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Patient Health Monitoring System Using IoT and Machine Learning

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ABSTRACT

Smart cities are densely populatedurban areas that increase the usage of technologically advanced devices to reduce service wait times and false alarms. It allows long-distance precondition monitoring with help of integrated IoT-enabled embedded sensor networks. In the healthcare field, the usage of such advanced gadgets allows distant access monitoring and/or access management of ICU patients' health at regular time intervals. In recent days, personal IoT devices and gadgets are gained popularity due to their divergent services and ability to connect remote devices wirelessly. This present work discusses the usage of IOT- based devices for distance accessing of the event-triggered patient-specific clinical data collection (ETPSCD) that is needed for long- term data recording/monitoring/assessment of the condition of ICU patients at regular time intervals. Additionally, here in this work shows the effective usage of personal IOT devices that helps to allow conditional programming for automatic events that need to be executed without the need for a caretaker's physical presence in various emergency situations. The main objective of the project work is the development of interactive event-triggered patient health parameter monitoring and the design of a patient-specific datalogger system for long- term monitoring. In presented work mainly includes four stages: firstly, the project work uses two ESP8266 Modules, one of which is used to monitor the pulse and temperature and additionally provided with a patient Assistant key, and another module predicts the condition of a patient who is in a coma using Machine Learning. Secondly, the datacollected from the two modules are sent to thecloud and from the cloud to the Android Mobile App.

Finally presented work explains the efficient datalogger algorithm design for long-term patient monitoring and data recording applications. In the future, the presented project work further tested its robustness in complete cardiac signal delineation on resource-constrained devices and also its feasibility studied for event triggered-automated drug delivery.

KEYWORDS- Health Monitoring, Machine Learning Based Health Monitoring System.

1. INTRODUCTION

The Internet of Things (IoT) has revolutionized the way healthcare services are delivered to patients. IoT based remote patient health monitoring system with Machine Learning is a project that seeks to leverage the power of technology to improve healthcare outcomes. The project aims to use IoT devices to monitor patients' vital signs and other health parameters remotely. The data collected by these devices is transmitted to a cloud-based platform where it is analyzed and processed using machine learning algorithms. This allows healthcare providers to receive real-time updates on

their patients' health status and make timely interventions when necessary.

Fig 1 ICU unit

The IoT based remote patient health monitoring system with Machine Learning project is designed to provide a comprehensive view of patients' health status. The devices used for monitoring are equipped with sensors that can measure a variety of health parameters such as body temperature, blood pressure, heart rate, and respiratory rate. These parameters are transmitted to the cloud platform, where machine learning algorithms are used to analyze and interpret the data. This helps healthcare providers to identify any trends or patterns in patients' health status and take appropriate action to prevent complications.

The project also provides patients with real- time feedback on their health status. Patients can access their health data through a mobile application and receive alerts when their vital signs deviate from normal levels. This helps patients to take proactive steps to maintain their health and avoid potential complications.

In conclusion, the IoT based remote patient health monitoring system with Machine Learning project represents a significant step forward in the delivery of healthcare services. The project leverages the power of technologyto improve healthcare outcomes and provide patients with real-time feedback on their health status. By providing healthcare providers with real-time data on patients' health, this project is expected to improve healthcare outcomes and reduce the burden on healthcare systems

2. PROPOSED SYSTEM

The idea of patient health monitoring system is entirely deals with two modules, first model which is used to forecast the movement of coma patient and another module used for monitoring of pulse and temperature of a patient and it also contains a push button switch for panic situation intimation. The first module comprises of ESP8266, MAX30100, LM35 and Buzzer. ESP8266 Wi-

Fi module offers a self-standing Wi-Fi networking with TCP/IP protocol stack which may supply Wi-Fi connection to any of the onboard microcontroller. ESP8266 is installed on-board, it includes storage and processing capabilities thus may be readily attached to the sensors dependent on the type of application. MAX30100 is a heart beat sensor which is used to read the patient pulse. LM35 is a temperature sensor which is used to read the patient temperature.

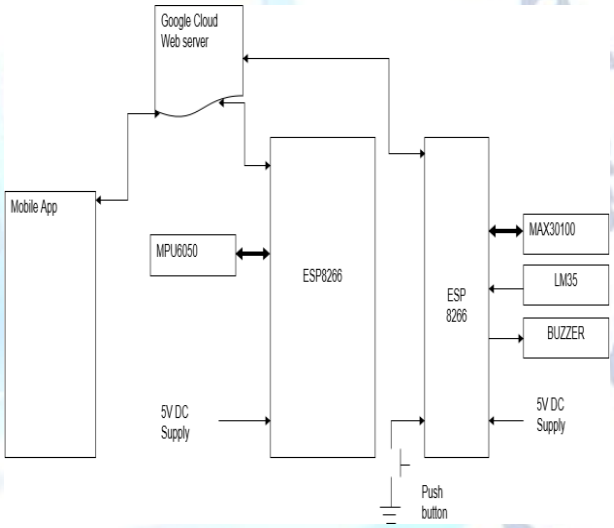

Fig 2 Block Diagram

In the first module, MAX30100 heart beat and LM35 temperature sensors are connected to the ESP8266 micro-controller. At a time, we can only monitor only one sensor's data, either MAX30100's or LM35's data. The collected data is processed by micro- controller, if the data is true data then only it will send to Firebase cloud platform which has the online real time database by using HTTP request and then we will receive pulseor temperature in the mobile app with respect

to the user. So user can monitor the patient pulse and temperature in his/her mobile from anywhere. A patient assistant key also is connected to the micro-controller, whenever the patient press the key a buzzer will ring and then nurse will take care of the patient. This all about the module one working.

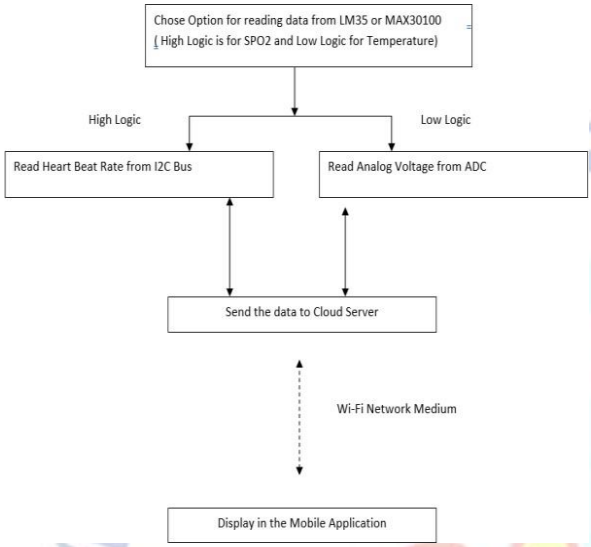

Fig 3 Flowchart for 1st module

In the second module, MPU6050 accelerometer MEMS sensor is utilized to anticipate the movement of a coma patient using Machine Learning. The MPU6050 sensor contains the 3-axis, from these 3-axis we will choose one axis to anticipate the movement of the patient. We have a numerous forms of false motions, like when nurse administering medication there may be a movement in patient body which is termed as fake movement of a body. The key subject of employing Machine Learning (supervised Machine Learning is employed) in this research is to eliminate the false movement detection and to forecast only actual movements of patient. We have utilized Tensor Flow module to produce correct results. This MPU6050 sensor is coupled to ESP8266 micro-controller. The ESP8266 micro-controller will gather the data from the MPU6050 and it analyses the data and once an actual movement of coma patient is expected, micro-controller will send an acknowledgment to the mobile over firebase cloud platform. After getting the acknowledgment the smartphone of the doctor vibrates for 3 seconds.

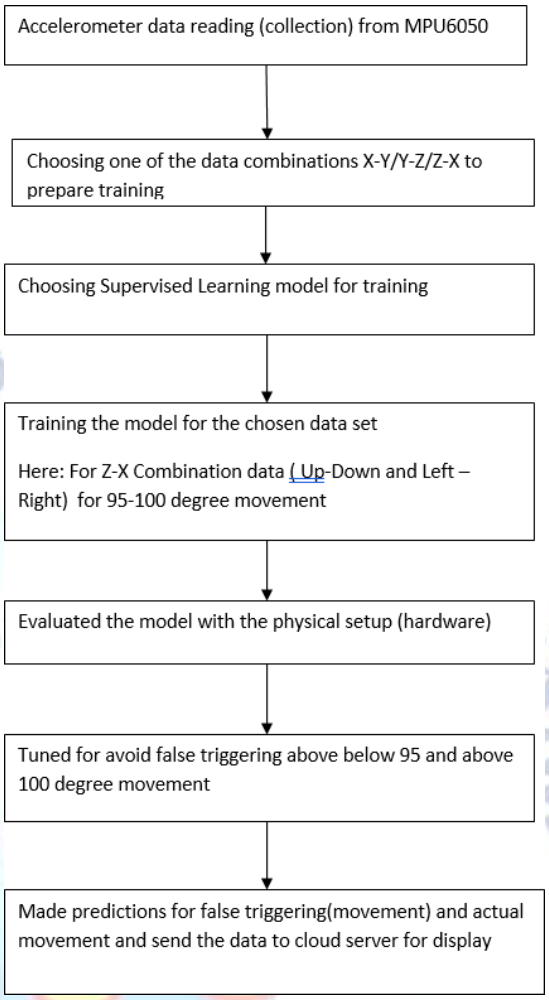

Fig 4 Flow Chart for 2nd Module (ML)

To see the output data of both the first and second modules, a single Android mobile application was created using MIT App Inventor. This application is only compatiblewith the Android operating system.

3. RESULT

Monitoring system for patient health IoT and machine learning projects can track coma patients' actual movements and take their temperature and pulse as well. The collected data is then delivered to an Android mobile application via Firebase's cloud server.

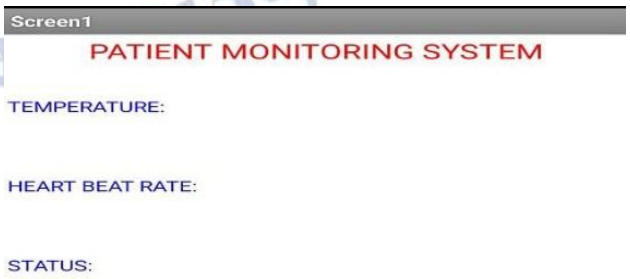

Fig 5 Android Application when thesystem is in OFF

The three text boxes in this section of our application are labelled Status, Heartbeat, and Temperature. The patient's body temperature is displayed in a text box labelled "Temperature," her heart rate is shown in a text box labelled "Heart Beat," and the status text box indicates whether the system- generated values are accurate or not. When the patient's movements are detected by this Android application, the user will receive a 3seconds vibrating alert on their phone. Whenever the patient press assistant key this will result in ringing buzzer

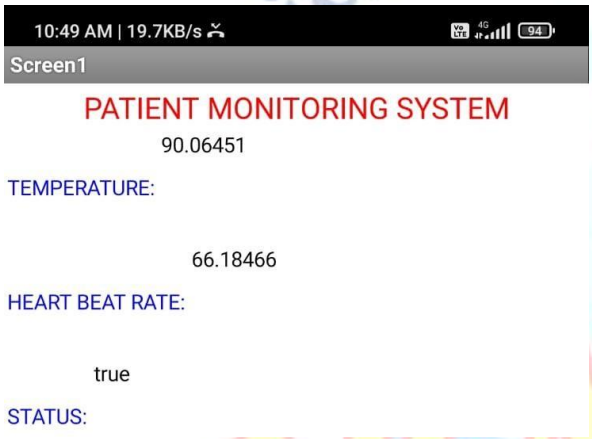

Fig 6 Result.

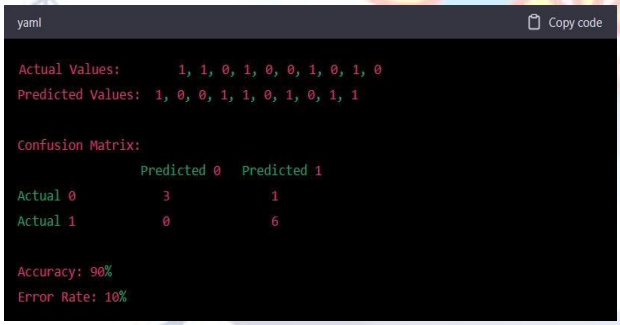

Fig 7 Confusion Matrix

Estimations	Values
Accuracy	94% (avg)
Error Rate	6% (avg)

TABLE 1: ACCURACY & ERROR RATE

These are results we are getting from the developed system.

5. CONCLUSION

In conclusion, patient health monitoring systems using IoT and machine learning have vast potential for future development and application in the healthcare industry. The integration of these technologies has the potential to provide personalized healthcare services, predictive analytics, remote patient monitoring, improved communication, and better integration with EHRs, ultimately improving the overall quality of care for patients.

6. FUTURE SCOPE

Patient health monitoring systems using IoT and machine learning have significant potential for future development and application in the healthcare industry. Some of the future scopes of this technology are:

Personalized Healthcare: The patient health monitoring system using IoT and machine learning can provide personalized healthcare services to each individual patient. The system can gather real-time data from various medical devices and sensors to create a unique healthcare plan for each patient based on their specific health needs.

Predictive Analytics: The system can use machine learning algorithms to analyze the collected data to predict health outcomes and alert healthcare professionals about potential health issues. This can enable early detection of diseases, reducing the cost of treatment andimproving the quality of care.

Remote Patient Monitoring: IoT-based health monitoring systems can enable remote patient monitoring, allowing doctors and healthcare professionals to monitor patients in real-time, regardless of their location. This can help reduce the need for hospital visits and provide better care for patients who live in remote areas.

Improved Communication: IoT-enabled devices can help improve communication between patients, healthcare professionals, and caregivers. Patients can share their health data with healthcare professionals in real- time, and doctors can monitor patients' health

remotely, providing timely interventions when necessary.

Integration with Electronic Health Records (EHRs): IoT-based patient monitoring systems can integrate with EHRs to create a complete digital record of the patient's health history. This can improve the accuracy and accessibility of medical records and make it easier for healthcare professionals to access patients' health data.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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