

## Real-Time Epidemiology Of Varicose Veins And Chronic Venous Disease Prediction Using Decision Tree Algorithm

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**Abstract:** This paper presents a system for identifying the veins that is suffered from the chronic venous disease called the varicose disease. Mostly, the physician determines whether there are varicose veins in human leg through diagnosis of images collected through transducer. Hence the automatic diagnosis has gained extensive attention. The varicose veins are the lesion veins that are swollen and twisted veins that usually occur in lower limbs. This disease occurs due to damaged or weak valves of the veins that lead to improper flow of blood against gravity. In this paper, a wearable sock with sensors based on non-invasive diagnostic and therapeutic solution is provided to predict and prevent the varicose veins at early stage. This project proposes a varicose vein detection algorithm based on decision tree in machine learning concept. Based on the values from the sensors, the dataset is predefined. The acquired positional is processed using Arduino-uno and decision tree algorithm from machine learning concept.

**Keywords:** Varicose veins, Sclerotherapy, Endovascular Laser Therapy, Decision Tree.

### 1. Introduction

Varicose veins are the inflammatory lesion veins that are swollen and twisted veins that usually occur in lower extremities of the human body. This occurs when the blood flow against the gravity is interrupted regularly during long standing times. It afflicts nearly 1-2% of the Indian population with 6-8% of people over the age of 40. Varicose veins cause stiffness in lower extremities and loss of function in the joints, which may lead to swelling and bulging. Treatments available for varicose veins are surgery, ligation and stripping, sclera therapy, radio frequency ablation, endogenous laser treatment, Tran's illuminated phlebectomy. The major problem faced by many physicians today is detecting the veins for intravenous drug delivery for the right vein. The patients face a heavy and recurrent pain after intervention of the drug into the vein. Therefore, the non-invasive detection of veins and therapeutic solution system has been successfully designed using Decision tree algorithm. Arduino UNO controller is been interfaced with pc and the sensors namely accelerometer sensor, spO2 sensor and force sensor. The experiment result shows the level of veins and predicts the disease in a best way.

### 2. RELATED WORK

This part clarifies about existing philosophies of identifying and foreseeing varicose veins. The varicose veins can be detected using infrared image processing, physical examine and scanning. In case of a non-invasive test, a transducer should be run on the skin and images will be sent to the monitor for examination[10][11]. The image processing is done using various deep learning algorithms.

The first work from the author Lau et al. [4] can achieve a good detection effect in 100 images of damage in skin using the Network algorithm. The author Kawahara et al. [7] applied a CNN structure, which interfaces the mind network as map, got from MRI dissemination tensor imaging DTI. CNN has the benefit of utilizing the end-to-end learning capacity to straightforwardly carry out the picture as input, without unnecessary manual interference, and staying away from pre-processes of the picture. A.S borde et al[3] aims the investigation of the bio-thermal mechanical response of the venous wall to the frequency ultrasound exposure, which is an advanced method in the treatment of LLVV.

A traditional method to cure this disease includes surgery, Sclerotherapy and endovascular laser therapy[2][5]. Surgery is one of the painful methods which involve intervention by tying and pulling away the veins which causes tremendous pain for the patient and takes deliberately long time to recover. Sclerotherapy is a method of injecting drugs into the affected veins for shrinking it, which is tedious process since it is highly tough to determine the exact affected vein. It causes heavy pain and inflammation the injecting spot. The complications include allergies and burning, sometimes stroke due to heavy dosage sclerosant. Endo vascular laser therapy is one the methods which uses laser beam that penetrates into the human skin surface and destroys the affected veins. It is the fastest procedure ever available since it takes nearly 20-40 minutes for the entire process[13][1].

Due to the exposure of skin to the laser, there exists a permanent damage to the color of the skin. This process makes the skin really sensitive hence forcing the patient to wear the pressure sock called the stockings. Side effects may include skin allergy, skin inflammation, skin darkening and sometimes heavy burning at the surface. Tran's illuminated phlebotomy is one the removal methods that makes use of bright light to penetrate into the skin which illuminates the infected vein and destroys the infected vein through tiny device passed through a small incision which removes the vein by suction. It may develop seroma and brown scar on the skin due the puncturing effect.

### 3. Existing Methodologies

The varicose vein is resolved utilizing different strategies like infrared picture handling, examining, and physical assessment. You need an ultrasound test to discover if the veins are ordinary or on the off chance that they have any blood coagulations in the lower part. In this non-intrusive test, the specialist runs a transducer against the skin over the territory of the body to be inspected. The Motivation behind the transducer is to send the pictures to the screen to look at. The picture preparing is utilized for the examination of the vein with the assistance of profound learning calculations.

#### a) Surgery

Surgery is one of the conventional therapies for these cases. This Surgery depends on composing and pulling away of more modest part of veins. Yet, these makes serious torment the patient and sets aside long effort to recuperate.

#### b) Sclerotherapy

This technique depends on infusing the meds to the veins, and makes them to recoil it. The intricacies of this treatment incorporate hypersensitivities, consuming, stinging at infusion destinations, skin ulcerations and aggravation. It might cause strokes due to over portion of sclerosant.

#### c) Endovascular Laser Therapy

This strategy utilizes the laser to obliterate the varicose veins. It by and large takes 30-35 minutes for methodology and recuperation effectively and quickly[8]. Endovascular laser Therapy changes in shading. After that it requires the patients to wear pressure stockings.

### 4. Proposed Work

This division has four segments. First segment describes about the hardware implementation. Second segment describes about the machine learning implementation where the decision tree algorithm fetches the output. The third segment describes about the existing methodologies and their limitations. The final segment describes about the work flow of the proposed work.

#### a) Hardware Implementation

The disease is determined using the help of sensors with respect to the time taken which is a non-invasive treatment. Force sensor, accelerometer and spO2 sensors have been implemented with the Arduino uno to get the desired output values. The voltage value appears to be normal and constant if the leg remains inert for period of long time. Hence, resulting in low blood circulation. Movement or idleness of the leg can be determined using force sensor. The variations in the values given out by the force sensor determines the pressure that is been given to the lower extremities.

Accelerometer basically determines the cx, cy, cz axis of the lower extremities. Hence it is used to find out the state of the leg i.e. Either walking or standing. spO2 sensor gives the value of heartbeat and o2 level in the blood. All these values are analog values. Using these values, the positional parameter of the lower extremities has been fetched. Positional parameter which in turn gives out the physical parameter of the leg. All these sensors have been interfaced with Arduino-uno which is a microcontroller board with ATMega328p microcontroller chip. Arduino-uno acts as a brain to the entire system.

#### b) Decision Tree – Machine Learning Implementation

All the analog output has been inputted into the Arduino-uno and it passes the values into PC for machine learning. The algorithm used on the proposed system is decision tree which belongs to the family of supervised learning[9]. Decision tree can be utilized to predict value or class of target variable by taking in straightforward choice principles found from the past information. Decision tree is a tree structured classifier. It has two nodes named as decision node and leaf node.

**Pseudo code:**

```

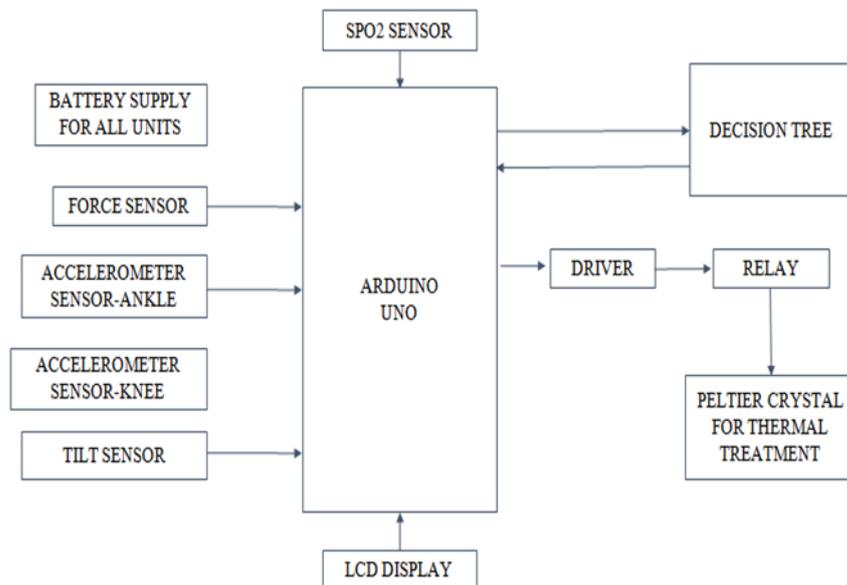
public void disease_Prediction(int force, int axis, int spo2)
{
    If (force>400 & force <600){
        If (axis> 560 & axis <580) {
            If (spO2>78 & spO2<99){
                print('patient value is normal condition')
            }}}
        else {
            print ('patient value is abnormal condition')}
        }
}

```

The internal node depicts the features of the dataset that is been fed from Arduino-uno. The branches of the tree represent the rules that are vitally used to decide on the conclusion. The tree models take the discrete set of models which are the target variable for the classification tree. Continuous values can be set as target variable for the regression tree. In the prediction algorithm used force, axis and spO2 value for predicting the condition of patients. If force values lies between 400 and 600, which decides the normal condition.

## c) System Architecture

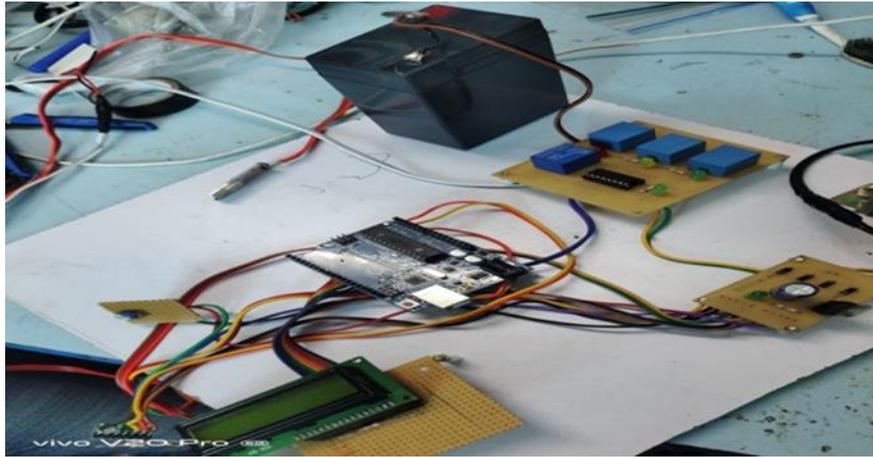
The Block Diagram of the proposed framework comprises of an obstruction based simple sensor, two movement distinguishing sensors and a sensor for checking blood oxygen. The simple sensors utilized are power sensor, accelerometers and a SPO2 sensor. The power sensor is utilized to decide the power given by the individual. The power esteems continue fluctuating for various places of the leg. At the point when the whole power is applied by the individual. There are two accelerometers; one is utilized to decide the movement of the individual. Another accelerometer is used to decide the bowing of the knee.

**5. Results and Discussion**

The entire system consists of 4 modules namely, hardware implementation module, Hardware interface module, decision tree implementation module and output module.

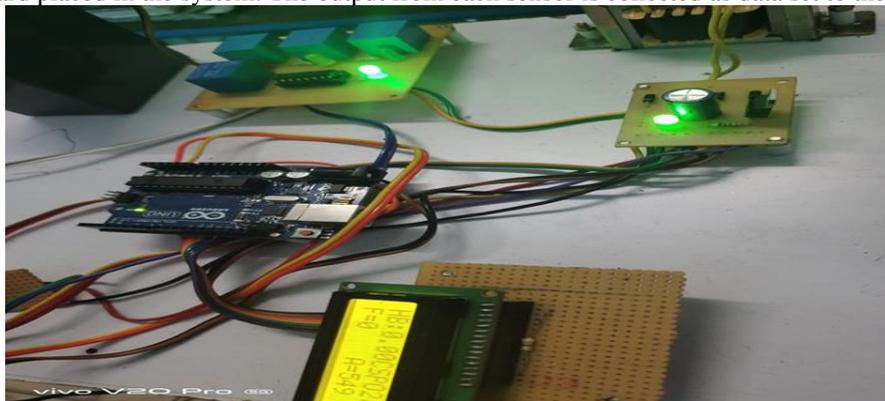
## a) Hardware Implementation Module

This module consists of all the hardware's such as force sensor, accelerometer, spO2 sensor, Arduino-uno, Peltier crystal, batteries, relay, accelerometer and wires for connection. These are connected through wires and soldered. The entire unit acts as hardware system.



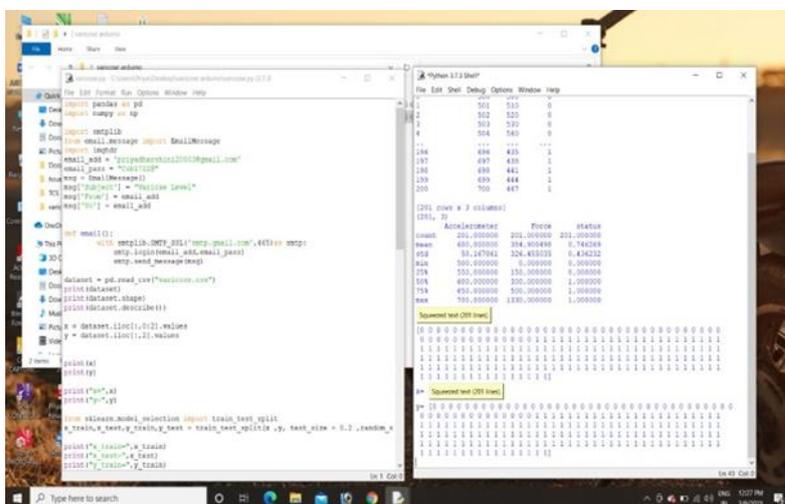
b) Hardware Interface Module

The above mentioned hardware unit is interfaced to Arduino-uno which acts as a brain for the entire hardware unit. The coding is done using embedded C program and output of every sensor is displayed in LCD display board placed in the system. The output from each sensor is collected as data set to the algorithm used.



c) Decision Tree

The dataset collected from sensors has been fetched and fed into PC for machine learning purpose. The algorithm used is decision tree algorithm. This algorithm classifies the train and test the entire data set. Thus providing the exact output. Based on the criteria set on algorithm, output is provided.



6. Conclusion

The ultimate point of this project has been to give the early prediction of varicose veins and to forestall the lower part of the veins from the illness. The blood stream is the primary issue that prompts inversion and obstructing of veins. This paper breaks down the yield information from the separate sensors and looks at these qualities utilizing Arduino This project has conquered these issues inside its execution. After consulting some

doctor ideas, we finish up and utilize some essential information to foresee the illness. The blood stream can be routinely observed by the separate sensor.

In anticipation measure the Peltier module which initiates by the hand-off driver circuit and at the same time it changes warmth and cold state for the normal blood stream. The vibration engine has been associated from the hand-off circuit furthermore, initiates if the stream hinder and furthermore, we check the execution of the sensor circuits like transition, accelerometer, slant, spo2. The Arduino is the 32 cycle 900mhz cortex A7 processor utilized for the correspondence between the simple and computerized portions of the circuit. By the help of these processor the yield result can be seen through the conventional PCs when the sensors are forced. The processor goes about as a computer chip the information's are put away in the Smash separately. The future work of these activities is to make them viable to the individual deprived to diminish the weight. Circuits like ADC, transfer driver, Arduino are compactly organized in straightforward bundles.

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