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IOT based Multi-Parameter Health Monitoring System

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A B S T R A C T

IOT is the network of physical "things" or object that contain embedded technology to interface and sense to move with their internal states or the external setting. Automation is the most often spelled term within the field of electronics. The hunger for automation brought several revolutions within the existing technologies. Healthcare is given the extreme importance now a- days by each country with the advent of the novel corona virus. So in this aspect, an IoT based health monitoring system is the best solution for such an epidemic. Internet of Things (IoT) is the new revolution of internet which is the growing research area especially in the health care. With the increase in use of wearable sensors and the smart phones, these remote health care monitoring has evolved in such a pace. IoT monitoring of health helps in preventing the spread of disease as well as to get a proper diagnosis of the state of health, even if the doctor is at far distance. In this paper, a portable physiological checking framework is displayed, which can constantly screen the patient's heartbeat, temperature and other basic parameters of the room. We proposed a nonstop checking and control instrument to screen the patient condition and store the patient information's in server utilizing Wi-Fi Module based remote correspondence. A remote health monitoring system using IoT is proposed where the authorized personal can access these data stored using any IoT platform and based on these values received, the diseases are diagnosed by the doctors from a distance. Whenever Raspberry receives any wireless message from Web browser, it displays on the display. The Internet of Things (IoT) belief system can be looked as an exceptionally unique and radically distributed networked system composed of a very large number of identifiable smart objects. These objects can convey and to interface among themselves, with end- users or different elements in the system. Entering the era of Internet of Things, the use of small, shoddy and flexible computer hardware that allow end-user programming become present. One of them, considered in this paper, is the Raspberry, fully customizable and programmable small computer board. Relative investigation of its key components and exhibitions with some of current existing IoT prototype platforms have shown that despite few disadvantages, the Raspberry microcontroller remains an modest PC with its effectively utilization in diverse range of research applications in IoT vision.

Keywords:
IOT, Raspberry Pi, AWS, Health Parameters, KNN, Machine Learning, Naïve Bayes.

1. Introduction

Health is characterized as a full state of physical, mental, and social well-being and not merely a lack of illness. Health is a fundamental element of people's need for a better life. Unfortunately, the global health problem has created a dilemma because of certain factors, such as poor health services, the presence of large gaps between rural and urban areas, physicians, and nurse's unavailability during the hardest time.

Health is characterized as a full state of physical, mental, and the core objective of this project is the design and implementation of a smart patient health tracking system. Fig.1 shows the overview of the proposed system. The sensors are embedded on the system to sense the temperature and heartbeat of the patient. Two more sensors are place at home to sense the humidity and the temperature of the room where the patient is staying. These sensors are connected to a control unit, which calculates the values of all the four sensors. These calculated values are then transmitted through an IoT cloud to the base station. From the base station the values are then accessed by the doctor at any other location. Thus based on the temperature and heart beat values and the room sensor values, one decide the state of the patient and appropriate measures can be taken.

IoT is making any objects internally connected in the recent decade and it has been considered as the next technological revolution. The most tremendous use of IoT is in healthcare management which provides health and environment condition tracking facilities. IoT is nothing but linking computers to the internet utilizing sensors and networks. These connected components can be used on devices for health monitoring. The used sensors then forward the information to distant locations like M2M, which are machinery for computers, machines for people, handheld devices, or smartphones. It is a simple, energy-efficient, much smarter, scalable, and interoperable way of tracking and optimizing care to any health problem.

1.1. Problem Statement

To design and develop a smart IOT based Multi-Parameter Health Monitoring System.
The main objective of this project is to develop a prototype of a Remote Patient Health Monitoring System (RPHMS) which check and detect a medical condition with unstable regulatory body system. This is in cases where a new drug is being introduced with a suitable match of preliminary record of the symptoms stored in the database.

1.2. Internet of Things

The Internet of Things (IoT) belief system can be looked as a exceptionally unique and radically distributed networked system composed of a very large number of identifiable smart objects. These objects can convey and to interface among themselves, with end- users or different elements in the system. Entering the era of Internet of Things, the use of small, shoddy and flexible computer hardware that allow end-user programming become present. One of them, considered in this paper, is the Raspberry Pi, fully customizable and programmable small computer board. Relativeinvestigation of its key components and exhibitions with some of current existing IoT prototype platforms have shown that despite few disadvantages, the Raspberry Pi remainsan modest PCwith its effectively utilization in diverse range of research applications in IoT vision.

2. Literature Survey

- FROM ENGINEER'S POINT OF VIEW

TarannumKhanTarannum Khan, **Manju K. Chattopadhyay** IEEE 2018 [1]Smart Healthcare is important for people who need continuous monitoring which cannot be provided outside hospitals. It is also important at rural areas or villages where nearby clinics can be in touch with city hospitals about their patient's health condition. This work presents a smart health monitoring system that uses biomedical sensors to check patient's condition and uses internet to inform the concerned. The biomedical sensors here are connected to Arduino UNO controller to read the data which is in turn interfaced to an LCD display/serial monitor to see the output. Data is uploaded to the server to store and converted it into JSON link for visualizing it on a Smartphone. An android application has been designed in order to easily see the patient's information by their doctors and family members.

ShubhamBanka ,Isha Madan and S.S. Saranya IJAER 2018 [2] – In this paper, we have proposed a system in which patient's body temperature, heart rate, body movements and blood pressure reading results that are being monitored by the system. The various sensors are placed on the patient's body and they take the readings and send the corresponding signal to the raspberry pi. The Raspberry Pi is a credit card-sized single-board computer that operates on Linux OS. Here, various sensors are used to measure the patient's body temperature, heart rate, Blood Pressure and their respective results are sent to the database via Raspberry Pi and can be monitored from anywhere worldwide through the internet facilitated via GSM module. The programming in Raspberry Pi is done in python language and it sends the data related to the patients' health to the server connected via Internet. The details can be easily accessed online by proper authentication and health status of the patient can be monitored.

3. System Requirements

3.1. Transformer

In this wireless electronic notice the transformer, which consists of two winding's primary and secondary is used for converting the 220V to 12V ac because this system is directly connected to the power supply.

3.2. DS1621

The DS1621 Digital Thermometer and Thermostat provides 9-bit temperature readings, which indicate the temperature of the device. The thermal alarm output, TOUT, is active when the temperature of the device exceeds a user-defined temperature TH. The output remains active until the temperature drops below user defined temperature TL, allowing for any hysteresis necessary. User-defined temperature settings are stored in nonvolatile memory so parts may be programmed prior to insertion in a system. Temperature settings and temperature readings are all communicated to/from the DS1621 over a simple 2-wire-serial-interface.

3.3. Voltage Regulator

The voltage regulator is used for providing the fix 5 volts, to the microcontroller and LCD display. In the absence of voltage regulator, the higher voltage may be damage the LCD display or microcontroller and in this system these two components are too much important.

3.4. MAX30100

The MAX30100 is an integrated pulse oximetry and heartrate monitor sensor solution. It combines two LEDs, a photodetector, optimized optics, and low-noise analog signal processing to detect pulse oximetry and heart-rate signals. The MAX30100 operates from 1.8V and 3.3V power supplies and can be powered down through software with negligible standby current, permitting the power supply to remain connected at all times.

3.5. Raspberry Pi3

The Raspberry Pi 3 Model B is the third generation Raspberry Pi. This powerful credit-card sized single board computer can be used for many applications and supersedes the original Raspberry Pi Model B+.Whilst maintaining the popular board format the Raspberry Pi 3 Model B brings you a more powerful processor, 10x faster than the first generation Raspberry Pi.Additionally it adds wireless LAN & Bluetooth connectivity making it the ideal solution for powerful connected designs.

Fig. 1- Raspberry Pi

3.6. GSR Seed Sensor

GSR stands for galvanic skin response, is a method of measuring the electrical conductance of the skin. Strong emotion can cause stimulus to your sympathetic nervous system, resulting more sweat being secreted by the sweat glands. Grove - GSR allows you to spot such strong emotions by simple attaching two electrodes to two fingers on one hand. It is an interesting to create emotion related projects like sleep quality monitor.

4. Methodology

Health is always a major concern in every growth the human race is advancing in terms of technology. Like the recent corona virus attack that has ruined the economy of China to an extent is an example how health care has become of major importance. In such areas where the epidemic is spread, it is always a better idea to monitor these patients using remote health monitoring technology. So Internet of Things (IoT) based health monitoring system is the current solution for it. Remote Patient Monitoring arrangement empowers observation of patients outside of customary clinical settings (e.g. at home), which expands access to human services offices at bring down expenses. The core objective of this project is the design and implementation of a smart patient health tracking system that uses Sensors to track patient health and uses internet to inform their loved ones in case of any issues. The objective of developing monitoring systems is to reduce health care costs by reducing physician office visits, hospitalizations, and diagnostic testing procedure. Each of our bodies utilizes temperature and also pulse acknowledging to peruse understanding wellbeing. The sensors are linked to a microcontroller to track the status which is thus interfaced to a LCD screen and additionally remote association with have the capacity to exchange alarms. If framework finds any sudden changes in understanding heart beat or body temperature, the framework consequently alarms the client about the patient's status over IOT and furthermore indicates subtle elements of pulse and temperature of patient live in the web. In this manner IOT set up tolerant wellbeing following framework viably utilizes web to screen quiet wellbeing measurements and spare persists time.

4.1. Proposed Model

Machine Learning is the domain that uses past data for predicting. Machine Learning is the understanding of computer system under which the Machine Learning model learn from data and experience. The machine learning algorithm has two phases: 1) Training & 2) Testing. To predict the disease from a patient's symptoms and from the history of the patient, machine learning technology is struggling from past decades. Healthcare issues can be solved efficiently by using Machine Learning Technology. We are applying complete machine learning concepts to keep the track of patient's health. ML model allows us to build models to get quickly cleaned and processed data and deliver results faster. By using this system doctors will make good decisions related to patient diagnoses and according to that, good treatment will be given to the patient, which increases improvement in patient healthcare services. To introduce machine learning in the medical field, healthcare is the prime example. To improve the accuracy of large data, the existing work will be done on unstructured or textual data. For the prediction of diseases, the existing will be done on linear, KNN, Decision Tree algorithm.

- Machine Learning And Algorithms

As a Data Scientist at a Hospital with an alarming number of patients coming in reporting various cardiac symptoms. A doctor measures vitals & hands you this data to perform Data Analysis and predict whether certain patients have Asthma Disease. We would like to make a Machine Learning algorithm where we can train our AI to learn & improve from experience.
We use here Python language and INTERNET protocol as the basic working principle.

- Random Forest

```
from sklearn.metrics import classification_report
from sklearn.ensemble import RandomForestClassifier

model6 = RandomForestClassifier(random_state=1)# get instance of model
model6.fit(x_train, y_train)  # Train/Fit model

y_pred6 = model6.predict(x_test)  # get y predictions
print(classification_report(y_test, y_pred6)) # output accuracy
```

	precision	recall	f1-score	support
0	0.88	0.70	0.78	30
1	0.76	0.90	0.82	31
accuracy			0.80	61
macro avg	0.82	0.80	0.80	61
weighted avg	0.81	0.80	0.80	61

Accuracy 80%

Hence, if we calculate the **accuracy** its Correct predicted/ Total.
In other words, where TP, FN, FP and TN represent the number of true positives, false negatives, false positives and true negatives.
Accuracy = (TP + TN)/(TP + TN + FP + FN).
Accuracy =(21+28)/(21+28+9+3) = 0.80 = **80% accuracy**

5. Training and Analysis of Data

Now we'll Train various Classification Models on the Training set & see which yields the highest accuracy. We will compare the accuracy of Logistic Regression, K-NN (k-Nearest Neighbors), SVM (Support Vector Machine), Naives Bayes Classifier, Decision Trees and Random Forest.
Note: these are all supervised learning models.

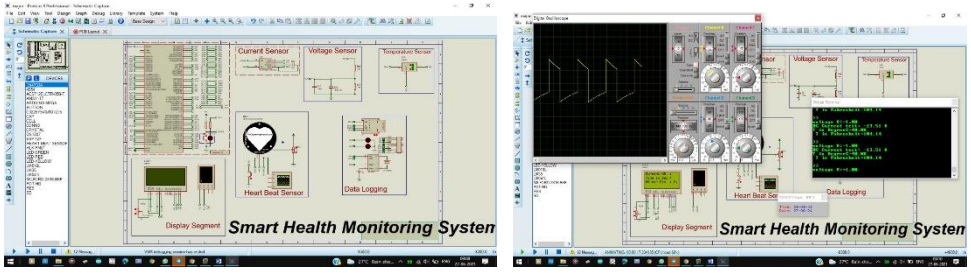

Fig. 2- Proteus

The proposed system was initially analyzed using Proteus Schematic tool using the various sensor and displays the recorded data. This helps to generate the numeric values which is used in further implementation on the hardware. Moving further we observed the graph via oscilloscope and their peak fluctuations recorded using current, voltage and temperature readings. In fig.10 the essential parameters like voltage, current, temperature are displayed. Asthmatics should always stay in a normal temperature field in this experimental setup, a Negative Temperature Coefficient (NTC) thermistor is interfaced with the processing unit to measure the temperature. As name implies the resistance value of the thermistor decreases as temperature increases, along with it the analog output voltage will increase in association with temperature. The sensitivity of thermistor varies from -55 ℃ to 120 ℃. The

voltage in variation will be from 0V to 5V. The analog voltage variation mainly depends upon the input supply voltage and the variance resistance of the thermistor used.

6. Result & Discussion

In the proposed design Fig.2shows the hardware implemented model comprises of three different sensors, which are the temperature, heart rate and the oxygen level sensor. When interfaced with raspberry pi unit monitors and shows the detected numeric values. These values are recorded from the patient's body in a span of 15 - 20 seconds. Henceforth, the role of raspberry pi comes into picture and which fetch and sends the data to the cloud for the further generation of the report. Initially the fetched data is recorded into JSON format and saved to Dynamo DB database. This not only helps us to monitor a patient's previous records but to improvise into future health conditions. Fig.3 shows the AWS console which interprets the recorded values from the sensors and sent via raspberry pi into the cloud.

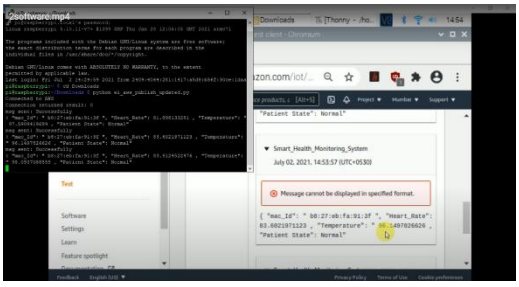

Fig. 3- AWS

7. Conclusion

The Internet of Things is considered now as one of the feasible solutions for any remote value tracking especially in the field of health monitoring. It facilitates that the individual prosperity parameter data is secured inside the cloud, stays in the hospital are reduced for conventional routine examinations and most important that the health can be monitored and disease diagnosed by any doctor at any distance. In this paper, an IoT based health monitoring system was developed. The system monitored body temperature, pulse rate and room humidity and temperature using sensors, which are also displayed on a LCD. These sensor values are then sent to a medical server using wireless communication. These data are then received in an authorized personals smart phone with IoT platform. With the values received the doctor then diagnose the disease and the state of health of the patient.

The current prototype certainly has its own limitation when it comes to more accurate result which can be suitably enhanced according to the future needs and scope of implemetation. For now the conditinal circuit predicts the 70 – 80 percent accuracy with smooth fuctioning. The current driving ability in small scale is reliable, however in larger scale its driving ability needs to be increased otherwise it would face a circuit failure and might burn the other sensors. The system can be driven using more basic sensors and testing for wide number of applications in medical healtcare field.

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