VARICOSE VEINS DETECTION USING IOT

A PROJECT REPORT

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We **ABISHEK R (211420104008), MUKESH S (211420104172), NAVEEN KUMAR R(211420104180),** hereby declare that this project report titled "**VARICOSE VEINS DETECTION USING IOT**", under the guidance of **Dr. G. SENTHIL KUMAR , M.C.A., MPhil., M.B.A., M.E., Ph.D.**, is the original work done by us and we have not plagiarized or submitted to any other degree in any university by us.

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ABSTRACT

Varicose veins can cause discomfort, swelling, and pain. In severe cases, they may lead to skin changes and ulcers. The impact extends beyond physical symptoms, affecting individuals' quality of life and potentially necessitating medical intervention for relief.

Motive of the project is to detect and prevent of varicose veins in earlier stage. Varicose veins are swollen, twisted veins that lie just under the skin and usually occur in the legs. Varicose veins are a common condition caused by weak or damaged vein walls and valves. Varicose veins may form whenever blood pressure increases inside your veins. It is the most common inflammatory arthropathy disease worldwide. This is because standing and walking increase the pressure in the veins of the lower body. In this project, a rehabilitation monitoring and exercise device.

Comparing the temperatures of the lower body as well as the upper body and with the detection of force in the legs will activate the motor to give in the exercise to subtle pain and the block of blood in the nerves. The signal acquired from the force, ND sensor, IR sensor is processed by NodeMCU using WiFi for varicose pain detection. When the system was running, it was able to identify a three-degree difference in force and temperature and successfully install the coin vibration motor.

Patients will be able to receive rapid temporary therapy and will not have to hurry to hospitals if the rehabilitation system is implemented.

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LIST OF SYMBOLS, ABBREVIATIONS

CPU	Central Processing Unit
IC	Integrated Circuit
AI	Artificial Intelligence
FSR	Force Sensing Resistor
LEDs	Light Emitting Diodes

CHAPTER – 1

INTRODUCTION

Varicose veins are a prevalent medical condition characterized by swollen, twisted veins, commonly occurring in the legs. They arise due to weakened or damaged vein walls and valves, leading to increased blood pressure within the veins. Factors such as prolonged standing, walking, and genetics contribute to their development. While varicose veins often manifest with physical symptoms, they can also impact individuals' quality of life and may necessitate medical intervention in severe cases. Early detection and preventive measures are crucial for effectively managing varicose veins and reducing associated complications.

The primary motivation behind this project is to address the need for early detection and prevention of varicose veins. By leveraging technology and innovative approaches, we aim to develop a system that can detect subtle physiological changes indicative of varicose vein development and deliver targeted therapeutic interventions. The goal is to empower individuals with tools for self-monitoring and proactive management of their vascular health, ultimately improving their well-being and reducing the burden on healthcare systems.

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1.1 PROPOSED SYSTEM

1.1.1 Overview:

The proposed system comprises a rehabilitation monitoring and exercise device equipped with sensors, data processing capabilities, and wireless communication functionalities. Key components include DHT11 sensors for temperature tracking, force sensors for detecting leg movements, IR sensors for muscle activity monitoring, NodeMCU for data processing, and a vibration motor for

therapeutic interventions. The system integrates seamlessly to provide real-time monitoring, analysis, and intervention for individuals at risk of varicose veins.

1.1.2 System Modules:

The proposed system comprises four main modules: Sensor Integration, Data Processing and Analysis, Therapeutic Intervention, and Wireless Communication. Each module plays a vital role in enabling the system's functionality and achieving its objectives. The Sensor Integration module collects data from various sensors, the Data Processing and Analysis module analyzes sensor data to identify varicose vein risk factors, the Therapeutic Intervention module delivers targeted exercises based on the analysis, and the Wireless Communication module facilitates real-time data transmission and remote monitoring.

CHAPTER – 2
LITERATURE SURVEY

[1] R. K. Kumar, G. S, S. S, I. G. G and B. Sakthivel presented A Novel Method to Remediate Varicose Veins," 2023 9th International Conference on Advanced Computing and Communication Systems (ICACCS), Coimbatore, India, 2023.

Blood arteries called veins transport blood with little oxygen to the heart. In the veins of the lower limbs, the average bloodpressure is determined to be between 60 and 70 mmHg. However, leg veins struggle against gravity to force blood up towards the heart. Usually present in the damaged blood arteries of the lower extremities, varicose veins are convoluted, swollen veins that cause swelling. Due to the weakening of the valves, varicosities generally develop in the larger and lesser saphenous veins of the leg. Obesity and prolonged standing are the main causes of varicose vein disease. About 30% of adults in the nation have this issue, which can be problematic for both health and appearance. A person's productivity and quality of life are impacted by this, which affects people with a prevalence that rises with age. The traditional method compression stocking usage may not, however, always be able to shield patients from developing post-thrombotic syndrome. There are many surgical, endovascular and chemical treatments that enhance quality of life, but we propose a novel method for the detection and corrective action that completely eradicates the secondary complications of varicose veins, considering some limitations of conventional surgical intervention and the gradually rising potential in non-invasive alternative treatments. This study increased the likelihood of discovering varicose veins in the leg earlier and offers a solution. When a person has varicose veins, his or her leg experiences more pressure. Using this as the key component, a pressure sensor

is consequently attached to the leg. It continuously checks the leg's pressure; if there is any variation in that pressure, the suggested model takes over. With the aid of a motor air pump, the cuff that is attached to the leg begins to pump. As a result, it restores normal blood pressure and provides relief. When compared to the earlier approaches on the market, the suggested solution has a larger chance of being adopted.

[2] V. Rajathi, A. Chinnasamy, S. Abarna, J. Sunanthinii and S. Bharathy presented A Study On Varicose Vein into Ulcer," 2022 1st International Conference on Computational Science and Technology (ICCST), CHENNAI, India, 2022.

Varicose ulcers are the chronic wounds caused by the venous valves. The venous valves allow the blood flowing in backward direction and increases the pressure in the veins. It leads to varicose ulcer that occurs in the medial side of the leg with irregular edges in appearance. The improper circulation of blood in the legs affects the veins and causes severe pain when they turn to ulcer wounds. Lack of medical attention creates open wounds in the area of the ankle, backside of the leg, etc., The treatment is based on the damaged tissues of the wound. Based on the tissues the doctors start their procedure to heal the wound. This survey paper examines the stages of varicose ulcer, classification, causes of varicose ulcer, identification of tissues, treatment.

[3] L. Zhorina, E. Tolstoy and Y. Shishkin presented Thermography of Lower Limbs Varicose Veins: Mathematical Modeling," 2023 IEEE Ural-Siberian Conference on Computational Technologies in Cognitive Science, Genomics and Biomedicine (CSGB), Novosibirsk, Russian Federation, 2023.

Chronic venous insufficiency affects up to 50% of the working population of European countries. The World Health Organization refers to this cardiovascular disease as a “disease of civilization”. Varicose disease develops due to pathological changes in the vascular wall of the venous bed and are accompanied by irreversible changes in the surrounding tissues and body systems, an increase in temperature at the site of inflammation. Thermography is used to detect visually unobservable pathological veins. The purpose of this work is to mathematically model the heat distribution over the surface of the human shin in the presence of lower limbs varicose disease, compare the distribution obtained with the results of thermography. This is the first time such mathematical modeling of varicose veins has been performed. By mathematical modeling of the heat spread using the heat conduction equation the following results were obtained. The temperature at the vessels projection site on the shin posterior surface is the higher, the greater the perfusion coefficient in the veins. The temperature at the projection site of varicose vascular areas on the shin posterior surface decreases with a decrease in the perfusion rate in the muscle tissue in which they are located. The thermal manifestation of varicose vessels increases when simulating a change in their shape and inflammation of the vascular wall by introducing tortuosity, setting the minimum perfusion coefficient and increasing the temperature on its surface. The development of mathematical modeling of the lower limbs varicose veins requires further versatile interdisciplinary research.

[4] R. K, S. Saranya, C. K and A. P. M presented Pressure optimization system for Varicose Veins management," 2023 IEEE Region 10 Symposium (TENSYMP), Canberra, Australia, 2023.

Veins have one way valves inside them that open and close to keep the blood flowing towards the heart. Varicose veins represent a condition where the weak or damaged valves in the veins can cause blood to pool and even flow backwards. It is most common in pregnant women and the elderly. Compression therapy is an established treatment for varicose veins, where the applied pressure has to be in specific ranges in order to have an effective treatment. No method currently exists for monitoring the pressure applied in the leg while tying the compression bandage on the affected leg. Improper application of compression bandage can be ineffective or can cause issues such as skin irritation, discoloration, dent in skin and can also cause necrosis. This paper aims to provide a pressure indicating system with Force sensing resistor (FSR) and Light emitting diodes (LEDs) integrated with compression bandage for pressure optimization and management of varicose veins. The effectiveness of the pressure indicating system is validated by measuring the subject's vein length within a span of four weeks.

[5] M. A. Das, I. Anand, C. Nihal, K. Subramaniyam and A. Mohanarathinam presented Early Detection and Prevention of Varicose Veins using Embedded Automation and Internet of Things," 2023 5th International Conference on Inventive Research in Computing Applications (ICIRCA), Coimbatore, India, 2023.

Varicose veins are enlarged and twisted veins found in the subcutaneous tissues of the legs. Often, the blood valves in these veins are ineffective, resulting in blood reflux and symptoms of venous hypertension. Varicose veins are a chronic condition caused by improper blood circulation in the leg veins, disrupting the

flow of blood from the legs to the heart. This occurs when blood accumulates in the leg veins, a condition called stasis, which causes blood to clot in the wrong direction and damages the inlet valve. Prolonged periods of both standing and sitting, aging, and reduced physical activity are among the primary causes of this chronic condition. Moreover, treatment for varicose veins can be expensive. Early diagnosis of this issue enables straightforward treatment and provides relief from discomfort and tension for the patient. Embedded automation and IoT play a significant role in the early detection of this condition by identifying various stages of varicose veins and assisting healthcare practitioners. According to the suggested plan of action, a micro controller (ESP32), force sensor, tilt sensor, SpO2 sensor, pressure simulator (vibration motor), Peltier crystal, and compression stocking with micro motors are utilized to measure pressure variations and vibrations. The technique involves continuous monitoring of blood oxygen levels, leg force, and leg angle. Real-time updates are then transmitted to the relevant parties through the Internet of Things.

[6] M. R. Thanka, E. B. Edwin, R. P. Joy, S. J. Priya and V. Ebenezer presented Varicose Veins Chronic Venous Diseases Image Classification Using Multidimensional Convolutional Neural Networks," 2022 6th International Conference on Devices, Circuits and Systems (ICDCS), Coimbatore, India, 2022.

Varicose vain is a chronic disease which occurs when leg vein blood circulation is not working properly. This cause problem in the blood circulation from leg to heart. This occurs because of blood get collected in the leg veins and this condition is said to as stasis which leads blood to drop backward and damage the valve. Prolong standing or sitting, aging, lack of mobility are some of the main reason for this chronic disease. The cost for treatment is also too high. Early

detection of this problem can be treated easily and help the patient relief from pain and stress. Deep learning technique plays a major role in early prediction and to identify the different stages of varicose vein and assist the clinician. Here the proposed model developed through multidimensional deep convolutional neural network outperforms doctor's diagnosis and provide better accuracy of 99.9% in classifying the different stages of CVI through which the patient can be treated appropriately.

[7] K. Haritha, B. Janney J, M. Hemalatha, T. Sudhakar, J. Premkumar and A. S. S presented Varicose Vein Diagnosis System and Therapy: A Review," 2022 International Conference on Computer, Power and Communications (ICCPC), Chennai, India, 2022.

Varicose veins are swollen and twisted veins that occurs on the legs. It is also known as varicose or varicosities. They appear in red or bluish - purple color. They are painful. It usually occurs when veins are weak, dilated, enlarged and overfilled with blood. It usually occurs in women. Varicosed veins appears on superficial layer. It mostly affects the veins in legs and occurs mainly due to pressure in the lower body veins. It is developed when the damaged valve in the vein allows blood to flow in opposite direction. So, it is necessary to develop a system which helps to diagnose and gives therapy to varicose veins.

[8] D. R, P. K, S. R. R, V. N, M. Anisha and G. M presented Air Compression Massage System for Chronic Vein Disorders," 2022 International Conference on Automation, Computing and Renewable Systems (ICACRS), Pudukkottai, India, 2022.

Pneumatic air compression massaging system widely helps to reduce the appearance and painful symptoms associated with chronic veins in some people. Compression stockings are frequently advised by medical professionals to enhance circulation, stop varicose veins from getting worse, and alleviate pain or discomfort. Leg chronic venous illness affects a large portion of the world's population. Varicose vein prevalence estimates range greatly, from 2 to 56% in males and 1-60% in females aged 18-64 years. Chronic vein disorders can be fatal for patients with diabetes if left untreated. The proposed device massages the lower limb very gently and carefully by providing optimal pressure. The pressure given to the cuff is controlled by the hand-operated controller. This devised technique improves circulation which involves short strokes to move blood from the valves to the veins. The ankle and lower leg get rhythmic air pressure from these unique pressure cuffs. They can minimize leg edema and aid in blood flow improvement.

[9] L. V. Zhorina and E. A. Tolstoy presented Mathematical Modeling of the Thermographic Image of the Lower Limbs Varicose Disease in Humans," 2023 IEEE XVI International Scientific and Technical Conference Actual Problems of Electronic Instrument Engineering (APEIE), Novosibirsk, Russian Federation, 2023.

Chronic cardiovascular diseases are classified as "diseases of civilization", which the World Health Organization identifies as a separate group. Lower limb varicose veins develop due to pathological changes in the vascular wall of the venous bed and are accompanied by irreversible changes in the surrounding tissues and body systems, an increase in temperature at the site of inflammation. Detection of visually unobservable pathological veins is possible with the help of thermography. It allows you to reconstruct the deformed venous bed, as well as

to build thermographic profiles, with which it is possible to compare data from the preoperative examination with the data from postoperative examinations. In this work, mathematical modeling of the distribution of heat over the surface of the human lower leg in the presence of varicose disease and comparison of the obtained distribution with the results of real thermography were performed. The simulation results are presented in the form of thermograms of the lower leg surface in normal and pathological conditions and thermographic profiles. The constructed mathematical model of thermal processes occurring in the lower limbs varicose disease in humans is in sufficient agreement with the actually observed thermographic picture. This is the first time such mathematical modeling of varicose veins has been performed.

[10] M. Viqar, V. Madjarova, V. Baghel and E. Stoykova presented Opto-UNet: Optimized UNet for Segmentation of Varicose Veins in Optical Coherence Tomography," 2022 10th European Workshop on Visual Information Processing (EUVIP), Lisbon, Portugal, 2022.

Human veins are important for carrying the blood from the body-parts to the heart. The improper functioning of the human veins may arise from several venous diseases. Varicose vein is one such disease wherein back flow of blood can occur, often resulting in increased venous pressure or restricted blood flow due to changes in the structure of vein. To examine the functional characteristics of the varicose vein, it is crucial to study the physical and bio mechanical properties of the vein. This work proposes a segmentation model Opto-UNet, for segmenting the venous wall structure. Optical Coherence Tomography system is used to acquire images of varicose vein. As the extracted vein is not uniform in shape, hence adequate method of segmentation is required to segment the venous wall. Opto-UNet model is based on the U-Net architecture wherein a new block

is integrated into the architecture, employing atrous and separable convolution to extract spatially wide-range and separable features maps for attaining advanced performance. Furthermore, the depth wise separable convolution significantly reduces the complexity of the network by optimizing the number of parameters. The model achieves accuracy of 0.9830, sensitivity of 0.8425 and specificity of 0.9980 using 8.54 million number of parameters. These results indicate that model is highly adequate in segmenting the varicose vein wall without deteriorating the segmentation quality along with reduced complexity.

CHAPTER – 3

EXISTING SYSTEM

The existing systems for detecting and preventing varicose veins have evolved over time, adapting to advancements in technology and medical understanding. Early systems primarily relied on manual examination by healthcare professionals, often detecting varicose veins only after they had progressed to a noticeable stage. As technology progressed, non-invasive imaging techniques such as ultrasound became widely used for diagnosis, offering greater accuracy and detail in assessing vein health. However, these imaging methods are typically utilized after symptoms have already manifested, limiting their effectiveness in early detection and prevention.

In recent years, there has been a growing interest in proactive approaches to vascular health, aiming to identify risk factors and intervene before symptoms develop. One notable advancement is the use of wearable sensors and monitoring devices to track physiological parameters associated with varicose veins. These devices typically focus on factors such as temperature differentials, muscle activity, and blood flow dynamics, which can provide valuable insights into vein health and function. By continuously monitoring these parameters, wearable devices offer the potential for early detection of varicose vein development, allowing for timely intervention to prevent progression. However, existing wearable devices for varicose vein detection and prevention still face several limitations. Many current devices are limited in their ability to provide continuous, real-time monitoring, relying instead on periodic measurements or user-initiated assessments. This can lead to gaps in data collection and limited opportunities for early intervention. Additionally, the accuracy and reliability of wearable sensors can vary, depending on factors such as sensor placement, user activity, and

environmental conditions. Ensuring consistent and accurate data collection is essential for the effectiveness of these devices in detecting varicose veins and guiding preventative measures.

Another challenge facing existing systems is the lack of personalized intervention strategies. While wearable devices can provide valuable data on physiological parameters, translating this data into actionable insights requires careful analysis and interpretation. Currently, many wearable devices provide generic recommendations for lifestyle modifications or exercise routines, which may not be tailored to individual risk factors or preferences. Personalized intervention strategies that take into account factors such as age, gender, medical history, and lifestyle habits could enhance the effectiveness of varicose vein prevention efforts. Furthermore, the integration of wearable devices into existing healthcare systems presents logistical challenges. Healthcare professionals must be trained to interpret data from wearable sensors and incorporate it into patient care plans effectively. Additionally, issues related to data privacy, security, and regulatory compliance must be addressed to ensure the safe and ethical use of wearable technology in healthcare settings. Collaboration between technology developers, healthcare providers, regulators, and patients is essential to overcoming these challenges and realizing the full potential of wearable devices for varicose vein detection and prevention.

Despite these challenges, the future outlook for wearable technology in varicose vein detection and prevention is promising. Advances in sensor technology, data analytics, and artificial intelligence are driving innovation in wearable devices, enabling more accurate and personalized approaches to vascular health monitoring. Integration with other health monitoring systems, such as electronic health records and telemedicine platforms, could further enhance the utility of wearable devices in varicose vein prevention efforts. With continued research,

development, and collaboration, wearable technology has the potential to revolutionize the way varicose veins are detected and prevented, improving patient outcomes and reducing healthcare costs in the process.

CHAPTER 4

PROPOSED SYSTEM

The proposed system represents an innovative approach to early detection and prevention of varicose veins through the development of a rehabilitation monitoring and exercise device. This section provides a detailed overview of the system's design, components, functionality, and potential impact on varicose vein management.

4.1 Overview of the Proposed System

The proposed system integrates sensor technology with therapeutic interventions to monitor varicose vein risk factors and deliver targeted exercises for prevention and symptom management. Key components of the system include DHT11 sensors for temperature monitoring, force sensors for detecting leg movements, and a central processing unit (CPU) for data analysis and intervention control. By continuously monitoring physiological parameters and providing timely interventions, the system aims to enhance patient well-being and reduce the burden of varicose vein-related complications.

4.2 Functionality of the Proposed System

The proposed system operates through a series of integrated modules designed to monitor varicose vein risk factors and deliver targeted interventions. The sensor integration module collects data from DHT11 sensors and force sensors, transmitting it to the CPU for analysis. The data processing and analysis module utilizes algorithms to analyze temperature differentials, muscle activity patterns, and other physiological parameters to detect varicose vein risk factors. The therapeutic intervention module activates a motor based on the analysis of sensor

data, delivering targeted exercises to prevent blood flow obstructions and alleviate symptoms associated with varicose veins.

4.3 Key Features

The proposed system offers several key features designed to enhance its effectiveness in varicose vein management. These features include real-time monitoring of physiological parameters, personalized interventions tailored to individual patient profiles, and wireless communication for remote monitoring by healthcare professionals or caregivers. Additionally, the system incorporates feedback mechanisms to adjust intervention intensity based on real-time physiological responses, ensuring optimal therapeutic outcomes.

4.4 Implementation

The implementation of the proposed system involves the integration of hardware and software components, calibration of sensors, and testing of algorithms for data analysis and intervention control. The system can be deployed in clinical settings, rehabilitation centers, or used at home under the guidance of healthcare professionals. Patients can benefit from regular monitoring, timely interventions, and personalized therapeutic exercises to manage varicose vein symptoms and prevent complications.

4.5 Potential Impact

The proposed system has the potential to revolutionize varicose vein management by providing early detection and targeted interventions for prevention and symptom management. By continuously monitoring physiological parameters and delivering personalized exercises, the system aims to improve patient outcomes,

enhance quality of life, and reduce healthcare costs associated with varicose vein-related complications. Moreover, the system can empower patients to take an active role in their healthcare and promote proactive measures for venous health maintenance.

4.6 Software Requirements

- Embedded C
- Arduino IDE
- Matlab

4.7 Hardware Requirements

- Power Supply Unit
- Power Supply Adapter
- Node MCU
- Force Sensor
- IR Sensor
- L293d
- Motor
- Camera

4.8 BLOCK DIAGRAM

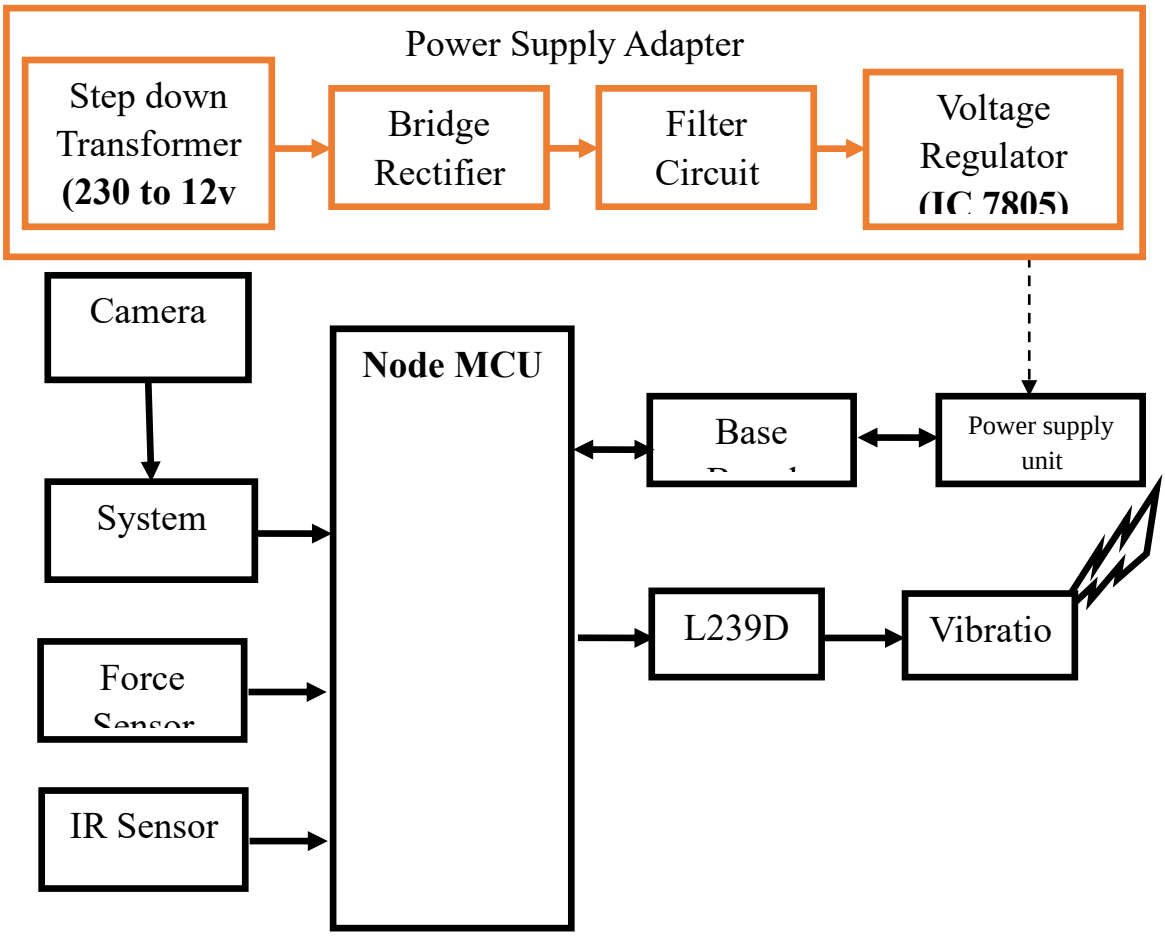


Figure 4.1 Proposed Block Diagram

4.8.1 POWER SUPPLY

Power supply is a reference to a source of electrical power. A device or system that supplies electrical or other types of energy to an output load or group of loads

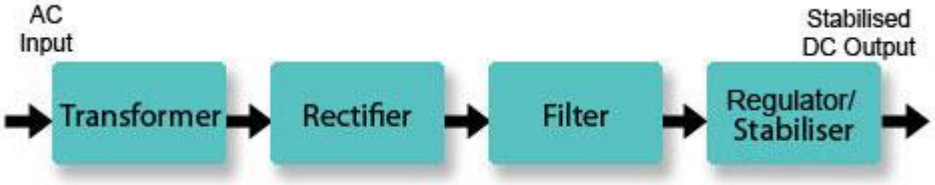


Figure 4.2 Power Supply flow chart

fis called a power supply unit or PSU. The term is most commonly applied to electrical energy supplies, less often to mechanical ones, and rarely to others.

4.8.2 TRANSFORMERS

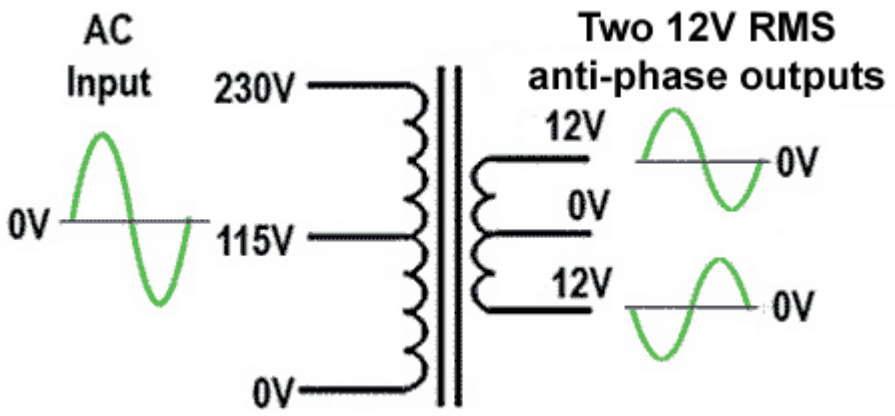


Figure 4.3 Transformers

Basic power supply the input power transformer has its primary winding connected to the mains (line) supply. A secondary winding, electro-magnetically coupled but electrically isolated from the primary is used to obtain an AC voltage of suitable amplitude, and after further processing by the PSU, to drive the electronics circuit it is to supply.

The transformer stage must be able to supply the current needed. If too small a transformer is used, it is likely that the power supply's ability to maintain full output voltage at full output current will be impaired. With too small a transformer, the losses will increase dramatically as full load is placed on the transformer. As the transformer is likely to be the most costly item in the power supply unit, careful consideration must be given to balancing cost with likely

current requirement. There may also be a need for safety devices such as thermal fuses to disconnect the transformer if overheating occurs, and electrical isolation between primary and secondary windings, for electrical safety.

4.8.3 THE RECTIFIER STAGE

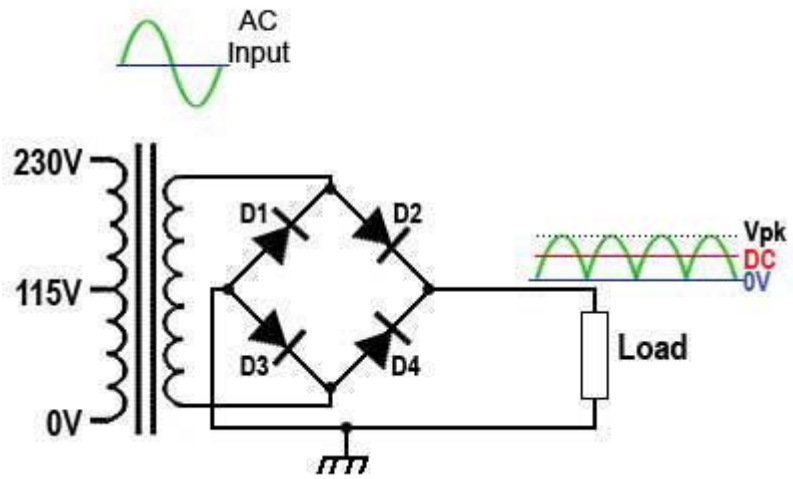


Figure 4.4 Bridge Rectifier

Rectifier circuit is used, to convert the AC input is converted to DC. The full wave bridge rectifier uses four diodes arranged in a bridge circuit to give full wave rectification without the need for a centre-tapped transformer. An additional advantage is that, as two diodes are conducting at any one time, the diodes need only half the reverse breakdown voltage capability of diodes used for half and conventional full wave rectification. The bridge rectifier can be built from separate diodes or a combined bridge rectifier can be used.

The current paths on positive and negative half cycles of the input. It can be seen that on each half cycle, opposite pairs of diodes conduct, but the current through the load remains in the same polarity for both half cycles.

4.8.4 FILTER

A typical power supply filter circuit can be best understood by dividing the circuit into two parts, the reservoir capacitor and the low pass filter. Each of these parts contributes to removing the remaining AC pulses, but in different ways.

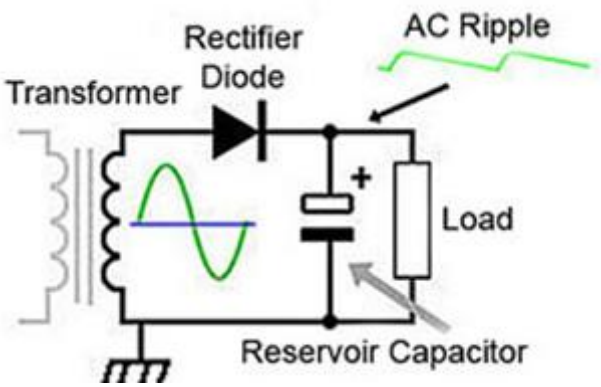


Figure 4.5 Electrolytic capacitor

Electrolytic capacitor used as a reservoir capacitor, so called because it acts as a temporary storage for the power supply output current. The rectifier diode supplies current to charge a reservoir capacitor on each cycle of the input wave. The reservoir capacitor is large electrolytic, usually of several hundred or even a thousand or more microfarads, especially in mains frequency PSUs. This very large value of capacitance is required because the reservoir capacitor, when charged, must provide enough DC to maintain a steady PSU output in the absence of an input current; i.e. during the gaps between the positive half cycles when the rectifier is not conducting.

The action of the reservoir capacitor on a half wave rectified sine wave. During each cycle, the rectifier anode AC voltage increases towards Vpk. At some point close to Vpk the anode voltage exceeds the cathode voltage, the rectifier conducts and a pulse of current flows, charging the reservoir capacitor to the value of Vpk.

Once the input wave passes Vpk the rectifier anode falls below the capacitor voltage, the rectifier becomes reverse biased and conduction stops. The load circuit is now supplied by the reservoir capacitor alone.

Of course, even though the reservoir capacitor has large value, it discharges as it supplies the load, and its voltage falls, but not by very much. At some point during the next cycle of the mains input, the rectifier input voltage rises above the voltage on the partly discharged capacitor and the reservoir is re-charged to the peak value Vpk again.

4.8.5 REGULATOR

Voltage regulator ICs are available with fixed or variable output voltages. They are also rated by the maximum current they can pass. Negative voltage regulators are available, mainly for use in dual supplies. Most regulators include some automatic protection from excessive current and overheating.

The LM78XX series of three terminal regulators is available with several fixed output voltages making them useful in a wide range of applications. One of these is local on card regulation, eliminating the distribution problems associated with single point regulation. The voltages available allow these regulators to be used in logic systems, instrumentation, HiFi, and other solid state electronic equipment. Although designed primarily as fixed voltage regulators these devices can be used with external components to obtain adjustable voltages and current.

1. Positive regulator

    1. input pin
    2. ground pin
    3. output pin

2. It regulates the positive voltage

3. Negative regulator

4. Ground pin

5. Input pin

6. Output pin

It regulate the negative voltage. The regulated DC output is very smooth with no ripple. It is suitable for all electronic circuits.

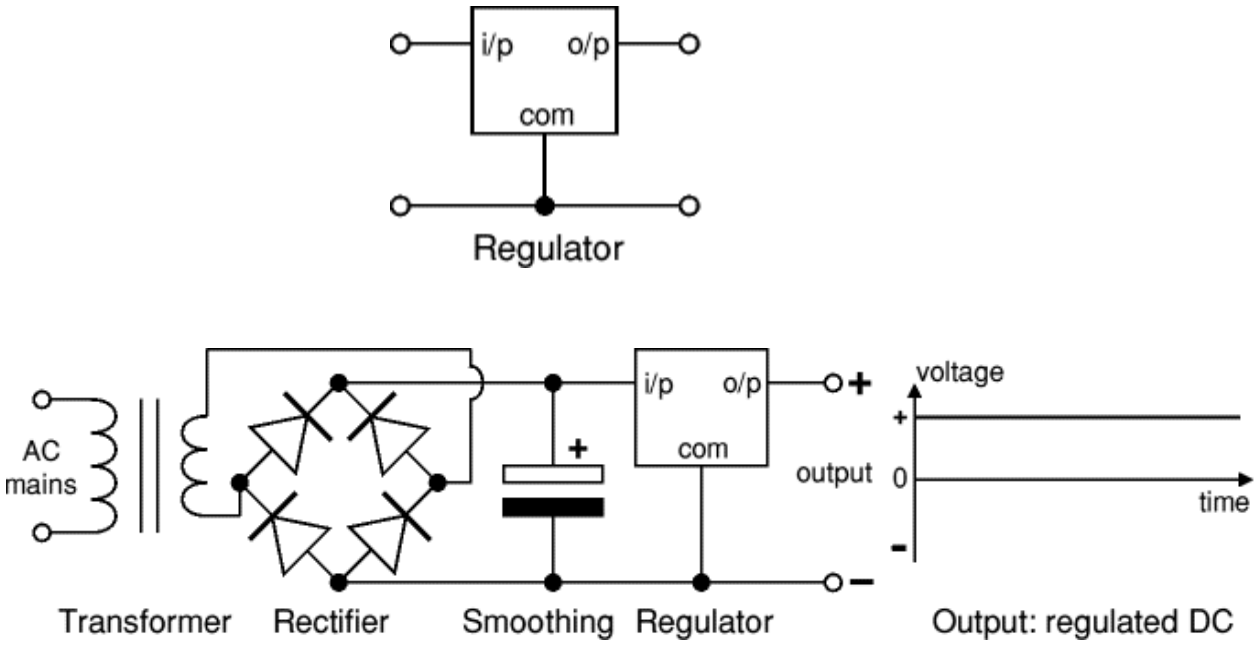


Figure 4.6 Regulator

4.8.6 DC MOTOR

A DC motor is any of a class of electrical machines that converts direct current electrical power into mechanical power. The most common types rely on the forces produced by magnetic fields.

4.8.6.1 PRINCIPLE OF DC MOTOR

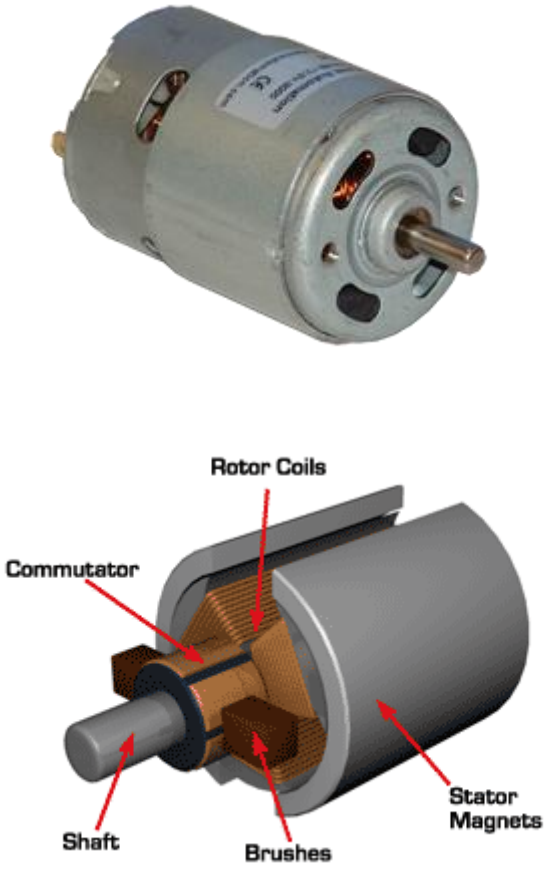


Figure 4.7 DC Motor

An Electric DC motor is a machine which converts electric energy into mechanical energy. The working of DC motor is based on the principle that when a current-carrying conductor is placed in a magnetic field, it experiences a mechanical force. The direction of mechanical force is given by Fleming's Left-hand Rule and its magnitude is given by F BIl Newton.

There is no basic difference in the construction of a DC generator and a DC motor. In fact, the same D.C. machine can be used interchangeably as a generator or as a motor. Like generators DC motors are also classified in to shunt-wound, series-wound and compound-wound.

A coil of wire with a current running through it generates an electromagnetic field aligned with the center of the coil. The direction and magnitude of the magnetic field produced by the coil can be changed with the direction and magnitude of the current flowing through it.

DC motors are seldom used in ordinary applications because all electric supply companies furnish alternating current. However, for special applications such as in steel mills, mines and electric trains, it is advantageous to convert alternating current into direct current in order to use dc motors. The reason is that speed/torque characteristics of d.c. motors are much more superior to that of a.c. motors. Therefore, it is not surprising to note that for industrial drives, d.c. motors are as popular as 3-phase induction motors.

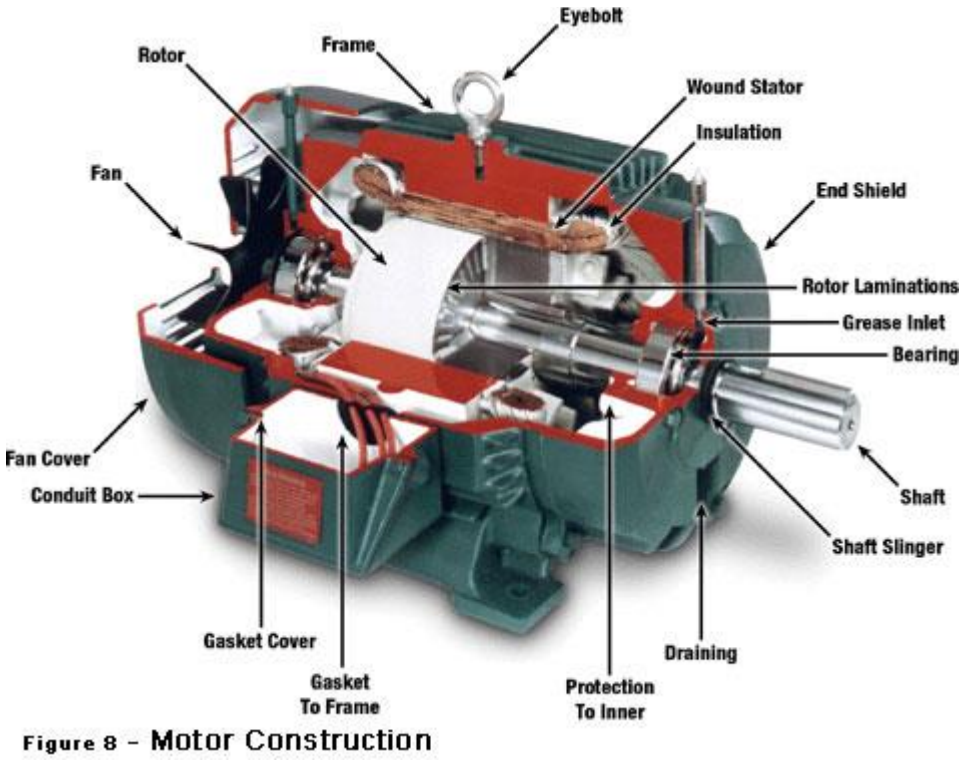


Figure 4.8 Motor Construction

A machine which transforms the DC power into mechanical power is called as a DC motor. Its operation relies on the principle that once a current carrying conductor is placed in a very magnetic field, the conductor experiences a mechanical force. The direction of this force is given by Fleming's left hand rule and magnitude is given by;

F=BIl Newton's

Fundamentally, there's no constructional distinction between a DC motor and a DC generator. The same DC motor will be run as a generator or motor.

It is based on the principle that when a current-carrying conductor is placed in a magnetic field, it experiences a mechanical force whose direction is given by Fleming's Left-hand rule and whose magnitude is given by

Force, **F = B I l** newton

Where B is the magnetic field in weber/m^2.

I is the current in amperes and

l is the length of the coil in meter.

The force, current and the magnetic field are all in different directions.

4.8.6.2 WORKING OF DC MOTOR

Consider a part of a multipolar d.c. motor as shown in Figure below.

The armature conductors carry currents. All conductors under N-pole carry currents in one direction while all the conductors under S-pole carry currents in the opposite direction.

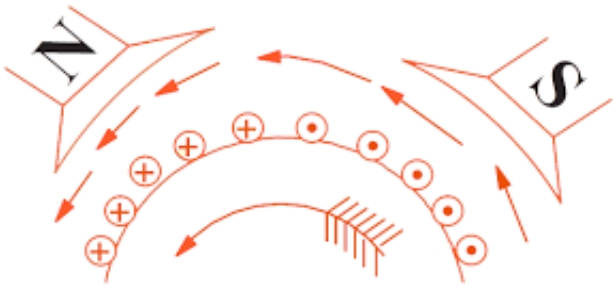


Figure 4.9 Armature Conductor

Suppose the conductors under N-pole carry currents into the plane of the paper and those under S-pole carry currents out of the plane of the paper as shown in Figure. Since each armature conductor is carrying current and is placed in the magnetic field, mechanical force acts on it. On applying Fleming's left hand rule, it is clear that force on each conductor is tending to rotate the armature in anticlockwise direction.

The armature conductors carry currents. All conductors below N-pole carry currents in one direction whereas all the conductors below S-pole carry currents within the opposite direction. Assume the conductors below N-pole carry currents into the plane of the paper and those below S-pole carry currents out of the plane of the paper which is shown in Fig. Since each armature conductor is carrying current and is placed within the magnetic field, mechanical force acts on that. Stating to the Fig and applying Fleming's left hand rule, it's clear that force on every conductor is tending to rotate the armature in anticlockwise direction. All these forces add along to provide a driving torsion that sets the armature rotating.

4.8.6.3 BRUSHED DC ELECTRIC MOTOR

The brushed DC electric motor generates torque directly from DC power supplied to the motor by using internal commutation, stationary magnets (permanent or electromagnets), and rotating electrical magnets.

Advantages of a brushed DC motor include low initial cost, high reliability, and simple control of motor speed. Disadvantages are high maintenance and low life-span for high intensity uses. Maintenance involves regularly replacing the carbon brushes and springs which carry the electric current, as well as cleaning or replacing the commutate. These components are necessary for transferring electrical power from outside the motor to the spinning wire windings of the rotor inside the motor. Brushes consist of conductors.

4.8.6.4 BRUSHLESS DC ELECTRIC MOTOR

Typical brushless DC motors use one or more permanent magnets in the rotor and electromagnets on the motor housing for the stator. A motor controller converts DC to AC. This design is mechanically simpler than that of brushed motors because it eliminates the complication of transferring power from outside the motor to the spinning rotor.

The motor controller can sense the rotor's position via Hall effect sensors or similar devices and can precisely control the timing, phase, etc., of the current in the rotor coils to optimize torque, conserve power, regulate speed, and even apply some braking. Advantages of brushless motors include long life span, little or no maintenance, and high efficiency. Disadvantages include high initial cost, and more complicated motor speed controllers. Some such brushless motors are sometimes referred to as "synchronous motors" although they have no external power supply to be synchronized with, as would be the case with normal AC synchronous motors.

4.8.6.5 ELECTROMAGNETIC MOTORS

The total amount of current sent to the coil, the coil's size and what it's wrapped around dictate the strength of the electromagnetic field created.

The sequence of turning a particular coil on or off dictates what direction the effective electromagnetic fields are pointed. By turning on and off coils in sequence a rotating magnetic field can be created. These rotating magnetic fields interact with the magnetic fields of the magnets (permanent or electromagnets) in the stationary part of the motor (stator) to create a force on the armature which causes it to rotate. In some DC motor designs the stator fields use electromagnets to create their magnetic fields which allow greater control over the motor.

If external power is applied to a DC motor it acts as a DC generator, a dynamo. This feature is used to slow down and recharge batteries on hybrid car and electric cars or to return electricity back to the electric grid used on a street car or electric powered train line when they slow down. This process is called regenerative braking on hybrid and electric cars. In diesel electric locomotives they also use their DC motors as generators to slow down but dissipate the energy in resistor stacks. Newer designs are adding large battery packs to recapture some of this energy.

4.8.6.6 APPLICATIONS OF DC MOTORS

D.C SHUNT MOTORS

It is a constant speed motor.Where the speed is required to remain almost constant from no-load to full load.Where the load has to be driven at a number of speeds and any one of which is nearly constant.

INDUSTRIAL USE:

- Lathes
- Drills

- Boring mills
- Shapers
- Spinning and weaving machines.

D.C SERIES MOTOR:

It is a variable speed motor. The speed is low at high torque. At light or no load ,the motor speed attains dangerously high speed. The motor has a high starting torque.(elevators, electric traction)

INDUSTRIAL USES:

- Electric traction
- Cranes
- Elevators
- Air compressor
- Vacuum cleaner
- Hair drier
- Sewing machine

4.8.6.7 D.C COMPOUND MOTOR:

Differential compound motors are rarely used because of its poor torque characteristics.

Industrial uses:

- Presses Shears
- Reciprocating machine.

4.8.7 NODE MCU

NodeMCU is an open source IoT platform.It includes firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware, which is based on the ESP-12 module. The term "NodeMCU" by default refers to the firmware rather than the dev kits. The firmware uses the Lua scripting language. It is based on the eLua project and built on the Espressif Non-OS SDK for ESP8266. It uses many open source projects, such as Lua-cjson and spiffs. LUA based interactive firmware for Expressif ESP8622 Wi-Fi SoC, as well as an open source hardware board that contrary to the $3 ESP8266 Wi-Fi modules includes a CP2102 TTL to USB chip for programming and debugging, is breadboard-friendly, and can simply be powered via its micro USB port.

4.8.7.1 FEATURES

- Wi-Fi Module – ESP-12E module similar to ESP-12 module but with 6 extra GPIOs.
- USB – micro USB port for power, programming and debugging
- Headers – 2x 2.54mm 15-pin header with access to GPIOs, SPI, UART, ADC, and power pinsMisc – Reset and Flash buttons
- Power – 5V via micro USB port
- Dimensions – 49 x 24.5 x 13mm

4.8.7.2 Arduino-like hardware IO

Advanced API for hardware IO, which can dramatically reduce the redundant work for configuring and manipulating hardware. Code like Arduino, but interactively in Lua script.

4.8.7.3 Nodejs style network API

Event-driven API for network applications, which facilitates developers writing code running on a 5mm*5mm sized MCU in Nodejs style. Greatly speed up your IOT application developing process.

4.8.7.4 Lowest cost WI-FI

Less than $2 WI-FI MCU ESP8266 integrated and easy to prototyping development kit. We provide the best platform for IOT application development at the lowest cost.

4.8.7.5 Development Kit

The Development Kit based on ESP8266, integrated GPIO, PWM, IIC, 1-Wire and ADC all in one board. Power your development in the fastest way combining with NodeMcu Firmware!

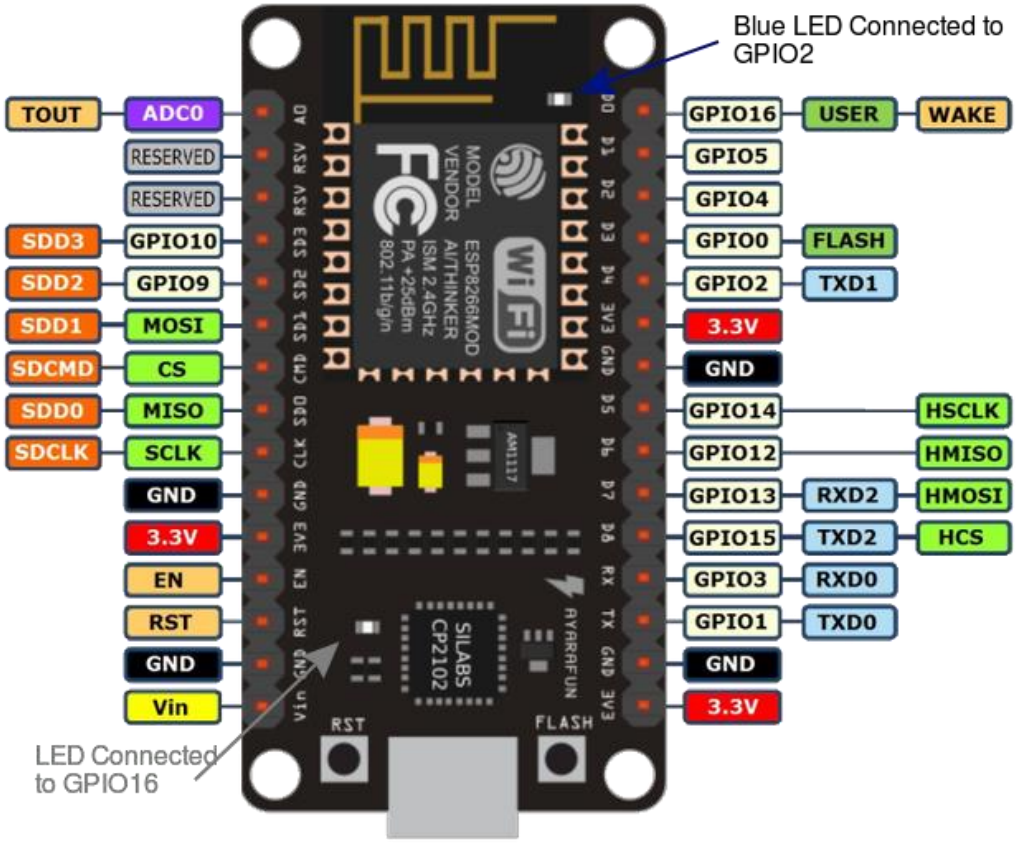


Figure 4.10 Node MCU

* The ESP8266 chip requires 3.3V power supply voltage. It should not be powered with 5 volts like other arduino boards.

* NodeMCU ESP-12E dev board can be connected to 5Vusing micro USB connector or Vin pin available on board.

* The I/O pins of ESP8266 communicate or input/output max 3.3V only. i.e. the pins are NOT 5V tolerant inputs.

4.8.8 FORCE SENSOR

A force-sensing resistor is a material whose resistance changes when a force or pressure is applied. They are also known as force-sensitive resistor and are sometimes referred to by the initialise FSR.

Figure 4.11 Force Sensor

Force-sensing resistors consist of a conductive polymer, which changes resistance in a predictable manner following application of force to its surface. They are normally supplied as a polymer sheet or ink that can be applied by screen printing. The sensing film consists of both electrically conducting and non-conducting particles suspended in matrix. The particles are sub-micrometre sizes, and are formulated to reduce the temperature dependence, improve mechanical properties and increase surface durability. Applying a force to the surface of the sensing film causes particles to touch the conducting electrodes, changing the resistance of the film. As with all resistive based sensors, force-sensing resistors require a relatively simple interface and can operate satisfactorily in moderately hostile environments. Compared to other force sensors, the advantages of FSRs are their size,low cost and good shock resistance.

4.8.8.1USES

Force-sensing resistors are commonly used to create pressure-sensing buttons and have applications in many fields, including musical instruments, car occupancy sensors, Foot probation systems and portable electronics.

4.8.8.2CUSTOM FORCE SENSORS

The unique construction and ink characteristics of Flex Force sensors enable Tekscan to create custom-designed force sensing resistor sensors to meet your specific OEM needs.

Flexiforce Sensors Are Ideal For Oem Products Due To Our Ability To Customize

- **Geometry** - sensors can be designed in a variety of shapes and sizes to meet your application and product needs.
- **Ink technology** - we offer three pressure-sensitive ink variations to meet your application and product needs: standard, enhanced, and high temperature.
- **Integration support** - our team of mechanical, electrical, and application engineers are here to ensure a successful product integration.

4.8.9 L293D

L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motor with a single L293D IC. Dual H-bridge *Motor Driver integrated circuit* (*IC*).

4.8.9.1 CONCEPT

It works on the concept of H-bridge. H-bridge is a circuit which allows the voltage to be flown in either direction. As you know voltage need to change its direction for being able to rotate the motor in clockwise or anticlockwise direction, Hence H-bridge IC are ideal for driving a DC motor.

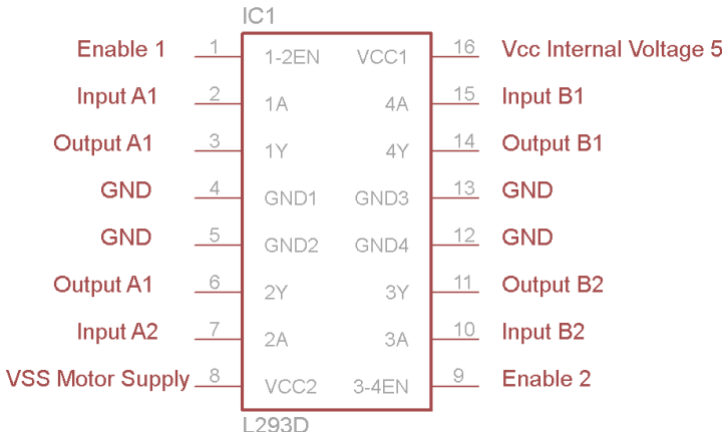
In a single L293D chip there are two h-Bridge circuit inside the IC which can rotate two dc motor independently. Due its size it is very much used in robotic

application for controlling DC motors. Given below is the pin diagram of a L293D motor controller.

There are two Enable pins on l293d. Pin 1 and pin 9, for being able to drive the motor, the pin 1 and 9 need to be high. For driving the motor with left H-bridge you need to enable pin 1 to high. And for right H-Bridge you need to make the pin 9 to high. If anyone of the either pin1 or pin9 goes low then the motor in the corresponding section will suspend working. It's like a switch.

TIP: you can simply connect the pin16 VCC (5v) to pin 1 and pin 9 to make them high.

Figure 4.12 L293D PIN DIAGRAM



4.8.9.2 WORKING OF L293D

There are 4 input pins for l293d, pin 2,7 on the left and pin 15 ,10 on the right as shown on the pin diagram. Left input pins will regulate the rotation of motor connected across left side and right input for motor on the right hand side. The motors are rotated on the basis of the inputs provided across the input pins as LOGIC 0 or LOGIC 1.

In simple you need to provide Logic 0 or 1 across the input pins for rotating the motor.

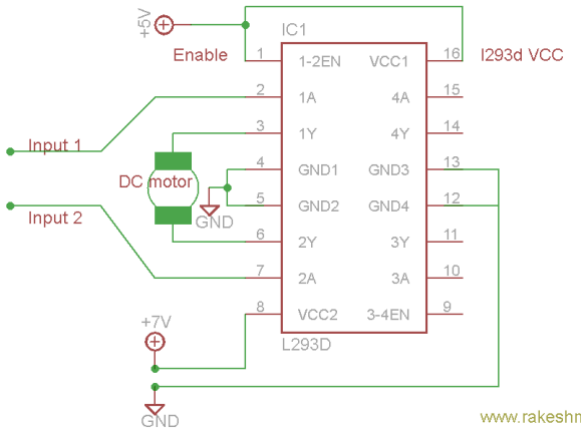
L293D Logic Table.

Lets consider a Motor connected on left side output pins (pin 3,6). For rotating the motor in clockwise direction the input pins has to be provided with Logic 1 and Logic 0.

- **Pin 2 = Logic 1** and **Pin 7 = Logic 0** | Clockwise Direction
- **Pin 2 = Logic 0** and **Pin 7 = Logic 1** | Anticlockwise Direction
- **Pin 2 = Logic 0** and **Pin 7 = Logic 0** | Idle [No rotation] [Hi-Impedance state]
- **Pin 2 = Logic 1** and **Pin 7 = Logic 1** | Idle [No rotation]

In a very similar way the motor can also operate across input pin 15,10 for motor on the right hand side.

Figure 4.13 Circuit Diagram For l293d motor driver IC controller.



CHAPTER 5

SYSTEM IMPLEMENTATION

5.1 CODING

```
#include <ESP8266WiFi.h>

#include <SPI.h>

#include <DHT.h>


#define DHTPIN D5

#define DHTTYPE DHT11


DHT dht(DHTPIN, DHTTYPE);


const int forceSensorPin = A0;

const int irSensorPin = D1;

const int buzzerPin = D2;

const int motorPin1 = D3;

const int motorPin2 = D4;


const char* ssid = "YOUR_WIFI_SSID";

const char* password = "YOUR_WIFI_PASSWORD";
```

```
void setup() {
  Serial.begin(115200);

  pinMode(forceSensorPin, INPUT);
  pinMode(irSensorPin, INPUT);
  pinMode(buzzerPin, OUTPUT);
  pinMode(motorPin1, OUTPUT);
  pinMode(motorPin2, OUTPUT);

  dht.begin();

  // Connect to Wi-Fi
  WiFi.begin(ssid, password);
  while (WiFi.status() != WL_CONNECTED) {
    delay(1000);
    Serial.println("Connecting to WiFi..");
  }
  Serial.println("Connected to WiFi");
}

void loop() {
  // Read sensor values
```

```
  float temperature = dht.readTemperature();
  float humidity = dht.readHumidity();
  int forceValue = analogRead(forceSensorPin);
  int irValue = digitalRead(irSensorPin);

  // Print sensor values
  Serial.print("Temperature: ");
  Serial.print(temperature);
  Serial.print(" °C, Humidity: ");
  Serial.print(humidity);
  Serial.print("%, Force Value: ");
  Serial.print(forceValue);
  Serial.print(", IR Value: ");
  Serial.println(irValue);

  // Check sensor readings and act accordingly
  if (temperature > 25) {
    digitalWrite(buzzerPin, HIGH); // Activate buzzer if temperature is above
25°C
  } else {
    digitalWrite(buzzerPin, LOW);
  }
```

```
  if (forceValue > 500) {
    digitalWrite(motorPin1, HIGH); // Rotate motor in one direction if force value is above 500
    digitalWrite(motorPin2, LOW);
  } else {
    digitalWrite(motorPin1, LOW);
    digitalWrite(motorPin2, LOW);
  }

  delay(1000); // Delay for stability
}
```

CHAPTER 6

RESULT AND DISCUSSION

The results and discussions of studies on varicose vein detection and prevention encompass a wide range of approaches, from traditional diagnostic methods to cutting-edge technological innovations. One prominent area of research involves the use of non-invasive imaging techniques, such as ultrasound and venous Doppler, to assess vein health and detect abnormalities. These imaging modalities provide detailed anatomical information about the venous system, allowing clinicians to visualize varicose veins and assess their severity. Studies have shown that ultrasound is highly sensitive and specific for detecting varicose veins, with the ability to identify venous reflux, valve incompetence, and other underlying pathologies. Venous Doppler, which measures blood flow velocity and direction, can further enhance diagnostic accuracy by assessing hemodynamic changes associated with varicose veins.

In addition to imaging techniques, researchers have explored the use of biomarkers and genetic markers for varicose vein detection and risk assessment. Biomarkers such as inflammatory cytokines, endothelial dysfunction markers, and oxidative stress markers have been implicated in the pathogenesis of varicose veins and may serve as diagnostic indicators of disease progression. Genetic studies have identified several gene polymorphisms associated with varicose vein susceptibility, providing insights into the underlying genetic factors contributing to vein wall weakness and valve dysfunction. While biomarker and genetic marker research is still in its infancy, these approaches hold promise for identifying individuals at increased risk of developing varicose veins and may inform targeted prevention strategies.

A growing body of research has also focused on lifestyle interventions and behavioral modifications for varicose vein prevention. Studies have shown that regular physical activity, weight management, and avoiding prolonged standing or sitting can reduce the risk of developing varicose veins. Exercise programs that promote muscle pump activity and improve venous return have been shown to be particularly effective in preventing venous insufficiency and reducing the severity of varicose veins. Dietary interventions, such as increasing fiber intake and reducing sodium consumption, may also help improve venous tone and reduce venous pressure. Lifestyle modifications aimed at reducing risk factors for varicose veins can play a crucial role in primary prevention and may complement other treatment modalities in managing the condition.

Furthermore, technological advancements have led to the development of wearable devices and mobile applications for varicose vein monitoring and management. Wearable sensors capable of measuring temperature differentials, muscle activity, and blood flow dynamics offer the potential for continuous, real-time monitoring of vein health. These devices can provide early detection of varicose vein development and prompt intervention to prevent progression. Mobile applications that track symptoms, monitor lifestyle habits, and provide personalized recommendations for vein health management can empower individuals to take control of their vascular health and adhere to preventive measures. Integrating wearable technology and mobile health solutions into existing healthcare systems may improve access to varicose vein prevention resources and facilitate remote monitoring and telemedicine consultations for patients with varicose veins.

Moreover, the integration of artificial intelligence (AI) and machine learning algorithms into varicose vein detection and prevention efforts shows promise for improving diagnostic accuracy and personalized intervention strategies. AI-based image analysis techniques can automate the interpretation of ultrasound and

venous Doppler images, allowing for faster and more objective diagnosis of varicose veins. Machine learning models trained on large datasets of patient information and clinical outcomes can identify patterns and risk factors associated with varicose vein development, enabling targeted prevention interventions tailored to individual patient profiles. AI-powered decision support systems can assist healthcare providers in making informed treatment decisions and optimizing patient care pathways for varicose vein management.

In conclusion, varicose vein detection and prevention research have made significant strides in recent years, driven by advances in imaging technology, biomarker research, lifestyle interventions, wearable devices, mobile health applications, and artificial intelligence. These multidisciplinary approaches offer new opportunities for early detection, personalized risk assessment, and targeted prevention strategies for varicose veins. By leveraging these advancements and fostering collaboration between researchers, clinicians, technology developers, and patients, we can improve the detection and management of varicose veins, ultimately enhancing patient outcomes and quality of life.

CHAPTER 7

CONCLUSION

In conclusion, the development of innovative approaches utilizing wearable technology holds immense promise for the early detection and prevention of varicose veins. Through continuous monitoring of physiological parameters such as temperature differentials, muscle activity, and blood flow dynamics, wearable devices offer the potential to identify varicose vein risk factors at an early stage, enabling timely intervention and personalized preventative measures. While existing systems have made significant strides in this direction, there are still several challenges and opportunities for improvement that must be addressed to realize the full potential of wearable technology in varicose vein prevention.

One of the primary challenges facing wearable technology for varicose vein prevention is the need for improved accuracy and reliability of sensor data. Variability in sensor placement, user activity, and environmental conditions can impact the consistency and quality of data collected by wearable devices. Addressing these challenges requires ongoing research and development to refine sensor technologies and calibration algorithms, ensuring accurate and reliable measurements across diverse user populations and settings.

Furthermore, personalized intervention strategies tailored to individual risk factors and preferences are essential for maximizing the effectiveness of wearable technology in varicose vein prevention. By integrating data analytics and artificial intelligence techniques, wearable devices can analyze physiological data in real-time to provide personalized recommendations for lifestyle modifications, exercise routines, and other preventative measures. Collaborative efforts between technology developers, healthcare providers, and patients are needed to design and implement these personalized intervention strategies effectively.

Another critical aspect of wearable technology for varicose vein prevention is the integration of these devices into existing healthcare systems. Healthcare professionals must be trained to interpret data from wearable sensors and incorporate it into patient care plans effectively. Additionally, issues related to data privacy, security, and regulatory compliance must be addressed to ensure the safe and ethical use of wearable technology in healthcare settings. Collaboration between stakeholders, including technology developers, healthcare providers, regulators, and patients, is essential to overcome these challenges and realize the full potential of wearable technology in varicose vein prevention efforts.

Despite these challenges, the future outlook for wearable technology in varicose vein prevention is promising. Advances in sensor technology, data analytics, and artificial intelligence are driving innovation in wearable devices, enabling more accurate, reliable, and personalized approaches to vascular health monitoring. Integration with other health monitoring systems, such as electronic health records and telemedicine platforms, could further enhance the utility of wearable devices in varicose vein prevention efforts.

In conclusion, wearable technology has the potential to revolutionize the way varicose veins are detected and prevented, improving patient outcomes and reducing healthcare costs in the process. With continued research, development, and collaboration, wearable technology can play a significant role in promoting vascular health and enhancing overall quality of life for individuals at risk of varicose veins.

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