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Health Monitoring System Using Arduino Uno and IOT

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ABSTRACT: Science and knowledge in the current healthcare environment are founded on Wireless-Sensing node Technology. Due to the specific cause of cardiac difficulties, patients are suffering from the troublesome scenario of an untimely death, which is caused by the absence of adequate medical maintenance of patients at the required time. This is specifically for monitoring elderly individuals and updating caregivers and doctors. Therefore, we are putting up an inventive idea to prevent such high rates of unexpected death using Patient Health Monitoring, which makes use of sensor technologies and the internet to contact loved ones in case of issues. Through the given IP server address, the doctor and patient can at any moment watch the patient data from anywhere in the world. When the sensor value exceeds the threshold data, the patient receives an emergency alarm. As a result, a doctor can make an excellent diagnosis and provide almost accurate care if the patient's health indicators are regularly monitored by a medical server. The patient will heal more quickly and can receive better medical care at a lower cost thanks to the IOT's data collecting. Therefore, a patient's health monitoring system based on the internet of things (IoT) uses the internet to effectively monitor patient health, send an alert in the event of an emergency or when the patient's health is not acting normally, and help the patient by taking the necessary precautions to prevent serious health problems.

KEYWORDS: IOT, Energy Efficient, Easy and Fast

I. INTRODUCTION

The "Internet of Things" is a topic that is becoming more important in social, economic, and technical contexts." With the help of sensors, processors and microcontrollers together with accessories used for internet-based communication, it is built with a protocol that facilitates interaction and communication with users and other systems, respectively. As a result, it has become a key element of the Internet. The Internet of Things (IoT), which connects every physical object to the internet, including sensor devices, is made possible by this online interaction.

Health care is significantly impacted by the Internet of Things,which makes it easier for patients and clinicians to interact. Instead of costly clinical care, homecare is offered, and an effective healthcare system offers prevention. Every person will benefit from this programme by receiving the fundamental medical care, which produces better outcomes.

IOT technology is developing to enhance patient care costs and quality while also extending patients' lives by providing them with the right medications. By using IoT technology, hidden health issues in conventional healthcare can be resolved, ensuring healthcare services and reducing complications by keeping each patient's digital identification. The complexity and expense of the system are decreased by communicating among the health sensor device and the desktop or our mobile phones, both of them by default have the capability to connect with the server.

The system can then be made compatible with M2M and IoT as a result. If there are any changes, the data will be updated in the cloud. This notification enables the patient's future health issues to be addressed by taking the proper action at the right time. Additionally, it enables the treating physician to act appropriately and timely.Other advantage is that it also stores the patient’s previous records so that the doctor can go through the medical history from anywhere around the world and can diagnose the problem.

II. PROBLEM IDENTIFICATION IN CURRENT SYSTEM

The problems that are existing in the current scenario is that the patient has to go physically to the doctor each and every time he needs to get his parameters diagnosed.It requires a lot of time and effort to go every time even there is no such major changes in the health report.The patient’s relatives also have to ask for the physical copy of the report and the doctor’s statement to prepare for the patient’s condition..Using this health monitoring system,we aim to solve that

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problem.We will create a remote database for the doctor and patient to view from anywhere in the world.This saves time and is a much more efficient process.Its even more useful in covid time as it reduces the unnecessary social interaction and keeps the people safe at their home and get the required services from their home.

III.OBJECTIVES OF THE STUDY

The main objectives are:

- To develop a health monitoring system where data can be stored on the cloud.
- To make maintenance and readability easy for doctors.
- Patient data can be sent to their relatives in the time of emergency.
- A single system to monitor various health parameters.
- To make it easier for patients and the doctors to contact each other.
- Better patient satisfaction.
- Reduce the unnecessary paper work by storing the data on the servers.
- Provide better accuracy and precision.

IV. PROPOSED METHODOLOGY AND DISCUSSION

Development of an IoT system for monitoring SpO2, heart rate, and temperature: First, a complete circuit for heart rate and Spo2 sensing is created. Since the MAX30100 sensor can provide both SpO2 and heart rate data, it is used. In order to connect the sensor and collect data from the user or patient, Arduino is utilised as a microcontroller. Additionally, it can send data to the internet using its WiFi module.DHT11 Sensor is used to keep track of body temperature.

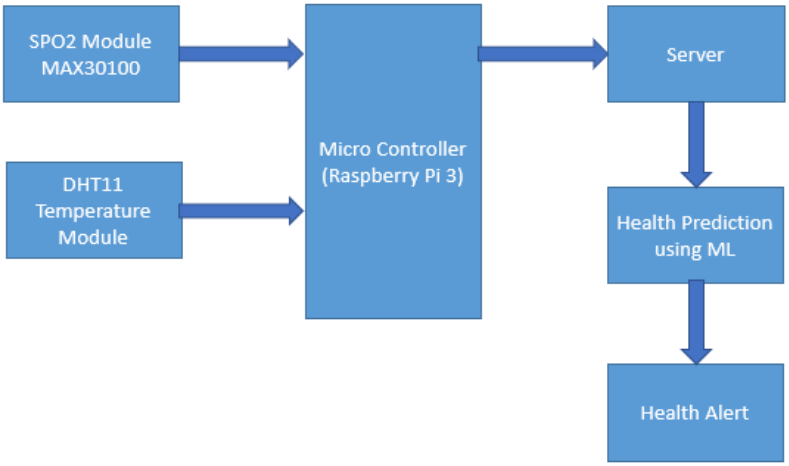

Fig1: Block Diagram

Data gathering and verification: The MAX30100 sensor offers a set of SpO2 data that is made up of IR and RED LED data. The Photoplethysmography (PPG) signal refers to these data. A datasheet containing references for healthy and harmful ranges is included with this sensor. Five healthy participants are therefore chosen to collect data from and validate the method that has been designed. Datasheet references and health regulations will be used to reference the gathered data.

Item	Measurement Range	Humidity Accuracy	Temperature Accuracy	Resolution	Package
DHT11	20-90%RH 0-50 ℃	±5%RH	±2℃	1	4 Pin Single Row

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Classification of healthy and unhealthy conditions: The system's last stage must display the classification of healthy and unhealthy conditions in order to inform caregivers or medical personnel of the patients' conditions. Before being integrated using a rule-based system, SpO2 and heart rate condition are first classified individually. In order to determine the SpO2 condition, a majority vote is used. Before, there were just a few segments for a single data set. One reading from the monitoring gadget constitutes one data set. There are two categories for SpO2 classification: normal and pathological. As illustrated in Table I, a normal situation occurs when the SpO2 value is 95 percent or higher
If not, it is seen as aberrant. The bulk of results will use the final SpO2 condition result based on the SpO2 readings from each segment.
There will be three condition levels for heart rate classification, as illustrated in Table II. A rule-based technique is used to extract and classify reading from MAX30100.

TABLE I. LEVEL OF SPO2 CONDITION

SpO2 reading (%)	Level
>=94	Normal
91 – 94	Mild hypoxemia*
86 – 90	Moderate hypoxemia*
< 86	Severe hypoxemia*

* Hypoxemia is defined as decreased partial pressure in blood and oxygen available to the body or an individual tissue or organ.

TABLE II. LEVEL OF HEART RATE CONDITION

Heart rate (bpm)	Condition
> 99	Abnormal
60 – 99	Normal
< 60	Abnormal

Rule-based algorithm was also used in the classification's final stage. At this step, the SpO2 and heart rate readings will be used to determine the final results. The project's significant contribution demonstrates that a pulse oximeter can be built utilising a Raspberry Pi 3, a MAX30100 High-Sensitivity Pulse Oximeter, a Heart Rate Sensor, and a DHT11 Temperature Sensor. It is a lightweight, inexpensive device that does not add weight. The sensor readings can be transmitted to the server for Health Prediction utilising Machine Learning Algorithm and the generation of customised alerts thanks to Internet of Things (IoT) applications.

HARDWARE
1.ARDUINO UNO
Arduino board designs employ a variety of CPU and controller types. It is a cheap, flexible, and user-friendly open-source microcontroller board that can be programmed. It can be applied in various electronic contexts. This board can communicate with other Arduino boards, Arduino shields, and Raspberry Pi boards as well as control relays, LEDs, servos, and motors as an output. The boards' sets of digital and analogue input/output (I/O) pins can be used to interface with a variety of expansion boards, breadboards (for prototyping), and other circuits. The boards contain serial communications interfaces, some of which may load programmes through USB(Universal Serial Bus).

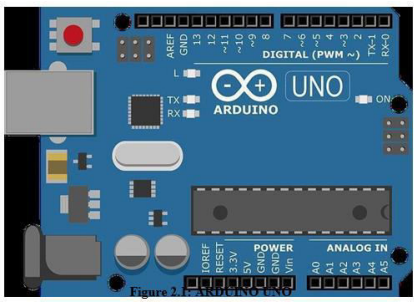

Fig:-Arduino Uno

2.Pulse Sensor

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The Pulse Sensor is a heart-rate sensor for Arduino that is plug-and-play. Any person can use it to quickly get their real-time heart rate data into their works so that in case of emergency it can be helpful to them.

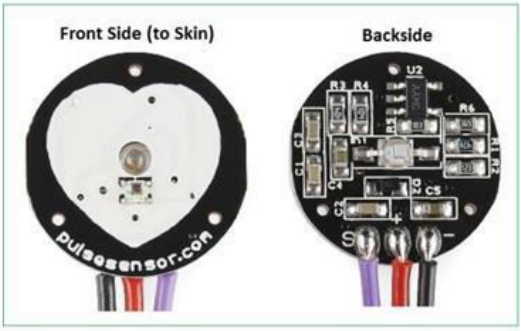

Fig:-Pulse Sensor

3.DHT11 Sensor

The DHT11 Temperature & Humidity Sensor has a temperature and humidity sensor complex with a calibrated digital signal output. By combining temperature and humidity sensing technology with a special digital signal acquisition method, it ensures high dependability and exceptional long-term stability. The range of its temperature is 0 to 50 Celsius.

Fig:-DHT11 Sensor

4.ESP8266

An easy-to-use and reasonably priced tool for linking your inventions to the internet is the ESP8266. The module may perform the dual roles of station (connect to Wi-Fi) and access point (make hotspots), enabling it to easily retrieve data and publish it to the internet, making the Internet of Things as straightforward as is practical.

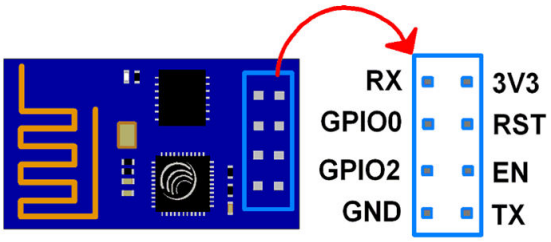

Fig :ESP8266

V.EXPERIMENTAL RESULTS

Using the KNN algorithm new data points are predicted and based on their performance the new data point is created which resembles how closely it resembles the values of the points in the training set.

Step 1: Datasets are required before we can use any method, therefore step one. Therefore, the initial KNN phase must load both the training and test data.

Step 2: Selecting the K value, or the nearest data points, is the next stage. K is any integer.

Step 3: Complete the actions listed below at each point in the test data

3.1: Calculate the distance between each row of training data and test data using the Euclidean, Manhattan, or Hamming distances. The method that is most frequently used to calculate distance is euclidean.

3.2: Sort them now based on the distance value in ascending order

3.3: The following step will select the top K rows from the sorted array.

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Step 4: End

EXAMPLE: An illustration of how the KNN algorithm functions and the idea of K is provided below: Let's say we have a dataset that can be plotted as shown below.

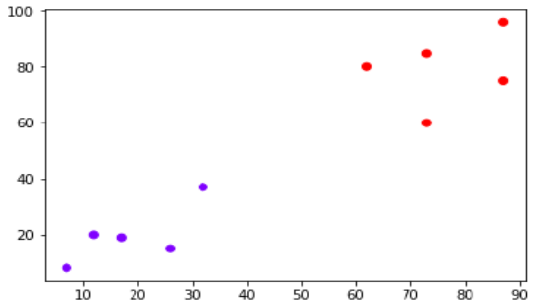

Fig (i)-Dataset (a)

We must now categorise a fresh data point (at location 60,60) with a black dot into the blue or red classes. Assuming that K = 3, it would locate the three nearest data points.

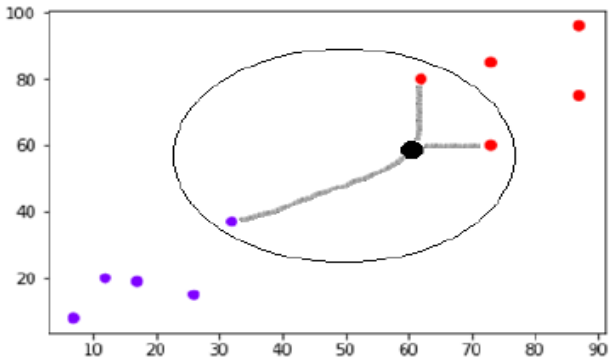

Fig (ii)-Dataset (b)

The graphic above shows the three closest neighbours of the data point with the black dot. The black dot will be included in the Red class as two of those three are Red.

Sample Output

```
Filename: Health_Test/input.txt
data 0#0.00#77
['0', '0.00', '77']
['0', '0.00', '77']
Health condition is Normal


Filename: Health_Test/input.txt
data 0#0.00#77
['0', '0.00', '77']
['0', '0.00', '77']
Health condition is Normal


Filename: Health_Test/input.txt
data 96#41.80#77
['96', '41.80', '77']
['96', '41.80', '77']
Health condition is Moderate
```

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VI.APPLICATIONS

Patients with chronic illnesses and those on medication who are unable to visit the clinic can still receive the treatment they need through remote patient monitoring (RPM). RPM enables healthcare professionals to remotely manage and monitor patients with a variety of illnesses while the patients are safely at home. These virtual channels include phone, email, video consults, remote specimen collection techniques, portable medical equipment, and home health kits. Wireless home medical equipment can be given to patients, including scales, blood pressure monitors, and cell phones or other data collection tools. The mobile gadget receives the medical data or measures automatically, which are then forwarded to the hospital's data server for examination.

VII. CONCLUSIONS

The goal of this project is to create a health monitoring system that doctors may use from the convenience of their homes and use to diagnose patients by seeing data from the Cloud service. By using the system from home instead of physically visiting the doctor, patients also save a lot of time.

This technique also aids family members who wish to learn about the patient's health. We gained knowledge of IOT, how Arduino functions, and how to use the ESP8266 module to link data to the cloud.This service can be easily set up for any patient and it can store the data of patient for future references. The system is very useful for monitoring the health of the patient from a remote perspective.

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