CHAPTER 1

INTRODUCTION

Plant diseases are important factors because its affects human being as well as animals etc. that's why as it can cause significant reduction in both quality and quantity of crops in agriculture production. Therefore, detection and classification of diseases is an important and urgent task. Traditionally farmers identify the diseases by naked eye observation method. Some researchers have used image processing techniques for fast and accurate detection of plant diseases and identifying the diseases in an early stage only and control them. When some diseases are not visible to naked eye but actually they are present, then it is difficult to detect it with the naked eye. And when it is visible it will be too late to detect disease and can't help anymore. Earlier, microscope is used to detect the disease, but it become difficult as to observe each and every leaf and plant. So, the fast and effective way is a remote sensing technique. Detection and recognition of diseases in plants using machine learning is very fruitful in providing symptoms of identifying diseases at its earliest. For small scale farmers, early identification of disease is very much possible and able to control the insects by organic pesticides or by the use of minimal amount of chemical pesticides. For large scale farmers frequent monitoring and early identification of disease is not possible and it results in a severe outbreak of the disease and pest growth which cannot be controlled by organic means. In this situation farmers are forced to use the poisonous chemicals to eradicate the disease in order to retain the crop yield. This problem can be solved by automating the monitoring process by use of advanced image processing techniques and machine learning.

The proposed work aims in making the automated system easily available for the farmer's using the device for early detection of the diseases in plants. Robotic is included in this system a field robot goes through the field and captures the images of the leaves and processing of the image is done using the processor that is integrated in it. After the evaluation of the diseases the result is sent to the farmer/owner of the field in the form of SMS. The steps involved in disease detection are Digital image acquisition, Image pre-processing (noise removal, Color transformation, and histogram equalization), K-means Segmentation, Feature extraction, and classification using the support vector machine algorithm which is a supervised learning algorithm.The processing that is done by using these components is divided into two phases. The first processing phase is the offline

phase or Training Phase. In this phase, a set of input images of leaves (diseased and normal) were processed by image analyzer and certain features were extracted. Then these features were given as input to the classifier, and along with it, the information whether the image is that of a diseased or a normal leaf. The classifier then learns the relation among the features extracted and the possible conclusion about the presence of the disease. Thus the system is trained.

India is well known for its agriculture production. Most of the of the population is dependent on agriculture. Farmers have variety of options to cultivate crops in the field. Still, the cultivating these crops for best harvest and top quality of production is done in a technical way. So the yield can be increased and quality can be improved by the use of technology. Generally, whenever there is disease to a plant, we can say that leaves are the main indicator of the disease caused to the plant. Mostly we can see the spots on the leaves of it due to disease. However when the amount of disease to the plant is large then the whole leaf gets covered by the disease spots.

1.1 PROBLEM DEFINITION

Gesture based moving robot is an effective solution to the existing problems in the field of agriculture and other related fields. The aim is to provide services to formers by reducing their efforts simplifying the tasks, save time consumption and boost the yield of crops. The common problem existing among the Indian farmers are they don't choose the right crop based on their soil requirements. Due to this they face a serious setback in productivity.

This problem of the farmers has been addressed through precision agriculture. Precision agriculture is a modern farming technique that uses research data of soil characteristics, soil types, crop yield data collection and suggests the farmers the right crop based on their site-specific parameters. This reduces the wrong choice on a crop and increase in productivity.

CHAPTER 2

LITERATURE REVIEW

A literature review is a scholarly paper, which includes the current knowledge including substantive findings, as well as theoretical and methodological contributions to a particular topic.

- **Agribot (International Journal of Advanced Research in Computer and Communication Engineering-2015)**

Ankit Singh, Abhishek Gupta et al[1] presented an idea that agribot is a robot designed for agricultural purposes. This Bot performs basic elementary functions like picking, harvesting, weeding, pruning, planting, grafting. It is designed to minimize the labor of farmers in addition to increasing the speed and accuracy of the work. The main feature of the robot is the ability to find the grass in the field using image processing. For this a special purpose web cam which will take photos inside the field and if the grass is found then the user will inform the robot to cut the grass in the crop field and also the user will pick the grass which has been cut by the robot. The image processing is also used for analyzing the height of the plant. If the height of the crop is larger than the reference height then the cutting mechanism will be used by the robot to cut the crop. A vision-based row guidance method is presented to guide the Robot platform driven along crops planted in row.

- **Autonomous farming robot with plant health indication (IJATES-2015)**

K.V.Fale and P.Bhureamit et al[2] designed an autonomous intelligent farming robot which indicates plant health by observing the color of their leaves and the height of the plant. It also notes environmental conditions such as temperature, moisture and humidity. The health of the plant is displayed on the LCD. The robot has also watering mechanism, it will water the plants according to their needs by observing soil moisture and humidity. The main feature of the robot is the ability to sense the health of the plants using image processing. Webcam will take the photo inside the field and analyses the growth according to the height, color of the leaves, etc.. Vision based row guidance method is used to guide the robot platform driven along crops planted in row.

- **Autonomous Robot Camera for Detecting the Leaf Diseases of Agricultural Plants using Image Theory Algorithm 2016 Ms. Wable A. A. Prof Gajare Y. R. Student Professor Department of Electronic and Telecommunication Engineering Department of Electronic and Telecommunication Engineering JCOE, Kuran, Signal Processing, Pune, India JCOE, Kuran, Signal Processing, Pune, India**

Because of the image processing on plant health detection and identify the disease of leaf with find the number of spots on leaf. With this technique we can increase the crop production with less power and save water. This is done using Matlab software. So this project is very useful for farmer for increase the crop production using sensing and image processing technique [3].

CHAPTER 3

ANALYSIS AND DESIGN

The complex and dangerous environment after the disaster can cause serious danger to the life safety of rescue workers. Rescue robot can perform many tasks instead of rescue workers, such as environmental monitoring and personnel search, and it can improve the rescue efficiency and information accuracy. So the rescue robot has broad application prospect. Because the post disaster environment is very complex, the adaptability of complex environment is the basic function of the rescue robot.

3.1 METHADOLOGY

Proposed System: If we consider traditional agricultural practices practically, it will not support mass food production, yield will be supported for local consumption and it is time consuming. To overcome the limitations in traditional agriculture practices and Unmanned Ground Vehicles (UGV's) we identified moving robot or UAV which can handle many of the agricultural tasks more effectively in terms of time and effort which is better than manual work. The operator takes pictures and videos using flying robot's inbuilt HD camera and these images show plant stress caused by: nutrients, water stress, disease, insect infestation, overall health status crop damage and insurance claim weed infestation, soil quality, soil map, the images show changes in crop vigor sooner than visible images. Sophisticated post-processing software to generate NDVI images, high-resolution geo located photographs and 3D surface gradient maps. A typical flight will take as many images we want based on the storage capacity, software stitched together into a single high-resolution image.

If we consider traditional agricultural practices practically, it will not support mass food production, yield will be supported for local consumption and it is time consuming.

3.2 High Level System Diagram

Figure 3.1 represents the proposed system's high level working of the system. The user's (operator) hand gestures are tracked by the leap motion device which is connected to the computing device via USB connection. The tracked information from leap motion

controller is sent to the computing device for processing. The hand gestures or voice are processed as commands and translated into control signal which is sent to the moving robot through Zigbee.

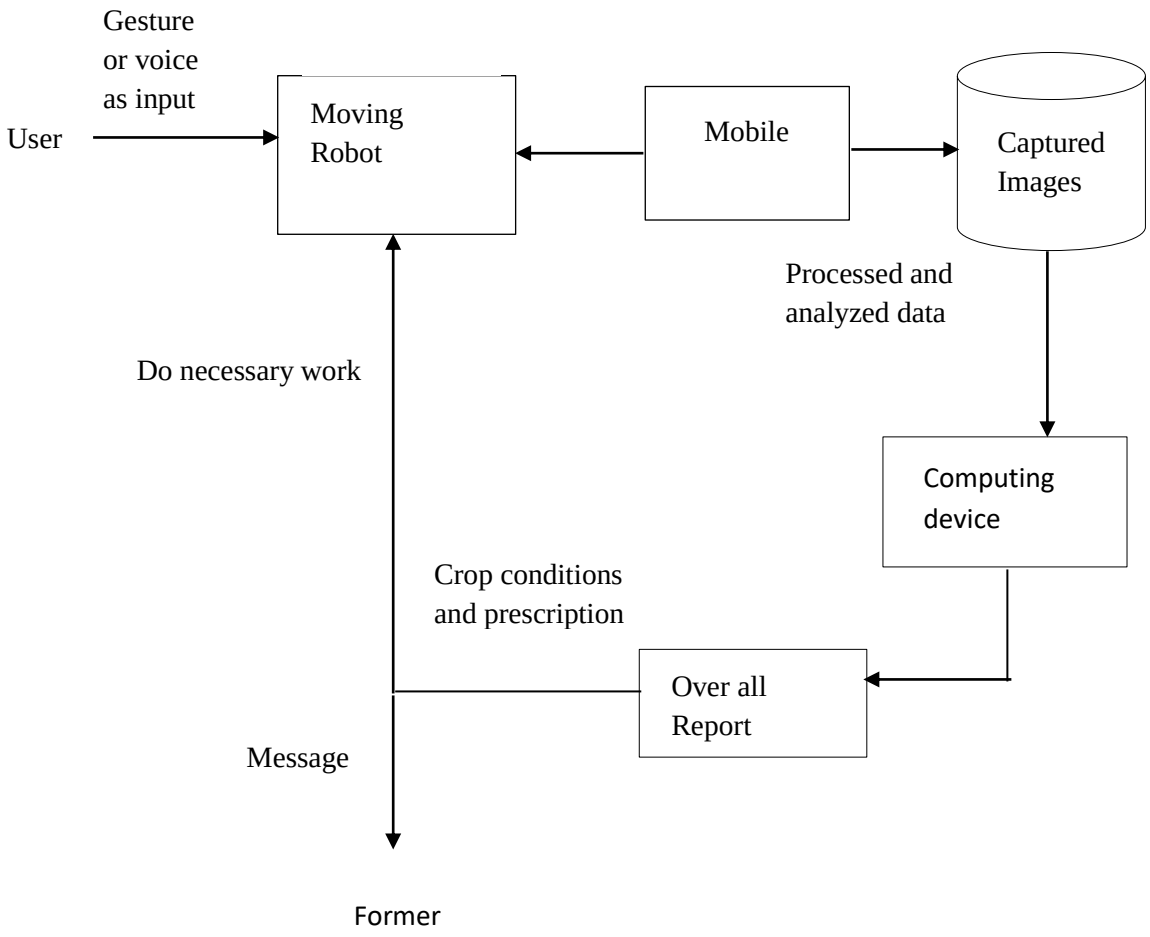


Figure 3.1: High level working model of proposed system

The images captured from the moving robot are stored in the computer for further analysis. The collected sets of images are sent for processing. Different precision agricultural software and digital image processing techniques are used to determine the crop condition based on various parameters prescribed by agro scientists. The detailed test results are studied to identify the problems in the crops and appropriate solutions to overcome the problem by prescribing suitable fertilizers, pesticides, insecticides, herbicides etc. are suggested to use in the specified ratio. The guidance related to weather conditions, growing of crops based on soil type and climatic conditions and some other agro information is given along with the documented report. The complete report is preferably made in the regional specific language in an easily understandable manner, and finally the detailed report is handed over to the farmer.

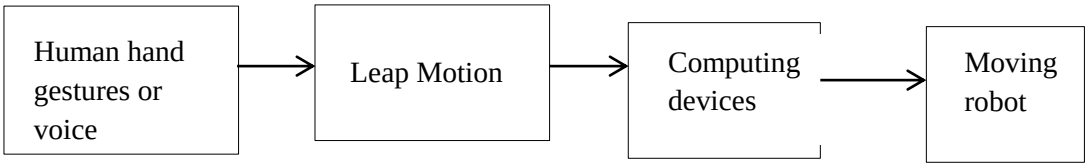


Figure 3.2: Connection between system components.

3.3 Block Diagram

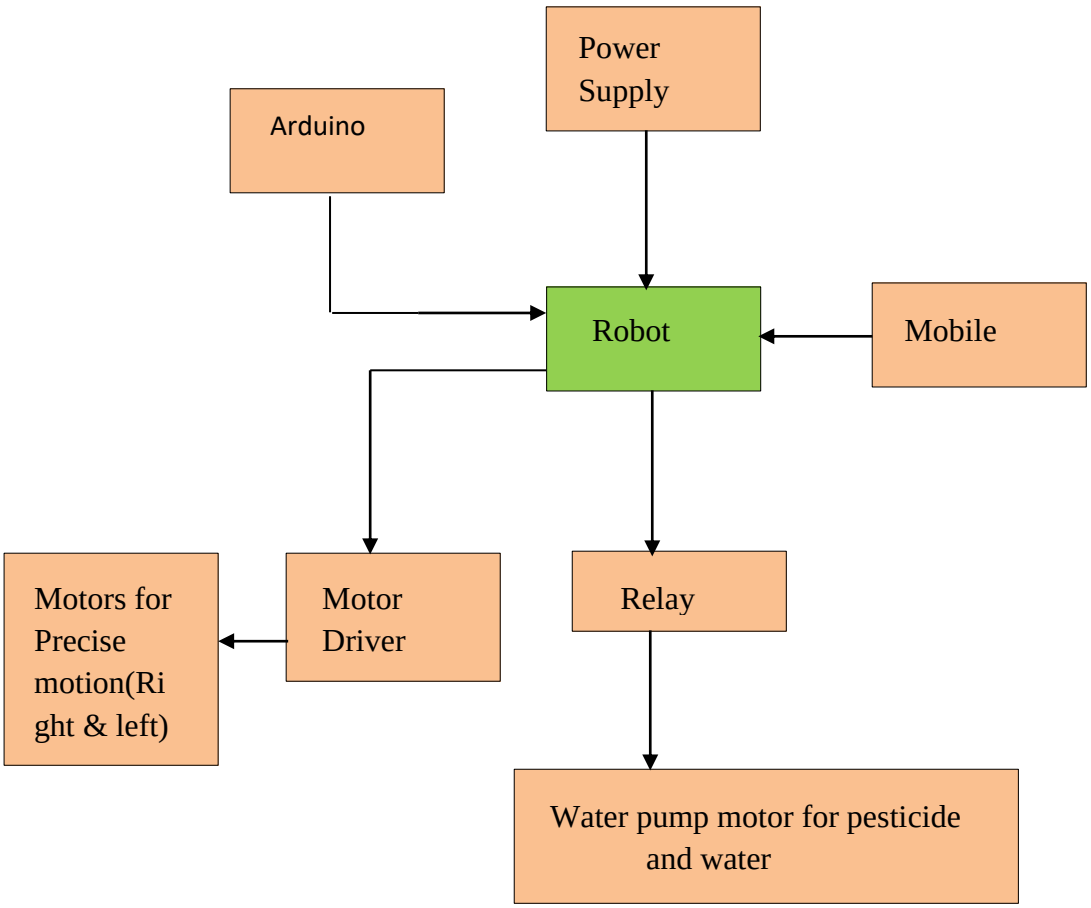


Figure 3.3: Hardware block diagram

Receiver:

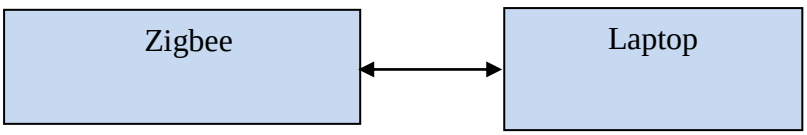


Figure 3.4: Software block diagram

3.4 System Design

Leaf miners are the insect family at larval stage. They feed between upper and lower part of the leaf.

Due to insect on very much amount in plant, it is severely damaged. On a single leaf the number of maggots can be six. Therefore, it can severely damage the leaf of plant. It can restrict plant growth, leads to reduced yields.

Hence we can develop a robot, using image processing to detect the disease, to classify it. This will avoid human interference and hence lead to précised unprejudiced decision.

Generally, whatever our observation about the disease is just used for the decision of the disease. A symptom of plant disease is a visible effect of disease on the plant. Symptoms can be change in color, change in the shape or functional changes of the plant as per its response to the pathogens, insects etc. Leaf wilting is a characteristic symptom of verticillium wilt. It is caused due to the fungal plant pathogens V. dahliaeand Verticil liumalbo- atrum. General common bacterial disease symptoms are brown, necrotic lesions which gets surrounded by abright light yellow halo at the edge of the leaf of the plant or at innerpart of the leaf on the bean plants. You are not actually seeing the disease pathogen, but rather a symptom that is being caused by the pathogen.

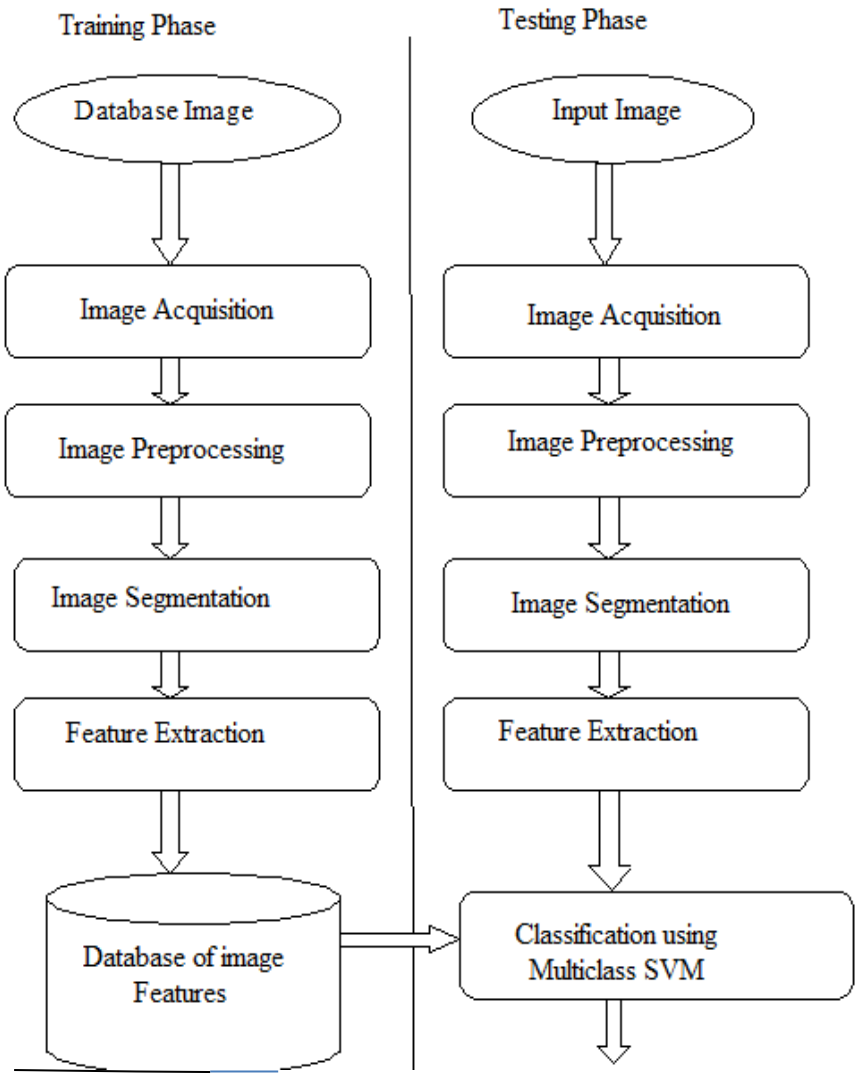


Figure 3.5: ML Model with Two phases

In order to build a machine leaning model it consists of two phase namely testing and training phase were the model is first trained and an input is given to test the model which is called the test data. The model consists of several image processing steps such as image acquisition, image pre-processing, segmentation, feature extraction and SVM classifier to classify the diseases.

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 dataset 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.

Image pre-processing: Image acquired using the digital camera is pre-processed using the noise removal with averaging filter, color transformation and histogram equalization. The color transformation step converts the RGB image to HSI (Hue, Saturation and intensity) representation as this color space is based on human perception. Hue refers to the dominant color attribute in the same way as perceived by a human observer. Saturation refers to the amount of brightness or white light added to the hue. Intensity refers to the amplitude of light. After the RGB to HSI conversion, Hue part of the image is considered for the analysis as this provides only the required information. S and I component are ignored as it does not give any significant information.

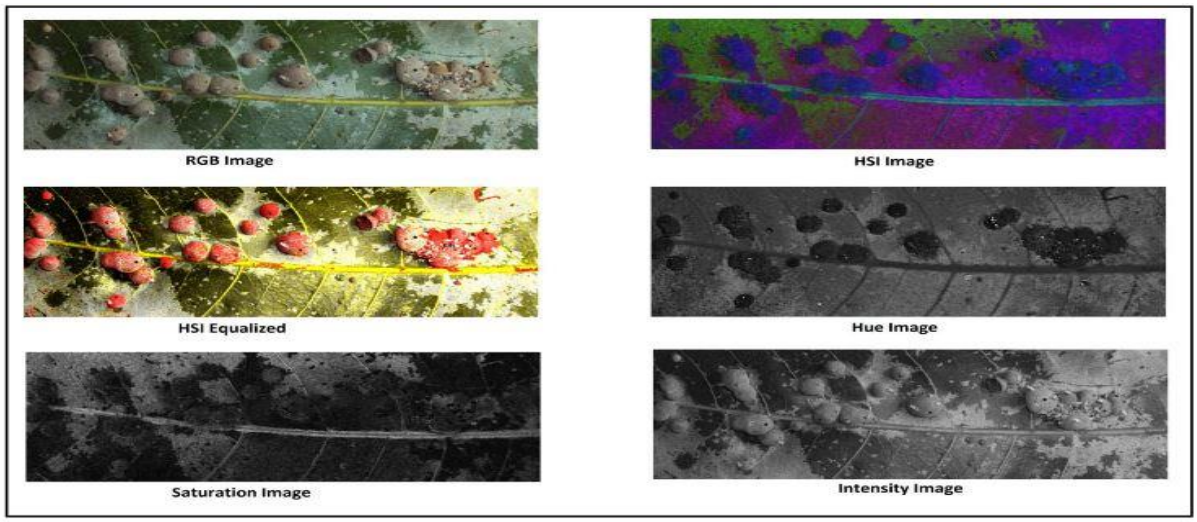


Figure 3.6: RGB to HIS

Masking green pixels: Since most of the green colored pixels refer to the healthy leaf and it does not add any value to the disease identification techniques, the green pixels of the leaf are removed by a certain masking technique, this method significantly reduces processing time. The masking of green pixels is achieved by computing the intensity value of the green pixels, if the intensity is less than a predefined threshold value, RGB component of that particular pixel is assigned with a value of zero. The green pixel masking is an optional step in our disease identification technique as the diseased part of the leaf is able to be completely isolated in the segmentation process.

Segmentation: There are different image segmentation techniques like threshold based, edge based, cluster based and neural network based. One of the most efficient methods is the clustering method which again has multiple subtypes, k-means clustering, Fuzzy C-means clustering, subtractive clustering method etc. One of most used clustering algorithm is k-means clustering.

K-means clustering is simple and computationally faster than other clustering techniques and it also works for large number of variables. But it produces different cluster result for different number of number of cluster and different initial centroid values. So it is required to initialize the proper number of number of cluster k and proper initial centroid. K-means is an general purpose methods that is being used at many domains to different problems.

Feature Extraction: feature extraction starts from an initial set of measured data and builds derived values (features) intended to be informative and non-redundant, facilitating the subsequent learning and generalization steps, and in some cases leading to better human interpretations. Feature extraction is a dimensionality reduction process, where an initial set of raw variables is reduced to more manageable groups (features) for processing, while still accurately and completely describing the original data set.

When the input data to an algorithm is too large to be processed and it is suspected to be redundant (e.g. the same measurement in both feet and meters, or the repetitiveness of images presented as pixels), then it can be transformed into a reduced set of features (also named a feature vector). Determining a subset of the initial features is called feature selection.[2] The selected features are expected to contain the relevant information from the input data, so that the desired task can be performed by using this reduced representation instead of the complete initial data.

3.5 FLOW DIAGRAM

Flow diagram is a type of diagram that represents an algorithm, workflow or process. It is a collective term for a diagram representing a flow or set of dynamic relationships in a system.

Flow diagrams are used to structure and order a complex system, or to reveal the underlying structure of the elements and their interaction.

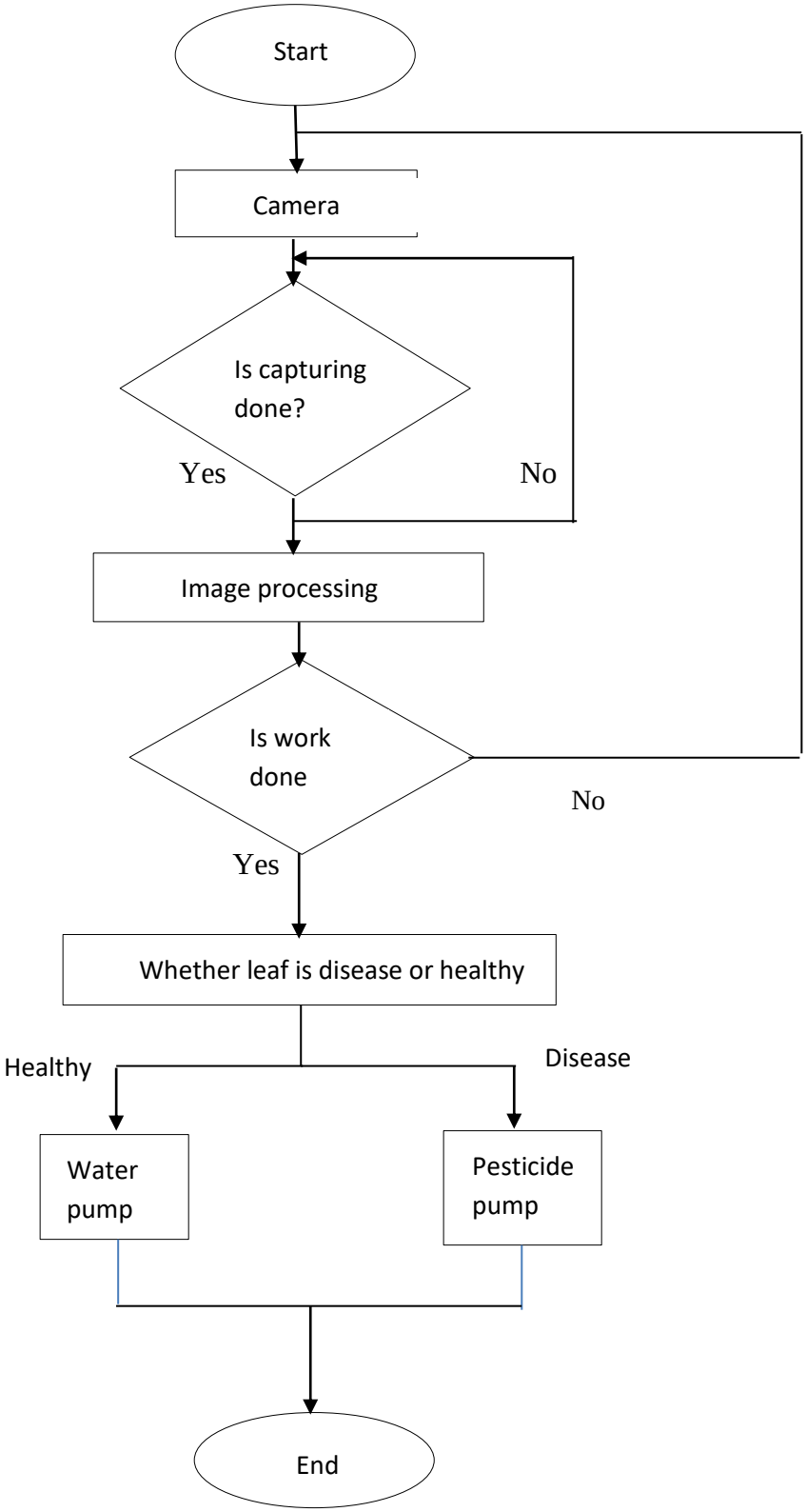
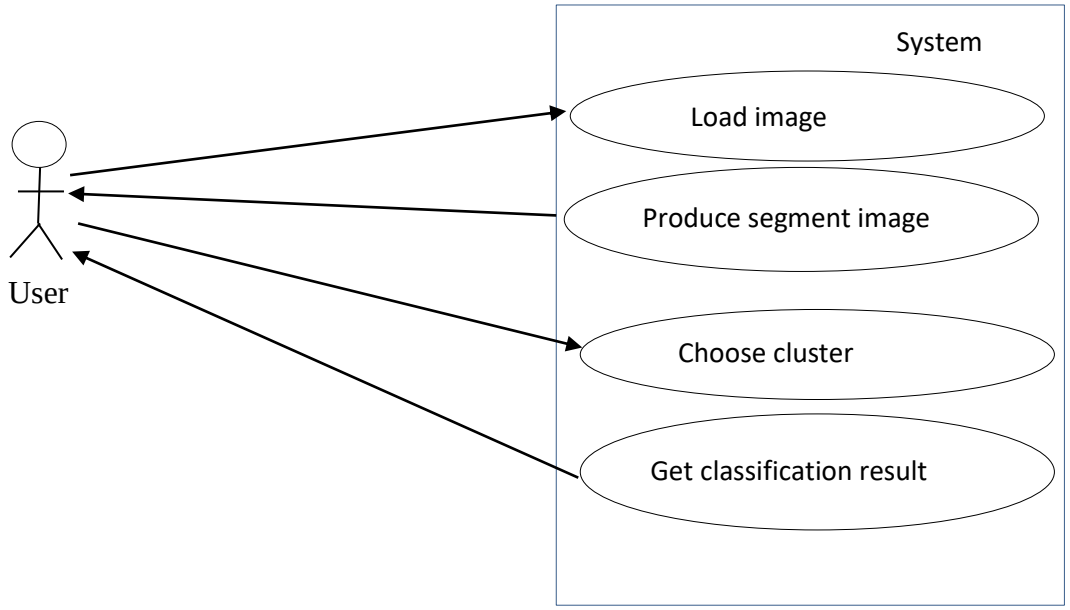
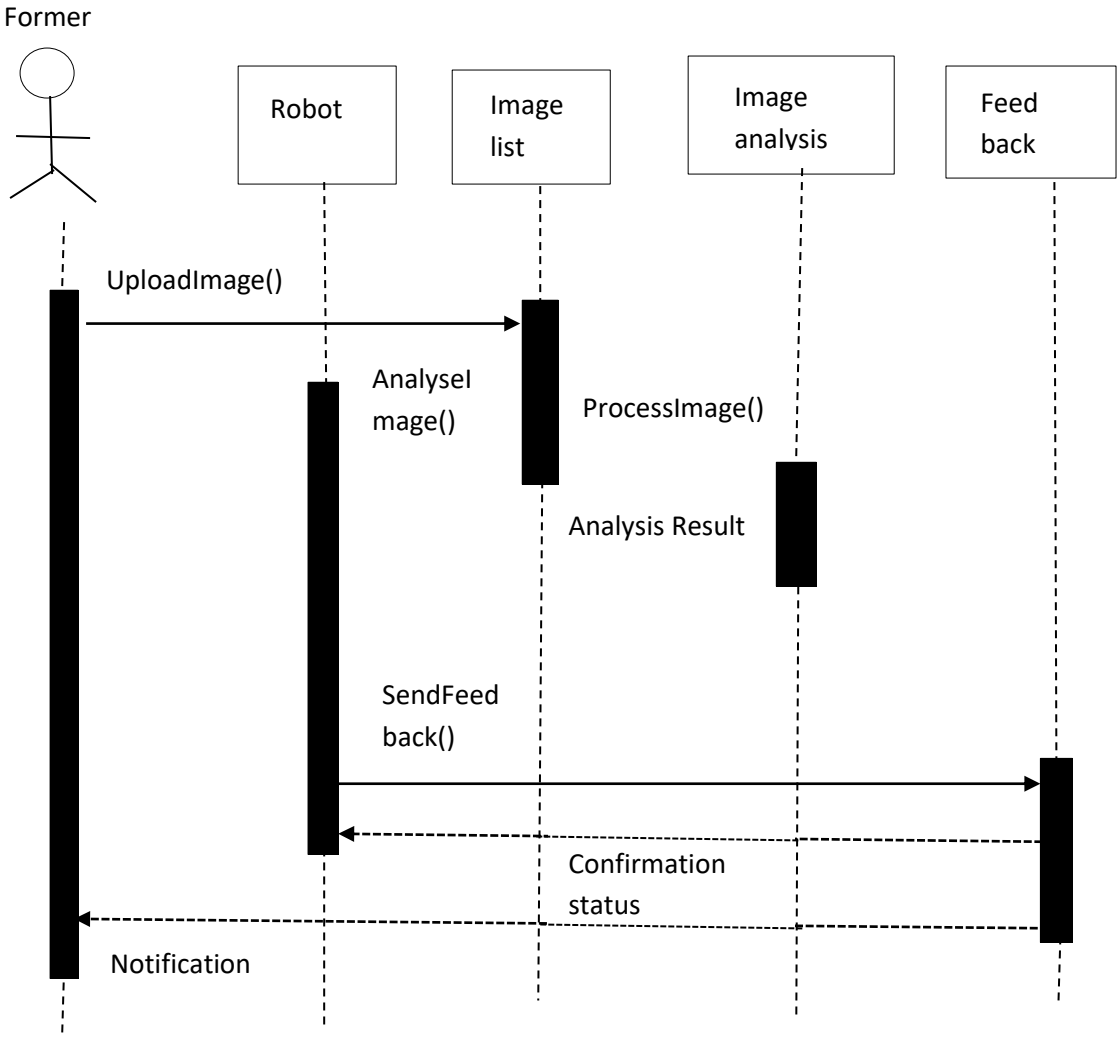


Figure 3.7: Flow diagram

USE CASE DIAGRAM



SEQUENCE DIAGRAM



CHAPTER 4

HARDWARE AND SOFTWARE REQUIREMENTS

Hardware Requirements

- Arduino
- Power supply
- Mobile Camera
- Battery
- DC motors
- Accelerometers
- Hybridge
- LCD display (Monitor as display)
- 2 Channel Relay
- ZigBee

Software Requirements

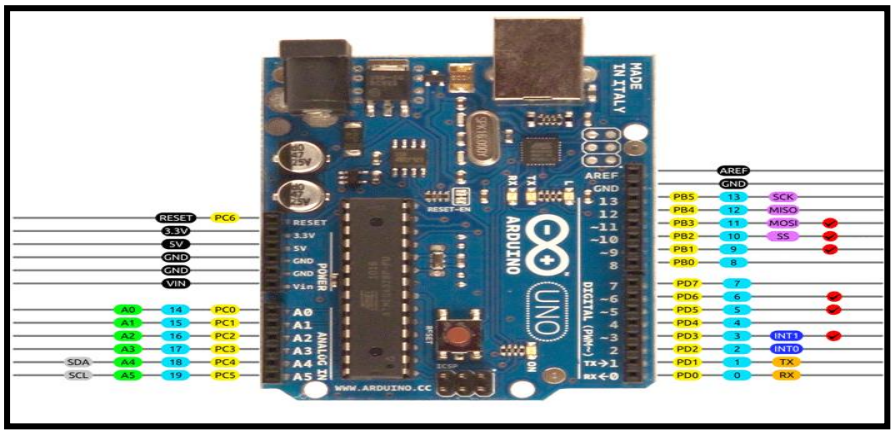
- Python 2.7 version
- Open CV

4.1 HARDWARE REQUIREMENTS

• ARDUINO UNO

Arduino is an open source computer hardware and software that designs single-board microcontrollers and microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical and digital world. The project's products are distributed as open-source hardware and software, which are licensed under the GNU Lesser General Public License (LGPL). Arduino boards are available commercially in preassembled form or by designing the kits with respect to different application.

The different types of Arduino Uno are Arduino Nano, Arduino Pro Minarine Mega, Arduino Due, and Arduino Leonardo.



.**How to use Arduino Board:** The 14-digital input/output pins can be used as input or output pins by using pin Mode (), digital Read () and digital Write () functions in Arduino programming. Each pin operates at 5V and can provide or receive a maximum of 40mA current and has an internal pull-up resistor of 20-50 K Ohms which are disconnected by default. Out of these 14 pins, some pins have specific functions as listed below:

1. **Serial Pins 0 (Rx) and 1 (Tx):** Rx and Tx pins are used to receive and transmit TTL serial data. They are connected with the corresponding ATmega328P USB to TTL serial chip.
2. **External Interrupt Pins 2 and 3:** These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value.
3. **PWM Pins 3, 5, 6, 9 and 11:** These pins provide an 8-bit PWM output by using analog Write () function.
4. **SPI Pins 10 (SS), 11 (MOSI), 12 (MISO) and 13 (SCK):** These pins are used for SPI communication.
5. **In-built LED Pin 13:** This pin is connected with built-in LED. When pin 13 is high, then LED will ON and when 13 pins is low, it represents led is OFF.

There are 14digital pins and 6 analog input pins, each of which provides 10 bits of resolution, i.e. 1024 different values. They measure from 0 to 5 volts but this limit can be increased by using AREF pin with analog reference () function.

Analog pin 4 Serial Data Access (SDA) and pin 5 scratch controlling Arduino (SCA) also used for TWI communication using wire library. Arduino Uno has a couple of other pins as explained below:

1. **AREF:** Used to provide reference voltage for analog inputs with analog Reference () function.
2. **Reset Pin:** Making this pin LOW, resets the microcontroller.

Arduino can be used to communicate with a computer, another Arduino board or other microcontrollers. The ATmega328P microcontroller provides UART TTL (5V) serial communication which can be done using digital pin 0 (Rx) and digital pin 1 (Tx). An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The ATmega16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, a in file is required.

- ## POWER SUPPLY

power supply is an electrical device that supplies electric power to an electrical load. The primary function of a power supply is to convert electric current from a source to the correct voltage, current, and frequency to power the load. As a result, power supplies are sometimes referred to as electric power converters. Some power supplies are separate standalone pieces of equipment, while others are built into the load appliances that they power. Examples of the latter include power supplies found in desktop computers and consumer electronics devices. Other functions that power supplies may perform include limiting the current drawn by the load to safe levels, shutting off the current in the event of an electrical fault, power conditioning to prevent electronic noise or voltage surges on the input from reaching the load, power-factor correction, and storing energy so it can continue to power the load in the event of a temporary interruption in the source power.

- ## DC MOTOR WITH GEAR

The DC motors don’t have enough torque to drive a robot directly by connecting wheels in it. Gears are used to increase the torque of dc motor on the expense of its speed**.**

L293 and L293D are quadruple high-current half-H drivers. The L293 is designed to provide bidirectional devices drive currents of up to 1 A at voltages from 4.5 V to 36 V. The L293D is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V. Both devices are designed to drive inductive loads such as relays, solenoids, DC and bipolar stepping motors, as well as other high-current/high-voltage loads in positive-supply applications. Each output is a complete totem-pole drive circuit, with a Darlington transistor sink and a pseudo-Darlington source. Drivers are enabled in pairs, with drivers 1 and 2 enabled by 1,2EN and drivers 3 and 4 enabled by 3,4EN. The L293 and L293D are characterized for operation from 0°C to 70°C.

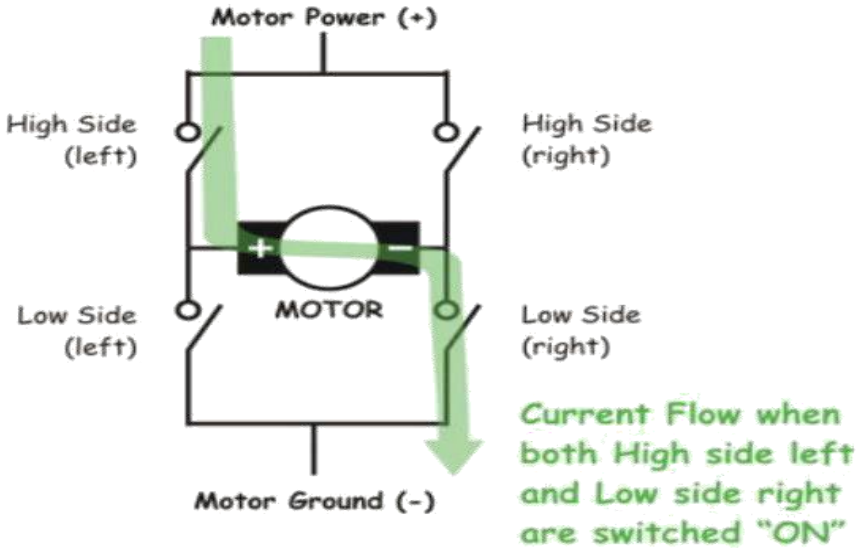
Whenever a robotics hobbyist talk about making a robot, the first thing comes to his mind is making the robot move on the ground. And there are always two options in front of the designer whether to use a DC motor or a stepper motor. When it comes to speed, weight, size, cost. DC motors are always preferred over stepper motors. There are many things which you can do with your DC motor when interfaced with a microcontroller. For example you can control the speed of motor; you can control the direction of rotation rather of being cheap, they only increase the size of the design board, which come is sometimes not required so using a small 16 pin IC is preferred for this purpose. In this part of tutorial we will learn to interface and control of a DC m t r with a microcontroller. Usually H-bridge is preferred way of interfacing a DC motor. These days many IC manufacturers have H-bridge motor driver available in the market

like L293D is set used H- Bridge driver IC. H-bridge can also be made with the help of transistors and MOSFETs etc.

- **H-Bridge**

The name "H-Bridge" is derived from the actual shape of the switching circuit which controls the motion of the motor. It is also known as "Full Bridge". Basically there are four switching elements in the H-Bridge as shown in the figure below.

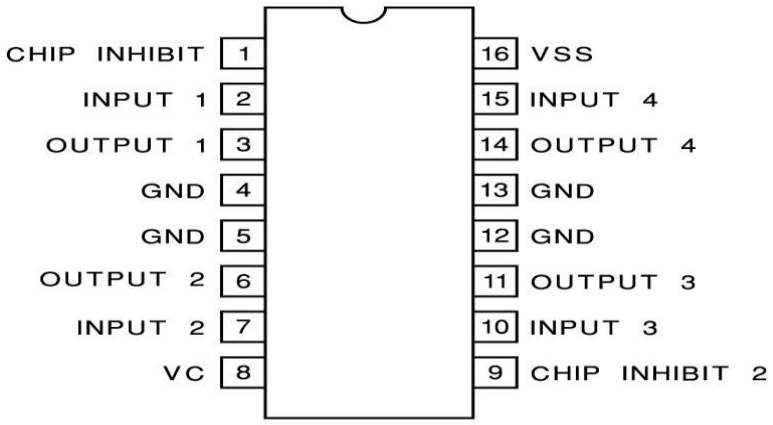
As you can see in the figure above there are four switching elements named as "High side left", "High side right", "Low side right", "Low side left". When these switches are turned on in pairs motor changes its direction accordingly. Like, if we switch on High side left and Low side right then motor rotate in forward direction, as current flows from P\power supply through the motor coil goes to ground via switch low side right. This is shown in the figure below.



When you switch on low side left and high side right, the current flows in opposite direction and motor rotates in backward direction. This is the basic working of H-Bridge. We can also make a small truth table according to the switching of H-Bridge explained above. As already said, H-bridge can be made with the help of transistors as well as MOSFETs; the only thing is the power handling capacity of the circuit. If motors are needed to run with high current then lot of dissipation is there. So head sinks are needed to cool the circuit. Now you might be thinking why I did not discuss the cases like High side left on and Low side left on or high side right on and low side right on. Clearly seen in the diagram, you don't want to burn your power supply by shorting them. So that is

why those combinations are not discussed in the truth table. So we have seen that using simple switching elements we can make our own H-Bridge, rather option we have is using an IC based H-bridge driver.

❖ **L293D Dual H-Bridge Motor Driver**



Two DC motors which can be controlled in both clockwise and counter clockwise L293Da dual H-Bridge motor Vision Robo driver, so with one IC. We can interface direction and if you have motor with fix direction of motion. You can make use of all the four I/O is to connect up to four DC motors. L293D has output current of 600mA and peak output current of 1.2A per channel. Moreover, for protection of circuit from back EMF output diodes are included within the IC. The output supply (VCC2) has a wide range from 4.5V to 36V, which has made L293D a best choice for DC motor driver. A simple schematic for interfacing a DC motor using L293D is shown below

As you can see in the circuit, three pins are needed for interfacing a DC motor (A, B, Enable). If you want the o/p to be enabled completely then you can connect Enable to VCC and only 2 pins needed from controller to make the motor work. As per the truth mentioned in the image above its fairly simple to program the microcontroller. Its also clear from the truth table of BJT circuit and L293D the programming will be same for both of them, just keeping in mind the allowed combinations of A and B.

- **LCD DISPLAY**

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven

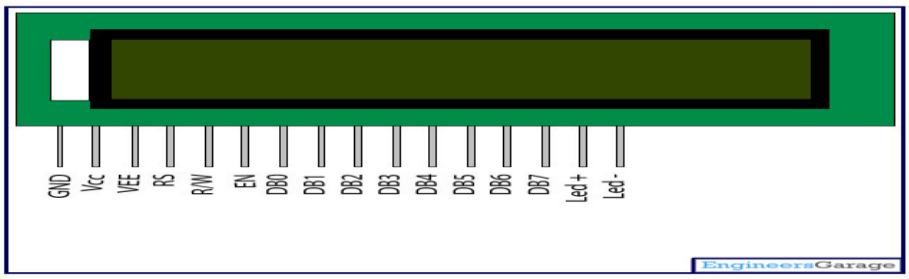
segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

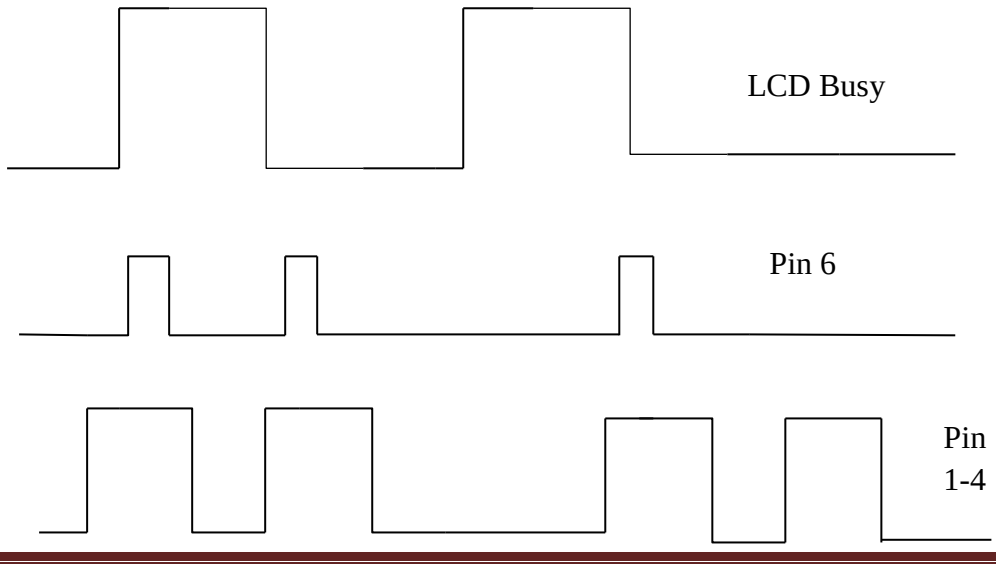
The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. Click to learn more about internal structure of a LCD

❖ **Features**

- E-blocks compatible
- Low cost
- Compatible

❖ **Pin Diagram:**





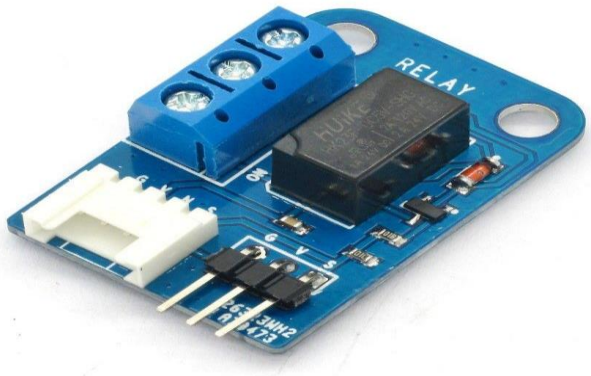
The first command to be sent to the LCD must be 'Function Set' [to setup the LCD], this is usually followed by 'Display Control' and then 'Clear Display'. According to 'Entry Mode Set' after each character is sent to the LCD, the position of the cursor changes [by default it is incremented].

- **Zigbee**

In 21st century, wireless sensor networks are becoming necessary and seen as indispensible in various medical and telecommunication equipment's, smart energy resources, home automation products etc., which require monitoring and control. Zigbee is a wireless technology, which communicates on the principle of IEEE 802.15.4 standard. IEEE 802.15.4 is a standard that states the details for the lower layers of the communication. This standard focuses on the low-cost and low power communication. Because of Zigbee's low cost, low power consumption and ability to connect in a mesh network, it is becoming more optimum solution for monitoring and control applications.

Ability to connect in mesh network allows Zigbee to provide more range compared to other wireless technologies such as "INFRARED", "BLUETOOTH" etc. In addition, it also provides high reliability of the data reproduced at receiver. It also consumes less power in communicating data between its transmitter and receiver, which means longer life with smaller batteries. The primary reason for low power consumption in Zigbee devices is that they work on very small duty cycle that helps them to have a longer life span. Variation in duty cycle depends upon the application usage, for example, some applications need data more frequently like in health centers compared to others such as home automation systems.

- **CHANNEL RELAY**



The 1 Channel 5V Relay Module provides a single relay that can be controlled by any 5V digital output from your microcontroller. The relay is accessible using screw

terminals and can handle up to 2A of current. A handy LED indicates the status of the relay. This module provides a standard 3 pin Signal/Voltage/Ground male header and a 4 pin"Grove"connector.

Specification

- Number of I/O Channels: 1
- Type: Digital
- Switching capacity available by 10A in spite of small size design for high-density P.C. board mounting technique.
- Control signal: TTL level
- Max. Allowable Voltage: 250VAC/110VDC
- Max. Allowable Power Force: From C(800VAC/240W), From A(1200VA/300W)
- UL, CUL, TUV recognized.

4.2 SOFTWARE REQUIREMENTS

- **PYTHON 2.7**

Python is an interpreted, high-level, general-purpose programming language. Created by Guido van Rossum and first released in 1991, Python's design philosophy emphasizes code readability with its notable use of significant whitespace. Its language constructs and object-oriented approach aims to help programmers write clear, logical code for small and large-scale projects. Python is dynamically typed and garbage-collected. It supports multiple programming paradigms, including procedural, object-oriented, and functional programming. Python is often described as a "batteries included" language due to its comprehensive standard.

Python 2.7's end-of-life date was initially set at 2015 then postponed to 2020 out of concern that a large body of existing code could not easily be forward-ported to Python 3. In January 2017, Google announced work on a Python 2.7 to Go trans compiler to improve performance under concurrent workloads.

Python uses dynamic typing, and a combination of reference counting and a cycle-detecting garbage collector for memory management. It also features dynamic name resolution (late binding), which binds method and variable names during program execution.

- The assignment statement (token '=', the equals sign). This operates differently than in traditional imperative programming languages, and this fundamental mechanism (including the nature of Python's version of variables) illuminates many other features of the language. Names may be subsequently rebound at any time to objects of greatly varying types, including strings, procedures, complex objects with data and methods, etc. Successive assignments of a common value to multiple names, e.g., `x = 2`; `y = 2`; `z = 2` result in allocating storage to (at most) three names and one numeric object, to which all three names are bound. Since a name is a generic reference holder it is unreasonable to associate a fixed data type with it. However at a given time a name will be bound to some object, which will have a type; thus there is dynamic typing.
- The `if` statement, which conditionally executes a block of code, along with `else` and `elif` (a contraction of else-if).
- The `for` statement, which iterates over an iterate able object, capturing each element to a local variable for use by the attached block.
- The `while` statement, which executes a block of code as long as its condition is true.
- The `try` statement, which allows exceptions raised in its attached code block to be caught and handled by `except` clauses; it also ensures that clean-up code in a `finally` block will always be run regardless of how the block exits.
- The `raise` statement, used to raise a specified exception or re-raise a caught exception.
- The `class` statement, which executes a block of code and attaches its local namespace to a class, for use in object-oriented programming.
- The `def` statement, which defines a function or method.
- The `with` statement, from Python 2.5 released on September 2006,[61] which encloses a code block within a context manager (for example, acquiring a lock before the block of code is run and releasing the lock afterwards, or opening a file and then closing it), allowing Resource Acquisition Is Initialization (RAII)-like behavior and replaces a common try/finally idiom.[62]

- The `pass` statement, which serves as a NOP. It is syntactically needed to create an empty code block.
- The `assert` statement, used during debugging to check for conditions that ought to apply.

- **OpenCV**

OpenCV (Open source computer vision) is a library of programming functions mainly aimed at real-time computer vision. Originally developed by Intel, it was later supported by Willow Garage then It seez (which was later acquired by Intel). The library is cross-platform and free for use under the open-source BSD license.

In the early days of OpenCV, the goals of the project were described as:

- Advance vision research by providing not only open but also optimized code for basic vision infrastructure. No more reinventing the wheel.
- Disseminate vision knowledge by providing a common infrastructure that developers could build on, so that code would be more readily readable and transferable.
- Advance vision-based commercial applications by making portable, performance-optimized code available for free – with a license that did not require code to be open or free itself.

OpenCV's application areas include:

- 2D and 3D feature toolkits
- Ego motion estimation
- Facial recognition system
- Mobile robotics
- Motion understanding
- Object identification
- Segmentation and recognition
- Stereopsis stereo vision: depth perception from 2 cameras
- Structure from motion (SFM)
- Motion tracking

CHAPTER 5

IMPLEMENTATIONS

An implementation is a realization of an application or execution of a plan, idea, model, design, specification, standard, algorithm or policy.

5.1 HARDWARE CODING

Here we are moving the robot either by Gesture or by Voice.

- A gesture is a form of non-verbal communication or non-vocal communication in which visible bodily actions communicate particular messages. Gesture includes the hands, face or other parts of the body. Here we are using hand gesture.

```
void GESTURE_MODE(){
        ……..
        while(1){
        Serial.print(analogRead(xpin));
        Serial.print("\t");
        Serial.print(analogRead(ypin));
        Serial.print("\t");
        ……
        if(analogRead(xpin)>400){
                Serial.println("FORWORD");
                FORWORD();
                }
        else if(analogRead(xpin)<300){
                Serial.println("REVERSE");
```

```
                REVERSE();
                }
        else if(analogRead(ypin)<300){
                Serial.println("LEFT");
                LEFT();
                }
        else if(analogRead(ypin)>400){
                Serial.println("RIGHT");
                RIGHT();
                }
        else{
                Serial.println("STOP");
                STOP();
                }
        serialEvent();
        }
}
```

- Voice recognition system enable consumers to interact with technology simply by speaking to it, enable hands-free requests, reminders and other simple tasks. Here we are using voice mode to move robot.

```
void VOICE_MODE(){
……………………}
```

5.2 SOFTWARE CODING

Here we are using Python code to detect the leaves condition.

- To store the captured image we are using below code.

```
image = Image.open(cwd+"/save_model/images.jpg")
photo = ImageTk.PhotoImage(image)
label = Label(root, image=photo)
label.image = photo  # keep a reference!
label.pack()
```

- Using this below command we are going to process the stored images.

```
def image_preprocessing(file):
…….
```

- After processing of images we are going to classify images using below command

```
def fd_histogram(image, mask=None):
```

- We are using below code to find diseased or healthy leaves.

```
if leaf_class[0]=='Diseased':
        print('D')
        ArduinoSerial = serial.Serial('COM7',9600)
        ArduinoSerial.write('D')
        time.sleep(1)
elif leaf_class[0]=='Healthy':
        print('H')
        ArduinoSerial = serial.Serial('COM7',9600)
        ArduinoSerial.write('H')
        time.sleep(1)
else:
```

```
ArduinoSerial = serial.Serial('COM7',9600)

ArduinoSerial.write('2')
```

- Results of leaves condition is sent to former's respected mobile through Twilio application. Here is the code for sending messages to user mobile.

```
def callback():

    account_sid = 'ACcd8fdfb901fda1030763642fc5445758' # Found on Twilio Console Dashboard

    auth_token = '476aa14eb644b5d3d9f091d500da1661'

    myPhone = '+919206622909' # Phone number you used to verify your Twilio account

     TwilioNumber = '+12138619956'

    client = Client(account_sid, auth_token)
```

CHAPTER 6

TESTING

Testing is a document which contains a summary of test activities and final test results. An assessment of how well testing is performed.

TYPES OF TESTS

- **Unit Testing:**

  Unit testing involves the design of test cases that validate that the internal program logic is functioning properly, and that program inputs produce valid outputs.

- **Integration Testing:**

  Integration tests are designed to test integrated software components to determine if they actually run as one program.

- **Black Box Testing:**

  Black Box Testing is testing the software without any knowledge of the inner workings, structure or language of the module being tested.

- **White Box Testing:**

  White Box Testing is a testing in which in which the software tester has knowledge of the inner workings, structure and language of the software, or at least its purpose.

Functional Testing

- Valid Input : identified classes of valid input must be accepted.
- Invalid Input : identified classes of invalid input must be rejected.
- Functions : identified functions must be exercised.
- Output : identified classes of application outputs must be exercised.

System Testing:

System testing ensures that the entire integrated software system meets requirements. It tests a configuration to ensure known and predictable results.

TEST CASES:

Model	Input	Output	Result
User	Gesture or Voice	Robot will move	Pass
	Gesture and voice both	Robot will not move	Fail
Mobile	Capture an image	Upload image	Pass
	File selection	Please select a file	Fail/please choose any image
Wi-Fi	Connect wi-fi	Get result	Pass
	Not connected	No result	Fail/please connect any wi-fi
Color	RGB	Detects whether a leaf is healthy or not	Pass
	Any Color	Error	Fail

CHAPTER 7

RESULTS AND DISCUSSIONS

The results of the project are as follows:

i. Device will move either by gesture or voice using Bluetooth and voice control bot applications.
ii. Capture the leaf image by using mobile camera and send it to the laptop.
iii. Detects whether captured image is diseased or healthy, if it is healthy water pump will be on otherwise pesticide pump will be turn on.
iv. The message of results will send to user mobile by using twilio application.

The setup of the project is as shown in the following figure.

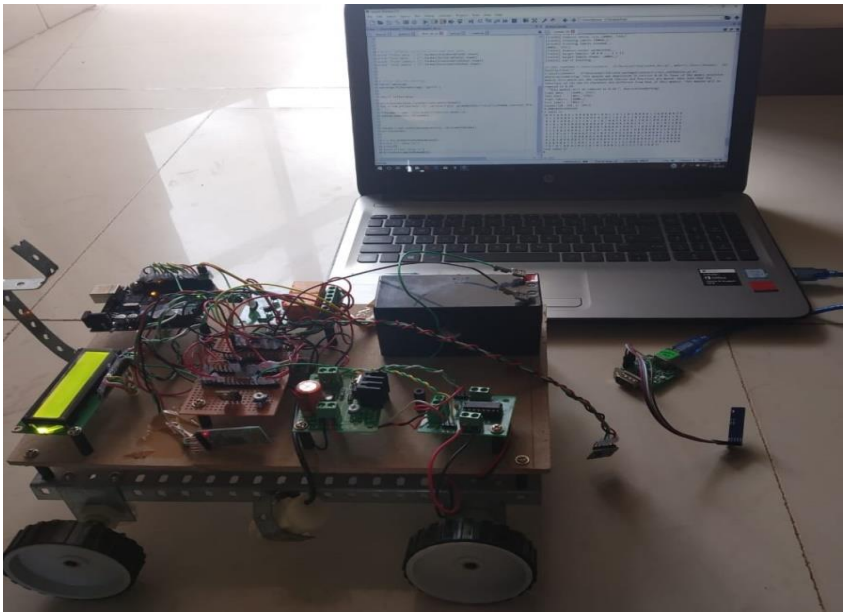


Figure 7.1: Setup of Project

Arduino is an open source computer hardware and software that designs single-board microcontrollers and microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical and digital world. A power supply is an electrical device that supplies electric power to an electrical load. The primary function of a power supply is to convert electric current from a source to the correct voltage, current, and frequency to power the load.

LCD (Liquid Crystal Display) screen is an electronic display module. The command register stores the command instructions given to the LCD. The data register stores the data to be displayed on the LCD.

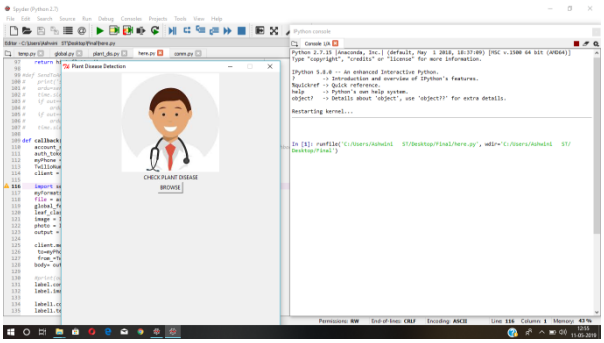
H-Bridge, which is controls the motion of the motor. When H-bridge switches are turned on in pairs motor changes its direction accordingly. When you switch on left and right, the current flows in opposite direction and motor rotates in backward direction.

A DC motor is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. A relay is an electrically operated switch that can be turned on or off, letting the current go through or not, and can be controlled with low voltages, like the 5V provided by the Arduino pins

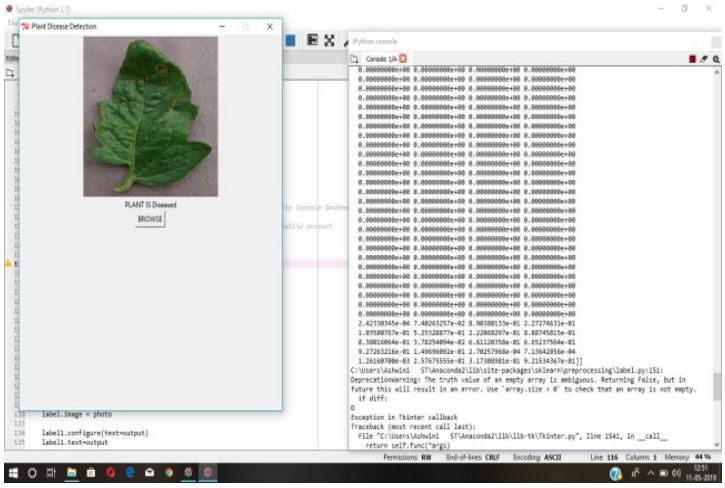
Accelerometer is a kind of sensor. We used this for the hand gesturing. It can work by giving analog data in left, right, forward and backward directions.

Zigbee is a wireless technology. Zigbee low cost, low power consumption and ability to connect in a mesh network, it is becoming more optimum solution for monitoring and control applications.

To execute this project, we are using Spyder 2.7 version software. This window is shown below. After opening the window, we running the project code. We get the browser window. This will be shown below.



After this we browse the captured leaf pictures then it send to the image processing unit, it find healthy or diseased leaf and verified and display the result on the screen.



At the end the message will send to the respected user by using the Twilio.

CHAPTER 8

ADVANTAGES, DISADVANTAGES AND APPLICATIONS

ADVANTAGES

i. Avoids professional training to control moving robots.
ii. Reduces human effort by simplifying the tasks.
iii. Saves time and boosts the yield of crops.
iv. Avoid crop destruction caused by manual inspection.
v. Useful in field surveys.
vi. To increase the speed and accuracy of detection as well as classification of leaf diseases.

DISADVANTAGES

i. Potential job losses.
ii. Initial investment costs.
iii. Hiring skilled staff.

APPLICATIONS

i. We can find its use in smart field planning.
ii. It can be used in agriculture field to improve the crop yield.
iii. It can also be used in Horticulture.
iv. Used to distinguish the disease.

CONCLUSION AND FUTURE SCOPE

CONCLUSION

The Agricultural Robot with machine learning concept and image processing techniques will be used for early detection of the crop and respected pesticides will be sprayed using the agricultural robot.

This is the concept that is used in our paper that helps to detect the leaf disease that uses both machine learning and image processing. This concept is integrated in an advanced processor known as anaconda and this is integrated on the robot. The robot moves around the field capturing the image of the leaf and also monitors the field condition that is controlled using an android application. This robot helps in early detection of the disease and monitors the field condition that help the farmer in increasing the yield. In this project, we demonstrated only few types of diseases which were commonly caused and it can be extended for more disease in future. Here only a text message was sent to the farmer along with a robot can be sent to spray the pesticides to the plants automatically without human interaction.

FUTURE SCOPE

In future the proposed idea may provide safe, fast, accurate and cost effective alternatives to traditional manned systems. It contributes for better economic growth, increases exports and motivates to do agriculture. Further feature work can be extended by developing better segmentation technique, selecting better feature extraction and classification algorithms and NN's in order to increase the recognition rate of final classification process.

To improve recognition rate in classification process Artificial Neural Network, Bayes classifier, Fuzzy Logic and hybrid algorithms can also be used.