IoT based Health Monitoring System using Machine Learning

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ABSTRACT

The concept of Internet of Things and Machine Learning are extensively used in the field of medical diagnosis and healthcare in order to monitor the condition of a patient. IoT has been used in the making of systems which notify the patient's peers in case of abnormality by implementing this through the functionality of a wearable sensor system which has sensors mounted on it. Machine learning has been used to aid the field of medical diagnosis through the use of models which are trained to identify any abnormality in the condition of the patient. In this paper, the proposed project integrates the concepts of IoT and Machine learning in order to provide efficient health monitoring for a patient, determine whether the patient has a particular disease or not as well as provide immediate relief measure in the case where the patient is facing some critical situation which requires immediate attention by the doctor and immediate relief measure through the design of a convenient wearable device.

Keywords: *IoT, Machine Learning*

1. INTRODUCTION

Health monitoring is a very needful and important asset in the detection and prevention of any kind of disease such as diabetes, especially in countries like the United States where the 70% of the population runs on prescription medication [1]. One of the major technology that aids the health care industry is the Internet Of Things (IOT). Through this breakthrough technology we will be able to monitor the vitals of the patient in an effortless and cost effective manner. The parameters such as the heartbeat, blood pressure and glucose level etc serves as the basis for identifying any illness or other problems. In, this project, a health monitoring system is being designed with which monitoring the patient's vitals such as heartbeat, temperature, blood pressure, glucose level will be easier and this system will also be able to detect if the patient is going through fits. There are five different sensors which will help the measuring of the above mentioned parameters. These five sensors are connected to the PIC microcontroller through which the data will be sent to a cloud database with the help of wi-fi module. The sensors are mounted on a wearable glove. If there is any abnormality in the patients vitals are observed then immediate relief measures are triggered and the doctors or the patient's peers are notified, so they can attend to the concerned patient. This notification is achieved through the GSM module that is connected through the microcontroller [2]. Further with the aid of Machine Learning it is possible to determine whether the patient is in an abnormal state or not and even identify that abnormal state. With the help of this system we will be able to read the live values of the patient and if there is any abnormalities such as low heart beat or increased temperature, immediate relief measures will be triggered and with the help of machine learning and this will enable to identify if the reason for abnormality in the vitals of the patient [3].

2. RESEARCH METHODOLOGY

The heart of the system is PIC microcontroller [6] to which five different sensors are connected such as heartbeat, temperature, blood pressure, blood glucose level and mems sensor to detect fits. Figure 2.1 shows the system architecture of the hardware setup of the health monitoring system.

- Collect the data from the patient through five sensors
- Administer these real time values into the cloud database
- Perform analysis on the values of the sensors
- If any abnormality is noticed then notify the doctor or patient peer using GSM and initiate immediate relief
- Perform Machine Learning on the values of the sensors and determine the condition of the patient i.e. whether the patient has hypoglycemia or not.

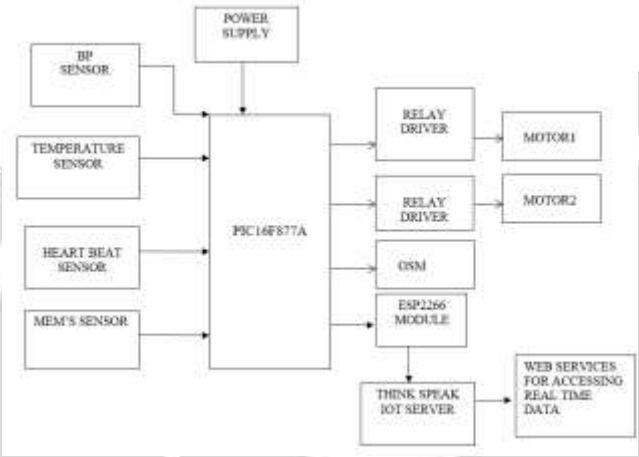

Figure 2.1 : System Architecture of the health monitoring system

The Figure 2.2 shows the wearable device in the form of a glove.

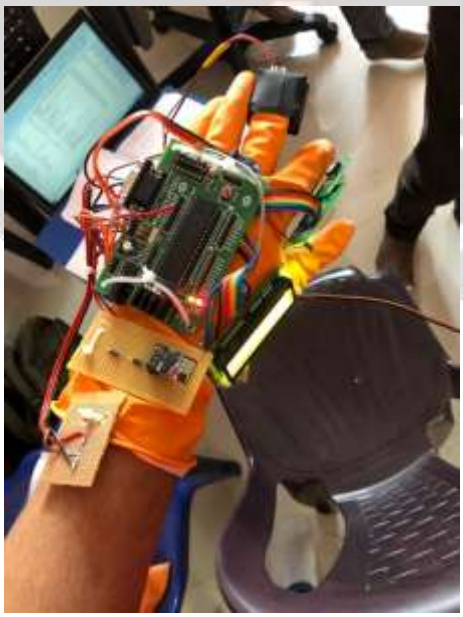

Figure 2.2: The wearable device

Figure 2.3: Relief Triggering System

The Figure 2.3 shows the relief triggering system which is in action when there is an abnormal condition detected by the wearable device. The system has two motors, one of them which gets turned on in case of high temperature situation and the other which gets turned on in case of low blood pressure. If any one of the situation arises, the motor gets turned on in order to show that the relief is being implemented as well as a notification is sent to the doctor or the patient's peers.

The data collected from the glove is then sent to the ThingSpeak cloud from where a dataset is formed and then machine learning is used on that particular dataset [5][7-11]. The dataset is trained for the classification of hypoglycemia and normal state. Since hypoglycemia exhibits symptoms of increased heartbeat, high blood pressure, low temperature and low glucose level, these symptoms are used to classify the status of the patient. The testing data is then taken from the wearable device and then fed into the trained model. The KNN algorithm is used in the model to classify a hypoglycemic and normal person. Figure 2.4 shows the working of KNN algorithm.

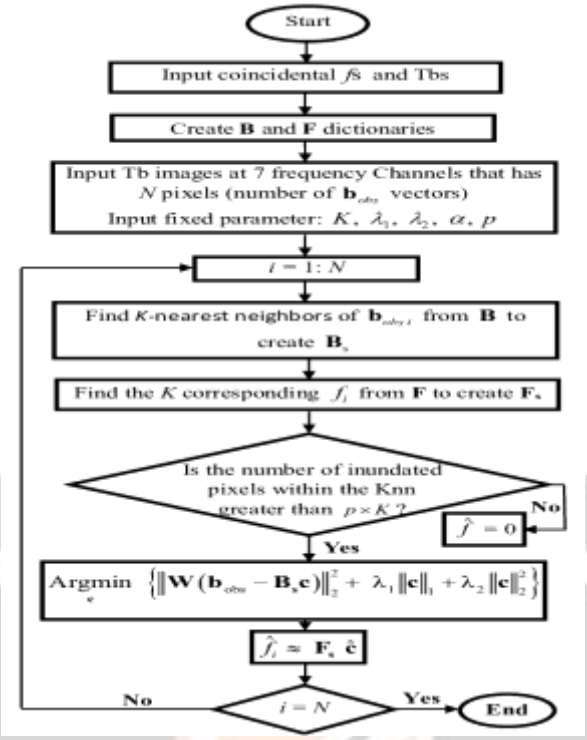

Figure 2.4: Working of KNN algorithm

3. RESULTS AND DISCUSSION

The hardware part of the project shows accurate results when the vitals of the patient are transferred to the ThingSpeak cloud and the relief triggering motors are turned on in case of an emergency situation in which the patient goes to an abnormal state which requires immediate assistance to the patient. The hardware also has the GSM module which should notify the peers as well as the doctor. The only way the hardware malfunctions is when there is a short circuit of the sensors on the wearable device. The Figure 3.1 shows the result of the machine learning model which classifies the current status of the patient using the trained dataset and the input given in the dashboard using the KNN algorithm.

Fig 3.1 The dashboard and the result of the classification model

Here, it is observed that the model shows that the patient is in a normal state which is true since the vitals of the patient are all normal.

Fig 3.2 The classifier showing the hypoglycemia result

In figure 3.2, the classifier predicts the outcome as the patient having hypoglycemia which is true as observed by the abnormal rise in the temperature of the patient, decrease in heart rate, increase in blood pressure and decrease in the blood sugar level.

The Figure 3.3 shows the performance analysis i.e. the confusion matrix of the machine.

On calculating this, we get

Precision = 0.7338

Recall = 0.514

F1 score = 0.61

N = 239	Predicted NO	Predicted YES
Acutal NO	86	33
Acutal YES	29	91

Figure 3.3 Performance Analysis of the Algorithm

4. FUTURE WORK

To propose different models and integrate them with the hardware in order to predict the possibilities of the patient having other kinds of diseases too. To use multiclass KNN in order to achieve the classification of various diseases. To make use of smaller and light weight sensors in order to accommodate more number of sensors on the wearable device in order to measure more number of parameters hence making the classification of diseases more accurate and precise.

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