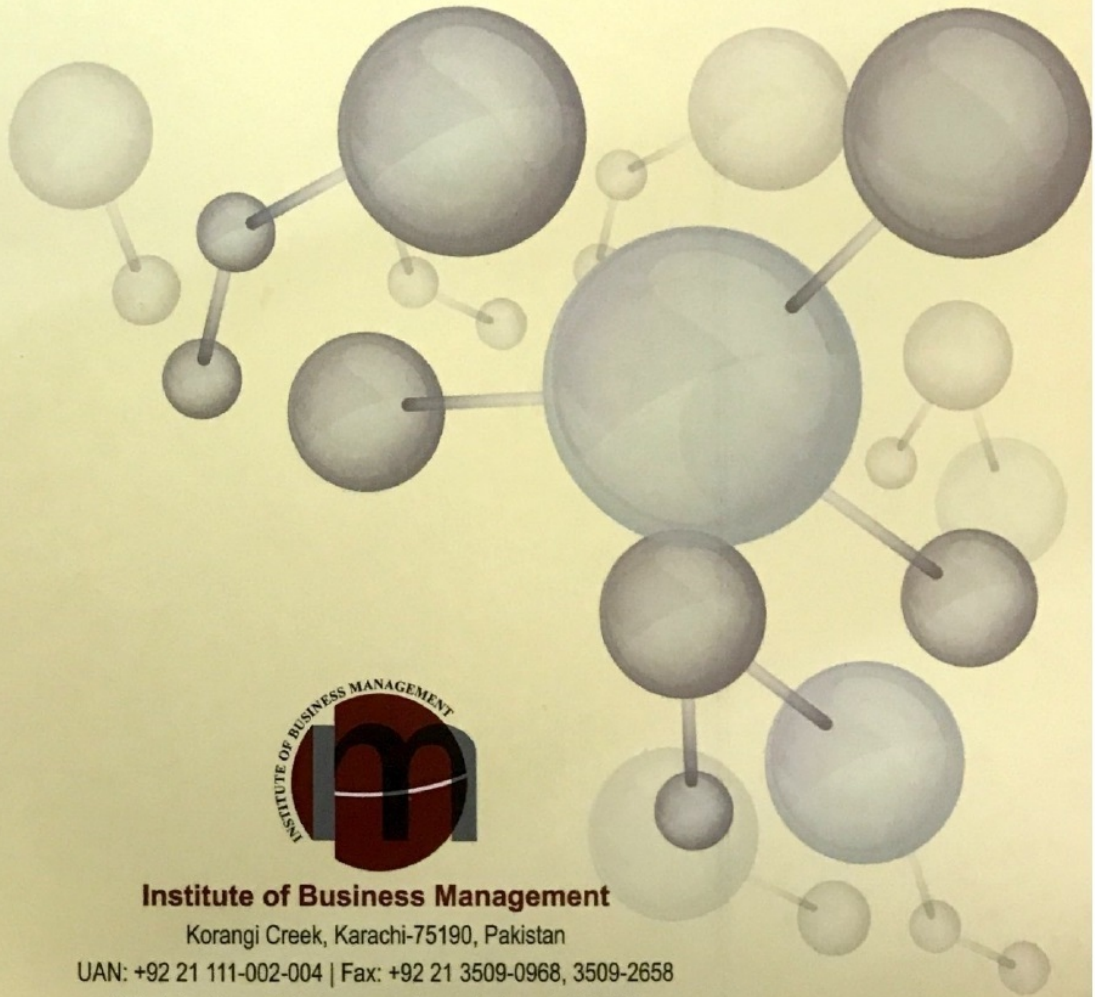
ISSN 2224-2333 (Online)
ISSN 2222-9930 (Print)

PAKISTAN JOURNAL OF ENGINEERING TECHNOLOGY AND SCIENCE

VOLUME8 NUMBER1



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Editors' Note

I am very much pleased to introduce new editorial team who took the charge from Vol. 8, Issue No. 1, June 2018 and onwards. This change marks the beginning of new era. PJETS has changes its review process, by introducing single non-blind internal review and double-blind external reviews. This means that initially after successful internal review, papers sent for double-blind external reviews having both the reviewers and author(s) identities kept confidential. We have completed six years of successful publications. The scope of PJETS is publishing and promoting innovative ideas and original research in the field of Science, Technology, Engineering and Statistical Science since 2011, twice a year. This journal aims at publishing authentic research papers with less than 19% of plagiarism to create a culture of innovation and scientific development. The focus of the journal is limited to "Computer Sciences", "Engineering", relevant "Emerging Technologies", along with "Mathematics" and "Statistics".

The mission of PJETS is to provide a platform to the researchers, faculty and students to spread their findings. The main goal is to link authors from different professions, for example academia and non-academia in particular and encourage them to share their research. We fortunately succeeded in developing a new editorial review board comprising of reputed scholars and researchers at national and international level, from academia and non-academia.

I hope the new editorial team will be great boon to give new energy to the journal and will impart their knowledge and experience to improve the quality of publications.

Note: Conference papers included in the issue are not subject to the standard of PJETS.

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Pakistan Journal of Engineering Technology and Science (PJETS)
Volume 7, No 1, June 2017

Contents

Performance Evaluation of a Novel Wearable HIS Patch Antenna for Mobile Applications

Hajira Masood, Zain Mohammad, [1]Naeem Khan, M. Kamran Shereen,

***Abstract*-In this paper an artificial magnetic material known as High Impedance Surface (HIS) is used for the performance evaluation and design of wearable patch antenna. HIS is actually a new type of ground plane that has considerably high surface impedance. Hence surface wave propagation on the ground plane is not supported. The use of HIS is now rapidly increasing due to its improved performance. In this paper, HIS is introduced with a new type of feeding technique known as line feeding technique at an operating frequency of 5.1 GHz and the antenna parameters evaluated here are Gain, Antenna efficiency and radiation efficiency. These parameters are improved to 15.54%, 28.84% and 3.4% respectively.**

Keywords: Patch Antenna, HIS, Antenna efficiency, Radiation efficiency.

I. INTRODUCTION

Patch or microstrip antenna is a kind of antenna which has lower size that can be mounted on a metallic sheet of rectangular shape which in turn is mounted on another metallic sheet usually of copper ground plane. The popularity of patch antenna is increased because it can be directly impressed on circuit board. A patch antenna having minimum cost, constructed easily with small size and gives optimal performance through wide band frequencies is known as Micro strip patch antenna [1]. Its light weight makes it easy to adhere to human bodies. One way to enhance the performance of antenna is to make its substrate thicker but with low di-electric constant in order to have improved efficiency, wide bandwidth and enhanced radiations. The microstrip patch antenna can be classified on the basis of length, width, and its height, gain and radiation patterns. These antennas are made such a small that they can be fitted easily on a human body. For this purpose, maximum work has been done at frequencies of WLAN or UWB in development of these antennas. A low Profile wearable antenna minimizes the effects of body on the overall antenna performance. Therefore, majority of the applications should be low profile and modest in the construction of wearable antennas. Hence, it is also practicable to integrate a ground-plane to fulfill these challenges

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(like PIFA) [2]. .Hence both the civil and military sectors have shown an immensive interest in the growth of human wearable antennas.

Figure 1 shows the structure of simple patch antenna. The problem with the ordinary ground plane was the propagation of surface waves that was resulted from leaky currents which could easily flow around the edges of ground plane and caused the surface waves to disturb our desired waves. In order to avoid this disturbance construction of high impedance surface is the only solution left. Ground plane is made rough and precipitous to make the flow of leaky currents arduous so that of surface waves. This modified surface is called as High Impedance Surface .High Impedance Surface (HIS) antenna is a typical example of wearable devices used in communication sector. Its design is complex as this antenna consists of a metallic electromagnetic structure with High Surface Impedance.

This surface estimates many of its electromagnetic problems and is considered as lumped parameter circuit [3]. The surface properties can be altered using conductive surface texture [4]. This modified structure has high impedance and does not cause reversal of reflected waves and thus in phase currents of images appears, on contrary to normal conducting phase. For the design of Micro strip Patch antenna by modern mobile communication, it leads to the requirement of antennas with minimum size, high gain and bandwidth. These antennas should provide better performance over a wide range of frequency spectrum [5].

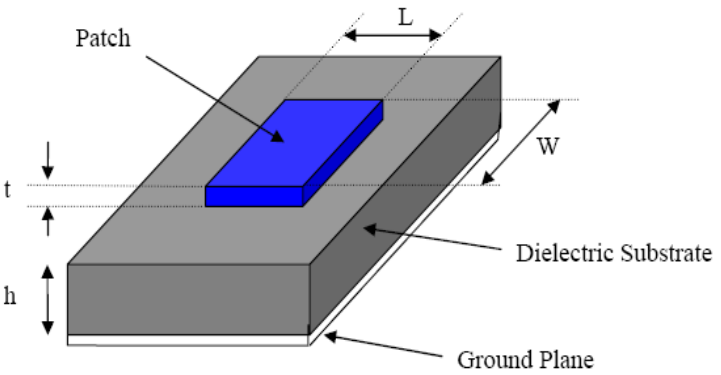


Figure 1. Microstrip Patch Antenna

The modified ground plane with HIS is also recognized as electromagnetic band gap (EBG) plate because of presence of insulative gaps whose function is to eliminate the surface waves. These electromagnetic band gap structures display some interesting electromagnetic properties, which includes phase reflection and surface suppression [6] and thus afforded the researchers with a new research area working in the field of electromagnetic and antennas. Their designs have been grown vigorously and the associated research has been developed from various perspectives including materials and geometries [7-8].

HIS can precisely minimize the induced current that flows on the ground plane surfaces. This result is showed by measurement and simulations [9]. It is the wearable antenna, which play an important part in maintaining an optimal and reliable wireless communication bridge between the surrounding and human body worn electronics. Materials used to help in manufacturing of wearable antennas are conductive textiles (electro textiles), having outstanding durability, flexibility and radio frequency [10]. Wearable antenna has numerous useful applications such as for military and police work, in medical science, in mines to measure the amount of uncut coal in mines and on can measure the thickness of ice on roadway. A high impedance surface consists of an array of metal extrusions on a flat metal plate or sheet as shown in Figure 2. They are arranged in a two dimensional lattice and each of these small extrusions are connected to ground via vertical conductor. They seem like mushrooms or pushpin extending from surface. A top view is shown in Figure 3. The evolution of high impedance surface has led to the emergence of a lot of applications.

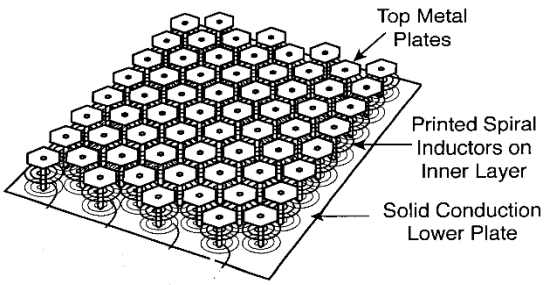


Figure 2. Cross Section View of High Impedance Surface

The aim behind such design is to analyze the improved performance of the modified HIS surface for a wearable patch antenna at frequency of 5.1 GHz applications. The parameters that we will discuss in this work will be Gain, antenna efficiency and radiation efficiency. Dimensions and

parameters of antenna are measured by high frequency simulation software, includes length, dielectric constant and width as dimensions and gain, impedance and return loss as parameters [11].

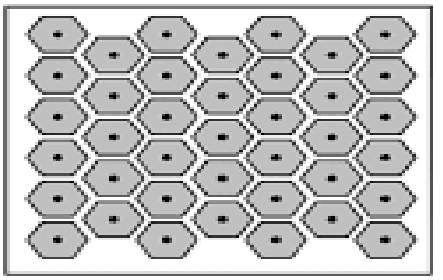


Figure 3. Top View of a High Impedance Surface

This paper is organized as follows: Section II illustrates the proposed antenna design. Section III presents the simulation results in CST Microstripes software. The paper is concluded in Section IV.

II. ANTENNA DESIGN

Computer simulation technology (CST) Micro stripe is the designing tool that was selected for designing and simulation purpose. CST is a full package tool for the implementation of 3D electromagnetic analysis. It uses high frequency range for designing systems. Followings are the most known features of CST.

- Supported by TLM technology, it is speedy, quick, efficient, correct and time domain problem solver.
- Parallel problems solved by multi-processor hardware stages
- Uses the acquainted Windows computer program.
- New advanced history bar, permits the user to easily select their approach

First we designed a simple patch antenna at the frequency of 5.1 GHz and simulated it in CST and noted the results for comparison. Then we moved to our proposed model to design the Novel HIS wearable microstrip patch antenna. So we started with designing High Impedance Surface using square patches. Then we impressed a substrate over it to avoid the short circuiting between the upper main patch and these small patches on HIS surface. The full structure view of our proposed antenna is given in Figure 4. The proposed HIS design is such that to work as artificial magnetic surface at frequency of 5.1 GHz. This antenna will work specifically for the mobile applications mentioned above that's why we designed this antenna on 5.1GHz. Figure 5 shows the working condition of our

patch antenna. In other words, the return loss should not exceed than -10db in order to place the antenna in operating state.

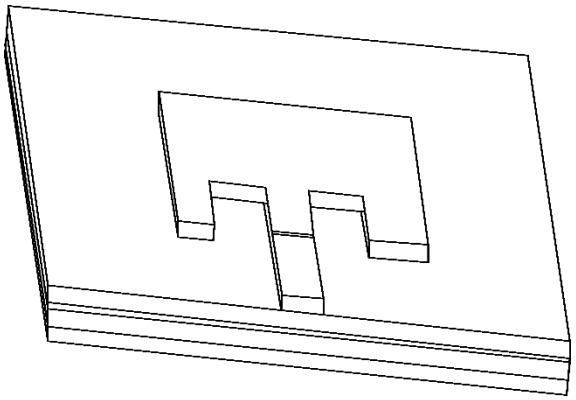


Figure 4. Structure of Wearable HIS Patch Antenna

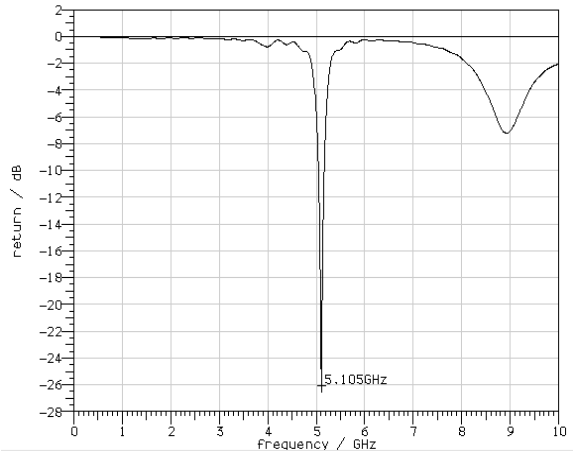


Figure 5. Working Condition of HIS Wearable Patch Antenna

A simple patch antenna is then impressed on the HIS as shown in Figure 4. Figure 6 shows our designed High Impedance surface while the side view of HIS patch antenna is shown in Figure 7.

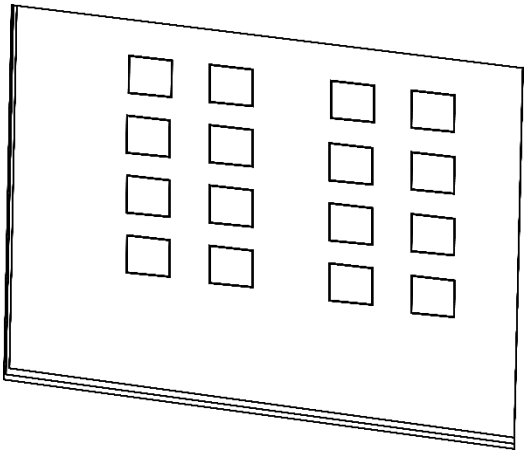


Figure 6. High Impedance Surface

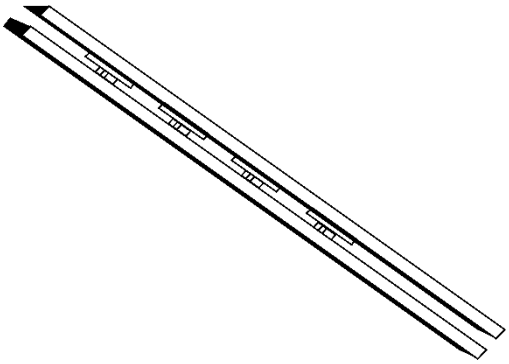


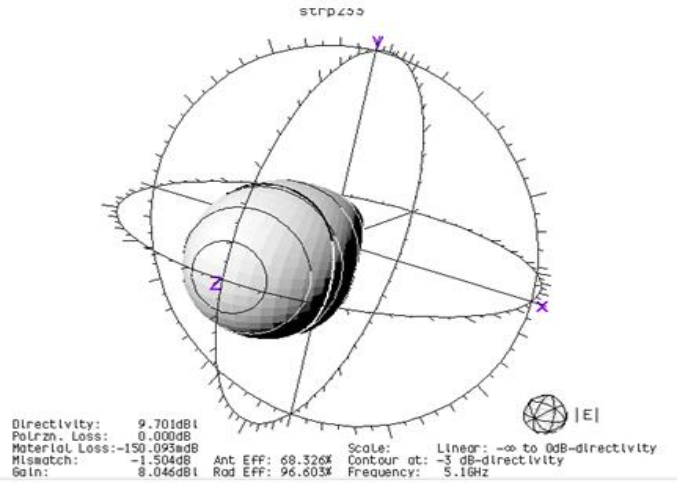
Figure 7. Side View of Wearable HIS Patch Antenna

III. RESULTS

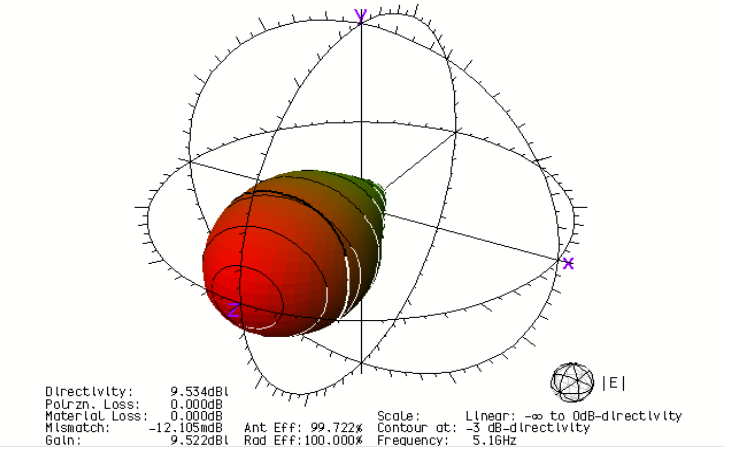
The performance of wearable Microstrip patch antenna with HIS was evaluated by comparing the proposed antenna with a simple patch antenna without HIS. Results for comparison of Gain, Antenna efficiency and Radiation efficiency for Patch antenna without and with HIS are shown in Figure 8.

This is the considerable amount of improvement in gain, the more is the gain more the antenna will be directive i.e. it will focus electromagnetic energy in the desired direction. Antenna efficiency describes the percentage of the physical aperture area which actually captures radio frequency (RF) energy, so improvement in antenna efficiency also enhanced the performance of antenna. Measurement of the power radiated through the antenna in the form of electromagnetic wave to the

power fed to the antenna terminals is known as radiation efficiency, and improvement in it helped the antenna to perform more efficiently.



(a). Radiation Pattern of The Patch Without HIS



(b). Radiation Pattern of the Patch with HIS.

Figure 8. Comparison of Radiation Pattern of Patch Antenna (a) Without and (b) With HIS

Figure 8 (a) shows the radiation pattern without HIS while (b) shows the radiation pattern with HIS. After comparing both patterns, the improvements in these parameters are tabulated in Table 1.

Table1. Comparison of Antenna Parameters for Patch Antenna with and Without HIS

TABLE I
COMPARISON OF ANTENNA PARAMETERS FOR PATCH ANTENNA WITH AND WITHOUT HIS

S. No.	Antenna Parameters	With HIS	Without HIS	Percent Improvement
1.	Gain	9.52 dbi	8.04 dbi	15.52 %
2.	Antenna Efficiency	96.29 %	68.52%	28.84%
3.	Radiation Efficiency	100 %	86.60%	3.4%

IV. CONCLUSION

The use of HIS for improving antenna performance is growing rapidly. This paper is a modified portable form of HIS defined as a non-uniform HIS is presented and Successful antenna integration for improved low profile performance. The HIS has also been integrated into a normal patch antenna to reduce its size and improve its gain and impedance bandwidth. The percentage improvement in-shape of Gain, Antenna and Radiation efficiency has showed. Performance evaluation of wearable patch antenna having High Impedance Surface at a frequency of 5.1GHz has been presented. Based on this, superior results containing various features of antenna performance have been achieved. Simulation results consist of Antenna efficiency, Gain and radiation efficiency are displayed to view the performance index. It can be deducted that HIS ground has enhanced the performance of antenna compared to the ordinary ground plane structure.

REFERENCES

[1] R. Goyal, Y.K Jain "Compact bow shape microstrip Patch antenna with different substrates" IEEE Conference Information & Communication Technologies (ICT), Jeju Island April.2013. Page: 64- 69
[2] J. C. G Mathews, B. Pirollo, A. Tylor, G. Pettitt "Body Wearable antennas for UHF/VHF", IEEE, Antennas and Propagation Conference, Loughborough. 18 March, 2008. Page: 357- 360
[3] Ma, L., et al. "A wearable flexible multi-band Antenna based on a square slotted printed monopole''. IEEE, Antennas and Propagation Conference, Loughborough, 18 March 2008. Page: 345 - 348
[4] Dan Sievenpiper, Lijun Zhang, Ramulo F. Jimenez Broas, Nicholas Alexopolous, Eli Yablonovitch,,"High Impedance Electromagnetic Surfaces with a Forbidden Frequency Band", IEEE Transactions on Microwave Theory and Technique conference, November 1999. Volume: 47, Issue: 11.
[5] C. Balanis, Antenna Theory, Analysis, and Design, 2nd ed., John Wiley and Sons, 1997.
[6] A. Aminian, F. Yang, Y. Rahmat-Samii., "In-phase reflection and EM wave Suppression characteristics of electromagnetic band gap ground planes" presented at the IEEE Antennas and propogation society International symposium, Columbus, OH, US. Jun. 2003, Volume: 4.
[7] T. H. Loh and C. Mias, "Photonic bandgap surfaces with interdigitated corrugations", IET Electronics Letters40.18 (Sep 2, 2004): page: 1-2
[8] Dan Sievenpiper, Lijun Zhang, Ramulo F. Jimenez Broas, Nicholas G. Alexopolous, Eli Yablonovitch, "High Impedance Electromagnetic Surfaces with a Forbidden Frequency Band", IEEE Transactions on Microwave Theory and Technique, Conference, November 1999, Volume: 47, Issue: 11.
[9] Xing-Chang Wei ; Xin Wei ; Yong-Sheng Li ; Jian-Bo Zhang ; Er-Ping Li ; Gao-Le Dai. "The application of high impedance surface for noise reduction inside the package" IEEE Microwave Conference (EuMC), 2014 Page: 428 - 432
[10] K. Koski, L. Ukkonen, L. Sydanheimo, Y. Rahmat- Samii "Embroidered ground plane implementation for wearable UHF RFID patch tag antennas" IEEE, Radio Science Meeting (Joint with AP-S Symposium), Memphis, TN 2014 Page: 274

[11] P. Subbulakshmi, R. Rajkumar "Design and characterization of corporate feed rectangular microstrip patch array antenna" IEEE Emerging Trends in Computing, Communication and Nanotechnology (ICE-CCN), International Conference, Tirunelveli 2013. Page: 547- 552
[12] Z. H. Jiang, Z. Cui, T. W. Yue, Y. Zhu, D. H. Werner, "Compact highly efficient and fully flexible circularly polarized antenna enabled by silver nanowires for wireless body-area networks", IEEE Trans. Biomed. Circuits Syst., vol. 11, no. 4, pp. 920-932, Aug. 2017
[13] Saud M. Saeed, Constantine A. Balanis, Craig R. Birtcher, Ahmet C. Durgun, Hussein N. Shaman, "Wearable Flexible Reconfigurable Antenna Integrated With Artificial Magnetic Conductor", IEEE Antennas and Wireless Propagation Letters, vol. 16, pp. 2396-2399, 2017.
[14] Roy B. V. B. Simorangkir, Yang Yang, Ladislau Matekovits, Karu P. Esselle, "Dual-Band Dual-Mode Textile Antenna on PDMS Substrate for Body-Centric Communications", IEEE Antennas and Wireless Propagation Letters, vol. 16, pp. 677-680, 2017.
[15] C. Mendes, C. Peixeiro, "A dual-mode single-band wearable microstrip antenna for body area networks", IEEE Antennas Wireless Propag. Lett, vol. 16, pp. 3055-3058, 2017.
[16] X. Y. Zhang, H. Wong, T. Mo, Y. F. Cao, "Dual-band dual-mode button antenna for on-body and off-body communications", IEEE Trans. Biomed. Circuits Syst., vol. 11, no. 4, pp. 933-941, Aug. 2017.
[17] Y. Kim, Y. Li, "Human activity classification with transmission and reflection coefficients of on-body antennas through deep convolutional neural networks", IEEE Trans. Antennas Propag., vol. 65, no. 5, pp. 2764-2768, May 2017.
[18] M. A. Amiri, C. A. Balanis, C. R. Birtcher, "Gain and bandwidth enhancement of a spiral antenna using a circularly symmetric HIS", IEEE Antennas Wireless Propag. Lett., vol. 16, pp. 1080-1083, 2017
[19] D. Wen, Y. Hao, H. Wang, H. Zhou, "Design of a wideband antenna with stable omnidirectional radiation pattern using the theory of characteristic modes", IEEE Trans. Antennas Propag., vol. 65, no. 5, pp. 2671-2676, May 2017.
[20] SP Oshin, Swetha Amit, "Design and Analysis of High gain UWB textile antenna for wearable application", IEEE International Conference on Recent Trends in Electronics Information Communication Technology (RTEICT-2017), May 19–20 2017.
[21] N. F. M. Aun, P. J. Soh, A. A. Al-Hadi, M. F. Jamlos, G. A. E. Vandenbosch, D. Schreurs, "Revolutionizing wearables for 5G: 5G technologies: Recent developments and future perspectives for wearable devices and antennas", IEEE Microw. Mag., vol. 18, pp. 108-124, May 2017.
[22] R. Azad, A. Mohan, "Sixteenth-mode substrate integrated waveguide bandpass filter loaded with complementary split-ring resonator", Electron. Lett. vol. 53, no. 8, pp. 546-547, Mar. 2017.

Pakistan Journal of Engineering Technology and Science (PJETS)
Volume 8, No 1, June 2018

Ranking and sensitivity analysis of key factors for successful project management performance: An application of AHP for oil and gas sector

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***Abstract*- Complexities faced by oil and gas projects due to uncertainty and risk, demand the implementation of project management techniques for their successful completion. Therefore, this is made by using analytical hierarchy process, to identify and prioritize the key factors for successful project management performance of oil and gas projects. These factors are categorized into three groups which include attributes of project staff, project planning process and assessment of project quality. Using Expert Choice, a hierarchy is developed followed by pairwise comparison based upon data collection from industrial experts of oil and gas sector. Results of analytical hierarchy process (AHP) concluded that, project completion within estimated time and budget, clarity of objectives and involvement of top management are most crucial elements for improvement in project management performance of oil and gas projects. Whereas sensitivity analysis being carried out according to three different scenarios highlighted factors according to their relative importance.**

Keywords: Oil and Gas sector, Project Management, Analytical Hierarchy Process and Sensitivity Analysis.

I. INTRODUCTION

Oil and gas sector is considered as major contributor of nation's economy and infrastructural development [1]. This sector has two major divisions i.e. upstream and downstream. Upstream sector is concerned with exploration and production of oil and gas and downstream sector deals with refining, transportation and marketing [2]. Oil and gas sector is known by certain characteristics such as huge investments, environmental effects, multi discipline workforce, global influence and high rewards. Many times oil and gas projects face complexities due to unstable political situation, increased market demand, fluctuations in price and tough schedule [3]. These issues sometimes lead oil and gas projects towards cost and schedule overrun as well. The reasons behind cost and schedule overrun are unavailability of skilled staff, unclear definition of projects scope, inappropriate planning, poor project control, lack of competent leadership and inexperienced project management personnel [4]. Besides this, these projects face issues like lack of trained staff, unfavorable market conditions and environmental concerns. Project of oil and gas industry are usually risky, uncertain and provide intangible benefits. These risk also exists due to uncertain cash flow and irreversibility of these projects incorporating economic risks as well [5].

Project management tools and techniques are highly important to handle complex projects within estimated time and budget [6]. It is used by organizations to handle frequent customer needs with in allocated timeframes along with fast decision making. A study based in UAE has concluded that project management practices have positive influence on project success [7]. Organizations use project management tools and techniques to achieve organizational goals in a focused manner. It is also used to predict crisis while handling uncertainties to make a project successful [8]. The success of project management process is analyzed by defined criteria based on cost, time and quality, whereas project success is measured by its objectives [9]. A project which is executed in right direction has an ability to be successful but successful project management always enhance success of projects [10]. Project management practices not only enhance the performance of project manager who is using it, but it also improves project performance. It improves project

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performance by proper budget control and time utilization as estimated [11]. Project management tools and techniques helps to complete projects with in estimated budget and time while meeting desired quality level [12]. Its tools and techniques (DMAIC, PDCA, risk map, decision tree, sensitivity analysis, SWOT analysis, cause and effect diagram) are also used by oil and gas sectors for successful completion of projects [13].

According to the literature, AHP is widely used for many purposes relevant to project and project management. It is one of the most promising technique used for multi criteria decision making [14]. In a study AHP has been used for the selection of investment project of solar thermal based power plant [15]. The application of AHP also exists for construction projects to access safety risk during planning and budgeting phase [16]. A study carried out in Italy used AHP for the assessment of hydropower projects by incorporating stakeholders [17]. AHP also has its application for identification and evaluation of critical success factors for projects of construction industry [18]. The performance measurement of green supply chain of a manufacturing organization is also made using AHP [19]. In Table 1, studies applying AHP for different projects is given.

Project management performance is directly associated with success of oil and gas projects. The knowledge of factors essential for improvement in project management process is helpful for project managers for execution and successful completion of oil and gas projects. Therefore, keeping in view, issues faced by oil and gas sector, this study is made using AHP to identify and prioritize the factors, which are essential for the successful project management performance of oil and gas projects.

II. Analytical Hierarchy Process

AHP is a multi-criteria decision making process which helps organizations to deal with complex and multiple conflicting objectives. It is widely used in many fields like engineering, manufacturing, management and social sciences. It uses pairwise comparison to rank alternatives subject to particular goals [20]. Analytical hierarchical process is a systematic way to prioritize and weight all the objectives. It is assumed that all the objectives of a particular problem are represented in a hierarchy. This technique has ability to deal with complex phenomena of real life by producing most consistent results. Analytical hierarchical process also has a potential for linking with linear programming and expert's systems. It also facilitates decision makers to tradeoff between criteria. It has following basic steps:

I) A hierarchy based structure is defined for identified problem by decomposing it into goal, criteria and sub criteria. It is most important and fundamental step of decision making process. Basically hierarchy based structure is used to link elements of one level to next associated level.

*II)*After the development of hierarchy, pair wise comparison is made between all the alternatives by expert's / decision makers. This comparison is made based on a scale, according to which decision maker's rate elements [14, 26]. Description of scale is given in Table 2.

*III)*Pairwise comparisons of previous step are synthesized to get result of overall priorities and weights of elements with respect to the goals.

TABLE 1
STUDIES USING AHP FOR DIFFERENT PROJECTS

Reference	Topic Addressed
[15]	Selection of investment project of solar thermal based power plant
[16]	Assessment of safety risk during planning and budgeting phase of construction project
[17]	Assessment of hydropower projects by incorporating stakeholders
[18]	Identification and evaluation of critical success factors for projects of construction industry
[19]	Performance measurement of green supply chain of a manufacturing organization
[21]	Evaluation of complexity of projects
[22]	Selection of a renewable energy project in Spain
[23]	Management of project risk for construction projects in India
[24]	Project selection process for six sigma deployment
[25]	Risk assessment for construction projects in China

AHP is developed using a software known as "Expert Choice". It allows group decision making to solve complex phenomena by sharing experience and knowledge. There are certain benefits of Expert Choice, which are explained below.

I) It helps to minimize the influence of dominant group member or groupthink.

*II)*Overall structure of hierarchy is based upon agreement of whole group by considering their concerns. With group discussion, modifications can be made to cover all the aspects.

*III)*In a situation where it becomes difficult to reach a conclusion, it may be decided through voting or average of judgments may be taken.

*IV)*It synthesizes the objectives with respect to goal to get overall priorities.

*V)*Sensitivity analysis is performed using Expert Choice to observe the result of change in objectives.

*VI)*It is an ideal tool for group decisions through cohesive and rigorous process.

TABLE 2
SCALE FOR PAIRWISE COMPARISON BETWEEN FACTORS

Level of Importance	Definition	Interpretation
1	Equally preferred	Two activities contribute equally to the objective
3	Moderately	Experience and judgment slightly favor one activity over another
5	Strongly	Experience and judgment strongly or essentially favor one activity over another
7	Very strongly	An activity is strongly favored over another and its dominance demonstrated in practice
9	Extremely	The evidence favoring one activity over another is of the highest degree possible for affirmation
2,4,6,8	Intermediate values	Used to represent a compromise between preferences listed above
Reciprocals	Reciprocals for inverse comparison	

III. METHODOLOGY

Key factors for successful project performance are identified with the help of literature review and discussion with experts of oil and gas sector. After which a hierarchy is developed based upon three level. Data collection is made by pair wise comparison of one factor with other factor according to their relative importance using scale ranging from 0 to 9. Then based on this data collection, key factors are prioritized according to their importance. After which sensitivity analysis is carried out considering different scenarios to help project managers to deal with varying conditions of oil and gas projects.

A. Key Factors of Successful Project Management Performance

There are many factors which influence project management performance to various extent. These indicators are identified with the help of literature and expert opinion. In this study, these factors are grouped into three categories which include attributes of project staff, project planning process and assessment of project quality.

Several studies indicates that technical knowledge, collaboration between technical and non-technical staff, training of staff and leaderships skills of team are important indicators of workforce's attributes [1, 2, 27, 28]. Clarity of objectives, project completion with in estimated time and budget, work norms and standards and involvement of top management are most important factors for project planning [2, 27-30]. Several investigations concluded that project quality assessment is based upon implementation of quality control programs, ability to respond quickly and adequate risk analysis [2, 27, 30-32]. All these variables are also given in Table 3.

B. Development of AHP Model

Hierarchy model being developed by AHP must meet the goal behind it. The model developed for this study is based on three levels as shown in Figure 1. First level is representing the goal of designed hierarchy i.e. key variables for successful project management performance. Objectives / criteria for achieving goal are represented by second level of hierarchy i.e. project staff, project planning process, project quality measures. Whereas sub criteria's for objectives are defined at level three. Sub criteria for project staff include staff's expertise, collaboration, training and leadership skills, whereas project planning process is sub categorized into project completion with in estimated time and budget, involvement of top management, project objectives clarity and its norms and standards. Sub criteria for project quality measures include quality control programs, quick response of queries, implementation of ISO standards and risk analysis.

TABLE 3
ESSENTIAL FACTOR FOR IMPROVEMENT IN PROJECT MANAGEMENT PERFORMANCE

Main	Sub Categories	Notation	References
Attributes of project staff (PS)	Technical knowledge	PS1	[1, 2, 27, 28]
	Collaboration	PS2	
	Leadership skills	PS3	
	Training	PS4	
Project planning process (PP)	Project completion with in estimated time and budget	PP1	[2, 27-30]
		PP2	
	Work norms and standards	PP3	
	Clarity of objectives	PP4	

	Top management involvement		
Assessment of project quality (PQ)	Quality control programs	PQ1	[2, 27, 30-32]
	Ability to respond quickly	PQ2	
	Risk analysis	PQ3	
	Implementation of ISO standards	PQ4	

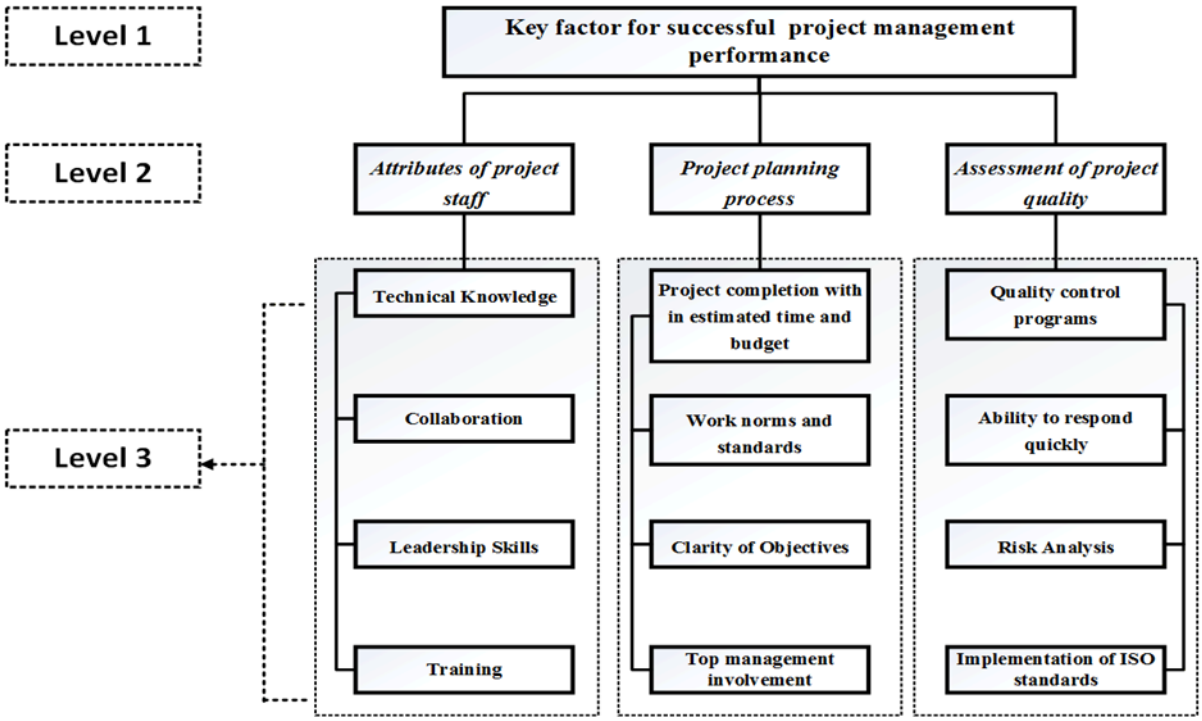


Figure 1. Hierarchy developed for essential factors of project management performance

C. Data Collection

A questionnaire based survey is carried out by industrial experts of oil and gas sector to determine the relative importance of each factor with respect to other. This questionnaire is based upon pair wise comparison between factors using a scale of 0 to 9. Each element is compared with other element to evaluate its relative importance based on some goal / criteria [33]. This method also allows cross checking and consistency between elements. First, a pairwise comparison is made between elements of second level according to the goal of this study. Attributes of project team, project planning process and assessment of project quality are compared with each other. After which, at third level three pairwise comparisons are made for each element of first level according to their respective sub criteria. Pairwise comparison between factors of first level is given in Table 4. Whereas comparisons between attributes of project staff, project planning process, and assessment of project quality are given in Table 5, 6 and 7 respectively.

TABLE 4
PAIRWISE COMPARISON BETWEEN FACTORS OF FIRS LEVEL

	PS	PP	QP	Priorities
PS		0.5	2	0.327
PP			1	0.413
QP				0.260

TABLE 5
PAIRWISE COMPARISON BETWEEN SUB CATEGORIES OF "ATTRIBUTES OF PROJECT STAFF"

	PS1	PS2	PS3	PS4	Priorities
PS1		0.67	1.47	1.58	0.281
PS2			0.70	0.86	0.249
PS3				1.18	0.254
PS4					0.216

TABLE 6
PAIRWISE COMPARISON BETWEEN SUB CATEGORIES OF "PROJECT PLANNING PROCESS"

	PP1	PP2	PP3	PP4	Priorities
PP1		1.29	1.33	1.58	0.286
PP2			0.69	0.97	0.204
PP3				.90	0.277
PP4					0.233

TABLE 7
PAIRWISE COMPARISON BETWEEN SUB CATEGORIES OF "ASSESSMENT OF PROJECT QUALITY"

	QP1	QP2	QP3	QP4	Priorities
QP1		1.09	2.31	1.59	0.344
QP2			1.40	1.37	0.278
QP3				0.97	0.179
QP4					0.200

D. Ranking of Key Factors using AHP

Pairwise comparison between factors is synthesized to get overall ranking of variables. For attributes of project staff, technical expertise of workforce is the most important element followed by leadership skills, collaboration and training respectively as shown in Figure 2. Whereas for project planning process, the most important attribute is project completion within estimated budget and time followed by clarity of objectives, involvement of top management and work norms and standards respectively as indicated by Figure 3. Assessment of project quality is based upon quality control programs, quick response of queries, implementation of ISO standards and risk analysis respectively as shown in Figure 4. Overall consistency of all measures is less than cut off value of 0.20 [34].

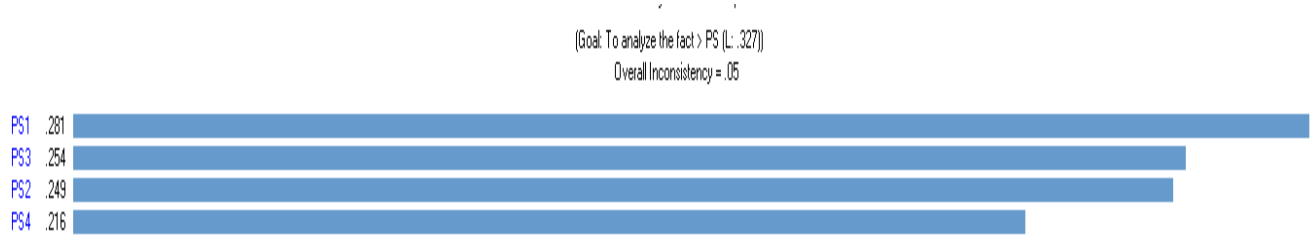


Figure 2: Prioritization of factors of "attributes of project staff"

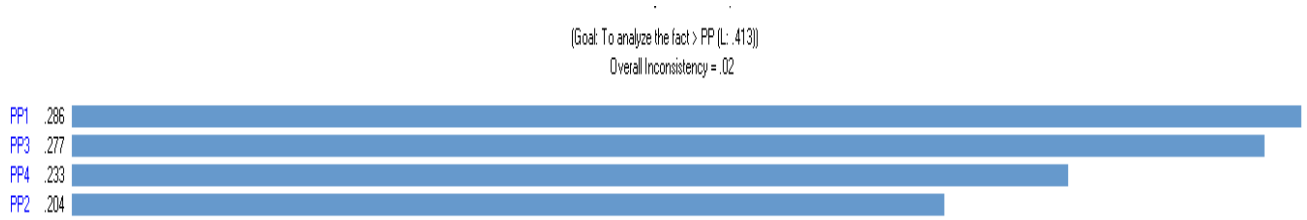


Figure 3: Prioritization of factors of "project planning process"

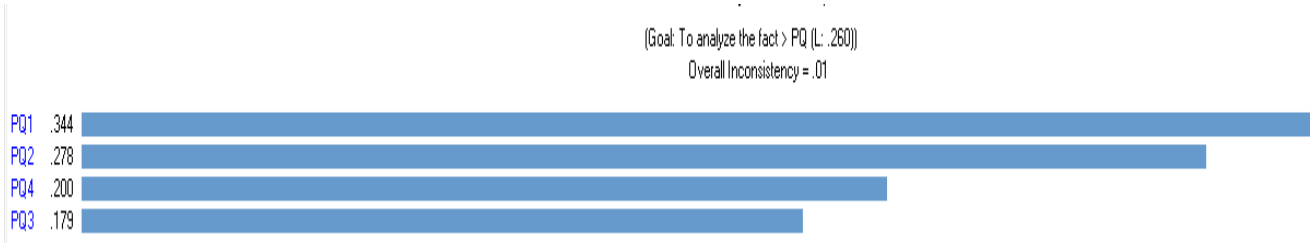


Figure 4: Prioritization of factors of “assessment of project quality”

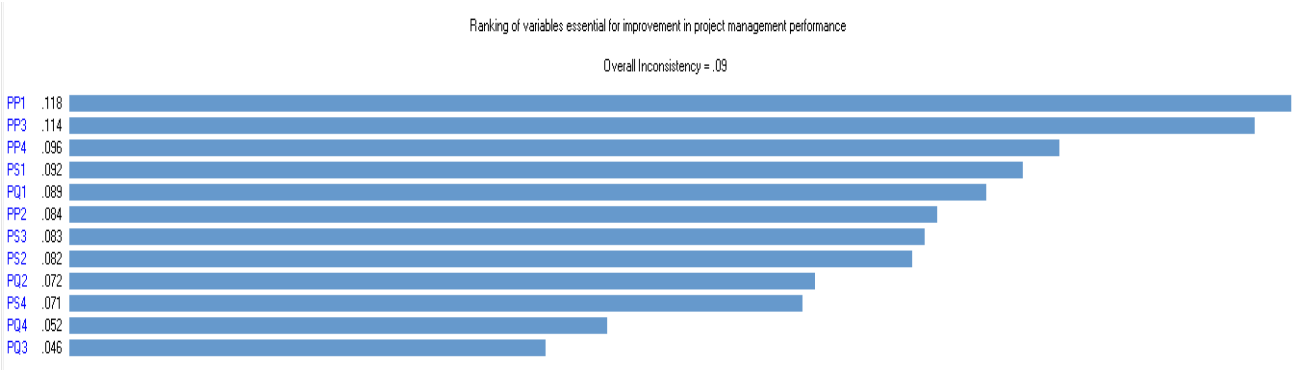


Figure 5: Overall Prioritization of factors for successful project management performance

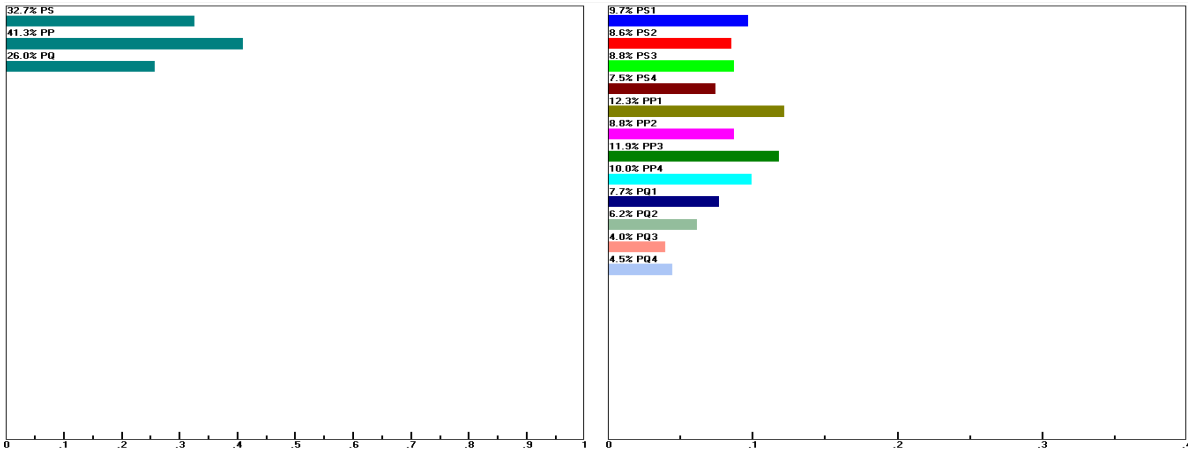
According to the results produced by analytical hierarchical process, most essential element for successful performance of project management process is project completion within expected time and budget followed by clarity of objectives and involvement of top management. Whereas least significant contributors for successful project management process are training of staff, implementation of ISO standards and risk analysis respectively. In Figure 5, all the factors contributing for better project management performance are shown in a sequence with consistency less than 0.1. All variables are ranked according to their priority level in Table 8.

TABLE 8
RANKING OF ALL FACTORS ESSENTIAL FOR PROJECT MANAGEMENT PERFORMANCE

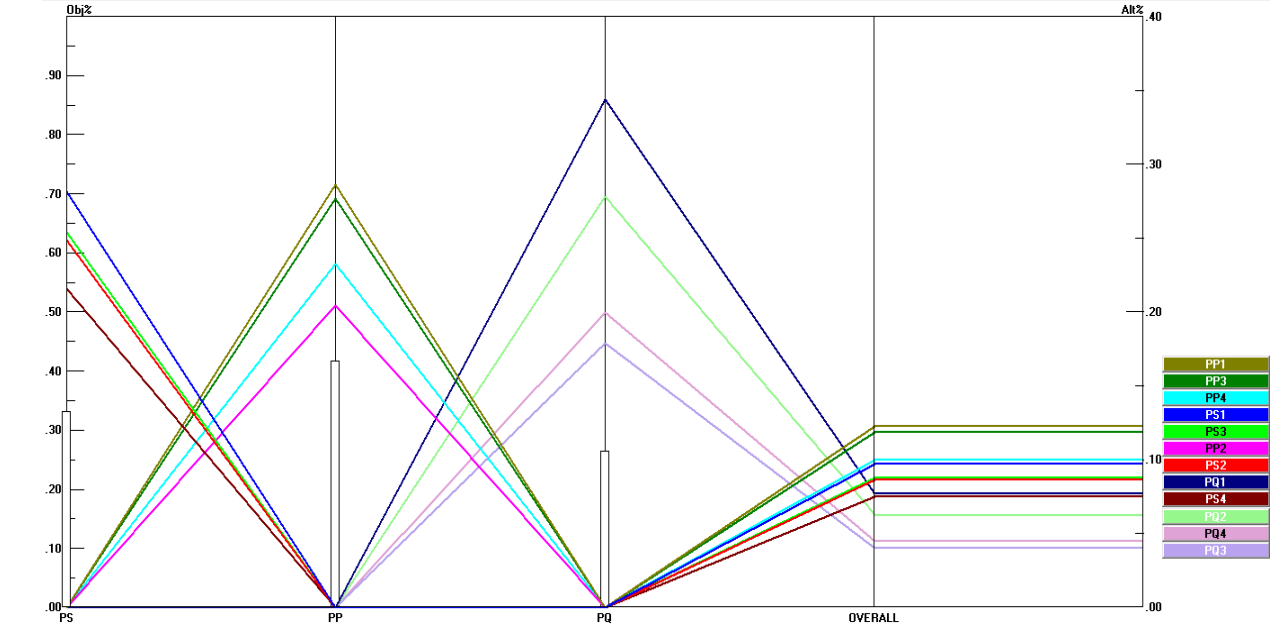
Main Factors	Sub Categories	*Notation*	Rank
Attributes of project staff (PS)	Technical knowledge	PS1	4
	Collaboration	PS2	8
	Leadership skills	PS3	7
	Training	PS4	10
Project planning process (PP)	Project completion with in estimated time and budget	PP1	1
	Work norms and standards	PP2	6
	Clarity of objectives	PP3	2
	Top management involvement	PP4	3
Assessment of project quality (PQ)	Quality control programs	PQ1	5
	Ability to respond quickly	PQ2	9
	Risk analysis	PQ3	12
	Implementation of ISO standards	PQ4	11

E. Sensitivity Analysis

The last step of AHP based decision making is sensitivity, where input data is slightly changed to observe effect on overall results [35]. It is best performed with graphical interface to help decision makers. Sensitivity analysis of AHP based model is shown in Figure 6 (a&b) with overall ranking of all elements. In figure 6a, percentage contribution of each main factor and sub categories is also shown. Besides this, three additional scenarios are discussed by rearranging overall priority structure of model. Analysis of model with different priorities structure, helps experts to evaluate different policies before making a final decision.



(a)



(b)

Figure 6 (a & b): Sensitivity analysis of AHP Model

I. Sensitivity Analysis w.r.t "attributes of project staff"

For first scenario, "attributes of project team" is given highest priority followed by planning process and quality assessment as shown in Figure 7. For this scenario, technical expertise of team is ranked at one followed leadership skills, collaboration and training respectively. Whereas least contributor for this scenario are quick response of queries, implementation of ISO standards and risk analysis. When factor "attributes of project staff" is dragged down by giving priority to other two factors, it is observed that project completion within estimated time and budget and clarity of objectives become dominant factors.

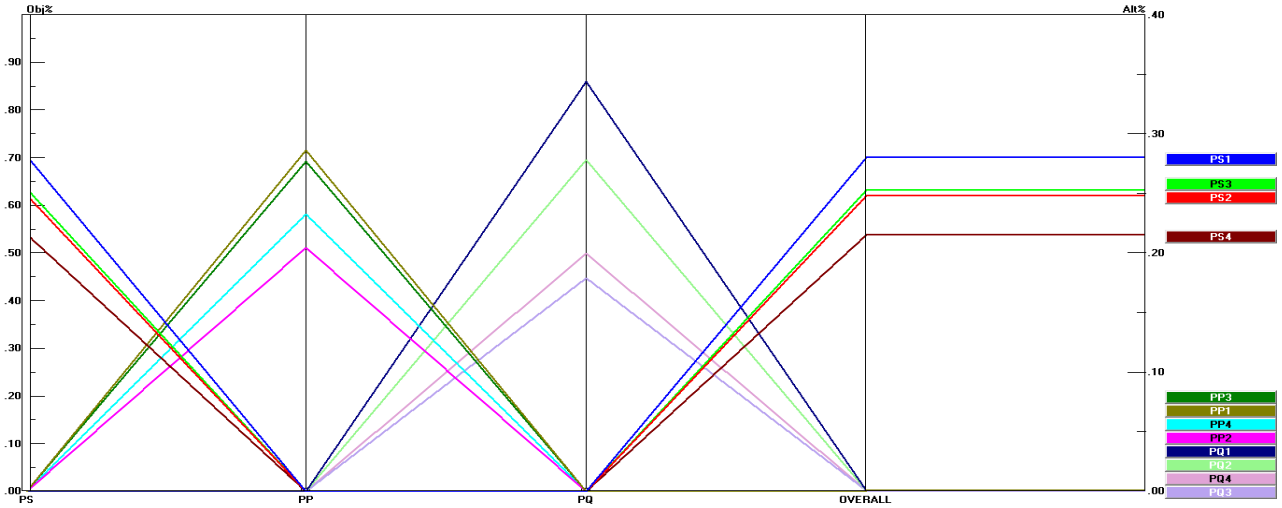


Figure 7: Sensitivity Analysis with priority to "attributes of project team"

II. Sensitivity Analysis w.r.t "project planning process"

In this scenario, project planning process is given highest priority followed by attributes of project staff and assessment of project quality as indicated in Figure 8. According to this scenario, most significant contributor for project management performance are project completion within expected budget and time followed by clarity of objectives, top management involvement and work norms and standards. The least contributor for this scenario are training of team, quick response of queries, implementation of ISO standards and risk analysis. When factor "project planning process" is dragged down by giving priority to other two factors, it is concluded that staff's knowledge and leadership skills become dominant factors.

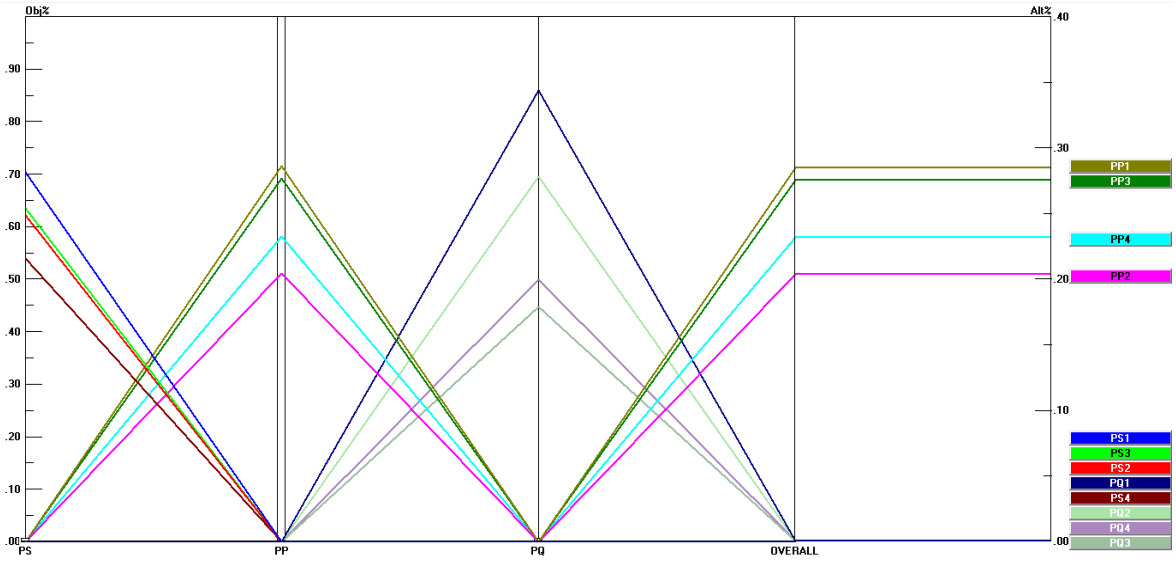


Figure 8: Sensitivity Analysis with priority to "project planning process"

III. Sensitivity Analysis w.r.t "assessment of project quality"

For third scenario, assessment of project quality is given highest priority followed by attributes of staff and project planning process as shown in Figure 9. Most important factors for this scenario are quality control programs, quick response of queries, implementation of ISO standards and risk analysis respectively. Whereas least significant contributor are work norms and standards, leadership skills, collaboration and training of project staff. Whereas, when assessment of project quality is less prioritized with respect to other two factors then project completion within forecasted time and budget and technical knowledge of team becomes most dominant factors.

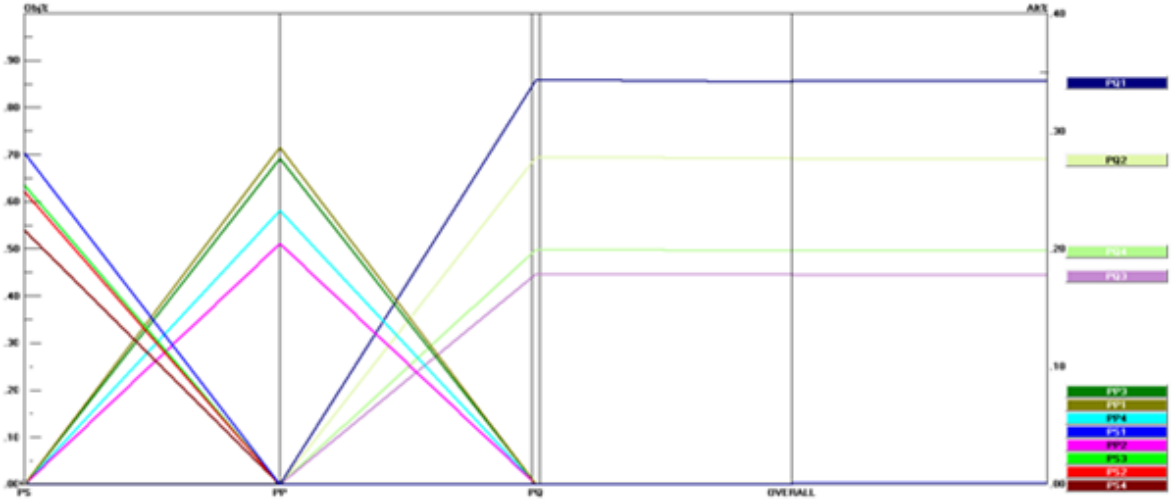


Figure 9: Sensitivity Analysis with priority to “assessment of project quality"

IV. Conclusion And Recommendations

Oil and gas project face many difficulties due to inappropriate planning, tight schedule and uncertainties. Therefore, this study is made using AHP to help project managers by ranking the key factors for successful project management performance. With the help of literature review and expert’s opinion, key factors are selected. After which an analytical hierarchy based model is developed using these factors to facilitate oil and gas industrial experts for decision making in different scenarios. Data collection is made from oil and gas experts using a scale ranging from zero to nine. Based upon pair wise comparison on Expert Choice, collected data is synthesized to get overall results of hierarchy. After which it is found that

1. Project completion within expected time and budget followed by clarity of objectives and involvement of top management are most crucial elements for better project management performance of Oil and Gas projects.
2. Least significant factors for improvement in project management process are quick response of queries, implementation of ISO standards and risk analysis.
3. Three different scenarios are also analyzed in this study by sensitivity analysis to help project managers in varying conditions. Each scenario has different dominant and least contributing factors.

Therefore, project managers should focus on highlighted factors of this study, to achieve success for oil and gas project management process while handling all uncertainties. It will help project managers to minimize difficulties faced during execution of oil and gas projects. Data collection for this study is made from oil and gas sector of Pakistan, whereas for more generic results, data collection can also be made from oil and gas companies of other countries as well.

References

[1] Weijermars, R., Accelerating the three dimensions of E&P clockspeed–a novel strategy for optimizing utility in the oil & gas industry. Applied Energy, 2009. 86(10): p. 2222-2243.
[2] Salazar-Aramayo, J.L., et al., A conceptual model for project management of exploration and production in the oil and gas industry: The case of a Brazilian company. International Journal of Project Management, 2013. 31(4): p. 589-601.
[3] Noreng, O., Crude power: politics and the oil market. Vol. 21. 2006: IB Tauris.
[4] Jergeas, G.F. and J. Ruwanpura, Why cost and schedule overruns on mega oil sands projects? Practice Periodical on Structural Design and Construction, 2009. 15(1): p. 40-43.
[5] Wagner, J. and K. Armstrong, Managing environmental and social risks in international oil and gas projects: Perspectives on compliance. The Journal of World Energy Law & Business, 2010. 3(2): p. 140-165.

[6] Madden, P.B. and J.D. Morawski, The future of the canadian oil stands: engineering and project management advances. Energy & Environment, 2011. 22(5): p. 579-596.
[7] Mir, F.A. and A.H. Pinnington, Exploring the value of project management: linking project management performance and project success. International journal of project management, 2014. 32(2): p. 202-217.
[8] Vrchota, J. and P. Řehoř, Project Management and the Importance of Crises in the Sectors of the National Economy. Procedia Computer Science, 2016. 100: p. 362-368.
[9] Joslin, R. and R. Müller, Relationships between a project management methodology and project success in different project governance contexts. International Journal of Project Management, 2015. 33(6): p. 1377-1392.
[10] Munns, A. and B.F. Bjeirmi, The role of project management in achieving project success. International journal of project management, 1996. 14(2): p. 81-87.
[11] Raymond, L. and F. Bergeron, Project management information systems: An empirical study of their impact on project managers and project success. International Journal of Project Management, 2008. 26(2): p. 213-220.
[12] Keri, E., S. Pearlson, and C. Saunders, Managing and using information systems: A strategic approach. 2006, USA: Wiley.
[13] Badiru, A.B. and S.O. Osisanya, Project management for the oil and gas industry: a world system approach. 2016: CRC Press.
[14] Zakria, G., et al., Selecting and prioritizing key factors for CAD/CAM software in small-and medium-sized enterprises using AHP. Frontiers of Mechanical Engineering in China, 2010. 5(2): p. 157-164.
[15] Aragonés-Beltrán, P., et al., An AHP (Analytic Hierarchy Process)/ANP (Analytic Network Process)-based multi-criteria decision approach for the selection of solar-thermal power plant investment projects. Energy, 2014. 66: p. 222-238.
[16] Aminbakhsh, S., M. Gunduz, and R. Sonmez, Safety risk assessment using analytic hierarchy process (AHP) during planning and budgeting of construction projects. Journal of safety research, 2013. 46: p. 99-105.
[17] Rosso, M., et al., Integrating multicriteria evaluation and stakeholders analysis for assessing hydropower projects. Energy Policy, 2014. 67: p. 870-881.
[18] Gudienė, N., et al., Identification and evaluation of the critical success factors for construction projects in Lithuania: AHP approach. Journal of Civil Engineering and Management, 2014. 20(3): p. 350-359.
[19] Dey, P.K. and W. Cheffi, Green supply chain performance measurement using the analytic hierarchy process: a comparative analysis of manufacturing organisations. Production Planning & Control, 2013. 24(8-9): p. 702-720.
[20] Masood, S.A., M. Jahanzaib, and K. Akhtar, Key Performance Indicators Prioritization in Whole Business Process: A Case of Manufacturing Industry. Life Science Journal, 2013. 10(4s): p. 195-201.
[21] Vidal, L.-A., F. Marle, and J.-C. Bocquet, Using a Delphi process and the Analytic Hierarchy Process (AHP) to evaluate the complexity of projects. Expert systems with applications, 2011. 38(5): p. 5388-5405.
[22] San Cristóbal, J., Multi-criteria decision-making in the selection of a renewable energy project in spain: The Vikor method. Renewable energy, 2011. 36(2): p. 498-502.
[23] Dey, P.K., Managing project risk using combined analytic hierarchy process and risk map. Applied Soft Computing, 2010. 10(4): p. 990-1000.
[24] Kumar, M., J. Antony, and B. Rae Cho, Project selection and its impact on the successful deployment of Six Sigma. Business Process Management Journal, 2009. 15(5): p. 669-686.
[25] Zhang, G. and P.X. Zou, Fuzzy analytical hierarchy process risk assessment approach for joint venture construction projects in China. Journal of Construction Engineering and Management, 2007. 133(10): p. 771-779.
[26] Mirza Jahanzaib, D. and K. Akhtar, Prioritizing Key Quality Indicators for Engineering Education using Analytical Hierarchical Process (AHP): Case Study.
[27] Doloi, H., K. Iyer, and A. Sawhney, Structural equation model for assessing impacts of contractor's performance on project success. International Journal of Project Management, 2011. 29(6): p. 687-695.
[28] Fortune, J. and D. White, Framing of project critical success factors by a systems model. International journal of project management, 2006. 24(1): p. 53-65.
[29] Xia, B., et al., Investigating the impact of project definition clarity on project performance: Structural equation modeling study. Journal of Management in Engineering, 2015. 32(1): p. 04015022.
[30] Xiong, B., et al., Examining the influence of participant performance factors on contractor satisfaction: A structural equation model. International Journal of Project Management, 2014. 32(3): p. 482-491.
[31] Li, H., D. Arditi, and Z. Wang, Transaction-related issues and construction project performance. Construction Management and Economics, 2012. 30(2): p. 151-164.
[32] Terziovski, M. and J.-L. Guerrero, ISO 9000 quality system certification and its impact on product and process innovation performance. International Journal of Production Economics, 2014. 158: p. 197-207.
[33] Khalil, N., S.N. Kamaruzzaman, and M.R. Baharum, Ranking the indicators of building performance and the users' risk via Analytical Hierarchy Process (AHP): Case of Malaysia. Ecological Indicators, 2016. 71: p. 567-576.
[34] Mirza Jahanzaib, D. and K. Akhtar, Prioritizing Key Quality Indicators for Engineering Education using Analytical Hierarchical Process (AHP): Case Study, in Proceedings of Pakistan's 4th National Conference on Quality Assurance in Education (NCQAE) Lahore- September 17-18, 2005. 2005: Lahore.
[35] Mansor, M.R., et al., Hybrid natural and glass fibers reinforced polymer composites material selection using Analytical Hierarchy Process for automotive brake lever design. Materials & Design, 2013. 51: p. 484-492.

Automatic Speaker Identification System for Urdu Speech

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***Abstract*- Speaker recognition is the process of recognizing a speaker from a verbal phrase. Such systems generally operate in two ways: to identify a speaker or to verify speaker's claimed identity. Availability of valuable research material witnessed efforts paid to Automatic Speaker Identification (ASI) in East Asian, English and European languages. But unfortunately languages of South Asia especially "Urdu" have got very less attention. This paper aims to describe a new feature set for ASI in Urdu speech, achieving improved performance than baseline systems. Classifiers like Neural Net, Naïve Bayes and K nearest neighbor (K-NN) have been used for modeling. Results are provided on the dataset of 40 speakers with 82% correct identification. Lastly, improvement in system performance is also reported by changing number of recordings per speaker.**

Keywords: MFCC, K-NN, Formants, Automatic Speaker Identification, Urdu.

I. INTRODUCTION

Automatic Speaker Identification (ASI) has two variants: Text-Independent and Text-dependent speaker identification. Text-independent includes different utterances during enrollment and verification while text-dependent involves same set of utterances during both steps [1-3]. There is normally a trade- off between accuracy and enrollment samples. Greater the duration of the utterances recorded and lesser the number of enrolled models, more will be the accuracy of the system and vice versa [4]. Speaker Identification is further classified into closed-set speaker identification or open-set depending upon its application. Open-set identification is close to speaker verification. In closed-set, test speakers are known to the system. While in open-set, test speaker may not be a part of system and the test user is usually identified by defining a threshold [5, 6]. For instance, if similarity measure of the test user is greater than the threshold, access is guaranteed to the user and vice versa. Speaker Identification has various applications including voice dialing, banking transaction over telephone network, telephone shopping, database access services, information and reservation system, security control for confidential information areas, voice mail and improving customer experience [7]. While designing automatic speaker identification

system (ASI) we have to predefine certain constraints on the speaker data that include language, age, gender, channel and environment on which our system has to be trained [8].

A. Generic Speaker Identification

Speaker Identification broadly involves two phases: Enrollment and verification. Enrollment is the step in which the voice of a speaker is recorded and feature vector (set of features that uniquely identify each speaker) is extracted from each frame which constitutes a template or model e.g. pitch or frequency etc. Enrollment is further divided into two steps: voice recording and feature extraction[9, 10]. In first step, Speech data (we call it S) is acquired using the dedicated hardware like telephone or microphone, and then preprocessed to visualize the acoustic patterns of speech in the form of frequency-time waveform. Speaker dependent features like frequency, pitch and loudness are then extracted from the waveform. Later, this voice recording (S) is divided into cut-out samples of equal length of 10ms, called frames. Hamming window, that remove the discontinuities at the edges is then applied to remove the discontinuities at the edges. Lastly, speaker dependent features, collectively known as a feature vector are extracted from one interval of speech (frame). These feature vectors are then trained for each speaker to form a template or model of that speaker and stored in the database. In verification, the utterance is compared with the multiple existing templates to find the optimal match. Verification is also accomplished in two steps that involves pattern matching and decision. In pattern matching, a test sample (T) is compared with the stored speech model (SM) to calculate match score that defines resemblance of the input feature vector of the newly recorded sample (T) with the known templates stored in a database. Thus, match score counts the number of features of the test sample (T) that have been matched with the recognized speaker model. Different pattern matching algorithms are used for this purpose of which most common are Hidden Markov Model, NN method and Dynamic Time Warping [11, 12]. Lastly based on the matching score, the speaker model (T) is either accepted or rejected (Decision).

B. Motivation

In Pakistan, with the growing trend of e-commerce and online transactions, maintaining and improving the customer experience is one of the core challenges of business and banks. Identifying the speaker over telephone is a challenging area mainly in our telecoms and banking sector. Most of the users, specifically who are semi-literate or non-literate are uncomfortable with remembering

passwords and pins so they often keep their passwords and sensitive information along with them which increases the theft and fraud rate in Pakistan every year.

A lot of work has been done in speaker identification in subsequent languages including English, Tamil, Japanese and Portuguese [13] . But not sufficient work has been done so far in Urdu and work has been done using features like formants only that when used alone will give us very limited information about speaker. However, systems that have been trained for other languages can't be used for Urdu language because each language has its own phonemes and all are designed on their native speakers.

C. Overview

This introductory section has been presented with a goal to describe general framework and need for speaker identification. The endeavor trains different classifiers with the aim to determine such a feature set that cannot only uniquely recognize a speaker but also provide better results as compared to the previous researches which has been conducted within the context of other languages. This has been accomplished by evaluating our dataset on different measures i.e. changing value of K and changing number of utterances etc.

Figure 1 describes the block diagram of ASI. Our research is based on system that is text-dependent and specific for Urdu Language. Section 2 gives an overview of datasets used in existing researches and gives a detailed description on requirements for collecting data set. Section 3 gives an insight on features i.e., MFCCS, Pitch and formants. Section 4 demonstrates training of speaker identification algorithms effectively used for ASI. Section 5 describes the results that comes from evaluation of data set and algorithms and section 6 gives conclusion and future prospects.

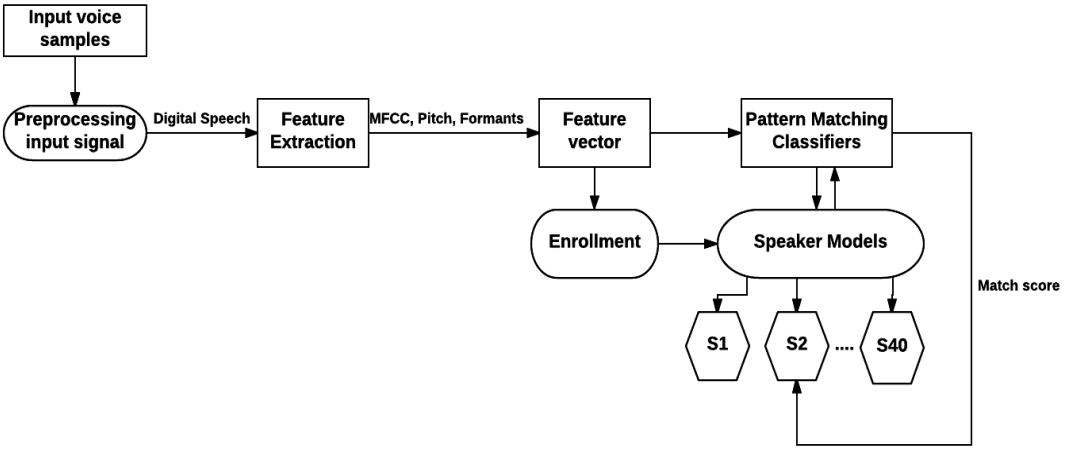

Figure. 1 Block Diagram of Automatic Speaker Identification

II. INPUT DATA REQUIREMENTS

Data collection for speaker identification poses certain constraints like number of speakers, language, medium of recording, size, gender distribution, text selection etc. [14]. Summary of different datasets used in multiple researches for Non-Urdu Languages is shown in the table 1.

TABLE I
SUMMARY OF DATA SETS IN EXISTING RESEARCHES

Number of Speakers	Gender Distribution	Text Spoken(Language medium, sentence, word)	Number of sentence/word(per speaker)	Medium of recording	Accuracy
10	Females only	"May we all learn a yellow lion roar"	6 utterances	High quality microphone	80%
50	Females+ Males	Isolated digits (1-10)	NA	Microphone	71%
40	22 males + 18 females	Telephone speech English corpus	20 utterances	Telephone	68.5%
51	Males only	Telephone quality version of Japanese speech	10 utterances	High quality microphone	96.80%
26	Males only	English Vowels	3 utterances	Recordings done in 5 months	72%

Urdu is a phonetically rich language with a large directory of 44 consonants, 7 long nasal vowels, 7 long oral vowels, 3 short vowels and various diphthongs [15]. All these consonants, vowels are made up of phonemes.

Fundamental distinct unit of language is called phoneme[16]. Phoneme is distinct in a sense that it separates words of a language. Following are major groups of phoneme: Vowel, nasal, fricative, consonants and stops. Our study aims towards vowels and their speaker dependent characteristics. We have recorded five words that cover all vowels as shown in Table 2. Atal et al., 1976 mentioned that larger the number of utterances, larger the accuracy would be[4]. Practically, collecting large number of recordings imposes huge computation but accuracy increases.

TABLE II
WORDS TAKEN FOR RECORDINGS

Words	Pronunciation	Phones (CISAMPA)
A	/e:/	A_Y
E	/i:/	I_I
I	/ɑ:/ /i:/	A_A I_I
O	/o: /	O_O
U	/j/ /u:/	J U_U

Initially we make recordings of 11 speakers. For each speaker, we took 25 recordings so that maximum data against single speaker must be preserved. Later, following this research we found that 11 speakers were not sufficient for making any strong argument and comparing accuracy. So taking all these researches as baseline and for analysis and evaluation purpose, we have taken average of all researches that have been done so far in the domain of speaker recognition and these researches has been conducted on around 40 numbers of speakers (18 females and 22 males).

III. FEATURE EXTRACTION

Once the data collection is completed the next step involved in the simulation environment is to train the system. In order to efficiently train the system, we need to have a feature set. Usually acoustic signals in the waveform contains a lot of parameters that can be either directly extracted or after transforming signal from spectral to frequency domain [17]. For successful speaker identification the most important step is extraction of such parameters from the acoustic signal that represent the maximum user dependent information. Extensive research is available regarding

selection of efficient speech parameters. Ideally, the selective parameters must be efficient enough to represent speaker information and should have some properties like time-stable, easy to compute, occur frequently in acoustic signal, environment independent and least subjected to mimicry [14].

For audio classification, speech features that have been widely used are Mel-frequency cepstral coefficients (MFCC), formants and pitch [18]. The idea behind is to report the accuracy difference by using either MFCC alone or MFCC along with formants and pitch.

A. Mel-frequency Cepstral Coefficients

MFCCs [9, 19] provides the best representation of speech signal and proves more efficient recognition performance. As human ears doesn't follow frequency contents on a linear scale so for each sound with some frequency, f, in Hz, a subjective frequency is calculated on a scale named as 'Mel' scale [9]. The Mel scale has a linear frequency spacing below 1000Hz and logarithmic spacing above 1000Hz. Like a tone with 1 KHz and 40 dBs above the perceptual hearing threshold defined to have a pitch of 1000 Mel's. So, for a given frequency f in Hz, following formula can be used to calculate the Mel's.

$$\text{Mel}(f) = 2595 * \log_{10}(1 + f/700) \quad (1)$$

We have used filter bank to simulate subjective spectrum where there is one filter for every Mel-frequency component. This filter bank consists of spacing and triangular band pass frequency response as well as bandwidth is calculated by a constant Mel-frequency interval. This Mel scale bank has a sequence of triangular band pass filters deigned to perform the band pass filtering supposed to happen in auditory system. This leads to a sequence of band pass filters on Mel-frequency scale having constant bandwidth and spacing. In last step, the log Mel spectrum is converted back to time and in result we get the Mel-frequency Cepstral coefficients (MFCC).

We can do discrete cosine transformation in order to transfer back the Mel coefficients to time domain.

$$C_{\underline{n}} = \sum_{k=1}^{k} (\log S_k) \cos\left\{ n\left(k - \frac{1}{2}\right) * \frac{\pi}{k} \right\}, \quad (2)$$

$$n = 1, 2, \ldots k$$

Whereas S_k, K = 1, 2, … K are the outputs of last step.

B. Pitch and Formants

Pitch is also a user-dependent feature and has been supported in research [18] but pitch is easily to mimic within same gender so using this feature alone doesn't gave fruitful results. Formants are the spectral peaks of the signal and Peterson and Barney have measured first and second formants for a large set of speakers and have documented 60% accuracy. As per above discussion, lesser the number of features, lesser would be the results. Formants are generally calculated as first, second and third only so they gave not much information against single speaker.

IV. TRAINING OF CLASSIFIER

It has been studied that different classification models have been proposed [20-22] to train the system. The classification models are dependent upon their preference/priority which are presented as follows:

- Naïve Bayes
- K-Nearest Neighbor
- Neural Network

First, we have taken the MFCCs features without normalization. By this, we mean that as each recording has different number of frames depending upon the user characteristics like speed of uttering word because different speakers utter the same word with different speed [23]. Taking MFCCs without normalization doesn't leads to useful results.

Therefore, in the second experiment, we take the mean of each Mel cepstral co-efficient for all frames and combine the results of all recordings of a single speaker. This is like let we have a recording of user consisting of 13 * 95 vectors. We first convert it into 13 * 1 vector then do this for all 25 recordings of the single user. Then we make a single file of 13 * 25 vector for a single user. This normalization technique resulted in comparatively better results than without normalization.

In the third experiment, we took normalized MFCCs along with pitch and formants and trained them on different classifiers to compare the accuracy in order to deduce that which set of features gave us the best accuracy. This experiment proved to be the best set of features for speaker identification task.

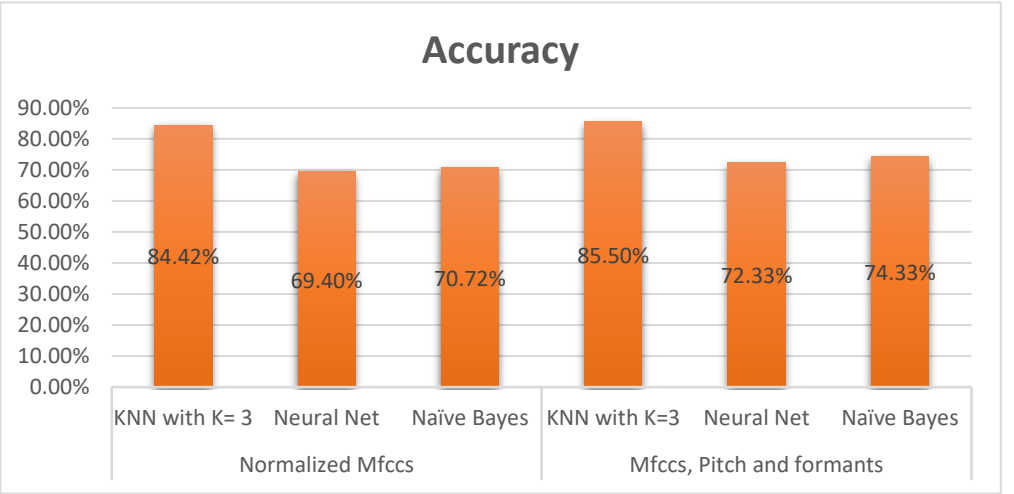

Figure. 2 Accuracy Results of all classifier

As shown in figure 2, it can be seen that KNN with K= 3 was able to produce the better results in both techniques. So there is a high probability to utilize the KNN with K= 3 classification model for training. We have got the best accuracy of 85.50% again by using the K-NN classifier with a combined feature set of MFCC, pitch and formants.

V. Analysis of Results

After training different models, additional experiments were made on data to ensure that the accuracy that have been achieved is sustainable or not. For this, following analysis were made on the dataset:

1. Changing value of K
2. Reducing number of utterances

A. Changing value of K

The NN, or more general k-NN, method can be used to estimate the probability density function (PDF) of the data within a class or itself can be used as a classifier. According to our analysis, the results suggest that the speaker population should directly be proportional to k. This is logical since for large populations, there will be more confusion among the nearest neighbors.

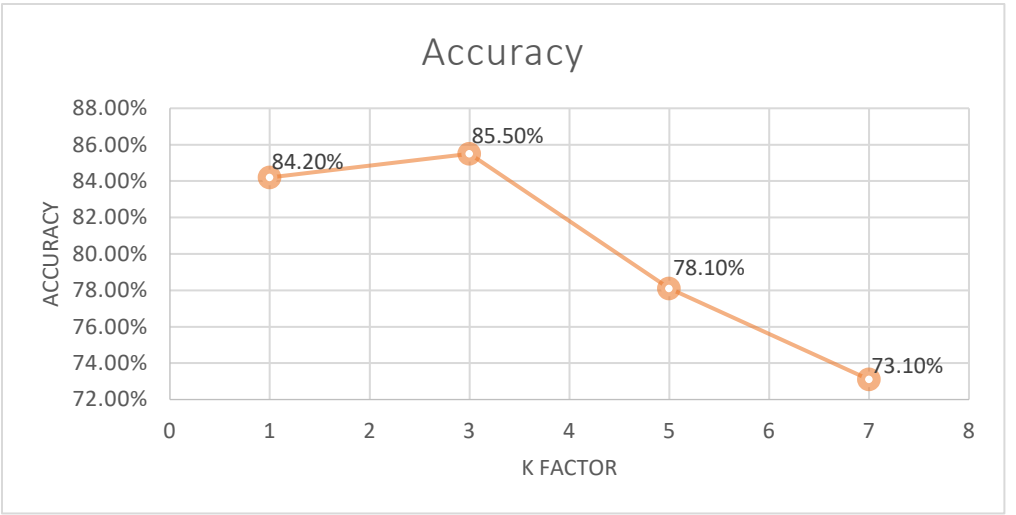

Figure. 3 Effect by changing NN k factor

The experiment has been conducted for identifying the change that might occur in accuracy by changing k factor. Data set has been trained and tested on odd values of k because setting odd value of k supports us in deciding the class label of the test utterance [23, 24]. It has been clear from the simulation results that excessive increase in the nearest neighbor results in drop of accuracy. As shown in Figure 3, accuracy falls as the value of k on the x-axis increases.

B. Reducing number of utterances

Reference [25], experiment has been conducted to measure the effect of reducing number of recordings within the context of classification model. There are two categories of recordings which has been utilized in the experiment such as “18 utterances/speaker and 25 utterances/speaker”.

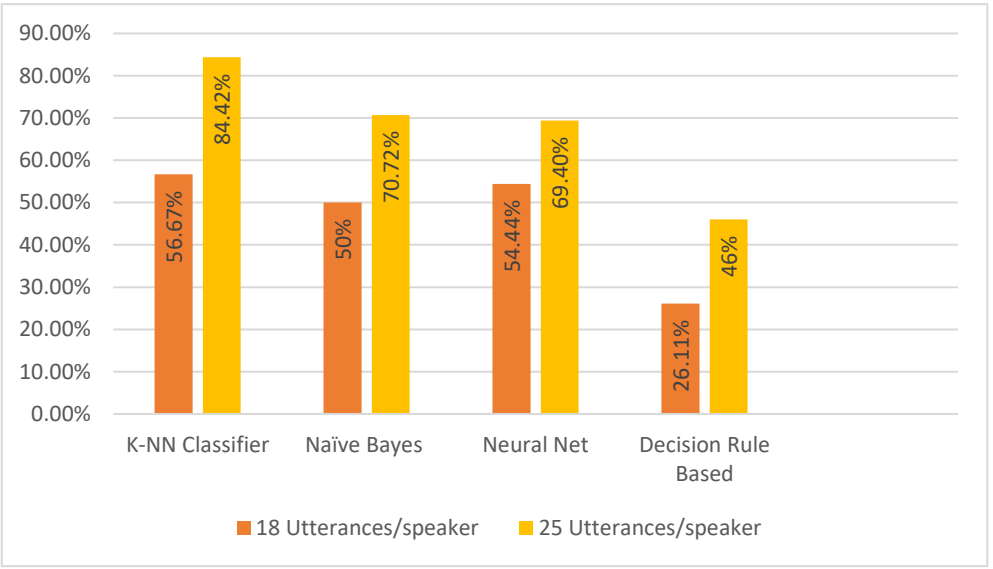

Figure. 4 reducing number of utterances

After conducting the experiment results as shown in Figure 4, it can be visualized that increasing the number of utterances per speaker helps us improving the accuracy measure. The figure clearly demonstrates that all classifiers have resulted in better and improved accuracy against 25 utterances rather than 18 utterances. Additionally, among all of them, k-NN classifier again here has been able to provide the best accuracy as compared to others for both set of utterances. The results obtained by the technique on both set of speakers are 56.67% on 18 utterances/speaker and 84.42% on 25 utterances/speaker.

VI. Conclusion

We came up with a new feature set for ASI that are not simple, robust and easily computable but also gives us high accuracy. We have shown that more competitive system can be made by using MFCC along with pitch and formants rather than using MFCC alone. Using pitch and formants (highly speaker dependent features) clearly demonstrates inter speaker and intra speaker variability. Use of K-NN as a pattern matching classifier has also shown significant improvement. Due to time constraints we have developed a text dependent system so in future we will try to improve the system to text independent system.

As future recommendations, it is highly recommended that porting code to C will also help in efficiency improvement of Automatic Speaker Identification System for Urdu Speech. In addition, Psychological studies have shown that human speech varies over a period of 2-3 years so speaker's data must be updated to maintain the accuracy of the system.

REFERENCES

[1] Reynolds, D.A. and R.C. Rose, Robust text-independent speaker identification using Gaussian mixture speaker models. IEEE Transactions on Speech & Audio Processing, 1995. 3(1): p. 72-83.
[2] Kenny, P., et al., A study of interspeaker variability in speaker verification. IEEE Transactions on Audio, Speech, and Language Processing, 2008. 16(5): p. 980-988.
[3] Pillay, S.G., et al. Open-Set Speaker Identification under Mismatch Conditions. in Tenth Annual Conference of the International Speech Communication Association. 2009.
[4] Atal, B.S., Automatic recognition of speakers from their voices. Proceedings of the IEEE, 1976. 64(4): p. 460-475.
[5] Reynolds, D.A., Speaker identification and verification using Gaussian mixture speaker models. Speech Commun., 1995. 17(1-2): p. 91-108.
[6] Kalaivani, S. and R.S. Thakur, Modified Hidden Markov Model for Speaker Identification System. International Journal of Advances in Computer and Electronics Engineering, 2017. 2(3): p. 1-7.
[7] Subhashini, P. and T. Pratap, TEXT-INDEPENDENT SPEAKER RECOGNITION USING COMBINED LPC AND MFC COEFFICIENTS.
[8] Raza, A.A., et al. Design and development of phonetically rich Urdu speech corpus. in Speech Database and Assessments, 2009 Oriental COCOSDA International Conference on. 2009. IEEE.
[9] Reynolds, D.A. An overview of automatic speaker recognition technology. in Acoustics, speech, and signal processing (ICASSP), 2002 IEEE international conference on. 2002. IEEE.
[10] Shinde, R. and V. Pawar, Fusion of mfcc & lpc feature sets for accurate speaker identification. International JOurnal of Current Engineering and Technology, 2013. 3: p. 1763-1766.
[11] Zhao, L. and Z. Han. Speech recognition system based on integrating feature and HMM. in Measuring Technology and Mechatronics Automation (ICMTMA), 2010 International Conference on. 2010. IEEE.
[12] Gaikwad, S.K., B.W. Gawali, and P. Yannawar, A review on speech recognition technique. International Journal of Computer Applications, 2010. 10(3): p. 16-24.
[13] Nawaz, O. and T. Habib. Hidden Markov Model (HMM) based speech synthesis for Urdu language. in Conference on Language & Technology (CLT). 2014.
[14] Radha, V. and C. Vimala, A review on speech recognition challenges and approaches. doaj. org, 2012. 2(1): p. 1-7.
[15] Ahmed, Z. and J.P. Cabral. HMM-Based Speech Synthesiser for the Urdu Language. in Spoken Language Technologies for Under-Resourced Languages. 2014.
[16] Huang, J.-T., et al. Cross-language knowledge transfer using multilingual deep neural network with shared hidden layers. in Acoustics, Speech and Signal Processing (ICASSP), 2013 IEEE International Conference on. 2013.
[17] Raza, A.A., Design and Development of an Automatic Speech Recognition System for Urdu. 2009, Thesis, FAST-National University of Computer and Emerging Sciences, Lahore Pakistan.
[18] Reynolds, D.A., et al. The 2004 MIT Lincoln laboratory speaker recognition system. in Acoustics, Speech, and Signal Processing, 2005. Proceedings.(ICASSP'05). IEEE International Conference on. 2005. IEEE.
[19] Dumitru, C.O. and I. Gavat. A comparative study of feature extraction methods applied to continuous speech recognition in Romanian Language. in Multimedia Signal Processing and Communications, 48th International Symposium ELMAR-2006 focused on. 2006. IEEE.
[20] Marhon, S.A. and D.N.U. Al-Aghar, Speaker Recognition Based On Neural Networks. The Higher Institute For Industry, Misrata, Libya.
[21] Cai, D., et al., Modeling splice sites with Bayes networks. Bioinformatics, 2000. 16(2): p. 152-158.
[22] Katz, M., et al. Sparse kernel logistic regression using incremental feature selection for text-independent speaker identification. in Speaker and Language Recognition Workshop, 2006. IEEE Odyssey 2006: The. 2006. IEEE.
[23] Maheswari, N.U., A. Kabilan, and R. Venkatesh, A hybrid model of neural network approach for speaker independent word recognition. International Journal of Computer Theory and Engineering, 2010. 2(6): p. 912.
[24] Sarfjoo, S.S., et al., Using eigenvoices and nearest-neighbors in HMM-based cross-lingual speaker adaptation with limited data. IEEE/ACM Transactions on Audio, Speech and Language Processing (TASLP), 2017. 25(4): p. 839-851.
[25] Maas, A.L., et al., Building DNN acoustic models for large vocabulary speech recognition. Computer Speech & Language, 2017. 41: p. 195-213.

WEB Based Applications Testing: Analytical Approach towards Model Based Testing and Fuzz Testing

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***Abstract*- Web based applications are complex in structure which results in facing immense amount of exploiting attacks, so testing should be done in proactive way in order to identify threats in the applications. The intruder can explore these security loopholes and may exploit the application which results in economical lose, so testing the application becomes a supreme phase of development. The prime objective of testing is to secure the contents of applications either through static or automatic approach. The software houses usually follow fuzz based testing in which flaws can be explored by randomly inputting invalid data while on the other hand model based testing is the automated approach which test the applications from all perspectives on the basis of abstract model of the application. The main theme of this research is to study the difference of fuzz based testing and model based testing in terms of test coverage, performance, cost and time. This research work guides the web application practitioner in selection of suitable methodology for different testing scenarios which save efforts imparted on testing and develop better and breaches free product.**

Keywords: ESG, MBT, SUT, TOE, UML.

I. INTRODUCTION

Web applications are the key part of today's world of internet where users perform different kinds of activities via remote device with ease such as online transactions, reservation of tickets for flights etc. This trend of services are now widely utilized by every organization such as banking sectors which manages a lot of daily transections and transport sector for issuing tickets etc., this trend looks easy and calm from end users perspective but it arises questionable debate when we talk about privacy and confidentiality of information that is, how much it is secure and what sort of parameters are followed in order to sure its safety?. Unfortunately, the web application didn't get much trust and satisfaction from users in context of safety of information and this put a question mark on its ability of protection and security of the information of an organization, providing the services through that application. In order to understand these factors, we need to understand the simple workout of banking sectors which utilizes this platform to manage their daily-based activities like transferring and depositing fund, balance inquiry, transections history withdrawal and so on. All

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these details are stored in centralized storage called database which linked with server of that bank. Now, if hacker accesses the server side's script or even if he able to crack the database of that application, then surely the whole system is under custody of that person and he able to steal those sensitive credentials of customers and bank and put both of them on the edge of forfeiture like transferring bank balance of customer to another account without prior to his and bank managements knowledge. Such uncertainties put both stakeholders and users at the edge uncertain risk; the primary factors of such uncertainties are actually come from customer's side when they continuously requesting for changes that in turn intended the developers to more be focused on user's modifications instead of prioritize security structure [11].

The secondary factor of susceptibilities and flaws are triggered due to flaws in applications designs and code which can be undone by following quality of testing experiments where several behavior aspects of applications are being analyzed in context of quality and security which verifies whether the application fulfills the properties of intended behavior or not as it makes sure that application remains in safe and quality shells and also shows the power of quality testing. Yes! The fact is confessed that it quite tired procedure as it demands a lot of effort and cost to ensure the applications compliance because most of the testing is done by following old-fashioned approaches instead of automatic testing which ensures the safety of application by consuming less time and effort yields betters results as compared to manual approaches.

Model based testing is increasing broad significance because of speedier and creation of test scripts for verifying application's security and reliability. This approach is seems to be a semi-automatic kind of approach that generate test cases on the basis of models where these models are actually action and events of the system that reflects the functionality and intended behavior of the system and are abstracted from set of requirements. These models are created manually or by the help of software's. Due to swift and complexity in the development industry, there comes a supreme task of testing application full-fledged at earliest possibility. Model based testing is type of black box testing because in such condition the test cases is obtained from model that are designs for system under test. These test cases are then packed in the form of test suits and executed on the system in systematic series. The priority reason to select model based testing is that its principle objective is to automate manual based activities by minimizing the cost of generating models for coverage and to reduce the efforts for designing and implementation of test cases [20].

While, the fuzz technique targets the application in order to verify its conformity and reliability by exploring important security loopholes in the application. The concept behind this approach is to act like an intruder in order to target the system by continuously inserting testing data that compose of malicious inputs and then analyze the system by monitoring it behavior. Actually fuzzing was initially used to find zero days in black-hat community. The main concern of this approach is to generate data for testing that able to strike the victim application or at least create a negative impact on the execution of the application and then monitoring the outcome. Although there are many others alternates available to explore hidden vulnerabilities but fuzz is more popular at industrial level as it does not required the source code and does not have blind spots to like human testers, and also cost saving technique than manual approaches [10].

II. Review Of Literature

Testing is actually an estimation of application applicability by observing its execution. Testing involves dynamic validation of tangible behavior of the system against its predictable behavior. This is achieved with a determinate set of test cases termed as test suites appropriately designated from the infinite set of anticipated traces of execution. The behavior of application is examined by smearing invasive tests that stimulated the application and then evaluate the system responses by observation. After execution of test cases, the actual and anticipated behavior of the application under test is compared with each other which results in conclusion, where the test oracle is used as mechanism for determining conclusion. The conclusion can either be pass, fail or inconclusive. The pass conclusion suggests that application's behavior is conformed while the fail and inconclusive conclusions suggests that application is either not conformed or unknown respectively [6].

The procedure of model based testing by stated that it's quite similar for every application that is first developing models for system which are under examined and then translate these models into test modeling and finally generate test cases which are executable on system based on coverage criterion. Though, implementation of model based testing to a new industrial application always faces tedious difficulties because of practices follows at industrial level are quite complex and need of proficient tools and category of the SUT [1].

The experimental study estimate the usage of model based testing in creation of models, their generation, and accomplishment of automatic test cases in context of mobile apps. However, they followed ESG (Event Sequence Graph) technique to design the artifacts of test models in order to define requirements and features of mobile apps which are under examination of testing procedure.

Their focus is on mobile apps, so they employed testing cases using a framework called Robotium. The results after analysis favors the model based approach and shows that this approach works well in terms of test case generation and ability to detect faults and flaws in application and the same time it enhanced the quality of test cases while reducing time and cost for testing and development of test models. Although there are supreme challenges might be occur during this technique that are problems of test modeling, concretization of test in context of mobile applications and the need of proficient tools. The experimental study concluded that Model based testing along with Event Sequence Graph modeling can be used as an efficient approach to test the applications based on android operating system [7].

Fuzz testing technique is actually based on comprehensive assessment. It is different from traditional way of fuzz testing that follows the concept of blind injection, this method divides the input into various fields by executing the dynamic assessment and make a rank for each field on the base of comprehensive assessment results in detecting vulnerabilities more quickly as compare to old ones. Experimental analysis shows that the field division is more effective as it makes fuzz testing approach more efficacious and coherent [10].

The study presented a methodology based on fuzzy logic with collaboration of model based methodology in order to rank test cases by means of information accessible from the symbolic tree's execution that acquired from a model. The responses to the fuzz based logic system are test suits, symbolic tree's execution dimensions, and comparative test case size. The fuzz based logic system yields particular crispy output termed as importance for each test case. The test cases are ordered on the basis of crisp output. This methodology presumes that the information covered from test cases at the model-level is accessible and uncertain to follow those models which are at higher abstraction level [17].

In order to explore security flaws in services of webs, the processes of the target system need to be thoroughly observed on the behalf of fuzz approach. The presence of susceptibilities in target system are recognized and evaluated based on the consequences achieved after monitoring. They also discussed the process of fuzz testing by stated that common methods of monitoring comprises observation analysis, following via debuggers, and dynamic binary composition. After that, a regular request is presented after sending a series of abnormal tests to the target system and the status of operations can be examined by the analysis of the responses of the systems for the regular or typical requests [10].

III. PROCEDURE

The research work is comprised of three sections: - Survey Experiments and proposed framework. The survey was mandatory part of research and data is collected by conducting survey which generates data that used for further analyzed by the help of statistical tools. While the experimental work dynamically validates the findings of survey results, however the least portion discuss the framework that based on the strengths of two above discussed techniques.

A. Survey Results

The respondents believe that model based testing works much better as semi-automated technique as it comes with more quality and reliability in context of applications testing while fully automatic suited more when deadline is little far away from the end as shown in Figure. 1.

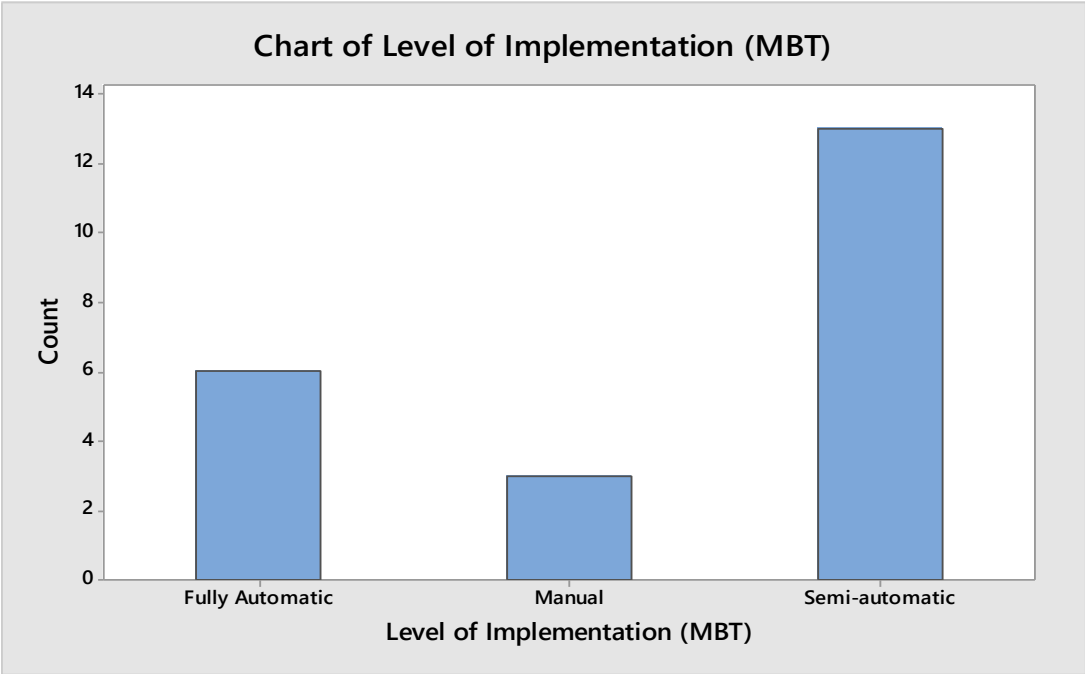

Figure 1: Level of MBT

While the survey results conclude that model based testing is best suited for testing functional requirements as it requirements are the raw information in order to develop models which further generated test cases on the basis of these models. If the raw information is available for non-

functional requirements, then it somehow test them well but not up to that standard mark as shown in Figure. 2.

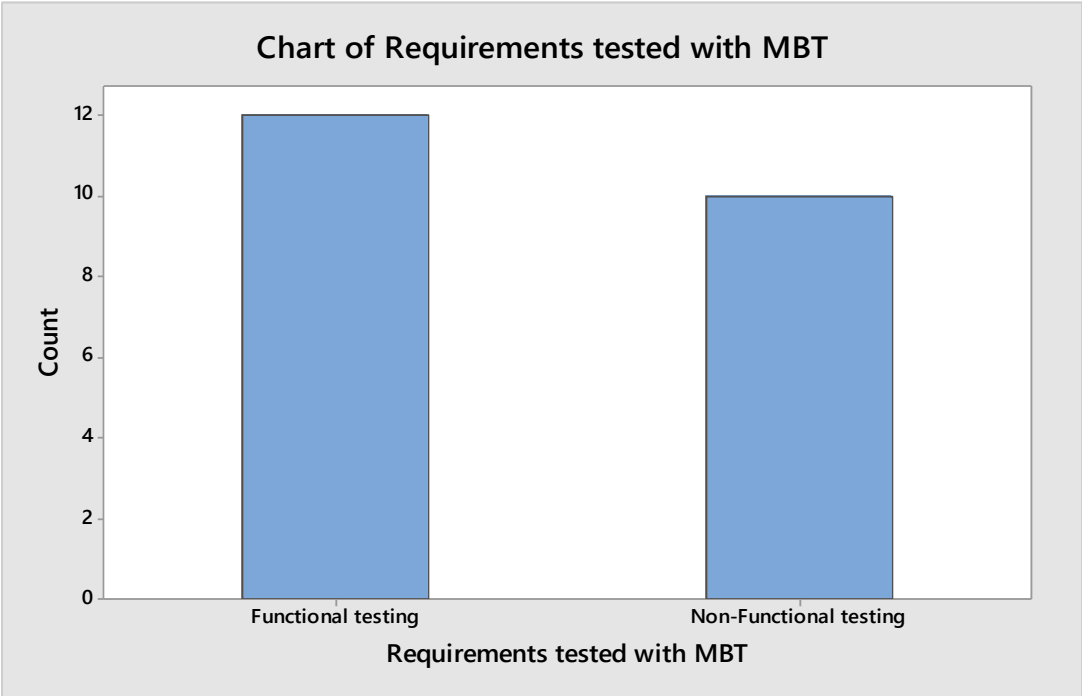

Figure 2: Requirement level in MBT

The model based testing is moderately cost effective, as it requires development of models and second, its best tools are available at commercial cost but it somehow reduces cost in terms of efforts as well as moderately effective in terms of time, as it requires development of models and test cases to generate which at the initial phase demands more time than other techniques. Where is the fuzz testing is very cost effective, as it requires test data and second, its best tools are available at lower cost and very effective in terms of time, as it requires simple testing inputs related to target application and then execute these inputs and verifies the behavior of the application. It also very efficient terms of execution as it simply requires a set of inputs and tools to insert these into target applications.

There are two ways to see the test coverage, one is as strength of Fuzz testing and other is model based testing. The coverage is solely depending on the experience of the tester, the one who is

writing that particular test and in the case if the test cases are not written by experience tester, then it should be approved by experience testers. Also note that in model based testing, the test coverage is always higher than Fuzz testing due to the fact that the cases is derived by examine the test coverage.

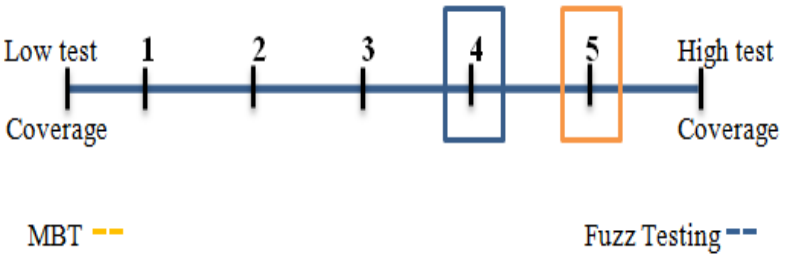

Figure 3: Test coverage of MBT and Fuzz

By consideration of test coverage and taking the help of average score of fuzzy testing and MBT the Figure.3 was created. It indicates that Fuzz testing has comparatively maximum test coverage then is path, branch, and statement coverage, it has also observed that due to zero- tolerance towards the test coverage the model based testing shows maximum coverage. The requirement traceability is one of strengths of model based testing. As per the data of survey, the requirement can be traceable through various ways by the test cases. However in MBT, the traceability is done in a different way. According to the respondents, it is a great challenge for companies and MBT to trace the requirement often it difficult in MBT approach to track the results back to the system requirements. Currently, remarkable studies related to finding out more appropriate way to make requirements traceable in MBT process have been done. According to the survey data analysis, figure 4 shows the requirement traceability in Fuzz testing and MBT.

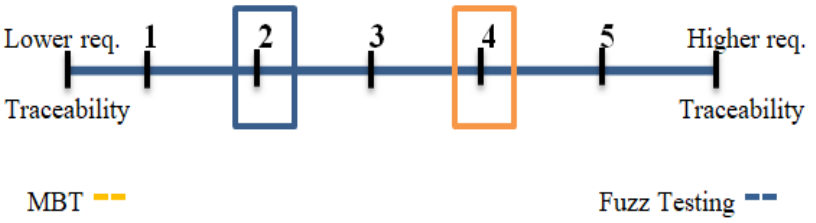

Figure 4: Requirement Traceability in MBT and Fuzz

B. Experiment Results

The comparison of test coverage results of the test cases generated from both approaches (MBT and Fuzz testing) are presented in Table 1. The test cases written by Fuzz group – 1, showed that there are two test cases required to test all conditions which sorted out during the analysis and design phase, and also two test cases are required to cover all the statements i.e. statement coverage and total of four test cases were required to test all possible paths i.e. path coverage. Similarly from Fuzz group – 2 test data, the branch, path and statement coverage was 3, 3 and 1 respectively. From test data gathered from Fuzz group – 3, branch, path and statement coverage was 3, 4 and 1 respectively. The test data from the three MBT teams resulted in branch, path and statement coverage of (3, 3, 2), (3, 4, 2) and (3, 3, 2) respectively.

TABLE I

MBT Group	Model Based Testing	Test Coverage	Fuzz Based Testing	Fuzz Testing Group
Group 1	3	Coverage of Paths	4	Group 1
	2	Coverage of Statements	2	
	3	Coverage of Branches	2	
Group 2	4	Coverage of Paths	3	Group 2
	2	Coverage of Statements	1	
	3	Coverage of Branches	3	
Group 3	3	Coverage of Paths	4	Group 3
	2	Coverage of Statements	1	
	3	Coverage of Branches	3	

While, the cost calculated by giving each team "x" value as standard cost per minute. For calculation we have given a standard value which is 0.5 units per minute i.e. 30 units per hr. The cost was calculated with respect to time consumed by each team. The results that were calculated are mentioned in the Table II.

TABLE II

MBT Group	Model Based Testing	Cost and Time	Fuzz Based Testing	Fuzz testing Group
Group 1	35 unit	Cost	57.5 unit	Group 1
	70 unit	Time	11.5 unit	
Group2	45 unit	Cost	55.5 unit	Group2
	90 unit	Time	111 unit	
Group 3	37.5 unit	Cost	48 unit	Group 3
	75 unit	Time	96 unit	

C. Proposed Framework

The conceptual framework is proposed based on the strengths of both approaches. The definition of good framework is the one which is appropriate to indicate the several types of bugs depend on the three components:

I) The ability to develop models of the target application accurately termed as Target of Evaluation (TOE).

II) The ability to cover the behaviors of target application in a broad variety with the generated set of test patterns.

III) The ability to cover a wide range of vulnerabilities and flaws with the generated test cases.

However, the proposed framework is composed of three primary sections such as Target Application profile, modeling of data and algorithm testing which merges the strengths of both testing techniques in quite different way.

a) Target Application Profile

Before the fuzz testing is used or organized, the dynamic behavior of the target application that is termed as target of Evaluation (TOE) should be recognized and studied also involved the internal behavior of entities and the interaction behavior between them. The modeling for which UML state machine model is established that is based on the analysis of specifications either static or manual. Then applying selected graph traversal algorithm to the finite state model which generates a set of test patterns that represent the abstract behavior of the target of evaluation (TOE).

b) Modeling of Data

This phase enhances the code coverage, grammar-based data descriptors are followed to create the well-formed input vectors, which usually comes from the application-specific knowledge. The smart test vectors can pass the parameters error check near the code interface, and go inside the program. The XML descriptors are best suited to describe the structure of the input vector.

c) Test Algorithms

In this phase numerous generic based algorithms can be developed for different levels of vulnerabilities such as security flaws, buffer-overflows, coding bugs, integer-overflow type bugs and null-pointer type bugs etc. A set of executable test cases that usually large in size is created by the test schema which merged with the test vector and testing algorithmic modification. Furthermore, for fully automated testing, few other factors need to be considered, such as

observation of the responses given for manipulated inputs and verify whether the target of evaluation took some unexpected action etc. The figure illustrates the working of the framework.

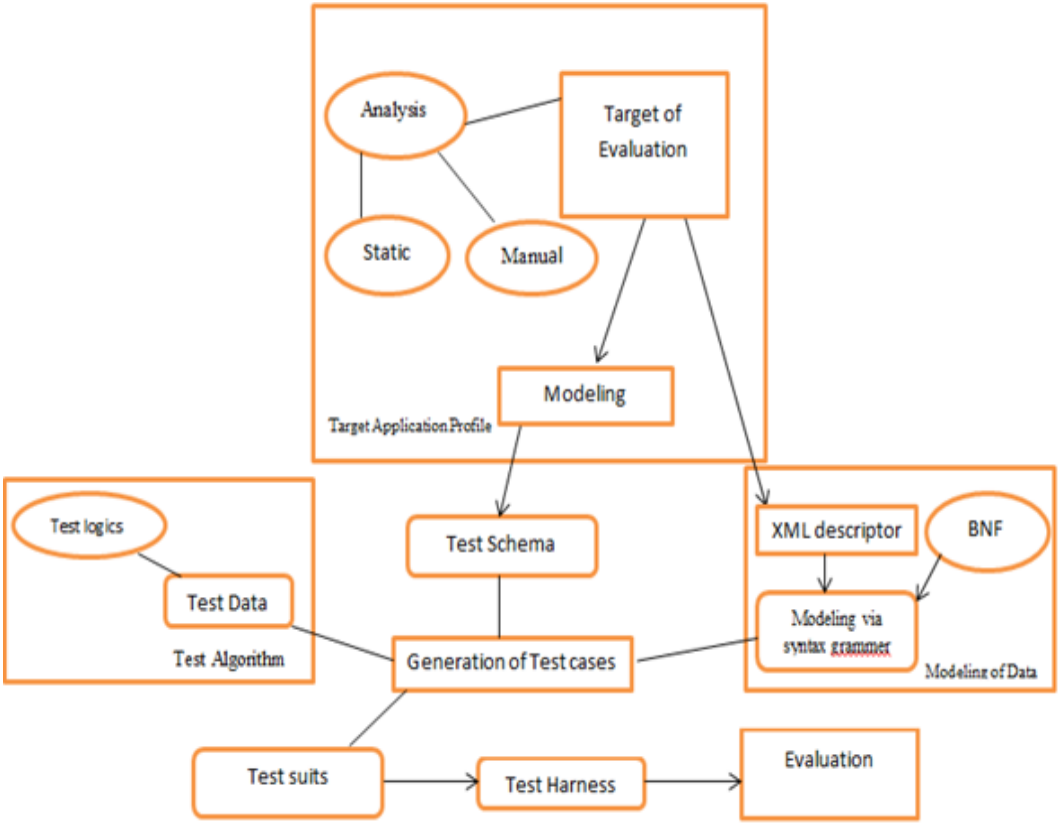

Figure 5: XMBFT FRAMEWORK

IV. CONCLUSION

The world of todays is totally based on internet, where tasks and operations are performed with in couple of minutes via remote access such as internet banking, seat reservation, or even online trading and shopping can be done via internet. The platform which is used for such activities are actually web based application which provide services to end users via remote devices by entering their secret credentials to login. The web application are actually a mixture of multiple programming languages such as JavaScript, AJAX and PHP which combine together to execute users operations. So, by keeping such concepts in mind, we must agree upon the fact that web applications should have a complex and tight security mechanism for securing users secrete credentials. But unfortunately the fact is against this concept, as security of websites are not still up to that mark

where users feels that its credentials are saved on a secure place. The reasons behind these issues is that we still don't give value to testing and consider it as a last phase of development life cycle and follow the traditional and manual ways to test the application by neglecting the fact that how precious would be to test the applications at that time before they launched online for performing operations. The researchers and experts try to overcome these security issues by introducing advance techniques which executes automatically in order to test the application with in little time and cost, the examples of such techniques are model based testing, fuzz testing etc.

Model based testing is best considering to be a craftsman art where we have to focus on three import aspects such as understanding the target application, ability to establish accurate and precise models from raw information and ability to use the tools. This technique is good for discovering potential conflicts that causes the application to crash as this technique is automated that submits tests as input and executed it for specific period of time. Where, Synopsys report defines the fuzz testing as a valuable technology that used to uncover flaws and vulnerabilities in application by bombarding series of malformed inputs to a target application and then observe the spotted areas of the application for results. If the target application performs unexpected actions then examination of that failure is required, that examination uncover the root causes of that failure that may exploited for illegal purposes. Fuzzing plays a role of verification agent during implementation and deployment phases where undetected flaws may distress the integrity of the application. These techniques are approaches in analytical way in order to discover their strengths and weakness during web applications testing. After analysis the results concludes that model based testing is good in context of generating quality of test cases, requirement traceability then fuzz testing, but cost and effort required during fuzz testing is lesser as compared to model based testing, as model based testing requires a lot of time at initial level in order to analysis the raw information and to create application models while in fuzz we just need to develop data sets for application and then bombard them towards application. However it is true that model based testing is better in discovering vulnerabilities as compare to fuzz technique. But model based approach may halt where application structure is either too complex or there is no raw information in the form of requirements related to that application, then here fuzz testing comes and generate effective results to some extent. But we have to admired that, model based testing can cover large variety of scenarios with moderately little effort and random execution of models can expose those issues which are not easy to discover upfront such as design and specification issues. Where, the fuzz technique is good at discovering

coding issues more accurately then other. But model based testing have some limitations too such as, if we need to test the application of large size then we need large set of random test cases of model based testing which requires a great deal of time and infrastructure. So we proposed a conceptual framework on the basis of their strengths which need further development and then require implementation in order to verify its outcome.

REFERENCES

[1] S. Ali, and H. Hemmati, "Model-based Testing of Video Conferencing Systems: Challenges, Lessons learnt, and Results," IEEE 7th International Conference on Software Testing, Verification and Validation (ICST), pp. 353–362, 2014.
[2] D. Amalfitano, N. Amatucci, A. R. Fasolino, U. Gentile, and G. Mele, "Improving Code Coverage in Android Apps Testing By Exploiting Patterns and Automatic Test Case Generation," International Workshop on Long-term Industrial Collaboration on Software Engineering, pp. 29-34. Vasteras, Sweden: ACM, 2014.
[3] I. Andrianto, I. Liem, and A. Y. D. Wardhana, "Web Application Fuzz Testing," International Conference on Data and Software Engineering (ICoDSE), pp. 978-984, 2017.
[4] M. Al-Refai, W. Cazzola, and G. Sudipto, "A Fuzzy Logic Based Approach for Model-based Regression Test Selection," International Conference on Model Driven Engineering Languages and Systems, pp. 55-62, 2017.
[5] W. Chunlei, L. Liu, and L. Qiang, "Automatic fuzz testing of web service vulnerability," International Conference on Information and Communications Technologies (ICT 2014), pp. 25-35, 2014.
[6] M. Felderer, P. Zech, R. Breu, M. Buchler, and A. Pretschner, "Model-based Security Testing: A Taxonomy and Systematic Classification," Software Testing, Verification and Reliability, pp. 530-560, 2015.
[7] C. F. Guilherme, A. T. Endo, "Evaluating the Model-Based Testing Approach in the Context of Mobile Applications," Electronic Notes in Theoretical Computer Science, pp. 3-21, 2015.
[8] A. M. Jamil, M. Arif, N. S. A. Abubakar, and A. Ahmad, "Software Testing Techniques: A Literature Review," 6th International Conference on Information and Communication Technology for The Muslim World (ICT4M), pp. 177-182, 2015.
[9] A. S. Kalaji, R. M. Hierons, and S. Stephen, "Generating Feasible Transition Paths for Testing from an Extended Finite State Machine (EFSM)," Software Testing Verification and Validation, pp. 230-239, 2009.
[10] C. Li, Q. Wei, and Q. Wang, "RankFuzz: Fuzz Testing Based on Comprehensive Evaluation," Fourth International Conference on Multimedia Information Networking and Security, pp. 939–942, 2012.
[11] L. Li, Q. Dong, D. Liu, and L. Zhu, "The Application of Fuzzing in Web Software Security Vulnerabilities Test," International Conference on Information Technology and Applications, pp. 130–133, 2013.
[12] A. Morozov, K. Ding, T. Chen, and K. Janschek, "Test Suite Prioritization for Efficient Regression Testing of Model-based Automotive Software," International Conference on Software Analysis, Testing and Evolution, pp. 20-29, 2017.
[13] C. Ma, and J. Provost, "A Model-Based Testing Framework with Reduced Set of Test Cases For Programmable Controllers," 13th IEEE Conference on Automation Science and Engineering (CASE), pp. 944-949, 2017.
[14] M. Mussa, S. Ouchani, W. A. Sammane, and A. Hamou-Lhadj, "A Survey of Model-Driven Testing Techniques," International Conference on Quality Software, pp. 167-172, 2007.
[15] T. Mouelhi, F. Fleurey, B. Baudry, and Y. L. Traon, "A Model-Based Framework for Security Policy Specification, Deployment and Testing Models," Lecture Notes in Computer Science, 537-552, 2008.
[16] H. Nikolas, "Efficient Fuzz Testing Leveraging Input, Code, and Execution," 39th IEEE International Conference on Software Engineering Companion, pp. 417-420, 2017.
[17] E. J. Rapos, and J. Dingel, "Using Fuzzy Logic and Symbolic Execution to Prioritize UML-RT Test Cases," 8th International Conference on Software Testing, Verification and Validation (ICST), pp. 52-62, 2015.
[18] N. Rafique, N. Rashid, S. Awan, and Z. Nayyar, "Model Based Testing in Web Applications," International Journal of Scientific Engineering and Research (IJSER), pp. 56–60, 2014.
[19] S. Roohullah Jan, S. T. Shah, Z. Johar, Y. Shah, and F. Khan, " An Innovative Approach to Investigate Various Software Testing Techniques and Strategies," International Journal of Scientific Research in Science, Engineering and Technology (IJSRSET), pp. 682-689, 2016.
[20] M. Utting, P. Alexendar, and B. Legeard, "A Taxonomy of Model-based Testing Approaches," Software Testing, Verification and Reliability, pp. 297-312, 2012.