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Detection of Foot Ulceration

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Abstract: Diabetes is a chronic illness that requires continuous medical care and precaution. Patients who are diabetic for a long time and those who have poor glycaemia control often leads to peripheral neurovascular disorder which results in foot ulceration.40% to 50% of diabetic patients are affected by foot ulceration. Diabetic foot ulceration is caused due to Diabetic mellitus. So, early detection and prevention of foot ulcers plays a vital role. This project describes the early detection of chronicity foot lesions in diabetic patients by monitoring their foot pressure and a hardware is set up to monitor the foot pressure in diabetic patients continuously with the help of force sensing resistors. In this method diagnosis of foot ulceration is done in an earlier stage thereby the further ulceration is prevented. The aim of this project is to develop low cost, lightweight foot pressure scanner and check its reliability and validity which can help to prevent foot ulceration. We accomplish this by placing pressure sensors in seven or eight pressure points in a sole which is then used by the patient. We have also made it user friendly by passing and storing these results to a server. It indicates the patient's current status and also can be accessed by the patient or the doctor through an application on any smartphone.

Keywords: Foot

I. INTRODUCTION

Diabetic foot ulcer is one of the major complications caused due to Diabetes. An increase in the blood sugar level above normal conditions causes several vascular problems (constriction of blood vessels) which leads to improper circulation of blood to the feet and is often noticed in patients with diabetes. Neuropathic foot ulcers form as a result of a loss of peripheral sensation and are typically seen in individuals with diabetes. Lack of sensation, over pressure points on the foot leads to extended micro trauma, breakdown of the tissues that are overlying, and eventual ulceration. When blood sugar levels are high or fluctuate regularly skin that would normally heal may not properly repair itself because of nerve damage, even a mild injury can therefore start a foot ulcer and the narrowed arteries can also reduce blood flow to the feet amongst some people with diabetes and this can impair the foot's ability to heal properly and when the foot cannot heal, a foot ulcer can develop.

Our project aims to identify the patients who are likely to develop diabetic foot ulcers at an early stage. We accomplish this by placing pressure sensors in seven or eight pressure points on a sole which can be used by the patient. The foot pressure readings are converted into corresponding value in kilo Pascal with the help of the code written in Thonny IDE. The data are read using a data acquisition device (Raspberry pi). We have also made it user friendly by passing and storing these results to a server and generates an image based on the values obtained. It indicates the patient's current status and also can be accessed by the patient or the doctor through an application on any smart phone. With the regular usage of sole whenever in doubt and with the resulted readings the patient can immediately take an action by consulting a doctor and getting a solution right in the early stage without any further delaying, it can be cured and not allowing it to next dangerous stages.

II. DESIGN METHODOLOGY

BLOCK DIAGRAM

Project aims to identify the patients who are likely to develop diabetic foot ulcers at an early stage. The hardware is set up to monitor the foot pressure in diabetic patients continuously with the help of a flexi force sensor. A diabetic patient is made to wear the sock and insole is the place where the flexi force sensors also known as force resistive sensors

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(FSR) are placed. We accomplish this by placing pressure sensors in five or six pressure points of the foot in a sock which is then used by the patient for the analysis. The design of the circuit is proposed to measure the pressure on the foot with the help of these sensors where these sensors are connected to the Raspberry pi microprocessor via jumper wires.

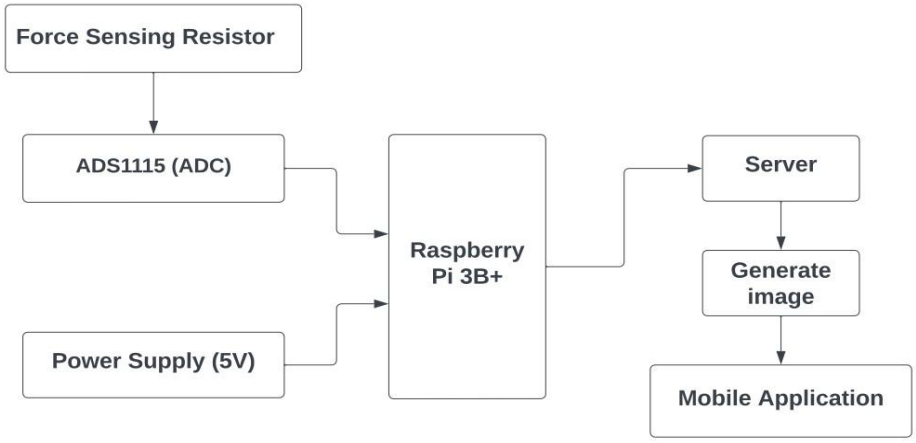

Fig 1. Block Diagram

CIRCUIT DIAGRAM

ADS1115 VDD to Raspberry Pi 5V (pin 4)
ADS1115 GND to Raspberry Pi GND (pin 6)
ADS1115 SCL to Raspberry Pi SCL (pin 5)
ADS1115 SDA to Raspberry Pi SDA (pin 3)
Wire the force sensing resistor Channel pins of ADS1115 FSR to VDD to Raspberry Pi 3.3V (pin 1)
Wire a 10k Ohm resistor to GROUND

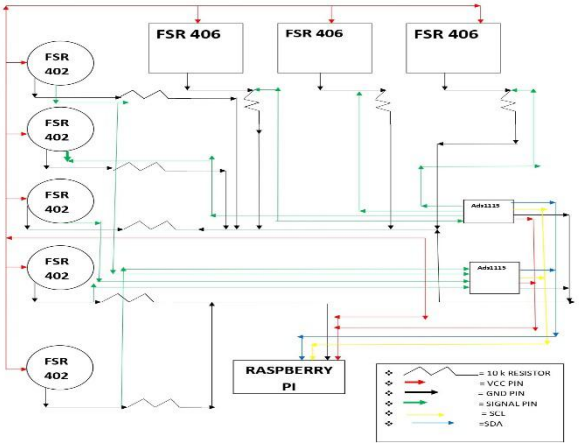

Fig 2. Circuit diagram of detection foot ulceration

III. WORKING

Project aims to identify the patients who are likely to develop diabetic foot ulcers at an early stage. The hardware is set up to monitor the foot pressure in diabetic patients continuously with the help of a force sensing resistor. A diabetic patient is made to place the foot on the sole where the force sensing resistor also known as FSR are placed.
We accomplish this by placing pressure sensors in seven or eight pressure points of the foot in a sole which is then used by the patient for the analysis. The design of the circuit is proposed to measure the pressure on the foot with the help of these sensors where these sensors are connected to the Raspberry Pi via ADS1115.

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The data is read on the Thonny IDE using a data acquisition device, which is connected to a personal computer through an USB cable. The Raspberry Pi is powered up by the supply voltage of 5V.

The code is written in Thonny IDE and is checked for errors. The correct code is executed. The results are compared to the present threshold value, if it exceeds, then the patient is alerted with a sign stating that they have been tested positive for further nerve damage if not taken care and also need immediate medication. The patients foot whose pressure value exceed this threshold limit, tend to get ulcers and asked to take precautions for the cause of ulcers. The intimation of foot screening results is being acknowledged to the patient using an App built using Android Studio.

The App is built in such a way that the values obtained are being stored in the Apache tomcat server and generates a image and sends the image to the mobile application.

Apache Tomcat server is used for tracking analytics, such that patients are likely to see their results in the App on their respective mobile phones immediately after their screening which shows the values and results acquired. So that it becomes easier for the patients to take the immediate action without any due of delay.

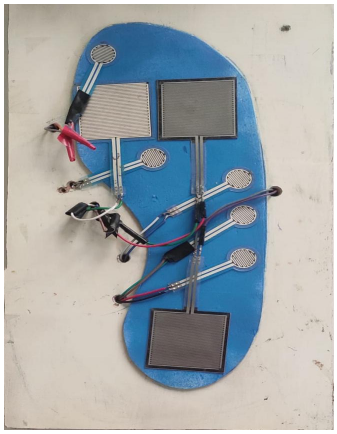

Fig 3. Hardware Assembly

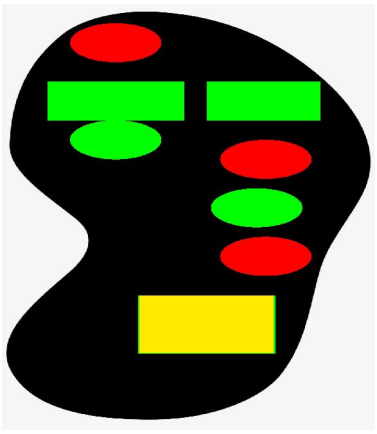

Fig 4. Image generated onto the mobile application

IV. CONCLUSION

Detection of Diabetic foot ulcers is imperative in the prevention of further diabetes- related complications and lower extremity amputations. Thereby, with the help of the sole all types of diabetic patients can undergo foot testing and will able to know whether the foot is normal or abnormal.

The root cause of the foot ulcers is due to pressure, the sensors keenly calculate the pressure values and notify the patient via App. Such that patient will be indicated with foot condition and to reach out Physician to treat at early stage.

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