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Machine Learning-based Diabetes Classification using Raspberry-Pi

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Abstract

Diabetes is one of the diseases that is spreading get along faster among people. Typically, determining the level of diabetes in patients takes time. To reduce this problem, machine learning algorithms are said to help predict and classify type 1 or type 2 diabetes. Then, a liquid crystal display (LCD) is said to be used to show the diabetes reading and communicated via the Internet of Things (IoT). alert and send messages to doctors and patients regarding diabetes by reading for other drugs. This project is useful for early detection and also presents a hypothetical IoT-based diabetes monitoring system for healthy and sick people to monitor blood glucose (BG) levels. The tools used in this project are Raspberry Pi, a non-contact infrared sensor and machine learning algorithms such as logistic regression, K-Nearest Neighbour, and Support Vector Machine. It has higher precision than other ML algorithms.

Keywords: logistic regression, K-nearest neighbour, vector machine support, Raspberry Pi, IR sensor, LCD, IoT (Internet of Things).

1. Introduction

More than 360 million people worldwide suffer from diabetes [3]. America is the largest country with a third of the population suffering from diabetes. India is the second largest country with the most diabetics [5]. Diabetes is a growing problem caused by “obesity” (or) “hyperglycaemia” and excess sugar [1]. There are three types of diabetes namely: type 1 diabetes, type 2 diabetes and gestational diabetes with levels (>100mg/dl) and (<100mg/dl).

Type 1 is an autoimmune disease in which the cells in the body that are important for producing insulin are destroyed. It can appear in childhood (or) adulthood. To reduce type 1 diabetes, you need a healthy diet and enough exercise. Type 2 diabetes usually affects overweight adults. In this type, the body is resistant to insulin absorption (or does not produce insulin to control type 2 diabetes and needs to take special medications). Gestational diabetes first occurs when a woman is pregnant. During pregnancy, the body produces more hormones and undergoes other changes, such as B. weight gain. These changes cause the body's cells to use less insulin. This condition is called insulin resistance [6].

2. Literature Review

In [1] the decision tree model was revised to achieve the best prediction performance with excellent accuracy compared to other soft computational models in this systematic meta-analysis. In [2], it was noted that the model could provide physicians and patients with valuable preliminary information about the onset of T2DM, which would help patients. In [3] the focus is on the integration of classification and clustering algorithms with other technologies such as IoT, cloud computing etc....develop intelligent monitoring systems and tools. In the article [4], the obtained results show that the RF algorithm has a prediction accuracy of 98% and an accuracy of 100%. In [5] various machine learning algorithms are discussed, such as and each algorithm is compared. In [6] it was found that among various machine learning algorithms, the artificial neural network (ANN) provides the highest accuracy with the min-max scaling method (MMSM) for the Indian Pima dataset (IPD). In [7] it was shown that the Support Vector Machine (SVM) algorithm can be successfully used to detect a common disease with simple clinical measures and without laboratory tests. In [8] it was shown that this method has about the same accuracy as normal SVM, with extra clusters reducing the accuracy, which can be controlled by choosing the right starting point for k-mean clustering. In [9] it was found that the neural network algorithm has the best accuracy (80.4%) than all other methods, and the naive Bayes algorithm requires shorter execution times than all other methods. Finally, [10] studied data classification using different machine learning algorithms. The logistic regression reached a maximum accuracy of 96%.

3. Hardware and Software Components

The hardware and software components used in this project are a Raspberry-pi 3B+ kit, a Non-invasive IR sensor, a GSM module, an LCD, a Relay, a Buzzer and Machine Learning algorithms.

3.1 Hardware Components

Raspberry Pi: The Raspberry Pi is a credit card-sized computer. The Raspberry Pi 3B+ model is an improved version of the Raspberry Pi 3B model.

Figure 1: Raspberry-pi 3 B+ model

Infra-Red (IR) Sensor: Sensors are electrical devices used to sense changes in the body and environment.

Figure 2: InfraRed (IR) Sensor

GSM Module: The GSM module is used to establish communication between a computer and a GSM (Global System for Mobile Communication) system, which allows a higher data transmission rate.

Figure 3: GSM Module

LCD Display: A Liquid Crystal Display (LCD) is a flat-panel display or another electronically modulated optical device that uses the light-modulating properties of liquid crystals in conjunction with polarizers.

Figure 4: LCD Display

Relay: Relays are electrically operated switches that open and close the circuits by receiving electrical signals from the outside.

. **Figure 5: Relay**

Buzzer: An acoustic signalling device such as a beeper or buzzer can be electromechanical, piezoelectric or mechanical type. Its main function is to convert the signal from audio to sound. It is an output device.

Figure 6: Buzzer

3.2 Software Components

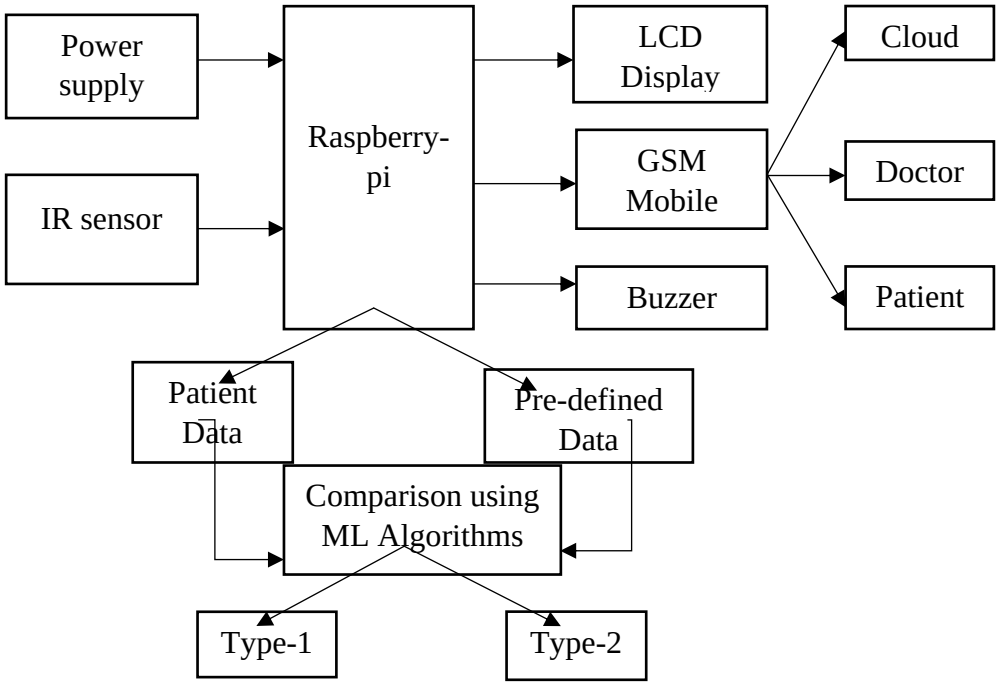
Machine learning algorithms such as Logistic Regression, K-Nearest Neighbour and Support Vector Machine are used as software components. KNN (K-Nearest Neighbours) algorithm: This algorithm can be applied to both classification and regression problems. In the data science industry, it seems to be used

more to solve classification problems. Support Vector Machine (SVM) algorithm: The SVM algorithm is a classification algorithm that represents the raw data as points in an n-dimensional space (where n is the number of features). Logistic Regression: Logistic regression is used to estimate discrete values (usually binary values like 0/1) from a set of independent variables. It helps predict the probability of an event by fitting the data to the logit function. This is also known as logit regression.

4. Classification of Diabetes

In previous technologies, many authors used various machine learning algorithms to predict diabetes. But in this project, a non-invasive infrared sensor is useful to test patients' glucose levels and classify diabetes types using machine learning algorithms such as logistic regression, K-nearest neighbour, and machine with support vectors. So, type 2 diabetes is changed with flashing lights (or) buzzers. The reports are then sent to Type 1 or Type 2 physicians and patients for further processing.

Figure 7: Block Diagram of Classification of Diabetes



4.1 Working Principle

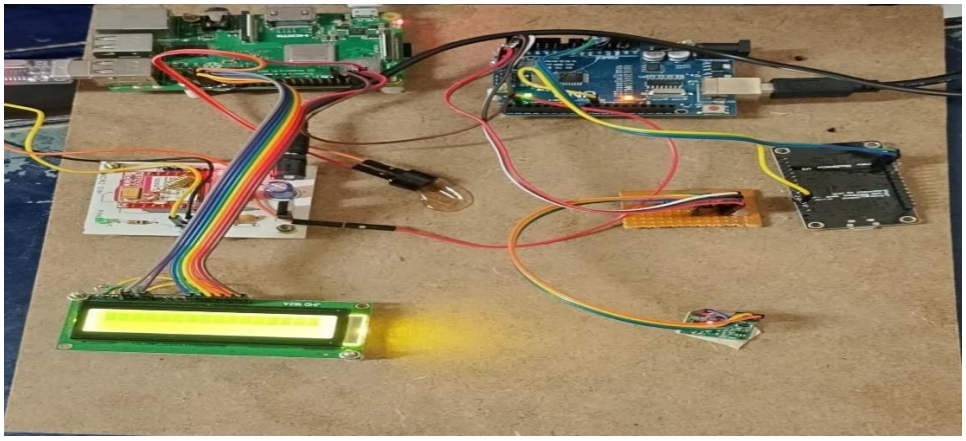
First, the power supplied to the Raspberry-pi kit. When the finger is held on the IR sensor, the glucose level of the patient is measured. The measured value is passed to the Raspberry-pi. In this kit, the patient's glucose level is compared with a predefined dataset and the classification of diabetes is performed using machine learning algorithms such as K-Nearest Neighbour, Support Vector Machine, and Logistic Regression. Then the blood glucose level is displayed on the LCD and this data is stored in the cloud via the GSM module. Type-2 diabetes patients are alerted by the buzzer. The patient's glucose level is sent to both doctors and patients with a precautionary message via SMS.

5. Experimental Setup and Results

The corresponding Non-invasive IR sensor is used to measure the sugar level and classify the diabetes type. Then the data is stored in the Raspberry-pi and displayed on a 16*2 LCD. In addition, the data is

updated on the ThingSpeak server and messages are sent to doctors and patients. The following figure shows the experimental setup.

Figure 8: Experimental Setup



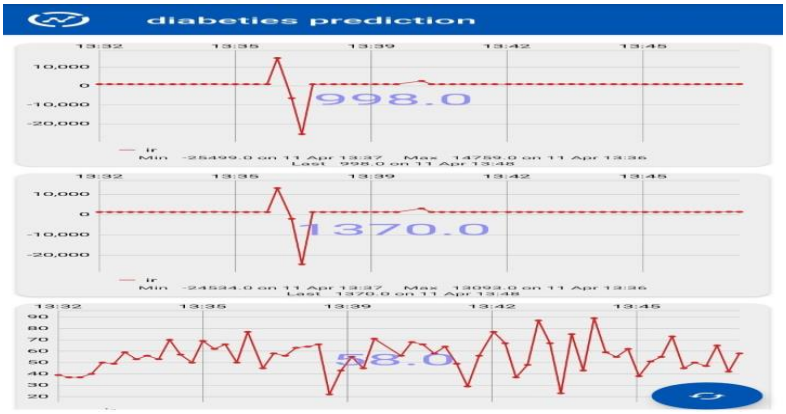
These are the results which are obtained from the LCD screen are shown below.

Figure 9(a): TYPE-1 Diabetes

Figure 9(b): TYPE-2 Diabetes

A blood glucose level of less than 90mg/dl is considered normal. A blood glucose level between 90mg/dl and 100mg/dl is considered Type-1 diabetes or pre-diabetes and a blood glucose level above 100mg/dl indicates Type-2 diabetes. The following graph shows the glucose level of the diabetic patient measured from the IR sensor, which shows that on the X-axis time and date and Y-axis the glucose level of the patient is stored in the cloud.

Figure 10: Glucose Level Accuracy of the Patient stored in the cloud



6. Conclusion and Future Scope

In this paper, a classification of diabetes is proposed which classifies the glucose level as either Type-1 or Type-2. It helps doctors, patients and their relatives to monitor the blood glucose level of patients. It alerts

physicians and patients when a patient has type-2 diabetes. Compared to standard clinical methods and commercial devices such as Continuous Glucose Meters (CGMs), almost 95% of correct results are obtained. In the future, communication can be made collaborative by adding two-way communication protocols for the IoT. This will allow physicians to monitor and counsel patients online.

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