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Perceived Usefulness of Big-Data for Store Layout: Evidence for Organized Retailers of Karachi

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Abstract

Big-Data is one of the most useful technologies available nowadays to understand behaviors and patterns. However, in addition to its societal benefits technology might also be used by practitioners in industrial settings. The Retail industry is also treated as the one which might receive major benefits from the use of Big-Data and therefore this study is purposively associated with implications of Big-Data for the retail sector. The Study uses store layout as the dependent variable as it has the most influence on purchase as the real purpose of Big-Data is to analyze behavior and patterns, therefore, the selection of variable is legitimate. However, the technology is not well-known in emerging markets like Pakistan therefore study is linked with quota sampling and uses SMART-PLS to analyze results. Results indicated that Big-Data was perceived as the potent tool for operations of the organized retail sector of Karachi.

Keywords: Big-Data, Store Layout, Organized Retail Sector & Perceived Usefulness

1   Introduction

The dawn of the 21st century resulted in exponential growth in the volume of digital data (Hajirahimova & Aliyeva, 2015). Studies indicated a 40% increase in the size of digital data every year (Hajirahimova & Aliyeva, 2015) while the reason for exponential growth is continuous use of web, social networking, credit cards and mobile devices etc (Hajirahimova & Aliyeva, 2015). Similarly, data generated from other form of devices like scanners, cameras and GPS transceiver s also getting more accessible (Aktas & Meng, 2017). Thus, abundance of information has been generated (Hajirahimova & Aliyeva, 2015), one of the studies in IBM (2016) indicated that 90% of overall digital data has been generated in the past two years.

Overall size of digital data till 2016 was 1.8 ZB (Cisco, 2018) & by 2020 size of digital data will touch 44 zeta-byte (Hajirahimova & Aliyeva, 2015). However, all of these activities require use of internet though this is also resulting in the increase of unstructured data which makes data beyond the control limits of databases. Big-Data is defined on the bases of volume, variety, velocity, and veracity (Aktas & Meng, 2017) and in field of marketing it has been used of device marketing mix elements (Cao & Manrai, 2020).

This technology has been used to take competitive advantage through development of insight so to gain competitive advantage. Moreover, benefits of Big-Data are not limited to marketing only as Wal-Mart, Google and Amzon etc are some examples of industrial leaders who gain edge through Big-Data (Cao & Manrai, 2020). However, research is still going on to analyze and

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synthesize insights from Big-Data (Aktas & Meng, 2017) as several associated with daily life are still the same (Dekimpe, 2020).

2   Problem Statement

Aktas and Meng (2017) indicated that research is still going on to analyze benefits that organizations and policy makers might achieve through using Big-Data. However emerging markets now became center of gravity for data generation as the percentage of data generation is much higher as compared to the matured markets (IDC., 2014). On the other hand, Dekimpe (2020) highlighted retailing as one of the most promising industry for applying Big-Data analytics as technology. Similar has been indicated by one of the prior studies McKinsey (2011) cited by Dekimpe (2020), that Big-Data may increase operating margin for retailers up to 60%.

However, Pakistan is still leap frogging in adopting the technology and NADRA is the only entity across the country with an advanced mechanism of Big-Data (Ashraf, 2013). Analysis made upon large data sets might result in the formulation of the best decision across leading directions (Hajirahimova & Aliyeva, 2015).

Though in Pakistan ignorance is not only because of lack of knowledge and technology (Gallop Pakistan, 2018) but the difference of culture is also preventing the use and implications (Latif, Tunio, Pathan, Jianqiu, Ximei & Sadozai, 2018). This ignorance even became severe when Big-Data acts as game changer for retail sector (Dekimpe, 2020 & McKinsey, 2011) which is critical for Pakistan's economy and yields 17% of GDP (Ahmed, Ullah & Paracha, 2012).

Moreover, the sector also contains several small and medium organizations which makes sector essentially important for several families (Dekimpe, 2020). On the other side studies of the west e.g. Grewal, Roggeveen and Nordfalt (2017) explained how Big-Data along with other technologies causes an increase in the retail business. Though there are almost no studies of Big-Data and its implications and use Pakistan. Therefore, a study is required to explore the potential advantages of Big-Data technology for retail sector of Pakistan. Especially when more and more retailers are adopting the hybrid model for sales (Dekimpe, 2020) & store layout has more impact on purchasing decision as compared to other two challenging processes of retail operation (Aktas & Meng, 2017). Thus, this study uses Big-Data analytics on store layout which is included in top three challenging processes of retail operation along with assortment and pricing.

3   Theoretical Framework and Delimitations

An organized form of retail operating in urban areas must adhere to the principles established for urban retail designs (Juel-Jacobson, 2015). This is potent as store layout produce a significant impact on shopping atmosphere and shopping behavior & increases the probability of having a positive response from customers. (Lewison, 1994). However, the use of outdated store layouts is also opted by some of the well-known brands of the recent era (Juel-Jacobson, 2015). Another important variable associated with effective store layout design is product assortment as indicated by Francher (1991). This arrangement will not only optimize the level of customer satisfaction and also produces a positive result on product sales.

Hence it is clarified that store layout is a combination of Aisle Design and Shelf Design and these two variables will also create an impact on retail sales. Therefore, study will link effect of Big-Data as indicated by Dekimpe (2020) and Grewal Roggeveen and Nordfalt (2017) on Aisle design and shelf design. Availability of skilled data scientist has also been used as moderator as Glass & Callahan (2014) indicated that effective analysis of data especially in marketing function requires a technical mix of creativity and analytical skills. Last but not least study will also check the impact of Aisle Design and Shelf Design on sales of retail as indicated by Dekimpe (2020) and Francher (1991).

Open Research Questions

Q1:   How Big-Data might benefit organized retail sector?
Q2:   How unavailability of Skilled Data Scientist affects application of Big-Data?
Q3:   How Big-Data is influencing consumer purchase at organized retail sector of Karachi?
Q4:   How effective layout design at organized retail influence sales

4   Scope & Significance

The study is particularly beneficial for the retail sector and therefore managers and practitioners associated with the sector might use the study to understand the impact of Big-Data on organized retail. Thus, they may device better mechanisms to collect data and gauge results. Moreover, the study is also beneficial for further studies and policy formulation as studies conducted on the implications of Big-data are far and few in between especially in emerging economies and Pakistan. Thus, this study must be treated as the base of conducting further research work and to make researchers and practitioners understand the pattern research of Big-Data.

5   Literature Review

Assortment, Product Design, Procurement, Marketing, & Supportive Functions which are required to perform necessary functions like logistic planning are included in the list of major function of retailing (Aktas & Meng, 2017).

Rautaray Pandey Chakraborty and Barua (2017) indicated that use of Big-Data is significant in optimizing customer's experience as well as company's decision so to aid sales. It provides an accurate analysis of customer's retail needs through gauging consumer behavior effectively (Rautaray et al., 2017). Therefore, it is optimal to indicate Big-Data analytics opens a new door of opportunities for retailers thus makes them enable to create value and making retailers perform micro targeting (Dekimpe, 2020).

Previously retailers tend to distribute products passively although through having appropriate information about the end customers; retailers became more proactive in their approach (Aktas & Meng, 2017). Study of also Dekimpe (2020) also indicated that implications of Big-Data also foster opportunities throughout the value chain. Although there are three challenging processes associated with retail business i.e. assortment, pricing and store layout. Among these three assortments and pricing require massive mental exercise as they might be influenced by

demand elasticity, customer preferences and store location etc. Therefore, effective quantitative analysis is required to predict the impact of Big-Data on these two processes. However, store layout is also a worthwhile variable to be explored in terms of effect of Big-Data as the process can influence consumer buying behavior (Aktas & Meng, 2017).

A   *Effect of Big-Data on Store Layout*

Store Layout has a significant impact on sales especially in the retail sector. It has also been indicated that layout might increase sales volume on the basis of per square foot of available space (Liao & Tsai, 2019). Store Layout has found to have significant impact on consumer purchase decisions therefore it's is potent enough to be explored in terms of its relationship with Big-Data (Aktas & Meng, 2017). Store Layout is usually used to indicate the size and location of different departments, structures, fixtures, any permanent structures and patterns used to highlight customer traffic (Liao & Tsai, 2019).

During past sampled customers were treated as the base of decision regarding the in-store behavior which is used to optimize store design and shelf layout (Aktas & Meng, 2017). Though task needs thorough efforts as keen observation of videos, mobile services, WI-FI, and RFID tags were used to track customer's in-store location. Moreover in-store location of customer is not a true predictor of consumer behavior however able to predict the correlation of in-store movement with sales (Aktas & Meng, 2017). However, the sales of retail outlet can further be strengthened by effective management of shelf space and optimization of space of movement i.e. Aisle Design (Dreze, Hoch & Purk, 1995)

B   *Aisle Design*

Effective designing of personal spaces in retail tends to influence retail experience as well as choice of purchase (Bittner 2002 & Turley & Miliman, 2000). These postulates are supported by Levay and Zhu (2009) availability of space inside store influences the decision of purchase. However, in most of the retail stores straight floor plan is used as best way to optimize customer's satisfaction and sales. The plan is also treated as most economical plan for optimizing store layout. However, hybrid of straight, diagonal and angular floor plans i.e. mixed floor plans has been proposed by GoHikings. The plan is the best possible solution for retail stores that prefers self-service and foster smooth flow of traffic and also provides excellent visibility (Liao & Tsai, 2019).

C   *Unavailability of Skilled Data Scientist*

A study of Iqbal Kazmi Manzoor Soomrani Butt and Shaikh (2018) indicated that the prime reason for shortage of in-house data management specialists is linked with an uncertain return on investment from big-data analytics. However, lacking of qualified data scientists and high cost of staffing are also included in the list of potent reasons for shortage of in-house data management specialists. Although data scientists must also have an adequate inventory of skills in order to deal effectively with the extraction of knowledge (Dolezel & McLeod, 2019).

Large firms manage that through allocating work to different people having expertise in different areas in order to cope up with the shortfall . Though small and medium sized enterprises (SME) face a lot of difficulties in managing the same as they need cross sectional experts who may deal with issues of IT as well as from the domain of business (Iqbal et al., 2018). Databases now can store in-store movement of customers through connecting their in-store movement during purchase. Therefore, there is a continuous flow of information to retailers which aids in making real-time decisions like inventory, re-socking and orders become easy. Thus, aids in making solution which is directly associated with point of sale systems as data have been generated through combination of sources and aids in understanding patterns of customer movement (Bradlow, Gangwar, Kopalle & Voleti, 2017).

D   Shelf Design:

Shelf (Placement) Design is actually the allocation of products in a way that the placement will aid in increase of sales and profitability. Thus, location of product has the motive to fix the space allocation and also has a potent role in resolving issue of customer engagement in retail stores (Rautaray et al., 2017). Shelf Spacing Problem was addressed in 1960 however after 2000 there was a significant growth in number of publications that are coherent with the issues of shelf planning (Bianchi-Aguiar, Hubner, Carravilla & Oliveira, 2020). However, shelf design remains one of the active fields of research in the retailing though available set of knowledge does not seem to be aligned with practices (Bianchi-Aguiar, Silva, Guuimaraes, Carravilla, Oliveira, Amaral & Lapela, 2016).

Studies like Soliman Janz Prater Frazier and Reyes (2005) also highlighted that the problem of shelf design has been more dominating for grocery stores the issues of shelf management are more potent than other forms of retailing. In fact, effective management of shelf space only improves level of customer satisfaction but also optimizes the return on investment made on inventory by reducing the out of stock occurrences (Yang, 2001).

Study also posited that price of product must be determined after gauging its shelf life as it will provide a good idea regarding the extent of discount that might be given (Rautaray et al., 2017). On the other side immense growth rate in publications associated with shelf design has been observed from 2010 and up till now more than 70 articles have been published in reputed journals. However, still there is no work that is specifically focused on space planning and models of purchase also vary shelf design (Bianchi-Aguiar et al., 2020). Therefore, significance need to devise literature as well as mechanism for better shelf design as it fosters sales as well as profitability of retail sector (Rautaray et al., 2017)

6   Research Methodology

Research Methodology is the generic logic linked with epistemology and ontological assumptions (Long, 2014), thus aids in conducting research (Sileyew, 2019). Use of methodology also aids in defining best way to reach conclusions through results (Long, 2014). Moreover, Methodology is the hybrid of parameters researchers undertake to show relevance among all the potent aspects of the study (Brannick & Roche, 1997). Therefore, the section has been divided into

two sections i.e. Research Design and Sampling Design in order to relate it with the indications of well-known authors of the field like Saunders Lewis Thornhill and Wilson (2009) etc.

A   Research Design

Research Design outlines the study from assumptions made by researcher till the findings and analysis thus treated as the strategy or structure which aids in finding answers to research questions (Kothari, 2004). However, there is a requirement of philosophical stance to predict most effective method for data collection (Zukauskas & Vveinhardt & Andriukaiteiene, 2018). Hence realism has been incorporated as the philosophical stance as it has the ability to be associated with qualitative as well as quantitative research (Saunders Lewis & Thornhill, 2012). Research strategy is survey (Saunders et al., 2015) and studies done on this domain like Aktas and Meng (2017) and method of data analysis is mono-method (Saunders et al., 2015). The purpose of the research is correlational (Sekaran & Bougie, 2016) & time horizon is cross-sectional; Saunders et al., 2015 & Sekaran & Bougie, 2016).

B   Sampling Design

Sampling is not only done in order to decrease cost associated with the process of research (Leedy & Ormrod, 2005) and thus one may realize the need to include specific units in the study rather than entire population (Mugenda, 2003). However, data must be coherent with the research questions and targeted survey is one of the best and most suitable option to collect data (Moorman. 2016). Though, due to in-house analytical department retail giants do not feel any potent need to share data with academia. In fact, for some of the discipline it has been already mentioned that academic practitioners must not try to intervene in research which might be done more effectively by the pragmatic world (Dekimpe, 2020).

Thus, this study uses primary data for analysis through taking the reference of Aktas and Meng (2017) who conducted data through interviews from the expert of the industry. The sampling design is also effective as in Pakistan most of the retailers are dealing in FMCG (IBM, 2018) and store design is more potent for retailers dealing in grocery items (Soliman et al., 2005). Hence through linking all of these points study uses the quantitative approach to conduct research as used by Le and Liaw (2017) and Seetharaman Niranjan Tandon and Saravanan (2016). The method of sampling used is quota sampling which is treated as best option to deal with slow response rate and higher cost of sampling (Yang & Banamah, 2014).

Thus, this study includes those IT experts which are working in senior positions in organized retail sector of Karachi and know the use and application of Big-Data. However, previously there was almost no prior study which is from eastern and developing side of the world and use quantitative measures for analysis. Therefore, in association with Pathirage, Amaratunga and Haigh's (2008) study is linked with theory building therefore the sample is of fifty (50) respondents.

C   Questionnaire

This study uses closed ended adapted questionnaire based on the elements indicated by Le and Liaw (2017) and Seetharaman Niranjan Tandon and Saravanan (2016).

However, to device questionnaire on store layout, indication made by Aktas and Meng (2017) and Valchanov (2017) were also incorporated in the instrument. Study also has a mediator i.e. skills and abilities of data scientists, therefore, the instrument also includes parameters by De Mauro Greco Grimaldi and Nobili (2016) and Glass & Callahan (2014).

D   Software

Grewal et al. (2017), indicated way through which Big-Data might foster the business of the retail sector. The sector is also significantly important for Pakistan due to 17% contribution to country's GDP (Ahmed et al., 2012) though it's been massive ignorance towards the technology in Pakistan due to lack of knowledge and difference of culture as compared to the western world (Gallop Pakistan, 2018). Thus, this study must be treated as theory building approach hence SMART-PLS is incorporated due to its ability to deal with similar sorts of conditions (Sinkovis, Richter, Ringle & Schlaege, 2016). Software is also treated as one of the better options for statistical trusting in recent times, especially for the studies linked with management sciences (Benitez, Henseler, Castillo & Schuberth, 2020).

7   Statistical Testing And Analysis

SMART-PLS incorporate two types of models for the purpose of statistical testing one is known as confirmatory (inner) model and the other one is known as (outer) measurement model and Benitez et al. (2020). For this study the measurement model is of reflective nature and thus it must be supplemented with indication of Afthanorhan (2014). On the other side Benitez et al. (2020) suggested that store layout is included in the list of top three challenges for the retail sector

A   *Outer Loadings*

Table 1: Outer Loading

	Aisle Design	Big Data	Moderating Effect 1 SDS	Moderating Effect 2 SDS	Sales	Shelf Design	Skilled Data Scientist
AD1	0.809						
AD2	0.768						
AD3	0.704						
AD4	0.757						
AD5	0.719						
BD1		0.762					
BD2		0.767					
BD3		0.710					
BD4		0.649					
BD5		0.791					
Big Data * SDS				1.119			
Big Data * SDS			1.119				
S1					0.776		
S2					0.801		
S3					0.811		
S5					0.678		
SD1						0.743	
SD2						0.764	
SD3						0.775	
SD5						0.682	
SD6						0.756	
SD7						0.771	
SDS1							0.714
SDS2							0.820
SDS3							0.768
SDS5							0.807

Hair Sarstedt Ringle and Mena (2012) indicated that each element associated with variable must predict at least 0.5 of the variance & the least acceptable value for outer loading of each element is 0.708. However, 0.60 is the least value for outer loading for any element and elements having outer loading between 0.6 and 0.7 might be included in the model (Afthanorhan, 2014) though the inclusion became more effective with the values getting closer to 1 (Khan, Sarstedt, Shiau, Hair, Ringle & Fritze, 2019).

In this study the least value of outer loading for any element is 0.649 and it is for only three elements for different variables therefore legitimate to include these elements in confirmatory (inner) model.

B   R Square

Table 2: Predictive Accuracy

	R Square	R Square Adjusted
Aisle Design	0.720	0.664
Sales	0.936	0.935
Shelf Design	0.591	0.554

Table 2 is indicating predictive accuracy which is the measure of variation in dependent variable through change in independent variable. Benitez, Henseler, Castillo and Schuberth (2020) also indicated the same that purpose of R-Square is to reflect the predictive accuracy of dependent variable through ordinary least square. However, the method for the analysis is same as of regression (Andreev, Heart, Moaz & Pliskin ,2009) and 0.26 is the least acceptable value for reflective predictive accuracy (Cheah, Memon, Chuah, Ting & Ramayah, 2018). On the other side Henseler, Ringle and Sinkovics (2009) and Hair Ringle and Sarstedt, (2013) indicated 0.5 and 0.75 as the moderate and substantial fit. In this study the value of R2 for 0.720 for Aisle Design., 0.591 for Shelf Design and 0.936 for Sales. Therefore, it is indicated that for two-stage model the values of all the variables are either moderate fit of substantial fit.

C   Construct Reliability and Validity

Table 3: Construct Reliability and Convergent Validity

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Aisle Design	0.808	0.812	0.867	0.566
Big Data	0.740	0.755	0.826	0.581
Moderating Effect 1 SDS	1.000	1.000	1.000	1.000
Moderating Effect 2 SDS	1.000	1.000	1.000	1.000
Sales	0.767	0.771	0.852	0.590
Shelf Design	0.789	0.805	0.849	0.570
Skilled Data Scientist	0.735	0.764	0.820	0.535

Table 3 is highlighting construct reliability and convergent validity. For construct reliability it has two reliability measures i.e. Cronbach's Alpha (α) and Goldstein's rho and for Convergent Validity it has Composite reliability and AVE. The combination of Composite Reliability and AVE has also been termed as Convergent Validity by (Sijtsma, 2009).
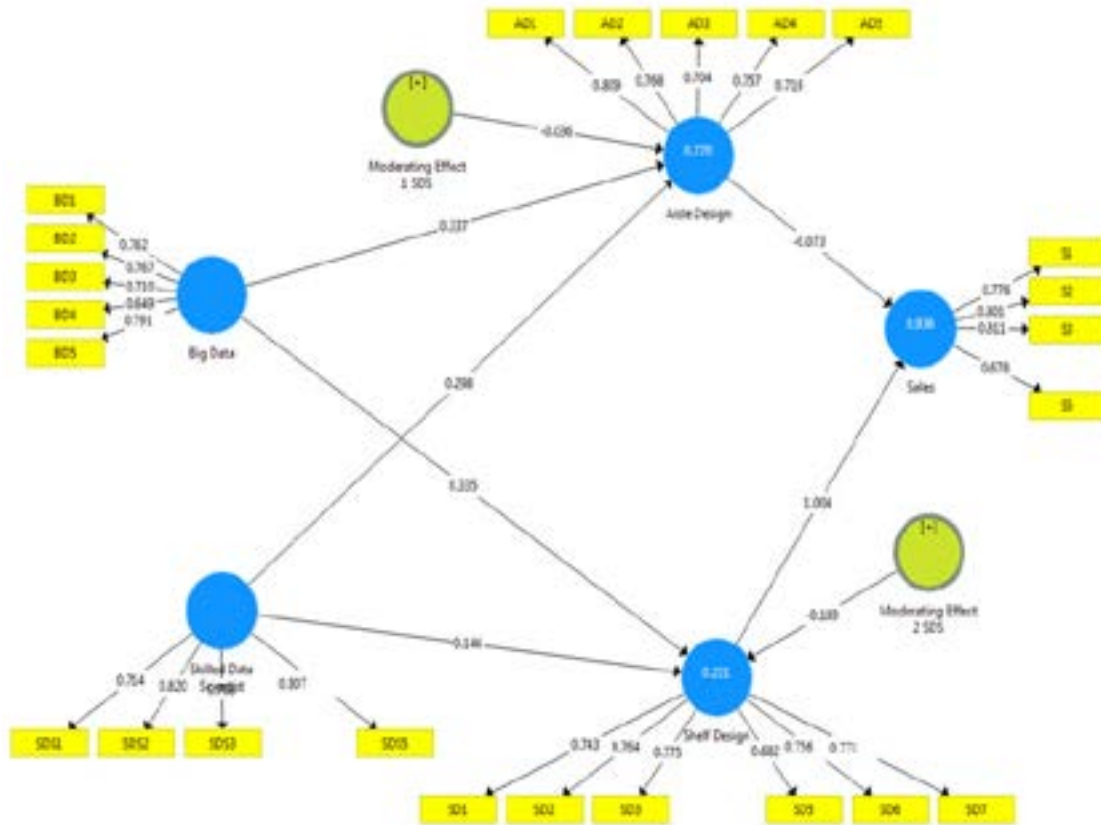
Figure 1: CFA & Outer Loadings

D   *Heterotrait-Monotrait Ratio (HTMT)*

Table 4: Discriminant Validity via Heterograft Monorail Ratio (HTMT)

	Aisle Design	Big Data	Moderating Effect 1 SDS	Moderating Effect 2 SDS	Sales Design	Shelf Data Scientist	Skilled
Aisle Design							
Big Data	0.531						
Moderating Effect 1 SDS	0.084	0.081					
Moderating Effect 2 SDS	0.084	0.067	0.482				
Sales	0.583	0.433	0.258	0.258			
Shelf Design	0.686	0.514	0.265	0.265	0.583		
Skilled Data Scientist	0.462	0.384	0.184	0.184	0.234	0.345	

Table 4 is highlighting discriminant validity through indicating Heterotrait-Monotrait Ratio (HTMT). The purpose of this measure is to highlight the difference in variables of the same construct via values of correlation (Cheung & Lee, 2010). The maximum value of correlation which might justify HTMT ratio is 0.85 and any value greater than 0.085 is out of the context of discriminant validity as far as HTMT ratio is concerned. (Hair Jr, Sarstedt Ringle and Gudergan, 2017)

E   Mean, STDEV, T-Values, P-Values

Table 5: Path Coefficient and Total Effect

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
Aisle Design -> Sales	-0.073	-0.072	0.017	4.290	0.000
Big Data -> Aisle Design	0.337	0.343	0.049	6.940	0.000
Big Data -> Shelf Design	0.335	0.341	0.051	6.557	0.000
Moderating Effect 1 SDS -> Aisle Design	-0.036	-0.036	0.063	0.567	0.571
Moderating Effect 2 SDS -> Shelf Design	-0.189	-0.192	0.055	3.437	0.001
Shelf Design -> Sales	1.004	1.004	0.050	20.08	0.000
Skilled Data Scientist -> Aisle Design	0.298	0.305	0.050	5.904	0.000
Skilled Data Scientist -> Shelf Design	0.146	0.146	0.052	2.807	0.005

Table 5 in association with figure 2 is used to indicate the impact of independent variable (Big-Data) on dependent variables (Aisle Design and Shelf Design for 1st Sage) & Sales of retail (for 2nd stage).

The impact is highlighted through inferential statistics which is one of the prime components of reflective models used through SMART-PLS (Hair, Risher, Sarstedt & Ringle, 2019). However, table 5 is reflecting inferential statistics through using t-values (Duarte & Amaro, 2018) & p-values (Kock & Hadaya, 2018) which mean both of these measures must be found effective to ensure the effect of independent variable (Big-Data). Hair Ringle and Sarstedt (2011) indicated that minimum t-value required to highlight effect is 1.97 and maximum value of p which may satisfy the condition is 0.05 (Kock & Hadaya, 2018). Hence in the light of above-mentioned references it has been legitimate to believe that all variables including moderation of skilled data scientists do have a significant impact except the moderation of skilled data scientists with big-data on aisle design.
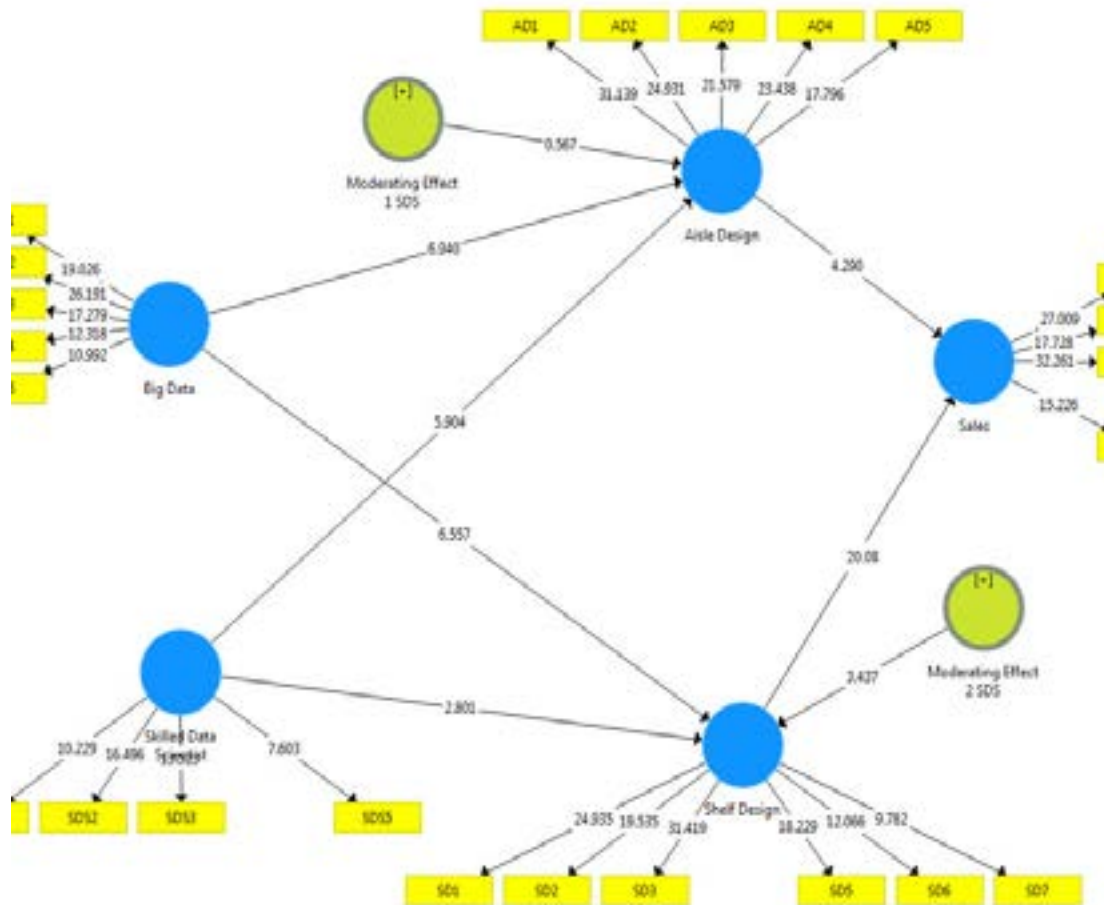
Figure 2: Path Coefficient

8   Conclusion and Discussion

On the basis of detailed statistical testing, it has been obvious that use Big-Data is perceived as fruitful for the optimization of store layout by IT specialists of organized retail sector. Therefore, it is also effective to indicate that findings of the study are coherent with the indications of Aktas and Meng (2017), that store layout has been affected significantly through the use of Big-data. Dekimpe (2020) also indicated that store layout is included in the three top challenging elements for retail as findings of this study looks to be most potent in devising store layout models through Big-Data. These implications seem to be potent enough as digital data is increasing day after another (Hajirahimova & Aliyeva, 2015).

Though unstructured data is making data beyond the control of databases (Aktas & Meng, 2017) and even articles which are focused on shelf design do not seem to be indicating similar models (Bianchi-Aguiar et al., 2020). However, overall sales of outlets might be improved through better designing of shelf and Aisle (Dreze, Hoch & Purk, 1995). Therefore, in the light of these parameters use of Big-Data for the optimization of store layout is one of way to devise

a model which has higher adaptability and also can optimize sales. Similar has been highlighted by Aktas and Meng (2017) that store layout is a worthwhile variable to be explored in terms of its association with Big-Data. On the other side Big-Data is also used to device marketing mix elements (Cao & Manrai, 2014) this in organized retail it is one of the most effective tools of in-store marketing (Avinash * Babu, 2018).

Moreover, it has been used to take a competitive edge not only by giants of online retail e.g. Amazon but also by the giants of organized retail Walmart (Cao & Manrai, 2014). Thus, the linkage developed through this study is potent enough to be related to the sales of retail industry.

9   Area For Future Research

Research is one of the initial studies which tries to explore the effect of Big-Data in the field of marketing and retail sector of Pakistan via quantitative technique. Although study uses the reference of IT experts through using loose quota sampling. However, for optimization of results, further studies might be conducted through having the secondary data regarding the use of Big-Data or large data by organized retail sector on their sales.

Furthermore, study has also been conducted from the retail segment of Karachi and comparative analysis of different cities and provinces through the application of big-data in retail might provide a better way of understanding.

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Poet Attribution for Urdu: Finding Optimal Configuration for Short Text

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Abstract

This study presents a machine learning system to identify the poet of a given poetic piece consisting of 2 lines (i.e. a couplet) or more. The task is more difficult than the general task of author attribution, as the number of words in verses and poems are usually less than the number of articles present in author attribution datasets. We applied classification algorithms with different sets of feature configurations to run several experiments and found that the system performs best when support vector machine using a combination of unigram and bigram are used. The best system (for 5 Urdu poets) has the accuracy of 88.7%.

Keywords: Poet Attribution, Author Attribution, Ngrams, Classification, Urdu.

1   Introduction

A poem is defined as "a piece of writing in which the words are chosen for their sound and the images they suggest, not just for their obvious meanings. The words are arranged in separate lines, usually with a repeated rhythm, and often the lines rhyme at the end"[1]. Poetry is a creative expression of words in which words most of the time do not reflect their true meaning.

Urdu is spoken majorly in Pakistan and India, and also in rest of the world [2]. It is an Indo Aryan language that has strong influence of Persian and Arabic in vocabulary and script. There are different forms of poetry in Urdu e.g. Ghazal, Qasida, Marsiya, and Masnavi etc. [3].

Author attribution is the problem of identifying the author of a given text [4]. It is usually modeled as a multiclass classification task. A model is trained by using the texts (articles or letters etc.) written by the authors, and then a new unseen text is processed by the trained system to give the most appropriate author of the given text.

Poet attribution appears similar to the task of author attribution. However, there are some differences between author identification and poet attribution. The poems are usually shorter than texts (e.g. articles etc.) that are used in training and prediction of the author attribution system. We may have to identify the poet of a couplet (i.e. two lines or sentences) that consists of only 10 to 20 words. Moreover, some words of the poetic lines appear for rhyming requirements, so we are left with a lesser number of words to model the writing style of the poet.

There is very little research present about this topic, so it has never been presented conclusively what should be the feature set for such a system. How much data is required to make a stable system and most importantly in how many lines a poem should be split in the training phase to get good results. In this work, we tried to get answers to all of these questions. To achieve

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this goal, multiple poet attribution systems for Urdu language using different machine learning algorithms are implemented and results are compared. Systems have been trained and tested on different feature sets and different length of poems.

2   Literature Review

The work under the computational linguistics for the poet classification or the author attribution in poetic text showed very thin contributions. Some of these techniques, specially for the languages other than English, are presented in the following:

The techniques broadly catered in most of the these works are the term-based such as a bag-of-words, n-gram; probabilistic approaches such as linear interpolation; and supervised Machine Learning (ML) algorithms such as Support Vector Machines, Naive Bayes, and decision trees such as C4.5 and ID3 (with further enhancement of employing ensemble techniques, for example random forest). The lately mentioned techniques, i.e. supervised ML, are used with different preprocessing steps of term-weighting (for example tf-idf).

Author attribution was employed by using a variational ensemble of PCFGs [5]. The task was to identify multiple text categories, i.e., football, cricket, business, travel, and poetry. The system models the author's writing style. There were two important studies for the Turkish poetry of the Ottoman period [6][7]. They modeled the poetic style by employing supervised ML approaches.

Researchers focused on the investigation of the dependencies of word count and choices of words for building word-vectors e.g. [8]. The Burrow's Delta Method [9] is employed in this study. There are other works [10][11] that used the extension of Burrow's Delta Method.

Another study [12], in the same regard, contributes to find the minimal data requirements for the author attribution. The study involves the text in the Latin script (English, German, Polish, and Hungarian novels). [13] is an important work on authorship attribution for the Arabic poets. The experiments involve the feature extraction based on the prosodic rules and probabilistic approaches.

Bangla language is genetically related to Urdu [3]. A novel technique for the feature extraction for Bangla poetry was employed in [14]. The extracted features were orthographic, phonemic, and synthetic, features which are more than ordinary lexical feature selections. They used these features with supervised ML techniques on the dataset of four distinguished poets of Bangla, namely, Rabindranath Tagore, Jibanananda Das, Kazi Nazrul Islam, and Sukumar Roy.

We find only one contribution related to poet attribution for Urdu [15]. They modeled the poetry of Allama Iqbal in the training phase. While in the testing phase, they used the poetry Mirza Ghalib, and Nasir Kazmi alongwith poetry of Allama Iqbal. They showed results with the bi-gram and tri-gram level matching, and probabilistic linear interpolation.

As mentioned above, most of the systems used supervised machine learning to model Author/ Poet identification. Following are the major techniques that are used to solve the multiclass classification problem.

Support Vector Machine (SVM) is a supervised learning algorithm which trains itself from labeled data and gives an optimal hyperplane which categorizes new examples [16]. The optimal hyperplane is the one which has the maximum margin from the nearest points of all the classes. The points nearest to the hyperplane are Support Vectors. These are the extreme points in the data set and these points are used to find the optimal hyperplane.

Naive Bayes [17] is a probabilistic classification model for supervised learning that works on the Bayes theorem. It works on the probabilities of the features of training examples, assuming that the value of each feature is not dependent on the values of other features which means that all the features have equal effect on the outcome.

LSTM neural network is a special type of Recurrent Neural Network [18]. The special thing about LSTM is it has some contextual state cells which acts for it as long-term and short-term memory. This additional power of keeping contextual history makes neural networks able to make good predictions on sequential data because now it maintains history over the sequence of input. This history adds value to the current input and provides the context for the current prediction. As time passes it becomes very unlikely that current prediction would not depend upon very old input so with time LSTM also learns when to forget and when to remember.

3 Methodology

As briefly mentioned in the introduction (section I), our goal is not only the poet attribution, but we also want to compare different configurations of the pottery identification models and then we want to recommend the best configurations for Urdu poet attribution and other similar tasks.

For this reason, we designed multiple experiments which are explained in III.C. Before describing these experiments, we present the data and its pre-processing.

A Data

Data was scraped form rekhta.org and then poems are extracted using the python package Beautiful Soup [19] which is used for parsing HTML and XML documents. Rekhta is an online resource to get Urdu poetry in Urdu, Hindi and Roman scripts. Data of Urdu poetry in Urdu script was collected for this experiment. Details about the data is given below:

Table 1: Information About Data

Total Count of Poets	1969
Count of poems	32667
Total Lines of Text	525835
Average words per line	1969

For the sake of simplicity, top 5 poets with the greatest number of poems were selected for the experiment. Poets chosen for the experiment and count of their poems in our dataset is mentioned in Table II.

Table 2: Poets and Count of their poems

	Poet Name	No. of Poems
P1	Meer Taqi Meer	433
P2	Mirza Ghalib	426
P3	Nazeer Akbar Abadi	261
P4	Faiz Ahmed Faiz	252
P5	Allama Muhmmad Iqbal	191

B   Preprocessing

The average length of (poetic) line is 8.92 words. In preprocessing, special characters and all the other Urdu non-alphabets were removed from the data. Then data was tokenized using python library NLTK (Natural Language Toolkit) [20].

We did not remove the stop words as the functions words are important in modeling the style of the author. It is different from the topic oriented text classification, in which only content words are used and stop words are removed.

C   Experiment

We executed several sets of experiments to find the best system for poet attribution. We focused on the following, which we termed as learning options.

The first learning option is the classification algorithm. As Naive Bayes (NB) works well for text classification problems, and support vector machine (SVM) works well generally including text classification problems, we chose these two as the classification algorithms. Moreover, we chose a deep learning model, LSTM as a classification algorithm.

The second learning option was number of (poetic) lines used in a training example. We chose the values from 2 to 10 in different experiments to see whether less number of lines e.g. 2 or 4 in each training example can give us results comparable to training by using a larger number of lines in each training example.

Then we have the choice of ngram used . We can use unigram, bigram, trigram or higher ngrams as features. We chose three configurations: (a) only unigram (b) only bigram (c) both unigram and bigram combined.

We also want to know whether we should use all the ngrams as features, or we will use some percentage of high frequency ngrams . As a lot of ngrams, especially bigrams, are created when a large corpus is processed, it is better to choose important ones (and reduce the size of the

featureset), if possible. We used percentage = 10%, 20%,.....,90%,100% for selecting high frequency ngrams.

The size of training examples is also important . We know that larger numbers of training examples give better results in machine learning. However, we want to discover the smallest size of training examples that is sufficient to give fair results. As in many low (annotated) resource datasets, we do not find many training examples, so we can have a rough idea of the smallest number of examples that can give fair or good results. We have maximum number of poems used = 50, 75, 100, ..., 225 or 250 as the different options for the size of training examples.

Every poem creates different number of examples on the basis of number of lines option. If we are creating 2 line examples, then the (upper limit) of training examples will be 4 times the case when we choose to create 8 line examples.

We wanted to run experiments using all of the above mentioned learning options, however all these experiments cannot be created and run manually one by one. On the basis of learning options mentioned above (excluding LSTM), we have to run 2x9x3x9x10=4,680 experiments. We wrote programming code to automate the process of creating, running and storing results of all these experiments.

The SVM and NB algorithms used the bag of word approach, hence we created feature sets out of words, and lost the information about the sequence of the words. In contrast, LSTM works on sequences of word features, hence most of the learning options mentioned above are not relevant to the LSTM. The only relevant learning option is number of lines , and we plan to run the LSTM on 2,3,...10 lines in different experiments.

4   Results and Discussion

As some extensive training was done and there were different systems to compare on the bases of different configurations. The table III gives the configuration of top 4 systems on the basis of accuracy.

Table 3: Top 4 & 10th Poet Attribution systems

Model	ngrams	lines	max poems	% of ngrams	Accuracy
SVM	uni+ bigram	10	100	20,30, 40%	0.8871
SVM	uni+ bigram	9	225	100%	0.8860
SVM	uni+ bigram	6	50	60%	0.8829
SVM u	ni+ bigram	7	125	40,50%	0.8720
.....	.....	.....	.....	.....	.....
NB	uni+ bigram	10	175 3	0-100%	0.8400

It is evident from the above table that all the configurations using SVM and combination of most frequent unigrams and bigrams outperformed the rest of the configurations that used only most frequent uni-grams or most frequent bi-grams. We achieved the highest accuracy

of 88.7% with average accuracy of 81% using SVM and highest accuracy of 84% with average accuracy of 77% using Naïve Bayes classifier.

Further we visualized the relation of average accuracy with maximum number of poems by each poet, number of lines and other learning options. The graphs and discussion are present below.
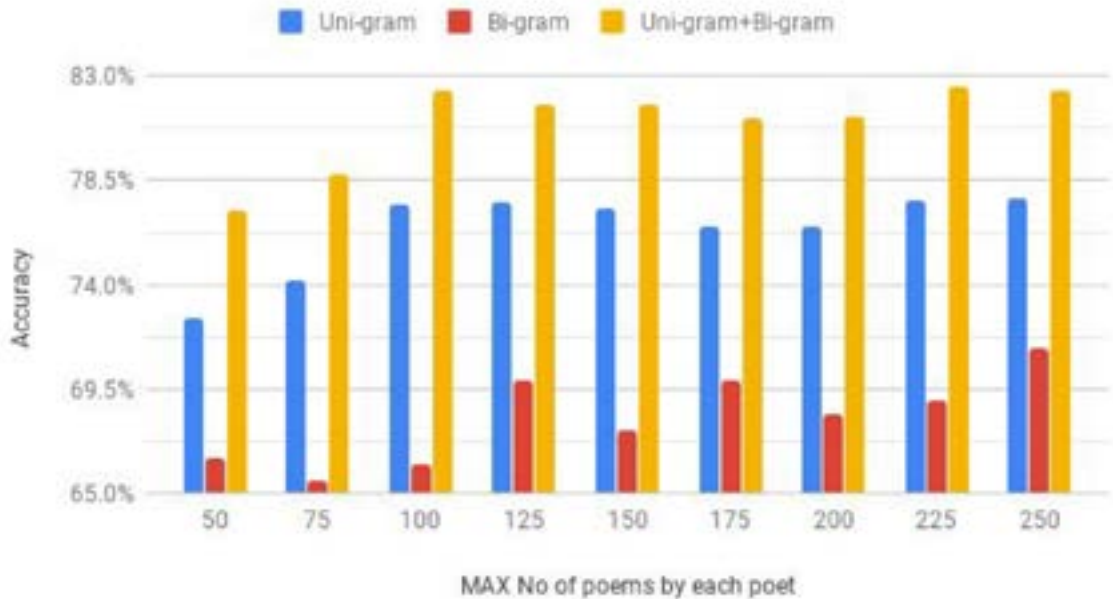

Figure 1: Accuracy for max. number of poems by each poet using SVM
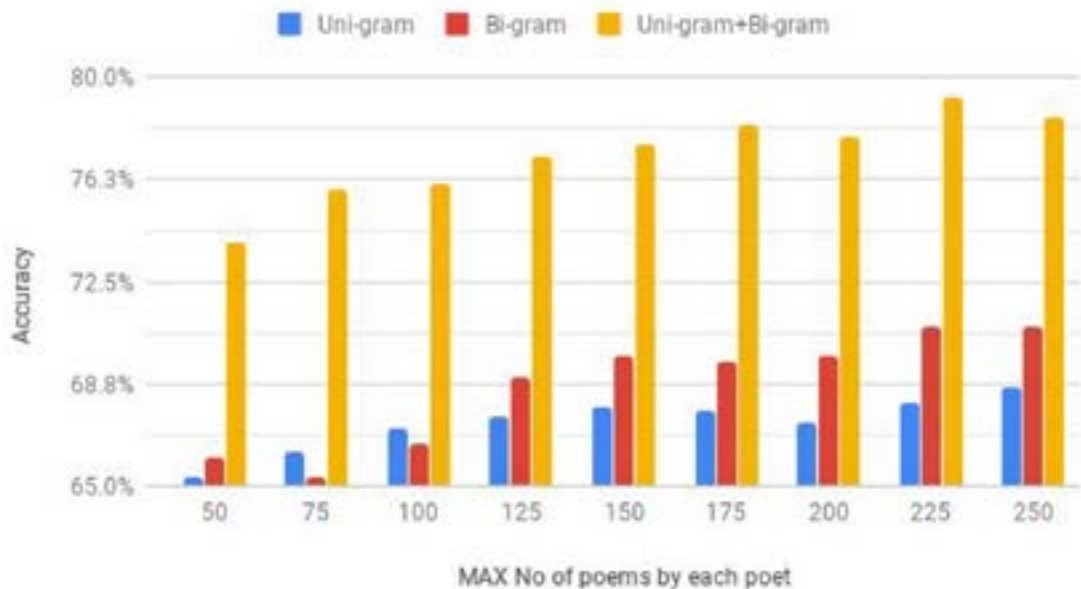

Figure 2: Accuracy for max. number of poems by each poet using NB

The figure 1 and 2 shows the accuracy corresponding to the different (maximum) count of poems per poet used in the experiment. The bar graph shows the accuracy when only ungram, only bigram, or a combination and unigram and bigram are used.

It is clear from these graphs and subsequent graphs that the combination of unigram and bigram outperforms the use of only unigrams or only bigrams. In the unigram+bigram setting, the individual words (As unigram) and multiwords (as bigram) voth can get suitable weight/ probability for the classification task.

Similarly the graphs in figure 1 & 2, and also in figure -3-6 shows that Support Vector Machine (SVM) is a better classifier than Naive Bayes (NB), as former give higher accuracy in almost all the cases.

In most of the cases, the accuracy increases or get uniform with the increase in maximum number of poems used. (The exception is bigram accuracy with SVM.) Hence, we found that using more examples is better. However, accuracy remains almost the same after 100 poems. So 100 poems is also a suitable size for any future work.
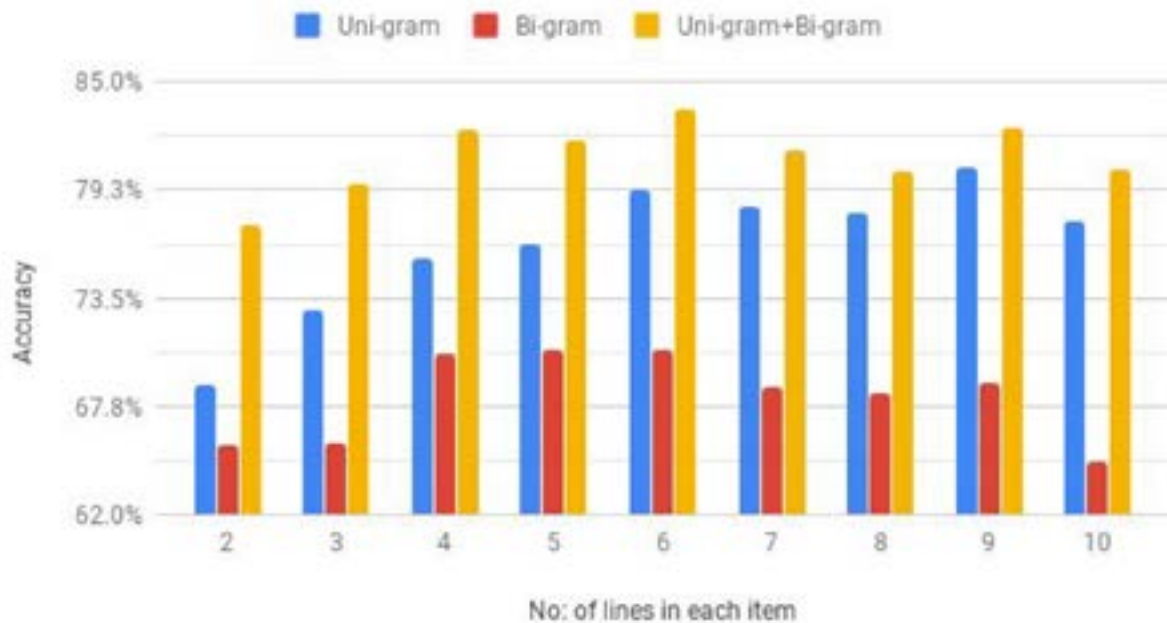
Figure 3: Accuracy for number of lines in each poem using SVM
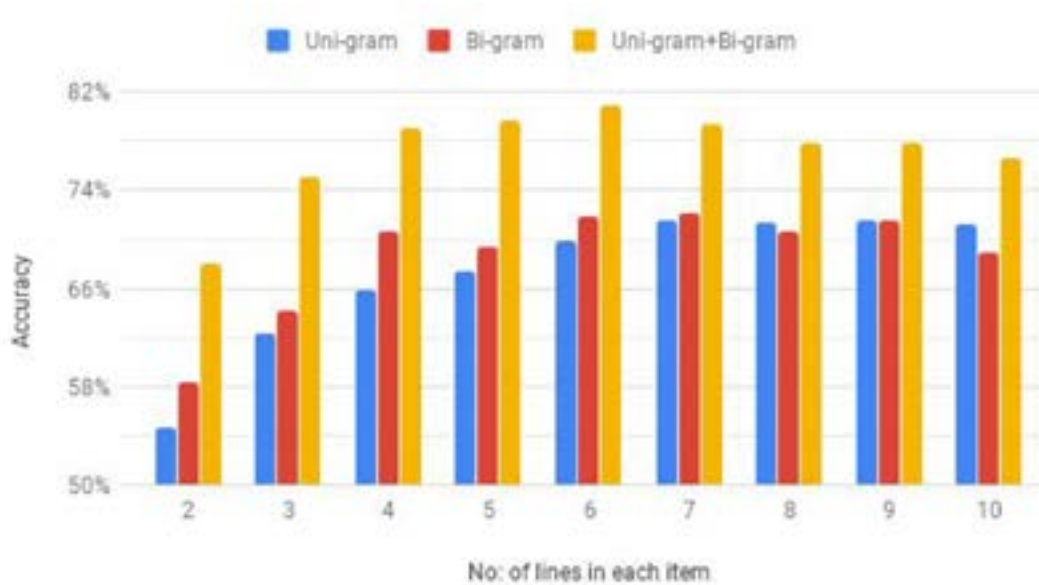
Figure 4: Accuracy for different number of lines in each item using NB

In figure 3 & 4, we present the accuracy corresponding to the number of (poetic) lines used in the training examples. The accuracy is lower for two lines (i.e. one couplet شعر.(However, it gets good for 4 or 6 lines. It means that our machine learning system needs more than one couplet to correctly predict the poet. As we are modeling the writing of the poet, we need more words.

As mentioned earlier, the average word size of the line is 8.92. So, we can infer that the use of more than 50 words (6*8.92= 54) in training examples gives a better model for writing style attribution. It must be noted that the usual text classification tasks involve modeling the frequency of keywords. However in author and poet attribution, the function words become more important. As function words are used by all the writers, their relative frequency usually suggest the difference in different author's/poet's style. For relative frequency, we need bigger text i.e. more number of words in the training examples.
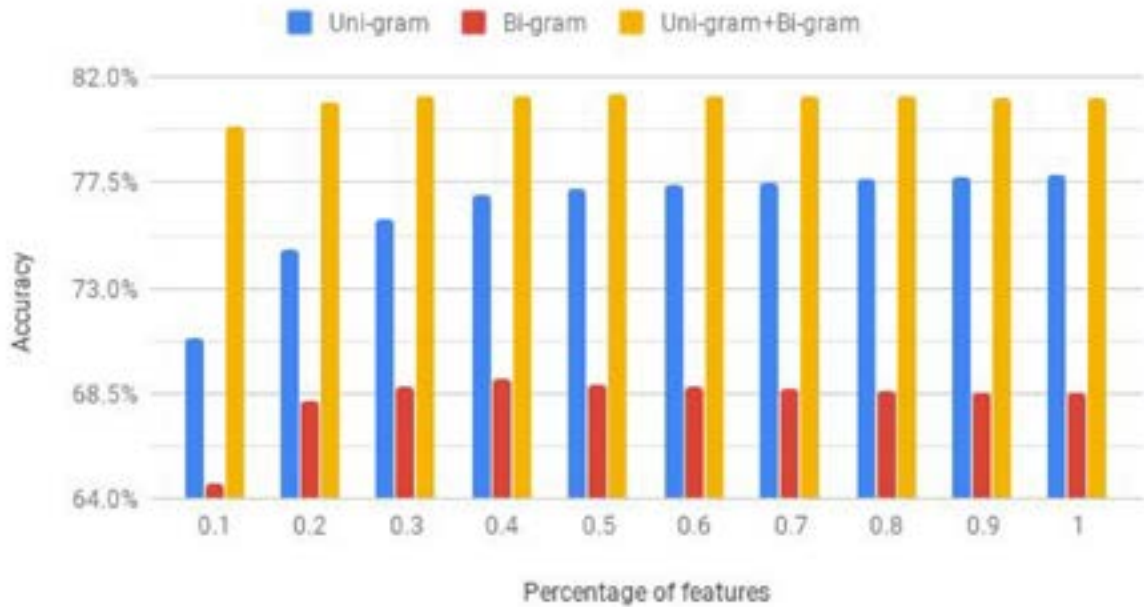
Figure 5: Accuracy for percentage of features using SVM
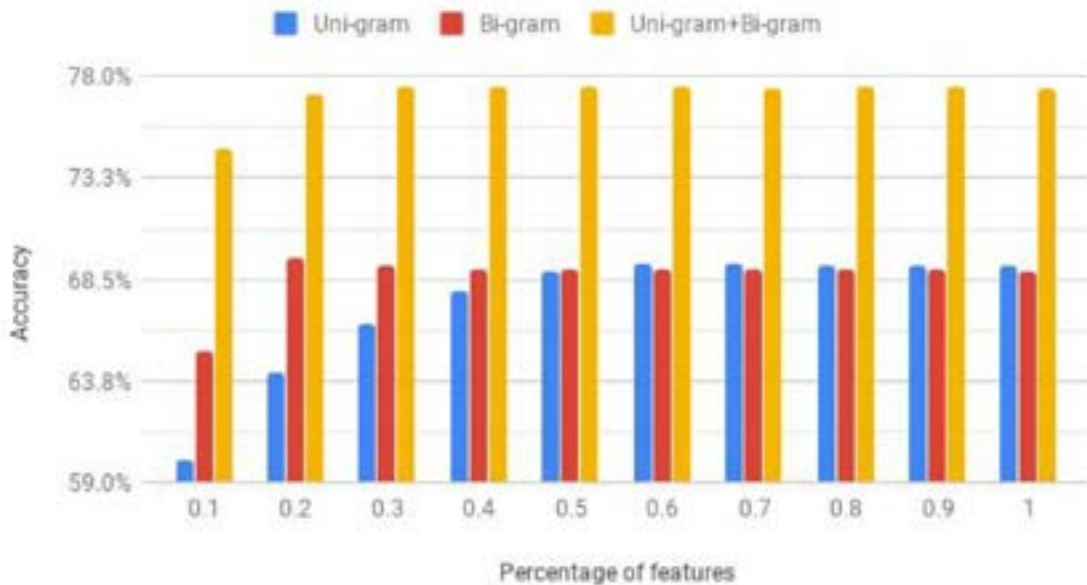
Figure 6.: Accuracy for percentage of features using NB (Naïve Bayes)

In figure 5 & 6, we present the accuracy corresponding to the percentage of ngrams used as features. We may not need to use the frequency of all ngrams as the features in the training. Zipf's Law tells that few high frequency words correspond to the majority of tokens in the text. Hence, we chose different percentages of high frequency words as features. The value 0.1 in the above chart means that we sorted the list of ngram on the basis of high to low frequency, and

chose the top 10% ngrams from this list. Similarly the value 0.9 at y-axis shows that top 90% high frequency words were chosen.

The graphs in figure 5 & 6 shows that accuracy becomes almost uniform after 0.2 i.e. top 20% of ngram features. Hence, we do not need to use all the ngrams as features. Around 20% high frequency ngrams can give good accuracy.

Hence, our general conclusion about bag of word approaches is that one should use support vector machine (SVM), combination of unigram and bigram, 6 or more lines (50 or more words) and 20% ngrams for training a good machine learning system for poet attribution. We may guess that this configuration may be beneficial for author attribution of other types of text too.

We also created a deep learning based system. As LSTM does not need feature creation, we do not need to create ngram and choose some percentage of those ngrams. We did not get good accuracy, as LSTM work well when huge data is provided, and our training data is too small to fulfill this requirement. The top three systems are listed in the following table. The best accuracy is almost half of the SVM based system.

Table 4: Top 3 LSTM system

No of lines	Error	Accuracy
2	1.4988	0.4578
5	1.9080	0.4290
3	1.6748	0.4166

5   Conclusion

We created a dataset for 5 Urdu poets and executed multiple experiments with different classification algorithms, training examples and feature configurations. We found that the SVM based classifier that uses a combination of unigrams and bigrams gives the best result. The best system gives 88.7% accuracy. These experiments show that we can create author attribution systems for short texts.

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An Autonomous Follow Me Platform for Carrying and Moving Objects

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Abstract

The technology of An Autonomous "follow me" platform for carrying and moving objects has gone through rapid technological advancements. Numerous follow me robots are accessible with various running advancements, yet the expense is high. These robots are not user-friendly and therefore not much successful. In this research, a fully automated, economical, fast, efficient and smart "Follow Me" robot is designed. This robot has the ability to carry luggage or move objects from one place to another place. It will help to pregnant women and elderly people to carry their things. An autonomous follow me robot has two working modes, the first one is the default mode and the second one is Bluetooth mode or remote mode. In default mode, the user will walk in the front of the ultrasonic sensor and it will follow the user until it goes beyond the range. In Bluetooth mode, the customer needs to interact with the robot with the help of a mobile application. The customer by then has the Graphical User Interface (GUI) to control the robot. This framework enables the client to vigorously communicate with the robot at various dimensions of the control (left, right, forward, backward, and stop). The application interface is built as simple as it can be used by a wide range of patients.

Keywords: Follow Me Robot, Autonomous Object Movement, Remote Object Movement

1. Introduction

Traditionally, robots are utilized for heavy industrial tasks such as assembly automation machines, material handling with minimum human interaction. The person following robots has been developed by many analysts, because of their valuable applications in different sectors and activities like carrying the objects, observing the motion of elderly people, etc. This motivates to create the robot which is user-friendly that can concur with humans and can support humans in different tasks.

In every country, there are so many cases exist where elderly peoples and pregnant women require assistance for carrying their things/luggage while shopping or even at home from one place to another. They do not even have enough physical power or capacity to drive the manual trolleys carrying their luggage's because it takes a lot of effort. Thus, the solution is to pay money to porter or manual lifter. Sometimes, unfortunately, if the porter is not available in the vicinity then they may have to wait for an unlimited time. Even sportsmen have to carry their sports kits

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with them during their practice sessions. A platform having the capability to carry the objects and follow the human can be useful in these situations.

The main aim of the purposed system is to design an autonomous follow me platform for carrying and moving objects by using an ultrasonic sensor and Bluetooth module. Some of the aims and objectives are given below:

- To design and implement an autonomous platform that would be able to carry things and move from one point to another point.
- To implement a user-friendly interface for humans to given instruction to the platform in an easy manner.
- To provide a low-cost solution for the target audience.

Operational mechanism and driven force is required to operate these robots. There are also certain parameters like hurdles, connectivity limitations, power consumption, weight capacity, and modular capability to catch signals remotely. To address these issues following parameters must be considered.

- Solar Panel can be utilized to charge the battery for providing power to the components required to drive the robot.
- The robot only can function properly when the weight of the load is below 20 kilograms.
- Sensors are used to avoid obstacles.

For the physical implementation of a smart robot just like "Follow Me", certain hardware and software modules will be connected. A complete prototype will be designed with the help of microcontroller and smart sensors like Arduino UNO, Bluetooth module, Ultrasonic sensor, L298N motor driver, 12V DC motor and operational capability of these sensor-based smart prototype will be controlled with the help of software modules. So interconnection of hardware and software will help in complete operational activities.

Considering the structure of the article, section 2 will elaborate on literature review or related work. The methodology will be discussed in detail in section 3. Section 4 will focus on the hardware and software components used in this smart prototype. Implementation and results will be discussed in section 5 and section 6 will present a good concluding statement regarding smart prototype.

2   Literature Review

A human following robot based on a laser range scanner is proposed by Kawarazaki et. al. [1]. This robot worked on the human detecting algorithm where the laser range scanner was used to detect the target person by identifying the shining surface. This human following robot was able to detect and follow the target person based on the position of the shining surface.

A suitcase that identifies its owner using the camera and then follows him has also been proposed by Çelik et. al. [2]. This platform was composed of the two technical fields of image processing

and controls. This human following suitcase worked on the tracking algorithm which provided good results as compared to single color-based tracking. The motor of the suitcase had been controlled by using the detected motion information.

A human indoor following robot using an IR sensor is proposed by Tsun et. al. [3]. This system also used the help of a few other sensors to detect an accurate position. This robot was designed to follow the person and avoid the nearby obstacles. Islam et. al. [4], an autonomous robot is presented that uses map-assisted Two-Dimensional (2D) path planning to avoid static and dynamic obstacles within the path. Some other techniques to implement human following robots were also presented and their accuracy is compared. The automatic luggage follower robot that tracks the human through the (Global System for Mobile Communications) (GSM) is proposed by Patil et. al. [5]. A mobile robot requires a knowing distance of the person to follow a human and allow it to find its path to follow its target. To prevent the obstacle's collision, the transmitter and receiver methods are used in this research model. A lot of innovative work has been done to lessen the effort of persons by realizing the smart trollies that follow the researchers [6-8].

Another technology to implement follow me a robot is a person following robot with vision-based and sensor fusion tracking algorithms [9]. By using this algorithm, the person following the robot targets person who measures the distance between the person and robot and directs the platform to him/her using stereo vision processing and Laser Range Finder (LRF) sensing data. The speed of the robot can be controlled to keep the distance to the person constant and follows him/her. Another approach to detecting the position of a mobile robot is using an infrared camera that is a basic technique. Dang and Suh [10], a camera, which can capture four groups of Infrared (IR)-Infrared Light-Emitting Diode (LED) installed on the robot, was attached to a human. The robot followed the IR-LEDs and followed with the person.

The person-following robots using active search are proposed by Kim. et. al [11]. This system was to make an ordinary human-robot to learn, detect, and track the feature of humans, and move towards the person. Features like Personal follow-up, planning, and robot behavior were integrated successfully. It is a problem for traveling People to drag heavy luggage at the airport or station. The system of automatic luggage followers can be utilized for solving this problem. The ultrasonic sensor (used to measure distance) and DC motor (used to move the object) play an important role in the implementation of this platform. For the tracking of the anti-theft, GSM and GPS (Global Positioning Systems) can also be integrated into a platform like this [12-13]. The users can access the location of the bag by GSM and GPS tracking system when the bag is lost.

This Automatic trolley can also be guided by the customer with the use of simple line following techniques. Another system is proposed by some researchers that used sensors to track the path where the customers walk [14]. The developed research used the mobile tablet in front of the trolley to track the goods which the person purchased and automatically generate the bill. Based on the literature survey, it is cleared that there are multiple techniques capable of accurately and efficiently directing the robots that carry the objects and moves in an efficient way. And, there is also some research gap related to security that can be filled by working on it.

3   Methodology

The methodology is referred to as the steps or techniques involved in the successful implementation of the desired prototype. In the smart "Follow Me" robot, different types of sensors are included. This prototype contains different sensors like an ultrasonic sensor and a PIR (Passive Infrared) sensor. Through these sensors, persons or obstacles can be identified. The proposed platform is further comprised of a micro-controller and Bluetooth modules to operate the movement of the robot. The purposed platform has two modes:

- Default mode
- Remote or Bluetooth mode

A detailed description and operational functionality of these modules can be identified with the help of a block diagram given in Figure 1. This prototype consists of two modes, one is the default mode and the other is Bluetooth mode. In default mode, the sender side is not required; the system can only work with the receiver side. In default mode, the ultrasonic sensors sense the person and follow the object if the object is in its range. If the person goes out of range of the ultrasonic sensor, the robot will stop. In Bluetooth mode, first, the user connects its smartphone with a Bluetooth module. After connection, the user can give commands through a mobile application to the robot and it can move according to the instructions of the user. At the receiver end, which is based on Arduino UNO provides a controlled environment to the system and connected with the power supply to drive the system, ultrasonic sensors are also interfaced with Arduino. Ultrasonic sensors get the data by detecting a person and send it to the Arduino controller for further processing. And then the controller sends instructions to the motor driver for the movement of the robot.
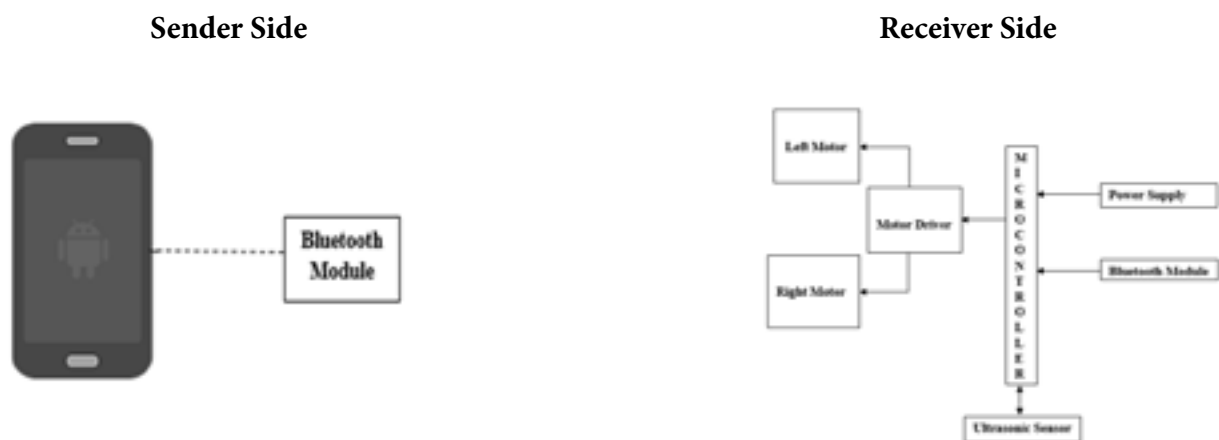
Sender Side   **Receiver Side**

Figure 1: Block Diagram of Designed Prototype

The operational flow chart of the designed robot is shown in Figure 2. There are two paths of execution in this prototype, one is the default mode and the second is Bluetooth mode. Anyone of these modes can be selected by a switch. This switch also helps in mode transition.

A   *Default Mode*

If the default mode is selected, the microcontroller and sensors are powered on. Then the controller and sensors (like Ultrasonic sensor and PIR sensor) are initialized. Firstly, the reading of distance of the person from the ultrasonic sensor is acquired and then the condition, set according to requirements, is checked. If the condition of distance is matched, then the robot starts following the person at the same time conditions are again checked. If the condition of distance does not match, then the robot will stop and again checks the condition of the distance. This operational activity can be analyzed in Figure 2.

Figure 2: Flow Chart of designed prototype

B   *Bluetooth Mode*

In Bluetooth mode, the microcontroller and Bluetooth module are turned on and initialized. Bluetooth connection is established by using a smartphone and a Bluetooth module. After the connection is established, an instruction can be sent through a mobile application i.e. BLANK. After this, it can be checked if any instruction about the movement of the robot is recorded. If an instruction is recorded, then follow that instruction and wait for the next one. If not received any command from Bluetooth, the robot will stop and check the condition again. If the system is required to remain active, then the program would carry out the same instructions

continuously. If the program is required to be stopped then the program will be terminated. The flow chart for the implementation of the "Follow Me" smart path following robot is shown in Figure 2. This flow chart covers both operational aspects i.e. Bluetooth mode and Default mode. All information regarding the operational activity of the proposed work is shown here.

4   Used Hardware and Software

In the design of any prototype, both hardware and software components are required. Hardware equipment help in sensing external environmental readings whereas software help in decision making based on hardware readings. Interconnection and mutual communication of both technologies result in the best design of the required prototype. Similarly, during the practical execution of the "Follow Me" robot, different hardware and software technologies are involved and utilized. Detailed analysis of equipment along with their specifications are listed in detail in the section below.

A   *Hardware Modules*

Arduino Uno: Arduino microcontroller board is an open-source board dependent on the ATmega328P microcontroller. Arduino Uno is created by Arduino.cc. The Arduino board has fourteen Digital pins, six analog pins, and program is burnt with the Arduino Integrated Development Environment (IDE) via a Type-B Universal Serial Bus (USB) cable. Powered by an external 9-volt battery or by a USB cable, though it accepts voltages between seven and twenty volts. Its functionality is the same as the Arduino Nano and Leonardo. The specifications of Arduino are listed below. Figure 3 represents the Arduino Uno R3 board.

- ATmega328 is the microcontroller.
- The 5 volt is the operating voltage.
- The recommended Input Voltage is 7-12V.
- The Input Voltage is 6-20V.
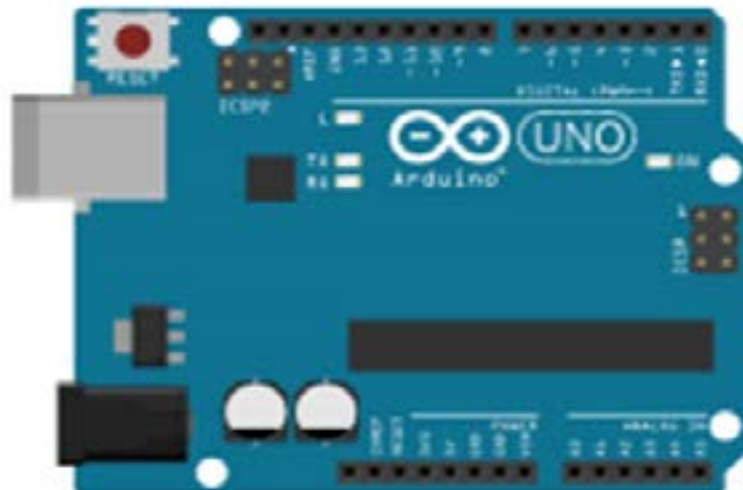- It has 14 Digital input and output Pins.

Figure 3: Arduino Uno R3 circuit board

The interconnection of Arduino with a computer is carried through a serial communication with the help of a solid wired connection. The computer USB port is connected with the Arduino serial port with the help of a connecting wire. In this way, a wired connection is established between the both physical devices. The only connection is not enough for operational activities. Arduino is made compatible with a computer with the help of an IDE. This IDE help in performing proper communication between both devices. Arduino interface is also approachable with the help of IDE. The code is written and burnt into Arduino chip with the help of IDE and the output is shown on the serial monitor window of the same IDE. The interconnection between computer and Arduino is shown in Figure 4.

Figure 4. Arduino R3 interfacing with Computer

B   *HC-05 Bluetooth Module*

The HC-05 is a Bluetooth module that can use both sending and receiving commands. One can perform communication between the microcontrollers by using this module like Phone or Arduino. Most of the android applications that are already available which makes this process a lot easier. The specifications of the Bluetooth module is listed below. Figure 5 represents the Bluetooth module.

- Integrated the HC-05 in two-way communication
- The USB protocol which use in the module is USB v1.1/2.0
- Authentication and encryption security features are use in this module.
- The Power Supply of module is +3.3VDC 50mA
- The Working temperature of module is –25 ~ +75 Centigrade
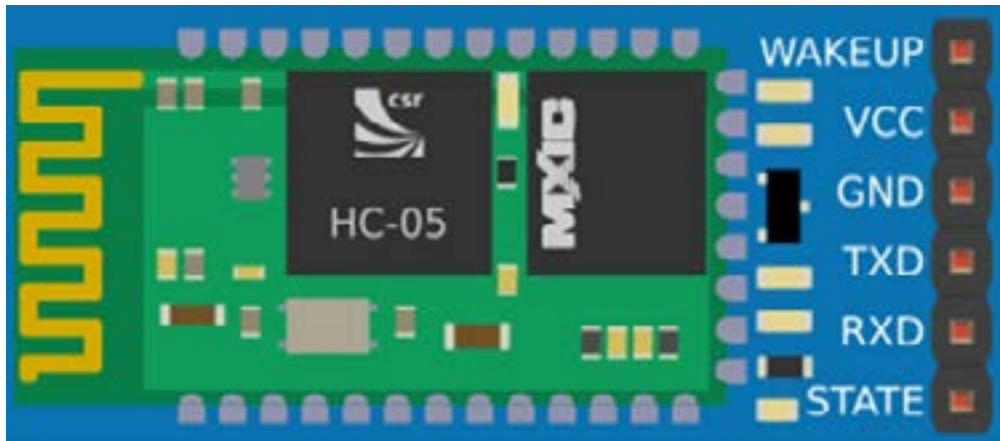
Figure 5: HC-05 Bluetooth Module

The interconnection of the Arduino Uno microcontroller with the HC-05 Bluetooth module is shown in Fig. 6. This figure illustrates pin wise connection of both modules. For connecting the Bluetooth module with Arduino, module VCC (Voltage Common Collector) pin Connect with Arduino Uno port of 5 Volt DC. After initializing power, the module GND pin connected with any Arduino Uno GND pin. Modular receiver pin Rx is connected with Arduino Uno digital pin 2 and modular transmitter pin Tx is connected with Arduino Uno digital pin 3. All connections are shown in below Figure 6.
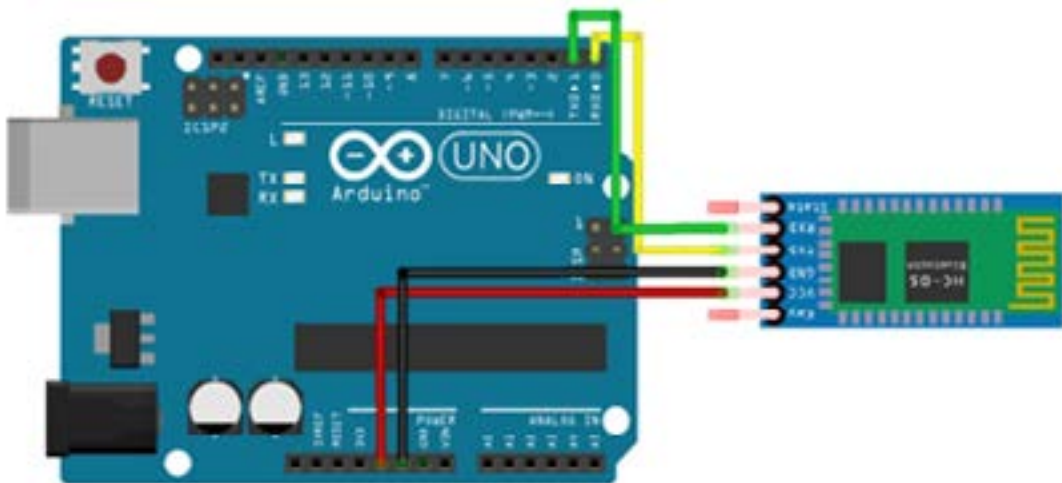
Figure 6: Interconnection of Arduino with HC-05 Bluetooth Module

C   HC-SR04 Ultrasonic Sensor Module

The ultrasonic sensor finds the distance to an object by using sonar. It has excellent non-contact range detection. It has high accuracy and stable readings. It is made complete with ultrasonic receiver and transmitter modules. HC-SR04 module is shown in Figure 8. Specifications of the Ultrasonic sensor include the following:

- The power Supply of this sensor is +5V DC.
- The quiescent Current is less than 2mA.
- The Working Current of the sensor is 15mA.
- Effectual Angle of ultrasonic sensor is less than 15°.
- The Ranging Distance is 2cm to 400 cm/1″ to 13ft.
- The Resolution is 0.3 cm.
- The Measuring Angle is 30o.
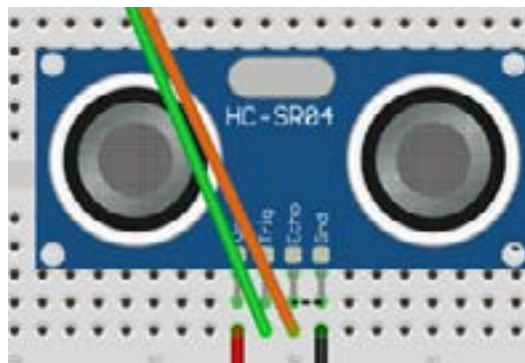
Figure 8: HC-SR04 Ultrasonic Sensor Module

The interconnection of the Arduino Uno microcontroller with the HC-SR04 Ultrasonic Sensor module is shown in Figure 9. This figure illustrates pin wise connection of both modules. For connecting the Ultrasonic sensor module with Arduino, module VCC pin Connect with Arduino Uno port of 5 Volt DC. After initializing power, the module GND pin Connect with any Arduino Uno GND pin. The modular Tigger pin is connected with Arduino Uno pin 11 and the modular Echo pin is connected with Arduino Uno pin 12. All connections are shown in Figure 9.
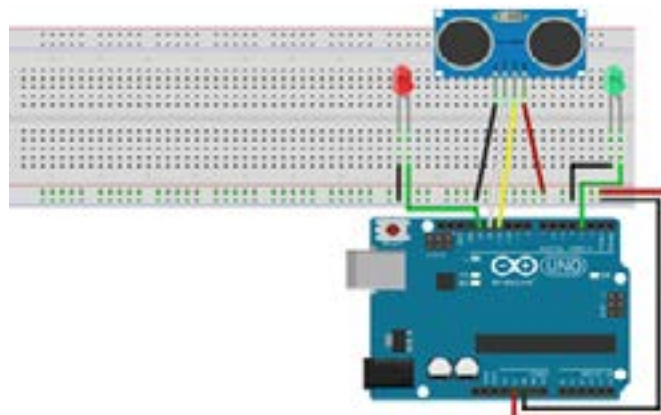
Figure 9: Interconnection of Arduino with HC-SR04 Ultrasonic Sensor Module

Testing of connection between the Ultrasonic Sensor module and Arduino Uno results in LED blinking as output. Whenever any object comes under a 30cm range of ultrasonic sensor an LED is lighted up for instance. Later on, a DC motor will be operated in case of any object under a specified range. The testing based output of Arduino and Ultrasonic Sensor module is shown in Figure10.
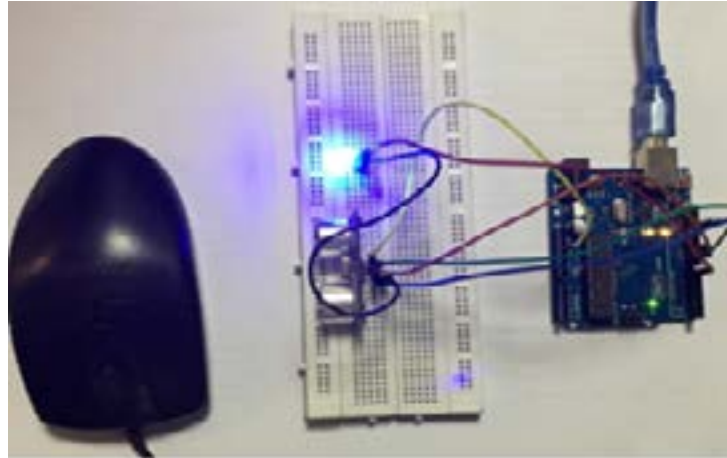
Figure 10: LED indication based testing result of Arduino and Ultrasonic Sensor

D   DC Motors and L298N Motor Driver

The motor driver L298N is a dual H-Bridge motor driver. It allows to control the two DC motors speed and direction at the same time. The DC motors which have 5V to 35V voltage with maximum current up to 2A this module can drive. The motor driver L298N is shown in Figure 11. Modular specifications of motor driver L298N are listed as

- The module can drives up to 2 bidirectional DC motors at same time.
- It integrated with 5V power regulator.
- The drive voltage of this module in between o 5-35V.
- The drive current of the module is 2A maximum.
- The double H Bridge Drive Chip is L298N.
- The logical Voltage is 5Volt.
- The logical Current is 0mA to 36mA
- The Max Power is 25W.
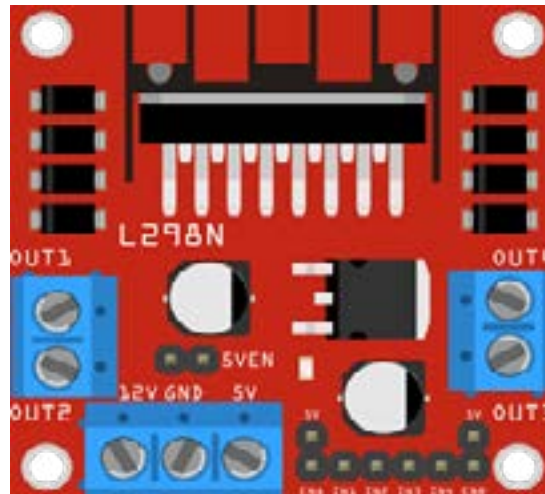
Figure 11: L298N H-Bridge Based Motor Driver

The interconnection of the Arduino Uno microcontroller with the motor driver L298N module is shown Figure 12. This figure illustrates pin wise connection of both modules. For connecting motor driver L298N with Arduino, module 5V pin Connect with Arduino Uno port of 5 Volt DC. After initializing power, the module GND pin Connect with any Arduino Uno GND pin. The motor driver L298N 12V pin is connected with an external 12V DC power supply. Module output 1 and 2 pins are connected with DC motor A and module output 3 and 4 pins are connected with DC motor B. Module IN1 pin is connected with Arduino digital pin 5 and the module IN2 pin is connected with Arduino digital pin 6. Similarly, the module IN3 pin is connected with Arduino digital pin 10, and the module IN4 pin is connected with Arduino digital pin 9. All connections are shown in Figure 12.
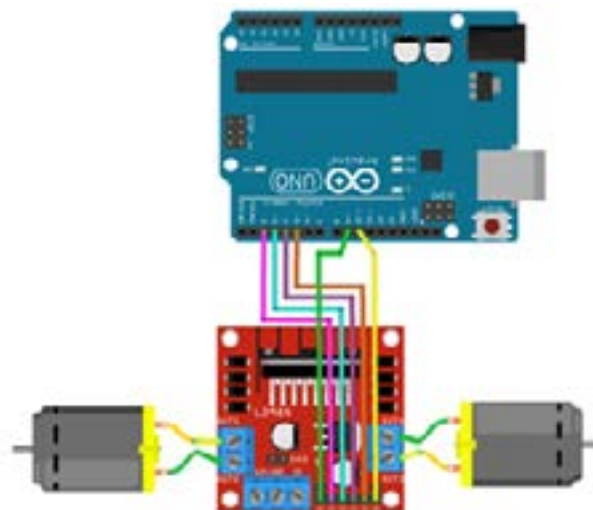
Figure 12: Interconnection of Arduino with Motor Driver L298N Module

Testing of connection between the motor driver L298N module and Arduino Uno results in motor movement as output. Whenever any object comes under a 30cm range of the ultrasonic sensor, motors as an output of the motor driver L298N module start working instantly. In this

way, DC motors are operated in case of any object under a specified range. The testing based output of Arduino and motor driver L298N module is shown in Figure 13.


Figure 13: Motor Movement Based Testing Results of Arduino and L298N Motor Driver Module

E   Software Modules

Arduino IDE: Arduino IDE is the interfacing platform that helps in controlling, analyzing, and monitoring equipment performance. This can be referred to as the interpreter between external sensors and computers. A lot of libraries are available online that are embedded into the header of the Arduino code. These libraries translate the communication of sensors and modeled their observational readings according to program requirements. As discussed earlier, sensors are attached to the Arduino microcontroller. So programming and translation of readings are basically performed through the Arduino board. Therefore, the Arduino IDE is required to make communication feasible between Arduino based prototype and user requirements. Through Arduino IDE, code can be burnt, modified, and tested on equipped sensors. Furthermore, performance evaluation can also be performed with the help of the Serial monitor window in Arduino IDE. The serial monitor displays resultant information in graphical and digital formats. Arduino IDE based resultant values on the serial monitor are shown in Figure 14. These are the testing values of the Bluetooth module attached in the "Follow Me" prototype.

Figure 14: Serial Terminal Based Testing Results of Bluetooth Module on Arduino IDE

F   Mobile Application

A very user-friendly mobile application is developed for controlling the "Follow Me" prototype remotely and wirelessly. (Both words are same). In default mode, there is no such functionality performed therefore there is no need for a mobile application. This application is only applicable when the smart prototype is operated in Bluetooth mode. There is a button attached to the application GUI that helps in producing a connection between the hardware modules of the robot and controlling software application. Other control buttons are also attached to the GUI display. That buttons control the forward, backward, right, and left movement of the robot. Ultrasonic sensor readings can also be displayed on a mobile application. Bluetooth terminal-based connectivity of the device is shown in Figure 15.
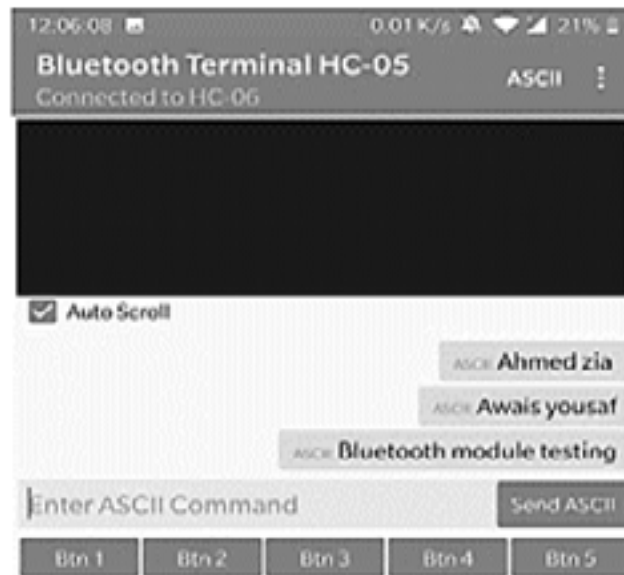
Figure 15: Mobile Application Based Connectivity and Testing Results of Bluetooth Module

5   Implementation and Results

The final integration of the circuit and Follow me platform is shown below. The circuit is attached under the structure of the follow-me robot. The structure of the robot is made of an acrylic sheet. The ultrasonic sensor is in front of the robot. This robot uses the three wheels, the front-wheel is freewheel and the two back wheels are controlled with motors. The robot shape is just like the trolley which carries the objects. The final prototype design is shown in Figure 16.

Figure 16: Front and Side View of Designed Prototype of Follow Me Robot

The L298N motor driver (which controls the motors), Bluetooth module (Use for connectivity with mobile), and ultrasonic sensor are connected with Arduino Uno. Arduino Uno receives the command from the mobile application through the Bluetooth module and performs the function according to the command. In the second mode, when the robot is in default mode, the ultrasonic sensor sends the data of distance from the object to Arduino and then Arduino insert into the code and perform the function.For implementation purposes, motor driver pins are connected with Arduino Uno that is defined in the program of Arduino. The L298N has six pins that are connected with Arduino. In the robot circuit, the ENA pin is connected with the Arduino digital pin 5. The ENB pin is connected with the Arduino digital pin 6. The IN1 pin is connected with the Arduino digital pin 8. The IN2 pin is connected with the Arduino digital pin 9. The IN3 pin is connected with the Arduino digital pin 10. The IN4 pin is connected with the Arduino digital pin 11. The pins configuration is defined in the Arduino controller board. The internal circuit based design of the robot is shown in Figure 17.
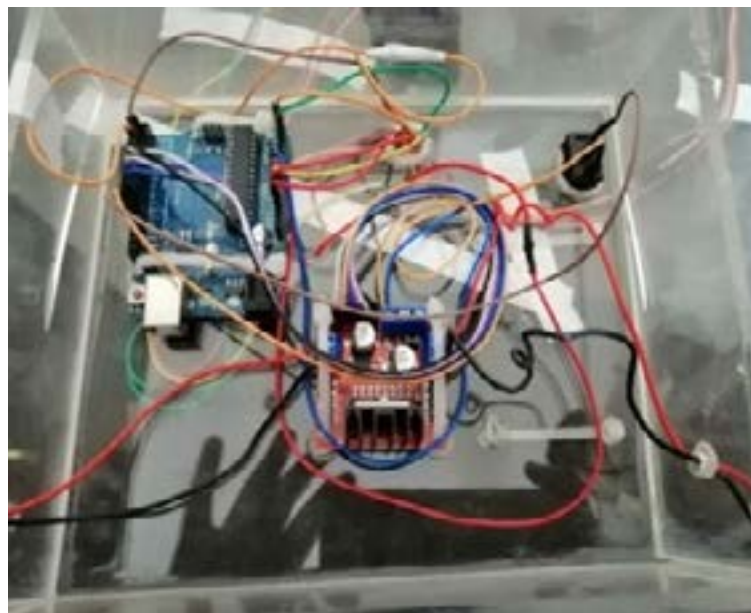
Figure 17: Internal Circuit Based Design of Designed Robot

The Bluetooth module has four pins, two for transmission and receiving and two pins are used

for power. Connect the Bluetooth module with Arduino through the connection of all the pins of the module with the Arduino. In the robot circuit, the VCC pin is connected with 3.3V pin of Arduino, the GND pin is connected with the GND Arduino pin, the RDX pin of the module is connected with the Arduino digital pin 3, and the TXD pin of the module is connected with the digital pin 2 of Arduino. The ultrasonic sensor has four pins two for sending data and two pins use for power. Connect the Ultrasonic sensor with Arduino by connecting all the pins of the sensor with the Arduino. In the robot circuit, the Vcc pins are connected with the 5V pin of Arduino, the ground pin is connected with the ground pin of Arduino, and the Echo pin of the sensor is connected with the Arduino analog pin A4 and the Trig pin of the sensor is connected with the Arduino analog pin A5. A4 and A5 pins send the data (data calculated by the sensor) to the Arduino. Integration of Arduino with Bluetooth module and Ultrasonic sensor is shown in Figure 18.

Figure 18: Integration of Arduino with Bluetooth module and Ultrasonic Sensor

In default mode, the robot is controlled with an Ultrasonic sensor. For the second mode, the android application is used for the movement of the robot manually. In application interface, the robot is controlled with the arrow's keys. Every key has a command which is sent to the Arduino by using the Bluetooth module. When the command is received by the Arduino, it performs function grading the command. The command is defined in the program which is burnt in the Arduino controller. In this application, digital values are used for robot movement. The digital value of 92 is used for forward, 91 for reverse, 79 for left, and 71 for right side movement.

There are four buttons for moving left, right, forward, and backward. Whenever a button is pressed, a string that is coded behind the button is sent to Arduino through Bluetooth and then the Arduino operates according to received instructions. When a user came in the range of the sensor, it will send instructions to Arduino and the robot will start following that user until he will accede its range. The robot stops when the object out from the range of the sensor. The android application interface is shown in Figure 19.
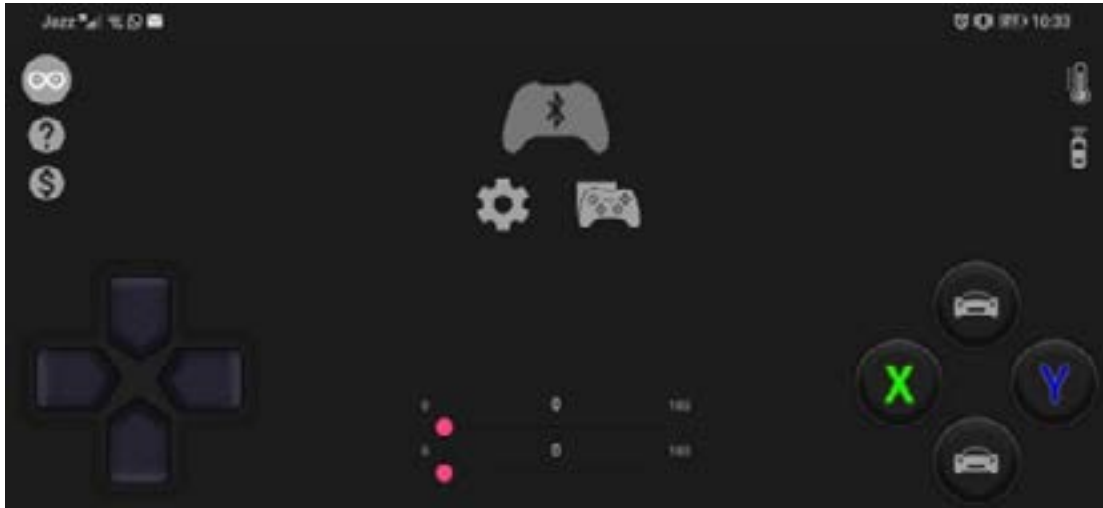
Figure 19: Android Application Based User Interface for Robot Controlling

6   Conclusion

In our daily life, different types of robots are used which are known or unknown by different users. In this research model, a planned Autonomous follow me platform is developed for carrying and moving objects with the help of an Ultrasonic Sensor and android application. The circuit will work properly after receiving the commands from the user through Ultrasonic Sensor or by a mobile application. This prototype will empower pregnant women and elder people to control their Autonomous "follow me" platform of carrying and moving objects by using an android application in their smartphones or by using an Ultrasonic Sensor. This proposed framework adds to the self-reliance of various pregnant women and elder people. In the future, more features would be added by attaching various smart sensors and cameras. In this way, it is our believed that the research-based prototype will be fruitful for many daily life purposes. Hence the purpose will be successful.

7   Recommendations

The mechanism of the steering is to be modified for competence in extensive vehicles. It is fatigue for non-electric vehicles like the power of petrol. This makes it not suitable for a rough territory from the lack of a three-wheel drive. This makes the robot unstable from the lack of speed control at times.

Acknowledgment

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Design and Implementation of Monitoring system for Paralysis patient using IoT

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Abstract

Internet of things represents a catch line of smart applications. At the same time, it plays a leading role in the health care systems, as it provides the connectivity of the distant patients, who are not able to express their concerns. In this modern era there are a lot of technologies that are being used in different healthcare fields for paralyzed people. This paper proposed a model for paralyzed patient by considering Arduino with the integration of gyro and flex sensors for the patient hand and finger and feet movement. Patient can easily be connected with this device by sending his message to caretaker only by moving their hands into respective directions, or they can send their message by moving their fingers and feet. Through this device paralyzed patient will be able to convey their messages to caretakers, so they can assist the patient timely. This system will enhance the medical care to those patients who are even not able to convey their message because of paralysis condition.

Keyword: Internet of things, healthcare monitoring, wearable devices, gyro sensors, flex sensors

1   Introduction

Advancement in IoT technologies has made human life much simple and easier. These IoT technologies have also created a major impact in the field of medical in terms of patient and caretaker connectivity. These IoT technologies provide various benefits such as data accuracy, reduces manual work. It also helps to increase the quality of life in a healthy way. Now a day people are suffering from various diseases such as heart attack, damage in the nervous system, trauma, brain tumor, damage in spinal cord and severe head injury due to serious accident causes paralysis. Paralysis is a loss of muscles functioning in a part of a person's body. Paralyzed patients need a proper care and attention. This should be monitored continuously and treated properly. For continuous monitoring of paralyzed patient's health, physical care is quite difficult and uncomfortable for the patient, doctor and the care taker to communicate with patient, communication with a paralyzed patient is the most difficult task, because they need run time proper care in order to save their lives. In case of unavailability of the caretaker or healthcare staff we need a connection from which patient can easily communicate and send messages to care taker. To reduce these difficulties paralysis patient health care system is accommodated. By adopting paralysis patient healthcare system communication between the paralyzed patient and the caretaker get much easier and there is no requirement for the patient's caretaker to visit them frequently, when the patient send their message according to their need by tilting

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their hands in different directions, at that time they can visit their patient easily when they receive messages sent by the patient by moving their hands in certain direction as connected [1,2]. The most enormous use of IoT is in healthcare system which provide facilities of health and environment as per their requirement [3]. For personal healthcare, medical awareness and fitness related activities use the healthcare systems these obtained a great approval over recent years. IoT devices enabled the paralyzed patient to be monitored by their medical provider remotely from distance [4].

2   Literature Review

IoT improves the internet and physical device connectivity, among other things as well. The main purpose of this connectivity of huge scale is to enabling the information of any object from anywhere. [5]. In IoT, the objects are integrated with some intelligent sensors, these sensors, sense the environment in order to get the meaningful information, after receiving this data they examined and processed further for the necessary action [6]. IoT is also used in health care systems. Sensors monitor the patient even-if the patient is in hospital, at home or staying anywhere else [6]. There is a persistent need for continuous interaction with the technologies, however the paralyzed patients can't interact with these gadgets like laptops, cellphones, tablets and notepads but there is a more devices that can act as a solution to interact with these machines, but they are expensive like google glasses, it is not possible for every paralyzed patient to connect and interact with these gadgets. To overcome this problem, [9] authors proposed a retina controlled device called "Eye-com". This device is constructed from cost effective IoT devices such as Micro controller Arduino, accelerometer, X-bee wireless sensor and IR diodes. This device easily ascended on the glasses. By using this device paralyzed patient can easily interact with the machines by simple head movements and their eye blinks [10-13] Proposed a prototype include three health sensors i.e. Galvanic Skin Response Sensor, Heart Pulse Sensor, Body Temperature Sensor, these sensors are combined together into a system with Arduino UNO to sense the health parameters of the patient's body and Raspberry Pi collect the data into a server and then transfer it to the cloud server. [11] Authors designed a glove which is helpful for quiet people and paralyzed patient as well as for the detection of the heart attack. In this health care system gloves uses are fitted with the Flex Sensor in three dimensions in order to collect data from every position and hand motion to differentiate and determine each and every word from specific sign. In [12] the system is proposed to serve the paralyzed patients hand movement issues. In this system patients wear the sensor gloves to recognize the movement of fingers to control the home appliances, like smart tv, fridge, ac and door locks, also it monitors the patient's heart rates and body temperature if it varies with actual value, heart rate of the patient exceeds then the buzzer will be activated and the system will send the message to care taker through GSM module [14]. IoT is a heart of all innovative domains like it worked in surveillance monitoring, supply chain management and healthcare monitoring, these capacities are integrated with IoT with the respected management vendor systems, these three categories with more applications are discussed in Figure1.
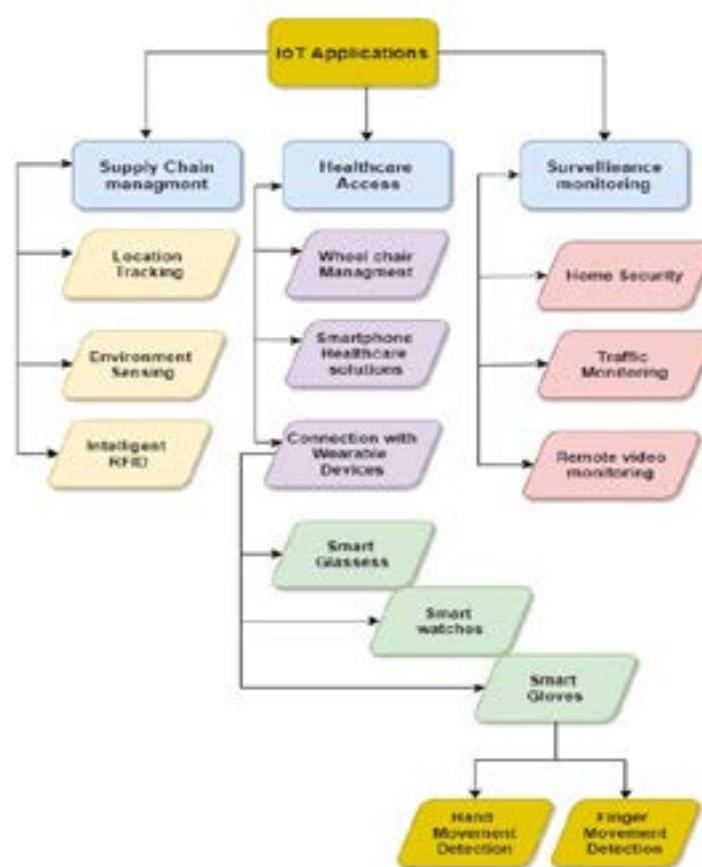
Figure 1: Taxonomy of IoT applications

Table 1: Comparison between Existing IoT Healthcare Monitoring Devices

Ref	Year	IoT Devices	Components
[7]	2020	Adaptive & Flexible Brain Energized Full Body Exoskeleton	Electroencephalogram (EEG)
[8]	2020	Soft Robot	Flex Sensor, Pressure Sensor
[9]	2019	Eye-Com	ADXL335
[10]	2019	Fitness Tracker	Heart-Pulse Sensor, Arduino UNO, Raspberry-Pi
[11]	2019	Gloves	Flex Sensor
[12]	2018	Sensor Gloves	LM-35, Flex Sensor, Voice Processor(APR33A3)
[13]	2018	Fitness Tracker	LM-35 Temperature Sensor, Heartbeat Sensor, Eye-Blink Sensor, Accelerometer Sensor
[14]	2017	Hybrid Wheel Chair	BNO-055 Module, ARM Cortex M3
[15]	2017	Eye-Blink	TCRT 5000
[16]	2016	Smart Gloves	Flex Sensor, Inertial Measurement Unit (IMU)

Some further work has been done in the healthcare sector by using IoT in order to monitor patient's health. In past, there are various point of views proposed to develop health care systems for the patients. For example, [7] proposed an adaptive and flexible brain energized full body exoskeleton to assist the paralyzed patients. It designates the design, testing and control of exoskeleton to support the patients in their daily basis activity. In this system, the signals of brain taken by the sensor called "EEG" i.e.: Electroencephalogram to control the movements of the Exoskeleton. Another work proposed by [8] is a health monitoring system for the patients using GSM module and IoT (Internet of Things). In this proposed system, the health parameters implemented are: Temperature Sensor (LM-35), Heartrate Sensors, Eye-blink Sensor and Accelerometer sensor. By using these implemented parameters, patient wellbeing can be easily monitored. In this system GSM module used for message sending to predefined caretaker contact number in order to get proper information of the patient from the distance. Some other work is also designed to cover and improve the functionality of the wheel chair system for the paralyzed patient [28]. In this system the additional functionality like sensors network error handling, speed handling in non-straight roads, emergency stop and confirmation of command function are tested for both environments i.e. indoor and outdoor. The demand of constant improvement in daily living for the paralyzed patient becomes more motivation to develop some new technologies to cure the difficulties faced by the paralyzed patient. In this paper a blink sensor device is developed which used to operate the home appliances easily without any somatic or human help. The system consists of four embedded electronics like TCRT 5000 as the eye blink sensor which can measure the intensity of IR bounced back on the eye, Bluetooth, Arduino adaptable microcontroller and RF link pair module [15]. The idea in [16] proposed smart gloves and hand recognition which can recognize and convert sign languages to voice output. The glove embedded with some flex sensors that enables to recognize the finger movements and IMU to distinguish the hand movement in each direction.

3   Proposed Methodology

Our proposed and implemented system are designed in which patient can convey their necessities through message by using hand movement, finger movement and feet movement. The movement is detected by using gyro MPU6050 which is connected to gloves as a product Arduino Uno. Flex sensors are used for the detection of the finger movement and gyro sensors is placed at the hand of the patient to sense the any changes in the patient hand. The system is bound in three significant tasks. These are to send messages in order to communicate and understand patient's requirement through hand movement, finger movement and feet movement, after the movement of any of them i.e. Hand, finger and feet, the system will inform the caretaker to the needs of the patient.

4   Implementation

Our system helps to communicate paralyzed patients to their attendant using hand gestures and feet gestures. The gyro MPU6050, flex sensor and aluminum foil are mounted on the

gloves with the help of connecting wires to the Arduino. for the detection of hand and finger movement, as shown in Figure 2 (a,b), whereas gyro MPU6050 is mounted on belt to detect the feet movement, all these are communicating and sending messages to the caretaker, these messages are "pre-coded" that is "call to doctor"," I need medicine" "I need water" with the help of connecting wires to Arduino UNO.

Figure 2: hand gloves (a) and Feet Belt (b)

Table 2: Hardware Components Comparison

References	GSM module sim 800L	Arduino	Gyro MPU
[17]	✕	✓	✕
[18]	✕	✕	✕
[19]	✓	✓	✓
[20]	✓	✕	✕
[21]	✓	✓	✕
[22]	✕	✕	✓
[23]	✓	✓	✕
[24]	✓	✕	✓
[25]	✕	✓	✓
[26]	✓	✓	✕
[27]	✓	✕	✓

5   Proposed System

We have designed a health care system for the paralyzed patient, by using thesmart gloves, through these gloves patients can easily send their disquieting messages to their assigned caretaker by the movements of their hands, fingers, and feet. In this paper, Arduino UNO is used to collect the raw data as well as a processor, for the communication between the caretaker and the patient, SIM 800L is also employed. To sense the movements of hand and fingers smart

gloves are designed in which gyroscope MPU 6050 and flex sensors are integrated with the gloves. If the patient desires to any food they can tilt their hands in the right direction if they feel necessities of medicine they can also tilt their hand to the left, same as for water they can tilt their hand in an upward direction, and in case of emergency they can tilt their hand downwards. The collected information used for message sending to the attendant's phone through the GSM module, in this way the attendant can easily respond to the needs of the patient. The flow diagram of the proposed model is shown below in Figure 3.

A   *Proposed Flow chart*
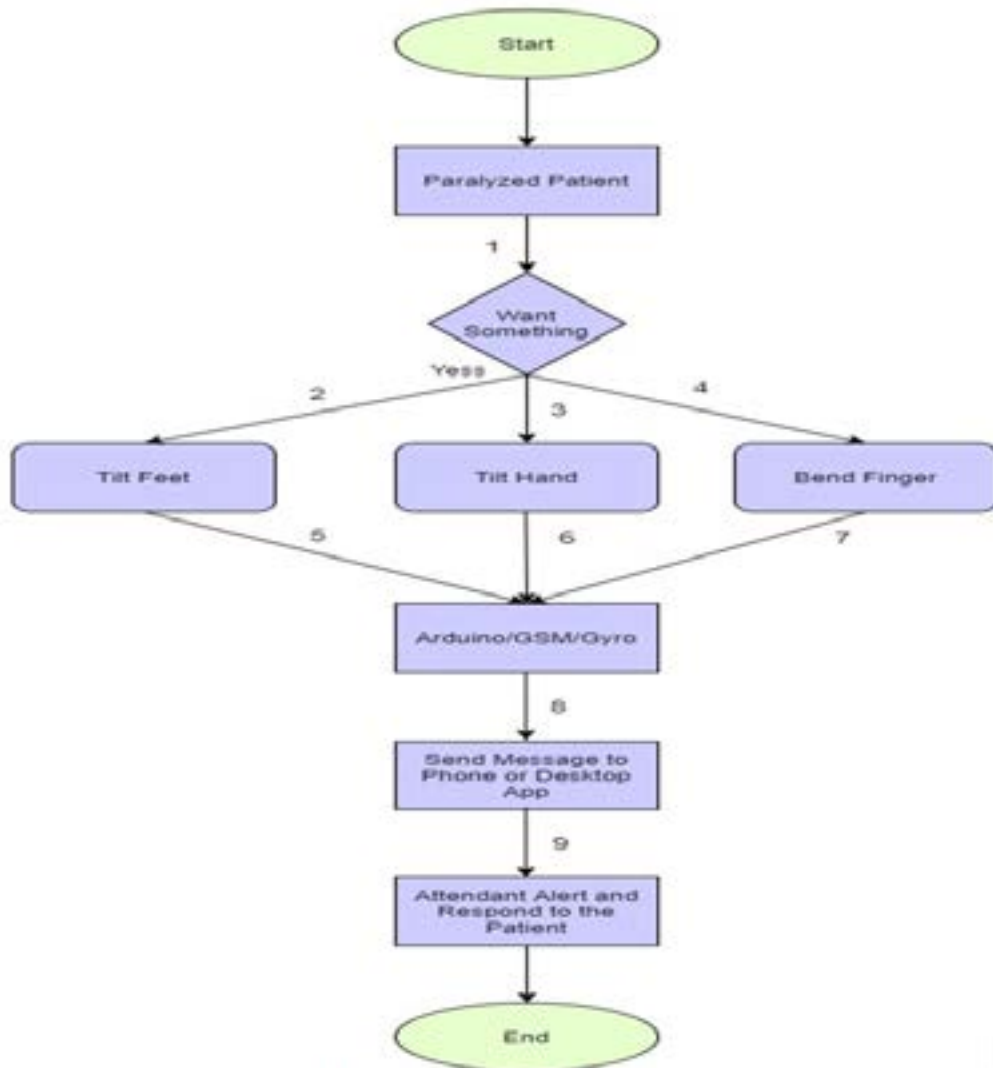
Figure 3: proposed flow chart

Figure 3 representing the flowchart for the working flow of proposed model i.e. initially, it is coupled with the basic power supply to Arduino for receiving the input signal, if the patient needs anything like he has an emergency or if he needs water, food, or medicine then they need to tilt their hands or foot in a particular direction. For example, if a paralyzed patient can move

his hand easily so he wears smart gloves in which we use a gyro sensor and tilt their hand in the particular direction as required, or if the patient's hand is not working then he can bend a particular finger as per their needs. If both hands and fingers are not working patient can wear a belt in their feet and move their feet in a different direction to send the message. We have designed a desktop app (in our future work) and in the hardware module integrated a GSM module from which attendant can get the message from the patient as an alert form and respond to the patient and full fill their needs.

6   Conclusion

Paralyzed patient faces difficulties to convey their messages to the caretakers for fulfill their needs because they are unable to express their problems and needs properly. To overcome this difficulty faced by the paralyzed patient, we have implemented a paralysis patient healthcare system using IoT and GSM. In this proposed system messages are conveyed by the paralyzed patient to the caretaker, by using gyro gloves, if the patient tilts their hand or fingers or feet GSM module triggered to send message to the predefined caretaker's contact numbers. In future we will integrate this implemented system to desktop screens and android app for the remote monitoring as well.

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PSL Eye: Predicting the Winning Team in Pakistan Super League (PSL) Matches

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Abstract

Pakistan Super League (PSL) is a well-known T20 cricket league with millions of viewers. With this large viewer base, predicting the outcome of PSL matches opens a new research avenue for academic researchers. In this paper, we collect PSL data from relevant sources and generate a validated data set for machine learning experiments. We implement the "PSL Eye" solution which employs Neural Networks (NNs) to predict the match winning team. We preprocess the dataset to eliminate the extra variables then we tune the hyper parameters of NN. After acquiring the optimal values of hyper parameters, we run our NN based PSL Eye to obtain the final results. The overall accuracy of PSL-Eye with testing data set is 82% which is very promising and shows the importance of NN in predicting PSL match outcome.

Keywords: Pakistan Super League, T20, PSL, Prediction, Neural Networks, Tensorflow, Keras, Machine Learning

1   Introduction

Cricket is a bat and ball game played between two teams. At the international level, cricket is played in three different formats, i.e., one-day, T20 (Twenty-20) and test matches. T20 is the most recent and shortened form of cricket restricted to 20 overs. It was introduced by the England and Wales Cricket Board (ECB) in 2003. Several T20 leagues started after 2007 ICC World T20 tournament. Bangladesh Premier League, Big Bash League, Indian Premier League, Pakistan Super League, and Caribbean Premier League are well known and successful T20 leagues[2][15][16].

Pakistan's population are sport loving people and cricket is the most popular sport in the country. In 2009, the Srilankan cricket team was targeted by militants. This tragic incident closed the doors for international cricket in Pakistan. Pakistan Super League (PSL) is a major progress to bring cricket back to Pakistan. It is a successful effort in revival of international cricket and provides an opportunity to train young and talented players. PSL runs between February

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and March every year. Karachi Kings (KK), Islamabad United (ISLU), Lahore Qalandars (LQ), Peshawar Zalmi (PZ), Quetta Gladiators (QG) and Multan Sultan (MS) are the current teams playing in PSL.

It is important to mention that cricket is the second most popular sport of the world with 2.5 billion viewers. Typically, viewers are interested in predictions to see which team will eventually win the match. This high interest of viewers in predicting the outcome of the cricket makes it a potential research avenue for the data science researchers. Several research solutions have been proposed to predict the cricket related variables. In [1], [5], [13] authors present predictive models to predict the players' selection in Indian Premier League (IPL). In [20], a data visualization and prediction tool for IPL data is presented. This HBase tool helps management to select a right team during auction. In [21], machine learning models are trained to forecast the outcome of IPL matches. To the best of our knowledge there is no research for PSL related predictions.

We already discussed that Pakistani are passionate for cricket and PSL fans also want to encourage their team to win the contest with confidence. Keeping all these things in mind, the primary objective of our research is to facilitate the PSL fans, Pakistan Cricket Board (PCB), academicians, researchers and students with the predictions of PSL matches winners. PSL has millions of supporters so it would be an interesting problem to make use of statistics and machine learning to predict the outcome of PSL matches.

Forecasting future from the past is highly subjective and thus requires extraordinarily expert decision making [10]. Machine Learning (ML) [11] is one of the well-known fields with successful implementations to predict the different variables related to healthcare, software engineering, sports and education [3][6][9]. So, application of ML techniques to PSL data seems justified from this perspective also. From the modern-day ML literature [1], we discovered that the most robust and scalable ML algorithm to learn the complicated patterns related to PSL games, and make predictions about their outcomes is the Neural Network (NN). This selection of neural network is also validated when we analysed the data of Pakistan Super League. Moreover, an important module of the Pakistan Super League is team-analytics and our research can help choice makers throughout the PSL matches to evaluate the strength of a team towards another. The main contributions of our work are as follows:

- We propose the first neural network-based model (which we label as PSL-Eye) to forecast the PSL match winner team.
- We also generate a validated PSL dataset (verified from multiple sources) for the researchers who are interested in working on PSL data.

The rest of the paper is organized as follows. Section II presents the relevant background, Section III presents the data collection and preprocessing. Section IV discusses the PSL Eye and its results. We conclude this paper in Section V.

2   Background

In this section we present the relevant background pertinent to this study. First, we discuss the PSL then we explain neural network, tensorflow and keras.

A   Pakistan Super League (PSL)

PSL is a T20 cricket league. It has become one of the top viewing cricketing leagues in the world. It was founded by PCB on 9 September 2015 at Lahore. Its first version was played in UAE. PSL was initiated with 5 teams, i.e., Karachi Kings (KK), Islamabad United (ISLU), Lahore Qalandars (LQ), Peshawar Zalmi (PZ) and Quetta Gladiators (QG). In the third edition which was held in 2018 one more team was introduced in the league named as Multan Sultan (MS). These franchises (teams) are handled and owned by the investors. Initially in 2015, the commercial rights of the league were sold for US$93 million and that for 10 years but according to the sources the market value of the PSL was up to US$300 million in 2017.

The league played in early 2nd and 3rd months of the year. The format of league is double round robin and the playoffs. The PSL is managed by the Pakistan Cricket Board (PCB) head office. Due to security reasons the initial season were completely held in UAE. But from the second season, some matches started to be played in Pakistan also. The main reason to play entire league in Pakistan is to bring the cricket back to home, to fill the empty stadiums and to promote the local talent.

PSL matches have not been the target of any tangible research activity to date. Considering the importance of this local brand and its impact on millions of viewers, our paper presents the first work in this direction.

B   Neural Networks (NN)

Today humans are being replaced by computers in the working environment because they can do work more efficiently at much lower cost to businesses [14]. Moreover, computers can adapt and learn according to certain trends, NN helps to make this possible just like human brain. As shown in Fig. 1, neural network itself consists of many small units called neurons. These neurons are grouped into several layers. Unit of one layer interact with the units of the next layer through weighted connections which really adjust connections is a real valued number. A neuron takes the value of a connected neuron and multiplies it with their connections weight. The sum of all connected neuron set in the bias value is then put into an activation function.

NNs have the potential to study and model non-linear and complicated relationships, in real-life, many of the relationships between inputs and outputs are non-linear as well as complex. After getting to know from the initial inputs and their relationships, it can infer unseen relationships on unseen data as well, hence making the model generalize and predict on unseen data. Unlike many other prediction techniques, NN does not impose any restrictions on the input variables (e.g., how they should be distributed).
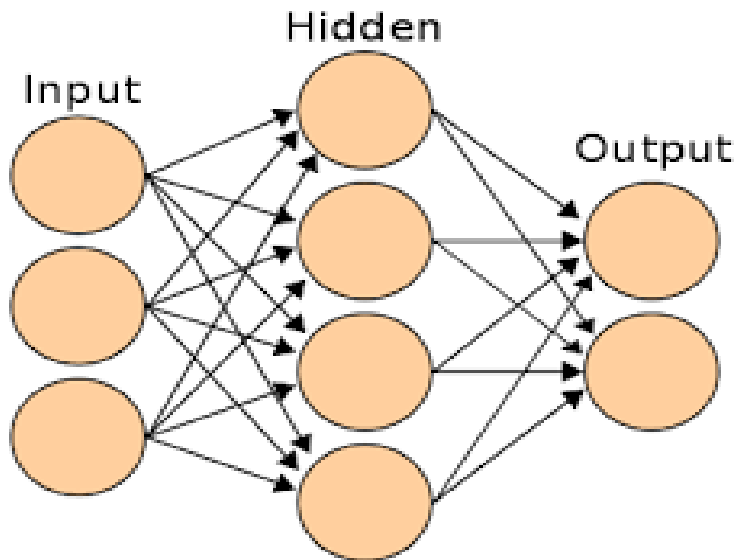
Figure 1: Architecture of Neural Network

C   *Tensoflow and Keras*

Tensor flow is an open source library developed by the Google brain team. It's a versatile library but it was originally created for tasks that require heavy numerical computations. For this reason, tensorflow was geared towards the problem of machine learning and deep neural networks. Due to a C, C++ backend tensorflow was able to run faster than pure python code. Tensorflow offers several advantages for an application. It provides both a python and a C++ API. But the python API is more complete and it's generally easier to use. Tensorflow structure is based on the execution of a data flow graph. A data flow graph has two basic units a node represents a mathematical operation and an edge represents a multidimensional array known as a tensor. Tensorflow's flexible architecture allows you to deploy computation on one or more CPUs or GPUs or in a desktop server or even a mobile device. All of this can be done while only using a single API. Tensor flow has built in support for deep learning and neural networks so it's easy to assemble a net assign parameter and run the training process. It also has a collection of simple trainable mathematical functions that are useful for neural networks and any gradient based machine learning algorithm will benefit from tensor flows auto differentiation and sweet a first-rate optimizer. Tensorflow provides a lot of flexibility because it gives you control over the network structure and the functions used for processing [8].

Keras is an interface that allows us to easily access and customize the Machine learning frameworks, including Tensorflow, Microsoft cognitive tool kit CNTK and Theano. These frameworks also known as backends do all the heavy lifting when importing keras in Jupiter notebook.

Using Tensorflow back end an extremely popular choice for programmers. It's a great easy way to start implementing machine learning and specifically deep neural networks. If someone is interested in the basics of neural networks then Keras allows for quick experimentation with deep neural networks and focuses on being user friendly.

3   Data Collection and Preprocessing

In this section, we discuss data collection procedure and the preprocessing of the PSL data set. We also explain the encoding scheme we used for the categorical variables.

We collected the data of four seasons of PSL from different sources. Pakistan Cricket Board (PCB) official website [22], espncricinfo [23] and Cricingif [24]. ESPN, Cricingif provided us all data about match's venue, toss, weather and ball-by-ball record of batting and fielding side. First PSL season started in 2016. Our dataset contains 115 entries. The data is scrapped from the site and maintained in a Comma Separated Values (CSV).

We want to predict the winner teams of the next PSL matches, so we added all the details of the teams, specifically., team, opposition, home team, toss winner, batting performance (team), bowling performance (team), fielding performance (team), batting performance (opposition), bowling performance (opposition), fielding performance (opposition) , weather, pitch, team last matches performance, opposition last matches performance, team result, opposition result, team score, and opposition score to our dataset.

In season 1, there are some missing values in weather and pitch column. So, we used imputation method to fill the missing values of columns according to remaining values of the same columns. According to imputation mostly there is flat value in pitch column and cloudy in weather column in Dubai.

For better understanding and to make the dataset look some way or another jumbled free, abbreviation is used for every team name instead of their complete name. The abbreviations used in the dataset are the official ones. Figure 2 shows these abbreviations.

Team Name	Abbreviation
Peshawar Zalmi	PZ
Islamabad United	IU
Quetta Gladiator	QG
Karachi Kings	KK
Lahore Qalandar	LQ
Multan Sultan	MS

Figure 2: Abbreviation Chart

There are categorical variables in our dataset. Thus, at whatever point there is an absence of numeric value we convert the categorical variables to numeric values by encoding. Self-encoding technique applied to the categorical data values to convert in numeric values. Columns which have categorical values (shown in fig. 3) like team names, pitch, weather, venue are encoded with the numeric values.

The initial dataset had many features. Trying to feed all these features into the model does not make sense. We need only those features which are significant and play a role in our predicting variable, i.e., match winner. Some variables are divided into multiple columns such as teams batting, bowling, and fielding performance. Weights are assigned to categories according to the correlation between those columns and our dependent variables (Categories: Platinum=0.8, Diamond=0.7, Gold=0.6, Silver=0.5, Emerging=0.4, Supplementary=0.5).

team	opposition	toss	home team	batting	bowling
ISLU	QG	QG	none	ISLU	QG
KK	LQ	KK	none	LQ	KK
PZ	ISLU	PZ	none	PZ	ISLU
QG	KK	QG	none	KK	QG
LQ	PZ	PZ	none	LQ	PZ
ISLU	KK	KK	none	ISLU	KK
QG	PZ	QG	none	PZ	QG

Figure 3: Image from Dataset of categorical variables

For calculating each team's performance points, we formulated several equations to get our variables in single format rather than multiple column with multiple values (as shown in Fig. 4). We took all variables and distributed them in all three departments of game (batting, bowling, fielding) to make one equation for each department. The equations are as follows:

$$Bt.P = (c*w/d) \tag{1}$$
$$Bl.P = (c*w/d) \tag{2}$$
$$F.P = (ct.t*w/t.wk.t)+(d.c*w/r.wk)+(r.o*w/t.wk.t) \tag{3}$$

Where,

Bt.P = batting performance
Bl.P = bowling performance
F.P = fielding performance
c = category (of players)
w = weight
d = depth (no of regular batsmen or no of regular bowlers in teams)
ct.t = catches taken
t.wk = total wicket(s) (lost)
t.wk.t = total wickets taken
d.c = drop catches
r.wk = remaining wicket(s)
r.o = runout

Depth: depth here is the total number of players of particular department played in a particular match. Sum of total number of players in all categories of a department in a match is the depth of that column.

Category: Category in our dataset represents the class of player that which class does he belongs. PSL has six categories of players, i.e., platinum, diamond, gold, silver, emerging and supplementary. We mentioned the total number of players from a particular category in our data set. It shows that how many players from all categories are representing a particular team in a particular match in all three departments which are batting, balling and fielding.

Weight: weight here is a value given to independent variable according to the importance of that independent variable towards the dependent variable. Higher the importance higher the value. It depends on how much that independent variable going to effect on the dependent variable. It determines the weightage of the independent variable in the equation.

Figure 5 presents an image from the preprocessed and validated data set. This dataset is available at [7] and can be shared with other researchers.

Figure 4: Image before preprocessing

Figure 5: Final data set – An Image

We also plot the graph of the team and opposition performances columns to compare the strength. Fig. 6 represents the scatter plot of batting, bowling and all-rounder performances of team and opposition. On x-axis of graphs shows team's batting, bowling and fielding strength and opposition on y-axis of the graph. In every graph each point indicates the co-relation between two variables.
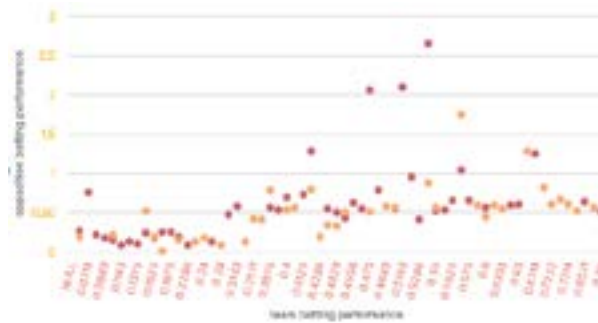
Figure 6A: Graph of batting performances

Figure 6B: Graph of bowling performances
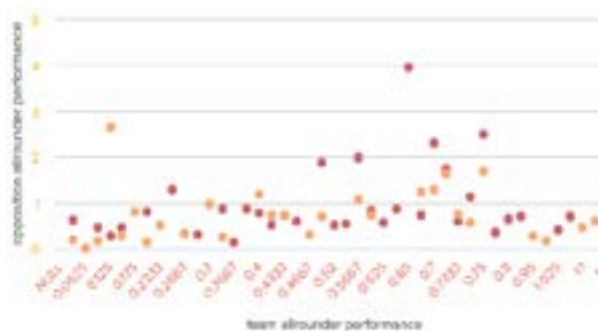
Figure 6C: Graph of all-rounder performances

Control chart is also used to figure out the yearly performance of the teams played in PSL from 1st season started in 2016 till the last season played in 2019 (Figure 7).

Figure 7: Yearly Team Performances

4   PSL EYE: Modeling And Results

In this section we discuss the modeling of PSL eye. Neural network algorithms apply mostly on numeric data and our dataset is primarily numeric in nature. In our problem domain, our model is used to distinguish match winner or loser, it is a binary classification problem. As already mentioned we have 115 records in our dataset.

Before the actual modeling, we applied weights (as per their significance) to predictors in order to achieve a successful and accurate NN implementation. We also grouped the sub variables (discussed in Section III) into single predictor column. For example, batting performance of the team is calculated by summing six columns (five categories and one batting depth). Weights are also used to simplify our network connections. Objective of the weight is to minimize the error. It is an input to neurons, and it is always 1.

In Batting and Bowling Performance, where category is player category column value, weight which we are assigned above, and depth is the number of batsmen or bowlers in playing eleven. In Batting and Bowling Performance, where category is player category column value, weight which we are assigned above, and depth is the number of batsmen or bowlers in playing eleven. After this calculation we have a modified dataset which is used to train NN for PSL match winner predictions.

We modeled the given match prediction problem to predict the wining possibility for the Pakistan super league teams, i.e., KK, LQ, QG, IU, PZ and MS. We modeled the neural network using Sequential Model which is simplest type of neural. The model is coded in python by using TensorFlow and Keras.

In our model, the name of parameters is set as: epochs as epochs, learning rate, batch size as batch size and output as results some values we put directly. We used sigmoid activation function because this is binary classification problem sigmoid scales the output on the scale of 0 to 1.

We have performed all these experiments on a windows 10 machine with Intel core i7-7th gen CPU, 8GB RAM. For optimal results, NN hyper parameters such as input neurons, hidden layers, output neurons, time steps, batch size, and optimizer are needed to be set. These parameters

are important for generating results and good accuracy. We tuned these parameters for our dataset. For this, we simply used trial and error methodology which is a right way to fix these parameters.

Our NN based PSL Eye model generates optimal results with the following values of hyper parameters. 2 hidden layers are used to construct PSL NN. Batch size is set to 10, the batch size is the number of units deal before the model is learned. For activation function in hidden layers we used "relu" and, "sigmoid" for result layer because relu provides probability and sigmoid provide results in the binary form either 0 or 1. We also used Adam Optimizer. Number of epochs is set to 20. Table I presents the accuracies of the model with different setting of hyper parameters.

Table 1: Model Accuracy

No #	Hyper parameters and results		
	Epochs	batch size	Results
1	16	10	60.98%
2	17	10	75.61%
3	18	10	79.08%
4	19	10	82.93%
5	20	10	80.34%

After acquiring the optimal values for these hyper parameters, we re-run the NN with PSL data to obtain the final result. Our model generates the results of winning team with 79%, 80% and 82% accuracies on validation, training and testing data set respectively. Table II shows the details of the results using an image from the results file. In comparison with a research Table III presents a comparison of existing research work PSL-Eye.

Table 2: Result of PSL EYE

Validation Results		Training Results		Testing Results	
Actual	Predicted	Actual	Predicted	Actual	Predicted
Win	Loss	Loss	Loss	Loss	Win
Win	Win	Loss	Loss	Win	Win
Win	Win	Loss	Win	Win	Loss
Loss	Loss	Win	Win	Win	Win
Loss	Loss	Win	Win	Win	Win
79%	80%	82%			
Overall Accuracies					

Table 3: PSL-EYE: A Comparison

Research	Problem	Solution	Accuracy (%)
PSL-Eye	PSL match winner	Neural Net	82
[21]	IPL match winner	Neural Net	72.6
[1]	Cricketer Performance	Neural Net	49-77

We also developed a web interface [25] of PSL Eye and uploaded these results to share with research community. It is a user-friendly interface with complete introduction and background of our work.

5   Conclusion and Future Work

A validated dataset for Pakistan Super League (PSL) is generated to run the Machine learning (ML) experiments. Experiments are run on the data set and, a Neural Network (NN) based solution (PSL Eye) is proposed to predict the winning team of the match. PSL eye model generates results with 82 % accuracy on testing data set. In future we will run experiments on PSL data with other ML algorithms to improve the accuracy of PSL Eye.

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Crypto Currency Cognizance: A New Entrant in Financial Heaven

Sarwat Liaquat[1]   Ammar Siddiqui[2]

Abstract

Cryptocurrency used an online ledger with highly strong cryptography to secure online transactions. There are multiple cryptocurrencies traded publicly that imparts an important role on the behavioral intention of users. The disruption in the economy of the world has provided some opportunities for the development of virtual money or cryptocurrencies so that financial crises of individuals can be removed. The study adapted Theory of Acceptance Model (TAM) that explains the factor that effect behavioral intention of the users of cryptocurrency. The data was collected through survey questionnaire from 177 participants to measure the impact of cryptocurrency on the behavioral intention of users. The findings of this study revealed that multiple factors such as social influence, facilitating conditions, financial literacy, and perceived risk of cryptocurrency imparts an important role on the behavioral intention of individuals to use cryptocurrencies. Moreover the findings will propose numerous methods to function with a greater chance of success in the block chain-related services and cryptocurrencies markets.

Keywords: Cryptocurrencies, behavioral intention, Perceived Risk, Financial literacy, facilitating conditions.

1 Introduction

Cryptocurrency is a digital currency that is used to buy goods and services online. Cryptocurrency worked by using blockchain technology that is a decentralized technology spread across many computers that manage all the transactions as well as records.

According to research Saleh (2018) almost 6,700 cryptocurrencies are traded publicly and also proliferate in the market by initial coin offerings but the most popular and first cryptocurrency is bitcoin. Spread across many computers that manage all the transactions as well as records. According to research Saleh (2018) almost 6,700 cryptocurrencies are traded publicly and also proliferate in the market by initial coin offerings but the most popular and first cryptocurrency is bitcoin. It is a type of virtual money and virtual money has become popular at different times in history. Cryptocurrency is also considered as the digital asset of an individual that is built to function as a medium of exchange based on cryptographic technology (Tamphakdiphanit, and Laukroach, 2020).This exchange of cryptocurrency ensures some basic points and features such as transactional flow and also can control the creation of multiple additional monetary units.

A study explained that the growth of cryptocurrency has increased day by day and almost $391 billion trade in cryptocurrency occurred on daily basis. The market of cryptocurrency

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developed with the development of technology and the high interest of individuals in virtual currencies (Venkatesh, & Davis, 2000). The theory of acceptance model is known as one of the most common model that influence the acceptance of technology by two important factors. Two factors included in TAM model are perceived usefulness and perceived ease of use are used to measure the acceptance of new technology by users (Tamphakdiphanit, and Laukroach, 2020). Cryptocurrency is a new technology so its acceptance in consumers is also measured by TAM model such as consumers who feel difficulty in traditional trading feel ease and usefulness in this digital trading. TAM model also examine the new technology by factors to measure the intention of older individuals towards this new technology.

Cryptocurrency also affects the behavioral intention of consumers towards this virtual currency. TAM model is used to measure the behavioral intention of consumers towards the use of cryptocurrency (Al-Amri, et al., 2019). Multiple factors such as performance expectancy of cryptocurrencies, effort expectancy of use of these cryptocurrencies, social influence of these cryptocurrencies, perceived risk of cryptocurrencies, facilitating conditions for the use of virtual money, and financial literacy are used to measure the behavioral intention of consumes towards cryptocurrency by using TAM model (Alaeddin, O., &Altounjy 2018). The performance expectancy of cryptocurrencies increased day by day as its rate always increased so it imparts a positive impact on the behavioral intention of individuals towards the use of these cryptocurrencies.

The presence of the recent financial crisis imparts importance towards the extensive use of this virtual money but lawmakers imposed some strict rules towards the financial activities. Studies explained that these stricter regulations of these cryptocurrencies have made these markets a safer place but most of the consumers also find a lack of trust in these technologies or virtual money that results in the disrupted economic growth. There is a need to have transparency in the financial system that imparts positivity of consumers towards the use of thee cryptocurrencies (Sharif, &Naghavi, 2020). The presence of these financial technologies, as well as blockchains, also provides opportunities to solve all these problems in disrupted economic growth. Block chain is a new technology or model that is used for the financial markets such as by various cryptocurrencies. The WEF also explained that blockchain imparts an important role in bringing the revolution of financial services and provides a basic platform where consumers can directly contact the manufacturer (Palos-Sanchez, Saura, &Ayestaran, 2021). Thus it is explained that block chain imparts its effect not only on the banking system but also renews the whole economy of the world.

The disruption in the economy of the world has provided some opportunities for the development of virtual money or cryptocurrencies so that financial crises of individuals can be removed. Most of the time individuals have to pay some extra amount in traditional trading that enhances the economic crisis and loss so the need for the development of these online technologies has increased at a great level (Shaalan, 2020). The innovations in technology impart an important role in the development of the economy as they enhance the competitive advantage by improving the economic performance of an organization, an individual, or a state, and also enhance the competitiveness in the market (Guych, 2018). It has been stated that perceived relative advantage imparts a positive in the behavioral intention of consumers

towards the use of these technologies. Studies explained that these technology adoptions add value to the guest service and also enhance the positive relationship between consumers and cryptocurrencies towards its use.

Accepting digital currencies as a payment method may serve as a marketing tool and help businesses distinguish themselves. It is necessary to examine whether digital currencies are accepted and implemented as a tool to trade with traditional currencies and conventional payment systems or not (Jani, 2018). TAM model comprised on two main factors and all these factors perceived usefulness and perceived ease of use so the problem of this study is to measure that either consumers of cryptocurrency are comfortable in use of cryptocurrency. The attitudes of consumers and behavioral intention of individuals towards the use of cryptocurrency is measured by using TAM model (Nasri, & Charfeddine, 2012). The younger generation comes towards the use of cryptocurrency as compare to older because they know the importance of digital technology in this era of technology.

2   Study Objectives & Scope

The primary objective of this study is to examine the impact of cryptocurrency on the behavioral intention of its users. This study also examines the impact of performance expectancy, effort expectancy, social influence, facilitating conditions, perceived risk, and financial literacy imparts an important role towards the use of cryptocurrency.

Some of the secondary objectives of this study are given as follows

- The objective is to measure the factors that prevent individuals from using these cryptocurrencies.
- The objective is to measure that how cryptocurrency enhances the establishment in the economy of a state and an individual.

The scope of this study is to measure the acceptance of cryptocurrency and also the behavioral intentions towards the use of digital and virtual money. The scope of research is very broad as it is not conducted on a specific region conducted to measure the intention of this use towards all over the world. The main objective of this study is to analyze the impact of performance expectancy, effort expectancy, social influence, facilitating conditions, perceived risk, and financial literacy on the behavioral intentions of consumers towards the use of these cryptocurrencies.

3   Literature Review

Multiple scholars have conducted their study to measure the enhanced use of cryptocurrency to reduce all economic crises. The review of some pieces of literature is given as follows to measure the impact of behavioral intention towards the use of virtual assets as well as these cryptocurrencies.

Eloy Gil-Cordero et al. (2020) has done a research to measure the acceptance factors of cryptocurrency as a financial tool. A cryptocurrency is a form of digital asset and all its functions

are operated by using blockchain technology. The basic purpose of using this technology or digital asset is to measure the means of exchange such as the exchange of money by goods and services. Cryptocurrencies constitute a modern digital asset, which is used as a medium of trade and operate by blockchain technology. Some, including Bitcoin, have been recognized worldwide in recent years but cryptocurrencies' insecurity poses concerns regarding their intended usage. The basic aim of this study is to examine multiple factors that imparts their effect on the intention behind the use of cryptocurrencies through the creation of a new research model and the use of Partial Least Squares. All the proposed frameworks have a substantial impact on the purpose behind the use of cryptocurrencies, either directly or indirectly. The findings of this study explained that all these constructs of the cryptocurrency imparts by both ways either by directly or indirectly that affect the behavioral intention towards the use of these cryptocurrencies. The results also concluded that provided value as well as the utility of the companies, and cryptocurrencies imparts an important role in the development of business strategies so that business is conducted effectively.

HamedHeidari et al. (2019) conducted a study to measure all factors that imparts its role in affecting the behavioral intention of an individual towards using of digital asset or cryptocurrency. This study was also conducted to measure the impact of the behavioral intention of an individual as well as organization to use blockchain technology as a financial instrument. This study explained that the use of various technology acceptance models is known as the best way to understand the attitude of individuals towards the use of these blockchain and digital technologies known as cryptocurrencies. This study explained that the use of acceptance modle of technology is an important model in understanding of attitude of users towards all new emerging technologies and cryptocurrencies. This survey examined pilots who affect the behavior of customers towards the use of blockchain capacity as a financial tool by using multiple technology acceptance models to analyze the factors that encourage and motivate the consumers towards the use of blockchain capacity as a financial tool. Therefore, the literature review was first examined and then the structural equation model has established according to the determinants of behavioral intentions to use blockchain abilities as a funding instrument.

Gazali (2018) explained that literature about the use of cryptocurrency and blockchain is studied in detail, and then implements the structural equation modeling to measure the impact of behavioral intention towards the use of these technologies. The findings of this study explained that trust, as well as structural assurance, imparts a positive effect towards the use of these digital technologies. This study also determined that the main characteristic of the technology also imparts an important role in the behavioral intention of consumers towards the use of this technology. The performance expectancy of cryptocurrencies also have a significant role in the behavioral intention of its users either individual or organizations (Alzahrani, &Daim, 2019). Thus the results of this study explained that the use of this blockchain technology and capabilities as a financial instrument raised due to the social need and disruption of the economy. This study also explained that blockchain has some limitations towards use as a financial instrument.

Mario Arias-Oliva et al. (2019) conducted a study to measure the various variables that influence the use of cryptocurrency. This study measured that the first transaction of cryptocurrency

occurred in 2010 and it is also known as the start of revolution in the transactions as transactions can done by online means. The presence of blockchain as well as cryptocurrency dramatically transforms these transactions and enhances the revolution in this form. This study explained that there are almost 2000 cryptocurrencies are present in the market and some are in process of launching after the initial coin offerings so that it can be used as an exchange method and provide opportunities for the individual to operate their business ecosystem and rights to their assets and liabilities. With the presence of financial technologies, these cryptocurrencies have multiple opportunities to operate in the business community. There are some challenges as well as limitations present in the use of these cryptocurrencies (Alqaryouti, et la., 2019). Cryptocurrencies as an evolving fintech open up many possibilities but also face major challenges and limitations. This article analyses from a consumers' point of view the key reasons for the growth of a cryptocurrency. Using a theoretical framework of technology acceptance, we evaluate a model that can clarify nearly 85% of cryptocurrencies' purpose. Amazingly, the danger was not a major factor (Mutambara, 2019). This could be done as most respondents found working with cryptocurrencies to be risky; this lack of explanatory power can be explained by the lack of heterogeneity in their answers to the perceived risk questions.

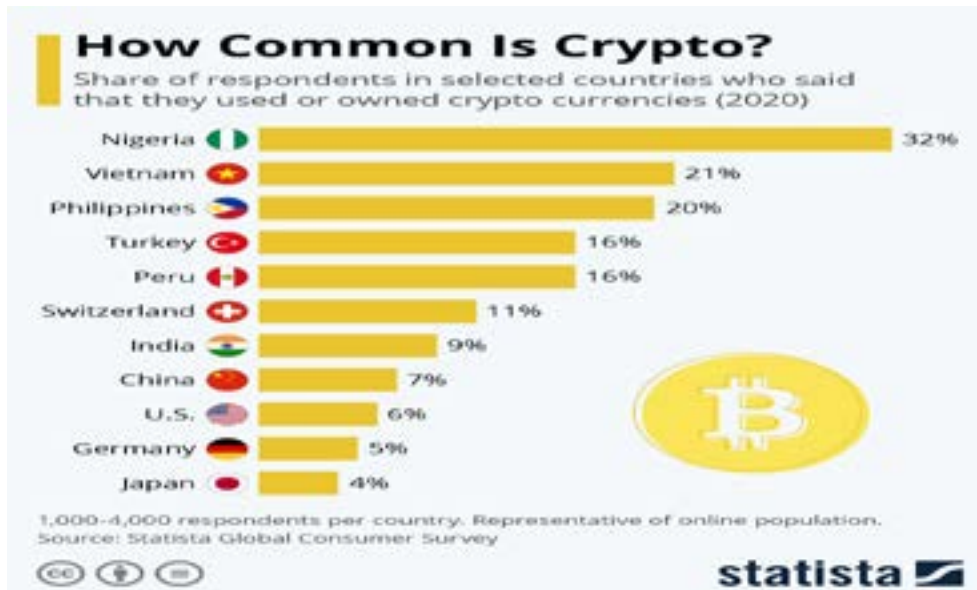## *A   Crypto Currency Review*

Cryptocurrency rely on the blockchain technology due to the major concern of security and safety. Multiple cryptocurrencies are in the market but top 10 cryptocurrencies are Bitcoin, IOTA, Enthereum, NEO, Ripple, Bitcoin Cash, Cardano, Litecoin, and Stellar (Gil-Cordero et al.,2020).

(Source: Statistics and data.org)
Figure 1: The Top 15h Currencies

Al-Amri (2017) explained that 2017 was a breakthrough year for the cryptocurrency because its combine's market cap jumped up to an extraordinary heights. The price of one Bitcoin in 2017 was $20,000 but at the end of July 2018 the price of one Bitcoin was only $8,000. This drop of price became an opportunity for new investors to come in the market. According to a survey, the ratio of owners of cryptocurrencies has increased at a great level. Cryptocurrency is legal in 18 countries: Turkey, Colombia, Mexico, Poland, Germany, Luxembourg, Romania, Netherlands, Brazil, Spain, UK, Belgium, Czechia, Argentina, Australia, Italy, USA, Austria, and France. The ratio of consumers that have their cryptocurrency is mentioned in given graph (Alzahrani, &Daim, 2019).


Figure 2: Common Crypto Currencies

The statistic shows that Nigeria is leading country in cryptocurrency as almost 32% consumers have cryptocurrency. Vietnam came at second in cryptocurrency as 21% of their individuals use various cryptocurrency for online trading. The concentration of cryptocurrency consumers in Philippine and Turkey are also same that is 16%. Japan has least interest in cryptocurrency as only 4% of individual have their own cryptocurrency from Japan.

B   Theoretical framework

Theory of Acceptance Model (TAM) is a model that is designed to measure the adoption of a new technology based on the attitudes of consumers. According to this model the acceptance of a new technology depend on the two main factors of that model such as perceived usefulness and perceived ease of use. These factors impart an important role towards the consumers' attitude that imparts its effect on the behavioral intention of consumers towards the use of that technology (Nasri, &Charfeddine, 2012). In the same way, the behavior attention of consumers towards the use cryptocurrency highly depends on perceived usefulness and perceived ease of use of digital technology in exchange of money. In figure 1,there are six main variable of this study on which theoretical framework of this study explained.
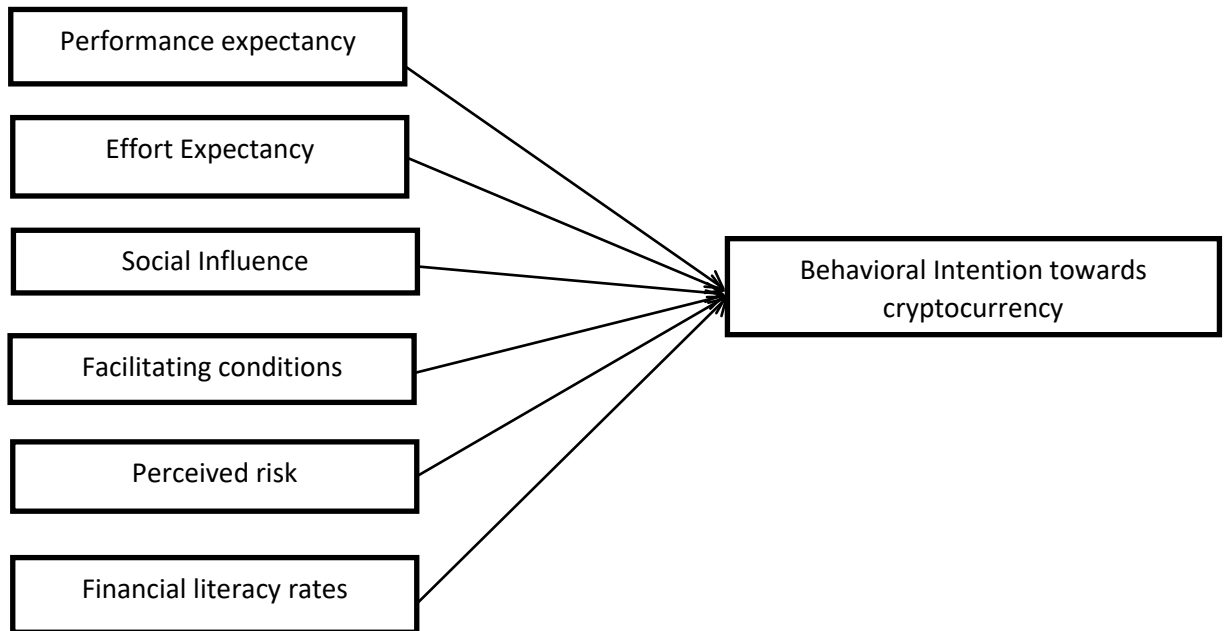
Figure 3: Theoretical Framework

C   Hypothesis

The hypothesis is a proposed explanation on which a study is performed to measure some results. This study is performed to measure the impact of cryptocurrency on the behavioral intention of people to invest. Major hypothesis development of this study are given as follows

H1   Performance expectancy of cryptocurrency imparts a positive impact on the intention of individual towards its use.

H2   Effort expectancy of an individual towards the use of cryptocurrency imparts a positive impact on the behavioral intention of individual to use.

H3   Social influence of cryptocurrency imparts a positive impact on individuals' intention towards its use.

H4   Facilitating conditions of cryptocurrencies' use imparts a positive effect on intention of an individual towards its use.

H5   Perceived risk of cryptocurrency use imparts a negative impact on the intention of an individual towards its use.

H6   Financial literacy imparts a positive impact on the intention of an individual towards the use of cryptocurrencies.

4 Research Methodology

A Research Philosophy & Approach

Research philosophy is known as the foremost step in the methodology of a study as it creates the base for data collection, extraction, as well as analysis of data (Jonker, 2019). There are three main research philosophies such as positivism, interpretivism, as well as realism that provide a basic structure to the study (Schaupp, &Festa, 2018).Positivism research philosophy supports the quantitative study so the research philosophy of the present study is positivism. In this study, the researcher has collected information from various quantitative sources to measure the relationship between all variables of the study. There are two main research approaches deductive approach and inductive approach that are connected with the philosophy of research and allow the researcher to collect and analyze the data. This study was based on positivism so it explained the deductive approach and it allowed the individuals to collect the quantitative data for research.

B Data Collection Method

The data collection method is one of the important steps in the conduction of the study. A researcher should focus on both primary as well as secondary resources to collect the data according to the objectives of the study. The primary methods are more specific as they provide specific information because first-hand knowledge is gathered by primary resources that are highly related to the study. Secondary resources are used to collect detailed information about from previously published articles and financial reports (Mehrwald, et al., 2019). In this study, the researcher has used both primary and secondary sources to collect the data because an individual needs specific and detailed knowledge about the impact of behavioral intention towards cryptocurrency (Albayati, Kim, & Rho, 2020). The secondary information was collected from previously conducted studies published in journal articles, Google scholar, online libraries, books, and other sources to get authentic information about cryptocurrency and its impact on the behavioral intention. The primary data was collected by survey questionnaires to collect the information from people of stock exchange and financial brokerage houses who likely to invest in cryptocurrency.

C Sample Size, Technique and Data Analysis

There are two main sampling techniques important as probability and non-probability (Mendoza-Tello, et al., 2018). In this study purposive sampling method is taken to collect the data efficiently. In this study the sample size is taken as 200 respondents who worked at different financial brokerage houses and stock exchange were approached, out of which 177 were participated in this research. The data were then statistically analyze by using statistical test which includes descriptive analysis, reliability, Pearson correlation, and multiple regression with the help of SPSS software.

5   Results

This section summarizes the result of collected data. The test includes descriptive analysis; reliability statistics, correlation used, and regression analysis were used to analyze the data with the help of SPSS software.

A   *Reliability Analysis*

Table 1: Reliability

Variables	Reliability	Number of Item
Performance expectancy	.820	3
Effort expectancy	.746	3
Social influence	.763	3
Facilitating conditions	.700	3
Perceived risk	.819	3
Financial literacy	.741	3

The table 1 shows the reliability analysis of performance expectancy, effort expectancy, social influence, facilitating conditions, perceived risk, and financial literacy. The value of Cronbach's accepted range is 0.7 to 0.9. Thus the results of each value lies in the range which showed that each construct is accepted. The results explained that intention to use of individuals of cryptocurrency imparts an important role towards the intention of people to use these cryptocurrencies.

Table 2: Descriptive Statistics

	N	Mean	Std. Deviation	Skewness		Kurtosis	
Performance Expectancy	177	3.6365	.84183	-1.143	.183	1.798	.363
Effort Expectancy	177	3.6761	.85534	-.970	.183	.875	.363
Social Influence	177	3.5047	.88199	-.587	.183	.395	.363
Facilitating Condition	177	3.5405	.85415	-.748	.183	1.136	.363
Perceived Risk	177	3.6497	.88782	-.888	.183	.910	.363
Financial Literacy	177	3.5687	.86044	-.633	.183	.610	.363
Intention to use	177	3.5311	.79483	-.696	.183	1.014	.363
Valid N (listwise)	177						

The table 2, descriptive analysis is used to measure the distribution of data and also explain the correlation of all variables of a study. The data was collected by 177 respondents and the mean values of all variables are related to each other. It also explains about the standard deviation and standard deviation tells us about the skewness of data that how much data is spread. The greater the value of SD shows the high spread of data and the results of this study explained that skewness value of performance expectancy, intention to use and facilitating condition is high which means that data of these variables are spread while data of other variable are not too much

spread. Kurtosis explained the heavy-tailed or a light-tailed relative to normal distribution. The value of Kurtosis shows that the data set have a light-tailed as compare to normal distribution.

B   *Correlation Analysis*

Table 3: Correlation analysis

		Performance Expectancy	Effort Expectancy	Social Influence	Facilitating Condition	Percived Risk	Financial Literacy	Intention to use
Performance Expectancy	Pearson Correlation	1	.718**	.620**	.701**	.765**	.681**	.656**
	Sig. (2-tailed)		.000	.000	.000	.000	.000	.000
	N	177	177	177	177	177	177	177
Effort Expectancy	Pearson Correlation	.718**	1	.565**	.689**	.778**	.645**	.666**
	Sig. (2-tailed)	.000		.000	.000	.000	.000	.000
	N	177	177	177	177	177	177	177
Social Influence	Pearson Correlation	.620**	.565**	1	.617**	.591**	.570**	.603**
	Sig. (2-tailed)	.000	.000		.000	.000	.000	.000
	N	177	177	177	177	177	177	177
Facilitating Condition	Pearson Correlation	.701**	.689**	.617**	1	.644**	.521**	.643**
	Sig. (2-tailed)	.000	.000	.000		.000	.000	.000
	N	177	177	177	177	177	177	177
Perceived Risk	Pearson Correlation	.765**	.778**	.591**	.644**	1	.713**	.687**
	Sig. (2-tailed)	.000	.000	.000	.000		.000	.000
	N	177	177	177	177	177	177	177
Financial Literacy	Pearson Correlation	.681**	.645**	.570**	.521**	.713**	1	.635**
	Sig. (2-tailed)	.000	.000	.000	.000	.000		
	N	177	177	177	177	177	177	177
Intention_ to_use	Pearson Correlation	.656**	.666**	.603**	.643**	.687**	.635**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	
	N	177	177	177	177	177	177	177

**. Correlation is significant at the 0.01 level (2-tailed).

The table 3, explains the relationship between both dependent and independent variables of this study. This matrix helped in concluding that there is a significant relationship between all independent and dependent variables of this study. The significant value of all variables to measure their relationship with behavioral intention to use cryptocurrency is 0.00.The result of this matrix show that independent variable have a significant relationship with dependent variable as significance value of all variables is 0.00.

C   *Regression Analysis*

Table 4: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.771[a]	.594	.580	.51536

a.Predictors:(Constant),Financial_Literacy,Faclitating_Condition,Social_Influence,Effort_Expectancy, Performance_Expectancy, Percived_Risk

The table 4, explains the Model summary of this study. It explains that either the model is fit or not. This model also explains the strength of relationship between dependent variables and the model of the study. The R value of this model determines the strength of relationship and high value of R determines the stronger relationship. The R value of this model is 0.771 that shows there is strong relationship between independent and dependent variable. Whereas the value of R2 is 0.594 that means that total 59% variance is explained by independent variables.

Table 5: ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	66.038	6	11.006	41.440	.000[b]
	Residual	45.152	170	.266		
	Total	111.190	176			

a.   Dependent Variable: Intention_to_use
b.   Predictors: (Constant), Financial_Literacy, Faclitating_Condition, Social_Influence, Effort_Expectancy, Performance_Expectancy, Percived_Risk

The table 5, ANOVA which is one of the most important tables in regression analysis as it tells whether the model is significant or not. The value of F is 41.440 and the significance value is 0 which shows that result of this study is significant.
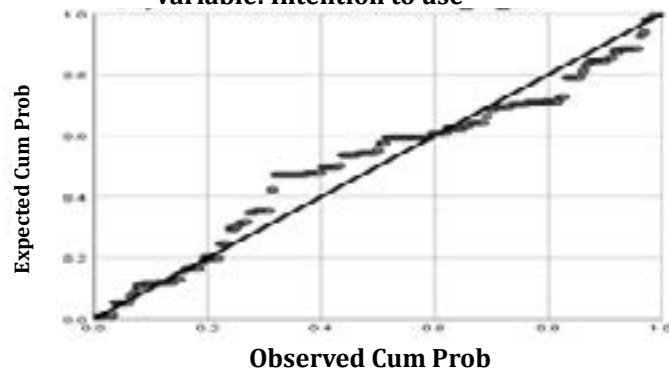
Table 6: Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.514	.197		2.609	.010
	Performance Expectancy	.048	.084	.051	.573	.567
	Effort Expectancy	.129	.080	.138	1.599	.112
	Social Influence	.138	.061	.153	2.241	.026
	Facilitating Condition	.185	.072	.199	2.581	.011
	Perceived Risk	.171	.083	.191	2.049	.042
	Financial Literacy	.170	.069	.184	2.448	.015

a.   Dependent Variable: Intention to_use

Normal P-P Plot of Regression Standardized Dependent Variable: Intention to use_ _

Figure 4: Normal P-P Plot regression

The table 6, Coefficient table explained the significance, strengths, and positive as well as negative relationship of dependent and the independent variables. The table 6 shows that 4 variables (social influence, facilitating condition, perceived risk, and financial literacy) have a positive and significant impact as the value of t is positive and the value of sig is less than 0.05. According to this table 6 performance expectancy and effort expectancy are not accepted as the value of t is lower than 2 also the sig value is above 0.05.

6   Conclusion and Recommendations

Cryptocurrency imparts a positive impact on the behavioral intention of individuals towards invest in these cryptocurrencies. The study is conducted to measure the factors that influence the use of cryptocurrency by examining blockchain technology. The results of this study concluded that the behavioral intention towards adopting the cryptocurrency payment is highly affected by the social influence, financial literacy, perceived risk, and facilitating condition. This study further explained that performance expectancy as well as effort expectancy doesn't show a significant impact on behavioral intention to invest in cryptocurrency. It is recommended that future cryptocurrencies must try to solve the problem related with risk as a condition for pre-adoption. Cryptocurrencies must be perceived as "risk-free" could achieve a significant competitive advantage in relation to the current offer. Moreover it is recommended that government should regulate the polices with this new technological investment option so that investors as well as individual can freely invest in it.

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