A

PROJECT PHASE - I

REPORT

ON

"Design and Implementation of AI Based Agri Robot"

Submitted by

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CERTIFICATE

This is to certify that

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Have successfully delivered a seminar on

“Design and Implementation of AI Based Agri Robot”

PROJECT GUIDE

Prof. Dr. S.S. Morade

Has submitted the project seminar report in the partial fulfillment of requirements of B.E. (Electronics and Telecommunication) course as expected by the Savitribai Phule Pune University for the academic year 2022-2023

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Chapter 1

INTRODUCTION

In recent years, technological innovation in the field of agriculture has advanced dramatically, and a new scientific field has emerged that effectively utilizes data to improve accuracy and agricultural productivity and minimize environmental impact. Farmers are increasingly turning to technology to address many pressing agribusiness issues, including: growing global shortage of food and dwindling agricultural workforce Surprisingly, agriculture, despite being the least digitalized, is showing momentum in agricultural technology development and commercialization.

Artificial Intelligence (AI) is starting to play a significant role in our daily lives, expanding our perceptions and our ability to change the environment around us. AI is a new technology in agriculture. AI-based devices and machines have taken today's agricultural systems to another level. The technology has improved crop production and improved real-time monitoring, harvesting, processing, and marketing the latest technology in automation systems using agricultural robots and drones has made a significant contribution to the agriculture-based sector. Various high-tech computer systems have been developed to determine a variety of important parameters such as weed detection, yield detection, crop quality and many other techniques. Image processing is categorized as signal processing and is commonly used to make multiple modifications to an image in order to enhance it or extract desired data or information from the acquired image. The process is straightforward, starting with a camera capturing an image, then using an image processing system such as deep learning to process the captured image and derive the required information from it.

Image processing is done using the steps given below:

I. Image acquisition through image acquiring tools.
II. Recognizing and manipulating the image captured.
III. Output of the same can be a modified image or extracted information from it.

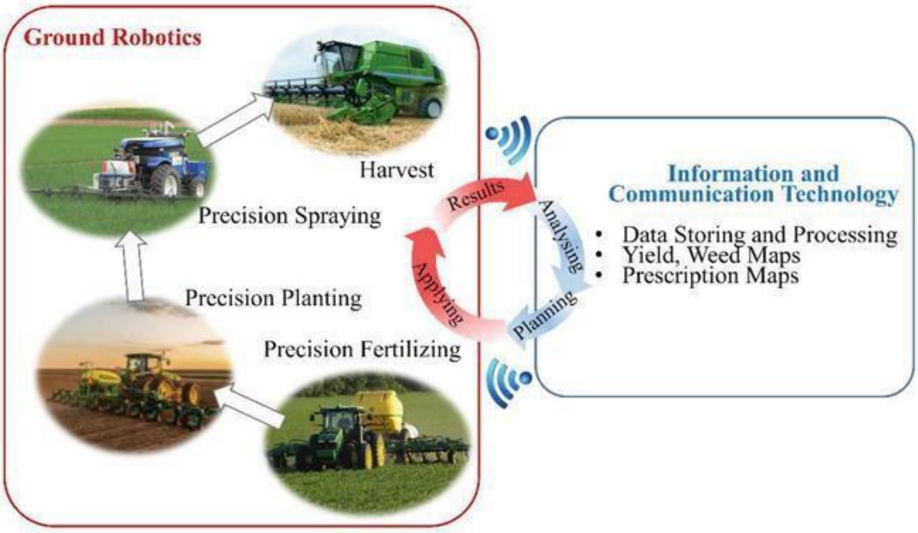

Fig. 1.1 Automation in Agriculture

The aim of this research is to develop a low-cost agricultural robot for spraying herbicides on farmland and recording their paths. To keep costs as low as possible, the herbicide spray robot prototype was assembled from simple, inexpensive, off-the-shelf components. The agricultural robot developed for this study focuses on four applications:

I. intelligent robot to spray Herbicides.
II. sense the grass density based on decision of nozzle adjustment.
III. sense the obstacles in front of it and take decision.
IV. memorize/record the path.

Fig. 1.2 - Manual herbicide spraying

Chapter 2

LITERATURE SURVEY

1] Autonomous Herbicides Spraying System Using AI and IOT - Anirudha.S. Tadpatri, Pramod P Ugargol, Rakesh Shridhar.

This paper describes a system build and modeling an autonomous spraying system using AI. For navigation system they used controller board, GPS, Compass module for retrieving GPS coordinates and heading data, motor driver and motors. For spraying they take input from image processing system. image processing is done using the YOLO algorithm. YOLO is an object detection model that is dynamic and compact and provides high performance considering its size and it has been continually improving. Object detection makes use of an object detector model that takes input images and extracts the features of train images subsequently feeding it to the prediction system to detect necessary objects of required classes. There are two classes considered; Healthy plants and weeds. The trained model can detect healthy plants as well as weeds. The features are bounded by colored boxes. The YOLO employs an end-to-end differential network to predict the boxes bounding the object and labelling them accordingly [1].

2] Development and Automation of Robot with Spraying Mechanism for Agricultural Applications - Mitul Raval, Aniket Dhandhukia, Supath Mohile. -

This paper describes design and construction of an autonomous mobile robot for use in pest control and disease prevention applications in commercial Farm. Pesticide spraying mechanism designing the chassis for robot. The process of pesticide spraying involves large amount of human labor thus making a greater number of -humans to get prone by the diseases. There is no other alternative to manual spraying in Indian open farms. Over usage of pesticides can cause degradation in soil. This happens mostly because the farmer hires labor for the work and the labor is unskilled. Until now the technologies used in farms are outdated and the present farming needs revolutionary technique of farming [2].

3] Development and Automation of Robot with Spraying Mechanism for Agricultural Applications - Palash Patil, Vaibhav Pardhi, Prashant Balkhande.

Pesticide spraying mechanism with the help of current robotics technology is the main purpose of this project which would help the farmer in his day to day spraying activity. This project is basically a robot with an attached spraying mechanism and is divided in two parts. Robotic Chassis Robotic Arm with spraying mechanism [3].

4] Weed Detection Using Image Processing Ajinkya Paikekari, Vrushali Ghule, Rani Meshram, V.B. Raskar. -

Design of economically viable robotic systems for grass cutting, crop scouting and autonomous weeding. Color segmentation is the method used to separate the crop (which also include weed) from the background. The method helps in separating all the visually distinguishable colors from one another. There is a trade-off between the block size and gained accuracy. If the block size is too large, frequency estimation can be faulty due to the existence of both crop and weed in the same block. If it is too small, the frequency cannot be calculated correctly because of an inadequate number of edges in a block. A small block may detect the inner part of the weed leaf as the crop because of a smaller number of edges in it. In an image, an edge is a curve that follows a path of rapid change in image intensity. Edges are often associated with the boundaries of objects in a scene. Edge detection is used to identify the edges in an image. To detect edges properly we must convert the color segmented image into the gray scale image.

In choosing the threshold value we need to take care because its value depends on two factors. They are: a) Type of weed present b) Type of crop the above factors affect the threshold value in this way: if we have narrow crop leaves and wide weed leaves then we can say that weed has more edge frequency than then crop, so here the threshold value will be more. Otherwise, the threshold value will be less. In this paper, we take the case of corn crop where the edge frequency of weed is more than that of the crop [4].

5] Amrutha A. Aware, Kavitha Joshi," Crop and Weed Detection Based on Texture and Size Features and Automatic Spraying of Herbicides," -

A pesticide application mechanism using current robotic technology is the main objective of this project to assist farmers in their daily application activities. The project is basically a robot with a spray mechanism attached and is divided into two parts. Robot chassis Robot arm with spray mechanism [5].

6] Autonomous Herbicide Spraying System using AI and IoT - Prajwal B, Rakesh Shridhar, Anirudha S Tadpatri Pramodh P Ugargol, Ajjaiah H B M -

The proposed system consists of three main parts. The first is image capture, which can be done with any kind of digital camera, including her regular webcam. The camera should be installed perpendicular to the ground. In this case, a webcam was installed on the chassis of the herbicide sprayer at a height of 1.20 meters from the ground. At this height, each output image covers approximately one line of what is suitable for the purpose and he two sides. Note that image acquisition was performed under naturally varying lighting conditions to assess the robustness of the algorithm. The webcam output image was in RGB format with a size of 640*480 pixels. The captured images are then processed in the LabVIEW environment to locate weeds in the images. The final part is to apply the herbicide to the desired location. To do this, an electric nozzle must be attached to the chassis. The number of these nozzles depends on the required accuracy. Three nozzles were used in this study. The central nozzle covers the row and the other two cover the sides of the row. The objective is to find weeds in the cornfield [6].

7] Automatic Weed Detection and Smart Herbicide Sprayer Robot. G.Y. Rajaa Vikhram, Rakshit Agarwal, Rohan Uprety, V.N.S. Prasanth –

The process started by capturing an image from the Raspberry Pi camera. The image is then converted to grayscale using OpenCV's cv2.cvtColor(). Then mask the image with green by specifying a masking range of (36,0,0) (86,255,255) with the cv2.inRange() function. After that I only get the green part of the image. Then the image is converted to black and white by default. Black pixels represent the background image and white pixels represent the green image. Calculate the threshold by providing multiple weed images. In the case of weeds, the threshold is high due to the wide leaves. Therefore, we set a condition that if the threshold of the input image is greater than the set threshold, then the image is a weed image. Otherwise, there are no weeds in the image. The assumed threshold here is about 90000.

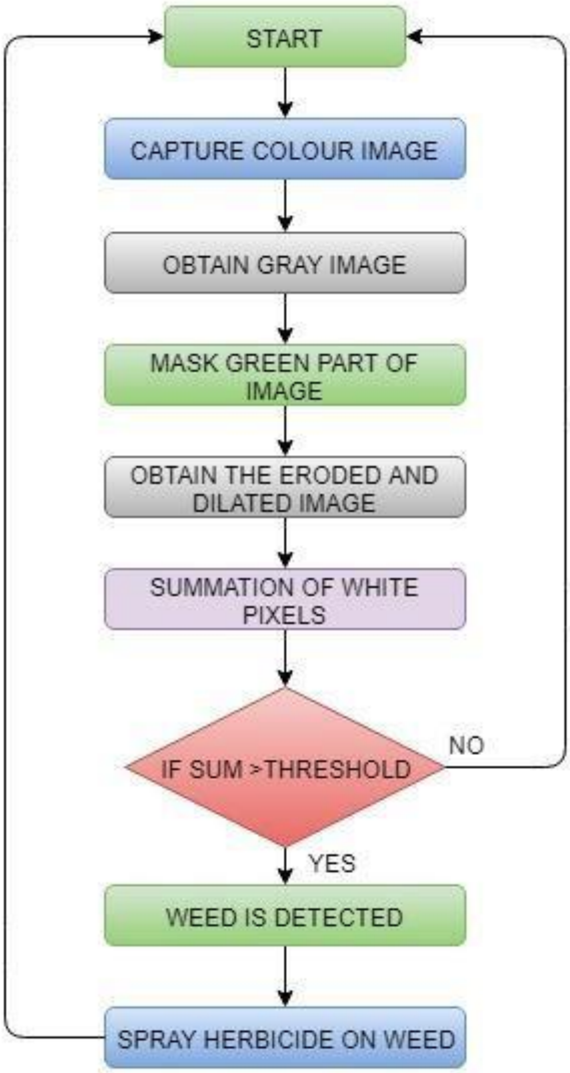

Fig 2.1: Flowchart of the algorithm

Result: -

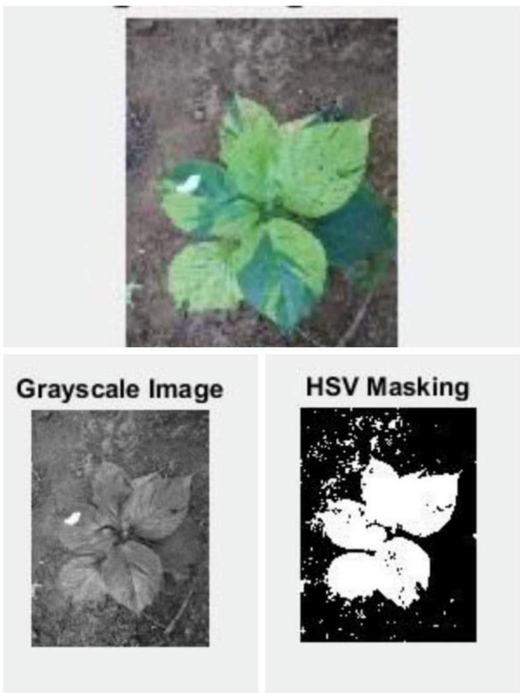

Fig 2.2: Different stages of image processing of weed plant

Calculations for detecting weeds between plots have been effectively performed, and models of automatic weed detection and intelligent herbicide application robots have been sketched and effectively updated. The robot included a device that could gradually increase herbicide application to the identified weeds for proper application [7].

8] Bonaccorso, F.; Muscato, G.; Baglio, S. Laser range data scan-matching algorithm for mobile robot indoor self-localization. In Proceedings of the World Automation Congress (WAC), Puerto Vallarta,

All point-to-point algorithms needs to associate each point in the actual scan with one in the previous one. Moreover, each point can require all points in the other scan to be checked. Some search restrictions can reduce computational costs.

Two successive local maps are analyzed in order to extract features of the environment than a matching of the common features is made to estimate the relative displacement between the starting point (1st Local Map) and the new position (2nd Local Map). The approach that will be shown is only based on LRF data. [8].

9] Tony E. Grift, Design and development of Autonomous robots for agricultural applications-

One of the main aspects of agricultural robotics is concerned with the substitution of the human workforce by field robots or mechanized systems that can handle the tasks more accurately and uniformly at a lower cost and higher efficiency. Weed control and precise spraying are perhaps the most demanded applications for agricultural field robots. In this regard, targeted spraying with robots for weed control application has shown acceptable results and reduced herbicide use to as little as 5%-10% compared to blanket spraying. While still not fully commercialized, various promising technologies for weed robots have been introduced and implemented over the past 10 years as the results of interdisciplinary collaborative projects between different international research groups and companies.   Some of the well-known names that are actively involved in the research and development for various types of weed control robots are the Wageningen University and Research Center. A real-time intelligent weed control system was introduced in for selective herbicide application to in-row weeds using machine vision and chemical application. A mini–robot to perform spraying activities based on machine vision and fuzzy logic has been described in. Development of an autonomous weeding machine requires a vision system capable of detecting and locating the position of the crop. Such a vision system should be able to recognize the accurate position of the plant stem and protects it during the weed control. A near-ground image capturing and processing technique to detect broad-leaved weeds in cereal crops under actual field conditions has been reported in the work of. Here the researchers proposed a method that uses color information to discriminate between vegetation and background, whilst shape analysis techniques were applied to distinguish between crop and weeds [9].

10] Cunha, M.; Carvalho, C.; Marcal, A.R.S. Assessing the ability of image processing software to analyse spray quality on water-sensitive papers used as artificial targets.

Digital image processing techniques for scanning WSP have been developed over many years. The advances in image processing technology have led to the development of different experimental or commercial software applications that produce indicators related to the spray quality based on the image processing of scanned WSP. Reviews of some of these programmed have been published, and their limiting factors investigated. This literature has revealed that there are still difficulties for these software tools in situations of high spray coverage with overlapping stains. Image processing techniques based on mathematical morphology have been used for granulometry studies and these have been adapted to develop a software application with low sensitivity to high coverage and overlapping stains software applications based on image processing of scanned WSPs is the lack of standard images that can be used to obtain absolute accurate measurements of the stain characteristics and number. The most common processes to test the accuracy of the image system results are the comparison with reference card with known coverage and droplet size microscopic measurements. and manual measurements on enlarged images of the artificial target [10].

Chapter 3

SYSTEM DETAILS

3.1 Block Diagram –

The robot's main parameter is the controller, which is nothing more than a Raspberry Pi. The input and output parameters of the robot are manipulated through controllers. However, before the robot can start working, the controller needs to be powered, so there is a control unit with a battery that powers the controller, as shown in the photo above. Upon receiving power from the battery controller, the controller begins accepting inputs and issuing outputs to the appropriate parameters. Essentially, the Agri Robot sprays weeds with herbicide, detects obstacles, records paths using a mobile application, and detects liquid levels.

The Agri Robot first gives some input to detect obstacles with an ultrasonic sensor, the controller detects obstacles such as grass, and then gives an output to Driver 1's cutter. The cutter is used to cut grass with obstacles in front. of Agri-robots. Then record the path with the Pi camera. Agri Robot's locomotion system was controlled via a mobile application. All movement parameters are designed in the mobile application, such as track record button, left, right, forward, backward, stop. For all this process control, the driver outputs the three motorcycles to match the movements of the agricultural robot. Next, measure the volume of herbicide solution with a level sensor. While recording a pass, the Agri robot takes pictures of unwanted weeds and grass and sprays herbicides to make them disappear or destroy them. In this herbicide application process, the controller powers the sprayer motor in Driver 2.

After recording the path, the robot should automatically move along this recorded path using the Ardupilot flight controller. For agricultural robot purposes, we will use 4 DC motors for the wheels and 2 DC motors for the spray pump and tank.

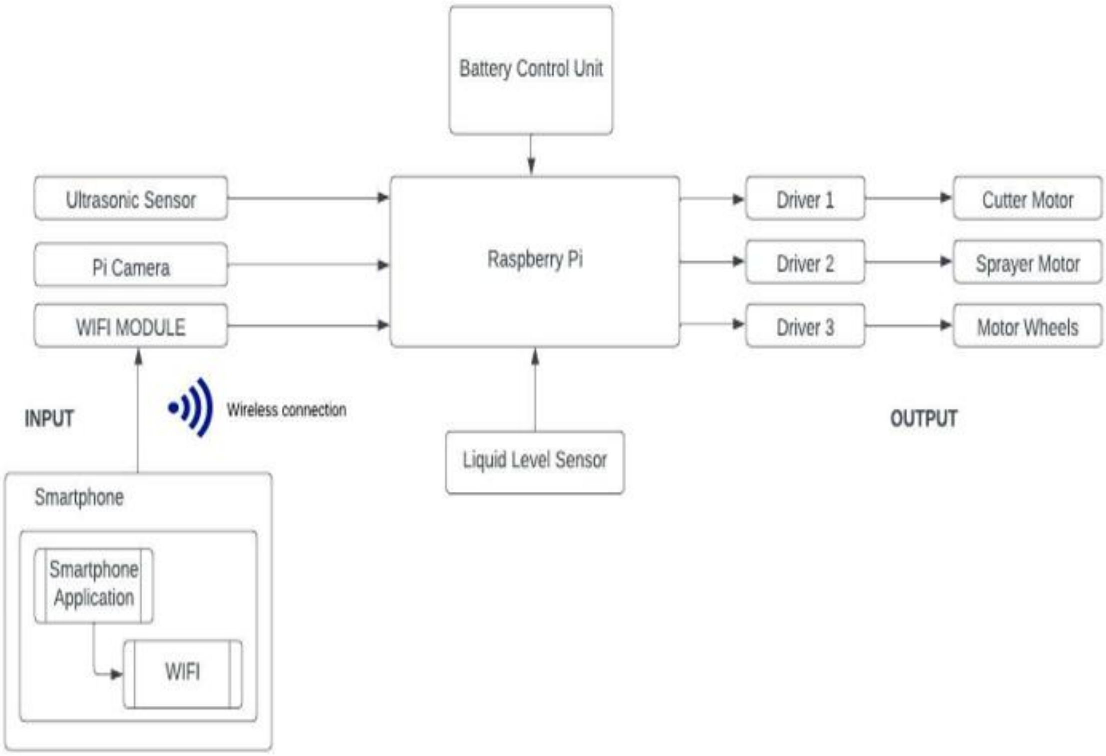

Fig 3.1: Block Diagram

3.2 Flowchart –

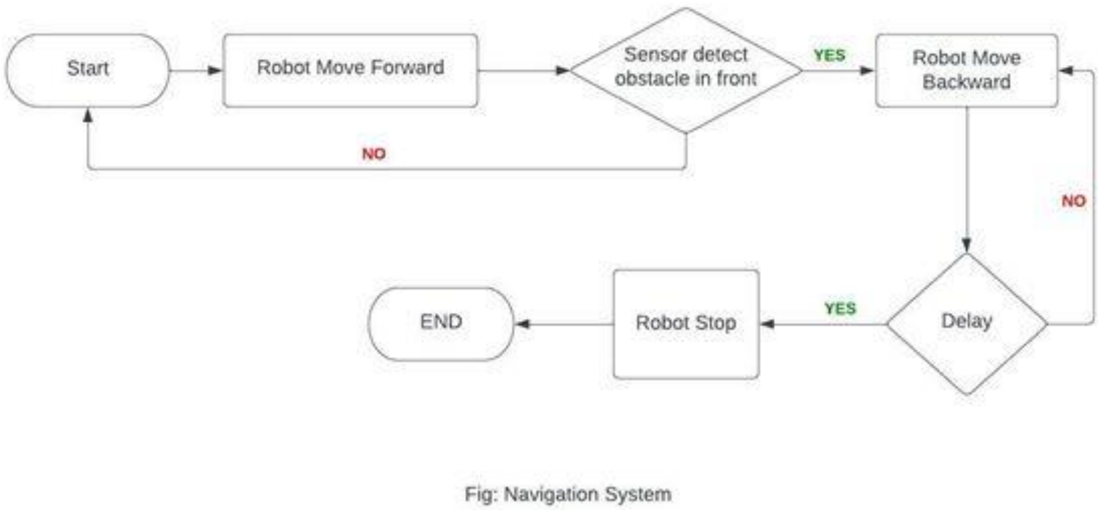

Fig.- 3.2

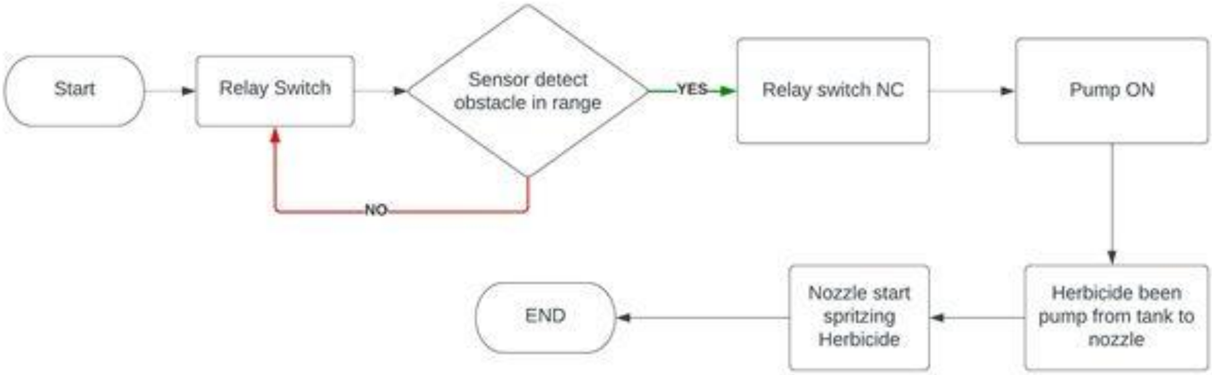

Fig: Spraying System Flowchart

Fig.- 3.3

3.3 Description of blocks –

I. Battery Control Unit –
The main use of the battery control unit is to store the supply and give it to the controller i.e., Raspberry Pi.

II. Raspberry Pi Controller –
The main parameter of the robot is the Raspberry Pi controller. The input and output parameters of robot are worked through the controller. Upon receiving power from the battery controller, the controller begins accepting inputs and issuing outputs to the appropriate parameters.

III. Inputs -

a) Ultrasonic Sensor –
The main function of the ultrasonic sensor in Agri Robot is to detect the obstacles which will come in front of the robot.

b) Pi Camera –
The main function of Pi camera in Agri Robot is to record the path of the agriculture field and will memorize it.
After the path recording it will perform function of image processing and will capture the images of the weed and will provide the feedback to the controller so that the nozzle will come into the function and spraying mechanism on weeds will take place.

c) Wi-Fi Module –
The main function of Wi-Fi module in Agri Robot is it will be connected to the app so that the farmer can control the robot and the app will display the herbicide chemical level.

d) Liquid Level Sensor -
The main function of Liquid Level Sensor in Agri Robot is to detect the herbicide level is high or low and will display it on the App.

IV. Outputs –

e) Driver –
The main function of Drivers in Agri Robot is to control the mechanism of the – Cutter Motor, Sprayer Motor and the Wheels of the Robot.
It will give the instructions based on the inputs gained from the controller.

f) Cutter –
The main function of Cutter in Agri Robot is to perform the cutting mechanism for the obstacles detected through the input from the ultrasonic sensor.

g) Sprayer –
The main function of Sprayer in Agri Robot is to perform the herbicide spraying based on the input from pi camera and it will adjust the nozzle spraying based on the size of the weed present.

h) Wheels –
The main function of Wheels in Agri Robot is to perform the moving mechanism of the robot.

Chapter 4

SYSTEM DESIGN

4.1 Design and Circuit Diagram –

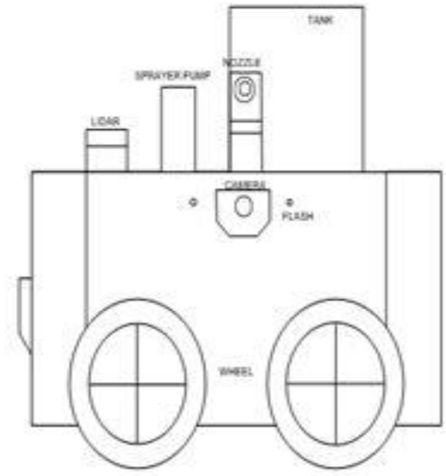

Fig.- 4.1

4.1.1 **Mechanical and Circuit Specification: -**

I. Chassis: -

a.	Length	1515 mm
b.	Width	1090 mm
c.	Height	1105 mm
d.	Weight	100 kg

II. Hose Pipe: -

a.	Inner diameter	Emm
b.	Outer diameter	12 mm
c.	Maximum pressure	220 kg/ cm2
d.	Material	plastic

III. Water Tank: -

a.	Length	720 mm
b.	Width	490 mm
c.	Height	730 mm
d.	Weight	10 Lit

IV. Herbicides DC Pump: -

a.	Weight of motor	800g
b.	Liquid discharge	4.8lit/min
c.	Power Required	10 W
d.	Operating current	0.8 A
e.	Motor speed	1500 rpm

V. Fogging Sprayer Nozzle: -

a.	Length	250 mm
b.	Width	210 mm
c.	Height	420 mm
d.	Weight	5g
e.	Max sprayer width	12 m

VI. Motor Specification: -

a.	Shaft diameter	0142 in
b.	Shaft length	1.33 in
c.	Speed	250 rpm
d.	Torque	1.55 N-mm

VII. Wheel Specification: -

a.	Wheel diameter	15 in
b.	Wheel width	4.5 in
c.	For Axle diameter	0.143 in
d.	Style	Tubeless

VIII. Mower Specification: -

a.	Shaft diameter	0142 in
b.	Shaft length	1.33 in
c.	Speed	1000 rpm
d.	Torque	0.995 N-mm

IX. Battery: -

a.	Length	189 mm
b.	Width	137 mm
c.	Height	312 mm
d.	Weight	8 kg
e.	Rated capacity	1800mAh Voltage 48v
f.	Discharge current	120 A
g.	Discharge power	3000W
h.	Charging voltage	56.55v
i.	Charging current	15A
j.	Charging power	750 W

4.2 3D Model: -

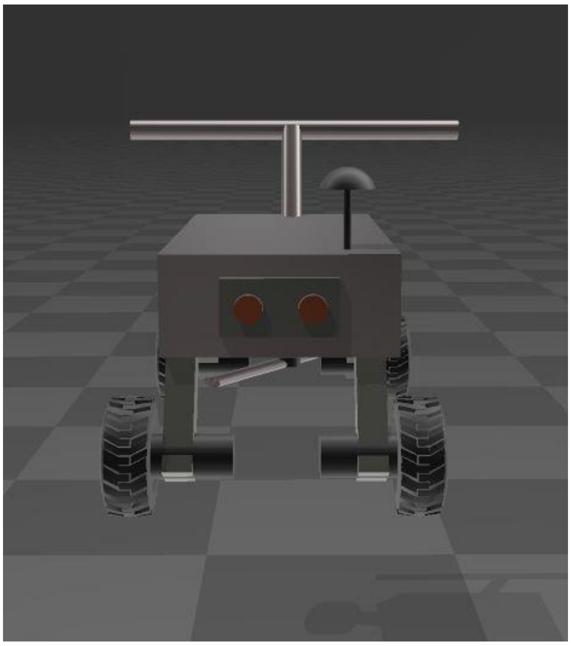

Fig. 4.2 – Front View

Fig. 4.3 – Top View

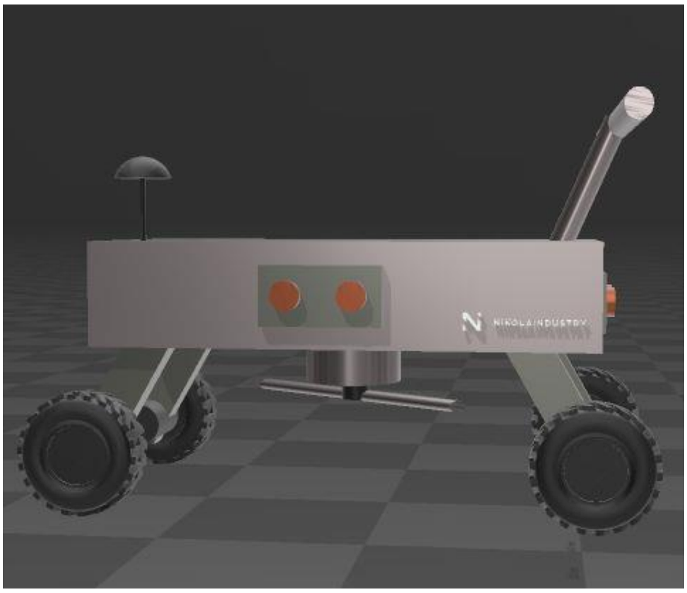

Fig. 4.4 – Side View

Fig. 4.5 – Bottom View

4.3 Circuit Diagram –

A circuit diagram is a simplified representation of the components of an electrical circuit using either the images of the distinct parts or standard symbols. It shows the relative positions of all the elements and their connections to one another. It is often used to visually represent the circuit of an Agri robot obstacle Detection. The following figure shows a simple circuit diagram.

These circuit diagram shows the simulation of an obstacle detection robot using 8051 microcontroller and Analog IR Sensor. This robot designed is an automatic robot i.e., no manual control is required for the operation of robot. We are connected ports of the 8051 microcontroller to the various components as shown in fig. We assigned port 2 from 8051 microcontroller which are connected to LCD display, to display the obstacle detection Agri Robot, Robot is moving, Obstacle detected and so on. After then we assigned port 1 which are connected to the IR Sensor which helps to detect the obstacle and also one Logicstate component is connected to IR Sensor. Logicstate is nothing but testpin where we tests the logic. And also we assigned port 0 and port 3 for L293D motor driver. Because the microcontroller sends the control signal to the DC motor driver Integrated Circuit (L293D) of robot to move the robot in forward, left or right direction. There are 4 wheels which we are connected to the L293D motor. They work when the microcontroller send the control signal to motor.

As we mentioned Logicstate is connected to the IR Sensor to detect obstacle and after detection to display in LCD. So first we test Logic 0, applying the logic 0 which means Robot is Moving in forward direction. And when we applying logic 1 which means Obstacle Detected and the Robot gets stop.

As per the logic operation wheels are worked either they moved in forward direction or get stop.

As applying all the operation during simulation, the result as shown below.

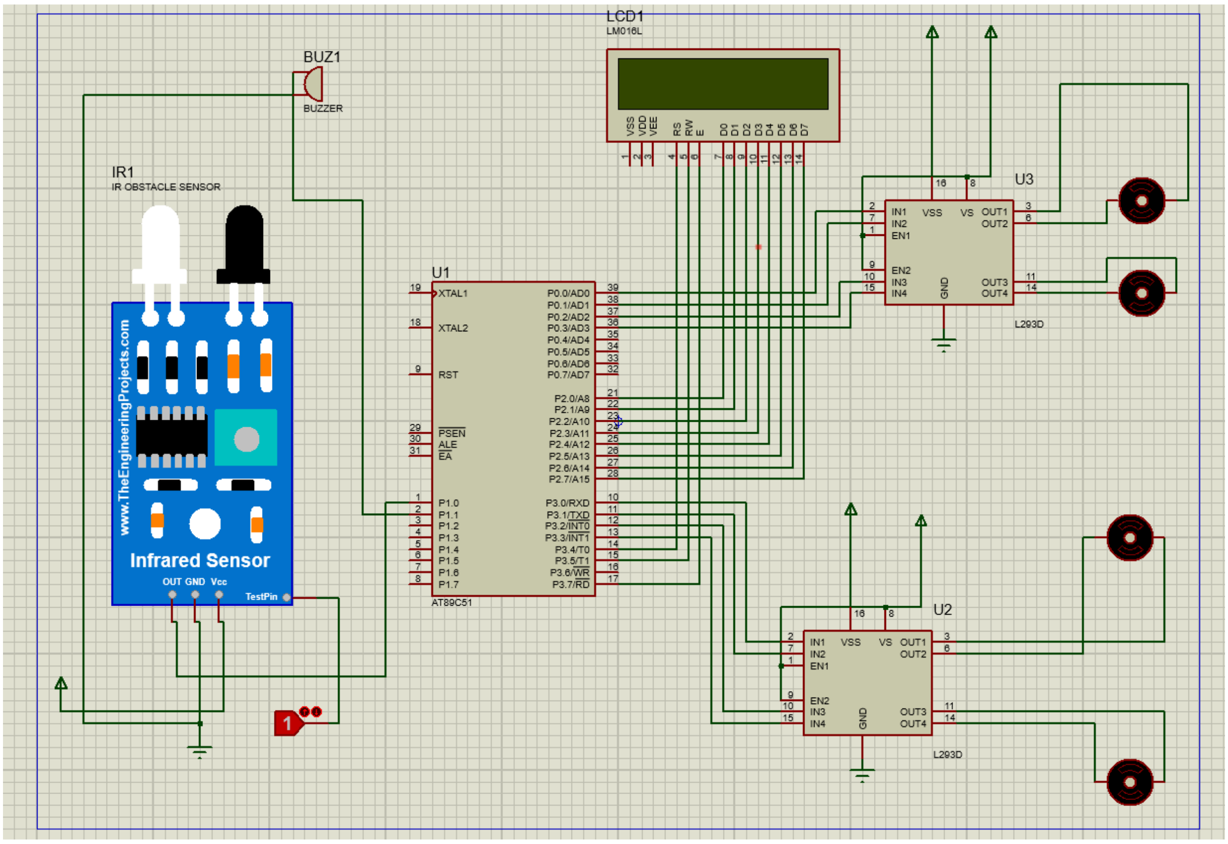

Fig.- 4.6 – Circuit Diagram

4.3.1 Simulation Results -

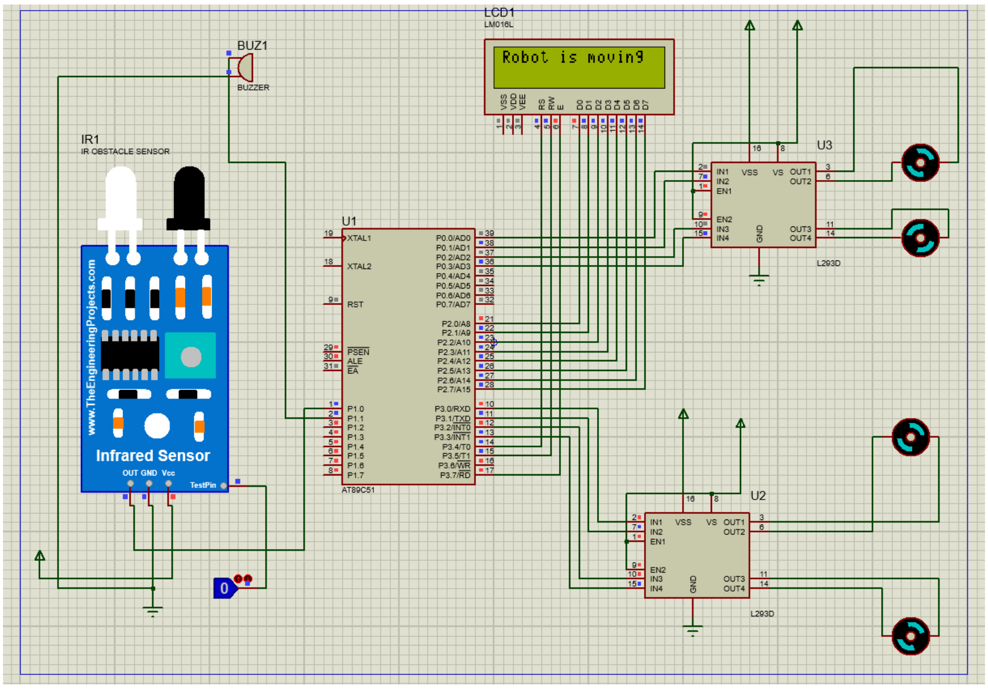

Fig. 4.7 – Logic 0(Robot is Moving)

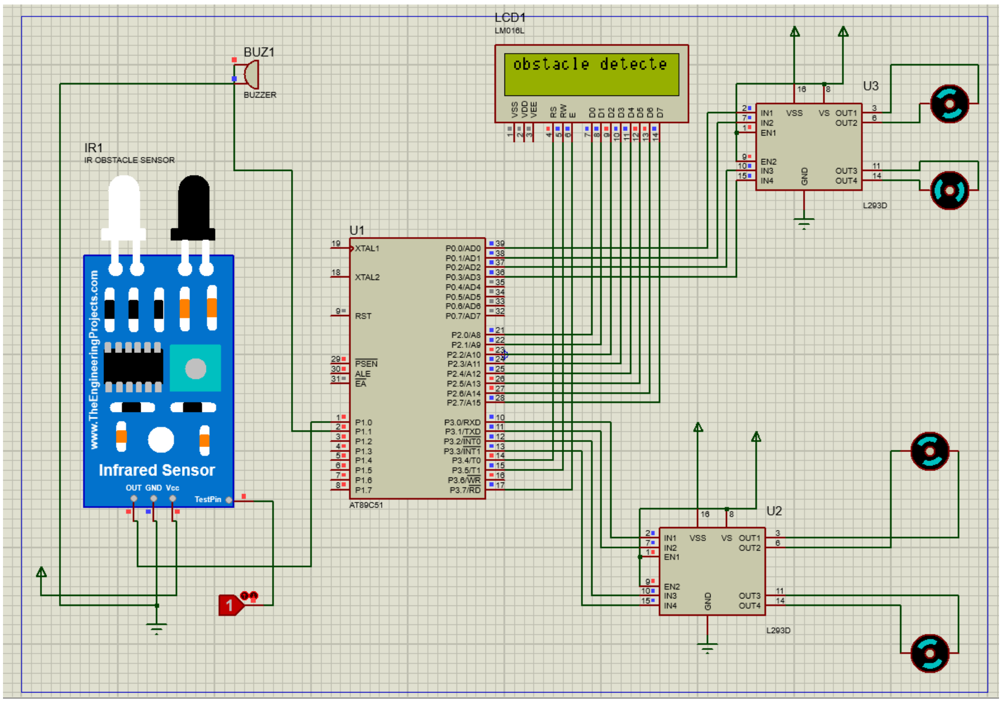

Fig. 4.8 Logic 1(Obstacle Detected)

4.4 Component Specification –

4.4.1: Raspberry pi Module –

Raspberry Pi is the name of a series of single-board computers made by the Raspberry Pi Foundation, a UK charity that aims to educate people in computing and create easier access to computing education. The Raspberry Pi works to put the power of computing and digital making into the hands of people all over the world.

Fig.- 4.9

Specifications. -

I. SoC: Broadcom BCM2711B0 quad-core A72 (ARMv8-A) 64-bit @ 1.5GHz
II. GPU: Broadcom VideoCore VI
III. Networking: 2.4 GHz and 5 GHz 802.11b/g/n/ac wireless LAN
IV. RAM: 1GB, 2GB, or 4GB LPDDR4 SDRAM
V. Bluetooth: Bluetooth 5.0, Bluetooth Low Energy (BLE)
VI. GPIO: 40-pin GPIO header, populated
VII. Storage: microSD
VIII. Ports: 2 × micro-HDMI 2.0, 3.5 mm analogue audio-video jack, 2 × USB 2.0, 2 × USB 3.0, Gigabit Ethernet, Camera Serial Interface (CSI), Display Serial Interface (DSI)
IX. Dimensions: 88 mm × 58 mm × 19.5 mm, 46 g

4.4.2: 12-Volt 7 Ah Sealed Lead Acid (SLA) Rechargeable Battery –

The battery which uses sponge lead and lead peroxide for the conversion of the chemical energy into electrical power, such type of battery is called a lead acid battery. The lead acid battery is most used in the power stations and substations because it has higher cell voltage and lower cost.

Fig.- 4.10

Specifications and Capacity: -

I. Nominal Voltage: 12v
II. Nominal Capacity @ 20hr rate (AH): 7.0
III. Discharge Current @ 20hr rate (mA): 350
IV. Dimensions: 15.1 x 6.5 x 9.4cm (5.95 x 2.56 x 3.7")
V. Weight: 2.7kg

4.4.3: L298 Motor Drive Controller Board Module –

Introduction: -

This L298N Motor Driver Module is a high-power motor driver module for driving DC and Stepper Motors. This module consists of an L298 motor driver IC and a 78M05 5V regulator. L298N Module can control up to 4 DC motors, or 2 DC motors with directional and speed control

I. Driver Model: L298N 2A
II. Driver Chip: Double H Bridge L298N
III. Maximum operating voltage: 24V
IV. Peak output current per channel: 2A
V. Maximum logic voltage: 4.5 V
VI. Minimum logic voltage: 7V
VII. Maximum power: 25W

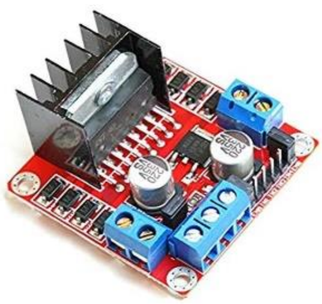

Fig.- 4.11

4.4.4: Cytron Enhanced 13Amp DC Motor Driver 30A peak –

MD10C is an enhanced version of the MD10B which is designed to drive high current brushed DC motor up to 13A continuously. It offers several enhancements over the MD10B such as support for both locked-antiphase and sign-magnitude PWM signal as well as using full solid-state components which result in faster response time and eliminate the wear and tear of the mechanical relay.

The MD10C has been designed with the capabilities and features of:

I. Bi-directional control for 1 brushed DC motor.
II. Support motor voltage ranges from 5V to 25V.
III. Maximum current up to 13A continuous and 30A peak (10 second).
IV. 3.3V and 5V logic level input.
V. Solid state components provide faster response time and eliminate the wear and tear
VI. of mechanical relay.
VII. Fully NMOS H-Bridge for better efficiency and no heat sink is required.
VIII. Speed control PWM frequency up to 20KHz.
IX. Support both locked-antiphase and sign-magnitude PWM operation.
X. Dimension:75mm x 43mm

Fig.- 4.12

4.4.5: Ultrasonic sensor –

Parameter: -

I. Power Supply: DC 5V
II. Working Current: 15mA
III. Working Frequency: 40Hz
IV. Ranging Distance: 2cm – 400cm/4m
V. Resolution: 0.3 cm
VI. Measuring Angle: 15 degrees
VII. Trigger Input Pulse width: 10uS
VIII. Dimension: 45mm x 20mm x 15mm

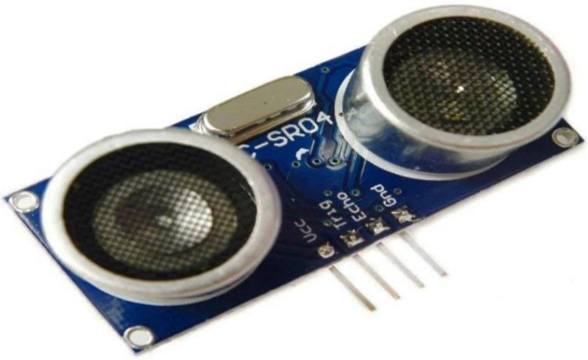

Fig.- 4.13

4.4.6: Heavy Duty 12V DC Electric Battery Sprayer Pump Motor –

I. Phase -Single-phase
II. Power Supply- 12 VOLT DC
III. Power Rating- 1 kW
IV. Motor Power- 1 hp
V. Type - Diaphragm

Fig.- 4.14

4.4.7: Ardupilot flight Controller –

APM 2.8 Multicopter Flight Controller is an upgraded version of 2.5, 2.6; for FPV RC Drone. The sensors are the same as the APM 2.6 flight controller; however, the module has the option to use an external compass via a jumper. This makes the APM 2.8 ideal for use with multi-copters and rovers.

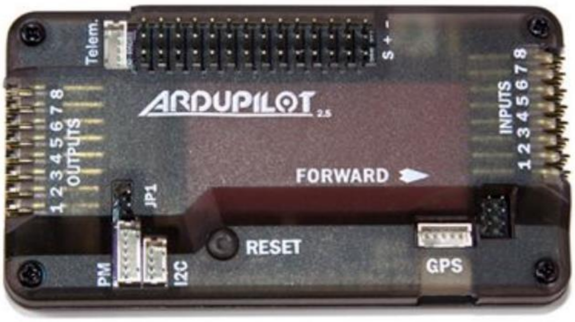

Fig.- 4.15

Features: -

I. Arduino Compatible
II. Built-in compass
III. Includes 3-axis gyro, accelerometer, and magnetometer, along with a high-performance barometer
IV. Onboard 4 Megabyte Data flash chip for automatic data logging
V. Optional off-board GPS, uBlox LEA-6H module with Compass.
VI. One of the first open-source autopilot systems to use Intenseness' 6 DOF Accelerometer/Gyro MPU-6000.
VII. Barometric pressure sensor upgraded to MS5611-01BA03, from Measurement Specialties.
VIII. Atmel's ATMEGA2560 and ATMEGA32U-2 chips for processing and USB functions respectively.

4.4.8: Raspberry Pi Camera –

Pi Camera module is a camera which can be used to take pictures and high-definition video. Raspberry Pi Board has CSI (Camera Serial Interface) interface to which we can attach PiCamera module directly.

Fig.- 4.16

Specifications -

I. Image Sensor-Sony IMX 219 PQ CMOS image sensor in a fixed-focus module
II. Resolution 8-megapixel
III. Still picture resolution 3280 x 2464
IV. Max image transfer rate 1080p: 30fps
V. 720p: 60fps
VI. Image control functions:
    a) Automatic exposure control
    b) Automatic white balance
    c) Automatic band filter
    d) Automatic 50/60 Hz luminance detection
    e) Automatic black level calibration
VII. Temp range Operating: -20º to 60º
VIII. Stable image: -20º to 60º
IX. Lens size 1/4”

4.4.9: Float Switch Sensor for Water Level Controller –

Cable Float Switch dual purpose float switch can be used for both emptying and filling operations. It is used in Both Overhead tank and Sump tank A float switch is a device used to detect the level of liquid within a tank. The switch may be used in a Automatic Pump/Level controller an Water Level indicator, Overflow Alert alarm, or other devices.

Fig.- 4.17

Features. -

I. Water resistant enclosure.
II. Instantaneous results.
III. Output Voltage is proportional to liquid level.
IV. Can Measure large changes in water level.
V. Low cost.
VI. Very low power operation
VII. Works with many different types of fluids.

Chapter 5

ADVANTAGES AND APPLICATIONS

5.1 Advantages –

I. AI enables better decision-making: -

Farmers can use AI to collect and process much more data than usual. Analyze market demand, predict prices, and determine the best time to sow and harvest. is an important issue that farmers can solve with AI. But AI can also gather insights on soil health, make fertilizer recommendations, monitor weather, and track crop maturity. All of this enables farmers to make better decisions at every stage of crop cultivation.

II. Automatic weeding: -

A robot runs through a crop field. The bottom camera shows plants and weeds. AI software detects weeds and issues commands to remove them. High-energy sprinklers remove weeds without disturbing the soil or crops with nozzle settings according to weed size. You can control this process with your smartphone. All you need is a mobile app specifically designed for this purpose. Yes, so you can send the robot his worker out in the morning and track his progress from anywhere.

III. Cutting the unwanted grass throughout the path: -

The mowing mechanism is to mow unnecessary grass that obstructs the path of the robot and continue the mechanism that the robot sprays herbicides on weeds.

IV. Time Saving: -

Most importantly, the robot automatically records the farm's path and navigates through it, saving the farmer time.

V. Identifying the path easily: -

The herbicide spraying system uses an AI-based Agri-robot. This is an agricultural robot that uses image processing technology and autonomous navigation algorithms to navigate field rows and effectively apply herbicide based solely on the number of weeds detected in a given frame.

VI. Herbicides can be applied before the weeds grow: -

Unlike other methods of weed control, it is possible to apply herbicides in the pre-plant and pre-emergence stages. This lets the crops grow in a weed-free environment without competing for nutrients even in the early stages of development.

VII. Herbicides can be effectively used in different crop arrangements: -

While mechanical forms of weed control can be effective in some cases, when it comes to broadcast sown and narrow-spaced crops, they cannot reach all the weeds present in the field which herbicides can easily do. Herbicides can also effectively reach intra-row weeds

VIII. Herbicides can get rid of deep-rooted weeds: -

Weeds that have roots deep into the soil cannot always be effectively removed with mechanical methods as while the top part may be removed, the weeds can grow back from the roots. For these, a combination of mechanical and chemical herbicides might be necessary for effective weed control.

IX. Herbicides prevent weeds from growing for a long time: -

When herbicides are applied, they tend to be effective for long periods of time and prevent the weeds from growing back soon.

X. Herbicides can get rid of structurally similar weeds: -

Weeds that look like crops can be missed when removed by mechanical methods. However, herbicides can be used to kill these weeds that look the same but are biologically different without harming the plants.

5.2 Applications –

I. Agriculture Robotics: -

Robotics are widely used in various fields, mainly in manufacturing, to perform complex tasks. Various AI companies are currently developing agricultural robots. These AI robots are designed to perform multiple agricultural tasks.AI robots will also be trained to check crop quality, detect and control weeds, and harvest crops faster than humans.

II. Intelligent Spraying: -

AI sensors can easily detect weeds and detect the area affected by weeds. If such areas are found, they can be applied in a targeted manner to reduce herbicide use, saving time and harvesting. There are various AI companies building robots with AI and computer vision that can spray weeds with precision. AI sprayers can significantly reduce the number of chemicals used in the field, improving crop quality and saving money.

III. Precision Farming: -

Precision agriculture is all about "Right place, Right time, and Right product". Precision farming techniques are highly precise and controlled methods that can replace labor-intensive parts of agriculture to perform repetitive tasks. One example of precision agriculture is the identification of plant stress levels. This can be obtained from high-resolution plant images and various sensor data. The data obtained from the sensors is fed into the machine learning model as input for stress detection.

IV. Automatic Weeding: -

The AI weeding is not just a clever sprayer. Other computer vision robots take a more direct approach to removing unwanted vegetation. Finding weeds doesn't save farmers much labor in the same way that computer vision finds insects and odd-behaving chickens. To be even more effective, AI needs to find and remove weeds.

V. Detection technology: -

Detection technologies (such as Weed seeker and We edit) use infrared and near-infrared to detect green weeds and only spray green plants in pastures. A light-emitting diode (LED) directs two different light sources into the ground, infrared and near-infrared. Green weeds have different reflective properties than stubble and dirt. The system can operate at speeds up to 20 kilometers per hour (km/h) and requires a stable boom to support operational efficiency.

VI. Boom sprayer: -

Boom sprayers are the most common type of equipment for large-scale application of herbicides in agriculture. The sprayer consists of many components, but the most important is the nozzle, which breaks the herbicide into many small droplets and propels them through the air towards the target. The nozzle is the only component of the atomizer that directly determines the effectiveness of the atomization. All other components are required to position the nozzle and continuously deliver herbicide at the correct pressure. Proper nozzle selection and operation are critical to successful spraying.

VII. Drill and fill method: -

The drill-and-fill method is used for trees and shrubs with a trunk or trunk circumference greater than 5 cm and is also known as tree injection. In this method, a battery-powered drill is used to drill downward-facing holes in the cotter pins at approximately 5 cm intervals. A backpack reservoir and syringe allow you to deliver a measured amount of herbicide solution. Only trees and shrubs that are safe to die and rot can be treated in this way. If trees or shrubs are to be felled, let them die completely before cutting.

Chapter 6

PROJECT COMPLETION PLAN

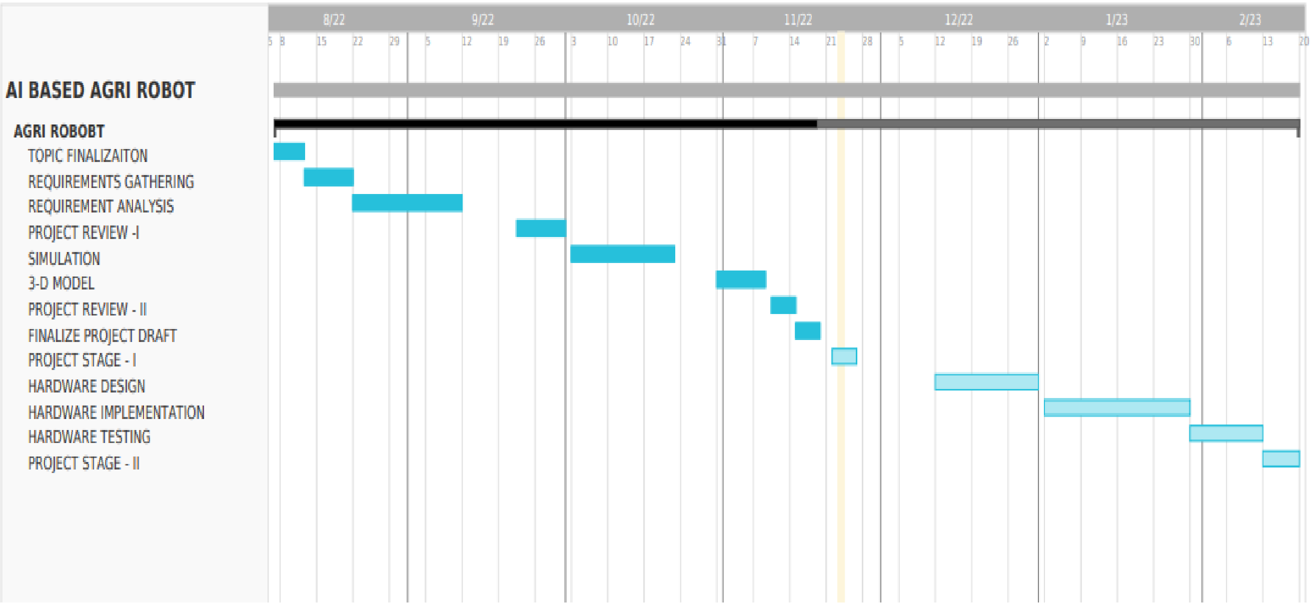

Fig.6.1 – Gantt chart

Chapter 7

REFRENCES

[1] Autonomous Herbicides Spraying System Using AI and IOT - Anirudha.S. Tadpatri, Pramod P Ugargol, Rakesh Shridhar.

[2] Development and Automation of Robot with Spraying Mechanism for Agricultural Applications - Mitul Raval, Aniket Dhandhukia, Supath Mohile.

[3] Development and Automation of Robot with Spraying Mechanism for Agricultural Applications - Palash Patil, Vaibhav Pardhi, Prashant Balkhande.

[4] Weed Detection Using Image Processing Ajinkya Paikekari, Vrushali Ghule, Rani Meshram, V.B. Raskar.

[5] Amrutha A. Aware, Kavitha Joshi," Crop and Weed Detection Based on Texture and Size Features and Automatic Spraying of Herbicides.

[6] Autonomous Herbicide Spraying System using AI and IoT - Prajwal B, Rakesh Shridhar , Anirudha S Tadpatri Pramodh P Ugargol, Ajjaiah H B M,

[7] Automatic Weed Detection and Smart Herbicide Sprayer Robot. G.Y. Rajaa Vikhram, Rakshit Agarwal, Rohan Uprety, V.N.S. Prasanth4 –

[8] Bonaccorso, F.; Muscato, G.; Baglio, S. Laser range data scan-matching algorithm for mobile robot indoor self-localization.

[9] Tony E. Grift, Design and development of Autonomous robots for agricultural applications.

[10] Cunha, M.; Carvalho, C.; Marcal, A.R.S. Assessing the ability of image processing software to analyse spray quality on water-sensitive papers used as artificial targets. Biosyst.