

VARICOSE VEINS TREATMENT USING AUTOMATED STOCKINGS

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Abstract—This work presents a home based automated temporary treatment for patient healthcare to be made easier. Varicose veins are veins that are twisted and bulging. Varicose veins can form near the surface of the skin (superficial veins). Varicose veins most commonly affect the veins in the legs. The proposed system consists of a wearable device with vibrating motors connected to an ESP32. Here pressure sensors are used to measure variation of blood pressure in the upper and lower region of the body and if the reading of pressure is higher in the lower region compared to the upper region, then it will activate the motor to give in the exercise to subtle pain and the block of blood in the nerves. This exercise is also given in a periodic time interval without waiting until pressure variation is observed. These automated stockings will also behave as a normal compression stocking when vibration is not applied. In simple words the new designed stocking can perform in 3 ways. The signal acquired from the pressure sensor is processed by ESP32. This in turn activates the motor(to provide periodic vibrations). Patients will be able to receive rapid temporary therapy if this rehabilitation system is implemented.

Keywords: Varicose Veins, Automated Temporary Treatment, Pressure Sensor, Variations, ESP32, Rehabilitation System.

INTRODUCTION

Varicose veins are a common condition that occurs when the veins in the legs become enlarged and twisted, resulting in a bulging appearance. They can appear as blue or purple, twisted cords on the legs, and may be accompanied by symptoms such as aching, swelling, and fatigue[1][11]. Varicose veins affect both men and women, but are more common in women, especially during pregnancy.[20]

There are several factors that contribute to the development of varicose veins, including

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age, genetics, obesity, and pregnancy[2][9]. In some cases, people may be more prone to developing varicose veins due to their occupation, as standing or sitting for long periods of time can increase the pressure on the veins in the legs.[18][19]

Varicose veins occur when the valves in the veins that help blood flow from the legs back to the heart become weakened or damaged[3-5]. As a result, blood pools in the veins and causes them to swell and bulge. Risk factors for varicose veins include age, genetics, obesity, pregnancy, prolonged standing or sitting, and a history of blood clots. While varicose veins may be a cosmetic concern for some people, they can also cause discomfort, pain, and other health problems[6][14]. Complications can include ulcers, bleeding, and deep vein thrombosis, which is a blood clot that forms in a deep vein.

Treatment options for varicose veins depend on the severity of the condition and can range from lifestyle changes to medical procedures. Lifestyle changes include regular exercise, maintaining a healthy weight, and avoiding prolonged periods of sitting or standing. Compression stockings can also help to relieve symptoms by applying pressure to the legs to improve blood flow[7][12].

Medical procedures for varicose veins include sclerotherapy, which involves injecting a solution into the affected veins to close them off, and endovenous laser treatment, which uses heat to seal the veins. Surgery may be necessary for severe cases of varicose veins. With proper treatment, most people with varicose veins can improve their symptoms and prevent complications.

It is important to consult a healthcare provider to determine the most appropriate treatment for your individual needs. They can provide guidance on the best treatment option based on the severity of your condition, symptoms, and overall health[8][15].

LITERATURE SURVEY

Relevant papers to this project have been studied and important key points are prepared, as the literature survey. The idea of implementing the rehabilitation in stockings itself was inspired from the [2] [13]but this had few real time shortcomings as this used air pressure circulation to act as massager. To make this more productive other factors were studied and at that time we encountered [6] which used a thermistor to check the temperature of the blood accumulation in veins. As per the expert's guidance it was clear that temperature is not a factor for the identification of blood accumulation, so we moved to a more sophisticated method of checking the pressure [3] and this provided the desired optimized results. The idea of making this device thoroughly non-invasive was obtained from [5]. The work is purely automatized with minimal components because [2] uses majority of components to achieve limited results and to overcome that we have designed a much productive and simple wearable device with greater efficiency[16][20].

METHODOLOGY

In recent times the impact of Varicose veins worldwide has increased to a greater extent. These varicose veins are superficial veins that are present on the skin surface in lower extremities. To mitigate this problem many solutions were proposed but nothing yielded the desired outcome. One such existing system is mentioned.[17]

The existing system proposes a wearable device which provides massage to varicose vein patients. To achieve this, they have utilized a cuff like product which is responsible for the compression and relaxation which in turn acts as massager. To provide the compression and relaxation they have used air supply by keeping a pneumatic pump. This pump is controlled with a micro controller and a MEMS Pressure sensor is used to

record the amount of pressure exerted through the cuff on to the body. This system can provide massage based on manual instruction and cannot be worn throughout the day; the patient should allot time for using this massager. In another system they have utilized a thermistor to observe the temperature differences in the blood flow and if the temperature is high through the veins in leg then this massager acts but here, they have used vibration motors. There are vast real-time improvements which have mentioned in our proposed system below.

PROPOSED SYSTEM

The system proposed is far developed from the existing system. Figure1 represents the transmitting unit. The improvements made to this system are, firstly we have equipped a MAX30100 pressure sensor which is a new method used from all the existing methods. The role of this pressure sensor is to observe the pressure of blood flowing through the vein. The main cause of using pressure sensor is that varicose vein causes accumulation of blood, this accumulation increases the pressure of the vein and hence this cannot be monitored using thermistors as mentioned in other existing systems. As an add on we have utilized coin vibration motors which provide vibrations that in turn acts as massager instead of using air supply, Figure 2 represents the receiving unit. The major idea is to implement these components in stockings so that the patients can wear them throughout the day.

And most importantly patients don't need to allot specific time for using this massager as this comes combined with the general stockings, so they can wear this throughout the day and by wearing this they can do all their day-to-day activities. The device is not completely dependent only on the working of MAX30100 sensor but also here we have equipped another scenario where the device also works in a specific time interval by providing vibrations which in turn becomes as a massage for these patients.

BLOCK DIAGRAM

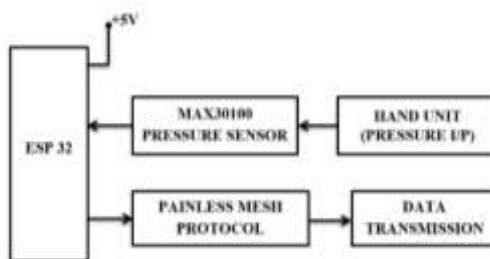


Figure 1: Transmitting Unit

Painless Mesh Protocol

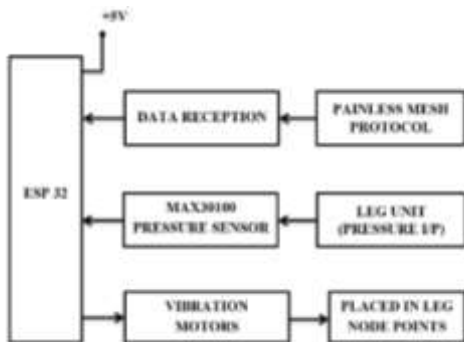


Figure 2: Receiving Unit

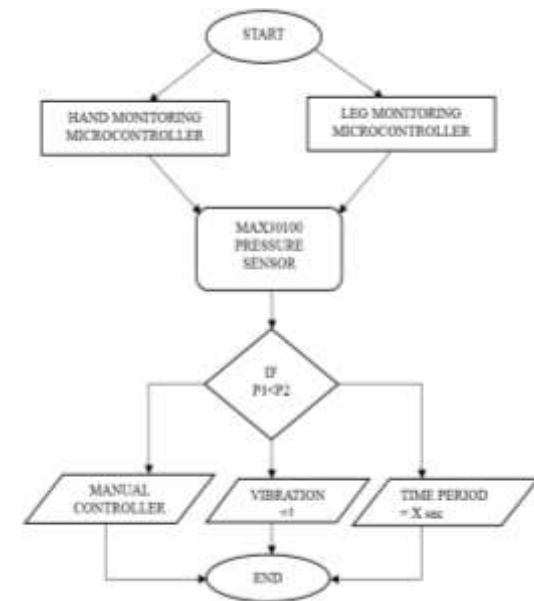
DESCRIPTION

The transmitter unit consists of an ESP32 module and MAX30100 pressure sensor attached to the wrist of the patient. The pressure sensor emits a red led which is transmitted into the body and reflects the value after touching the capillary vessels. The reading is transferred to the ESP32 module, which uses the painless mesh protocol to transmit the recorded value from one module to another. This protocol is free and can be accessed easily.

The receiver unit consists of an ESP32 module, MAX30100 pressure sensor, coin type vibration motor and compression stockings. The ESP32 module receives the value transmitted from the wrist, while the MAX30100 pressure sensor records the flow of blood in the veins. When there is a great difference in the lower part reading, the vibration motors will be turned on and provide vibrating massage until the pressure in the leg reaches equal value to the reading obtained from the wrist. The timer unit can also be controlled manually. The components are placed inside the compression stockings to provide additional relief to the patients. Prolonged use of vibration does not harm the valves in the leg because the pressure given by the motors is 20mmHg whereas the anatomy valves are also 20mmHg.

FLOW CHART

Figure 3: Flow Execution



EXPLANATION

The working of the project is represented through a flow chart, Figure 3. This flow chart contains the pictorial representation of how the work is carried out. Initially start is the first step. This is getting categorized into two units and they are called Hand Monitoring Microcontroller and Leg Monitoring Microcontroller. These two microcontrollers are individually connected to a Max 30100 pressure sensor, to monitor the pressure of blood flowing through the veins. Here a protocol called Painless Mesh comes into action. The purpose of enabling this protocol is that mesh doesn't follow any conventional set of rules to establish a connection, and this also doesn't require a central hub. Now the decision block performs the role of comparing the pressure values obtained in both microcontrollers by taking two variables P1 and P2 which represent the hand and leg vein pressure respectively. If the pressure of $P1 < P2$ then the vibration motor turns on which provides vibrations until the condition $P1 = P2$ is achieved, then the vibrations will go to a halt. In other condition if P1 and P2 have no difference in readings then after a period the vibration motor will start its operation and in other scenario the microcontroller can be controlled manually using the IOT enabled device.

RESULTS & DISCUSSION

The figure 4 represents the overall men and women who are affected with varicose vein in different age groups.

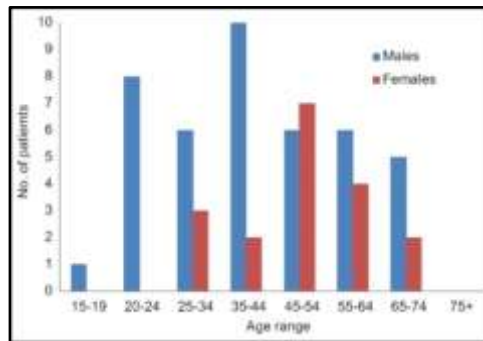


Figure 4: Bar Representation Of Affected People

On analyzing the pie chart in Figure 5 now it's evident that the entire people of the world have this common disease and this is categorized based on regions. The APAC includes Asia-Pacific countries like India, Japan, Indonesia, New Zealand, Bangladesh, Singapore etc. The RoW depicts the non-major countries.

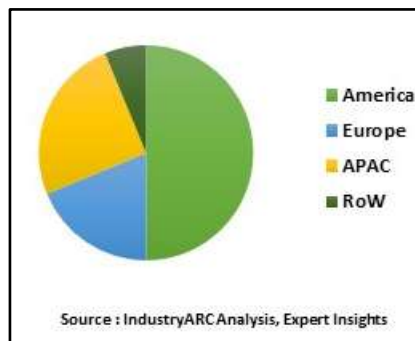


Figure 5: Pie Chart Depict Varicose Affected Country

RESULTS

The result Figure 6 shows us the importance of using stockings and the rate in which the stockings greatly help in streamlining the blood flow. The difference between with and without using stockings is clearly marked and we can arrive to a result that using stockings we can very well provide cure for this condition.

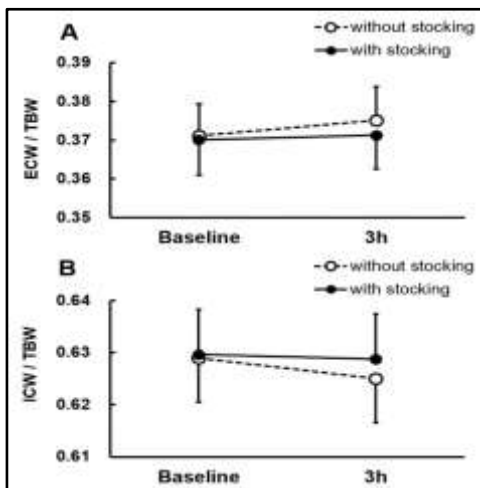


Figure 6: Effectiveness Of Wearing Stockings

CONCLUSION

In conclusion, wearing compression stockings can be a helpful tool in the prevention and management of varicose veins and related conditions. They are safe, non-invasive, and can provide relief from uncomfortable symptoms. However, they should be used in combination with other treatment options and under the guidance of a healthcare professional for optimal results. It is important to note that compression stockings are not a cure for varicose veins and should be used in combination with other treatment options, such as lifestyle changes and medical procedures, for best results. Additionally, it is important to use properly fitted compression stockings and follow the recommendations of a healthcare professional to ensure maximum effectiveness and safety.

FUTURE ENHANCEMENT

In future flex-pcbs can be used because for real time comfort it is necessary that the boards are flexible because they cause more ease in wearing the compression stockings. The currently used micro controllers can be made into nano size components so that they won't obtain more space while mounting them on the flex-pcbs. The pressure sensor can also be upgraded as PPG sensor. This PPG sensor is the most accurate and the medically approved component which is placed in many of the bio-medical devices.

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