multinomial Classifier

As explained earlier, the outcome of this classification task is entity extraction, either teacher or course, from the raw input text. This means, we have filled the first term of our triple that expects entity, aspect and opinion orientation. The next section focuses on aspect extraction.

3.2. NLP Rule Based Aspect Extraction

Once the feedback text is classified into its desired entity whether teacher or course then it is used to extract desired

```
Algorithm 2 Semantic Graph Dependencies Extraction
INPUT : Classified Input Sentence
OUTPUT : Semantic Graph Dependencies of Input Sentence
    while INPUT ≠ NULL do
        step1_Output ← applyCoreNLPAnnotators(INPUT)
        step2_Output ← generateGrammaticalStructures(step1_Output)
        step3_Output ← createSemanticGraphTypedDependencies(step2_Output)
        semanticGraphOutput ← step3_Output
    end while
```

aspects (e-g: teacher's behavior, methodology, attitude, approach or course's contents, quality, etc.), their relevant

opinions (e-g: good, best, pathetic, worst) and semantic orientation of those opinions (e-g: positive, negative or neutral). To achieve above, we have used Stanford CoreNLP API in JAVA. Algorithm 2. explains these steps.

3.3. Semantic Graph Dependencies

The common annotators provided by CoreNLP which we are using are tokenize, ssplit, pos, lemma, ner, parse, mention, dcoref. Manning. et al. in [19], the developers of these annotators have discussed all annotations in detail with purpose of each annotator. The next step is to create parse tree from annotations to understand word associations and relations. See Fig.5 for further explanation.

Once the parse tree for desired input is generated using parse annotator, the Grammatical Structure stores dependency relations between the nodes in a tree. It actually defines in detail hierarchy for input text using grammatical dependencies in terms intermediate step before going to actual step which is Step\#3.

The output from step2 in form of tree and grammatical structures gives support to generate type dependencies of desired sentence using CoreNLP Semantic Graph Dependencies. It is used for generating syntactic dependencies of words in given sentence. These dependencies are based on sentence annotations, providing alot of support to traverse sentence for different grammatical formats for understanding its structure and writing style. see Fig. 6 for sample output generated by CoreNLP Semantic Graph Dependencies.
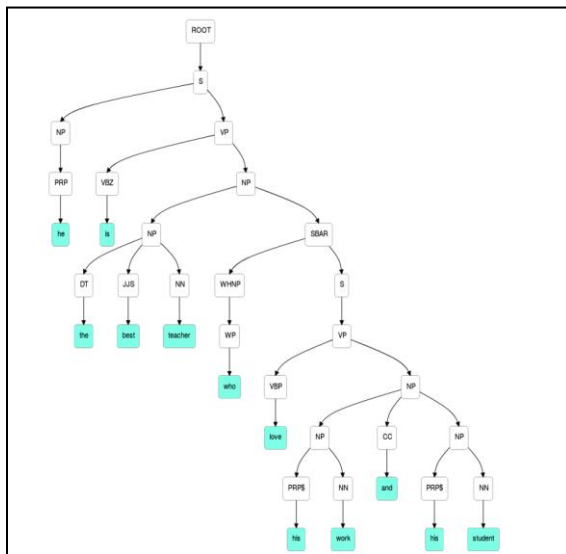

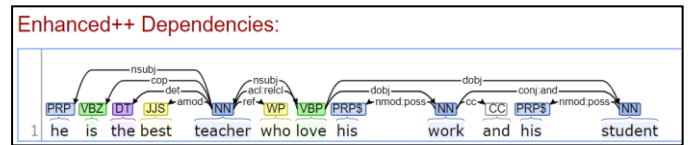Figure 5: Sample parse tree generated after annotations

Figure 6: Semantic Graph Dependency Graph View

3.4. Aspects, Opinion Extraction

As discussed previously in section 3.3, we have seen output of semantic graphs dependencies. These dependencies are used to extract aspect, their opinions using rule-based approaches developed against different grammatical structure patterns. Below section will explain different rules developed for extraction on top of typed dependencies extracted using semantic graphic dependencies. See Fig. 7 for rules developed for extraction of aspects and their desired opinions from
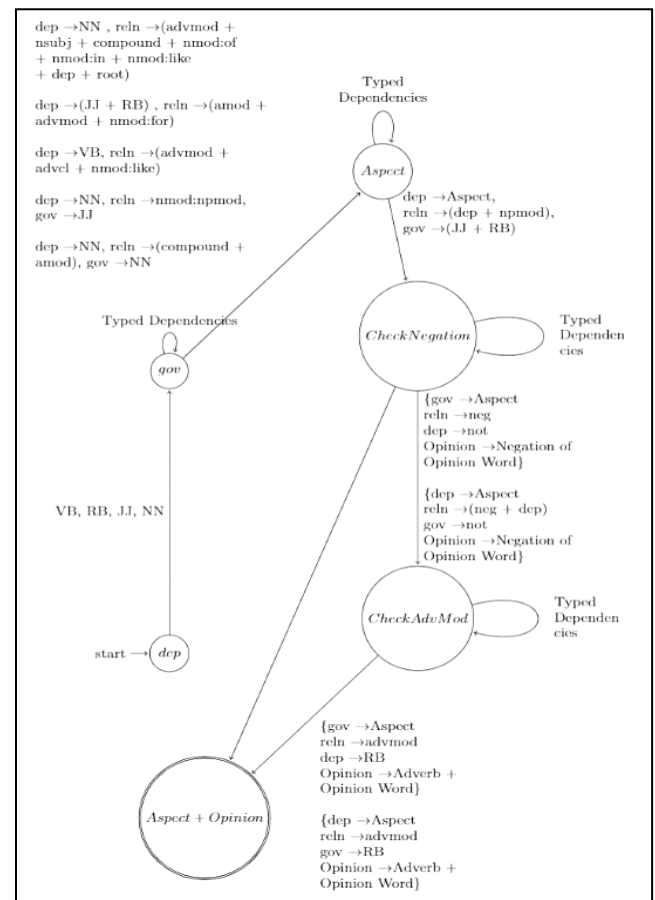

Figure 7. Aspect Opinion Extraction Rules

feedback text. This figure represents extraction flow in form of state diagram.

Algorithm 3 explains flow of extraction and calculating semantic orientation using SentiWordNet [20].

Table 5 explains some of major supplied test opinions with details of desired extracted component. The semantic orientation calculation of opinion words is based on Eq. 3

$$\sum_{n=0}^{count\ (opinionTokens)} calculatePolarity\ (n) \rightarrow SentiWordNetCorpus \quad (3)$$

```
Algorithm 3 Aspect, Opinion Word Extraction with Semantic Orientation
INPUT : Entity Classified Input Opinion Text
OUTPUT    :    Aspects,    Desired    Opinion    with    Semantic    Orienta-
tion
  while INPUT ≠ NULL do
    sentences ← extractSentences(INPUT)
    while sentences ≠ NULL do
      aspects ← extractAspect(sentences)
      while aspects ≠ NULL do
        opinion ← extractOpinion(sentences)
        if negation is linked with opinion word then
          opinion ← negation + opinionword
        else if adverb modifer is linked with opinion word then
          opinion ← adverb modifier + opinionword
        else
          opinion ← opinion word
        end if
        semanticOrientation ← SentiWordNet(opinion)
      end while
    end while
  end while
```

3.5. Data Bank

We have used \$10,000\$ labelled student feedback texts collected during teacher's / course evaluation task at the end of academic semester at Sukkur IBA University Pakistan.

The collected texts are labelled by domain experts into three classes positive, negative and neutral, manually. These texts are used as initial data to run test cases and to evaluate proposed strategy for aspect-based opinion mining. Moreover, the feedback is in the form of raw text and stored into Microsoft Excel File with their desired label. see Table 1.

If we focus on third and fourth comment in Table I, it is labelled as negative opinion by domain expert as the domain expert

knows meanings of opinions discussed against course as well as teacher and also knows relations between words. This is a major motivation for us going towards aspect-based opinion mining so that machine can also identify and separate different aspects and also can find out relations of words with each other. Our proposed model is able to identify such confusing comments correctly.

Table I: Raw Feedback Text Sample Used

Feedback Text	Manual Labelled Class
course was very interesting and very good	positive
course was useful	positive
subject is interesting but due to teacher it become the boring one for me	negative
well instructor but he should try to improve his teaching skills	negative
Subject is ok	neutral
it should be more updated	neutral

4. Results

In this section, we show the results of feedback text entity classifier, aspect and opinion extraction rules as well as semantic orientation of extracted opinions.

4.1. Entity Classifier Results

Table II & III shows our experimental results on both entities (e-g: teacher, course) by using 10-fold cross validation for total 7,675 instances. We present our results in precision and recall as defined in Eq.4 & Eq.5.

$$Precision = \frac{No.of\ correctly\ classified\ entity}{Total\ classified\ entities} \times 100 \quad (4)$$

$$Recall = \frac{No.of\ correctly\ classified\ entity}{No.of\ actual\ entities} \times 100 \quad (5)$$

The average precision and recall results for teacher and course entity class were 84% and 83% respectively

Table II: Classification Results for TEACHER Entity Class

Actual Instances	Machine Classified Instances	Correctly Classified Instances	Precision	Recall
4,324	4,720	3,904	82.8%	90.3%

Table III: Classification Results for COURSE Entity Class

Actual Instances	Machine Classified Instances	Correctly Classified Instances	Precision	Recall
3,351	2,955	2,535	85.5%	75.6%

Table IV: Aspect, Opinion Word Extraction with Semantic Orientation (Precision, Recall) Results

	Actual Aspects with Opinion	System Extracted Aspects with Opinion	Correct System Extracted Aspects with Opinion	Precision	Recall
TEACHER	25	24	21	87.5%	84%
COURSE	20	19	15	79%	75%
OVERALL	45	43	36	83%	80%

Table V: Sample Results for Aspect, Opinion Word Extraction with Semantic Orientation Results

Input Test Sentence	Extracted Aspects	Extracted Aspects with Opinions	Opinion Semantic Orientation
he is my favorite teacher	teacher	teacher (favorite)	POSITIVE
He is a very good teacher and the course is awesome	teacher, course	teacher (very good) , course(awesome)	POSITIVE, POSITIVE
he is one of teacher which teach us in very nice and effective way	teacher's way	teacher's way (nice , effective)	POSITIVE
It is a challenging course as we are studying it for the first time but all the things are very basic.	course	course (challenging)	NEGATIVE
good behavior	teacher's behavior	teacher's behavior (good)	POSITIVE
A great teacher having vast experience and knowledge. He always follows student centered approach	teacher, teacher's experience, teacher's approach	teacher (great), teacher's experience (vast), teacher's approach (centered)	POSITIVE, POSITIVE, POSITIVE
He is not a very good teacher	teacher	teacher (not very good)	NEGATIVE
great teacher. tremendous efforts he did for each student.	teacher, teacher's efforts	teacher (great), teacher's efforts (tremendous)	POSITIVE, POSITIVE
course is bit difficult.	course	course (difficult)	NEGATIVE
this subject helps me a lot to learn the new things	course's things	course's things (new)	POSITIVE
the nature of course was conceptual and very informative	course's nature	course's nature (very informative)	POSITIVE
worst learning Objective	course's learning	course's learning (worst)	NEGATIVE
good teacher and good teaching methodology	teacher, teacher's methodology	teacher, teacher's methodology (good)	POSITIVE
course has a lot of things to learn from it. it has enhanced my analytical skills	course's skills	course's skills (analytical)	NEUTRAL

4.2. Aspects, Opinion Extraction Rules Results

We evaluated real time student's feedback to extract aspects and opinion words based on rules developed using CoreNLP Semantic Graph Dependencies in Fig 7. Some feedback was selected to test these rules for extraction, based on different grammatical patterns which convey one or more opinions regarding some aspects of teacher entity or course entity. Table IV summarizes our results of aspect extraction. Table V shows sample results of aspect extraction and opinion orientation from our experiments. We achieved an overall accuracy of 90% on opinion orientation extraction on our test dataset.

5. Limitations & Future Work

The major limitations of this system are 1) Input of such new feedback text structures of which the system is unaware and cannot correctly extract the desired aspects as well as opinion words. 2) Usage of SentiWordNet to query opinion words for polarity assignment, there is a chance of occuring such opinion words which do not exists in SentiWordNet. 3) Occurance of roman urdu language-based students' feedback. 4) Usage of wrong English words spellings in feedback text. We will try to approach these limitations in future work of this research study.

6. Conclusion

Teachers and course evaluation are an important task in academia to analyze or assess performance of teachers and relevance of course in any academic program. Most of the time, the written feedback text do not give overall opinion for desired entity (i-e teacher or course), but it discusses different aspects of those entities.

In this research, we proposed a syntactic rule-based system for automatic aspects extraction and its polarity analysis from student's feedback given for a teacher or course. The proposed solution consisted of three steps, 1) Entity classification of feedback text whether it is for a teacher or course. 2) The classified text is given to developed rule-based system to analyze and extract aspects as well as opinion words from text using pre-defined rules. 3) Once the desired aspects are extracted, the system calculates semantic orientation of the opinion words using SentiWordNet for overall assignment of polarity score to all opinion words regarding aspects in a text. We got quite satisfactory results with overall precision of 83.89% and 84% on entity classification. The system extracted different aspects of teacher and course with a precision of 83% and recall of 80%, whereas overall sentiment classification accuracy is 90%. The results are very much satisfying as compared to research studies done in the past for the same domain as discussed in section existing approaches of related works portion of this paper.

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Robotic Techniques Used for Increasing Improvement Rate in The Rehabilitation Process of Upper Limb Stroke Patients

Faheem Ahmed [1] , Aqeel Ahmed[1], Zeeshan Bhatti[1]

Abstract:

The rate of stroke patients in Pakistan is increasing, resulting in the decrease mobility of the patients. The movement of the upper limb stoke patient is decreased due to the weakness and loss of joint control in his upper body. To improve the coordination of movement of the upper limb stroke patients, many methods e.g. passive and active modes for improving the disrupted mobility are introduced. The objectives of this paper are to first review the studies on upper limb stroke patients and the techniques used for increasing the improvement rate through physical therapy by exoskeleton and evaluation of the performance of the patient using methods such as quantification and graphical representations so that it can be shown to the patient for his motivation to improve further. The paper introduces a mechanical design of exoskeleton with 1 degree of freedom for elbow and 2 degrees of freedom for shoulder movement for rehabilitation of joints of stoke patients. It also mentions the safety that will be taken in the process so that the exoskeleton is safe to use when it is in contact with humans. The model of the exoskeleton has the characteristic of being modular and easily operable and use admittance control strategy. The control strategy of the exoskeleton is discussed to maintain the position and orientation of the device and also is able to cater the gravitational attraction which plays an important part in the movement of the actuators. The mathematical model of motion attained due to the degrees of freedom of the exoskeleton is then evaluated and the lastly areas where the future work of exoskeleton can be done are discussed.

Keywords: *Rehabilitation, Exoskeleton, robotic techniques, admittance control, physical therapy, coordinatedmovement, stroke patients, 3 degrees of freedom, mechanical design*

1. Introduction

In the field of rehabilitation medicine, a physiotherapist is working for the better muscle movement of stroke and orthopedic patients. There is a need for physical exercise on a regular basis so that the patient is able to recover quickly. According to A Sunderland, D J Tinson et al., the studies have shown that the patient is able to recover quickly if he gets encouragement and is able to move his body muscles in home-based exercises and use of bio-feedback therapy [1].

The patient feels that he is a burden on his family and the society. This is true as there is a cost of living and welfare of the patient, which reduces his motivation and also decrease the motor outcomes [2]. If he is provided a good nursing, hospital care and good assistance at home, he is able to recover quickly and assist his family monetarily [2].

Upper limb injury in stroke and orthopedic patients is a common problem and it does require rehabilitation. The injury not only affects the patient, but also affects his family economically as he is not earning and is dependent on others which creates further consequences if his recovery takes a long time [3]. The study done by Roberto Colombo, Fabrizio Pisano et al states that if we

[1] *Institute of Information and Communication Technology, University of Sindh, Jamshoro*
Corresponding Email: faheemas1907@gmail.com

want to optimize the motor outcome of the patient then we have to evaluate the patient's rehabilitation in a quantitative way and also show those results to the patients. This way the patients will get motivated and will try to achieve more quantitative motor outcome value, resulting in shorter rehabilitation time. [2].

Considering Low Income Countries (LIC) like Pakistan, the rehabilitation of stroke and orthopedic patients is performed mostly manually. This increases high personal cost of the physiotherapist, the time and money invested by the family to go to the rehabilitation center will also increase. Basic kind of exercises can be performed at home, but due to lack of knowledge, the patient is not able to perform the same exercises at home for recovery, which creates frustration and decreases the motivation of the patient [3].

Some devices that are used by the physiotherapists uses a continuous passive mode of operation, which means that the robot does not take any feedback and is performing the same tasks within a regular interval of time and limits. These kinds of devices are not used for diagnosis as there are no sensors integrated in it [3].

Due to its versatile applications of robotics, this branch of engineering is growing its importance every day. It provides numerous opportunities to the patients and to the physiotherapists in increasing the rehabilitation outcomes and lowering the cost of therapy [4].

To broadly classify rehabilitation robots, two categories are used: end effector and exoskeletons.

End-effector rehabilitation robots: End effort is the distal part of the robot which is attached to the patient's limb and is used for the movement to his body. For Example, MIT-Manus and ARM Guide [5].

Exoskeleton rehabilitation robots: These robots have at least two points of contact. It allows torque at individual body joints. The mapping is used to align the joint of exoskeleton with the joints of the user. Examples of Exoskeleton are mpower ARM Brace, ARMin III, Rice wrist and CADEN 7 [5].

Exoskeleton imitates the external structural mechanism of a human body with its corresponding joints and links. These devices have high torque actuators installed in the exoskeletal body to assist the human in its routine tasks. These devices are growing in their popularity due to their use in the field of rehabilitation medicine and virtual reality i.e., It is beneficial for disabled people and also for healthy population [6].

The exoskeleton has a different mode of operations designed with different control algorithms to assist them in their routine tasks. The uses of the exoskeleton are as follow:

1. **Rehabilitation Medicine (Physiotherapy):** It has a great application in the physical therapy of patients as it helps in the training exercises of the patient to increase the extremity of the joints of the patient.
2. **Assistive Devices:** These devices work as human amplifier. It interacts with the objects that are in its surroundings by carrying most of the load. The operator do not have to worry about the load carried by the body.
3. **Haptic and Master/Slave Devices:** The exoskeleton is present in virtual or real environment and the interaction it has with its environment are transmitted to the user as a feedback. The user is able to feel the conveying interaction of the exoskeleton by knowing the shape, texture, stiffness and other characteristics of that environment depending on the sensors installed in the device. This mode is used in simulation as well as tele-operations.

The exoskeleton has a great application in the field of medicine. The robotic aided therapy's effectiveness is gaining its popularity among the patients with spinal cord injury and stroke. The main purpose that these devices serve in conducting rehabilitation, improving the outcomes of patient and quantifying the improvement of the patients through rehabilitation research and methodologies. Some techniques that are used to quantify the improvements include range of motion (ROM), smoothness in movement and strength. These values are used for the feedback to the exoskeleton if it is working in active mode or can be utilized by the therapist and researchers in robot design and control [5].

One of the best-known exoskeleton rehabilitation robots is InMotionARM Interactive Therapy System is continuously taking data from the patients and is trying to challenge the patient to improve his motor therapy. The other one that is similar to InMotion ARM Interactive Therapy System is MAHI EXO II. It has a definite workspace and the torque output and bandwidth to match with the human capabilities. Low inertia, static friction and other damping also result in improved control system [5].

To measure the progress of patients, a research was conducted by Janet H. Carr, Roberta B. Shepherd to measure the motor capabilities was introduced known as Motor Assessment Scale (MAS). The quantitative analysis through this medium was found to be highly reliable in clinical practice. The progress of each patient was easily analyzed in later cases and the score achieved by the patient also boost up the motivation scale of the patient to rehabilitate earlier [7].

2. Problems in Pakistan

The rehabilitation in Low Income Countries (LIC) including Pakistan is a bit different. According to research conducted in Pakistan Institute of Prosthetic and Orthotic Sciences (PIPOS), there are over 30 million individuals in LICs who require prosthetic and orthotic services. The percentage of Upper limbs surpass the percentage of Lower limb therapy to a great extent [8].

The responsibilities of physiotherapists in LIC are greater as the patients do not want to depend on the expensive treatment from the machines. The rehabilitation process is itself time consuming and also very expensive [9]. The patients do not feel comfortable when asked for a large amount for health services. Economic problems arise in these countries to get the required funding in rehabilitation projects and to get the required training from High Income Countries (HIC) to Low Income Countries (LIC).

So, there is a need of making technology locally that is economical, easily available and easy maintained. As the device is made locally, proper training to the technicians can be arranged easily. In Pakistan, Research in the field of rehabilitation on a larger scale is very limited. Some of the institutes working in Pakistan are DOW University of Health and Sciences, Liaquat National Hospital, Dept. of PTR, Hayatabad Paraplegic Centre and National Institute of Rehabilitation Medicine. But the output of these institutes should be increased so the patients are able to once again take the burden of their family and give back to the society.

3. Model Design

There are many techniques which are used for the rehabilitation of stroke patients. Some of them are Electrical Stimulation, Physical Therapy, Passive Manipulation and

sensory Motor Rehabilitation Technique [2]. Electrical Stimulation and Passive Manipulation techniques are used in early stages of therapy when there is no movement in the limbs of the patients. Once the signals in the body are restored, then it is time for the physical or active therapy to rehabilitate further movement of the limbs. Our exoskeleton model focuses on physical therapy using sensory motor rehabilitation techniques.

According to Johanna H van der Lee et al, in clinical messages, intensive exercise therapy for the rehabilitation of stroke patients appears to be beneficial in their rapid recovery. The improvement is also dependent on how much the patients are putting effort in exercise. Therefore, the patient should be encouraged time to time to exercise more often so that he rehabilitates quickly [10].

A Motor Assessment Scale (MAS) model was created during 1980s by Janet H. Carr and Roberta B. Shepherd to quantify the rehabilitation of the patient [7]. The aims of the project were to monitor the daily activities of the patient display the result in a quantified manner which is understandable by other health professionals. The best performance of the patient should also be displayed for the motivation of the patients to perform well in the rehabilitation process. As it was a software-based model therefore it was also inexpensive to implement in a rehabilitation machine.

While modelling the design of exoskeleton, similar strategies were considered as explained below:

4. Mathematical Model

The exoskeleton model involves three degrees of freedom. Two for shoulder joint and one for elbow joint each incorporating a high torque motor. Through simplification, the closed loop of a motor can be related to a first order damp system which means that the control system has no overshoot.

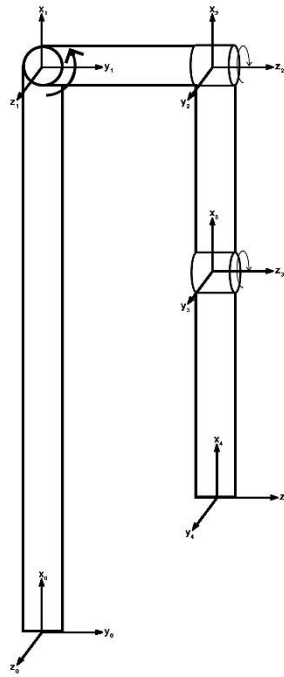A simplified diagram of one arm of exoskeleton is shown in figure 1.

Figure 1: One arm of exoskeleton

Table I: DH parameters for the exoskeleton

	θi	di	Ai	αi
1	0	10	0	0
2	θ_1	0	2	90
3	θ_2	-3	0	0
4	θ_3	-3	0	0

Using the values given in Table I, the homogeneous transformation of each step is calculated as:

$$A_1 = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 10 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$A_2 = \begin{bmatrix} c_1 & 0 & s_1 & 2c_1 \\ s_1 & 0 & c_1 & 2s_1 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$A_3 = \begin{bmatrix} c_2 & -s_2 & 0 & 0 \\ s_2 & c_2 & 0 & 0 \\ 0 & 0 & 1 & -3 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$A_4 = \begin{bmatrix} c_3 & -s_3 & 0 & 0 \\ s_3 & c_3 & 0 & 0 \\ 0 & 0 & 1 & -3 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Using these values, the rotation and transformation matrices for the end-effector are:

$$R = \begin{bmatrix} c_1c_2c_3 - c_1s_2s_3 & -c_1s_2c_3 - c_1c_2s_3 & c_1 \\ s_1c_2c_3 - s_1s_2s_3 & -s_1s_2c_3 - s_1c_2s_3 & c_1 \\ s_2 + s_3) & c_2 + c_3 & 1 \end{bmatrix}$$

$$T = \begin{bmatrix} 2c_1 - 6s_1 \\ 2s_1 - 6c_1 \\ 10 \end{bmatrix}$$

Using these values from the DH-parameter, the simulation in MATLAB showed following result showing all the three links on one side from the base of the exoskeleton.
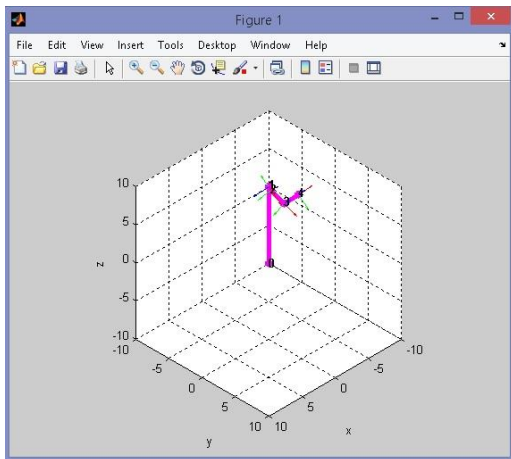
Figure 2: Tree links on same side of Exoskeleton.

5. Hardware Design

The exoskeleton comprises of three parts. The manipulator – mechanical moving structure, electrical part - electrical drives, actuators and power circuitry and the computer - for controlling the exoskeleton. While considering hardware design, the following conditions were taken into consideration:

The body of the exoskeleton should be made of non-conductive durable material. The body of the exoskeleton can be made using Laser cutting (light weight steel, carbon fiber or aluminum) or using CNC machines for fabrication. Easy to wear and removing straps were also part of patient's facilitation so use of Velcro was necessary. The links of exoskeleton with foam/cotton pads be used to remove blood blockage of the patient and increase comfortability.

The structure should be mechanically well, easy to manufacture and easier for maintenance purposes. The design of the exoskeleton should include adjustable height and shoulder sizes.

Great care should be taken on the links that are in contact with the patient. The designer has to first define the maximum and the minimum rotation of the joints. If the exoskeleton exceeds its rotational motion, it might become a liability and will affect the rehabilitation process. Limiter switched should be incorporated in the design for maxima and minima so that the motors should not go beyond the required limits.

Joints of stroke are stiff and resist motion as there is no blood flow in their arteries and veins. The same is the case with orthopedic patients, after the operation, the arm is at rest for 1-2 months, reducing the moving capability of the arm thus the muscles get stiff. To cater this problem, high torque servo motors or linear actuators can be implemented in the design to overcome the resistance provided by patients. A controller should be integrated to operate the motors of exoskeleton, gets necessary feedback from the actuators and decides the path to reach its destination point. To compensate weight, friction and spatial gravity, the motors in stall position will require power to provide the required amount of compensation torque [11]. For the protection of the actuators, casing should be used.

At the initial stage of rehabilitation, PID controller cannot be used as our requirement is not reaching to the destination point quickly, rather than we want to gradually increase the motor capability of the patient. Once the motor capacity is increased, a PIC controller can be implemented for fast to and fro motion to reduce the stiffness in the joints. Gain (Kp, Ki and Kd) of PIC controller can be controlled to control the speed of the motor rotation.

Microcontroller will be controlling the electrical components of the exoskeleton for controlling the overall circuitry of the hardware.

A regulated power supply circuitry is needed to reduce the hazard of increasing current limits while the motor is working on high torque. Safety consideration like kill switches and fuses should also be taken while designing the electrical circuitry to save the patient in case exoskeleton misbehave.

Due to unknown environment, the inaccuracies due to round-off errors will increase and can be calculated using:

$$\text{Robot accuracy} = \tfrac{1}{2}\,(\text{Basic Resolution Unit}) + \text{Mechanical Accuracy}$$

6. Control Design

According to Johanna H van der Lee, et al. the control system must be of simple design and should integrate the methods which involve effective therapy to improve the movement of the stroke patients [10].

There are two modes in which rehabilitation of stroke patient is done. Passive mode (Impedance Control) exercises and active mode (Admittance Control) exercises.

In passive mode exercises, the patient is not able to move his/her arm, the exoskeleton will support the arm and will help the patient to exercise. It means the displacement is being input from the therapist and the motor motion is the output for the exercise of the patient [2].

While in active mode exercises, the patient has recovered some movement and has a spatial area in which he is able to move his arm but lacks the coordination. In this method, the exoskeleton should know what the recovered areas of the patient are and assist the patient in those areas where he/she finds difficult to move his muscles [11]. It means, the force is applied by the patient and the movement of exoskeleton is the output. This method will help the patient to move his muscles a little further and recover some more ground to speed up his/her recovery process.

To improve the shoulder-elbow coordination, the program is easier to understand and use accordingly. After a therapy from the exoskeleton, the improvements of the patients should be monitored. The therapist will guide the program depending on the performance of the patient i.e. the need of active mode exercises or passive mode exercises. As the patient learns a certain degree of the motor learning program, the level of difficulty will increase, thus making it challenging for the patient and increasing the motor movement in less amount of time [11].

This could be achieved through Adaptive-assistance-as-needed algorithm. This algorithm utilizes a combination of feedback as well as feedforward loops. The feedback loop is controlled by the position of the motors of exoskeleton that how much the motors are actuated while the feedforward loop depends on the ability of the patients to improve his/her joints without assistance of the exoskeleton. As the feedforward loop increases, the feedback loop will decrease. It means greater the patient tries to achieve his/her recovery objectives to accomplish a motor task, the dependency on the exoskeleton will reduce. This decrease in feedback loop will show the better recovery of the patient [11].

Games play a vital part in catching the attention of the user and improve the coordination of brain with the body. It is a great source of learning and can be implemented for rehabilitation. The idea behind implementing games in admittance control is by using the feedback from the exoskeleton, a virtual 3D space is designed. In that space, obstacles will be placed near the locality of the patient's motor outcomes. The task of the patient is to go beyond the limits of his joint movement to achieve those tasks thus enabling him in faster recovery.

A simple technique for taking feed forward control is by using EEG and ECG signals from the wrist and elbow of the patient, but this has transmission interference due to sweat from patients and poor signal to noise ratio (S/N ratio) [11]. This system can be improved by implementing and algorithm parallel to ECG and EEG which calculates the movement of patient without assistance from exoskeleton using the position feedback of from servo motors and the reduce drainage of power during this time and provide the compensation in the error cause by EEG and ECG.

7. Result

Using the above analysis, a 3D model of exoskeleton was modelled in SolidWorks. The maxima and minima were examined. All the parameters discussed above, were implemented in the model.

To make the size of the exoskeleton modular for each patient, prismatic joints are used for the base so that it is easier for the therapist to adjust the size for each patient as shown in the figure 3.
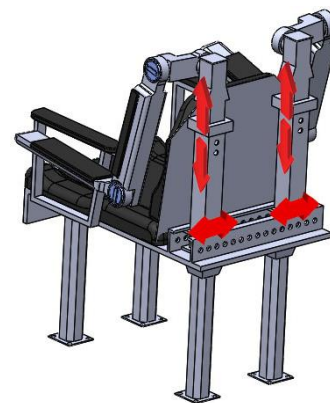

Figure 3: Adjustable prismatic joints

The motion of each revolute joint was monitored for maxima and minima and how much they are able to rotate in free space so that they can be controlled using the described control strategy as illustrated in figure 4.
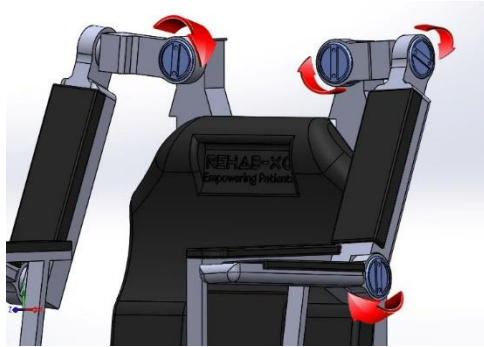

Figure 4: Rotation of each revolute joints.

8. Conclusion

In this research work, a technique used in robotics was used for assisting stroke patients with their rehabilitation and physiotherapy, explicitly the upper limb, with a special designed chair. The model is easy to fabricate and is a platform for implementing our admittance control algorithm for faster rehabilitation of stroke and orthopedic patients. In order to improve the motivating level of the patient, path orientation games can be used in control design so that the patient can move his/her joints to move to the desired location in space in order to achieve the task of the game.

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Analysis of Optimum Velocity and Pressure of the Air Flow through the Screens with the Help of Resistance Coefficient

Abid Ali Memon[1]

Abstract:

The present study based on applying the finite element's methodology to analyze the fluid flow through the two-dimensional channel rectangular shaped and escorted by the three blocks imposing with screen boundary conditions on them. These blocks or screens are affixed at unit distance from each other with two different angles -45^0 and 45^0. The two-dimensional incompressible Navier Stokes equations are discretizing by finite element-based software COMSOL MultiPhysics 5.4 which embraced the Galerkin's least square operation. The air is working fluid which endures to enter from the exit of the channel with the average velocities of 1 m/sec to 10 m/sec, the resistance and refraction coefficients are tested from 2 to 3 and 0.2 to 1 respectively. The objective of the study to analyze the maximum velocity and the maximum pressure when the fluid enters the region which comprises three screens inclined at angles by enhancing the resistance coefficient by fixing refraction coefficient. We uncovered that the maximum velocity magnitude, as well as pressure, is increasing with the enhancement of the resistance coefficient for a fixed refraction coefficient and the influences of average inlet velocities are to be determined with the help of resistance coefficient along with the refraction coefficient. Also, utilizing the statistical analysis method, we found that with the enhancement of the average inlet velocity by fixing refraction coefficient the relationship between maximum velocity magnitudes and resistance coefficient weakens, whereas the maximum pressure showed a strong connection with the resistance coefficient.

Keywords: *resistance, refraction, angle, metalic screens*

1. Introduction

In the field of design and engineering study, while any type of fluid be willed into any region it would be crucial to manage the velocity field and pressure distribution in the domain. For the reason some times, it is a need to study the fluid flow through porous medium or block with screen boundary conditions. The study of blocks with screen boundary condition is more reliable and relaxed as compared to that of the porous medium. Controlling a rate of flow of any fluid comes into any region. The metallic screens are used from decades. While learning the fluid flow actions via the screens it is demanded or essential to describe the

association between the maximum velocity magnitude and maximum dynamical pressure with resistance coefficient κ.

There are number of scientists, engineers and fluid flow analysts who accord to understand the dynamics of the fluid in the existence of screens. Elder [1] searched out the asymptomatic solution which discloses the relationship between the stream-wise velocity at the outlet of the channel related the small angle which is determined from the

[1] *Department of Mathematics, Sukkur IBA University Sukkur, Pakistan*
Corresponding Email: abid.ali@iba-suk.edu.pk

51

focus of single screen. To upgrade airing system of the rooms or compartment, Teital [2] performed experiments in the lab while setting the inclined screens at angles from 45^0 to 150^0. The investigation was carrying out and validated the results with ANSYS CFX-11 working the porosities 0.4, 0.52 and 0.62. It was exposed that the mass flow rate while putting the screens at 45^0 for all valued porosities is much better than that when screens are set at 135^0. While analyzing fluids of nitrogen gas, air and water through Dutch Twilled Screens (DTS) and a Broad Mesh Geometry (BMG) a connection between non-dimensional Reynolds number Re and Euler number Eu was shaped by German and Fischer [3]. With the help of discrete element process, the fluid flow in the shape of rough particles past the screens at various angles was affected by Sawant et al [4]. He detected that the mass transfer is optimized by improving the arrangement of the angle. In short, his simulation links or provides basic to form a relationship between mass transfer and angle of the inclination of screens. While the fluid particles are passing or come into the junction through the screens, they actually give up energy. The head loss or energy loss of the particles presented with the screens are determined by the Santiago and Wang [5]. They found that the loss of energy can resist by transforming the screens from one angle to another angle. The whole research told us about the importance of saving energy. Abid, et al [6], studied the laminar and Newtonian fluid flow through the channel affixed with the three screens facing the resistance of 2.2 and refraction coefficient of 0.78 and all screens are movable from -45^0 to 45^0 using the commercial software COMSOL Multiphysics 5.4. They contributed the empirical equations using the linear regression analysis for the maximum velocity, the maximum pressure in the whole domain and the drag force applying by each screen in terms of the angle of the screens. Brooke and Haughs [7] pioneered the new and very general approach for solving the compressible and incompressible fluid flow problems with one formulation recognized as Galerkin's Least Squares finite element method. According to the formulation if the velocity, pressure and temperature are the primitive variables then a unique discretized weak formulation, can be governed with the use of basic of finite element method with the help of least squares scheme.

The objective of the present study is to contribute about the distribution of optimized velocity as well as pressure while fluid passed through the three screens with the help of resistance coefficient along with the fixing refraction coefficient. The motivation behind the problem is that it provides the numerical visualization through the graphs for controlling the optimized
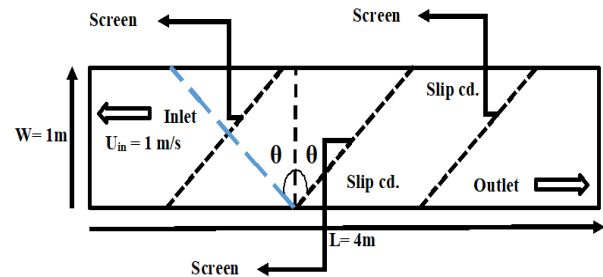

Fig. 1: Schematic diagram of the channel

velocity and pressure with the help of resistance coefficients for specific refraction coefficient. The problem is examined by using the screens boundary conditions with the special parameters of resistance coefficient (2 to 3) and refraction coefficient (0.2 to 1). The results are achieved using the package of finite element methods COMSOL MultiPhysics 5.4 and presented through graphs and tables. The result is contrasted with the asymptotic solution provided by Elder [1959].

2. Methodology

2.1. Geometry and Boundary Condition
Reckoning the rectangular channel, we place the length and width of the geometry with 4m and 1m respectively. The three blocks with screen boundary conditions are set at the 1m distance from each other which are moveable at -45^0 and 45^0. The schematic diagram in the Fig.1 is shown with inlet and outlet boundary conditions. Air as working fluid is approved to flow from the doorway of the channel with speed from 1 to 10 m/sec in series and while at the exit of the channel pressure is considering zero pressure.

2.2. Meshes of Geometry
The designated rectangular domain of the geometry with three blocks has been split into irregular triangular elements about 2386 with minimum and maximum quality elements of 0.76 and 0.12 respectively. As this problem of the fluid flow are analyzed using rich techniques of Galerkin's Least Square of finite element approach. It was the fundamental necessity of any numerical strategy to put in the meshing process over the interested area. Also, it is the naked truth that to obtain more and more unambiguous or predictable numerical result the mesh of the geometry should be more and finer. Although it would get enough time to perform the simulation and to prepare the acquired convergence of the problem. However, the present problem has been put into analysis by doing a normal meshing in the domain, and we got the results which will be comparable to asymptotic solution sought by Elder [1959].
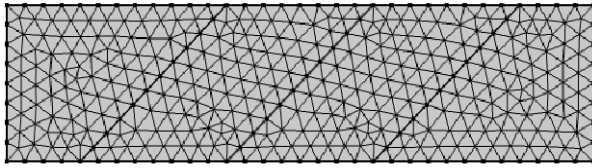
Fig. 2 Irregular Triangular Meshes of the Geometry

The selected geometry is meshed using the irregular triangular elements shown in Fig.2 and the mesh statistics are given in Table I.

Table I: Mesh statistics of the Geometry

Property name	Value
Minimum quality element	0.7629
Maximum quality element	0.9793
Number of triangular elements	2382
Edge elements	215
Vertex elements	10

2.3. Governing Equations

The steady state and two dimensional incompressible Navier Stokes equations are worked out numerically with constant viscosity ν and density ρ employing the screen boundary conditions putting in on the three blocks of the channel. Expected to the non-linearity of the second order Navier Stokes equations, it is very stiff or almost unfeasible to get the accurate solution function for the velocity field and pressure without regulations which is not but a settlement. In the meadow of numerical methods, several numerical procedures were implemented from the periods. Every one of them was assessed, as a best numerical procedure to get the solution of the fluid dynamics problems of their particular times. In this article, we are attending to debate the numerical results acquired through least square procedure of the finite element methods. For the grounds we use COMSOL MultiPhysics 5.4 to descritize the second order Navier Stokes equations utilizing the screen boundary conditions. The governing partial differential to calculate the velocity and pressure is given below:

$$\frac{\partial \vec{V}}{\partial t} + (\vec{V} \cdot \nabla)\vec{V} = -\frac{1}{\rho}\nabla p + n\nabla^2 \vec{V} + F \qquad (1)$$

$$\nabla \cdot \vec{V} = 0 \qquad (2)$$

Where $\vec{V}$ is the velocity field with u and v as x and y components respectively. Due to the steady state study, we can assume the time derivative of the velocity field equal to zero. Hence, we have (3)

$$\frac{\partial \vec{V}}{\partial t} = 0 \qquad (3)$$

Further, our requirement is that the viscous impact should not be seen in the upper and lower wall of the channel. Therefore, slip boundary condition will facilitate us. If $\vec{n}$ is the vector normal to the velocity field then:

$$\vec{V} \cdot \vec{n} = 0 \qquad (4)$$

$$\vec{K} - (\vec{K} \cdot \vec{n})\vec{n} = 0 \qquad (5)$$

Where

$$\vec{K} = \nu(\nabla \vec{V} + (\nabla \vec{V})^T)\vec{n} \qquad (6)$$

Finally, we will describe the screen boundary condition referring equation (7), (8) and (9). In the fluid flow investigation screen boundary condition suppress the tangential component of the velocity field and helpful to boost the speed in the channel.

$$[\rho \vec{V} \cdot \vec{n}]_-^+ = 0 \qquad (7)$$

$$[\rho - (n)^T \vec{K}\vec{n} + \rho(\vec{V} \times \vec{n})^2]_-^+$$
$$= -\frac{k}{2}\rho_-(\vec{V} - \times \vec{n})^2 \qquad (8)$$

$$\vec{n} \times \vec{V} + = \eta(\vec{n} \times \vec{V}_-) \qquad (9)$$

In equations + and - shows the presents of the parameter up and downstream respectively.

After doing the numerical calculation, we will apply the statistical technique to calculate the correlation coefficient r by using the equation (10) as given below:
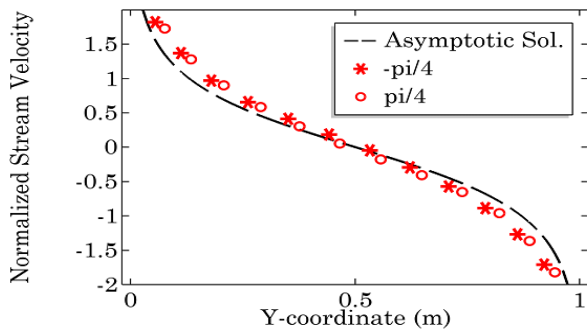
Fig 3. Comparison with asymptotic solution

$$r = \frac{\sum_i (x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_i (x_i - \bar{x})^2}\sqrt{\sum_i (y_i - \bar{y})^2}} \qquad (10)$$

Where

$$\bar{x} = \frac{\sum_i x_i}{n} \quad \text{and} \quad \bar{y} = \frac{\sum_i y_i}{n} \qquad (11)$$

To calculate the V_{corr} for 45^0 and -45^0 we will take $x = V_{max}$ and $y = \kappa$. Also, for calculating P_{corr} either at 45^0 and at -45^0 we will consider $x = P_{max}$ and $y = k$.

3. Results and Discussion:

Initially, we attempt to validate our method of solution by numerically calculating the stream –wise velocity at outlet of the channel and compared with that of asymptotic solution given by [1], see Fig. 3. The result shows the strong agreement with the numerical procedure.

3.1. Velocity and Pressure Distribution at 45^0

In the first stage, all screens are standing at 45^0. The fluid flow is investigated through the channel with three blocks facing screen boundary condition. Maximum velocity flowing through the whole interested domain is calculated by keeping constant one of the refraction coefficients from 0.2 to 1 for all of the resistance coefficient κ from 2 to 3. Fig.4 shows the maximum velocity magnitude in the domain calculated for the initial speed at uin at 1 m/sec at all resistance coefficients κ from 2 to 3 at particular refraction coefficient η. The figure conveys the message with fixing η the maximum velocity magnitude is increasing with increasing in resistance coefficient κ due to the

increment in the hydraulic energy of the fluid. As soon as we increase refraction coefficient η, the maximum velocity magnitudes is decreasing due to the change of the direction of the air while crossing the screen. In Fig. 5 responses of average inlet speeds 4, 8 and 10 is given which conveys the message that for a particular refraction coefficient the response of maximum velocity is decreasing for all inlet velocities and for all corresponding resistance coefficient.

It might be a tradition of the research study if there is argument for the velocity distribution in the domain there should be argument for pressure distribution. In the article, we have also produced the graphs for maximum pressure resulting in the domain beside resistance coefficient for particular refraction coefficient that is worked out from the numerical scheme. The Fig. 6 shows that for a Particular refraction coefficient η the maximum pressure is increased linearly for all resistance coefficients due to the declining of the kinetic energy of the fluid when the fluid comes to strike with the screens. In the article we have also put on the graphs for maximum pressure occurring in the domain against resistance coefficient for particular refraction coefficient that are calculated from the numerical scheme. The responses of all uni, the average inlet speed at 4 m/sec, 8 m/sec and 10 m/sec are calculated in the shape of maximum pressure shown through the Fig. 7. This also clearly concentrates on the forecast that with decreasing in refraction coefficient the maximum pressure is decreasing.

We also enhance our investigation in the direction of the statistics judgment by finding the correlation coefficients between κ with maximum velocity and pressure at particular η ,inlet velocity at the angle look at Table-2. It is very understandable from the results due to boost in inlet velocity the correlation between resistance coefficient κ and maximum velocity is turning down, while the maximum pressure shows the strong relationship with κ. Furthermore, the given Table-2 also admitted about the average maximum velocity right through as well as pressure in the channel. However, we were unable to define the correlation coefficient between κ, and max velocity at η at 1m/sec.

3.2. Velocity and Pressure Distribution at -45^0

In the 2nd phase, we also attend to look at the maximum velocity causing in the domain with the aid of increasing resistance κ coefficient with fixing of refraction coefficient η for all the screens at -45^0. Fig. 8 shows the consequences of Vmax when the inlet velocity uin =1 m/sec. Of course, likely to the screens is prepared at 45^0, in this case the maximum velocity magnitude is also raised by fixing refraction coefficient as a
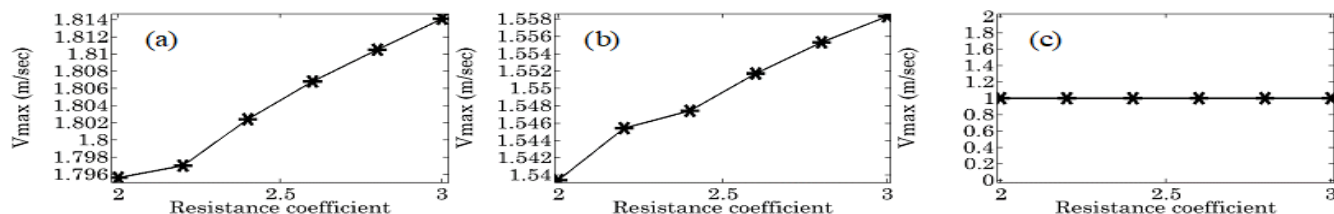
Fig. 4 Optimum velocity magnitude against the resistance coefficient at the unit initial speed for a particular refraction coefficient at (a) 0.2 (b) 0.4 and (c) 1
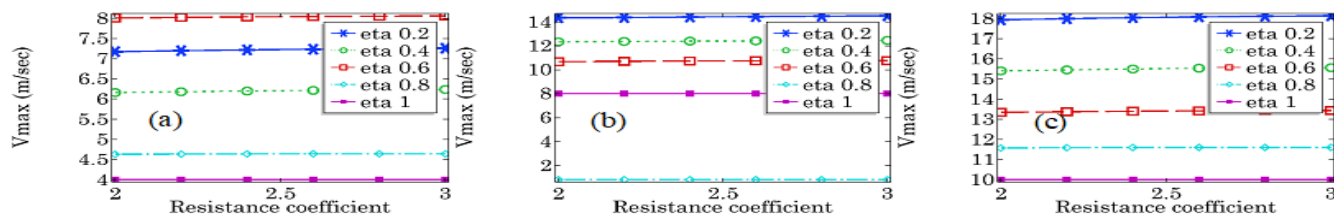

Fig. 5 Optimum velocity magnitude against the resistance coefficient for all refraction coefficients at initial velocities of (a) 4 m/sec (b) 8 m/sec and (c) 10 m/sec
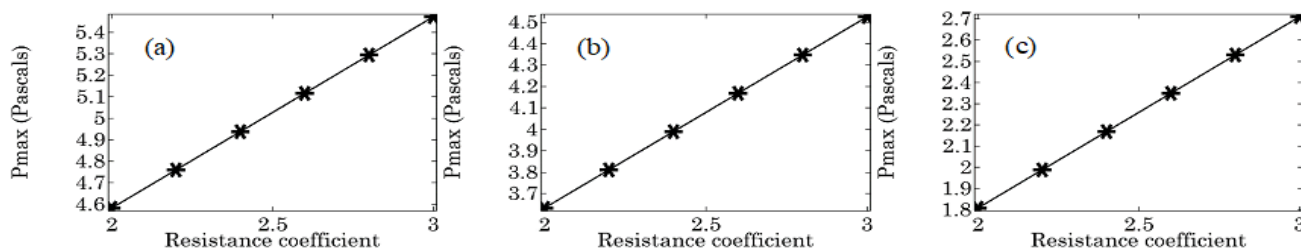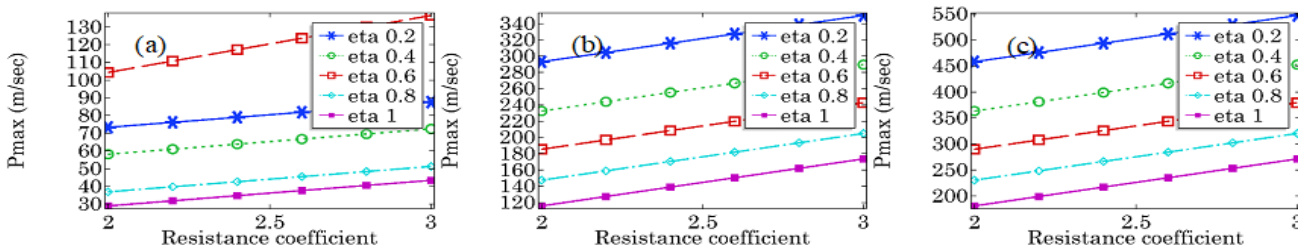

Fig. 6 Optimum Pressure (Pa) against the resistance coefficient at the unit initial velocity for a particular refraction coefficient at (a) 0.2 (b) 0.4 and (c) 1

Fig. 7 Optimum Pressure (Pa) against the resistance coefficient for all refraction coefficients at initial velocities of (a) 4 m/sec (b) 8 m/sec and (c) 10 m/sec
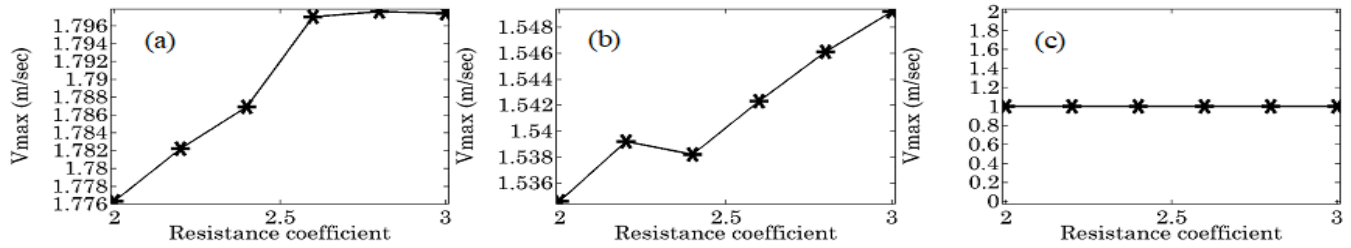
Fig. 8 Optimum velocity magnitude against the resistance coefficient at the unit initial speed for a particular refraction coefficient at (a) 0.2 (b) 0.4 and (c) 1
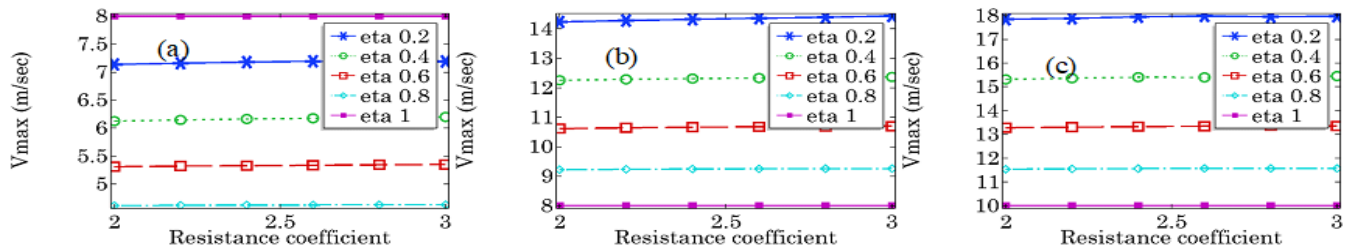

Fig. 9 Optimum velocity magnitude against the resistance coefficient for all refraction coefficients at initial velocities of (a) 4 m/sec (b) 8 m/sec and (c) 10 m/sec
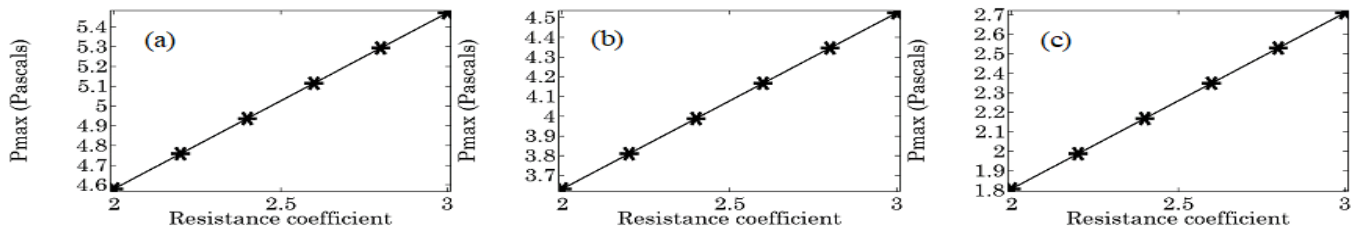

Fig. 10 Optimum Pressure (Pa) against the resistance coefficient at the unit initial speed for a particular refraction coefficient at (a) 0.2 (b) 0.4 and (c) 1
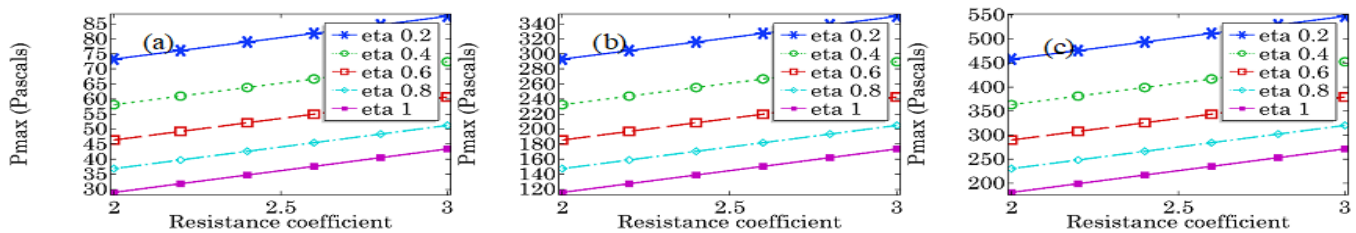

Fig. 11 Optimum Pressure (Pa) against the resistance coefficient for all refraction coefficients at initial velocities of (a) 4 m/sec (b) 8 m/sec and (c) 10 m/sec

constant and altering the resistance coefficient from 2 to 3. Further, the responses of average inlet velocity magnitudes are also assessed at 4 8 and 10 m/sec to get the maximum speed running in the domain. The maximum pressure endured on the channel is also determined by fixing eta and enabling kappa to boost from 2 to 3. Fig. 10 evidently renders that maximum pressure is boosting linearly with the resistance coefficient kappa. Thus, a linear relationship can be determined by least square procedure between κ and optimized pressure for each η .The optimized pressure possesses the same relationship for the inlet average velocities uin 4, 8 and 10 m/sec. See Fig.11. From the essence of thought of statistics reasoning, the Table-2 presents the correlation coefficient for the relationship between κ and maximum velocity magnitude as well as pressure. The results demonstrate that for a specific η the pressure habitually shows causal relationship with kappa whereas the correlation coefficient is dropping for max: velocity as we increase inlet velocity. However, we were powerless to define the correlation coefficient between κ max velocities at eta at 1 m/sec.

In the present paper, we were attempting to demonstrate the air flow attitude through the rectangular channel fitted with three blocks by tricking boundary conditions. The two-dimensional incompressible Navier Stokes equations were numerical worked out, and the simulation was carried out with the help of commercial software COMSOL MultiPhysics 5.4. The density and viscosity of the fluid were gripped as constants. The contemplation was parametric, and the parameter was specified as resistance coefficient κ from 2 to 3 with refraction coefficient from 0.2 to 1. The behavior of the maximum velocity magnitude and pressure was monitored by fixing η and moving κ and further we estimate the correlation coefficient between resistance coefficient and maximum speed and pressure in the domain. At the moment we are in place to put forward the following terminal points:

1. In the channel while checking out the maximum velocity field resulting when screens are affixed at either 45^0 or -45^0 is increased for increasing resistance coefficient at a particular refraction coefficient. But maximum velocity magnitude does not keep linear relationship with resistance coefficient.

2. For a particular average inlet velocity magnitude, the maximum velocity in the domain is decreased while increasing the resistance coefficient at a specific refraction coefficient.

3. For all inlet average speeds in setting the screens either in 45^0 or -45^0 degree, the maximum pressure is increasing linearly by enhancing resistance coefficient at fixed refraction coefficient. At a particular average inlet speed, the optimum pressure is decreasing with increasing in refraction coefficient for all resistance coefficients.

4. With the helping hand of theory of statistics analysis, we have calculated the correlation coefficient between the maximum velocity as well as pressure with the resistance coefficient at fixed refraction coefficient. We conclude that with the increase in inlet average velocity magnitude, the relationship between the maximum speed in the domain and resistance coefficient weakens at fixing eta. But resistance coefficient possesses strong relation with maximum pressure by fixing eta.

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Review of Available Barriers to the Wind Energy Development Activities in the Coastal Areas of Pakistan

Zeeshan Alam Nayyar[1],*, Nayyer Alam Zaigham[2], Nadeem Mahmood[3], Muhammad Saeed[3], Ahmed Ali[1], Nazia Sadiq[1]

Abstract:

The fossil fuels including coal, oil & gas, nuclear and other waste burning methods for power generation are the main cause of our climate to change drastically, and are contributing factor to global warming. And these conventional forms of energies are also finite and depleting with a fast pace. The alternate to this situation is the adaptation of clean, renewable forms of energies, like wind, solar, hydel, geothermal, etc. The coastal belt of Pakistan is the supposed to be the windiest part of the country, so we have a massive wind energy resource waiting to be used for the development of wind-based power plants. Despite the efforts made at provincial and central governments level and in different private sectors, the wind electricity generation capabilities and/or technologies so far couldn't be developed as it should be. This paper describes the salient natural and anthropogenic barriers against the wind energy development activities along the coastal belt of Pakistan.

1. Introduction

A United Nation's panel of scientists and over 160 governments agree that "The burning of fossil fuels like coal, oil & gas, wood and other waste & agriculture leftovers are causing our climate to change drastically, contributing to global warming that exposes many millions more people to the risks of hunger, drought, flooding and diseases and produce irreversible losses of species" (UNFCCC, 2006).

The alternate of this alarming situation is to adopt clean, cheap and environment friendly forms of energy, i.e. renewable energies like wind, solar, biomass, hydel, geotherm, tidal, etc. The adaptation of renewable energy sources instead of conventional energy sources will also help to minimize the threats causing by nuclear power, a life-long threat to the human health and to the global eco system. Among the renewable energy sources, the wind energy is proved to be the cleanest, cheapest, most environment-friendly in terms of less GHGs emission form of energy source.

There are many concerns that are related to power generation plants either by conventional or renewable energy sources, such as, no power plant is capable to generate electricity without stopping because of any unexpected outages or maintenance issue. Furthermore, renewable energy resources like wind are not available for all the time and hence power generation through it is also a question of availability and reliability. Therefore, these types of reliability factors are much difficult to deal with than the

[1] *Renewable Energy Research Group, Department of Applied Physics, University of Karachi, Pakistan*

[2] *GeoEnvoTech Services, Karachi, Pakistan*

[3] *Department of Computer Science, University of Karachi, Pakistan*

Corresponding Email: zanayyer@uok.edu.pk

intermittency of wind energy resource. One of the main advantages of wind energy is its availability is much higher during the hotter months of the year, when the energy demand is at its peak in the countries like Pakistan. Hence, wind energy hybridizing all other available renewable energy resources in the country such as solar, biomass and wave & tidal could meet most of the electricity demand.

The coastal areas of Pakistan supposed to be the windiest part of the country, therefore we do have an unlimited and free resource to be utilized. And in the future, all or most of our electricity demand could meet from the mix of complementary renewable resources, balancing wind energy with solar, biomass, wave & tidal (Zaigham and Nayyar, 2005).

This paper describes the salient natural and anthropogenic barriers in the development of the wind energy technology against of the sincere efforts of the government.

2. Anthropogenic Barriers to the Wind Energy Development

Despite the efforts made at provincial and central governments levels and by many different private sectors, the wind energy-based power generation capabilities and/or technologies so far couldn't be developed as it should be (Kamran, 2018; Bilal et al., 2018; HDIP 2017; Nayyar et al., 2014; Nayyar, 2009; Dawood, 2002; Farooqui, 2002; Fatehally, 2002; Zaigham, 2002). Table 1 shows current grid connected wind energy-based power generation installations in Pakistan.

By a detailed overview study of the situation relevant to activities related to wind energy technological developments, it is found that there are certain barriers which could be classified as:

2.1. Lack of Institutional Coordination

Different institutions in public and private sectors are working in the field of wind energy technology without any cohesive interaction or exchange of their working outputs. Even one institute hesitates to share its data with other. It is interesting to note that focal point for the development of renewable energy technology in Pakistan is changing since last few decades very regularly which is a discouraging situation to decide the national priority. With the view to develop a strong focal point, Pakistan Council of Renewable Energy Technologies (PCRET) was created by the Government of Pakistan by merging several institutes working separately for the development of renewable energy

technologies few years back (Hassan, 2002a; Hassan, 2002b). In state of strengthening the newly developed focal point, another focal point has been created as Alternate Energy Development Board (AEDB) in 2003 (AEDB, 2019). Similarly, Ministry of Environment has their independent programs in collaboration with UNDP-GEF and UNEP.

In addition, there are other institutions at provincial and central level which are also working independently on their conceived projects. This is also very important issue to note that most of the institutions do not have adequately educated and/or trained manpower to work on the promotion and development of wind energy resource as well as technology. The status of coordination among these focal points is not very clear, rather reflects state of confusion.

Table 1: Installed Capacity of Wind Projects at the End of 2017. Source (GWEC, 2018; AEDB, 2019)

Year	Installed Capacity (MW)	Location	Annual Growth Rate (%)
2013	105.9	Jhampir, Sindh	-
2014	99.5	Jhampir and Gharo, Sindh	93.6
2015	102.8	Jhampir and Gharo, Sindh	103.3
2016	282.3	Jhampir and Gharo, Sindh	274.6
2017	248.5	Jhampir and Gharo, Sindh	88.1
2018	446.7	Jhampir and Gharo, Sindh	179.8
Total	986.6 MW		

2.2. Lack of Baseline Data Pertaining to Wind Energy Potential

For the development of wind energy generation capability, the imperative prerequisites are the assessment of wind potential in general and the site-specific baseline wind studies. With the financial support of Ministry of Science and Technology, Pakistan Meteorological Department established a network of wind masts along the coastal areas in 2001-2002 to conduct an extensive wind survey of the coastal areas to assess wind power potential at 10m and 30 m heights (Chaudri, 2002). The design of the wind mapping system indicates the lack of background knowledge of wind energy

technology. As the result, the design they could not decide adequate measuring heights of the wind layers and resulting wind potential.

2.3. Lack of Interactive Background Knowledge of Basic Wind Technology

A well-established commercial technology in developed countries does exist, which is largely unfamiliar to developing countries. Like for example, in Pakistan so-called wind farms were installed with great publicity through national media claiming sufficient generation of electricity for the need of nearby townships, which were failed after few months since the introduction of the technology was without proper study and basic knowledge (Figure 1).

Figure 1: So-called wind farm installed at Karachi Beach and failed after few weeks.

Such types of activities have created bias thinking and misperceptions about applicability, cost and reliability of the wind energy technology in Pakistan in general. On the contrary in countries where wind power has been adequately introduced its growth has been very rapid, like in the case of China, India and/or Turkey (GWEC, 2018).

2.4. Least Priority Given to Research Institutions

It is experienced that the research institutions and industrial personnel have discouraged and disallowed to release the wind and other relevant data by the public institutions. Generally, the data sets are considered to be confidential by most of the public institutions. In some cases, huge cost has been asked from the research scholars to provide the raw data which is a great hindrance for the research scholars to continue his/her studies since they generally do not have research grant to purchase the data. This is surprising that research scholars can acquire relevant data of Pakistan from international organizations through Internet which is not available in their own country due to the non-cooperation. In developed countries research scholars are always encourage and provided all kind of technical and financial assistance to accomplish their studies, so that basic baseline and future technological trend could be modeled sustainably.

2.5. Unattractive Policy and Operational Issues

In countries where wind energy-based power generation is not practiced, important shortcomings exist in the applicable policy framework that must be redressed before such projects can be established. For instance, the variability of wind power output requires power purchase agreements and tariff regimes that take the daily and seasonal availability of the wind resource explicitly into account so that the investor can be assured of a reasonable and practical financial payback mechanism. Furthermore, the operational arrangements in acquiring suitable land leases, connecting wind power to a distribution grid, including load dispatch and balancing, backup supply, switching controls, and power quality must also be resolved at the outset to the satisfaction of both the producer and purchaser of wind-generated electricity, and experience in formulating such agreements may not be locally available (PPIB, 1998).

Albeit, some incentives have been included in the current power policy relevant to renewable energy development, which need clarifications and major updates to attract national and international investors of private sectors particularly for the development of wind energy technology on Pakistan.

3. Natural Barriers to the Wind Energy Development

For the development of the wind energy resource, only the wind-mapping through network of wind masts is not sufficient. There are number of natural hazards which can directly affect the development of wind technology if adequate consideration against their adverse effect is not given. The reports available on wind analysis/mapping do not

have a correlative study with relevance to particular natural hazard prevailing in the specific area of study.

Along the coastal belt of Pakistan, we have different trends of natural hazards. For example, the coastal areas of Sindh and Balochistan have frequent dust storms. The trend of these dust storms reflects different characteristics from one region to another (Nayyar and Zaigham, 2014). Along the coastal belt of Balochistan province, the impacted velocities of the dust storms are relatively much higher and stronger and they do carry coarser sediments (Figure 2 and Figure 3), which results in creating enormous abrasion, attrition and other physical & mechanical damages. On the contrary, along with the coastal areas of Sindh province these dust storms exhibit relatively low velocities and carry finer sediments. The main problem associated with such finer dust is that they can in-house and stick to the sensitive components of the wind machines and also to the other mechanical devices and can reduce their working life, if appropriate and suitable systems are not design under these specific prevailing climatic conditions.

Figure 2**:** On March 20, 2012, a giant dust storm stretched across the Arabian Sea from the coast of Oman to India. The Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's Aqua satellite took this picture the same day. This extensive plume followed days of dust-storm activity over the Arabian Peninsula including Pakistan coastal belt. Source: (Ichoku and Przyborski, 2012).

Beside the dust storms, the Sindh and Balochistan coastal belt is also prone to periodic Tropical cyclones (Figure 3 and Figure 4). Sindh coastal areas, particularly Thatta and Badin districts, have heavy and regular variable impacts of the tropical cyclones. Comparatively, Balochistan costal belt has low intensity of the cyclones in general. The maximum sustained wind speed during the cyclone period has a range

from 18 m/s to over 54 m/s and the maximum gust speed has a range from 29 m/s to over 67 m/s.

Without detailed studies relevant to these natural hazards of long-term and short-term recurrence frequency, the sustainable development of wind energy technology is not assured in Pakistan. Presently, such analysis or studies are not available in relevance to their impact on the development of wind technology as baseline study in Pakistan.
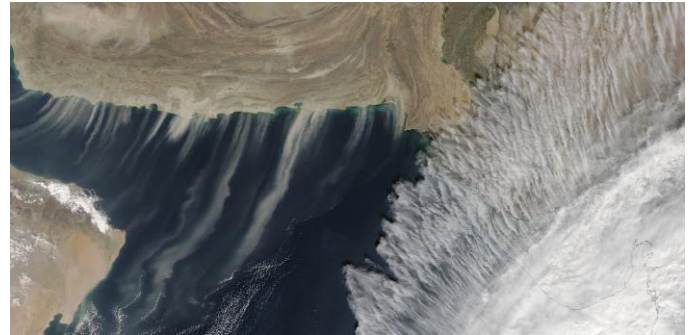

Figure 3: NASA's Terra satellite provided a visible image of Tropical Cyclone Ockhi on Dec. 4, 2017 and dust storms that were blowing over the Arabian Sea. Source: (Przyborski, 2017)
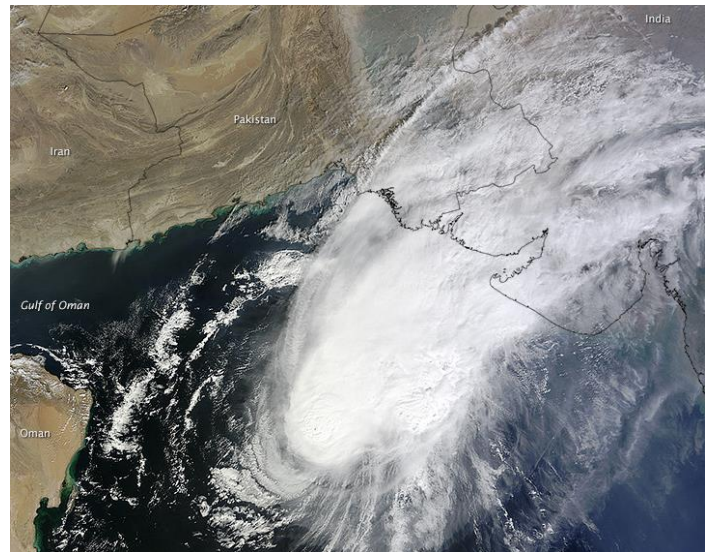

Figure 4: Tropical cyclone Nilofar in the last week of October 2014. This category 4 cyclone was a threat to the coast of Pakistan. This image was acquired by the Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's Terra satellite. Source: (Carlowicz, 2014)

4. Recommendations

- Research institutions must be encouraged for the development of baseline data and sustainable research-based model(s) for the particular technology.
- There should be politically unbiased strong focal point and sustainable mechanism of coordination among the public, private and research organizations and institutions.
- National projects on wind energy development must be prepared in consultation with the research technical committee consisting research scholars from national universities of the country.
- For the accomplishment of special national projects, like Wind Mapping of Pakistan, the research scholars should also be associated officially by the public institutions on their merit of work.
- A project is recommended for the detailed study of natural hazards relevant to the development of wind energy generation capability in Pakistan.

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