PROJECT REPORT

LEAF DISEASE DETECTION SYSTEM WITH PLOUGHING AND SEEDING ROBOT

Submitted by

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In partial fulfillment of the requirements for the award of the B.Tech Degree in Electronics and Communication Engineering under the APJ Abdul Kalam Kerala Technological University

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

GOVERNMENT ENGINEERING COLLEGE, WAYANAD

2020

GOVERNMENT ENGINEERING COLLEGE
WAYANAD

CERTIFICATE

This is to certify that **Mazen Hamza (WYD17EC064), Akshay Konoor(WYD17EC013), Abdul Akhil Pasha(WYD17EC001)** has completed the project titled **LEAF DISEASE DETECTION SYSTEM WITH PLOUGHING AND SEEDING ROBOT** towards the partial fulfillment for the award of the degree of **B.Tech** in Electronic and communication engineering.

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Acknowledgement

It is with great enthusiasm and the learning spirit that we bring out this project report. We also feel that it is the right opportunity to acknowledge the support and guidance that came in from various quarters during the course of the project.

We are extremely grateful to the Principal **Dr. Anitha V. S.** , Government Engineering College Wayanad, for providing the necessary facilities.

We take this opportunity to express our sincere thanks to **Dr. Ajayan K.R.**, Head of the Electronics and Communication Department, for the valuable suggestions and guidance. The stimulating technical interactions we had with him will be very helpful in the future.

We also thank **Mr. Jobin Jose**, Assistant Prof. in Electronics and Communication Engineering, project co-ordinator & **Mr. Irshad V K**, Assistant Prof.(Adhoc) . in Electronics and Communication Engineering, project co-ordinator for coordinating the project.

We are extremely thankful to our guide **Mr. Abdul Rauof Khalid M T**, Assistant Prof. in Electronics and Communication Engineering for the inevitable guidance which leads us.

Our acknowledgment would not be complete without acknowledging our gratitude to our beloved **parents** who have been the pillars of support and constant encouragement throughout the course of this report.

Abstract

In India, 70% of its population is in the agriculture sector. The remaining 30% is an inseparable part of this field. From agriculture, we get various raw materials especially crops, which serve as a staple food for people. Research and Development in the field of agriculture, to reduce the work the effort of the people involved is gaining high acceptance nowadays. Developing such a system will attract more people to this field by making agriculture an easier and more efficient, it also promotes scientific management by utilizing modern technology. This project aims at the design, development, and fabrication of a multitasking robot that can perform automatic ploughing, seed dispensing and leaf disease detection. The system helps in the reduction of labour costs and restrictions on working hours can be significantly improved. Once the concept of automation in agriculture is accepted the adoption rates will become high and the costs of technology will come down.

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Chapter 1

INTRODUCTION

Agricultural robotics is the use of automation in bio-systems such as agriculture, forestry and fisheries. It is replacing the conventional techniques to perform the same task with efficiency. Applying automation to agriculture has helped create several advancements in the industry while helping farmers save money and time. The agricultural robots are the robots deployed for agricultural purposes. In agriculture, the opportunities for the robot enhanced productivity are immense and the robots are appearing on the farms in various forms and in increasing numbers. The robots can perform the agricultural operations autonomously such as the ploughing, spraying, seed dispensing etc., allowing the farmers to reduce the environmental impact, increase the precision and efficiency, and manage individual plants in novel ways. The robotics are spreading every day to cover further domains, as the chance of replacing the human operators provides effective solutions with return on the investment. The robots do the difficult tasks that are harmful to the health of the workers. So, they offer safety for the workers.

The conventional agriculture system is more dependent on human labour and assistance and efficiency is low. There is also some limitation to human labour in some agriculture field due to varied property of land. it also leads to wastage of resources due to unscientific crop management. An automated agricultural system (which uses field robots) is exemplified by the above problems. Robots can work restlessly in all environments as they are programmed to perform the desired activities. Although large-sized wheels are required in muddy soils, robots small sized wheels perform well. The lightweight of the robots is a major advantage since they do not compact the soil as larger machinery does.

The idea of applying robotics in agriculture is very new. Nowadays agriculture is shrinking because of a lack of workers and lack of investments. Except for the introduction of hybrid crops no other advancements have been made in agriculture. The instruments which are introduced to reduce the manpower in the field will be either costly or maintenance is high. Then it will take several years for those instruments to reach the farmers. But this Agriculture Automation System with Field Assisting Robot is a very simple technique where many instruments are coupled together and the irrigation system is fully automated. An innovative idea of our project is to reduce human effort and to increase the yield. It may mean a rethinking of how crop production is done. Robots are useful when the duties that needed to be performed are potentially harmful to the safety or the health of the workers. Robots can work restlessly in all environments.

The objective of the project is to promote research, development, innovation and standardization in robotics and automation to enable safe, efficient and economical agricultural production.

1. To provide access to a hazard environment.
2. Reduced operating costs due to the lower cost of employing robots.
3. To complete a large amount of work in less time.
4. To increase precision and efficiency.

The identification of plant disease is very difficult in the agriculture field. If identification is incorrect then there is a huge loss on the production of crop and economical value of the market. Leaf disease detection requires a huge amount of work, knowledge in the plant diseases, and also requires more processing time. So, we can use image processing for identification of leaf disease.

1.1 PROBLEM DEFINITION

Introducing a field assisting the robotic system which can reduce the requirement of large manpower and which monitor the plant disease and thereby increase the yield. The system helps in the reduction of labour costs and restrictions on working hours can be significantly improved. India is a fast developing country and agriculture is the backbone for the country's development in the early stages. Due to industrialization and globalization concepts, the field is facing hurdles. On top of that, the awareness and the necessity of cultivation need to be instilled in the minds of the younger generation. Nowadays technology plays a vital role in all the fields but till today we are using some old methodologies in agriculture. Increased labour cost and identifying plant disease wrongly leads to huge loss of yield, time, money and quality of the product. A system that can solve all this problem is to be implemented.

1.2 SOLUTION TO THE PROBLEM

The agricultural field is facing many problems. In India, 70% of its population is in the agriculture sector. The remaining 30% is an inseparable part of this field. From agriculture, we get various raw materials and especially crops, which serve as a staple food for people. Research and Development in the field of agriculture, to reduce the work the effort of the people involved is gaining high acceptance nowadays. Developing such a system will attract more people to this field by making agriculture an easier and more efficient, it also promotes scientific management by utilizing modern technology. This project aims at the design, development, and fabrication of a multitasking robot that can perform automatic ploughing, seed dispensing. It also provides plant monitoring, plant disease detection. The system helps in the reduction of labour costs and restrictions on working hours can be significantly improved. This system will be a boon to the struggling agriculture sector. The introduction of this system will result in efficient crop management combined with modern technology. It promotes sustainable agriculture by efficient utilization of resources. Once the concept of automation in agriculture is accepted the adoption rates will become high and the costs of technology will come down. This field is the backbone of our economy. Automation of this field is necessary. We were intent to make a robot that can assist the farmers in the field and identify the condition of plants. Identifying the condition of plants plays an important role in successful cultivation. In olden days identification is done manually by experienced people but due to so many environmental changes, the prediction is becoming tough. So, we can use image processing techniques for the identification of plant disease. Generally, we can observe the symptoms of the disease on leaves, stems, flowers etc.

Chapter 2

LITERATURE REVIEW

We critically reviewed 6 different published papers that describe various agriculture automation systems and plant disease monitoring systems.

"Identification of Maize Leaf Diseases Cause by Fungus with Digital Image Processing." Marlinda Vasty Overbeek; Yampi R. Kaesmetan; Fenina Adline Twince Tobing, 2019 5th International Conference on New Media Studies.

Experiments in this study to identify the disease in maize leaf caused by the fungus using image data as many as 140 images. The division of the image is healthy leafy 34 images, 34 images of leaves affected by southern leaf blight, 35 leaves affected by northern leaf blight, and 37 leaves affected by southern rust. Maize leaf data image taken by a digital camera and the maize leaf is laid down in board coated by black fabric. After the image was acquisition, then the image will be enhanced with median filter kernel 3 x 3. Median filter of a window containing a number of odd pixel values is shifted by points over the entire image area. Values that are in the window are sorted in ascending to the median value is then calculated by equation.

“Plant disease detection and its solution using image classification”. G. Saradhambal, R.Dhivya S. Latha R. Rajesh,International Journal of Pure and Applied Mathematics 119(14):879-883, January 2018.

In their approach they collect 75 images of different diseased plant leaves such as Bacterial Blight and more. There were total of 5 classes that include 4 disease classes and one normal healthy leaf class. Removal of noise is done with some image preprocessing and then conversion into lab color model was done. They segmented the image with clustering and Otsu’s method. After that some feature extraction is done on the basis of which class is determined. They have not discussed the accuracy that they have achieved.

"Detection of plant disease using threshold, k-mean cluster and ANN algorithm”. Tete, T. N., & Kamlu, S. (2017). 2017 2nd International Conference for Convergence in Technology (I2CT).

The methodology is used in this paper are two different segmentation techniques such as thresholding and K-means clustering algorithm. For the various input, k- Figures show the original images which are followed by output of thresholding and Kmeans cluster for segmented image.Algorithm of k mean clustering requires a priori specification about number of cluster centers. In this paper ANN algorithm are used for detection of plant disease. Accuracy of ANN algorithm is 85%.SVM algorithm is more accurate compared to ANN Accuracy of SVM is 91%

“Intelligent Autonomous Farming Robot with Plant Disease Detection using Image Processing”D. A. Shaikh, Ghorale Akshay G, Chaudhari Prashant A, Kale Parmeshwar L. International Journal of Advanced Research in Computer and Communication Engineering Vol. 5, Issue 4, April 2016

A robot system to manage crops and for identifications and monitoring of crops diseases & pesticides. In this system the captured images from camera processed by using image processing technique, the processed result are then converted into binary codes and transfer through RF module and given it to the microcontroller unit. In this paper, an Agricultural robot is used to move around the field. It captures the image of the leaf and perform the disease detection operations. Here a camera is placed on a robotic car that captures the images which is transferred to the system wirelessly using RF module. In this system, the captured image process on MATLAB for detection of the disease. Open CV is more efficient compared to MATLAB.

"An overview of the research on plant leaves disease detection using image processing techniques." Gavhale KR, Gawande U. IOSR Journal of Computer Engineering (IOSR- JCE).

This study summarizes major image processing used for the identification of leaf diseases are k- means clustering, SVM. This approach can significantly support an accurate detection of leaf disease. There are five steps for the leaf disease identification which are said to be image acquisition, image pre-processing, segmentation, feature extraction, classification. By computing the amount of disease present in the leaf, we can use a sufficient amount of pesticides to effectively control the pests in turn the crop yield will be increased. This approach can be extended by using different algorithms for segmentation, classification. By using this concept the disease identification is done for all kinds of leaves and also the user can know the affected area of leaf in percentage by identifying the disease properly the user can rectify the problem very easily and with less cost.

" Autonomous Agri robot for smart farming" Ashish Lalwani , Mrunmai Bhide, and S. K. Shah.IRF International Conference, Pune, India

A manual switch is used to control the robot action like for N P K measurement of soil, seeding, fertilizer spray, harvesting of on tree fruit. When the power supply is turned on the robot will be in idle mode it performs nothing till any one manual switch is pressed. As soon as the switch is pressing, the robot will perform the dedicated task provided in the program. After the robot starts performing the task at the same time it can detect obstacles in the path of the robot using IR sensors. If any obstacle comes in the path then the robot will try to avoid that obstacle by changing the path but at the same time, it continuously monitors any other obstacles in the path. The robot will follow only the dedicated path if there is no obstacle in the path. By developing this robotic vehicle with its multi-tasking agricultural features, it overcomes the difficulty of farmers in farming their land in every season no matter what is the weather that day but it uses IR sensor which can't be used in direct or indirect sunlight and also the distance calculated is not accurate.

Chapter 3

PROPOSED SYSTEM

The proposed Robotic system can perform multiple operations like ploughing, seed dispensing and leaf disease detection. The objective of the proposed system is to promote research, development, innovation and standardization in Robotics and automation to enable safe, efficient and economical agricultural production.

1. To provide access to a hazard environment.
2. Reduced operating costs due to the lower cost of employing robots.
3. To complete a large amount of work in less time.
4. To increase precision and efficiency.

3.1 SYSTEM DESIGN

Agricultural robotics is the use of automation in bio-systems such as agriculture, forestry and fisheries. The robotic system can perform multiple operations like ploughing, seed dispensing and leaf disease monitoring. The entire system is divided into two parts. production.

1. Ploughing and seed dispensing

    - To plough and disperse seed in a plantation

2. Leaf disease detection system

   - To detect the leaf disease and under stand the solutions of particular disease

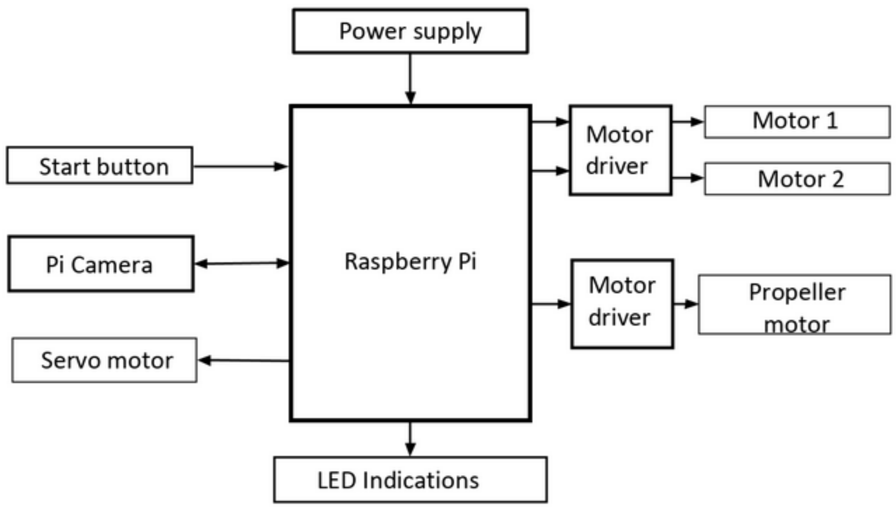

Figure 3.1: Block diagram of proposed system

3.1.1 Ploughing and seeding robot

The block diagram of the system is shown in Figure 3.2 . The controlling of the system is achieved by a microcontroller, WIFI module is also provided for the communication with the microcontroller. The robot is composed of 4 DC motors. Two DC motor is attached to the wheels on either side such that each side is driven by one motor each. One motor each is used for controlling the plougher and seed dispenser.

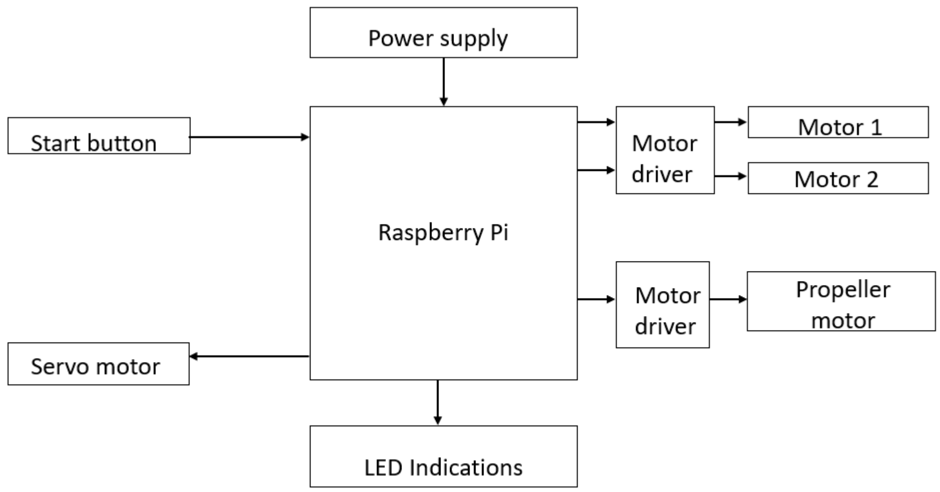

Figure 3.2: Block schematic diagram of Ploughing and seeding robot

3.1.2 Leaf disease detection system

The leaf disease monitoring is achieved by digital image processing. Raspberry pi microcontroller is used in this system as shown in Figure 3.3. When leaf disease of a particular type is identified, the proper curing method can be adopted. Raspberry pi camera is used for image acquisition.

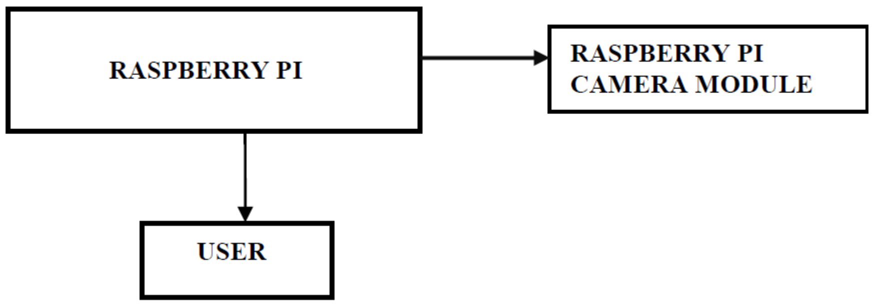

Figure 3.3: Block schematic diagram of the leaf disease detection system.

3.2 TRAINING PHASE AND TESTING PHASE

The proposed system consists of two phases namely the training phase and testing phase. The training phase mostly consists of three sub-phases; data collection, feature extraction, and classifier. The primary phase of data collection has got to be finished training models for leaf disease recognition. Feature extraction may be a process to urge the feature of the leaf which may distinguish one type of disease from another. Analysis of leaves goes to be administered for identifying features for leaf disease recognition. The images are going to be classified employing a Support Vector Machine (SVM) based classifier. The hardware part of the system consists of a Raspberry pi camera module and a processing module (Raspberry pi). Figure 3.4 shows the different processes involved in the training and testing phase.

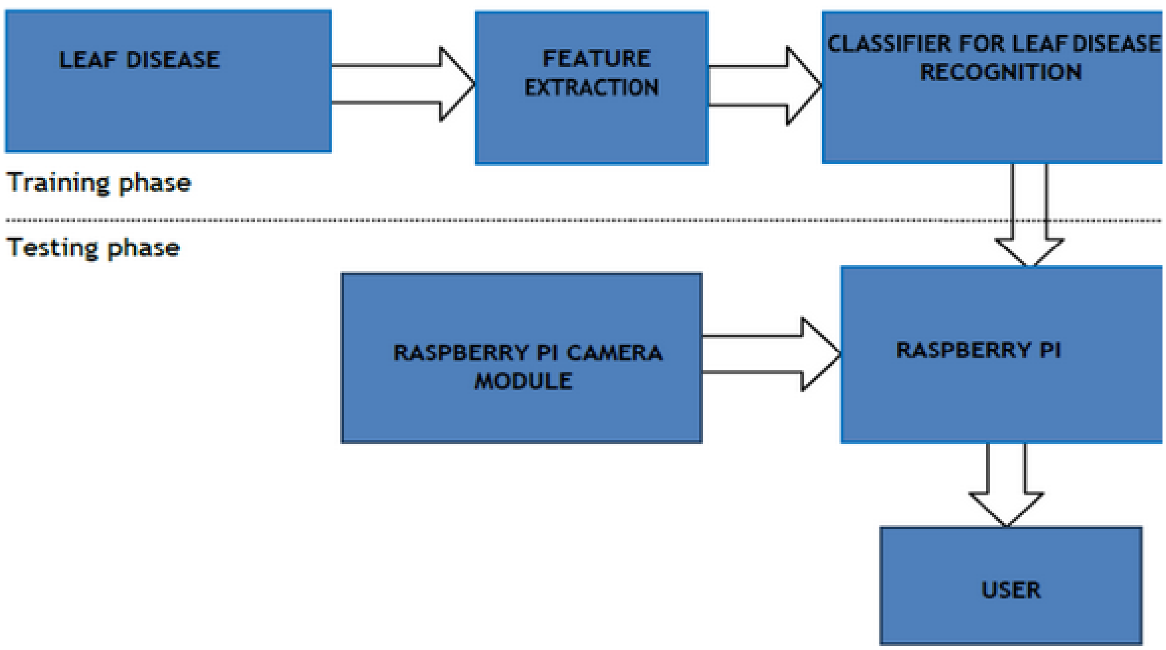

Figure 3.4: Block schematic diagram of the training and testing phase of the system

Chapter 4

HARDWARE REQUIREMENTS

For designing the hardware part, several devices from from different manufactures are used in this project. All the components are widely available in the market. They are listed below.

- Raspberry Pi.
- L293D.
- Pi camera.
- Power supply.
- Resistor.
- Diode.
- Regulator.
- Transistor.
- Connecting wires.
- LED.

The main part of the circuit is Raspberry Pi. All the other devices are connected to Raspberry Pi. A power supply is connected.

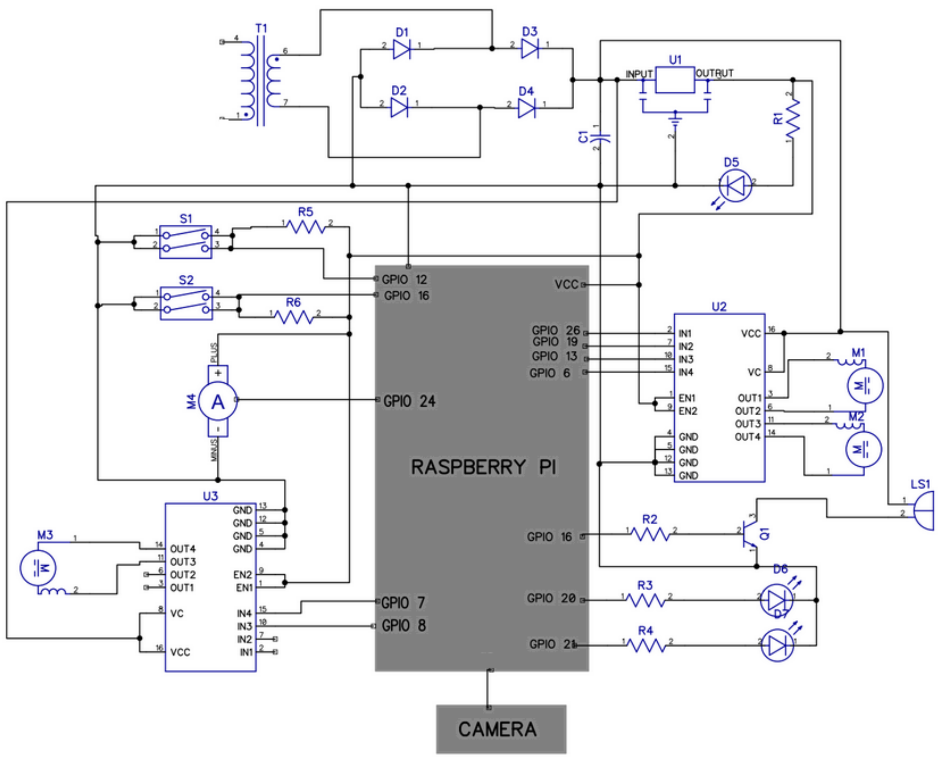

Figure 4.1: Circuit diagram of the proposed system.

4.1 RASPBERRY PI

The Raspberry Pi is a computer, and from a connections point of view it doesn't look much different to a normal desktop computer. It has USB ports for connecting a keyboard and mouse, and a video output port for connecting up a display. Because it is more compact and lower cost than a large desktop PC, it becomes possible to use the Raspberry Pi or other small single board computers (SBCs) as they are known, for many scenarios where a desktop or laptop PC would not be feasible.

- Raspberry Pi is cheap.
- Many connected devices.

- Raspberry Pi is small.
- Raspberry Pi is powerful.
- A lot of inputs and outputs.

In the proposed system the Raspberry Pi that is used is a credit-card-sized single-board computer developed in the UK by the Raspberry Pi Foundation.

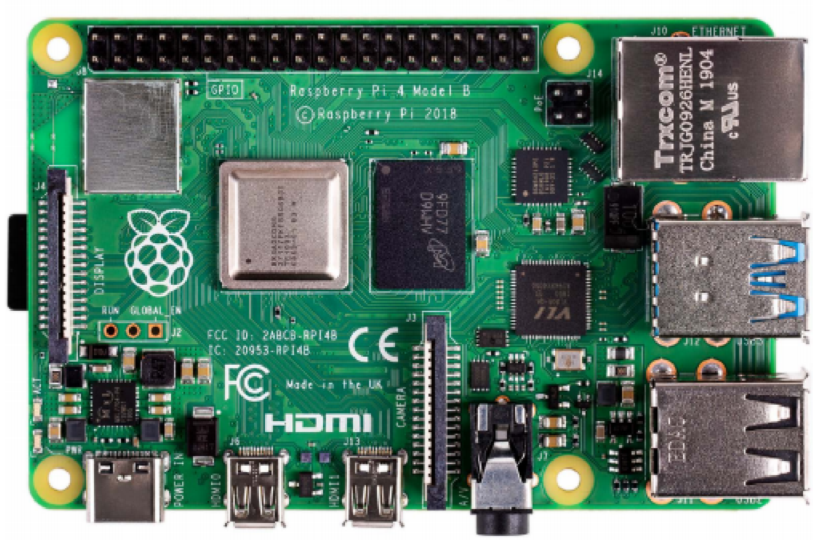

Figure 4.2: Raspberry Pi 4.

Specifications:

- Broadcom BCM2711, Quad core Cortex-A72 (ARM v8) 64-bit SoC @ 1.5GHz
- 2GB, 4GB or 8GB LPDDR4-3200 SDRAM (depending on model)
- 2.4 GHz and 5.0 GHz IEEE 802.11ac wireless, Bluetooth 5.0, BLE
- Gigabit Ethernet
- 2 USB 3.0 ports; 2 USB 2.0 ports.
- Raspberry Pi standard 40 pin GPIO header (fully backwards compatible with previous boards)

- 2 × micro-HDMI ports (up to 4kp60 supported)
- 2-lane MIPI DSI display port
- 2-lane MIPI CSI camera port
- 4-pole stereo audio and composite video port
- H.265 (4kp60 decode), H264 (1080p60 decode, 1080p30 encode)
- OpenGL ES 3.1, Vulkan 1.0
- Micro-SD card slot for loading operating system and data storage
- 5V DC via USB-C connector (minimum 3A*)
- 5V DC via GPIO header (minimum 3A*)
- Power over Ethernet (PoE) enabled (requires separate PoE HAT)
- Operating temperature: 0 – 50 degrees C ambient

Raspberry Pi 4 Model B is the latest product in the popular Raspberry Pi range of computers. It offers ground-breaking increases in processor speed, multimedia performance, memory, and connectivity compared to the prior-generation Raspberry Pi 3 Model B+, while retaining backwards compatibility and similar power consumption. For the end user, Raspberry Pi 4 Model B provides desktop performance comparable to entry-level x86 PC systems.

This product's key features include a high-performance 64-bit quad-core processor, dual-display support at resolutions up to 4K via a pair of micro-HDMI ports, hardware video decode at up to 4Kp60, up to 4GB of RAM, dual-band 2.4/5.0 GHz wireless LAN, Bluetooth 5.0, Gigabit Ethernet, USB 3.0, and PoE capability (via a separate PoE HAT add-on).

The dual-band wireless LAN and Bluetooth have modular compliance certification, allowing the board to be designed into end products with significantly reduced compliance testing, improving both cost and time to market.

4.2 VOLTAGE REGULATOR

As the name itself implies, it regulates the input applied to it. A voltage regulator is an electrical regulator designed to automatically maintain a constant voltage level. In this project, power supply of 5V and 12V are required. In order to obtain these voltage levels, 7805 and 7812 voltage regulators are to be used.

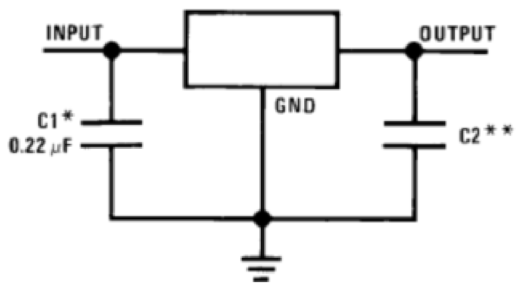

Figure 4.3: Voltage regulator circuit.

The 78xx (sometimes LM78xx) is a family of self-contained fixed linear voltage regulator integrated circuits. The 78xx family is commonly used in electronic circuits requiring a regulated power supply due to their ease-of-use and low cost. For ICs within the family, the first number 78 represents positive supply and the xx is replaced with two digits, indicating the output voltage. 78xx ICs have three terminals and are commonly found in the TO220 form factor, although smaller surface-mount and larger TO3 packages are available. These devices support an input voltage anywhere from a couple of volts over the intended output voltage, up to a maximum of 35 to 40 volts depending on the make, and typically provide 1 or 1.5 amperes of current. These regulators can provide 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. Each type employs internal current limiting, thermal shut-down and safe area protection, making it essentially indestructible. If adequate heat sinking is provided, they can deliver over 1 A output current. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltage and currents.

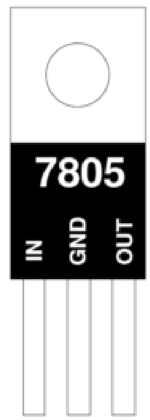

Figure 4.4: 7805 Voltage regulator.

These are monolithic integrated circuits designed as fixed voltage regulators for a wide variety of applications including local, on card regulation. These regulators employ internal current limiting, thermal solution and safe area compensation. They can also be used with external components to obtain adjustable voltages and current. Its features are,

- Output Current up to 1A .
- Output Voltages of 5, 6, 8, 9, 10, 12, 15, 18, 24.
- Thermal Overload Protection.
- Short Circuit Protection.
- Output Transistor Safe Operating Area Protection.

4.3 PI CAMERA

The Pi camera module is a portable light weight camera that supports Raspberry Pi. It communicates with Pi using the MIPI camera serial interface protocol. It is normally used in image processing, machine learning or in surveillance projects. It is commonly used in surveillance drones since the payload of camera is very less. Apart from these modules Pi can also use normal USB webcams that are used along with computer.

Figure 4.5: PI Camera.

Features:

- 5MP colour camera module without microphone for Raspberry Pi.
- Supports both Raspberry Pi Model A and Model B.
- MIPI Camera serial interface.
- Omni vision 5647 Camera Module.
- Resolution: 2592 * 1944.
- Supports: 1080p, 720p and 480p.
- Light weight and portable (3g only).

4.4 12V DC MOTOR

These motors are simple DC Motors featuring gears for the shaft for obtaining the optimal performance characteristics. They are known as Center Shaft DC Geared Motors because their shaft extends through the center of their gearbox assembly.

These standard size DC Motors are very easy to use. Also, you don't have to spend a lot of money to control motors with an Arduino or compatible board. The L298N H-bridge module with an onboard voltage regulator motor driver can be used with this motor that has a voltage of between 5 and 35V DC.

This 12 Volts DC Motor – 500 RPM can be used in all-terrain robots and a variety of robotic applications. These motors have a 3 mm threaded drill hole in the middle of the shaft thus making it simple to connect it to the wheels or any other mechanical assembly.

Three 12V dc motors are used for the proposed system. One is used as the propeller motor for the rotation of the propeller, For the ploughing process. And the other two is used for the rotation of the wheels. L293D motor driver is used to drive three motors because Raspberry Pi only gives 5V as output and needed 12V to drive DC motors.

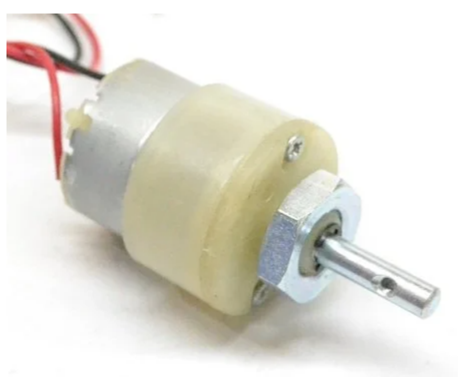

Figure 4.6: 12V DC Motor.

Specifications:

- Operating Voltage(V): 12
- Rated Speed (RPM): 100
- Rated Torque(kg-cm): 0.7
- Stall Torque(kg-cm): 3
- No Load Current (A): 0.6
- Load Current (A): 0.3

4.5 L293D MOTOR DRIVER

L293D is a basic motor driver integrated chip (IC) that enables us to drive a DC motor in either direction and also control the speed of the motor. The L293D is a 16 pin IC, with 8 pins on each side, allowing us to control the motor. It means that we can use a single L293D to run up to two DC motors. L293D consist of two H-bridge circuit. H-bridge is the simplest circuit for changing polarity across the load connected to it.

There are 2 OUTPUT pins, 2 INPUT pins, and 1 ENABLE pin for driving each motor. It is designed to drive inductive loads such as solenoids, relays, DC motors, and bipolar stepper motors, as well as other high-current/high-voltage loads.

It is used to drive motors which need appropriate voltage to work. Here, two 12V L293D MOTOR DRIVERS are used. Two motors can be connected to one L293D motor driver. Here, two motors are used for wheel rotation and they are connected to one motor driver. Propeller motor is connected to the second motor driver. Raspberry Pi only gives an output of 5V and the motors needed 12V to work. For this L293D MOTOR DRIVER is used.

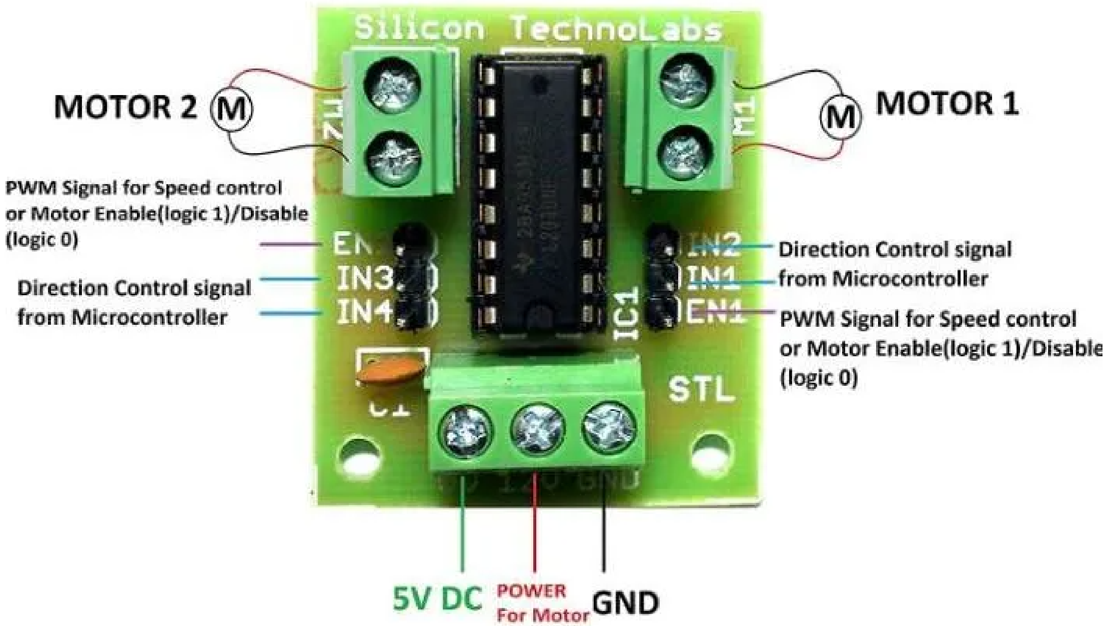

Figure 4.7: L293D Motor driver.

Specifications:

- Wide Supply-Voltage Range: 4.5 V to 36 V.
- Separate Input-Logic Supply.
- Internal ESD Protection.
- High-Noise-Immunity Inputs
- Output Current 600 mA Per Channel.
- Peak Output Current 1.2 A Per Channel.
- Output Clamp Diodes for Inductive Transient Suppression.
- Operation Temperature 0°C to 70°C.
- Automatic thermal shutdown is available.

4.6 SERVO MOTOR

SG-90 is a high quality, high torque servo motor for all your robotics and RC needs. This servo is specially made for use in Hexapods, RC airplanes, fixed-wing airplanes, helicopters, robotics, mini robot, mini manipulator and grippers, etc. Easily available libraries make is easy to use this servo motor in you project. This motor generates a massive 18.0kg.cm torque. We have carefully selected this servo motor for the best quality and performance among the numerous similar motors available in the market.

It comes with a 3-pin power ,control cable, control horns and mounting hardware. It comes in a standard 3 pin connector. It is simple and easy to control. It can be directly used with an Arduino and uses only digital input/output pin.

Figure 4.8: Servo motor.

Features:

- Operating Voltage is +5V typically
- Torque: 2.5kg/cm
- Operating speed is 0.1s/60°
- Gear Type: Plastic
- Rotation : 0°-180°
- Weight of motor : 9gm
- Package includes gear horns and screws

4.7 LED

A light-emitting diode (LED) is a two-lead semiconductor light source. It is a p–n junction diode, which emits light when activated. When a suitable voltage is applied to the leads, electrons are able to recombine with electron holes within the device, releasing energy in the form of photons. This effect is called electroluminescence, and the colour of the light (corresponding to the energy of the photon) is determined by the energy band gap of the semiconductor.

Figure 4.9: Led.

4.8 RESISTORS

Figure 4.10: Resistors

A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. Resistors act to reduce current flow, and, at the same time, act to lower voltage levels within circuits. In electronic circuits, resistors are used to limit current flow, to adjust signal levels, bias active elements, and terminate transmission lines among other uses. High-power resistors that can dissipate many watts of electrical power as heat may be used as part of motor controls, in power distribution systems, or as test loads for generators. Fixed resistors have resistances that only change slightly with temperature, time or operating voltage. Variable resistors can be used to adjust circuit elements (such as a volume control or a lamp dimmer), or as sensing devices for heat, light, humidity, force, or chemical activity.

Chapter 5

SOFTWARE REQUIREMENTS

5.1 DIPTRACE

Figure 5.1: DipTrace

DipTrace is EDA/CAD software for creating schematic diagrams and printed circuit boards. The developers provide multi-lingual interface and tutorials . DipTrace has 4 modules: Schematic Capture Editor, PCB Layout Editor with built-in shape-based autorouter and 3D Preview and Export, Component Editor, and Pattern Editor

DipTrace is an advanced PCB design software application that consists of 4 modules PCB Layout with efficient auto-router and auto-placer, schematic capture, component and pattern editors that allow you to design your own component libraries. DipTrace has a powerful automatic router, superior to many routers included in other PCB layout packages. It can route a single layer and multilayer circuit boards, and there is an option to auto route a single layer board with jumper wires, if required. DipTrace also provides you with external auto router support . Smart manual routing tools allow users to finalize the design and to get the results they want in a blink of an eye. There are number of verification features, that allows you to control accuracy of your project. DipTrace modules allow you to exchange schematics, layouts and libraries with other EDA and CAD . Output formats are DXF, Gerber, Drill and G-code. Standard libraries contain more than 98,000 components

- Simple UI
- Multi-sheet and hierarchical schematics
- High-speed shape-based auto router
- Smart manual routing tools
- Differential pairs
- Wide import / export capabilities
- Advanced verification's with real-time DRC
- Real-time 3D PCB preview and STEP export
- ODB++ and Gerber manufacturing outputs

5.1.1 Schematic Capture

Advanced circuit design tool with support of multi-sheet and multi-level hierarchical schematics that delivers a number of features for visual and logical pin connections. Cross-module management ensures that principal circuits can be easily converted to PCB, back annotated, or imported/exported from/to other EDA, CAD formats and net-lists. DipTrace Schematic has ERC Verification and Spice export for external simulation

5.1.2 PCB Layout

Engineering tool for board design with smart manual routing, differential pairs, shape-based autorouter, advanced verification, and wide import/export capabilities. Design requirements are defined by net classes, class-to-class rules, and detailed settings by object types for each class or layer. When routing with real-time DRC, the program reports errors on the fly before actually making them. DRC also checks length and phase tolerances for differential pairs..

5.2 PYTHON

Figure 5.2: Python and open cv

Python is a widely used high-level programming language for general-purpose programming, created by Guido van Rossum and first released in 1991. An interpreted language, Python has a design philosophy that emphasizes code readability (notably using whitespace indentation to delimit code blocks rather than curly brackets or keywords), and a syntax that allows programmers to express concepts in fewer lines of code than might be used in languages such as C++ or Java. It provides constructs that enable clear programming on both small and large scales.

Python features a dynamic type system and automatic memory management. It supports multiple programming paradigms including object oriented, imperative, functional and procedural, and has a large and comprehensive standard library. Python interpreters are available for many operating systems. C Python, the reference implementation of Python, is source software and has a community-based development model, as do nearly all of its variant implementations. C Python is managed by the non-profit Python Software Foundation.

Python is a multi-paradigm programming language. Object-oriented programming and structured programming are fully supported, and many of its features support functional programming and aspect oriented programming. Many other paradigms are supported via extensions, including design by contract and logic programming.

The standard library has two modules (itertools and functools) that implement functional tools borrowed from Haskell and Standard ML. The language's core philosophy is summarized in the document The Zen of Python (PEP 20), which includes aphorisms such as

- Beautiful is better than ugly
- Explicit is better than implicit
- Simple is better than complex
- Complex is better than complicated
- Readability counts

Rather than having all of its functionality built into its core, Python was designed to be highly extensible. This compact modularity has made it particularly popular as a means of adding programmable interfaces to existing applications.

5.2.1 Open CV

It is a library of programming1functions mainly aimed at real-time1computer vision. It is developed by Intel research center and subsequently supported by1Willow Garage and now maintained by itseez. It is written in C++ and its primary interface is also in C++. Its binding is in Python, Java, and Mat lab. OpenCV runs on a variety of platform

Windows, Linux, and Mac-OS, openBSD in desktop and Android, IOS and Blackberry in mobile. It is used in diverse purpose for facial recognition, gesture recognition, object identification, mobile robotics, segmentation etc. It is a combination of OpenCV C++ API and Python language. In our project we are using OpenCV version 4.5.2. OpenCV is used to gesture control to open a camera and capture the image. It is also used in the image to text and voice conversion technique.

5.3 MY SQL

Figure 5.3: My SQL

My SQL is an open-source relational database management system (RDBMS). Its name is a combination of "My", the name of co-founder Michael Widenius's daughter, and "SQL", the abbreviation for Structured Query Language. A relational database organizes data into one or more data tables in which data types may be related to each other; these relations help structure the data. SQL is a language programmers use to create, modify and extract data from the relational database, as well as control user access to the database.

In addition to relational databases and SQL, an RDBMS like MySQL works with an operating system to implement a relational database in a computer's storage system, manages users, allows for network access and facilitates testing database integrity and creation of backups. MySQL is free and open-source software under the terms of the GNU General Public License, and is also available under a variety of proprietary licenses.

The features of My SQL are

- Relational Database Management System
- Easy to use
- It is secure
- Client/ Server Architecture
- Free to download
- It is scalable
- Compatible on many operating systems
- High Performance
- Platform Independent

Chapter 6

LEAF DISEASE DETECTION USING IMAGE PROCESSING

The leaf disease detection using image processing includes steps like

- Image acquisition
- Pre processing
- Feature extraction
- Classification

The detailed block diagram of the proposed methodology is shown in Figure 6.1. The figure shows the different methods involved in the image processing technique to identify different leaf diseases.

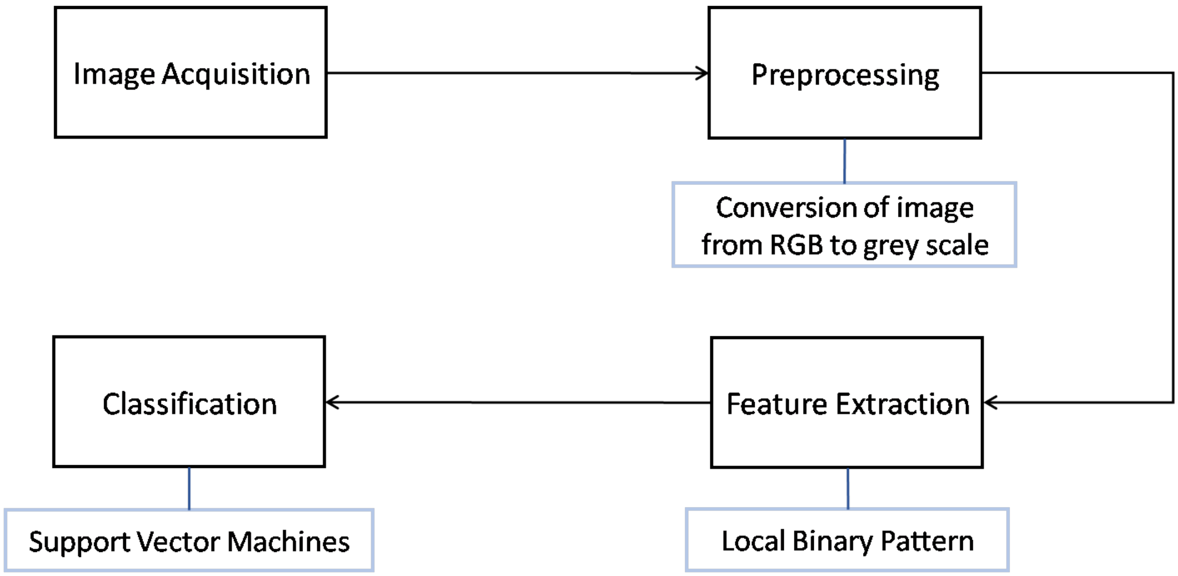

Figure 6.1: Block diagram of steps included in leaf disease detection

6.1 TYPES OF DISEASES

6.1.1 Cassava bacterial blight

Characteristic of Cassava bacterial blight are small, angular, water-soaked spots occur on the leaves which are restricted by the veins; the spots are more clearly seen on the lower leaf surface. The spots expand rapidly, join together, especially along the margins of the leaves, and turn brown with yellow borders . Droplets of a creamy-white ooze occur at the centre of the spots; later, they turn yellow.

6.1.2 Cassava brown leaf spot

Cassava brown leaf spot Cassava leaves are characterized by leaf spots visible on both sides. On the leaves' upper surface, uniform brown spots appear, with defined and dark margins. On the leaves under surface, the lesions have less-defined margins and, towards the center, the brown spots have a gray-olive background because of the presence of the fungus's conidiophores and conidia. As these circular lesions grow, from 3 to 12 mm in diameter, they take up an irregular angular form, their expansion being limited by the leaves major veins.

6.1.3 Cassava grey leaf spot

A fungus causing a leaf spot on cassava affected areas usually larger, somewhat angular and more commonly resulting in withering and death of the leaves. The leaf spots are circular, up to 10 mm diameter, with pale centres and wide brown or purplish borders.

6.1.4 Cassava mosaic disease

This disease is commonly known as Cassava mosaic disease or Tapioca Mosaic Disease .It is one of the worst disease of tapioca severally affecting the productivity of the plant.Cassava mosaic disease is characterized but the severe mosaic symptoms on the leaves. Light-green, Yellow or White spots are formed on the leaves. Affected leaves shows mottling in the beginning. Later the leaves show severe symptoms. Discoloration, Malformation, and Puckering of the leaf blade occur. Vein clearing, Vein Banding ,Vein thickening is also happened. Then the entire plant become distorted and stunted.

6.2 IMAGE ACQUISITION

The diseased leaf image is acquired using the camera, the image is acquired from a certain uniform distance with sufficient lighting for learning and classification. The sample images of the diseased leaves are collected and are used in training the system. To train and to test the system, diseased leaf images and fewer healthy images are taken. The images will be stored in some standard format. The image background should provide a proper contrast to the leaf color. Leaf disease data set is prepared with both black and white background, based on the comparative study black background image provides better results and hence it is used for the disease identification leaf.

6.3 IMAGE PRE-PROCESSING

Image acquired using the digital camera is pre-processed using the noise removal with color transformation. The color transformation step converts the RGB image to grayscale images. In grayscale images, however, we do not differentiate how much we emit of the different colors, we emit the same amount in each channel. What we can differentiate is the total amount of emitted light for each pixel; little light gives dark pixels and much light is perceived as bright pixels.

When converting an RGB image to grayscale, we have to take the RGB values for each pixel and make as output a single value reflecting the brightness of that pixel. One such approach is to take the average of the contribution from each channel: (R+B+C)/3.

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6.4 LOCAL BINARY PATTERN

LBP concept is applied to area like face recognition , dynamic texture recognition and shape localization . The Local Binary Pattern (LBP) method is widely used in 2D texture analysis. The LBP operator is a non-parametric 3x3 kernel which describes the local spatial structure of an image. It was first introduced by Ojala et al who showed the high discriminative power of this operator for texture classification. At a given pixel position(xc; yc), LBP is defined as an ordered set of binary comparisons of pixel intensities between the centre pixel and its eight surrounding pixels. The decimal values of the resulting 8-bit word (LBP code) leads to 28 possible combinations, which are called Local Binary Patterns abbreviated as LBP codes with the 8surrounding pixels. The basic LBP operator is a fixed 3x3 neighborhood.

If the gray value of the center pixel is Ic and the gray values of his neighbors are Ip, with n = 0, ..., n − 1, than the texture T in the local neighborhood of pixel (xc, yc) can be defined as:

$$T = t(I_C, I_0........I_n - 1)$$

Once these values of the points are obtained is it also possible do describe the texture in another way. This is done by subtracting the value of the center pixel from the values of the points on the circle. On this way the local texture is represented as a joint distribution of the value of the center pixel and the differences:

$$T = t(I_c, I_0 - Ic, ...I_{n-1} - I_c)$$

Since t(Ic) describes the overall luminance of an image, which is unrelated to the local image texture, it does not provide useful information for texture analysis. Therefore, much of the information about the textural characteristics in the original joint distribution is preserved in the joint difference distribution

$$T = (I_0 - Ic, ...I_{n-1} - I_c)$$

Although invariant against gray scale shifts, the differences are affected by scaling. To achieve invariance with respect to any monotonic transformation of the gray scale, only the signs of the differences are considered. This means that in the case a point on the circle has a higher gray value than the center pixel (or the same value), a one is assigned to that point, and else it gets a zero

$$T = s(I_0 - Ic), ...s(I_{n-1} - I_c)$$

In the last step to produce the LBP for pixel (xc, yc) a binomial weight 2n is assigned to each sign s(In − Ic). These binomial weights are summed:

$$LBP(X_c, Y_c) = \sum_{n=}^{8} s(I_n - I_c)2^n$$

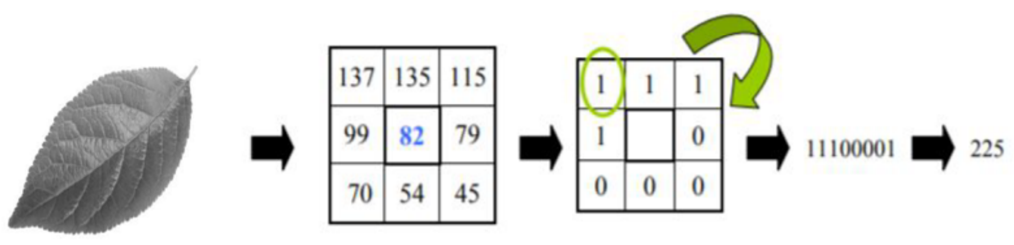


Figure 6.2: The basic Local Binary Pattern (LBP) operator

Later the LBP operator was extended to use neighborhoods of different sizes. In this case a circle is made with radius R from the center pixel. P sampling points on the edge of this circle are taken and compared with the value of the center pixel. To get the values of all sampling points in the neighborhood for any radius and any number of pixels, (bi-linear) interpolation is necessary. For neighborhoods the notation (P, R) is used. Figure 6.3 illustrates three neighbor-sets for different values of P and R.

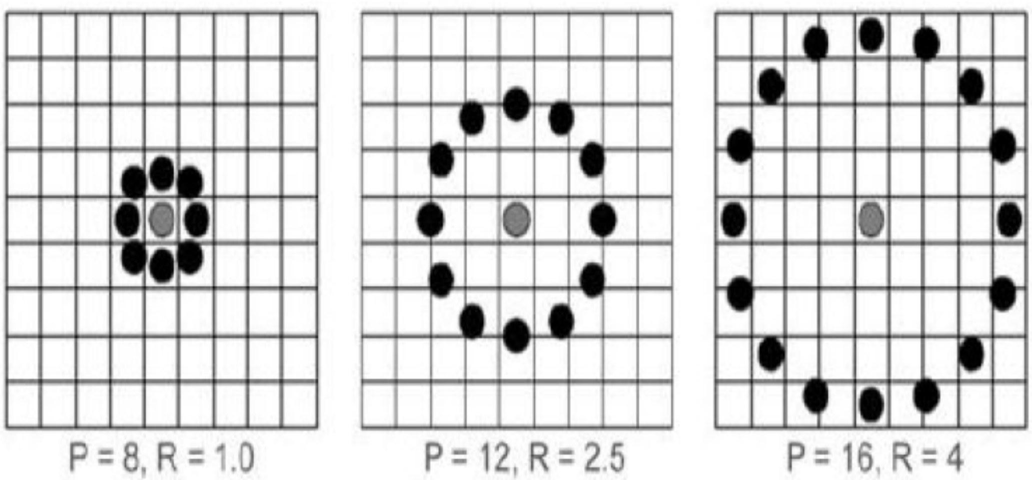


Figure 6.3: Circularly neighbor-sets for three different values of P and R

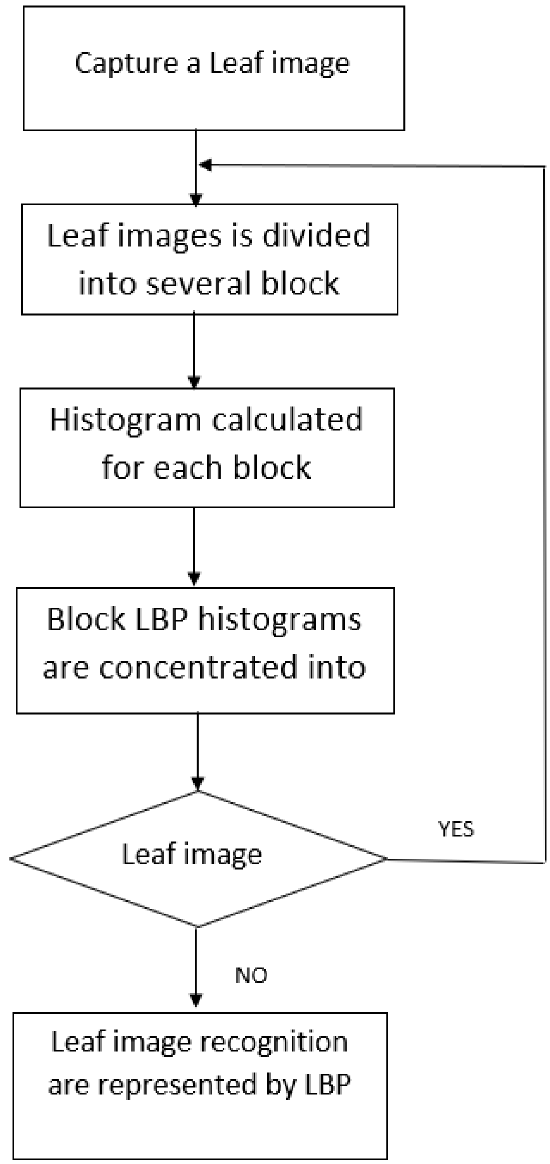


Figure 6.4: Flowchart of the LBP Process

6.5 SVM PATTERN RECOGNITION

Moreover, for the classifier ensemble design of MCS, the design object is basically to make classifiers have “independent” behavior. For example, there are no coincident errors and for each test input, there is a classifier that produces the correct answer. To test the “independent behavior” of SVM, we use different –level feature vectors as different training sets, that is, the color, texture and shape feature vectors of each sample are treated as different training sets into three corresponding SVM classifiers.

6.5.1 SVM Classifiers

Support vector machines provide a solution to two-class classification problems by mapping the input vectors into a new high-dimensional feature space through some nonlinear mapping and constructing an optimal separating hyper plane by determining the largest margin to separate positive and negative classes. This concept is illustrated in Figure 4. For the selection of the kernel function as the nonlinear mapping, a degree-2 polynomial kernel is used.

In a SVM a linear training sample is separable by a hyper plane according to the decision function

$$\mathrm{f}\ (\mathrm{x}) = \mathrm{sign}(\mathrm{w} \cdot \mathrm{x}) + \mathrm{b}$$

where w is a weight vector and b is a threshold cut-off. To maximize the margin w belongs f and b have to be minimized to

$$\mathrm{yi}(\mathrm{w.xi}){+}\mathrm{b} \geq 1$$

6.5.2 Multiple classes of classification

When the problem of classification involves more than two classes, as it is the case in this study, a number of methods can be used to deal with this very common scenario.

We used the one against- one method, which constructs $k(k-1)/s$ classifiers where each one is trained on data from two classes. Multiple Classifiers System is a combination of a number of classifiers and aims to obtain higher classification accuracy. The combination of classifiers is able to complement the errors made by the individual classifiers on different parts of the input space. K different classifiers are trained on the training set and every classifier is able to provide the classification of the input pattern x. Considering an M class classification problem, then in general each classifier will provide M different outputs . A "decision function" will then take the outputs of the classifiers and eventually also the input pattern x and will produce the final output. The output can be either a scalar value representing the class assigned to the input pattern or a vector representing an estimation of the a posterior probability for each class. Like any other classification technique, the probability of correct classification of an MCS strictly depends on the effort devoted to the design of the components. The design of MCSs can be divided into two phases: the design of the classifier ensemble and the design of the decision function

6.6 Types of SVM Classification results

Classifying data is a common task in machine learning. Suppose some given data points each belong to one of two classes, and the goal is to decide which class a new data point will be in. GLCM features were extracted from each segmented region and used as inputs to a classifier.

6.6.1 Linear Classification

In the support vector machines, a data point is viewed as a p- dimensional vector and we want to know whether we can separate such points with a (p−1) - dimensional hyper plane. This is called a linear classifier. There are many hyper planes that might classify the data. One reasonable choice as the best hyper plane is the one that represents the largest separation, or margin, between the two classes. So we choose the hyper plane so that the distance from it to the nearest data point on each side is maximized. If such a hyper plane exists, it is known as the maximum-margin hyper plane and the linear classifier it defines is known as a maximum margin classifier.

6.6.2 Non-linear classification

The original optimal hyperplane algorithm suggested a way to create nonlinear classifiers by applying to maximum-margin hyperplanes. The resulting algorithm is formally similar, except that every dot product is replaced by a nonlinear kernel function. This allows the algorithm to fit the maximum margin hyperplane in a transformed feature space. The transformation may be nonlinear and the transformed space high dimensional; thus though the classifier is a hyperplane in the high-dimensional feature space, it may be nonlinear in the original input space. To evaluate classification performance, our experimental study focuses on the comparison between ANN and SVMs that is trained by the single-step learning approach.

The training and test data sets for both approaches include 100 images of five diseases of leaves. As for the mid-categories, we manually assigned for the color and shape feature sets of original datasets. Here we use nonlinear classification because of its higher accuracy. The accuracy obtained for ANN, linear SVM and nonlinear SVM are shown in Table 2, based on which we can choose the more accurate method.

Classifiers	Accuracy obtained
ANN	85%
Linear SVM	91%
Non-Linear SVM	94%

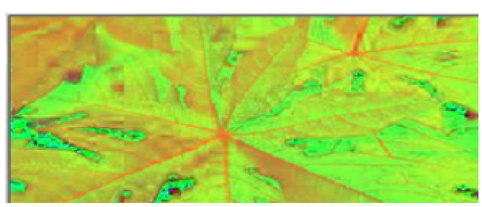
Table 6.1: Accuracy for classifiers

6.7 REPRESENTATION OF OUTPUT

The output of different steps included in the leaf disease detection can be extracted by dividing the python program. The changes in each step can be identified using these outputs. The images of output of different steps in leaf disease detection using image processing is shown in Figure 6.5 .

1) Image Acquisition

2) Grey Scale Conversion



3) HSV Conversion

Figure 6.5: (1-3) Images of output of different steps in disease detection in leafs using image processing

6.8 WORKING OF THE SYSTEM

The system includes the Pi camera which is integrated to the Raspberry Pi as shown in the block diagram.

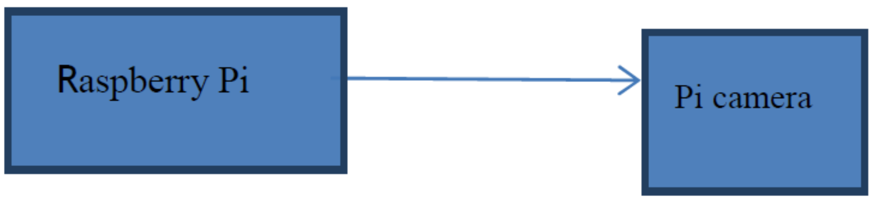


Figure 6.6: Block diagram of leaf disease detection system

The leaf for testing is captured by using pi camera as depicted in Figure. The testing image of the leaf undergoes stages like RGB to Grey conversion, HSV conversion, blurring, inversion, histogram equalization, feature extraction, labeling and given a value by considering the output of these stages. The database of diseased leaves is already created and stored. This value is compared with the value of leaves in the database. The database value which is closer to the testing leaf value is selected. Thus the disease is identified.

The output by running the python program to detect the disease of a cassava leaf is given below in Figure.

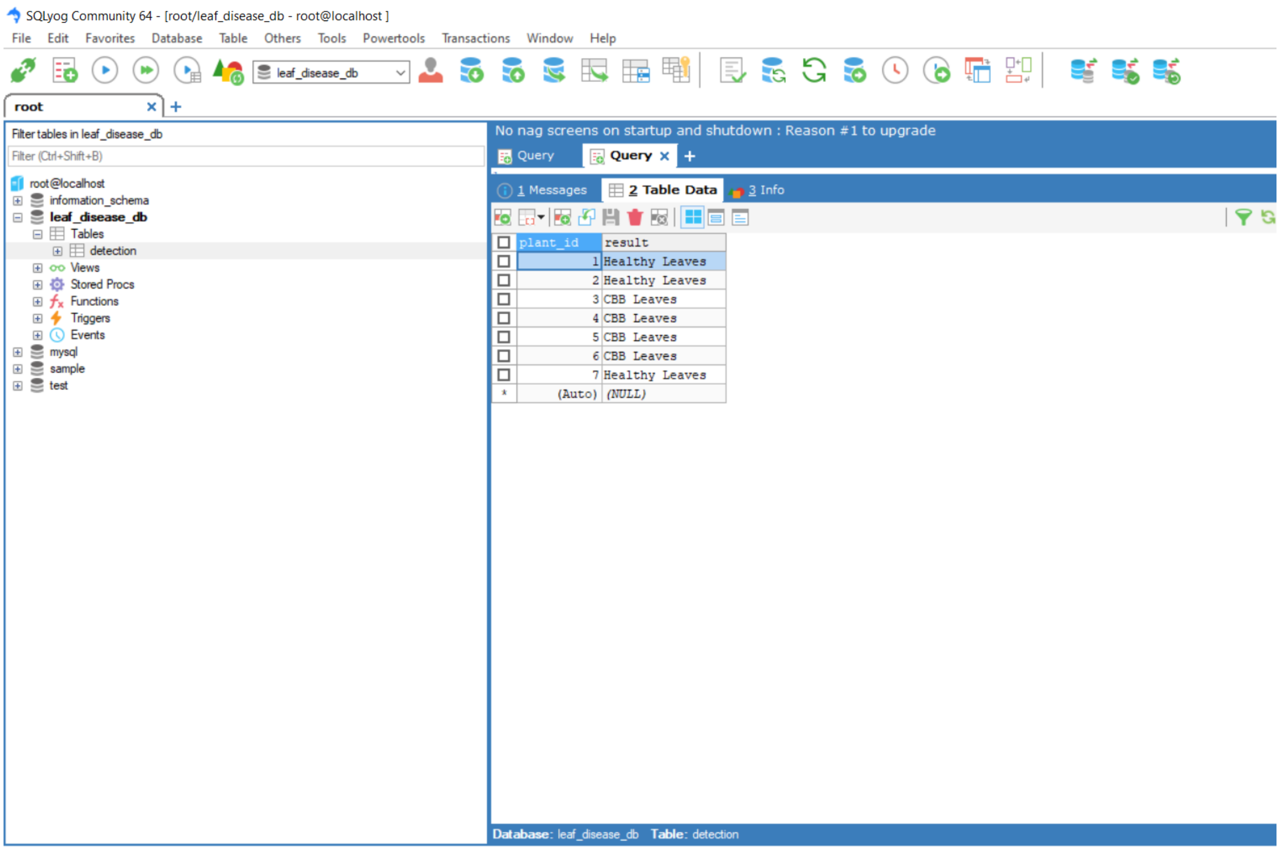


Figure 6.7: Data collected in SQL Data base

Chapter 7

IMPLEMENTATION DETAILS

7.1 PRINTED CIRCUIT BOARD

ARES (Advanced Routing and Editing Software) forms the PCB layout module of the PROTEUS system and offers net listed based PCB design complete with a suite of high performance design automation tools. The latest version is compatible with Windows 998/Me/2k/XP and later. It includes a brand new Auto-placer, improved auto-placing, automatic gate swap optimization and even more support for power plans.

7.2 PCB LAYOUT

A printed circuit board, or PCB, is used to mechanically support and electrically connect electronic components using conductive pathways, tracks or signal traces etched from copper sheets laminated onto a non-conductive substrate. It is also referred to as printed wiring board (PWB) or etched wiring board. A PCB populated with electronic components is a printed circuit assembly (PCA), also known as a printed circuit board assembly or PCB Assembly (PCBA). Printed circuit boards are used in virtually all but the simplest commercially produced electronic devices.

Alternatives to PCBs include wire wrap and point-to-point construction. PCBs are often less expensive and more reliable than these alternatives, though they require more layout effort and higher initial cost. PCBs are much cheaper and faster for high-volume production since production and soldering of PCBs can be done by automated equipment. Much of the electronics industry's PCB design, assembly, and quality control needs are set by standards that are published by the IPC organization.

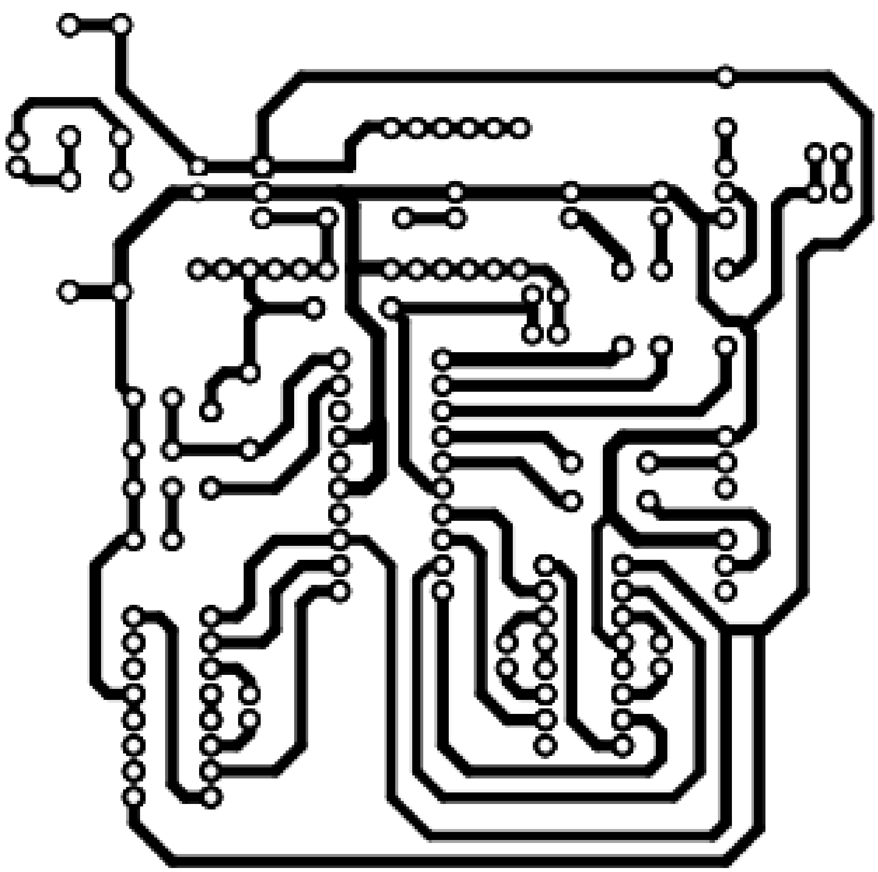


Figure 7.1: PCB Layout

7.3 SOLDERING OF COMPONENTS

Soldering is the process of joining two or dissimilar metals by melting another metal having low melting point. In order to make the surfaces accept the soldering readily the component terminals should be oxides and other obstructing films. Soldering flux cleans the oxides from the surfaces of the metal; the lead should be cleaned chemically or by scrapping using a blade or knife. Small amount of lead should be coated on the cleaned position of leads and the bits of soldering iron. This process is called tinning. Zinc chloride, ammonium chloride, rosin are commonly used fluxes. The solder is used for joining two metals at temperature below the melting point .The popularly used alloys of tin and lead that melts at375degree F and solidifies when it cools. The most of the solder wires are flux core type. Soldering iron is the tool used to melt the solder and apply at the joint of the circuit. It operates at 230v main supply. The power ratings of the soldering iron are 10W, 25W, 35W, 65W, 125W.

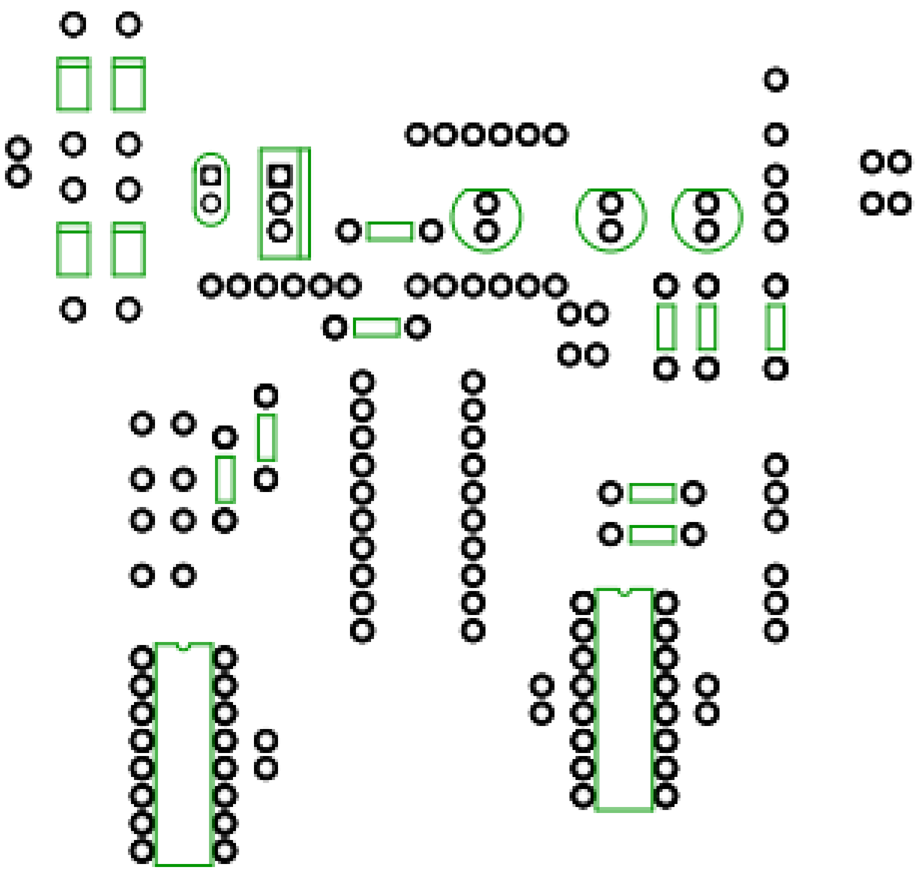


Figure 7.2: Components layout

7.4 MECHANICAL STRUCTURE OF PROPOSED SYSTEM

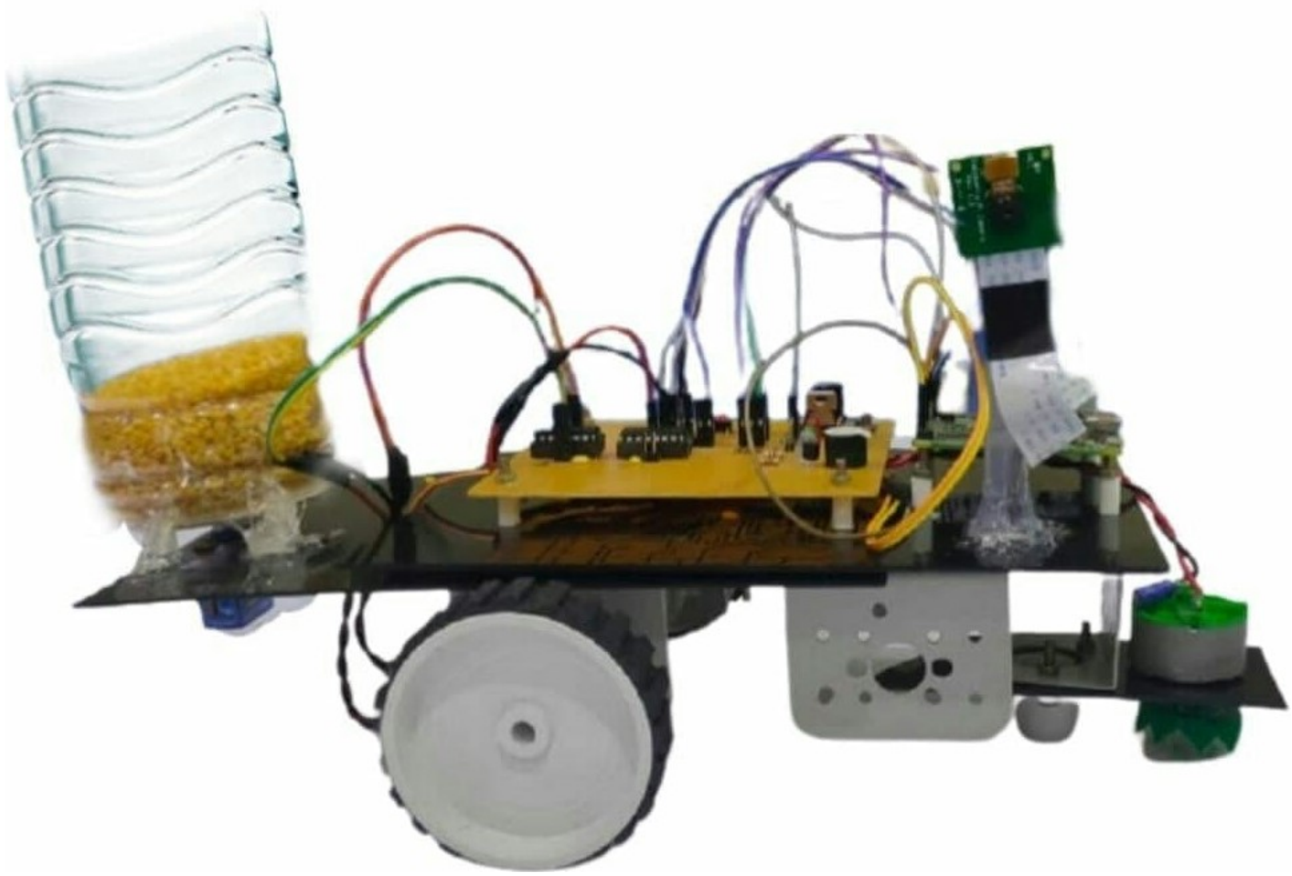


Figure 7.3: Side view of proposed system

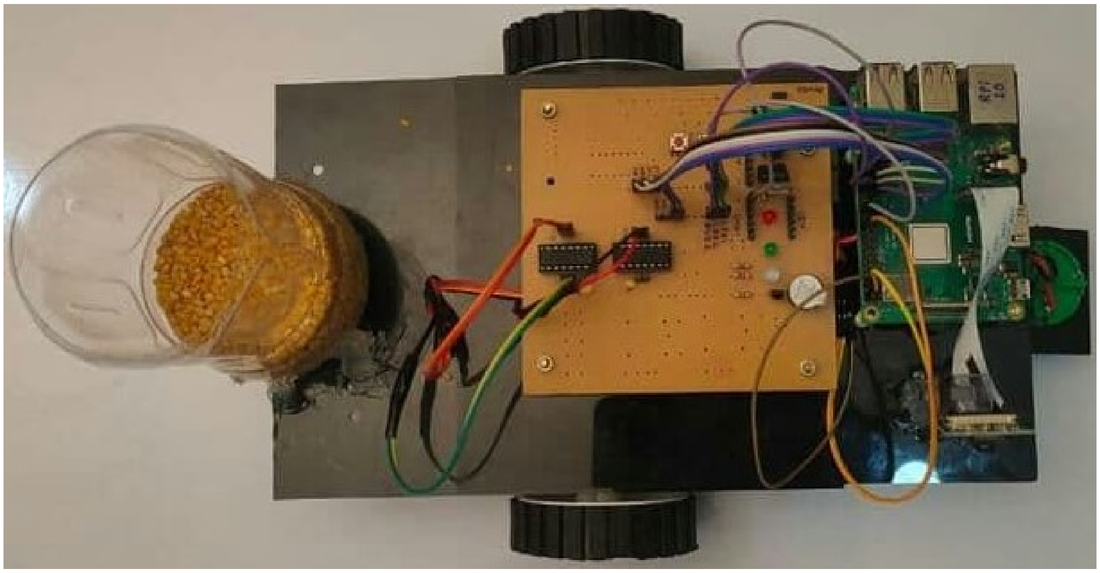


Figure 7.4: Top view of proposed system

Chapter 8

COST ANALYSIS

SI.NO	COMPONENTS	FIELD OF USE	NO:OF UNITS	PRIZE PER UNIT
1	12V Power supply	Robot vehicle	1	400
2	Raspberry Pi 4	Leaf Disease Detection	1	4000
3	Pi Camera	Leaf Disease Detection	1	500
4	12V DC Motors	Robot vehicle	3	200
5	5V Servo Motors	Robot vehicle	1	125
6	L293D Motor driver	Robot vehicle	2	130
7	Wheels	Robot vehicle	4	40
8	Motor chassis	Robot vehicle	1	200
9	PCB	Circuit design	1	500
10	LED	Indication	3	3
11	Others			250
.	.	.	Total	7254

Table 8.1: Cost Analysis

Chapter 9

CONCLUSION

The project aims the design, development and fabrication of a multitasking robot that can perform automatic ploughing, seed dispensing and leaf disease detection. Seed dispensing allows controlling the flow of seeds. This project intends to reduce the requirement of large manpower and the cost of equipment making it affordable to farmers. The system helps in the reduction of labour costs and restrictions on working hours can be significantly improved. The agricultural robot is designed to facilitate the farmers to ease their work. Plant diseases cause major losses in terms of production, economy, quality and quantity of agricultural products. So, it is necessary to control the loss incurred by the plants.

The project can be implemented with enormous results on a large scale that benefits all farmers of the world. In the future, apart from ploughing, seed dispensing and other farming processes like spraying pesticides, harvesting etc. can also be implemented in one robot thus making the machine capable of multitasking. Once the concept of automation in agriculture is accepted, the adoption rates will become high and the costs of technology will be low.

Chapter 10

FUTURE SCOPE

The project can be implemented with enormous results on a large scale that benefits all farmers of the world. Apart from ploughing and seed dispensing other farming processes like water spraying, spraying pesticides, harvesting etc. can also be implemented in one robot thus making the machine capable of multitasking. In the future, the drip irrigation system can also supply agricultural chemicals like calcium, sodium, ammonium, zinc, fertilizers to the field along with water with adding new sensors and valves

Chapter 11

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