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WI-FI Based Patient Monitoring System

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ABSTRACT: The increased use of mobile technologies and smart devices in the area of health has caused great impact on the world. Health experts are increasingly taking advantage of the benefits these technologies bring, thus generating a significant improvement in health care in clinical settings and out of them. Among the applications that Internet of Things (IoT) facilitated to the world, Healthcare applications are most important. In general, IoT has been widely used to interconnect the advanced medical resources and to offer smart and effective healthcare services to the people. The advanced sensors can be either worn or be embedded into the body of the patients, so as to continuously monitor their health. The information collected in such manner, can be analyzed, aggregated and mined to do the early prediction of diseases. The processing algorithms assist the physicians for the personalization of treatment and it helps to make the health care economical, at the same time, with improved outcomes. Also, in this paper, we highlight the challenges in the implementation of IoT health monitoring system in real world.

I. INTRODUCTION

Today increasingly growing number of people with chronic diseases, this is due to different risk factors such as dietary habits, physical inactivity, alcohol consumption, among others. The world population is increasing tremendously. The cities accommodating more population face astounding pressure of urban living. Even though the medical resources and facilities in cities are expanded daily, still the suffice level is not attained. The massive pressure towards the management of healthcare in cities has triggered the advancement in technologies to come out with the proper solutions to the booming problems. With the increased rate of medically challenged people, remote healthcare has become a part of our life. In recent years, we observe the increased interest in wearable sensors and such devices are available in market for cheaper rate for personal healthcare and activity awareness. Researchers considered implementation of such advanced devices for the medical applications for data recording, management and also to continuously monitor the patient's health. The Internet of Things offers a rising technology to attain the next level of health services. It assures for the affordable, low-cost, reliable and handy devices to be carried or embedded with the patients, so that to enable seamless networking between the patients, medical devices and physicians. The sensors will record signals in a continuous manner, they are then correlated with the essential physiological parameters and communicated over the wireless network. The resulting data is stored, processed and analyzed with the existing health records. Using the available data records and decision support systems, the physician can do a better prognosis so that to suggest early treatment. Even when the doctor is not available, this analysis enables the today's machines to predict the health issues. Not only prediction, machines can also be able to come out with the medicines from the systematic study of the medicinal databases. The progressive technology will have a transformative impact in every human's life and health monitoring; it will remarkably cut down the healthcare expenses and a step ahead in the accuracy of disease predictions. In this paper, we present a idea of a service model in technological and economic views for the comfort of patients and also the open challenges in implementing IoT in real world medical field.

II. SYSTEM ARCHITECTURE

In the health monitoring system, the existing Wireless Sensor Networks(WSN) must be customized so as to remodify the sensing nodes based on relative distance between sensors and health center, also to acquire more physical information for long time by avoiding redundant tasks. When we focus on low energy consumption, threshold levels should be set so as to handle the emergency situations. At the same time, the other sensors can be powered off to save batter lifetime. Another wireless communication preferred is Bluetooth low energy (BLE) which is for short range communication with low power consumption. It suits for particular requirements of applications such as health monitoring, home entertainment and also sports. Using BLE, the components can be put in sleep for long intervals and so the energy consumption will be highly reduced in terms of number of bytes sent per Joule of energy. Nowadays, the smart phones are coming with much and more advanced facilities so that it can be used as both LTE and Wi-Fi. Such smart phones can act as concentrators in this system. Data collected by the concentrator will be transmitted to the cloud to storage. Such data, if stored, it will be much helpful to access on demand by the physicians or for analytics. A small

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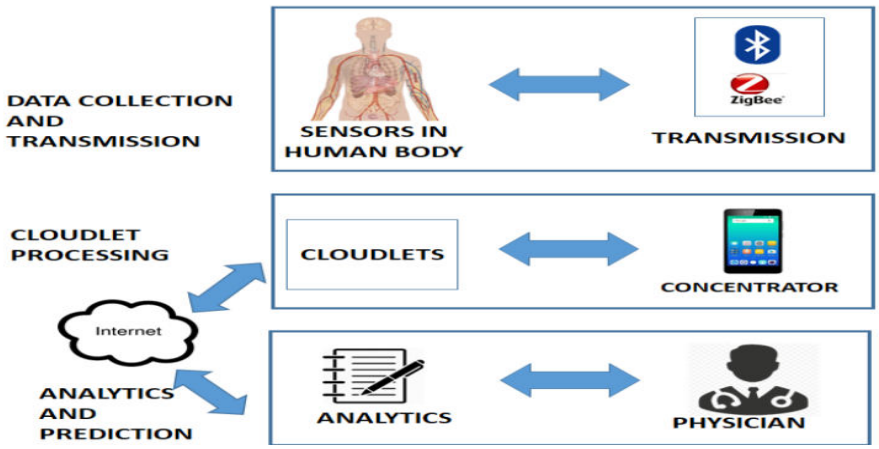
processing unit called cloudlet which is used for both storing and processing locally when the local resources are not suffices to fulfill the requirements. It also helps to run timecritical tasks on the patient's medical data. When data is stored in cloudlet, it enables all time access for data analytics to produce better diagnostic details. Cloudlet Computing has been proposed as a better solution for the health applications through PAN as they often deal with offline data. The consenter and cloudlet are allowed to communicate through Wi-Fi interface in order to reduce the data transfer latency for critical tasks on the collected data. At last, the data in the cloudlet will be saved in the cloud for reliable storage and distributed access of data. The data aggregation performed between cloud and cloudlet can be differentiated by context aware concentration where context is nothing but the current and expected status of the patient. It has become highly essential to keep the patient's electronic medical records secure while storing in cloud. In order to prevent unauthorized access, appropriate privacy preserving measures should be taken when we transfer offline data to the cloud. Therefore, secure cloud storage frameworks were introduced to deal with the sensitive medical information, but it is still a challenge. As the medical datasets are rich in quantity, the data analytics is also big task. The machine learning algorithms do this work of correlating sensor parameters and clinical data. By analyzing this for longer duration, accuracy in the medical diagnostics can be better improved. Data from the wearable sensors will undergo the process of pattern recognition and machine learning techniques. In order to handle with more heterogeneous and constantly changing sensor data, machine learning must be developed further. Also, those algorithms must be capable of dealing with inevitably missing data values, streaming data and information of varying dimensionality and semantics as the design of sensors often change. There are three main challenges while we do the analytics process in the implementation of IoT in medical fields. Firstly, in the field of medicine, almost every day new measuring devices and equipment's will be introduced. And so, they need periodic updating of the IoT devices and the sensor data will also be different. Obviously, it will make a huge impact in the database design and the IoT devices must be capable of managing all those. The machine learning algorithms are expected to be developed further to handle the constantly changing sensory information. Secondly, every time depending upon the condition of the patient, the data to be collected will differ as directed by the physician. Hence it is somewhat infeasible to additional input changing over time. It is possible to match the prior sensor data with the clinical records, still it is challenging because of the rare patient conditions. The concept of classification and regression methods can be helpful to prepare the common training data for providing machine learning algorithms, but again it will be the additional burden to the physicians. Finally, as we take input from different sources, the sensory data will produce heterogeneous modalities. Graphical models may be helpful to combine different input data in a centered framework with significant customization. Even though the sensor data are numerical; the medical data are plotted graphically to continuously monitor the patient's health. The concept of visualization plays a vital in health monitoring. The data from IoT warble sensors are spanned using different visualization methodologies for the effective prediction. The visualization tools must be always ready to interact with the heterogeneous data to quick and accurate prediction in emergency cases. The visualization must be capable of handling the static images for comparing the medical reports of patients.



III. ARCHITECTURE PERFORMANCE

The architecture developed operates under the philosophy of client/server; it shows the distribution of architecture. Here are the features of the components of the server and client will be described. Server: The server consists of three basic components: - Detector context: is the component responsible for obtaining context information. The information

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is captured through the answers given by the web services that make communication available between the server, the database patients, and types of workouts, illness and doctors. Reasoning engine: It is in charge of making inferences based on the contextual information provided by the detector context. Ontology used to make recommendations as workout routines to patients and inform that moment readings are at knowledge layer.

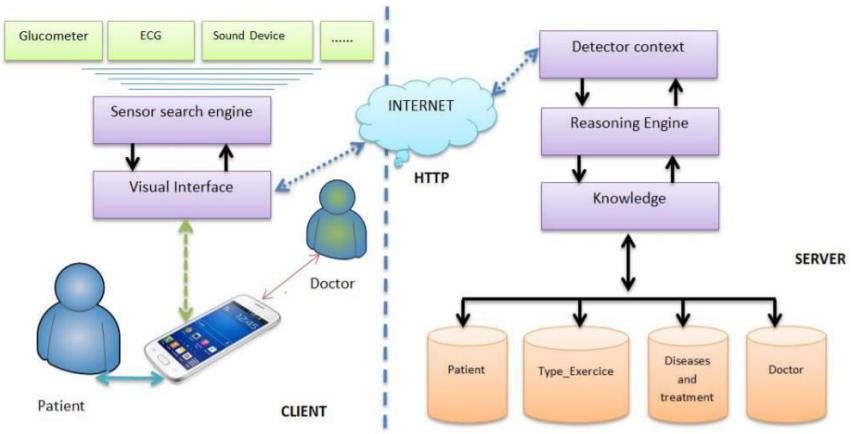

Fig. 2. Architecture of system

Client: is a system developed on Android 4.4, which consists of two main layers are the Visual Interface, which makes regular web server invocations, the presents on the screen as the event that requires the interaction with the patient, namely, a reading of blood pressure, blood glucose meter among others. In the event that is to take a reading, the search engine sensor is activated to acquire the data and inform the patient hearing that the readings and workout routines to be performed must be done. Meanwhile the doctor can check the history of the patients. Given the circumstances of the patient readings are outside the normal range, the system sends alert notifications to the doctor where he reports on the readings obtained by the patient.

IV. CASE STUDY

To validate the efficiency of the system is used in patients with diabetes and heart arrhythmia. For this, a sample of 16 people which used the system for a month, each measuring sensors had diabetes, and EGC, Bluetooth audio devices to broadcast audio guide was made to take readings and workout routines, in addition to containing the Smartphone application.

Fig 3. Patient Application Options and Monitoring Option

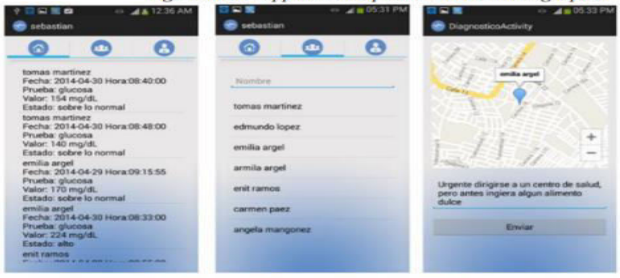

Fig 4. Patient Application Options and Monitoring Option

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V. CONCLUSION & FUTURE WORK

In this paper, we found the importance and fruitful benefits of implementation of IoT in remote health monitoring systems. The compact sensors with IoT will make a huge impact on every patient's life, that even though they are away from home and physician, this helps them to reduce the fear of danger. The sensory data can be acquired in home or work environments. Also, the challenges in sensing, analytics and prediction of the disease are also highlighted and those can be addressed to provide a seamless integration into the medical field. The system developed patient monitoring based on Internet of things, is an alternative that can be used to help patients with chronic diseases. Likewise with this set of solutions the aim is to improve the quality of life of patients, not just monitoring them, but also to enable direct them to improve their eating habits and workout routines. The context model developed for the system proved to be efficient when making inferences related to the context, such as recommendations for taking measures through sensors, as well as recommendations and workout routines tips to improve the eating habits of patients.

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