A Smart Health Care System using IoT and Machine Learning

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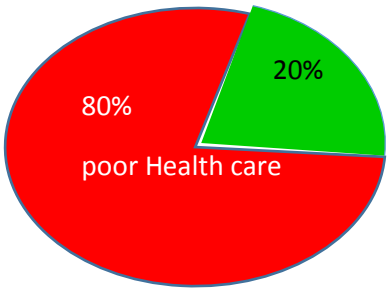
ABSTRACT: Elder people are suffered many kind of disease like heart disease, High pressure, High sugar. The medical facility of Indian villages is very poor. Villagers face a great problem when anyone of them is ill. A smart health care system is designed to monitor people from their home and take their timely health status. It helps to reduce pressure over doctors and hospitals and saves the life of many old people .Some sensors like heart beat sensor, blood pressure sensor, Blood sugar sensors, temperature sensors are attached to human body. The sensors are connected to a health care app. The app has two sections for both users and doctors. At first the patients have to register in this app. Patients regular health records are sensed by the sensors and stored in the database of this app. The system analysis the data. If any data is found wrong then it is automatically sent to the nearest hospital through GPS tracker and they will take immediate action.

1. INTRODUCTION

The population of India is increasing day by day. A recent survey said that the population of India is increasing almost 15% in every decade. So the number of patients are also increasing at the same rate. It will create pressure upon doctors and hospitals. If the patients can be monitored from their home then the pressure upon doctors and hospital will be reduced and it will be very economical for Government also. In the rural areas of India not a good treatment facility is available. Even there is some villages in India where not a single doctor is available. They face a big problem when a patient's condition is very serious. To solve this problems In this paper we will discuss about a smart health care system. The smart health care system is designed using IOT.IOT means Internet of Things that means things connected to the internet. Using this IOT technology we can control any substance from anywhere through internet. Some sensors are connected to human body which take the data .The data are se a health care app. All the data are uploaded to the cloud database of the app and it detects whether the patients' condition is serious or not. If the patients' condition is found serious then the data is automatically sent to the doctors and they take immediate action.

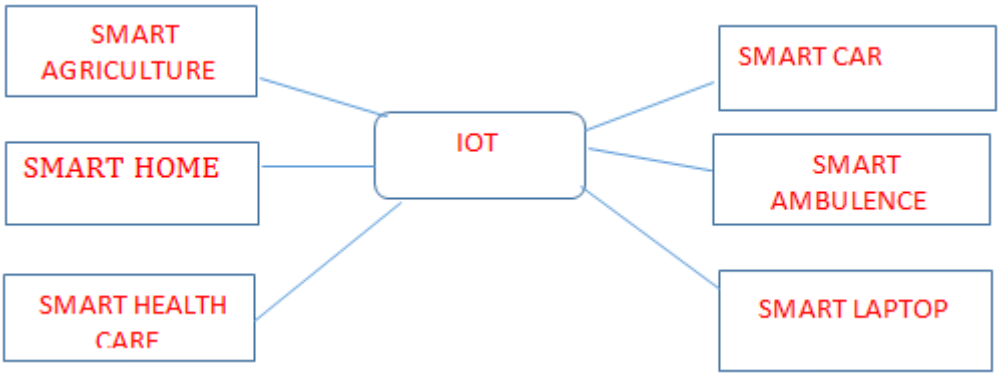
HEALTH CHALANGES:

One of the main concern is death of elder people. The causes of their death are high blood pressure, high blood sugar and heart disease. In India the medical facility in the village is very poor. In a recent survey it has been noticed that 80% villages and rural areas in India has no quality medical facility. Among them there are some villages where not a single doctor is available. They face a big problem when anyone of them is ill. The current population of India is 135 core. This huge population is the one of main causes of the poor health facility.



INTERNET OF THINGS:

The full form of IOT is internet of things. The term IOT was first used by Kavin Asthon in 1999. The concept of IOT is connected all devices to internet or cloud. It may be car, electric bulb, Electric fan, laptop, sensor and even human and we can control those devices from anytime and anywhere. IOT can make our life more easy and comfortable. Some applications of IOT are smart health care, smart city, smart home, smart car, smart agriculture e.t.c.



SMART HEALTH CARE USING IOT:

Smart health care is an application of IOT. The concept of smart health care is to control the health care system through internet of things. It makes a bridge between patient and doctors Some health sensors are connected to human body. These sensors sense the health data from the body and update to the cloud. The doctors watch the data and take further action.

PROPOSED WORK AND METHODOLOGY

Architecture of Smart Health Care:

The architecture of IOT based smart health care system mainly consists of 5 parts-Health care app-i> heartbeat sensor ii> blood pressure sensor iii> blood sugar sensor iv> body temperature sensor v> Arduino vi> Node MCU vii>ECG sensor

Arduino:

Arduino is an electronics device based on hardware and software. It uses microcontroller Atmega328. It has both Analog and digital pins. All the sensors are connected to Arduino. The Analog pins are used to connect with the sensors. It reads the input light of a sensor and converts it to output. Arduino collects all the data from the sensors and sends them to Database storage through MCU Node.

MCU Node:

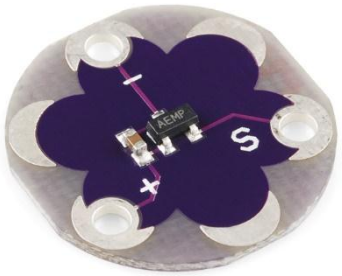
MCU node is an open source IOT device. It uses microcontroller Esp8266. Node MCU is connected to Arduino and enabled through Wi-Fi. It receives all the data from Arduino and Sends them to cloud database storage through Wi-Fi.

GPS TRACKER:

GPS tracker tracks the current location of an object. In this case it tracks the current location of the patients. GPS works by providing the information of exact location. It uses global positioning system to track the current location of object.

Temperature sensor:

Temperature sensor measures the temperature of body. One can wear it and measures the body temperature in anytime and anywhere. The temperature sensor is connected to an Arduino. The Arduino collects the data from sensor. The connected data is sent through the node MCU to cloud storage database.



Blood pressure Sensor:

Blood pressure sensor is used to measure the blood pressure of human body. It has the same function of sphygmomanometer but instead of mercury column a pressure sensor is used to detect the blood pressure .A pressure sensor detects the pressure in artery .It measures both systolic and diastolic pressure. It is a wearable and wireless sensor. The sensor is connected to an Arduino. The Arduino collects the sensed data from sensor. The sensed data is stored in the cloud storage database through node MCU.

Pulse Sensor:

Heart disease is a major disease in current generation. It is the cause of death of many old people. A pulse sensor helps to measure the pulse of a human body. It generally measures our heartbeat. The sensor is attached to finger. When the finger place on it it sense data. It measures the pulse of human body. It is connected to an Arduino. The Arduino collects the data from the sensors and the data are sent to the cloud database storage through node MCU.

Blood Sugar Sensor:

Blood sugar is the concentration of glucose present in the blood of human body. High blood sugar increase the chances of heart attack and stroke. Blood sugar sensor measures the blood sugar of human body. It measures the amount of glucose in blood. It is a wearable and wireless sensor. It is connected to an Arduino. The Arduino collects the data and the data is sent to the online storage database through Node MCU.

Many people have heart disease like cardiac arrest, Heart blockage, heart damage. A huge number of people are died due to heart attack and heart failure. So heart disease is a major concern for human. Through ECG we can familiar our current condition of heart. In smart ECG monitoring system we can take our ECG from home using an ECG sensor. The ECG sensor is connected to human body and It collects the ECG data from our skin. In this system four modules are used-i>sensor module ii>controller module iii>WI-FI module iv> power module

SENSOR MODULE:

Sensor module sense the ECG data from human body. The frequency of ECG signal is from 0.5Hz to 100Hz. A band pass filter is used to remove the noise of outside frequency band. Then an operational amplifier amplified the filtered signal. Finally with the help of a sensor module ECG signal 0v to 3.3 v are gathered.

CONTROLER MODULE:

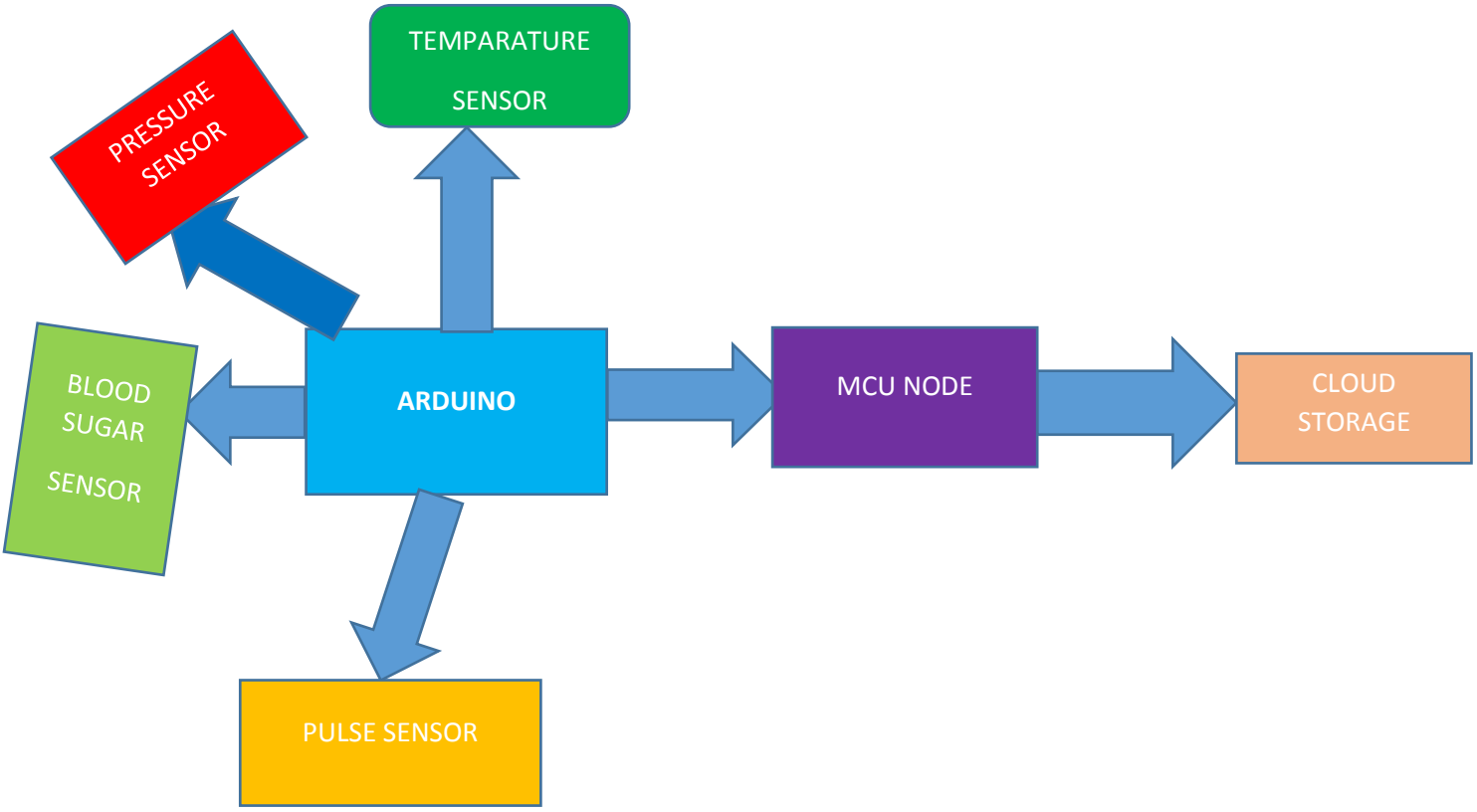
Controller module process the gathered ECG signal and send to WI-FI module. All the signal processing functions are performed in a MCU.

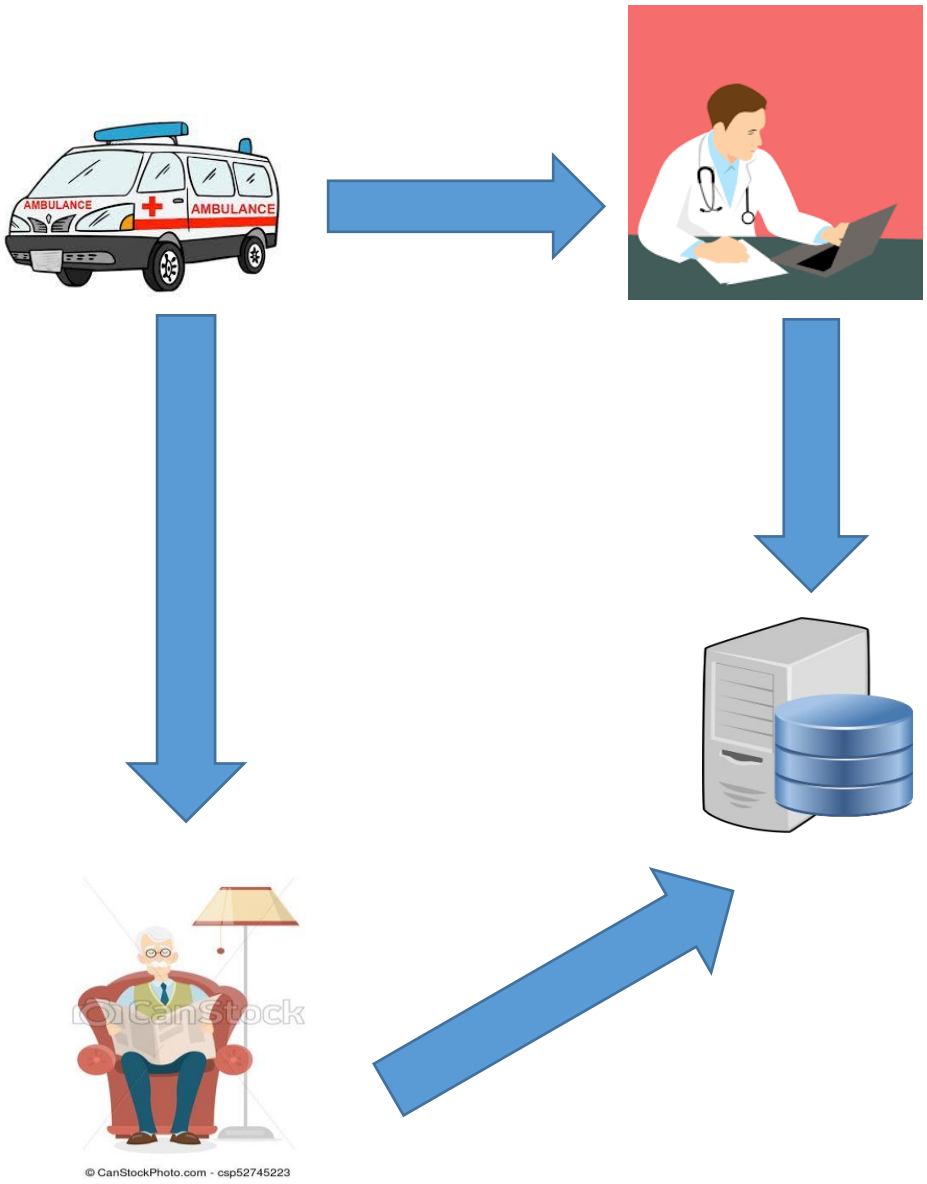
WI-FI MODULE:

WI-FI module takes the ECG data and from the controller module. Then the WI-FI module sends the real time ECG data to cloud storage to fast internet access.

POWER MODULE:

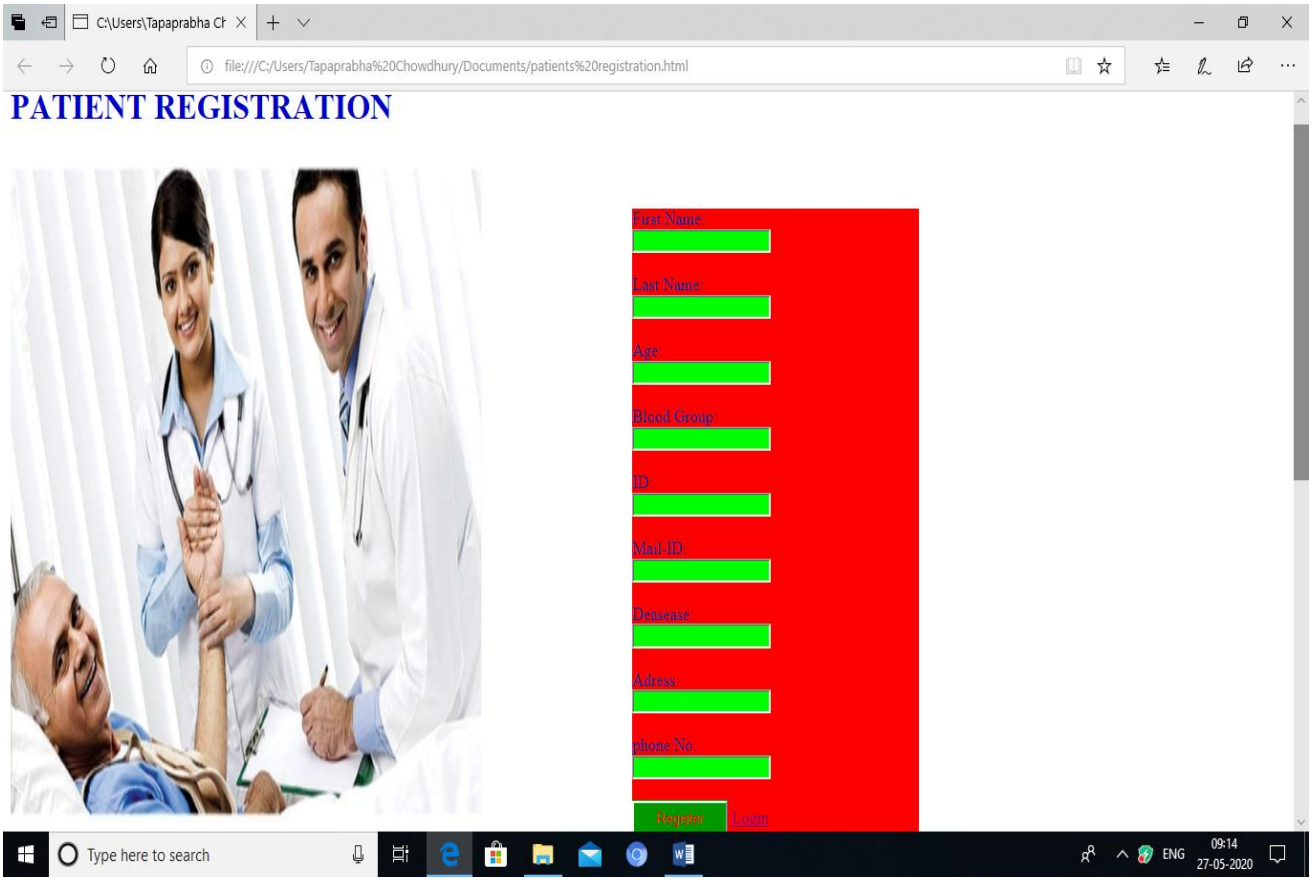
Power module supply energy to rest of three modules. USB AND Lithium battery are used to provide power supply.





Healthcare app:

A health care app is designed to analyse, store all the data taken by the sensors. In this app there is a page for registration for both patients and doctors. Patients and doctors can register in this page .Then they get their user ID and password. By this user Id and password patients can login the system. The health data sent from the sensors are stored in the database of the app. The app system analysis the data and If anybody is found unwell then it is automatically reported to the doctors of nearest hospital.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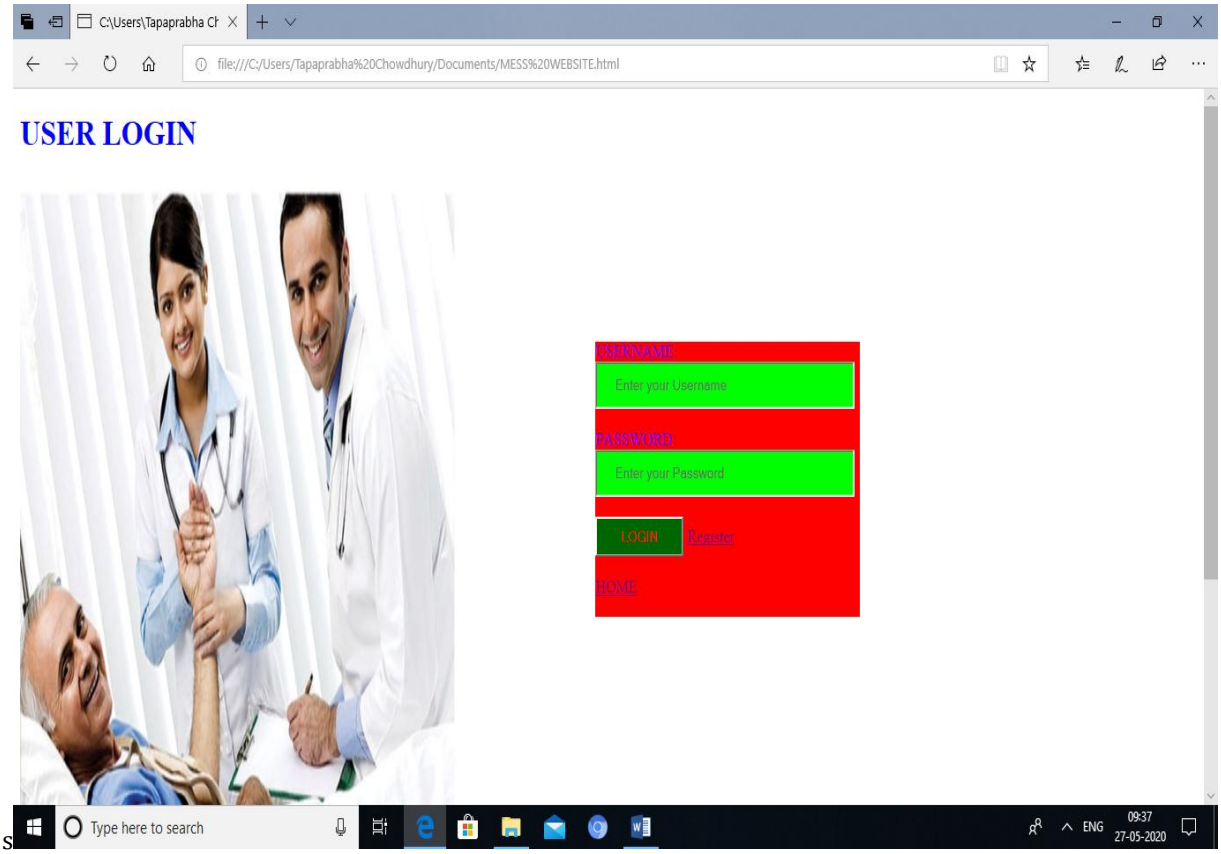
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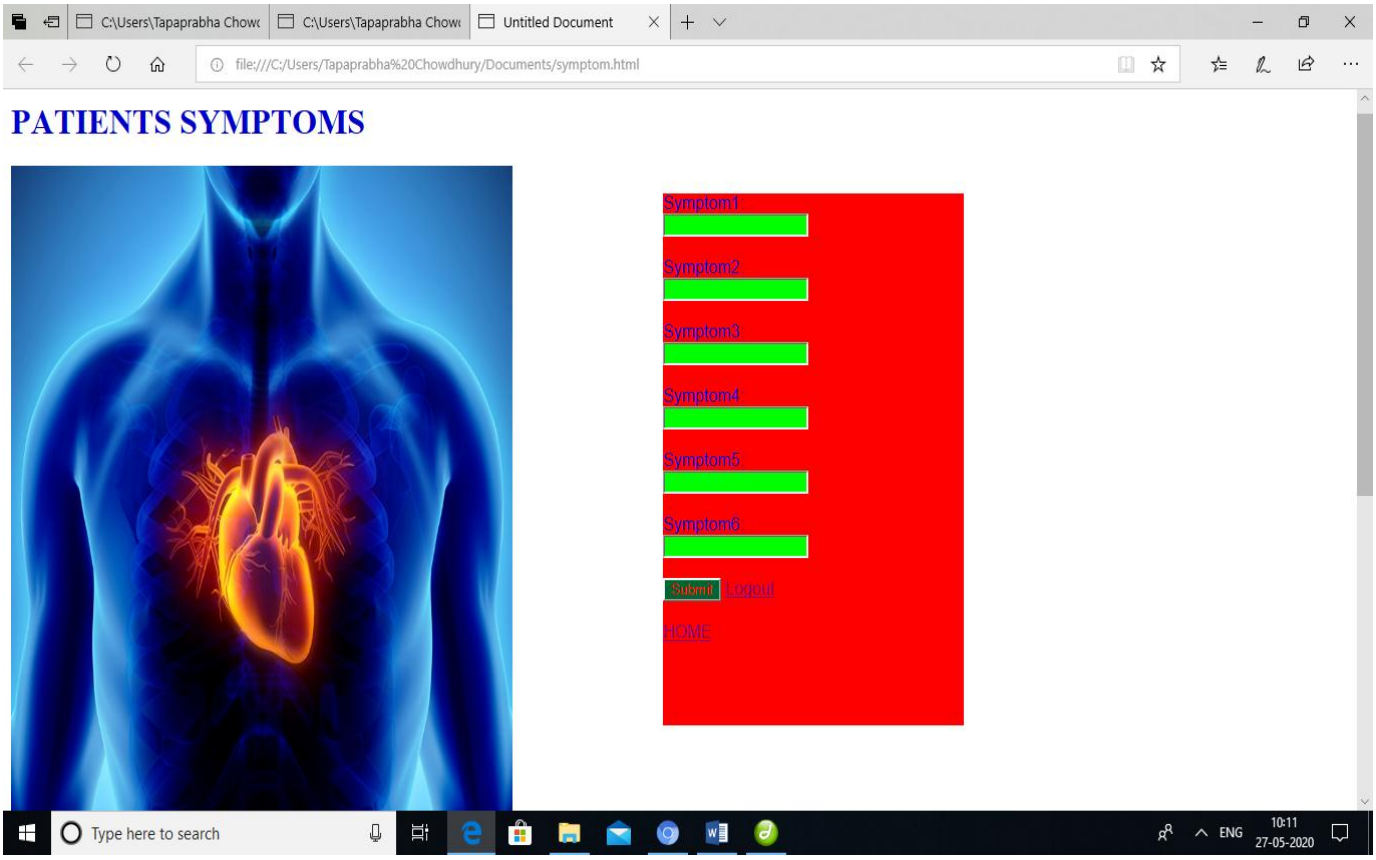
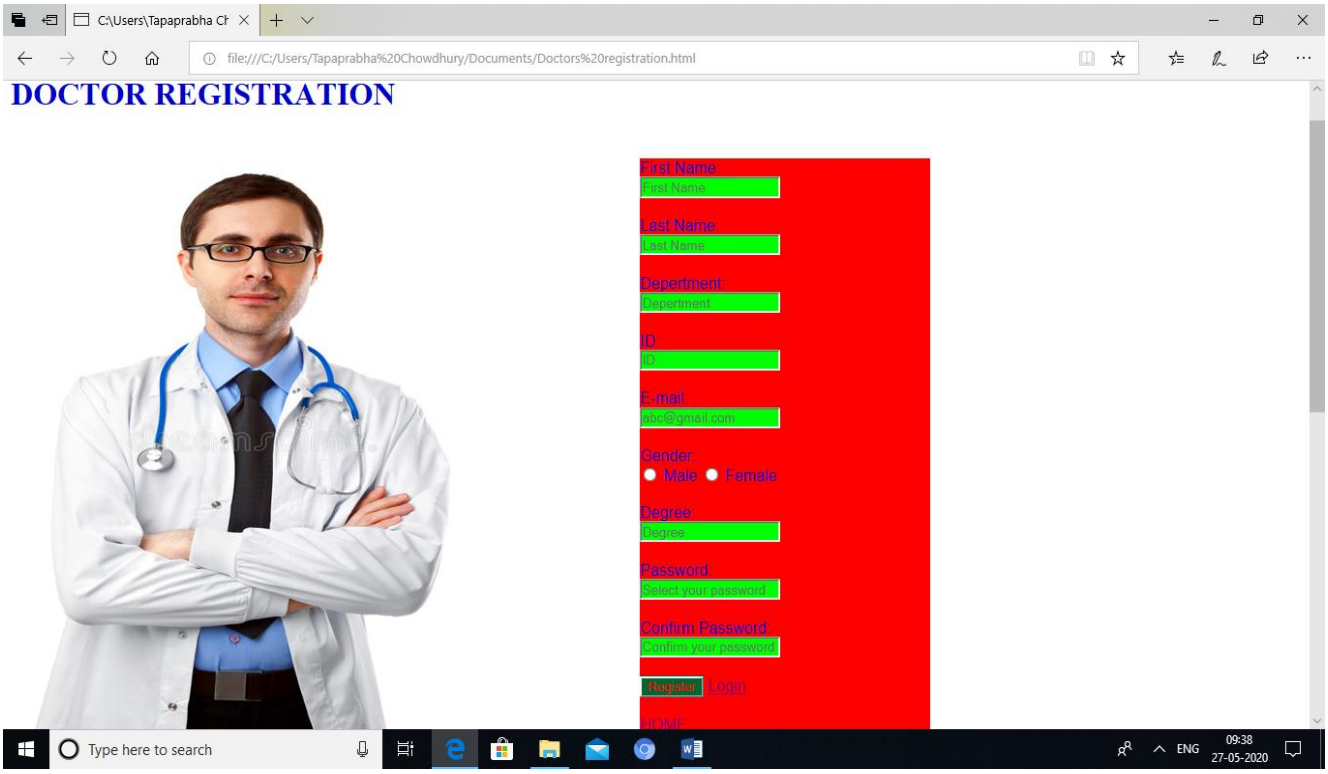
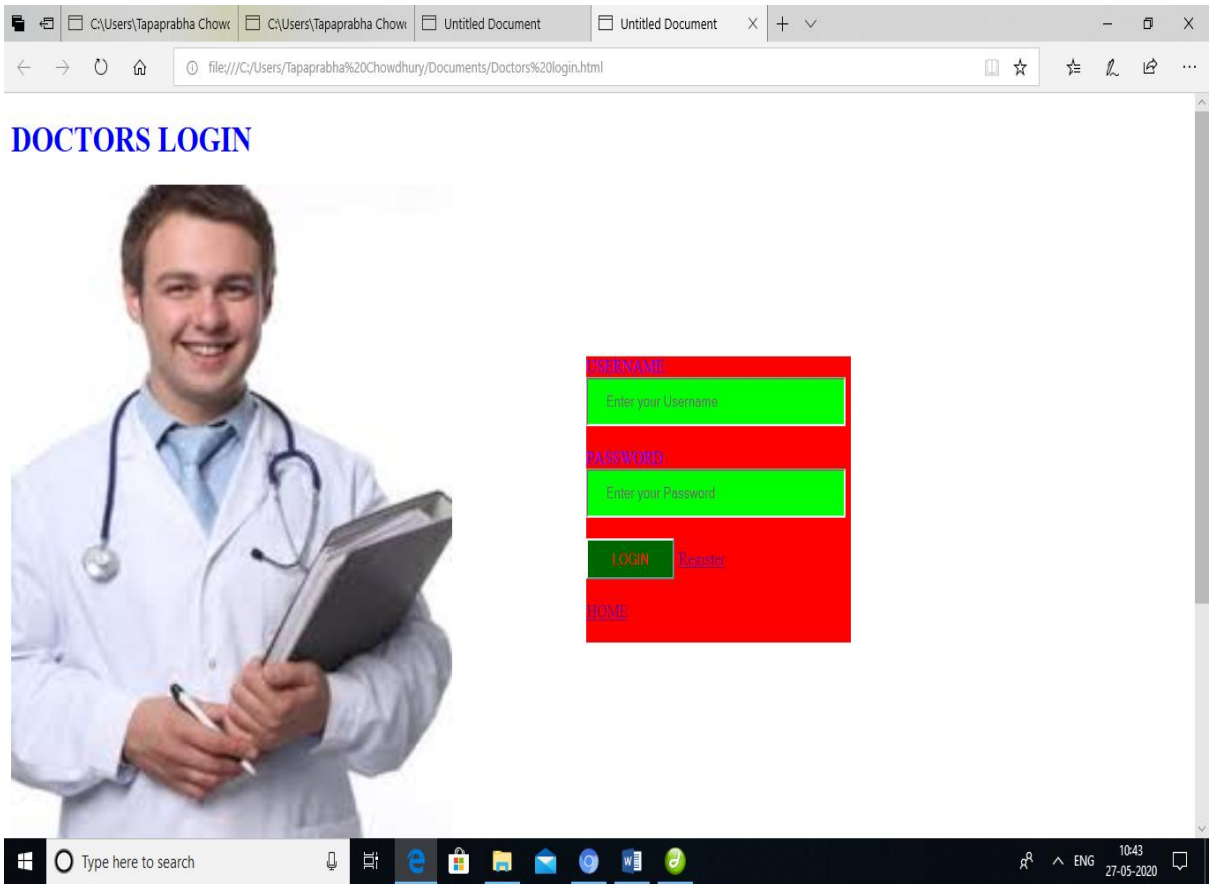


Patients can enter their symptoms here.



Doctors are registered by their name, department, qualification, age and degree,E-mail. After registration they get username and password.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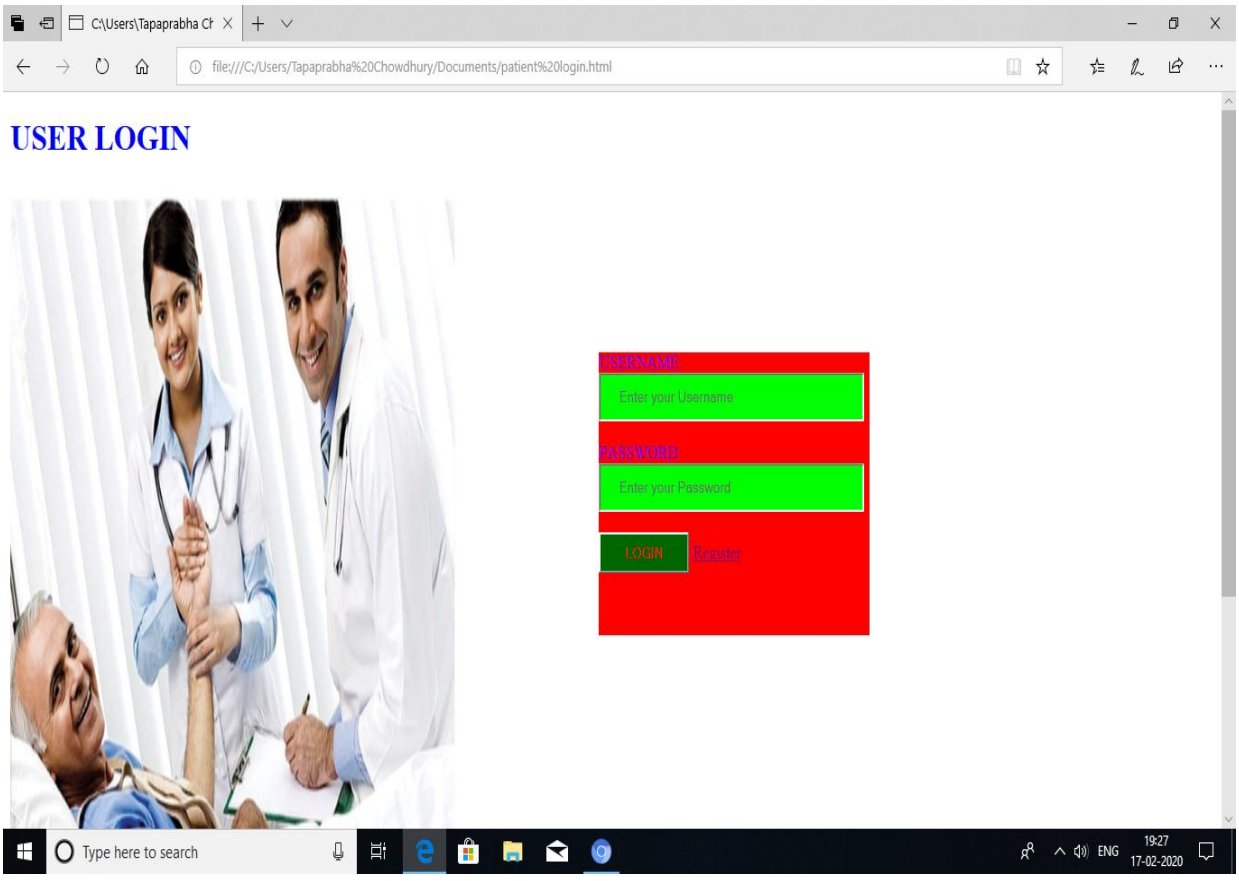
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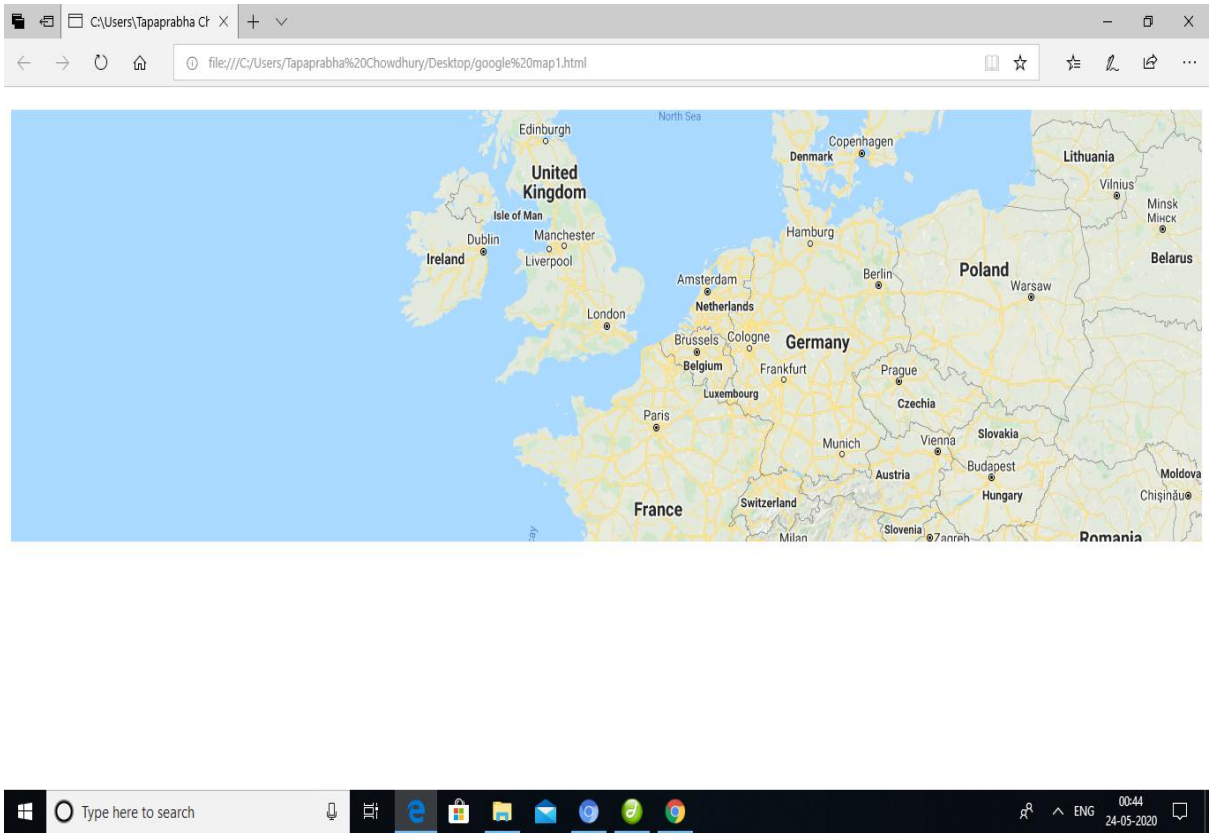
Doctors and users can login by username and password.

User can register by t heir name, age, blood group, address, phone no, E-mail-Id. After the registration they will get their User-ID and password. By this User-ID and password they can login the system and their health details are stored in the database through sensors. The system analysis the data. If it is not suitable for patient's health then a notification sent to the patient's email and phone no and asked them to enter their another symptoms if they have. All the symptoms are stored in the database and sent to the nearest hospital through GPS tracker. Patients can also add their own symptoms without any notification. Doctors have to register in this app by their name, qualification details, Department, mail-id and they get a user-Id and password. By this user-ID and password they can login the system and check the details of the users and prescribed medicine. If the patients' condition is found serious then ambulance will be sent to the patients' home through GPS tracker and admit them to hospitals.

If any user's heart condition is found unwell then the user can take the ECG in his/her home through smart ECG sensor. Then the ECG report is sent to the cloud.



This web based application is installed in smart phone or laptop. This app has three tire-

The front end is designed by HTML, CSS, JAVA-SCRIPT.

The middle tire is designed by python. It contains the main system logic. The logic is set by machine language.

The back-end tire is database server. The database server is create by MYSQL. In this database server all the register data of doctors and patients are stored. The health data records of every user are stored in this database.

MACHINE LEARNING CONCEPT

Machine Learning:

Machine learning is a subset of Artificial Intelligence(AI) which provides the machine to learn automatically from experience without being explicitly programed.

Classification of Machine Learning:

i>Supervised Learning

ii>Unsupervised Learning

iii>Semi Supervised Learning

iv>Re-Inforcement Learning

Supervised Learning:

In supervised Learning machines learn through labelled data. It is the learning through guidance. In this learning machines learn through input output based labelled data. In this learning machine learns through input output based training data. In supervised learning machine learns for a particular input what the desired output should be.

Classification of supervised Learning:

i>Classification

ii>Regression

Classification:

In supervised learning if input data are different classes then the input data are classify by classification problem.

Regression:

In supervised learning regression problem is when the output variable is a real or continuous value. The simple regression model is linear regression.

In this project the machine learning technique is used in the system. Supervised learning method is used in the system. The sensors will give some input to the system and the system has to give an output. So the system will be learned by supervised learning that for a certain input value what the desired output should be. Classification and regression both supervised learning methods are used.

LOGISTIC REGRESSION ALGORITHM:

Decision tree:

A decision tree is a machine learning technique in tree like structure. It uses for both prediction and classification. In tree like structure it guides the machine for a particular input what the desired output should be. Decision tree mainly uses supervised learning method and uses both classification and regression technique. In decision tree each node denotes a test on an attribute and each branch represents the outcome of the test and each leaf node holds a class level.

In this project decision tree method is used. It guides the system like tree structure for a particular input what the desired output should be. The sensors measure our pulse, sugar, pressure, temperature. By this decision tree the system is guided that in which input what the output will be or what action the system has to take.

PROPOSED WORK ON THIS PROJECT ON MACHINE LEARNING

The doctors set a normal value for pulse, blood sugar, blood pressure, Temperature.

X=Normal range for pulse Y=Normal blood sugar reading Z=Normal blood pressure readings

The decision tree compare if pulse readings=x or!=x. If pulse reading!=x then the system ask you for another symptoms.

If you have another symptoms then then you add the symptoms and pulse readings, pressure readings and blood sugar readings sent to the nearest hospital. And a notification sent to patient to take their ECG.

The same theory is also applied for blood sugar and pressure sensors also.

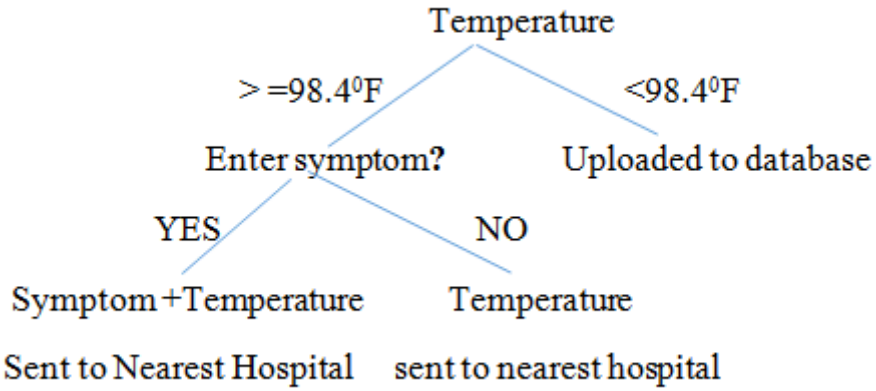
For temperature the decision tree first check if the temperature is greater or less on normal temperature range.

If the temperature is greater than the normal temperature range (98.4^{o}F) then the decision tree detects it as fever and send it to the nearest hospital.

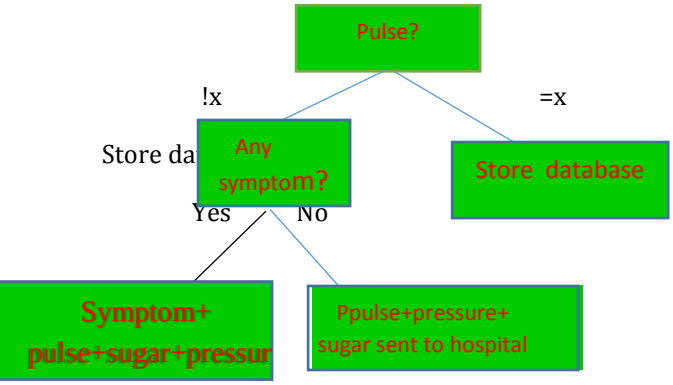
X=Normal pulse detected by doctor Y=Normal Blood sugar detected by doctor

Z=Normal Blood pressure detected by doctor

DECISION TREE

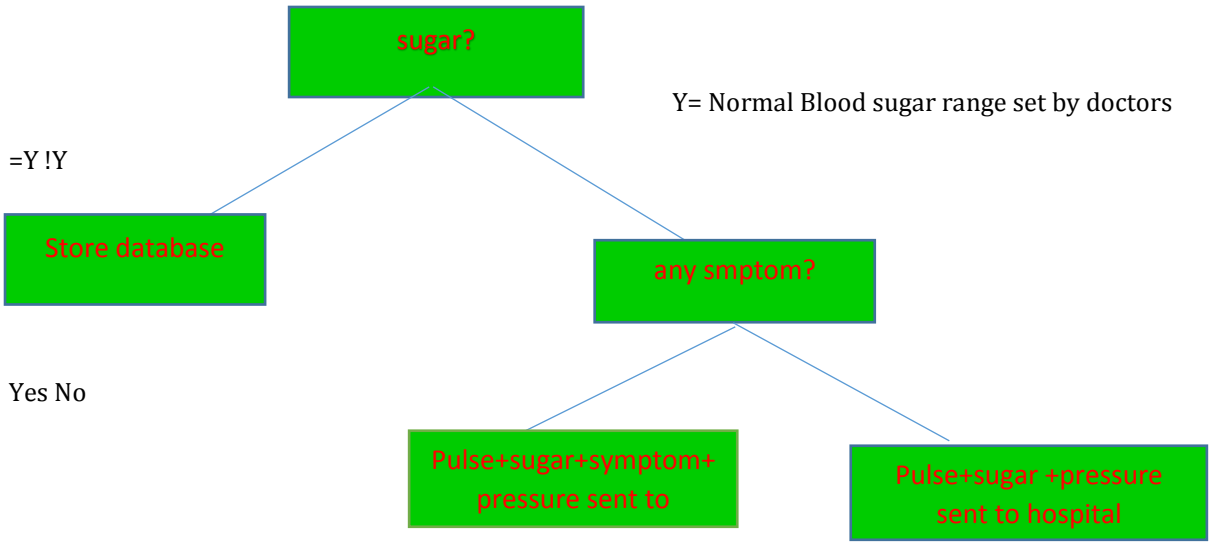


Pulse sensor

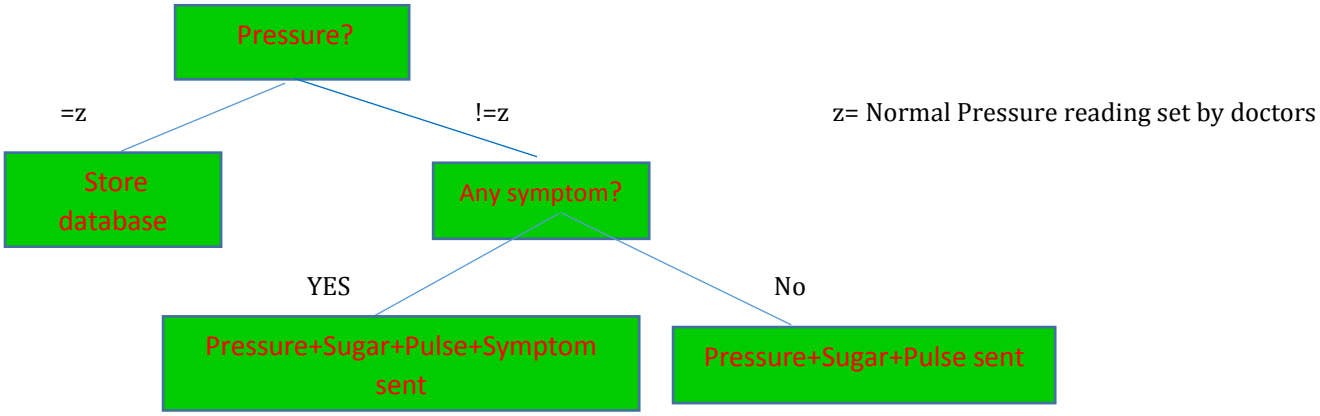


X=Normal pulse rate set by doctors

Sugar sensor



Pressure Sensor



RANDOM FOREST ALGORITHM

Random forest algorithm is one kind of supervised learning algorithm. Random forest is the collection of decision trees. As a forest is made by some trees, a random forest is also made by some decision trees. Random forest algorithm is used to find out the mean decision if many decision trees exists.

According to this paper the sensors sense the health data each and every time. So there are many decision trees for one decision tree algorithm. By this random forest algorithm the mean decision of those decision trees is find out.

Random Forest algorithm generally find out which decision is made in most of the decision tree.

A pulse sensor takes the heart beat in every minute. Many decision trees are made for every minute pulse reading.

In among 5 pulse readings if 4 are found normal and 1 is found abnormal reading then according to random forest algorithm. Then the system declares the pulse reading as normal.

The same theory is applied for temperature, pressure and blood sugar sensors also.

FUTURE WORK

In this paper we see that Different sensors measure body temperature, pressure, sugar, pulse and sent to cloud storage database. The system analysis the data and if anyone is found unwell then it gives notification to patients and sends the data to the nearest hospitals and the doctors watch the patients' health condition and take action. In future the project can be developed as the system will give treatment to users of the primary diseases instead of doctors.

CONCLUSION

This paper is about a smart health care system using machine learning where a system monitors our regular health data and if there is anyone is found unwell then it is automatically reported to doctors and users. It reduces the extra pressure over doctors and hospitals.

The life Many Elder people having blood pressure, heart disease, high sugar will be saved by using this system. The condition of medical facility in most of Indian villages is very poor. Even there is some villages in India where a single doctor is not available. They face a great problem when anyone is ill. This projects can solve their problem also. If any villager is found unwell then their whole medical report will reach to nearest hospital's doctors and they get proper treatment. In serious condition an ambulance will be sent to patients' location through GPS tracker and admit the patient to hospital.

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