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Detection of Diabetic Foot Ulcerusing Knn Algorithm

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ABSTRACT— A diabetic foot ulcer is a wound that mostly affects the bottom of the foot and develops in people with diabetes. The proposed method makes use of sensors and the KNN algorithm to detect diabetic foot ulcers. The term "internet of things" refers to actual physical items equipped with sensors that share information with other systems and devices over the internet. The KNearest Neighbor algorithm is the most basic machine learning method for assessing data similarity. An open source electronics platform called an Arduino board can read inputs and convert them into outputs. This concept eliminates time-consuming tasks like routine medical visits and provides real-time updates on the patient.

Index Termss—Diabetic Footulcer, sensors ,IoT, KNN algorithm

I. INTRODUCTION

The most frequent foot wounds resulting in lower extremity amputation are diabetic ulcers. According to estimates, diabetic foot ulcers account for about 40% of hospital admissions among people with diabetes mellitus. Multiple problems are common in diabetes mellitus patients, with foot ulcers being one of the most serious. If essential care is not given, diabetic foot ulcers are more likely to grow, which could result in infection, gangrene, amputation, and even death.

Type-1 and type-2 diabetics are the two different subtypes of the disease. Patients with type 1 diabetes either do not produce any insulin or produce it in very little amounts. Although insulin is created in type-2 individuals, it is not enough for the body to operate. Diabetic foot ulcers are more likely to develop in long-term type-1 or type-2 diabetes patients. A diabetic foot ulcer is a condition where the patient's foot becomes injured. It primarily develops and remains open on the bottom of the foot.

To spot foot ulcers early on, a diabetic patient should monitor changes in their ulcers on their feet. In the beginning, a few symptoms like swelling, redness, cracks, pus, sores, stench coming from any foot, gangrene, and open lesions are very important to recognise. Individuals may experience different symptoms. The majority of diabetic people experience diabetic foot ulcers (DFU), a consequence of diabetes. On the foot, it will result in open wounds DFU that is left untreated can end in infection and amputation, which require the removal of a foot or a leg. Early detection of foot ulcers is crucial because diabetes is the primary health issue that people of all ages encounter. This study investigates the medical status of diabetic ulcers and forecasts the diseased state.

The system consist of various sensors which are used to measure the parameters such as temperature, Dynamic foot pressure additionally change in heartbeat and Blood pressure are measured. The pathogenic factors cause superficial temperature change than can be qualitatively measured by using temperature sensor LM35.Plantar ulcers in diabetics are due to excessive pressure on the soles exerted during normal activities such as walking andrunning (dynamic foot pressure) Static plantar pressures are significantly lower than dynamic foot pressures in a stationary person.With the help of the pressure sensor dynamic foot pressures are measured and abnormal pressure points identified.

The patient's smart phone uses a bluetooth connection to transmit the readings, which are then stored in a cloud database. The term "internet of things" refers to actual physical items equipped with sensors that communicate and share information with other systems and devices over the internet. The Internet of Things is essential for addressing current issues in the healthcare industry.Internet of things (IOT) consist of sensors/

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Devices which attach to the cloud through some kind of connectivity. This is rapidly growing network that are able to collect and exchange data in realtime with the help of embeded sensors. Once the data is in the cloud, software processes it and may then choose to take some action, such as issuing an alert or automatically altering the devices or sensors. All of these actions are carried out without the user's involvement. Therefore, the integration of IOT with healthcare has been a significant progress in technology for a higher quality of life.

The exchanged data is compare with the predefined situations ,which means inside the cloud the data is analysed as per the condition set and with the help of KNN algoritham. One of the simplest machine learning algorithms, based on the supervised learning method, is K-Nearest Neighbour. The K-NN algorithm makes the assumption that the new case and the existing cases are comparable, and it places the new instance in the category that is most like the existing categories. A new data point is classified using the K-NN algorithm based on similarity after all the existing data has been stored. This means that utilising the K-NN method, fresh data can be quickly and accurately sorted into a suitable category.This will make it easier for both patients and doctors to analyse and forecast foot ulcer symptoms. In order to alert the patient and the doctor, this task will be able to spot any abnormalities in the patient's behaviour. This makes it simple and quick to locate various patients' medical reports. In fact, this model lessens the time-consuming tasks, such as frequent medical visits, and provides real-time updates on patients.

II. LITERATURE REVIEW

Amine Rghiou has developed an intelligent architecture for monitoring diabetes patients using machine learning algorithms in "A Smart Architecture for Diabetic Patient Monitoring Using Machine Learning Algorithms." The cost of the healthcare system can be reduced by the use of many technologies, including the Internet of Things, embedded systems, artificial intelligence, and smart devices. This study used 5G technology to monitor the diabetic patient's blood glucose levels. A set of sensors, wearable technology, a smartphone application, and a server with a database were presented as the architecture.In this architecture, various wireless technologies were applied. The various sensors were connected to the smartphone via Wi-Fi. The cellphones were connected to the cellular network using 5G technology in order to send data to the database server. The suggested system was designed to collect information on a diabetic patient's blood glucose level, temperature, and physical activity, then transport that information to a base station using a smartphone and a 5G connection. The system later analysed the data intelligently using artificial intelligence and complementary learning techniques to assist users in controlling their blood sugar levels and anticipating future changes in health.

In " Exploiting Machine Learning Algorithms to Diagnose Foot Ulcers in Diabetic Patients" Shiva Shankar Reddy and Gadiraju Mahesh studied various machine algorithms to predict diabetic foot ulcer.The most typical application of ML approaches is the prediction of various diseases. Extreme Learning Machine (ELM), a neural network approach, is suggested to meet the goals by properly predicting DFU. Three other existing algorithms—KNN, SVM with a Gaussian kernel, and ANN—are also taken into consideration. These are put into practise with R programming. Accuracy, zero-one loss, threat score/critical success index (TS/CSI), false omission rate (FOR), and false discovery rate are the five evaluation measures used to compare algorithms (FDR). For ELM, the results for accuracy, 0-1 loss, TS/CSI, FOR, and FDR are 96.15 percent, 0.0385, 0.95, 0, and 0.05, respectively. KNN and ELM achieved better result.

In "IoT Based Hybrid Method for Patient Monitoring and Medication," Naveen Kumar has put forth a cutting-edge system to send the patient's vital signs to the doctor's smartphone from a distance. The doctor can deliver or recommend the drug from a remote location after observing the patient's critical characteristics. An Android app is created to let the medical personnel monitor patient data in real time while seeing the patient from a distance. The suggested model enables the physician to remotely prescribe medication and monitor the patient's physiological data (HR, NIBP, Temperature, ECG, and SPO2). The virtual presence of the doctor will be made possible by this method.

A way to create a scanner to measure dynamic foot pressure has been suggested by Milka De Madhale in "A study of dynamic foot pressure measurement in diabetic patients." The purpose of this project is to create a low-cost, portable foot pressure scanner and evaluate its validity and reliability in order to aid in the prevention of foot ulcers. Dynamic foot pressures are monitored and aberrant pressure sites are found using the scanner.

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With the use of these data, offloading protective footwear can be created, potentially balancing loads and redistributing pressure on the foot.

The proposed system, which was described in "Diabetic foot ulcer mobile detection system using smart phone thermal camera: a feasibility study" by LuayFraiwan, MohanadAlKhodari, JoluNinan, Basil Mustafa, Adel Saleh, and Mohammed Ghazal, consists of a thermal camera that is connected to a Samsung smart phone that is used to capture thermal images. This thermal imaging system simulates an ulcer-indicating temperature gradient of more than 2.2 °C, which corresponds to the temperature differential described in the literature.Basic image processing techniques are used to process and segment the obtained images. Otsu thresholding and the Point-to-Point mean difference techniques are used in the analysis and interpretation. Thermal pictures were examined and interpreted as part of the proposed system's implementation on the MATLAB Mobile platform.

To evaluate this approach, four test images—three with skin temperatures raised to more than 2.2 °C injected at various areas and one with no temperature fluctuation to the feet—were employed. The system was able to pinpoint the site of the temperature increase with the help of the two methodologies used during the analysis and interpretation step.

III. METHODOLOGY

Fig 3.1 FLOW CHART

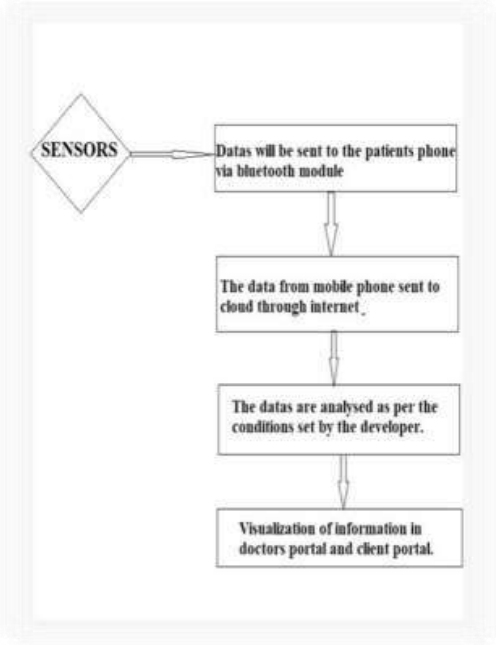
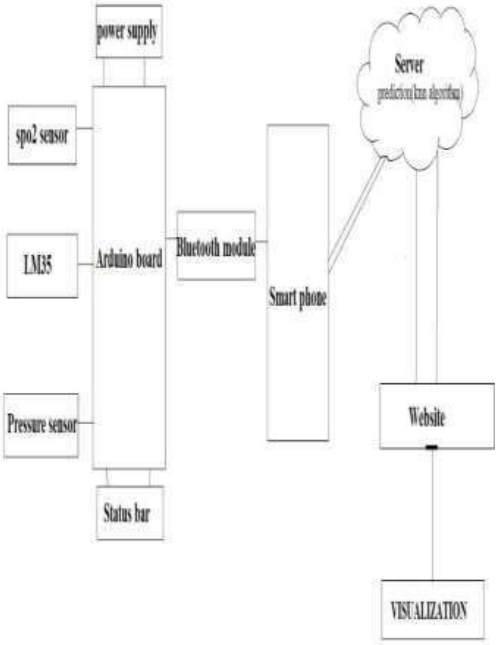


Fig 3.2BLOCK DIAGRAM



Prediction technique

The data are evaluated using the KNN method, which is one of the simplest machine learning algorithms based on supervised learning. It predicts whether the patient has a diabetic foot ulcer. The K-NN algorithm makes the assumption that the new case and the existing cases are comparable, and it places the new instance in the category that is most like the existing categories. A new data point is classified using the K-NN algorithm based on similarity after all the existing data has been stored.This means that utilising the K-NN method, fresh data can be quickly and accurately sorted into a suitable category. Although the K-NN approach is most frequently employed for classification problems, it can also be utilised for regression. Since K-NN is a non-parametric technique, it makes no assumptions about the underlying data. It is also known as a lazy learner algorithm since it saves the training dataset rather than learning from it immediately. Instead, it uses the dataset to perform an action when classifying data. The KNN method simply saves the information during the training phase, and when it receives new data, it categorises it into a category that is quite similar to the new data.

If there are two categories, Category A and Category B, and we have a new data point, x1, which category does this data point belong in? We require a K-NN algorithm to address this kind of issue. First, we'll decide on the number of neighbours; we'll go with k=5. The Euclidean

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distance between the data points will then be determined. The distance between two points, which we have already examined in geometry, is known as the Euclidean distance. We determined the closest neighbours by calculating the Euclidean distance. As you can see, the three closest neighbours are in category A, hence this new data point must also fall within category A.

IV. RESULT AND DISCUSSION

Diabetic foot ulcer detection using KNN algorithm is designed and developed successfully. The temperature, dynamic foot pressure, spo2 information of patient is captured using relevant sensors and results are transferred to smart interface using hc-05 bluetooth module. The datas obtained from sensors are transferred to a sever over the internet and are analyzed as per the conditions set.

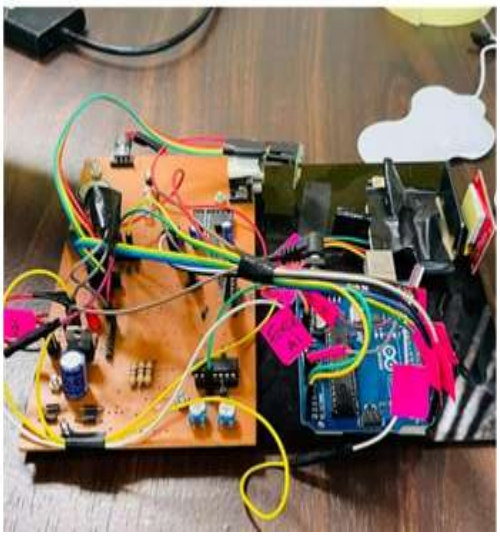

Fig 4.1 Hardware

Figure 4.1 shows the hardware part of proposed model. It consist of three sensors, Arduino board, leds,and a power supply unit. The three sensors are pressure sensor, temperature sensor and spo2 sensor.The Arduino board stores all the program to store and transfer the datas from the sensors. The status led blinks when the data transfer takes placeFig 4.2 Smartphone-bluetooth interface.

Figure 4.2 shows the smartphone interphase.

The datas from the hardware part send to the patients smart phone via Bluetooth. The data from the smartphone sent to cloud through internet.

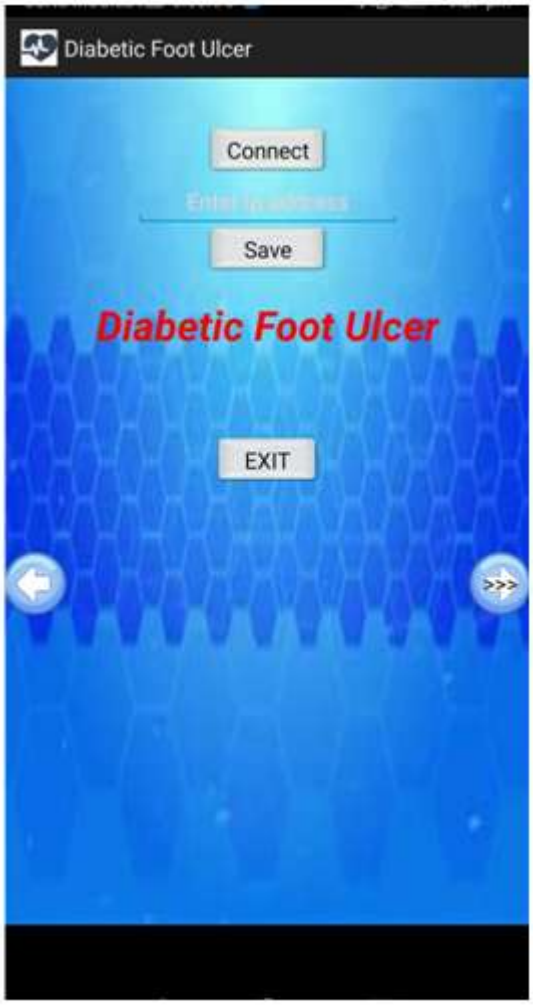

Fig 4.3 website interface

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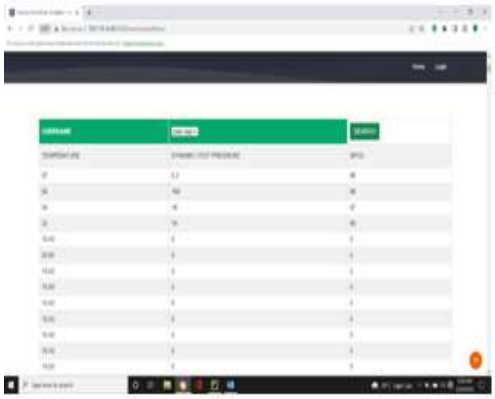

Fig 4.4 Sensor value page

The figure 4.3,4.4 shows the webpage interface in doctors side. Figure 4.3 is the welcome page, it consist of Home button and login button. While clicking on login button it goes to login page. The login page allows the doctor to access the information of each patient by entering the username and password. The figure 4.4 shows the sensor value page, from the sensor value page doctors can select the patient name and can search patients medical condition. The datas from the senors can visualize in this page. While clicking the predict button,it will goes to the result page.

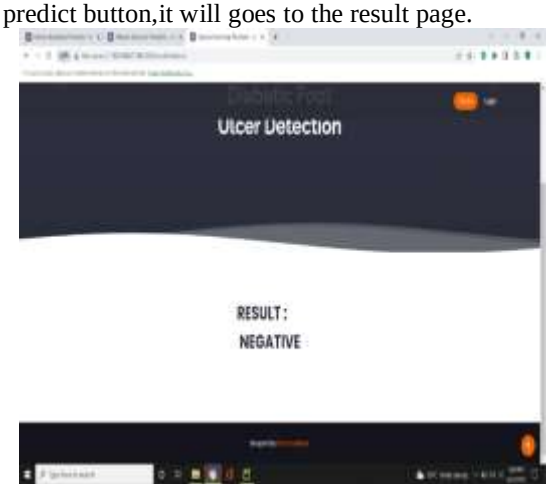

Fig 4.5 Result page

Figure 4.5 shows the result page of the proposed model. It shows negative result for the normal value. By clicking the predict button in sensor value page , it goes to this page and shows the result.

V.CONCLUSION

In this work it is very useful to know the basic physiological parameter of the diabetic foot ulcer patient in realtime.Most diabetic patients who develop diabetic foot ulcers (DFU) do so because it is a consequence of the disease. The foot will get open wounds as a result. DFU that is left untreated can end in infection and amputation, which require the removal of a foot or a leg. Early detection of foot ulcers is crucial because diabetes is the primary health issue that people of all ages encounter. This study investigates how ulcers are caused by diabetes and forecasts the unhealthy condition. The system consist of various sensors which are used to measure the parameters such as temperature, Dynamic foot pressure additionally change in Blood pressure are measured. The pathogenic factors cause superficial temperature change than can be qualitatively measured by using temperature sensor LM35. Plantar ulcers in diabetics are due to excessive pressure on the soles exerted during normal activities such as walking and running (dynamic foot pressure).Static plantar pressures (as opposed to dynamic foot pressures) are significantly lower in a stationary person. With the help of the pressure sensor dynamic foot pressures are measured and abnormal pressure points identified. The temperature, dynamic foot pressure, spo2 information of patient is captured using relevant sensors and results are transferred to smart interface using bluetooth module. The datas obtained from sensors are transferred to a sever over the internet iot and are analyzed as per the conditions set using knn algorithm.

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