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Internet of Ambience: An IoT Based Context Aware Monitoring Strategy for Ambient Assisted Living

S.Balamurugan [#1], R.P.Shermy [#2],V.M.Prabhakaran[#3] and Dr.R.Gokul Kruba Shanker[*4]

[#]Department of Computer Science and Engineering, KIT-Kalaignarkarunanidhi Institute of Technology, Coimbatore, Tamilnadu, India

**Consultant Surgical Gastroenterologist, Advanced Laparoscopic and Bariatric Surgeon, VGM Hospital-Institute of Gastroenterology, Coimbatore, Tamilnadu, India*

[1] sbnbala@gmail.com

Abstract— *In this paper we enhance the innovative architectural model for context-aware monitoring, BDCaM that uses cloud computing platforms. Every generated context of Ambient Assisted Living (AAL) systems is sent to the cloud. A number of distributed servers in the cloud store and process those contexts to extract required information for decision-making using this novel technique. We develop a 2-step learning methodology. In the first step, the system identifies the correlations between context attributes and the threshold values of vital signs. Using Map Reduce Apriori algorithm, over a long term context data of a particular patient, the system generates a set of association rules that are specific to that patient. In the second step, the system uses supervised learning over a new large set of context data generated using the rules discovered in the first step. In this way, the system becomes more robust to accurately predict any patient situation. We demonstrate the performance and efficiency of BDCaM model in situation classification by implementing a case study. Our system refines patient-specific rules from big data and simplifies the job of healthcare professionals by providing early detection of anomalous situations with good accuracy. The big data producers of BDCaM model are a large number of AAL systems. The low level setup of each system varies according to the requirements of the patient. The sensors, devices and software services of each AAL system produce raw data that contain low level information of a patient's health status location, activities, surrounding ambient conditions, device status, etc. This paper would promote a lot of research in the area of application of IoT in Ambient Assisted Living.*

Keywords- Internet of Things, Cloud Computing, Big Data, Ambient Assisted Living, Context Aware Monitoring.

I. INTRODUCTION

An ambient assisted living (AAL) [1] system consists of heterogeneous sensors and devices whichgenerate huge amounts of patient-specific unstructured raw data every day. Due to diversity of sensors and devices, the captured data also have wide variations. A data element can be from a few bytes of numerical value (e.g. HR = 72 bpm) to several gigabytes of video stream [3][4]. We propose a knowledge discovery-based approach that allows the context-aware system to adapt its behavior in runtime by analyzing large amounts of data generated in ambient assisted living (AAL) systems and stored in cloud repositories. The outcomes of this learning method are then applied in context-aware decision-making processes for the patient. To identify the true abnormal conditions of patients having variations in blood pressure (BP) and heart rate (HR)[5]-[8]. Here we are using FP-Growth algorithm for mining process. The FP-Growth Algorithm [9]-[16] is an efficient and scalable method for mining the complete set of frequent patterns by pattern fragment growth, using an extended prefix-tree structure for storing compressed and crucial information about frequent patterns named frequent-pattern tree (FP-tree). So, we are using FP-Growth algorithm in our concept BD-Cam for using the medical data very efficiently.

The rest of the paper is organized as follows: Section 2 describes The Object Oriented Perspective Of Context-Aware Monitoring Systems. Section 3 gives a broad overview of Discussion and Results. Section 4 concludes the paper giving the future research direction.

II. THE OBJECT ORIENTED PERSPECTIVE OF CONTEXT-AWARE MONITORING SYSTEMS

2.1 USE CASE DIAGRAM

The Context management system [2] collects the raw data and pre-process the data using the data collected from the database and monitors the records in the database. The big data manages all the input data and collects, Pre-process and mining the data using the FP-Growth and then it Monitors the records and provide the required service for the user [17][18]. The user only gives the Input data and they are provided with the required services.

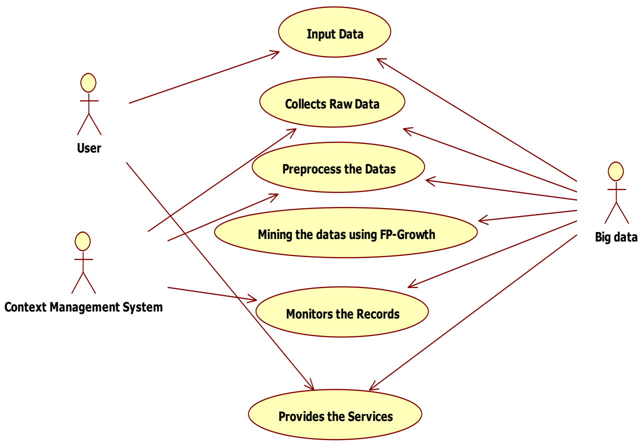

Figure 1. Use Case Diagram

2.2 ACTIVITY DIAGRAM

The input data are collected from the user and they are stored in data collector and forwarder, the data are been processed and aggregated and stored in the cloud repository. Then it mines the frequent data and provides context and queries to service providers.

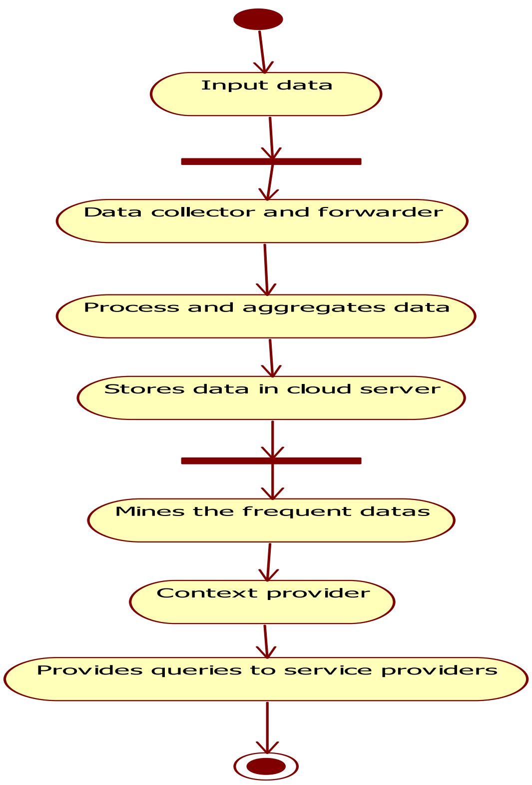

Figure 2. Activity Diagram

2.3 STATE DIAGRAM

The input data are collected from the user and they are stored in data collector and forwarder and the context is aggregated and stored in cloud server. The context provider provides the context, it helps in the construction of the context management system and then required service is provided.

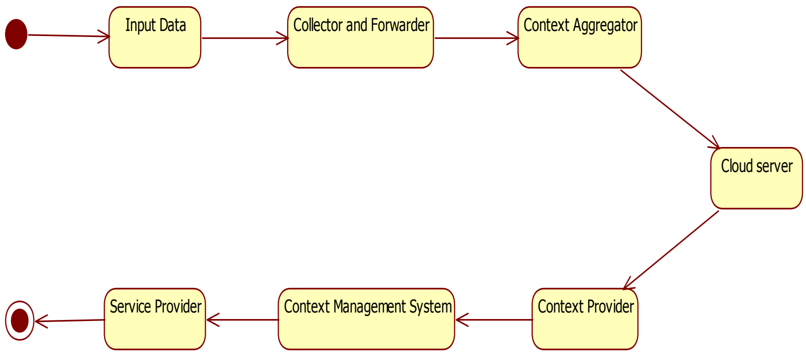

Figure 3. State Diagram

2.4 SEQUENCE DIAGRAM

The user inputs the raw data to the context management system and the system collects the raw data from the user. The cloud server Pre-processes the collected data from the user and the context management system stores all the data in the cloud. The context management system aggregates all the context data and the cloud server manages all aggregated data. Then the system provides the data filtering and classification to the cloud server and the results are provided to the user. Figure 4. Sequence Diagram

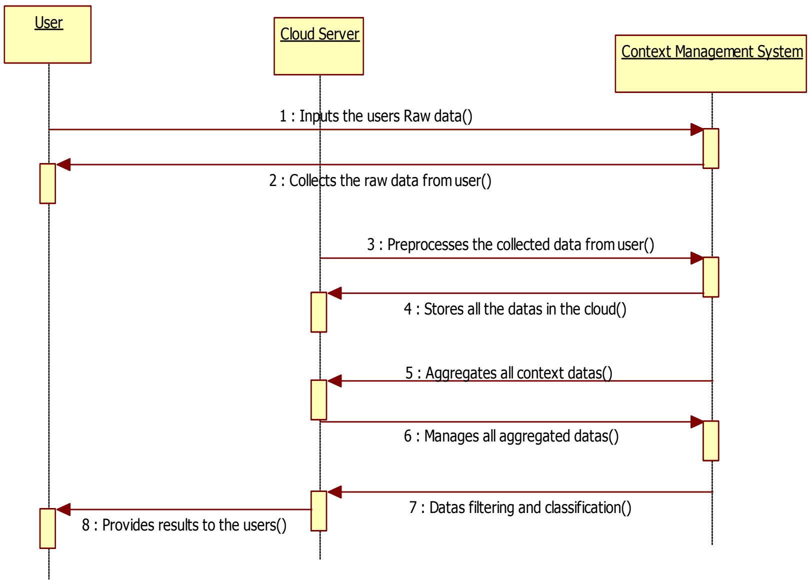

Figure 4. Sequence Diagram

III. DISCUSSION AND RESULTS

3.1 INPUT DATA

A computerized administrative system used to manage and record patient details and any treatments that the patient has, as an inpatient or outpatient. It is vital to effective operation and management of the system, generating such documents as labels and letters and providing information to monitor throughputs against contracts and report performance against key targets.

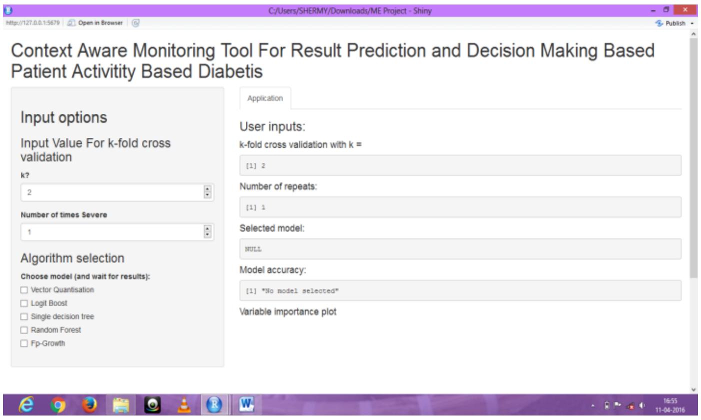

Figure 5. BDCAM

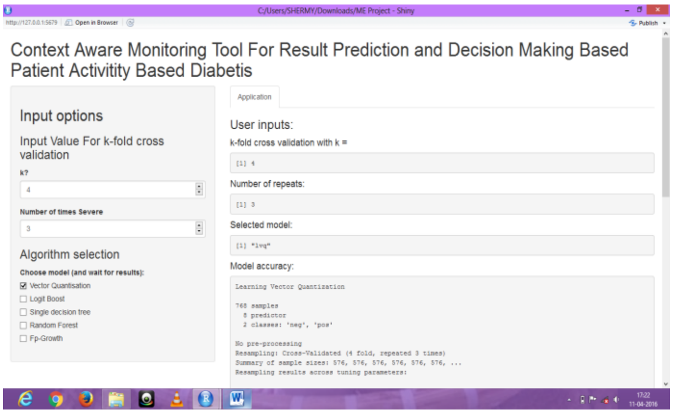

Figure 6. Vector Quantization

The vector quantization technique from signal processing that allows the modeling of probability density functions by the distribution of prototype vectors, data compression.

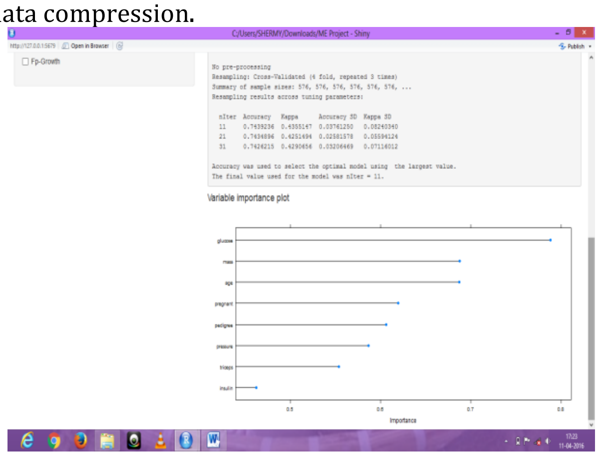

Figure 7. Vector QuantizationVariable Plot

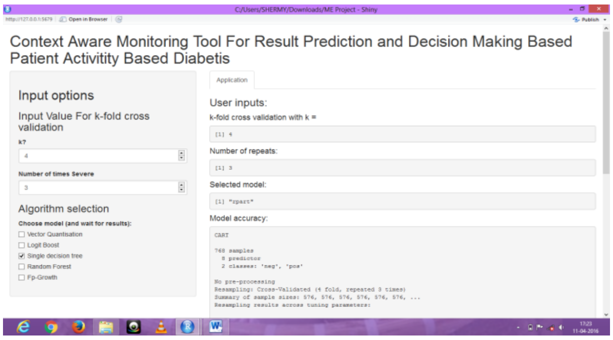

Figure 8. Logit Boost

Logit boost is a ada boost algorithm is a generalized additive model and then applies the cost functional of logistic regression.

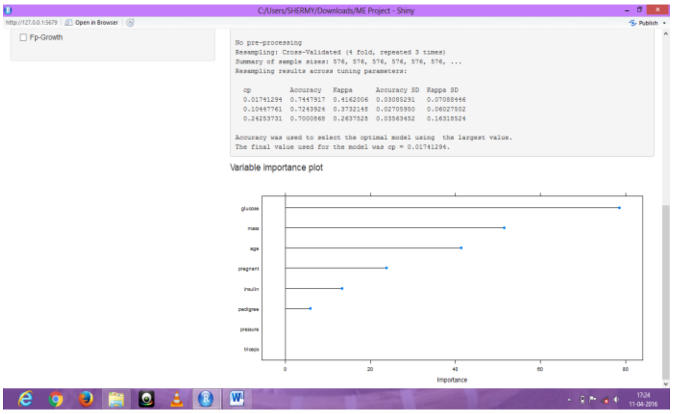

Figure 9. Logit BoostVariable Plot

3.2 DATA ACCESS CONTROL

Data access controller is main of the context aware in the management systems. The admin provide and valid for patient and emergency external user account are maintained. In the emergency situation external login Id is given to the third party accessed. It provides management with information system on service delivery. Emergency user need to request to view patient details sent request to the admin. Admin view the request details and give access permission to the emergency users.

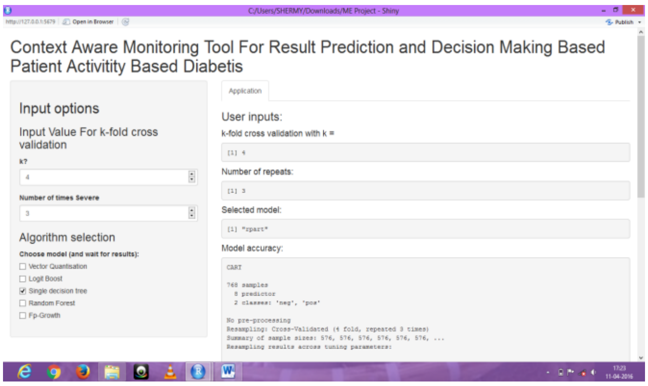

Figure 10. Single Decision trees

A decision tree is a decision support tool that uses a tree-like graph or model of decisions and their possible consequences, including chance event outcomes, resource costs and utility. They are commonly used in operations research, specifically in decision analysis, to help identity a strategy most likely to reach a goal, but are also a popular tool in machine learning.

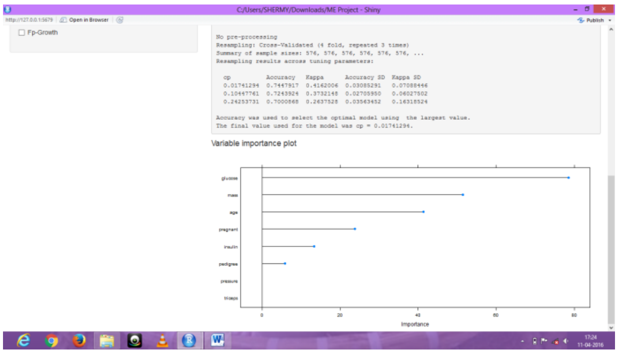

Figure 11. Single Decision treesVariable Plot

3.3 POSTPROCESSING

In the Post processing module, the required data are collected from the previous phase. Each CP applies well-known techniques to obtain primitive context from the low level data. The data should be classified based on the Rule-based method and the classified data are then stored in the Personal Cloud Servers. A Context Management System (CMS) is the core component of the framework. The CMS consists of a number of distributed cloud servers that hold the big data. It stores the context histories of millions of patients. Different machine learning techniques run inside the CMS that infer different personalized and generic rules for various user events. When the CMS discovers any personalized rules, they are sent to the corresponding PCS. Any newly identified generic rules are forwarded to the service provider's (SP) cloud. This is how the CMS keeps every component of the model up to date with new knowledge. Sometimes, existing rules are required to reason new high-level knowledge.

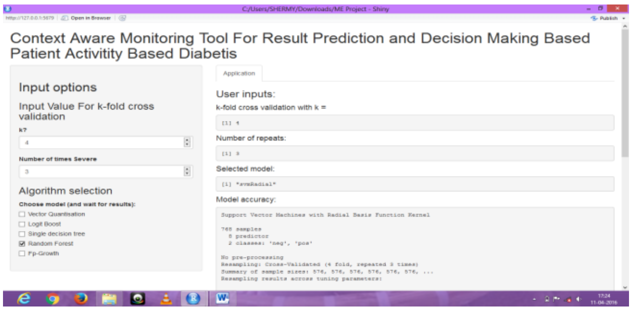

Figure 12. Random Forest

Random forest is a motion of the general technique of random decision forests that are an ensemble learning method for classification, regression and other tasks, that operate by constructing a multitude of decision trees at training time and outputting the class that is the mode of the classes.

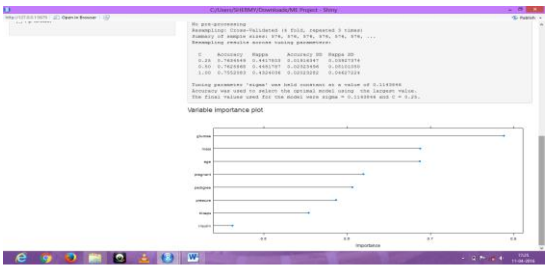

Figure 13. Random Forest Variable Plot

3.4 CONTEXT AWARE DECISION

The data collector module runs in the local server, collects the raw data from an AAL system and forwards them to the CA cloud. As described, the CPs convert low level data to high level context and send them back to the CA cloud. From existing research literature we assumed that such capabilities of context conversions already exist. To make the computation simpler, each context attribute value set Ai is converted to a numerical value. Some context attributes already have numeric values. Numerical annotations are used for contexts having nominal value. The static or historical contexts that have Boolean values are combined together.

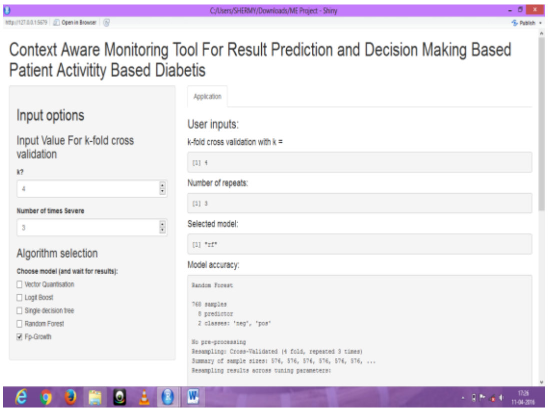

Figure 14. FP-Growth Algorithm Trace

A FP-Tree is a tree data structure that represents the database in a compact way. It is constructed by mapping each frequency ordered transaction onto a path in the FP-tree.

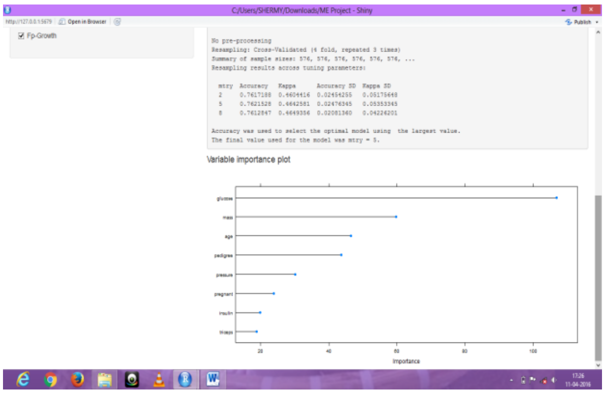

Figure 15. FP-Growth Variable Plot

IV. CONCLUSION AND FUTURE WORK

The BDCaM, a generalized framework for personalized healthcare, which leverages the advantages of context-aware computing, remote-monitoring, cloud computing, machine learning and big data. Our solution provides a systematic approach to support the fast-growing communities of people with chronic illness who live alone and require assisted care. The FP- Growth model also simplifies the tasks of healthcare professionals by not swamping them with false alerts. The system can accurately distinguish. The FP- Growth method used to validate the model are obtained via artificial data generation based on data derived from real patients, preserving the correlation of a patient's vital signs with different activities and symptoms. The FP-Growth stronger relationship between vital signs and contextual information will make the generated data more consistent and the model will be more accurate for validation. The experimental evaluation of our system in cloud model for patients having different HR and BP levels has demonstrated that the system can predict correct abnormal conditions in a patient with great accuracy and within a short time when it is properly trained with large samples.

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