

# A Survey on Various Techniques in Internet of Things (IoT) Implementation: A Comparative Study

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**Abstract** - As per the current trends in computing research socialization and Personalization in Internet of Things (IOT) environment are quite trending and they are being widely used. The main aim of research work is to provide socialized and personalized services along with creating awareness of predicting the service. Here various kind of methods are discussed which can be used for predicting user intention in large variety of IOT based applications such as smart mobile, smart television, web mining, weather forecasting, health-care/medical, robotics, road-traffic, educational data mining, natural calamities, retail banking, e-commerce, wireless networks & social networking. By common consent it is found that the prediction is made usually for finding techniques that can be accessed by the mobile user, predicting the next page that is most likely to be used by web user, predicting favorite and most likely TV program that can be viewed by user, getting a list of browsing usage and need of user and also predicting user navigational patterns, predicting future climate conditions, predicting the health and welfare of user, predicting user intention so that implicit could be made and human-like interactions could be possible by accepting implicit commands, predicting the exact amount of traffic at a particular location, predicting curricular performance of student in schools & colleges, having prediction of frequency of natural calamities and their occurrences such as floods, earthquakes over a long period of time & also the required time in which precautionary measures could be adopted, predicting & detecting the frauds in which false user try to make transaction in the name of genuine user, predicting the steps and work done by the user to improve the business, predicting & detecting the intruder acting in the network, by the help of context history predicting the mood transition information of the user, etc. Here in this topic of discussion, different techniques such as Decision Tree algorithm, Artificial Intelligence and Data Mining based Machine learning techniques, Content and Collaborative based Recommender algorithms are used for prediction.

**Keywords:** *Impact on Personalization, IoT, navigational behavior, intruder, security.*

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## I. INTRODUCTION

In presenting computing applications user intention prediction which is based on contextual data generated by Internet of Things has become an emerging research trend. By the use of contextual data Prediction could turn out being more meaningful when the contextual data generated by Internet of things (IoT) is being utilized for achieving user intention prediction. By providing a link between different objects and things human intervention can be minimized which result in perfection of work done by them. From getting into each and every point it can be noted that, even though the ubiquitous computing devices provide certain entertainment programs but then also they could not reach to the level of expectation people have from them. Thus unsatisfaction is created among users. On basis of personal interaction and day to day discussion the need of people must be noted and work must be carried as per that data. Among main goals to be accomplished by internet prediction system, one must be to get things done at the span of time in which user want to get the work completed. For gaining new skills and knowledge, effective assistance of the prediction system can be acquired by the users which help them to easily get the recommended service through

which their satisfaction level can be boosted up. To accomplish needs of user and to make user more comfortable there are several applications where prediction techniques are applied on the contextual data generated by IoT. They are as under: 1) Smart Mobile 2) Smart TV 3) Web mining 4) Weather forecasting 5) Health-care 6) Robotics 7) Road traffic 8) Educational Data Mining 9) Natural calamities 10) Retail Banking 11) E-commerce 12) Wireless Networks 13) Social networking.

There are several applications such as Web mining where the prediction is necessary to infer user's future actions on computer. There are several uses of Prediction techniques through which services can be provided like predicting the next page which is going to be accessed by the user, for predicting the navigational patterns of user and its usage needs on websites, to get the knowledge of browsing behavior of the user. In web mining Association, RuleMining, Modified Naive Bayesian Classifier, Markov Model Techniques, Clustering Techniques, Sequential Patterns, Apriori algorithm are the most widely used intention prediction techniques with which the needs of user can be fulfilled and satisfaction can be attained by the user.

For making human-like interactions in Robotic application it is necessary to predict user intention it could be done by accepting implicit commands, even not directly but by observable desires. For instance if a robot is assisting the user in the house then it has work of recognizing that when does the user wants to eat the food, drink coffee, etc & provide all the intended services to the user without his intervention. In robotic application Hybrid Dynamic Bayesian Networks & Hidden Markov Model are the two most widely used prediction techniques.

In Road Traffic application, prediction is necessary for accomplishing the factors stated below: 1) by making use of previous determinations understanding the amount of traffic occurring at a particular location 2) for avoiding road accidents driver's behavior & state of mind must be predicted 3) road accidents are also caused by conditions of road so predicting them is also an important task to do. Least Squares Method, Artificial Neural Network (ANN), feed forward-back propagation algorithm, Regression analysis are various kinds of prediction techniques that are being used for reducing the rates of road traffic accidents (RTA) in road traffic application.

In the condition of Natural calamities, prediction is required to estimate number of times floods, earthquakes & occurrence of other natural disasters over a long period of time with which the precautionary measures can be taken and damage can be minimized. Delphi method, last period demand, simple and weighted N-Period moving averages, simple exponential smoothing, and multiplicative seasonal indexes are more commonly used prediction techniques for predicting natural calamities.

Prediction is required in Wireless Networks application so that the intruder can be detected & then eliminated i.e. false user acting in the network. The behavior of attacker can be found out with this, based on his previous actions & data. The time at which attacker transmits the data can also be found out. Prediction techniques widely used are ARMA, ARIMA, Fractal forecasting, Neural networks, Mutual Information and Non parametric noise estimator.

## II. LITERATURE SURVEY

**DilpreetKaur, A.P. SukhpreetKaur [7]**, invented a KFCM method of fuzzy clustering approach through which prediction of next webpage which is going to be requested by the user can be done. From experiments and researches it can be found that KFCM pick more pages that has highest weight and highest probability than FCM which can be opened by user in near future. Further, FCM clusters are not as good as KFCM clusters on the basis of prediction and it also uses Kernel induced function instead of Euclidean distance function. To evaluate its performance and

effectiveness proposed method can be applied on different kinds of websites and it can also be applied on large data sets in future.

**Shaul Karni, Hermona Soreq [12]**, proposed a gene prediction approach that helps in predicting that whether the person is suffering from the disease myasthenia gravis or not. It is basically related to integration of protein-protein interaction network data with gene expression data that can be used to derive a set of disease-related genes. Its function is to find out the disease related genes that the proposed method applies a set-cover-like heuristic. This mainly acts in direction of finding the germs that cause the disease known as myasthenia gravis.

**Gabriela Serban, Istvan-Gergely Czibula [13]**, proposed a programming interface that can be used for assisting physicians in medical diagnosis. With the help of relational association rules & a supervised learning method the interface provides perfect diagnosis of the disease. As an experiment interface was tested for diagnosing biggest disease cancer & as obtained result was with accuracy of 90% for the testing data set. And hence it can be concluded that this interface can be used for diagnosing any disease.

**Darcy A. Davis, Nitesh V. Chawla [14]**, proposed an approach called *CARE*- Collaborative Assessment and Recommendation Engine that predicted future diseases risk by depending on patient's medical history with the help of ICD-9-CM codes & even by combination collaborative filtering methods with clustering. *ICARE*, the iterative version of *CARE* is also described which incorporates ensemble concepts for improving the performance. With these illustrations of experimented huge medicare dataset it is found that the proposed systems perform well at predicting future disease risks.

**Gianluca Dell'Acqua, Francesca Russo [15]**, proposed two accident prediction models: the first model indicates two-lane rural roads & second is associated with multilane roads. Explanatory variables used in the proposed models include roadway segments length, curvature change rate, vertical slope, traffic flow, lane width. To analyze the accidental data the procedure based on Least square method was used. The predicted values which were obtained by calibration procedure with several other models are known as t-test method.

**Francisca Nonyelum Ogwueleka, Sanjay Misra [16]**, proposed Artificial Neural Network (ANN) model for the analysis and prediction of accident rates. The parameters that were being used by the proposed model were: the number of vehicles, accidents, and population. For predicting accident rates a feed forward-back propagation algorithm with linear & sigmoid active functions were used.

In achieving road accident prediction the experimental results illustrated that the proposed ANN model is better than other statistical models.

**Jemuel Dalino, John Sixto Santos [18]**, proposed an approach which compares the performance of Decision Trees, Artificial Neural Network & Support Vector Machines. The aim of these models was to attain prediction rate of student’s success. It was found that decision tree algorithm is best suited for predicting the success rates of students.

**Saptarsi Goswami, Sanjay Chakraborty [20]**, proposed an approach with which the reviews and application of analytical & data mining techniques to predict natural disasters can be done. It comprises of three steps which are based on the data collected from disasters: 1) Prediction 2) Detection and 3) Development of appropriate disaster management strategy.

**Zhang, Xiao Yu, Xiang Li, and Xiao Lin [21]**, proposed Particle Swarm Optimization approach from that the prediction of magnitude of the earth quake can be done. From a laboratory in china the seismological data for achieving the prediction was taken.

**Sahay, Rajeev Ranjan, and Ayush Srivastava [22]**, proposed a model which was based on wavelet transform, genetic algorithm & artificial neural networks through which monsoon flood could be predicted. Auto regressive models were not as forceful and perfect as these models.

These hydrological time series data was taken from laboratory in India.

**Carsten Magerkurth, Martin Strohbach [25]**, proposed an approach which uses mobile & IoT technologies to predict value added services within retail store environment based on product quality known as dynamic pricing. The main aim of this research work is to facilitate the prediction by with which complex processes of real-world integration can be simplified to an great extent.

**Aditya Mogadala, Vasudeva Varma[31]**, proposed an approach through which mood transition of a user on social media can be predicted social sites like twitter by taking into account tweets which were posted over time line with the help of SVM regression analysis. Experimental results reveal that the proposed approach attained less root-mean-square error of about 2.72 & relative absolute error of about 98.36% compared to other regression approaches like isotonic, linear, etc for mood transition prediction. More robust features & techniques can be utilized for prediction of the mood transition of the user in future so that accuracy rate can be improved and error rate can be reduced.

### III. COMPARISON OF EXISTING PREDICTION TECHNIQUES

The table below shows the discussed applications, algorithms & their purpose, parameters used for achieving prediction in each application.

**Table 1: Applications & their Prediction Techniques**

Sl.No	Prediction Techniques	Application	Purpose	Parameters used for measuring the Performance
1	Classification & Clustering algorithms	Smart Mobile	For predicting mood of the mobile user	<ul style="list-style-type: none"> <li>Mental states of the mobile user</li> <li>acceleration, light, ambient sound, location &amp; call log</li> </ul>
2	Data mining and machine learning techniques such as Decision tree classifier, Naive Bayesian classifier, Back-propagation (a neural network), and Case-based reasoning technique, Support Vector Machine (SVM), Bayesian Belief Network (BBN)	Smart TV	For predicting the channel/TV program of user interest	<ul style="list-style-type: none"> <li>User profile, user context &amp; user ratings</li> <li>User preferences, watching habits, age, occupation, etc</li> </ul>
3	Fuzzy clustering algorithms like KFCM, FCM, Markov models, Prefix Span, Apriori, WAP-tree, UAM, PNT, IBD, etc	Web mining	For predicting the web user intent & their navigational patterns	<ul style="list-style-type: none"> <li>User web context history(web logs)</li> <li>Keyword &amp; concept features</li> </ul>
4	EnKF, EnVE, 4DVar	Weather forecasting	For predicting the	<ul style="list-style-type: none"> <li>Temperature</li> </ul>

			future weather conditions	<ul style="list-style-type: none"> <li>• Pressure</li> <li>• Humidity</li> </ul>
5	Heuristic method, Association rules, Supervised learning method, Collaborative filtering with clustering	Medical/Health care	For predicting future disease risks	<ul style="list-style-type: none"> <li>• Genes</li> <li>• Medical history</li> </ul>
6	Least Square Method, t-test method, Artificial Neural Network	Road Traffic	For predicting the occurrence of road accidents, road accident rates & to take precautionary measures	<ul style="list-style-type: none"> <li>• Explanatory variables like roadway segments length, curvature change rate, vertical slope, traffic flow, lane width</li> <li>• Number of vehicles, population &amp; number of accidents</li> </ul>
7	Classification based Apriori algorithm, Decision trees, Artificial neural networks, Support vector machines	Educational Data Mining	For predicting student performance in academics	<ul style="list-style-type: none"> <li>• Attendance,</li> <li>• Internal assessment tests &amp;</li> <li>• Involvement in doing assignment</li> </ul>
8	Particle Swarm Optimization, genetic algorithm, wavelet transform	Natural Calamities	For predicting the magnitude of earth quake, monsoon flood	<ul style="list-style-type: none"> <li>• Seismological data</li> <li>• Hydrological data</li> </ul>
9	Classification based Logistic regression, Decision tree, Association rules	Retail Banking	For customer attrition prediction	<ul style="list-style-type: none"> <li>• Customer data</li> </ul>
10	Association analysis based decision tree & clustering algorithms	E-commerce	For predicting the actions performed by the user	<ul style="list-style-type: none"> <li>• Association rule based context history</li> </ul>
11	ARMA, ARIMA, Fractal forecasting, Neural networks, Non-parametric noise estimation	Wireless Networks	For detecting and eliminating the intruder acting in the network	<ul style="list-style-type: none"> <li>• Time based context history</li> </ul>
12	Isotonic, linear, LMS, SVM regression algorithms	Social Networking	For predicting mood transition information, matching social media navigation with the temporal intent of the user	<ul style="list-style-type: none"> <li>• Tweets posted by the user</li> <li>• Context information of the user</li> </ul>
13	Hybrid Dynamic Bayesian Networks & Hidden Markov Model.	Robotics	For making implicit & human like interactions possible	<ul style="list-style-type: none"> <li>• Implicit commands</li> </ul>

#### IV. CONCLUSION

Here we got to know about the usage of data mining & machine learning techniques and also to predict user intentions so that personalized services can be provided. As we all know various kind of algorithms are there and they are used at different predictions as per their type. List of prediction technique discussed in this topic are as follows: for predicting the user intentions in smart mobile application Classification & Clustering algorithms are used. Data mining and machine learning techniques such as Decision

tree classifier, Naive Bayesian classifier, Back-propagation (a neural network), and Case-based reasoning technique, Support Vector Machine (SVM), Bayesian Belief Network (BBN) for predicting user favorite TV program in smart TV application. Fuzzy clustering algorithms like KFCM, FCM, Markov models, Prefix Span, Apriori, WAP-tree, UAM, PNT, and IBD for predicting user navigational patterns in the web mining application. EnKF, EnVE, 4DVar algorithms for predicting future weather conditions like temperature, humidity, etc in weather forecasting application. Heuristic method, Association rules, Supervised

learning method, Collaborative filtering with clustering for predicting whether the person is suffering from the disease in medical/health care application. Least Square Method, t-test method, Artificial Neural Network for predicting the mental state of the driver, road conditions & preventing the road accidents in road traffic application. Classification based Apriori algorithm, Decision trees, Artificial neural networks, Support vector machines for predicting the student performance in educational data mining application. Particle Swarm Optimization, genetic algorithm, wavelet transform for predicting the occurrence of earth quakes, floods in natural calamities application. Classification based Logistic regression, Decision tree, Association rules for predicting customer attrition in retail banking application. Association analysis based decision tree & clustering algorithms for predicting the actions performed by the user in e-commerce application. ARMA, ARIMA, Fractal forecasting, Neural networks, Non-parametric noise estimation for detecting & eliminating the intruder in wireless networking application. Isotonic, linear, LMS, SVM regression algorithms for predicting mood transition information in social networking application.

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