

# **IOT INTEGRATED PAIN RELIEF FOR VARICOSE VEINS**

Submitted in partial fulfillment of the requirements for the award of  
Bachelor of Technology degree in Biotechnology

Interdisciplinary project

By

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**DEPARTMENT OF BIOTECHNOLOGY**

**SCHOOL OF BIO AND CHEMICAL ENGINEERING**

## **SATHYABAMA**

**INSTITUTE OF SCIENCE AND TECHNOLOGY**

**(DEEMED TO BE UNIVERSITY)**

**CATEGORY-1 UNIVERSITY BY UGC**

**Accredited with Grade “A++” by NAAC |12B status by UGC| Approved by AICTE**

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**MAY-2024**



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**DEPARTMENT OF BIOTECHNOLOGY**

**BONAFIDE CERTIFICATE**

This is to certify that this Project Report is the bonafide work of **G Akshaya Vardhini (41230007), S.Sweetha(41240046)** who carried out the project entitled "lot integrated pain relief for varicose veins" under my supervision from January 2024 to april 2024.

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## **DECLARATION**

We, **G. Akshaya Vardhini (41230007)** and **S. Sweetha (41240046)** hereby declare that the Project Report entitled “**IOT INTEGRATED PAIN RELIEF FOR VARICOSE VEINS**” done by us under the guidance of **Dr. Roselin Jenifer, M.Sc., M.Tech., Ph.D.** at Sathyabama University is submitted as the interdisciplinary project

**DATE:06/05/2024**  
**PLACE: CHENNAI**



**SIGNATURE OF THE CANDIDATE**

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## ABSTRACT

We propose an inexpensive, light weight and wearable device for the early detection and prevention of varicose veins using non-invasive methods. The device includes ESP32 microcontroller which acts as the client and which acts as the main server. The controller communicates wirelessly with the main server. NTC thermistors are used for measuring the temperature of the affected area as well as the normal body. A microcontroller pressure simulator is used for obtaining pressure variations and a compression stocking with micro motors are used for providing vibrations. The method includes continuous monitoring of blood pressure and temperature of the affected area. When the blood pressure exceeds the threshold value and when the temperature of the affected area becomes more than the normal body temperature, improper blood flow is detected and the information is sent to the application and vibrations are applied automatically to make the blood flow proper. Index terms—Varicose veins, non-invasive treatment. his project proposes observing individuals who have varicose veins and automatically delivering treatment as needed. This study takes the stance that people with varicose veins might profit from using a temporary pain-killing gadget. In conclusion, the proposed IoT-integrated pain relief system offers a promising approach to improving the management of varicose veins by providing personalized, data-driven interventions. By leveraging IoT technology, healthcare providers can deliver more effective and efficient care, ultimately enhancing the quality of life for patients with varicose veins.

**Keywords:** Blood pressure monitoring, Non-invasive treatment, Temperature monitoring, Varicose veins.

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## LIST OF ABBREVIATIONS

|     |                                  |
|-----|----------------------------------|
| DIP | Dual in line package             |
| IoT | Internet of Things               |
| MCU | Microcontroller unit             |
| NTC | Negative temperature coefficient |
| PCB | Printed circuit board            |
| PID | Proportional-Integral-Derivative |
| PTC | Positive temperature coefficient |
| USB | Universal serial bus             |

## LIST OF FIGURES

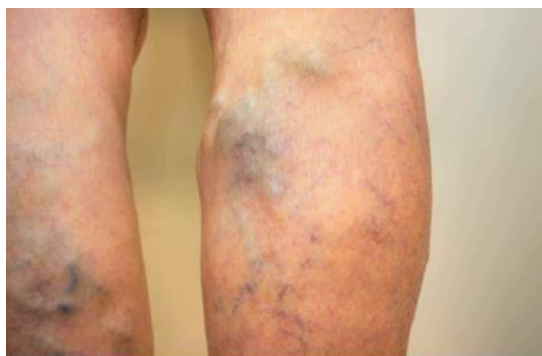
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# CHAPTER 1

## INTRODUCTION

Varicose veins are enlarged, twisted veins that commonly occur in the legs and feet. They develop when the valves within the veins malfunction, leading to blood pooling and increased pressure within the affected veins. This pressure causes the veins to stretch and become distorted, resulting in the characteristic appearance of varicose veins. Several factors contribute to the development of varicose veins, including:

1. **Genetics:** A family history of varicose veins increases the likelihood of developing them.
2. **Age:** As people age, the valves in their veins may weaken, making them more prone to varicose veins.
3. **Gender:** Women are more likely than men to develop varicose veins, partly due to hormonal changes during pregnancy and menopause.
4. **Pregnancy:** Increased blood volume and pressure on the veins during pregnancy can lead to the development or worsening of varicose veins.
5. **Obesity:** Excess weight puts additional pressure on the veins, increasing the risk of varicose veins.



***Fig.1.1 Varicose veins affected area in leg***

The symptoms of varicose veins can vary from mild discomfort to more severe complications. In addition to the visible appearance of bulging veins, individuals with varicose veins may experience.

Varicose veins are a common vascular condition characterized by twisted, dilated veins, predominantly found in the lower extremities. While the exact pathophysiology remains a subject of debate, several contributing factors have been identified. These include a genetic predisposition, incompetent valves within the veins, weakened vascular walls, and increased pressure within the veins. Various risk factors can predispose individuals to varicose veins, including a family history of venous disease, female gender, advancing age, and conditions or behaviors that lead to chronically increased intra-abdominal pressure, such as obesity, pregnancy, chronic constipation, or the presence of tumors. Prolonged periods of standing can exacerbate symptoms and contribute to the progression of varicose veins.

Symptoms of varicose veins commonly include a sensation of heaviness or aching in the legs, along with itching or burning sensations, particularly after prolonged standing. These symptoms can significantly impact quality of life and may worsen with continued venous insufficiency. Complications associated with varicose veins can range from mild to severe and may include infection, the development of leg ulcers, stasis changes in the skin, and even thrombosis in more severe cases. (Mandar, *et al.*, 2022).

Conservative treatment options are often recommended as initial management strategies and may include external compression with the use of compression stockings, lifestyle modifications such as avoiding prolonged periods of standing or straining, regular exercise, wearing nonrestrictive clothing, weight loss, and interventions to reduce peripheral edema. Elevating the affected leg can also help alleviate symptoms. Medical therapy may be considered in some cases, although evidence supporting its effectiveness is limited. Interventional treatments, such as external laser thermal ablation, endogenous thermal ablation, endogenous sclerotherapy, and surgical procedures, may be indicated for more severe or refractory cases. Endovenous thermal ablation has emerged as a preferred treatment option for many patients due to its efficacy, minimal invasiveness, and relatively low risk of complications. It can often be performed under local anesthesia and may yield better outcomes compared to traditional surgical approaches. (Vwaire, *et al.*, 2021).

Aching or heaviness in the legs, especially after prolonged periods of standing or sitting.

- Throbbing or cramping sensations in the legs.
- Swelling, particularly in the ankles and feet.
- Itching, burning, or aching around the affected veins.
- Skin changes, such as discoloration, inflammation, or the development of ulcers in severe cases.

While varicose veins are often considered a cosmetic concern, they can cause significant discomfort and, in some cases, lead to complications such as venous ulcers or superficial thrombophlebitis. Therefore, seeking appropriate treatment and management strategies is essential. Treatment options for varicose veins aim to alleviate symptoms, improve blood circulation, and prevent complications. Lifestyle modifications, such as regular exercise, maintaining a healthy weight, and avoiding prolonged periods of standing or sitting, can help reduce symptoms and prevent varicose veins from worsening.

Compression therapy, using specially designed stockings or bandages, helps support the veins and improve blood flow. Elevating the legs above heart level can also help reduce swelling and discomfort. Medical interventions for varicose veins include minimally invasive procedures such as sclerotherapy, in which a solution is injected into the affected veins to close them off, and endovenous laser ablation, which uses laser energy to seal the veins shut. Surgical removal of varicose veins, known as vein stripping or ligation, may be necessary for severe cases or when other treatments are ineffective. (Judith C., *et al.*, 2020).

Alternative therapies such as acupuncture, herbal supplements, or herbal creams may provide relief for some individuals, although scientific evidence supporting their effectiveness is limited. Risk factors for varicose veins can be categorized as hormonal, lifestyle, acquired, and inherited. The effect of estrogen on the risk of varicose veins may explain, in part, the increased prevalence among women. Smoking is an important modifiable risk factor for varicose veins and more severe forms of chronic venous disease, including venous ulceration. Post-thrombotic syndrome after deep

The development of IoT (Internet of Things) technology is progressing swiftly, creating new possibilities for enhancing healthcare solutions. A unique approach to pain management for persons with varicose veins is provided by the IoT-enabled system connected with the Arduino system employed in this work. These sensor measurements are transmitted wirelessly to the Arduino microcontroller. This real-time adjustment ensures the optimum relief from pain, in accordance with each person's requirements. The system's efficacy is to deliver rapid and customized pain relief. The system's IoT connectivity makes remote monitoring and data collection possible. It assists medical professionals to understand patients' condition and make wise decisions. (Magdoleen H., *et al.*, 2022).

In this innovative approach to pain management for individuals with varicose veins, an Internet of Things (IoT)-enabled system is utilized in conjunction with an Arduino microcontroller. The system incorporates sensors that measure various physiological parameters relevant to varicose vein pain, such as temperature, pressure, or blood flow, depending on the specific design of the system. (Sakthivel *et al.*, 2023).

The Arduino microcontroller serves as the central processing unit, responsible for receiving, processing, and analyzing the data collected by the sensors. It also controls the transmission of this data wirelessly to a designated endpoint, such as a smartphone application or a cloud-based server. (Gregory, *et al.*, 2020).

## CHAPTER 2

### LITERATURE SURVEY

selvi *et al.*, (2021) used a decision tree algorithm to create a system for predicting varicose veins. It is a diagnostic and therapeutic treatment for varicose veins. The decision tree algorithm is a machine learning concept. Wearable socks have sensors attached to them. The dataset is predefined based on sensor values. The Arduino UNO is linked to a spO2 sensor, a force sensor, and an accelerometer sensor. The spO2 sensor is used to calculate the heart rate and O2 level. Low blood circulation occurs when values remain constant, i.e., when the leg is inactive for an extended period of time. The ATmega 328p microcontroller chip is used in this application. The sensor's output is sent to the PC. The decision tree algorithm is a type of supervised learning. Peltier crystal is also linked to Arduino UNO for thermal treatment, as well as a relay, which aids in changing the temperature of normal blood flow.

Wang Yixuan *et al.*, (2021) created a varicose vein prevention method. In this article, a thin film pressure sensor is utilized to determine if a person is standing, and it enables users to customize their standing and massage time using their phone. After the predetermined period, the instrument begins to massage automatically, allowing the user to focus on their task.

Anantha Padmanabhan *et al.*, in (2000), where they developed a device called the Good Vibe gadget aimed at aiding in the detection and prevention of varicose veins. The device continuously monitors blood pressure and temperature in the afflicted region, utilizing sensors such as a pressure stimulator and NTC thermistors. When the blood pressure exceeds a predefined threshold or when there is a rise in body temperature indicating poor blood flow, the device automatically triggers vibrations to stimulate blood circulation. Importantly, users also have the option to manually regulate the intensity of the vibrations. Additionally, the data collected by the device is relayed to a central platform, which can be accessed visually via a website. The device's functionality is powered by a Raspberry Pi, a small and versatile computer.

Shing-Hong Liu *et al.*, (2021) used to illumination rheography to identify the deeper venous in the blockage in the lower limbs. It employs a non-intrusive approach. It is a method for assessing non-ionizing radiation. The entire system is built around a smart device with PPG detectors, a gyroscope, and a new software. A gyroscope is used to track S signals. A smartphone app controls the detectors and also directs foot movement and stores the signal. justify this paragraph

Kumara *et al.*, (2019) created an IOT-based stress monitoring system. Because the foot is a shock absorber and stress carrier, our work focuses on foot stress. It aids in determining the amount of foot stress delivered to the foot and takes preventative measures to keep it from developing other serious illnesses. Liu *et al.*, (2021) released a paper on identifying and categorizing venous congestion. It is a hybrid of the oscillometric and PPG techniques. It employs a cuff pressure control module in conjunction with an oscillometric ABP monitor. PPG is implanted in little cuffs for the toes and fingertips. It is a non-invasive method of monitoring CBP alterations.

Deekshita *et.al.*,(2022) introduce an Air Compression Massage System for Chronic Vein Disorders, as presented at the 2022 International Conference on Automation, Computing, and Renewable Systems. The paper discusses the development and application of a massage system using air compression technology, aiming to address chronic vein disorders through innovative therapeutic approaches.

Ahmed *et.al*(2021) present the design and implementation of a control system for a self-balancing robot using the Internet of Things (IoT) and an Arduino microcontroller. Published in the Periodicals of Engineering and Natural Sciences, the paper focuses on the integration of IoT technologies to enhance the control mechanisms of a self-balancing robot for improved functionality.

The research paper titled "PID Control System Analysis, Design, and Technology" by Kiam Heong Ang, G. Chong, and Yun Li *et.al.*, (2005) published in the IEEE Transactions on Control Systems Technology in 2005, explores the analysis, design, and technological aspects of Proportional-Integral-Derivative (PID) control systems. The authors delve into the theoretical foundations and practical applications of PID control, providing valuable insights for understanding and optimizing these systems in Engineering.

## **CHAPTER 3**

### **AIM AND SCOPE**

#### **3.1 AIM**

Within this innovative system, the utilization of a thermistor serves as a pivotal component, playing a crucial role in autonomously detecting abnormalities and administering treatment without the need for human intervention. This groundbreaking approach offers a temporary yet effective solution for individuals grappling with varicose veins.

#### **3.2 SCOPE**

The system employs a non-invasive therapeutic methodology, combining thermal and vibration therapy to address the challenges associated with varicose veins. By harnessing the power of these modalities, the system aims to provide relief to patients in a manner that is not only technologically advanced but also minimally intrusive.

The integration of a thermistor as a detection mechanism underscores the system's ability to proactively identify abnormalities, allowing for swift and precise responses to varicose-related issues. This real-time detection capability enhances the efficiency of the treatment process, offering a timely and tailored solution for individuals experiencing discomfort.

In essence, this system represents a cutting-edge approach to varicose vein management, positioning itself as a non-invasive therapeutic solution that combines the advantages of thermal and vibration therapy. By incorporating autonomous detection through a thermistor, the system not only provides temporary relief but also demonstrates a commitment to advancing the field of varicose vein treatment through technological innovation.

#### **3.2 PROPOSED SYSTEM**

- The project's technology innovations include varicose veins patient monitoring and automated therapy, with the goal of providing a temporary solution for varicose veins patients to enhance blood circulation and normalise their veins.
- This will result in immediate temporary treatment to the patient which is reduce the pain easing the patient.

- They would not have the need to rush to the near hospital or their physiotherapist. This will also make them independent as they don't have to rely on any medical assistance for further treatment.
- This also decreases the expensive bills to be paid to their respective therapist. wearing clothing that is too tight can limit blood flow. Wearing loose-fitting garments that do not limit blood flow to the lower body may promote circulation.
- Wearing loose-fitting clothing promotes circulation by allowing blood to flow freely throughout the body, particularly in the lower extremities. Tight clothing can restrict blood flow, leading to discomfort and potential health issues. Loose garments prevent constriction of blood vessels, reducing the risk of varicose veins and blood clots. They also enhance comfort, minimize skin irritation, and promote relaxation, contributing to overall well-being.

## CHAPTER 4

### MATERIALS AND METHOD

#### 4.1 MATERIALS

##### ***IoT:***

IoT encompasses both software and hardware components, making it an interdisciplinary field that involves various technologies and disciplines.

1. Hardware Requirements: This includes physical devices such as sensors, actuators, microcontrollers, and communication modules that collect data from the environment, process it, and communicate it over the network. These devices are often embedded in everyday objects to make them "smart" and capable of connecting to the internet.

2. Software Requirements: IoT software involves the development of applications, firmware, and middleware that enable devices to communicate with each other, process data, and interact with users or other systems. This includes protocols for data transmission, data analytics algorithms, user interfaces, and backend systems for data storage and management.

#### 4.2 HARDWARE AND SOFTWARE REQUIREMENTS

##### ***4.2.1 Hardware requirements***

- Node MCU
- Thermistor -1
- Force sensor
- Buzzer

##### ***4.2.2 Node mcu***

Node MCU is an open-source Lua based firmware and development board specially targeted for IoT based Applications. It includes firmware that runs on the ESP8266 Wi-Fi SoC from Express if Systems, and hardware which is based on the ESP-12 module Programming Node MCU ESP8266 with Arduino IDE

The Node MCU Development Board can be easily programmed with Arduino IDE since it is easy to use.

Programming Node MCU with the Arduino IDE will hardly take 5-10 minutes. All you need is the Arduino IDE, a USB cable and the Node MCU board itself. You can check this [Getting Started Tutorial for Node MCU](#) to prepare your Arduino IDE for Node MCU. Node MCU is an open source firmware for which open source prototyping board designs are available. The name "Node MCU" combines "node" and "MCU" (micro-controller unit). The term "Node MCU" strictly speaking refers to the firmware rather than the associated development kits.

Both the firmware and prototyping board designs are open source.

The firmware uses the Lua scripting language. The firmware is based on the Elua project, and built on the Express if Non-OS SDK for ESP8266. It uses many open source projects, such as lua-cjson and SPIFFS. Due to resource constraints, users need to select the modules relevant for their project and build a firmware tailored to their needs. Support for the 32-bit ESP32 has also been implemented.

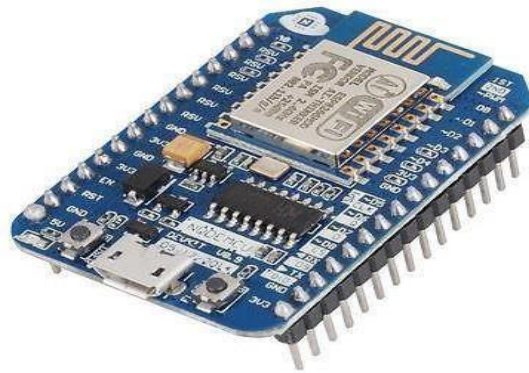
The prototyping hardware typically used is a circuit board functioning as a dual in-line package (DIP) which integrates a USB controller with a smaller surface-mounted board containing the MCU and antenna. The choice of the DIP format allows for easy prototyping on breadboards. The design was initially based on the ESP-12 module of the ESP8266, which is a Wi-Fi SoC integrated with a Ten silica Xtensa LX106 core, widely used in IoT applications (Ali, *et al.*, 2021).

#### **4.2.3 ESP8266 Arduino Core**

As Arduino.cc began developing new MCU boards based on non-AVR processors like the ARM/SAM MCU and used in the Arduino Due, they needed to modify the Arduino IDE so that it would be relatively easy to change the IDE to support alternate toolchains to allow Arduino C/C++ to be compiled for these new processors. They did this with the introduction of the Board Manager and the SAM Core. A "core" is the collection of software components required by the Board Manager and the Arduino IDE to compile an Arduino C/C++ source file for the target MCU's machine language. Some ESP8266 enthusiasts developed an Arduino core for the ESP8266 Wi-Fi SoC, popularly called the "ESP8266 Core for the Arduino IDE". This has become a leading software development platform for the various ESP8266-based modules and development boards, including Node MCUs.

Node MCU is an open-source LUA based firmware developed for the ESP8266 wifi

chip. By exploring functionality with the ESP8266 chip, Node MCU firmware comes with the ESP8266 Development board/kit i.e. Node MCU Development board.



***Fig:4.1 Node MCU Development Board/kit v0.9 (Version1)***

Since Node MCU is an open-source platform, its hardware design is open for edit/modify/build.

Node MCU Dev Kit/board consist of ESP8266 wifi enabled chip. The ESP8266 is a low-cost Wi-Fi chip developed by Express if Systems with TCP/IP protocol. For more information about ESP8266, you can refer to the ESP8266 Wi-Fi Module.

There is Version2 (V2) available for Node MCU Dev Kit i.e. Node MCU Development Board v1.0 (Version2), which usually comes in black colored PCB.



***Fig 4.2 Node MCU Development Board/kit v1.0 (Version2)***

For more information about Node MCU Boards available in the market refer to Node MCU Development Boards

Node MCU Dev Kit has Arduino like Analog (i.e. A0) and Digital (D0-D8) pins on its board.

It supports serial communication protocols i.e. UART, SPI, I2C, etc.

Using such serial protocols we can connect it with serial devices like I2C enabled LCD display, Magnetometer HMC5883, MPU-6050 Gyro meter + Accelerometer, RTC chips, GPS modules, touch screen displays, SD cards, etc. (Mohammed, *et al.*,2021).

#### Node MCU ESP8266 Specifications & Features

- Microcontroller: Ten silica 32-bit RISC CPU Xtensa LX106
- Operating Voltage: 3.3V
- Input Voltage: 7-12V
- Digital I/O Pins (DIO): 16
- Analog Input Pins (ADC): 1
- UARTs: 1
- SPIs: 1
- I2Cs: 1
- Flash Memory: 4 MB
- SRAM: 64 KB
- Clock Speed: 80 MHz
- USB-TTL based on CP2102 is included onboard, Enabling Plug n Play
- PCB Antenna
- Small Sized module to fit smartly inside your IoT projects

#### ***How to start with Node MCU?***

Node MCU Development board is featured with wifi capability, analog pin, digital pins, and serial communication protocols.

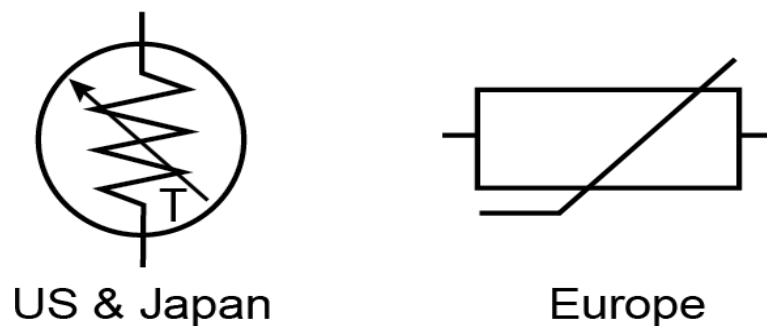
To get started with using Node MCU for IoT applications first we need to know about how to write/download Node MCU firmware in Node MCU Development Boards. And before that where this Node MCU firmware will get as per our requirement.

There are online Node MCU custom builds available using which we can easily get our custom Node MCU firmware as per our requirement.

To know more about how to build custom Node MCU firmware online and download it refer to Getting started with Node MCU

#### 4.2.4 Thermistor

- A thermistor is a resistance thermometer, or a resistor whose resistance is dependent on temperature. The term is a combination of “thermal” and “resistor”. It is made of metallic oxides, pressed into a bead, disk, or cylindrical shape and then encapsulated with an impermeable material such as epoxy or glass.
- There are two types of thermistors: Negative Temperature Coefficient (NTC) and Positive Temperature Coefficient (PTC). With an NTC thermistor, when the temperature increases, resistance decreases. Conversely, when temperature decreases, resistance increases. This type of thermistor is used the most.
- A PTC thermistor works a little differently. When temperature increases, the resistance increases, and when temperature decreases, resistance decreases. This type of thermistor is generally used as a fuse.
- Typically, a thermistor achieves high precision within a limited temperature range of about 50°C around the target temperature. This range is dependent on the base resistance.
- The thermistor symbols are:



**Fig 4.3 Thermistor Symbol — US and Japan**

- The arrow by the T signifies that the resistance is variable based on temperature. The direction of the arrow or bar is not significant.
- Thermistors are easy to use, inexpensive, sturdy, and respond predictably to changes in temperature. While they do not work well with excessively hot or cold temperatures, they are the sensor of choice for applications that measure temperature at a desired base point. They are ideal when very precise temperatures are required.

- Some of the most common uses of thermistors are in digital thermometers, in cars to measure oil and coolant temperatures, and in household appliances such as ovens and refrigerators, but they are also found in almost any application that requires heating or cooling protection circuits for safe operation. For more sophisticated applications, such as laser stabilization detectors, optical blocks, and charge coupled devices, the thermistor is built . Naser, *et al.*, 2020).

### ***How does the Thermistor “Read” Temperature?***

- A thermistor does not actually “read” anything, instead the resistance of a thermistor changes with temperature. How much the resistance changes depends on the type of material used in the thermistor.

- Unlike other sensors, thermistors are nonlinear, meaning the points on a graph representing the relationship between resistance and temperature will not form a straight line. The location of the line and how much it changes is determined by the construction of the thermistor. A typical thermistor graph looks like this:

### ***Which Thermistors Shapes are Available?***

- Thermistors come in a variety of shapes-disk, chip, bead, or rod, and can be surface mounted or embedded in a system. They can be encapsulated in epoxy resin, glass, baked-on phenolic, or painted. The best shape often depends on what material is being monitored, such as a solid, liquid, or gas.

- For example, a bead thermistor is ideal for embedding into a device, while a rod, disk, or cylindrical head are best for optical surfaces. A thermistor chip is normally mounted on a printed circuit board (PCB). There are many, many different shapes of thermistors and some examples are:



***Fig 4.4 Thermistor Types***

- Choose a shape that allows maximum surface contact with the device whose temperature is being monitored. Regardless of the type of thermistor, the connection

to the monitored device must be made using a highly thermally conductive paste or epoxy glue. It is usually important that this paste or glue is not electrically conductive.

#### ***What are the maximum and minimum temperatures for the device?***

Thermistors are ideal when measuring a single point temperature that is within 50°C of ambient. If the temperatures are excessively high or low, a thermistor will not work. While there are exceptions, most thermistors work best in the range between -55°C and +114°C.

Since thermistors are nonlinear, meaning the temperature to resistance values plot on a graph as a curve rather than a straight line, very high or very low temperatures do not get recorded correctly. For example, very small changes in very high temperatures will record negligible resistance changes, which won't translate into accurate voltage changes.

#### ***4.2.5 Force sensor***

The piezoelectric sensor is used for flex, touch, vibration and shock measurement. Its basic principal, at the risk of oversimplification, is as follows: whenever a structure moves, it experiences acceleration. A piezoelectric shock sensor, in turn, can generate a charge when physically accelerated. This combination of properties is then used to modify response or reduce noise and vibration.

Why is that important? Because vibration and shock can shorten the life of any electronic and electromechanical system. Delicate leads and bond wires can be stressed, especially after exposure to long term vibration. Solder joints can break free and PCB traces can ever so slightly tear from impact and impulse shock, creating the hardest type of system failure to debug; an intermittent failure

This article discusses piezoelectric shock and vibration sensors and sensor technology, focusing on available products (all parts mentioned here can be found on the Digi-Key website — links are provided), as well as design issues and design techniques. (Pratap, *et al.*, 2020).



**Fig 4.5 force sensor**

## 4.3 SOFTWARE REQUIREMENTS

### 4.3.1 1-Arduino IDE

Arduino IDE is an integrated development environment.

Can be used over different operating systems or platforms i.e. Windows, macOS, Linux.

IDE is used for writing and uploading the code of the hardware for programming the microcontroller accordingly.

The IDE consists of the different software libraries from the previous wiring project.

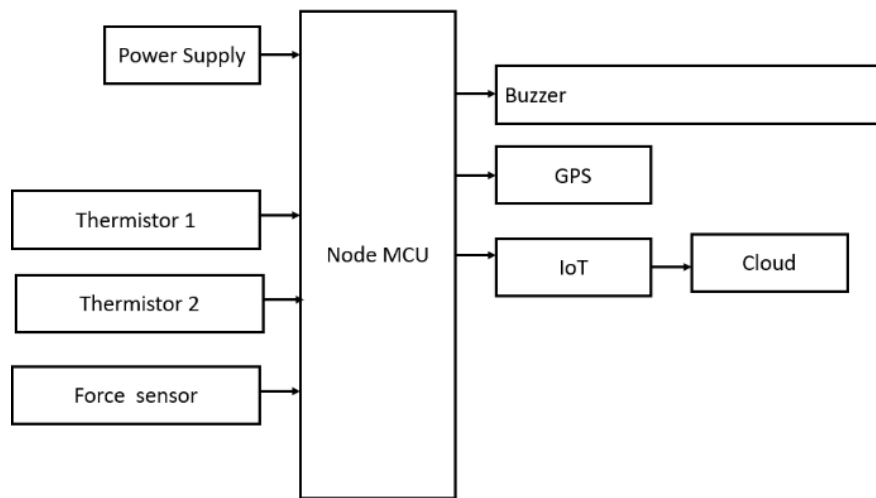
Features:

- 4.3.1.1 Both Analog and digital signal can be read by the IDE.
- 4.3.1.2 Directly connected to the microcontroller over a USB.
- 4.3.1.3 Arduino IDE supports different languages for writing the code  
-C, C++, JAVA

## 4.4 METHOD

### 1.power supply

- The power supply provides the necessary electrical power to the entire system.
- It can be a battery pack or an external power source connected to the device.



***Fig 4.4.1 block diagram***

## **2. thermistor-1**

- Thermistor 1 is a temperature sensor that measures the skin temperature near the varicose veins.
- It provides input to the Arduino microcontroller regarding the temperature of the affected area.

## **3. thermistor-2**

- Thermistor 2 is another temperature sensor that may be placed at a different location for comparative temperature measurement.
- It provides additional input to the Arduino microcontroller for temperature monitoring.

## **4. force sensor**

- The force sensor measures the pressure exerted on the skin's surface, particularly in areas with varicose veins.
- It detects changes in pressure, such as from external stimuli or movements, and relays this information to the Arduino.

## **5. buzzer**

- The buzzer is an output device used to provide auditory feedback to the user.
- It emits sound signals to alert the user of certain conditions, such as high skin temperature or excessive pressure on the affected area.

## **6. GPS module**

- The GPS module receives signals from GPS satellites to determine the device's current location.
- It provides location data to the Arduino, which can be useful for tracking the user's movements and providing location-specific alerts or notifications.

## **7. IoT module**

- The IoT module enables wireless connectivity to the Internet, allowing the device to transmit data to remote servers or cloud platforms.
- It facilitates communication between the device and external systems, such as healthcare databases or mobile applications.

### ***8. cloud connectivity***

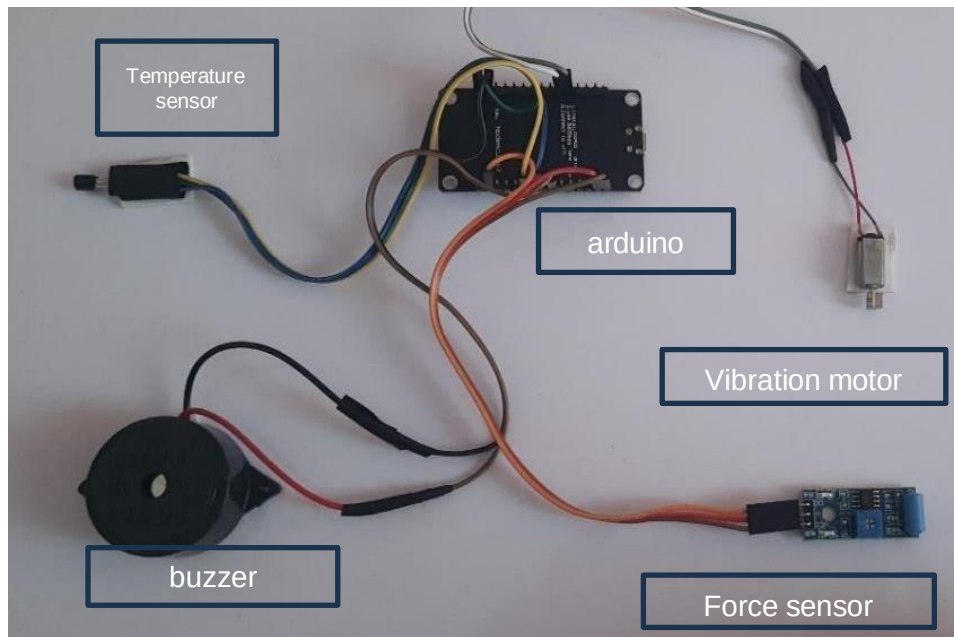
- The cloud connection enables the device to store and retrieve data from cloud-based platforms.
- It allows for remote access to patient data, real-time monitoring, and data analysis by healthcare providers or researchers.

### ***9. Node MCU***

- The NodeMCU is a microcontroller board based on the ESP8266 Wi-Fi module.
- It serves as the central processing unit of the system, receiving inputs from sensors, controlling output devices, and managing communication with external networks via Wi-Fi.

## CHAPTER 5

### RESULTS AND DISCUSSION



***Fig 5.1. working of lot integrated pain relief for varicose veins***

1. In fig 5.2 Connecting the Arduino device with the computer using a USB.



***Fig 5.2 b-type data cable***

2. In fig 5.3 Writing the code in the preferred language that is in java

```
#include "ThingSpeak.h"
#include <ESP8266WiFi.h>

#define Vibration D2
#define Temp1 A0
#define Temp2 D2

#define Motor D4
#define Buzzer D6

char ssid[] = "Painproject"; // your network SSID (name)
char pass[] = "12345876"; // your network password
int keyIndex = 0; // your network key Index number (needed only for WEP)
WiFiClient client;

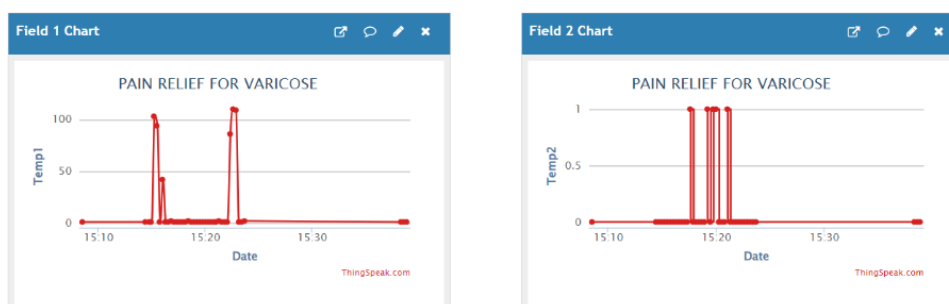
unsigned long myChannelNumber = 2504511;
const char * myWriteAPIKey = "0VZHS0JRO92YHFFM";

void setup()
{
  Serial.begin(9600); // Initialize serial
  pinMode(Buzzer, OUTPUT);

  WiFi.mode(WIFI_STA);
  ThingSpeak.begin(client); // Initialize ThingSpeak
}
```

**Fig 5.3 matlab code**

3. In fig 5.3 after Uploading the code over to the Arduino UNO microcontroller,



**Fig 5.4 temperature graph**

4. Fig 5.4 Analog and digital graph is displayed where we can check the upper and lower body temperature of the individual by the body temperature the vibration motor apply vibration on the affected area and if the temperature and vibration goes above 100 degree celsius the buzzer coin will be activated.

The integration of embedded sensors within wearable devices enables continuous monitoring of physiological parameters associated with varicose veins. Real-time data collection and analysis facilitate the early detection of subtle changes indicative of varicose vein development, such as alterations in blood flow dynamics, vein diameter, and skin temperature gradients. By identifying these early indicators, the system enables proactive intervention before symptomatic manifestations occur, potentially preventing disease progression and associated complications. Personalized Prevention Strategies:

Leveraging machine learning algorithms, the IoT platform provides personalized prevention strategies tailored to individuals' specific risk profiles and physiological characteristics. Based on the analysis of collected data, the system generates recommendations for lifestyle modifications, exercise regimens, and dietary adjustments aimed at improving venous circulation, reducing venous insufficiency, and mitigating the risk of varicose vein formation. By customizing prevention strategies to each patient's needs, the system maximizes effectiveness and promotes long-term adherence to preventive measures.

**Remote Monitoring and Teleconsultation:** The IoT platform facilitates seamless communication between patients and healthcare providers, enabling remote monitoring and teleconsultation services. Patients can transmit data from wearable devices to healthcare professionals for real-time assessment and feedback, enhancing the continuity of care and enabling timely intervention when necessary. Teleconsultation services offer convenient access to healthcare resources, reducing the need for in-person visits and minimizing barriers to care, particularly for individuals in remote or underserved areas.

**Patient Engagement and Compliance:** The integration of IoT technology fosters greater patient engagement and compliance with preventive measures through personalized feedback, educational resources, and reminders. Patients receive timely notifications and alerts regarding adherence to lifestyle modifications, medication regimens, and follow-up appointments, empowering them to take an active role in managing their vascular health. By promoting patient empowerment and accountability, the system enhances treatment outcomes and reduces the likelihood of disease recurrence.

**Scalability and Long-term Outcomes:** The scalability of the proposed system allows for widespread implementation across diverse healthcare settings, ranging from primary care clinics to specialized vascular centers. Further research and long-term monitoring are necessary to assess the sustained effectiveness and impact of the system on varicose vein incidence, progression, and associated healthcare costs. Additionally, ongoing technological advancements and refinements will enhance the capabilities and usability of the system, further optimizing patient care and outcomes.

## CHAPTER 6

### SUMMARY AND CONCLUSION

This project proposes a novel method for early detection as well as a treatment to prevent the onset of varicose veins. For the detection of the disease, we continuously monitor both the temperature and pressure in the targeted area. Once both values are found to be more than the threshold values, the vibrator modules fixed to the compression stockings switch on. Their combined action will enhance the blood flow in that region and prevent the accumulation of blood. The future work for this project includes measuring the blood flow for more accurate detection of varicose veins. The integration of IoT (Internet of Things) technology into pain relief solutions for varicose veins represents a groundbreaking approach to improving patient care and outcomes. By leveraging IoT-enabled devices, healthcare providers can offer real-time monitoring, personalized treatment plans, and remote accessibility for individuals suffering from varicose vein pain. Pain relief for varicose veins encompasses a range of treatment options aimed at alleviating discomfort and improving quality of life for affected individuals. Conservative measures such as wearing compression stockings, elevating the legs, and adopting lifestyle changes like regular exercise and weight management are often recommended as initial strategies. These approaches aim to improve blood circulation, reduce swelling, and alleviate symptoms associated with varicose veins. The choice of treatment depends on factors such as the severity of symptoms, the presence of complications, patient preferences, and the expertise of the healthcare provider. Additionally, ongoing research and innovation in the field continue to drive advancements in pain relief strategies, with emerging technologies and novel treatment modalities offering promise for improved outcomes. Pain relief for varicose veins is to alleviate symptoms, improve venous circulation, and enhance the overall quality of life for affected individuals. By adopting a comprehensive approach that combines conservative measures, medical interventions, and ongoing monitoring, healthcare providers can effectively manage varicose vein pain and optimize patient outcomes. The integration of IoT (Internet of Things) technology into pain relief solutions for varicose veins represents a significant advancement in healthcare innovation. By leveraging IoT-enabled devices, healthcare providers can offer real-time monitoring, personalized treatment plans, and remote accessibility for individuals suffering from varicose vein

pain. The ability to continuously monitor physiological parameters such as skin temperature, pressure on the affected area, and patient activity levels allows for early detection of changes in the patient's condition, enabling prompt intervention and adjustment of treatment strategies as needed. This real-time monitoring, coupled with remote accessibility, empowers healthcare professionals to monitor patients' progress, track treatment effectiveness, and provide guidance or support from anywhere, at any time.

Furthermore, the integration of IoT facilitates personalized treatment approaches by analyzing data collected from sensors to tailor treatment plans to each patient's unique symptoms and responses. This data-driven approach ensures that patients receive customized pain relief solutions optimized for their particular condition, ultimately leading to improved quality of life and enhanced overall well-being.

Overall, IoT-integrated pain relief solutions for varicose veins offer a revolutionary approach to healthcare delivery, providing real-time monitoring, personalized treatment, and remote accessibility for patients and healthcare providers alike. By harnessing the power of connectivity and data analytics, these innovative devices have the potential to transform the management of varicose vein pain, ultimately improving patient outcome and enhancing the patients experience after the treatment.

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