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The Prediction and Prevention of Varicose vein using Raspberry pi

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***Abstract*—The habit of idleness is becoming common these days. In this technological era people are becoming lazy. This leads to physical inactivity. It causes reduced blood flow in our body. Therefore, the vascular epithelial cell undergoes inflammation which is called as varicose vein. Mostly it affects our lower extremities, but it can be anywhere in the body. When varicose veins clot, the condition is called superficial thrombophlebitis and it is usually very painful. Based on the survey the collected data is used to form predefined dataset. The predefined dataset acts like threshold value. The positional data of a person is analysed using various sensors. The data to be analysed are standing, bending of knee and movement with respect to time. The acquired positional data is processed in Raspberry pi using Artificial Intelligence (AI). It is a non-invasive diagnostic & therapeutic solution for varicose vein using thermal & vibration therapy.**

Keywords— lower extremities, vascular epithelial cell, varicose vein, thrombophlebitis, Artificial Intelligence, non-invasive.

I. INTRODUCTION

Varicose veins are larger and swollen veins that appear on the legs and the feet. It happens when the blood flow is interrupted regularly. The veins need treatment for health issues, but if swelling, aching, and painful legs result, if there is discomfort. Treatments available for varicose veins are surgery, ligation and stripping, sclera therapy, radio frequency ablation, endogenous laser treatment, Trans illuminated phlebotomy. The veins have one-way valves so the blood can travel only in one direction.

If the walls of the vein become stretched and less flexible (elastic) then the valves may get weaker. A weakened valve can allow the blood to leak backward and eventually flow in the opposite direction. When this occurs, blood can accumulate in the vein(s), which become enlarged and swollen veins. This can happen because of pregnancy, age, constipation, tumour, or overweight and obesity.

Nearly 50% of the population in the age of 40 has some smaller form of varicose veins. Generally 10% and 20% adults have significant varicose veins, and 0.5% has superficial varicose veins with chronic venous and ulceration. In India over 10 million people were affected in a year. The Edinburgh Venous study (EVS) published examined over 1500 adults in UK, showed that 39.7% of men and 32.2% of women had a dilated tortuous trunk of the long or short saphenous vein and their first or second order branches. The No of varicose vein cases in India is increasing exponentially and it become clear that venous thrombosis, varicose veins, and venous diseases are as problematic here as all over the world.

A prospective study was conducted in CG hospital and Bapuji hospital attached to JJM Medical College, Davangere from June 2009 to May 2011. A total of 40 cases were included in the study duration. All patients who presented to the outpatient department with signs and symptoms of primary varicose veins were interviewed. The incidence of varicose veins was seen most commonly in male

when compared to female in this study. The family history of varicose veins was seen in only 12.5% of the subjects. In this study patients presented with different symptoms, out of which the dilated veins was most common of 37 (92.5%) patients followed by the aching pain 22 patients [55%].

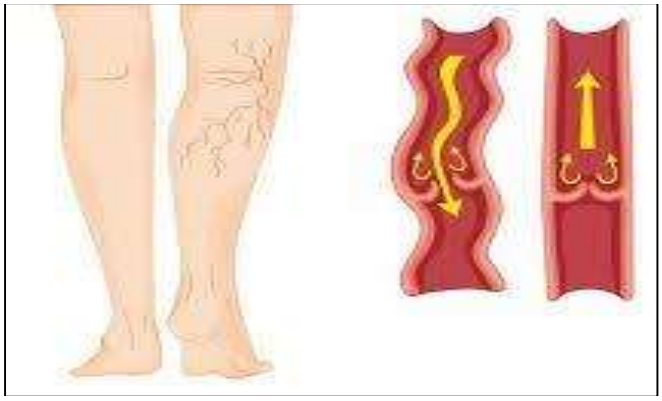


Fig.1 Varicose vein

When the vein is affected, the blood flows in a backward direction. It makes the blood deoxygenated and the colour of blood is changed.

II. LITERATURE REVIEW

Yapei Zhao analyses the algorithm based upon the vascular endothelial cell in ammation images and multi-scale deep learning, called MSDCNN. Ruizong zhu1, Huipingniu they obtained the images of vascular endothelial cells in patients with varicose veins of the lower extremities and normal subjects & convolutional layers extract multi-scale features of vascular endothelial cell images. The MFM activation function is used to introduce a competitive mechanism that extracts more features that are compact and reduces network layer parameters. The network uses a 3×3 convolution kernel to improve the network feature extraction capability and use the 1×1 convolution kernel for dimensionality reduction to further streamline network parameters[6].

The mechanical parameters of the human vein are often measured and the uniaxial test is conducted under various temperature conditions in the proposed system of Alexander Vasilyevich Gavrilenko [2].

Parth rana suggests the machine learning process for the prediction of obesity disease in the modern era. This is due to the growing lifestylebecause of the irregular biological pattern [5]. Prof G.D Parmar using the IR image processing technique to find the varicose vein with the computer software module and modified IR webcam [3]. Navdeepsinh V. Limbad ‘s proposed system says the detection of vein pattern using the IR sensitive Webcam, this system is also a non-invasive system[5]. Ultrasound (US) is the main modality for examination of venous disease. Color Doppler and occasionally spectral Doppler US (SDUS) are used for evaluation of the venous flow. Thor Bechsgaard proposed this system, the main base is chronic venous, which creates the varicose veins, by using ultrasound the chronic venous are eliminated [4]. H.Clarke’s proposed system mainly deals with the elasticity of the vein while origin of the disease. The elastic modulus test was determined with normal veins and varicose veins[7]. Machine learning based obesity & varicose prediction. Pick the most suitable algorithm with the best accuracy through ROC, Confusion Matrix, Calibration Plot and test it with various sampling schemes [1].

III. EXISTING IDEA

The varicose vein is determined using various methods like infrared image processing, scanning, physical examination. You need an ultrasound test to find if the veins are normal or if they have any blood clots in the lower part. In this non-invasive test, the technician runs a transducer against the skin over the area of the body to be examined. The Purpose of the transducer is to send the images to the monitor to examine. The image processing is used for the analysis of the vein with the help of deep learning algorithms.

SURGERY

Surgery is one of the traditional treatments for these cases. This surgery is based on typing and pulling away of smaller branch of veins. But these causes severe pain to the patient and takes long time to recover.

SCLEROTHERAPY

This method is based on injecting the medicines to the veins, and make them to shrink it. The complications of these therapy includes allergies, burning, stinging at injection sites, skin ulcerations and inflammation. It may cause strokes due to over dose of sclerosant.

ENDOVASCULAR LASER THERAPY

This method uses the laser to destroy the varicose veins. It generally takes 30-35 mins for procedure and recovery easily and fastly. Endovascular laser therapy changes in color. After that it requires the patients to wear pressure stockings.

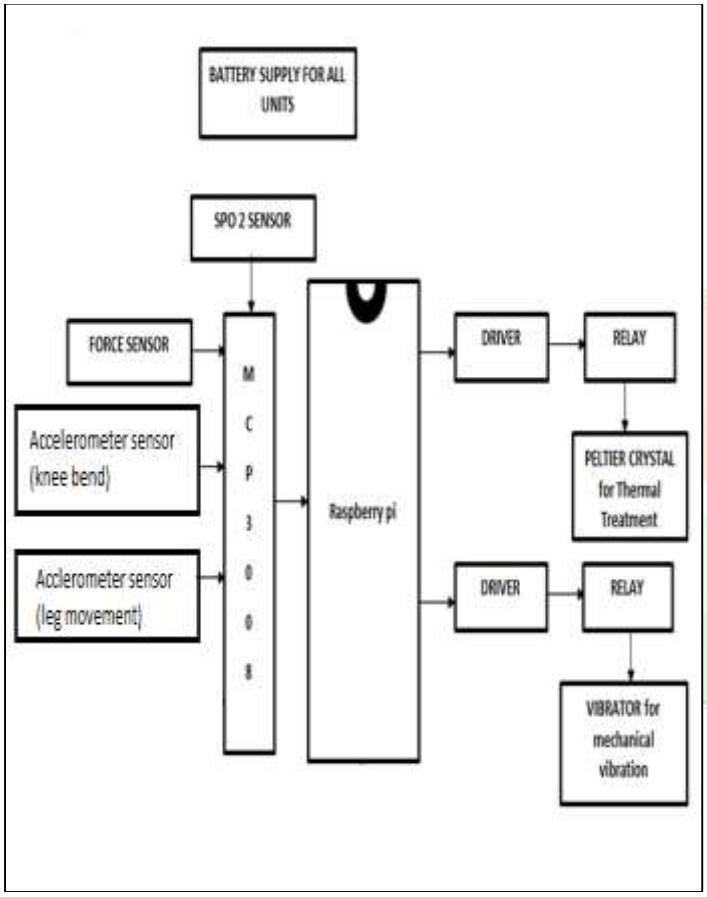
IV. NEED FOR VEIN DETECTION

For providing medical and drug support to the patients, intravenous supplements are given by doctors after thorough medical inspection. If any vein diseases occur for example deep vein thrombosis and varicose veins, bruises on skin, treatment and medical support for these diseases is highly recommended for easy recovery. Skin scarring may also occur in terms of any accidental damage to the vein. So the skin appears deterred which causes the skin to appear in whitish colour or darker. The identification of these veins become tough. In this process blood is given to the person intravenously. Blood donation, kidney dialysis also requires good vein detection. In case of children and infants vein detection may be especially difficult and requiring to puncture the veins with a needle is very frightful and agonizing. Also in case of some age old people require numerous blood tests or medicinal injections and an efficient puncture would decrease the extra bruise and enhance the victims comfort.

V. BLOCK DIAGRAM

The block diagram of the proposed system consists of a resistance based analogue sensor, two motion detecting sensors and a sensor for monitoring blood oxygen. The analogue sensors used are force sensor, accelerometers and a SPO2 sensor. The force sensor is used to determine the force given by the person. The force values keep on varying for different positions of the leg. When the entire force is applied

by the person. There are two accelerometers, one is used to determine the motion of the person. Another accelerometer is used to determine the bending of the knee. This is obtained from the axis values that change with respect to the person. The analog values from the sensors are converted into digital values as the Raspberry pi module processes only digital values. The analog sensors are interfaced to the Raspberry pi using an analog to digital converter (ADC – MCP3008). The ADC is an eight channel module. The analogue input from the person is fed to the Raspberry pi to check the status of the person's leg. This data is processed in the Raspberry pi module and compares the current data with the previous data. The driver circuit which connects to the raspberry pi is used to activate the peltier module and vibration motor. This non-invasive solution is obtained using a four channel relay circuit which is a driver circuit. The switch consists of a driver module ULN2003 which is basically a transistor.



VI. PROPOSED IDEA

The determination of the disease is done using non-invasive diagnostic techniques with the help of sensors. These values are obtained with respect to time.

The sensors used are flex sensor, force sensor and accelerometer. The flex sensor gives bending of the knee as the blood circulation gets reduced when the knee is in a bending position. When the leg is in an idle position for the long time then the voltage value will be constant for a given period of time. The force gives the state of the leg (i.e. standing or walking). If the person is standing then, the force given by the person is determined. This is to determine the pressure given to the veins in the lower extremities. Accelerometer is also a sensor used to determine the state of the leg, especially for walking. When the accelerometer value varies it means the person is walking. With these analog inputs the positional and physical parameters of the leg are obtained.

Non-invasive methods of treatment do not require a catheter or anything that is required for the operation. It takes very less time for the procedure and recovery also occurs at a very high rate. In this wearable socks, we are using SPO2, force sensor, accelerometer sensor, flex sensor & tilt sensor to monitors the blood flow, pressure and long time standing which reduces blood regulation inside body leads to varicose vein. These sensors values are fed to raspberry pi which is diagnoses early based artificial intelligence. Some therapies which are based on the use of heat or other energy can be applied to tissues of the body which occur in numerous therapeutics results. It achieves a required treatment effect, reaching a temperature of the tissue at least reaches 45ºC to 50ºC. Low cost wearable device based sock therapy, we are using the peltier crystal & vibration to treat the varicose vein non-invasively and to increase blood flow inside veins. In this thermoelectric therapy there are two ways of treatment, one by thermal and mechanical.

VII. HARDWARE

FORCE SENSOR

This force sensitive resistor with a round of having a 0.5" diameter sensing area is known as Force Sensing Resistor. The FSR varying the resistance depending upon the pressure is being applied to the scan area of the sensor. The harder the force makes the lower resistance. When no pressure is applied to the FSR its resistance have larger than 1MΩ. This sensor senses the force anywhere in the range of 100g-10kg.

Two pins extend from the bottom of the sensor with 0.1" pitch making it bread board friendly. There is a peel-and-stick rubber backing on the other side of the sensing area to mount the FSR. These sensors have simple setup and having great sensing pressure, but it is less accurate. It may not want to use it as a scale. This force sensor is placed under the heel to know the person's various movements like standing, walking, continuous standing, and continuous sitting. The dataset is taken for decision making operation. Dataset is made based on the values taken from the sensors output.

The dataset may vary for different person. So for the every individual a new dataset need to be created.

ACCELEROMETER

The ADXL337 is a low power, small, thin complete 3-axis accelerometer having signal conditioned voltage outputs. The product measuring range acceleration with minimum full-scale range of ±3 g, also measures the static acceleration of gravity in tilt sensing applications, as well as dynamic acceleration resulting from motion, shock, or vibration. The user can selects the bandwidth of the accelerometer using the CX, CY, and CZ capacitors at the

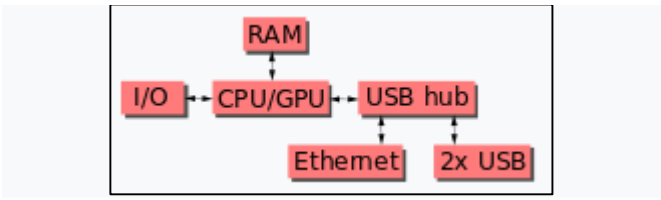
XOUT, YOUT, and ZOUT pins. Bandwidths are selected to suit the application, with a range of 0.5 Hz to 1600 Hz for X and Y axes, and a range of 0.5 Hz to 550 Hz for the Z axis. The ADXL337 is available in small and low profile. This sensor is a three axis sensor giving values of X, Y and Z axes. In this non-invasive therapeutic treatment two accelerometer is used. One is fitted just above the knee bend and the one is placed in the calf. These two will help to find the person is standing or walking or sitting. If he is standing means then he is continuously standing or continuously walking is identified.

SpO2

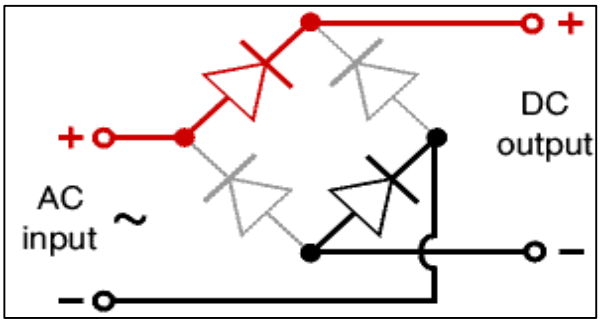
The SpO2 (peripheral capillary oxygen saturation) sensor uses two emitting LED's one in the red region and the other in the infrared region of the spectrum. The reflected light of each one of these LED's is absorbed by a photodiode that converts this current into a digital value that is sent via SPI. This sensor can be used to estimate the oxygen saturation level on the blood with +/- 2% accuracy compared to a medical sensor.

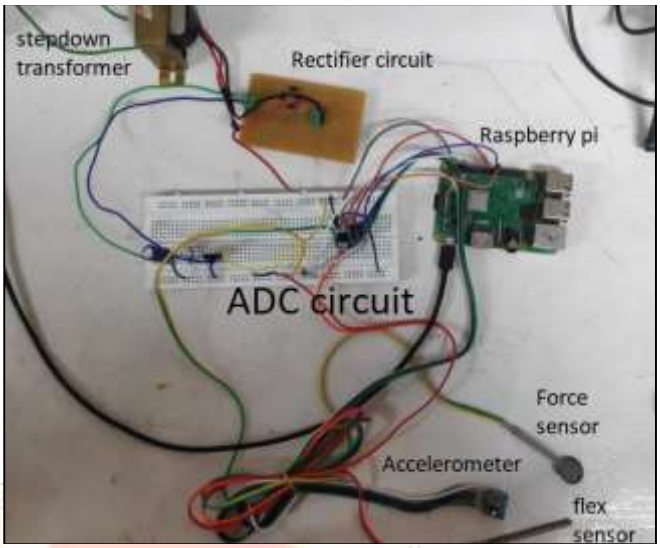
RASPBERRY PI

The Raspberry Pi hardware has several versions that feature the variations in memory capacity and various peripheral-device support.



This block diagram describes Model B and B+; Model A, A+, and the Pi Zero is similar, but lacks the Ethernet and USB hub components. The Ethernet adapter is internally connected to an additional USB port. In Model A, A+, and the Pi Zero, the USB port is connected directly to the system on a chip (SoC). On the Pi 1 Model B+ and later models the USB/Ethernet chip contains a five-port USB hub, of which four ports are available, while the Pi 1 Model B only pro0vides two. On the Pi Zero, the USB port is also connected directly to the SoC, but it uses a micro USB (OTG) port. Unlike all other Pi models, the 40 pin GPIO connector is omitted on the Pi Zero with solderable through holes only in the pin locations. The raspberry pi acts as a processor and stores the data temporarily in it. The Raspbian operating system controls the whole processor. There are several versions of Raspbian including Raspbian Buster and Raspbian Stretch. The movement of the person is detected and activate the respective Peltier module and vibration motor.

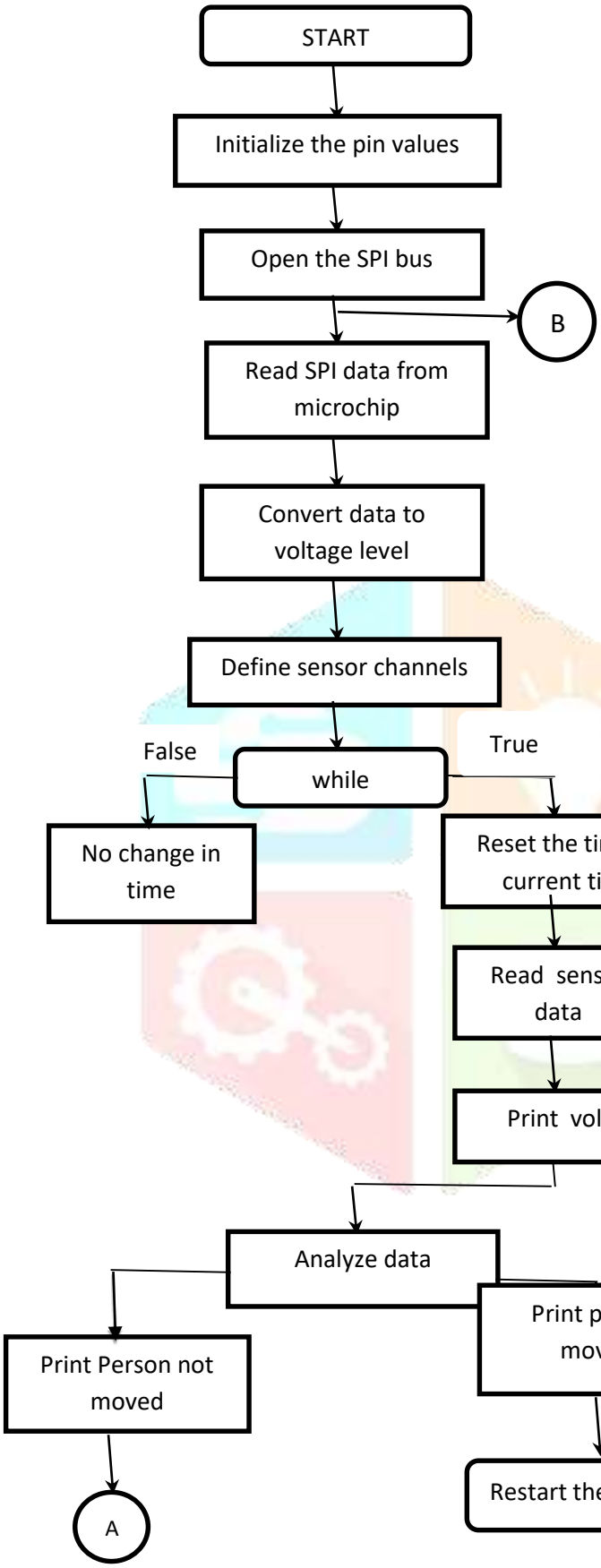


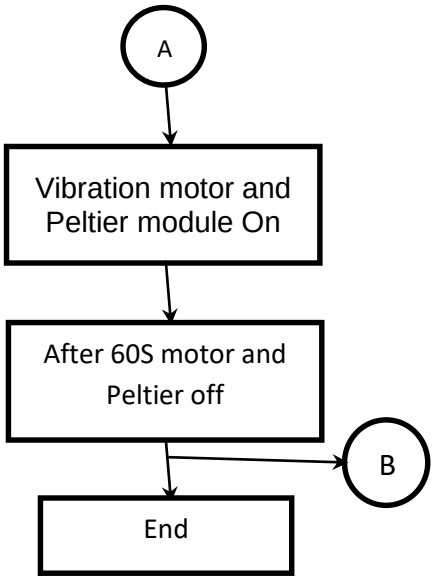


BRIDGE RECTIFIER

A bridge rectifier can be made using four individual diodes.1.4V is used in the bridge rectifier because each diode uses 0.7V. Bridge rectifier are rated by the maximum current they can pass and maximum reverse voltage they can withstand.

VIII. FLOWCHART





The program is executed based on python

IX. CONCLUSION

The ultimate aim of this project has been to provide the early prediction of varicose veins and to prevent the lower part of the veins from the disease. The blood flow is the main problem that leads to reversal and blocking of blood vessels. This paper analyzes the output data from the respective sensors and compares these values using raspberry pi. This project has conquered these problems within its implementation. After consulting some doctor suggestions we conclude and use some basic data to predict the disease. The blood flow can be regularly monitored by the respective sensor. In prevention process the peltier module which activates by the relay driver circuit and simultaneously it changes heat and cold state for the regular blood flow. The vibration motor has been connected from the relay circuit and activates if the flow interrupt and also we verify the performance of the sensor circuits like flux, accelerometer, tilt, spo2. The raspberry pi is the 32 bit 900mhz cortex A7 processor used for the communication between the analog and digital parts of the circuit. By the help of these processor the output result can be viewed through the generic computers when the sensors are pressured. The processor acts as a CPU the datas are stored in the RAM respectively.

The future work of these projects is to make them compatible to the person in need to reduce the weight. Circuits like ADC, relay driver, raspberry pi are compactly arranged in simple packages.

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