Implementation of Portable Vital Sign Monitoring System using Internet of Things (IoT)

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Abstract: **The objective of the work is to make a simple wireless vital sign Monitoring system for rural use. The system uses Internet of things domain where, Things will be on Network in movable forms. Vital sign monitoring system combine the use of telecommunication and information technologies to eliminate distance barriers and give access to medical services that would often not be available in distant rural communities. A vital Sign monitoring system implemented using Wireless Sensor Network(WSN). Vital monitoring system will be rapidly developing application of the clinic where medical information is transferred through the Internet. The vital monitoring system may be as simple as to wear equipment and to have talks with the doctor.**

Index Terms **- Vital Sign, Electrocardiogram, Blood Pressure, Temperature, Wireless Sensor Network.**

I. INTRODUCTION

Vital sign monitoring system is an upcoming field in health science. It meets the Information Technology with Communication for human services conveyance to provincial and remote territories other than a few different applications in the wellbeing division.It might be as basic as to wear framework and after that let Doctor have all understanding's information next to him.Experts talking about restorative issues and looking for counsel more than a basic phone is as unpredictable as transmission of electronic medicinal records of clinical data, demonstrative testsfor example electrocardiogram, blood pressure, temperature.Essential sign checking framework do constant and store and forward intelligent therapeutic information transmitted with the assistance of IT based equipment and programming. As indicated by the World Health Organization, Vital sign checking framework is characterized as, "The conveyance of human services, where space is a divisor, by all experts utilizing Technologies for the trading of substantial information for diagnosis"[1]. The basic sign checking system means "Therapeutic Diagnosis at distance". As we expressed here with two Approaches Real Time and Store and Forward[3]. In Real Time Approach quick Data activity is done where as in store and forward mode information is put away and later time it can be dissected. It makes utilization of data innovation, through the utilization of PCs, software, hardware and telecom systems. People living in country and remote territories are not by any means getting essential therapeutic care because authority doctors are more inclined to be situated in urban zones. Because of the new thoughts in figuring and telecom innovation, numerous components of therapeutic practice can be finished when the patient and social insurance supplier are geologically at a separation. Key sign observing framework is the exchange of electronic medical information (i. e. ECG, BP, temperature and patients record) starting with one area then onto the next.

II. MOTIVATION

In India more than 70% of the population lives in provincial regions implies the larger part of an individual's life in rustic zones where the state of therapeutic offices is discreditable. Number of Primary human services focus is constrained in the country, zoneand 8% of the foxes don't have specialists or restorative staff, 39% doesn't have lab professionals [2]. By examining the way that rustic patients need to travel long separations further more to spend extra costs to have admitted to the basic Medicare Facility. This persuaded to make accessible some framework for persistent torment from Heart Problem, Blood Pressure issue for right on time analysis.

III. LITERATURE SURVEY

One of existing Implementation of a WAP-Based TelemedicineSystem for Patient Monitoring System in which system will monitor BP and ECG in only store and forward method. The system uses WAP devices as mobile terminals for general Enquiry and patient-monitoring services [3].

Alert based remotely health monitoringdiscuss a system where medical alert is generated for remote health monitoring. This system uses sensors and cloud computing to develop an Application[4]. Vital sign monitoring system can also use as android application. System used for detection of heart failure using android as media. In emergency situation system used to send alert on doctor and relative mobile[5].Many of remotely vital sign monitoring system useZigbee for Connectivity of Wireless sensor Network to User Interface to remotely Monitor Patient data [6].

Recently, one of system design for vital sign monitoring system based on WSN and Telemedicine. This system uses Bluetooth for connectivity. Also, Android Media is used and 3G network or IEEE 802.11 Wi-Fi based transmission is done [7].

This paper, "Implementation of portable Vital Monitoring System" proposes a Sensor cloud technology, which enables the early detection of conditions and diseases. A number of recent research focuses on wearable sensors which are worn by patient to regulate their health condition. A secure cloud server allows authenticated doctor or user to access real-time and already acquires patient information to consult with medical specialists.

IV. PROPOSED SYSTEM

The system is implemented for a vital sign monitoring system which is part of Telemedicine. This system, especially concentrates on the monitoring vital sign and prediction of emergency. The Proposed system is implemented considering specialized use not for generalize use. System implementation is divided into three tiers.

- **Remote Monitoring Node:**Remote monitoring node is hardware that will be used on the patient side. Figure 1shows hardware that patient needs to carry for his health status. First of all we collect different sensor values and send it to the ADC for Analog to digital conversion, and then these digital signals are forwarded to the microcontroller. We use ATMEGA Microcontroller which has task to convert this digital data into user defined format and send data to the server with the help of internet. Every collected values or Data Logs are stored in Database. By applying the Data mining on a database we can get the prediction about the patient. We give users alert when reading goes beyond the normal. An alert is the basis of Real-time which send alert with a parameter value and location of patient.

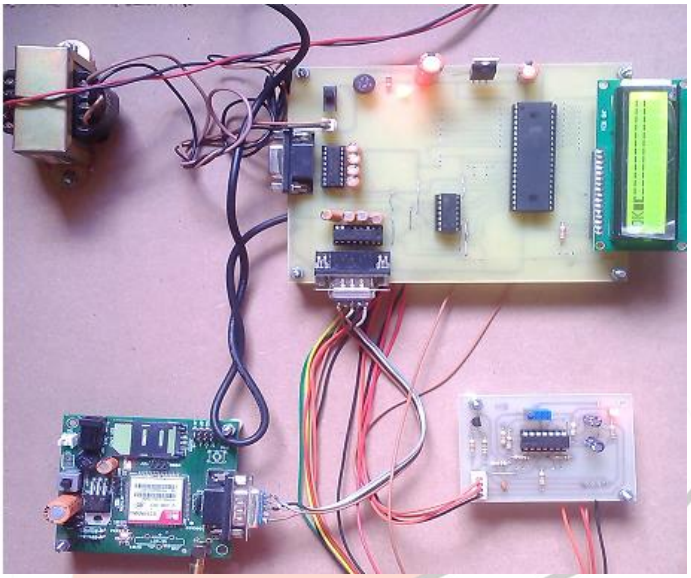

Fig.1 Hardware Setup

- **Central Web server:** Remote nodes or hardware can be installed in any area. Patient data collected with hardware belonging to patient send to remote web server. The web server is a globally accessible server connected to hardware with the help of internet communication. Central web server has given a unique IP address. Software technology used at central web server is SQL database created with the help of Xampp.
- **Graphical user interface:** Graphical user interface is a software application in this system. After patiently attach this hardware following process done.
  1. Open website, logging into the system.
  2. There are functionally provided like dashboard, sign up for patient and doctor, Monitor status of patient, Location tracking of patient, Prediction and report generation of patient data. Figure 2 shows homepage of the website through which expert will determine status of the patient.

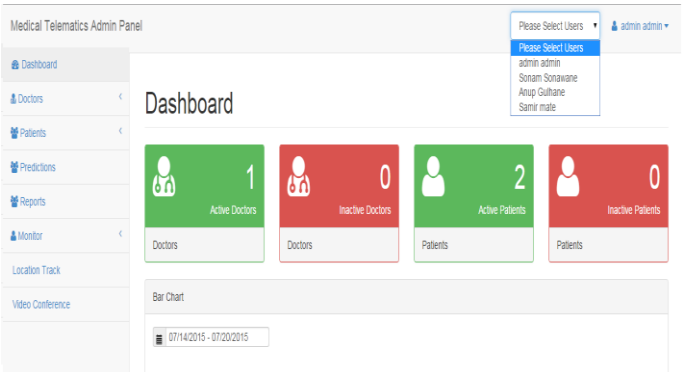

Fig. 2 Homepage

V. FUZZY MODEL FOR SYSTEM

Definition of Fuzzy model applied to Medical system in complex frameworks and procedures, systems require mechanisms for managing wrong data. Applying fuzzy rationale could give more advantages and tasteful results in context of an acquisition of expert information, rule generation, the procedure mechanization and increase accuracy.

1. Membership Function

The membership function represents the fuzzy set and also provides a measure of the degree of similarity of an entity to a fuzzy set.

Input Variable: A membership function for a fuzzy set is shown below.

Temperature: Figure 3 shows Membership function for temperature

Temp (x)
- Hypothermia if x < 36
- Normal if 36 < x < 38
- Fever if x > 38

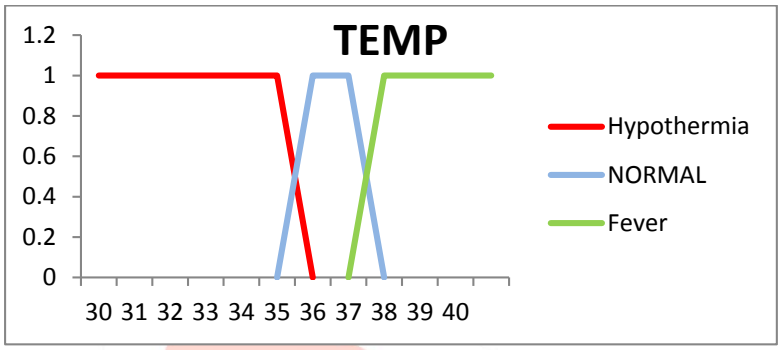

Fig. 3 Membership function for temperature

Blood Pressure: Figure 4 shows Membership function for blood pressure

BP (y)
- Low BP if y < 90/60
- Normal if 90/60 < y < 120/90
- High BP if y > 120/90

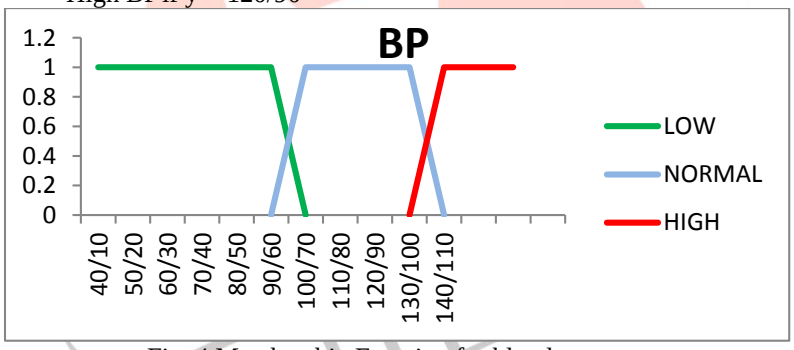

Fig. 4 Membership Function for blood pressure

ECG: Figure 5 shows Membership function for ECG

ECG (z)
- Low if z < 60
- Normal if 60 < z < 100
- High if z > 100

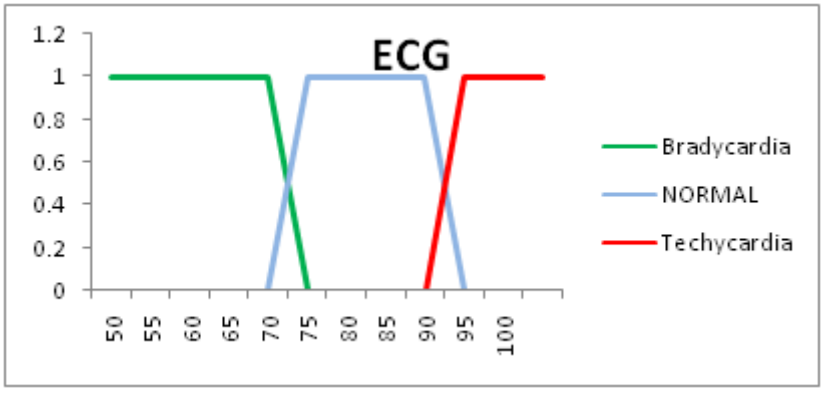

Fig. 5 Membership function for ECG

Output Variable: Figure 6 shows Membership function for temperature

Emergency
- Low (x) if x< 36
- High (x) if x> 38
- Low (y) if y< 90
- High (y) if y> 120/90
- Low (z) if z< 60
- High (z) if z> 100

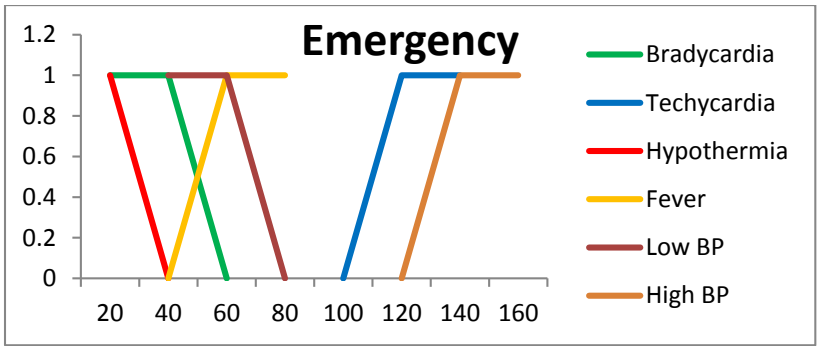

Fig. 6 Membership Function for Emergency

2. Defined Rule:

1. If Temp < 35 then emergency EM1
2. If Temp > 38 then emergency EM2
3. If BP > 140/90 then emergency EM3
4. If BP < 90/60 then emergency EM4
5. If ECG < 60 then emergency EM5
6. If ECG > 100 then emergency EM6

Quality of results in a fuzzy system depends on the fuzzy rules.

VI. RESULT

TP means True Positive, FP means False Positive, TN means True Negative and FN means False Negative. Using the proposed method the specificity, sensitivity, accuracy, error is calculated. Table 1 Provide the confusion matrix that explains the prediction accuracy of the proposed study. Classification Matrix shown below displays the number of correct and incorrect predictions. It compares the actual values in the test dataset with the predicted values in the trained model. Our Case database consists of 40 records.

Table 1 Classification Matrix

Predicted	Classified as Healthy	Classified as not Healthy
Actual Healthy	TN[33]	FP[0]
Actual Not Healthy	FN[1]	TP[6]

Performance Evaluation:

Recall Or Sensitivity (True positive rate) = TP/(TP+FN) = 1
Specificity (True negative rate) = TN/(TN+FP) = 0.96
Precision (positive predictive value) = TP/ (TP+FP) = 0.85
Accuracy = (TP+TN) /total obs = 0.975
The calculated accuracy of the proposed approach is 97.5%.
Error = (FP+FN) /total obs= 1/40 = 0.025
Proposed algorithm shows error 0.025%.

VII. SYSTEM REQUIREMENTS

Hardware Requirement : Microcontroller ATMEGA, ECG Sensor, Temp Sensor, ADC, GSM Module.
Software Requirement : For PC and Mobile Side Portal PHP code Igniter is used for user interaction. Mysql database is utilized to store all types of data. ECG, BP, Temp reading are measure and save in Mysql so doctors can see patients continuous reading. Fusion chart is used to plot the ECG graph, jquery, HTML,CSS3 is also utilized in this project.
For embedded Side Programming C Language is used for microcontroller ATMEGA. Kiel C Compiler is used to burn c program on ATMEGA.

VIII. CONCLUSION

This framework is to be utilized for remote estimations of obliged parameter and distinguish monitored condition.System task was to provide a wearable vital sign monitoring system to contribute towards the health of rural area. To accomplishthisgoalvital sign monitoring system was fixed. Development of a relational database and loading of patient data will do to make system helpful for prediction. Patient Monitoring System helps the healing center, particularly the doctors to screen the tolerate condition

whenever and from any area in light of the fact that it can be gotten to by means of the web (electronic). Using proposed calculation precision is expanded to 97.5. With the presence of the Patient Monitoring System, the tolerant conditionsare introduced in exact structure and accordingly permitting client to acquire data on the quiet's conditioneffortless and precisely. This application can extend to diagnosis of more diseases by encompassing more biomedical parameters so that wider area of diseases can be tracked.

IX. REFERENCES

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