Mr. Alan Thomas Joseph, Mrs. R.Ambigai

Design and Modelling of Pest Detection and Spraying of Pesticides Robot

Mr. Alan Thomas Joseph [a*], Mrs. R.Ambigai [b]

[a*] M. Tech student, Robotics Engineering, Department of Mechanical Engineering SRMIST, Katankalathur, Chennai-603203, India
[b] Assistant Professor (Sr.G)Department of Mechanical Engineering,SRM

Corresponding author: ambigair@srmist.edu.in&aj5572@srmist.edu.in

Abstract

As of India's growing population farm land and farmers are getting decreased due to our country's rapid development process and other issues. Here a design is proposed for pest detection and spraying robot which will ease the procedure of spraying for farmers. As other internal factors like global warming and other climatic changes spraying procedures will be difficult for the farmers so as to ease their effort a spraying robot will be essential with ease of control through a controlling pad. As India's rapid concern over farming land this robot will be a relief as the controlling robot has a microcontroller which will receive the data from the controlling pad through antenna which allows the movement of robot and spraying mechanism taken out with servo motors. Pest detection is been initiated by image processing technique which will be taken through the camera in the robot and obstacle avoidance with ultrasonic sensors to the front of the robot. As robot is more stable, waterproof and small in size with ease of movement.

Keywords: Pest detection, spraying robot, Image Processing, Pest in fields, compact design

1. Introduction

As India is a developing country and increasing of population day by day leads to production of farm land and securing the need of Greenland is needed in this upcoming society. As India is second when you consider the farm land area as of 159.7 million hectares of land just behind United State of America, we can imagine the need of healthy and pest free vegetables and fruits [2][3]. As pests not only affects crops but it also affects green plants which can lead to serious problems in our agriculture society. As the project advances the research on pest detection and spraying of pesticides in advance level which leads to a healthy and pest free society in future wellbeing [6]. Here a friendly kind of robot is been initiated which helps an ease of control of the robot for spraying and pest detection mechanism [1]. Here a control pad is been used to control the robot which has 4 operating modules and this 4 modules is been encoded using an encoder which is been sent through an antenna of 433Mhz into the air which will be decoded using same antenna in the robot of 433Mhz and this information given to Atmega microcontroller through a single data which helps the motor drive to function and helps to run the wheels and on other side servo motors for spraying and camera module also been added and signals are sent through 5.8Ghz antenna for image processing for detection of pests [4].

The robot is mainly designed for an ease movement of the robot through land which helps for the detection of pest and leaf diseases and spraying according to it. The robot is light weight and easy to handle which helps the farmers or anyone using it a ease of using it which helps in the mobility of the robot [5]. This robot can also be used in homes for spraying variety of plants and flowers in the basement of the house making it ease and comfort for them to spray using pipes and pumps. The camera will help to locate the things and also the ultrasonic sensors will help to avoid any obstacles and holds the robot to move forward [7].

2.Methodolgy

The main significant part of this robot is the design which is to make it more compact and more stable with an ease of movement. The robot has been made with good material which helps the robot for more stability as the robot structure is been designed through AutoCAD as the concept was to make a compact as well as small type of robot. The design was done through Auto Cad in which the 2D design as well as 3D design was made. Here the design which include the tank part to store pesticides liquid a spraying nozzle is been used for spraying purpose which will be controlled through servo motor.
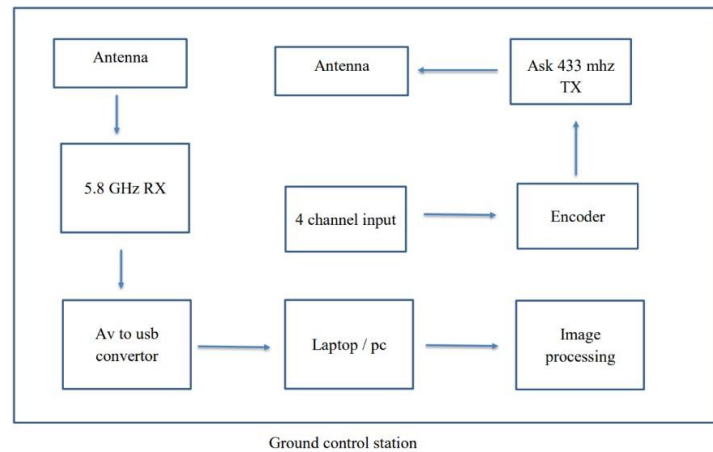

Figure 1: Block Diagram Of Control Station

Wheels is been designed in a way for smooth and comfortable movement of the robot and other segment including the modelling setup which helps the robot a more rigid variant with aluminum metal used for the chassis of the robot and final segment includes the coding and electronics setup which helps for the functioning of the robot and the working mechanism is been illustrated through a block diagram in fig 1& fig2.The working mechanism makes it more easily controllable for the farmers and the users of this robot.
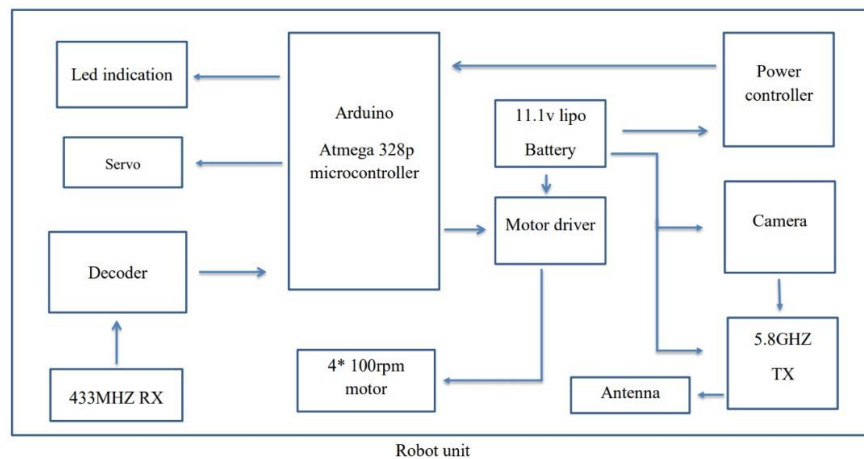

Figure 2: Block Diagram of Robot Unit

 3.Robot Design

As the project progress the main element of the project is the design part which tend to be an integral part of it. As the main purpose of the design is the stability and the designing pattern which fits to the pattern of the robot.

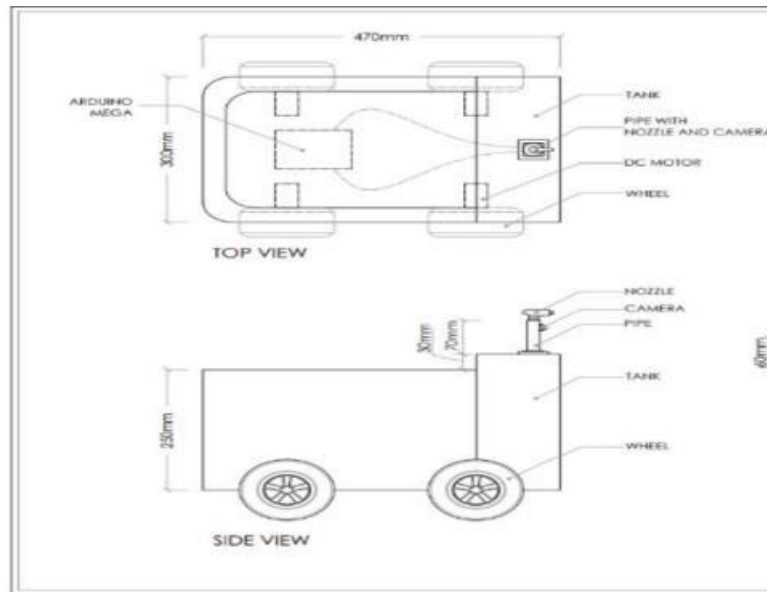### 3.1 2D Model of Robot (Software-Autocad)

Figure 3:2D View Of Robot

Here the given design work has been done in AutoCAD providing appropriate dimensions. It has provided a vivid information about the basic dimensions required for the robot. It is easy to understand the actual length and width of each material in the above 2d diagram using top view and side view. Apart from the 2d views wheel dimensions has been provided which is around 5inch width to sustain the robot,3D design is been discussed in next section. As work progresses it is been understood the final design of the project that has been done in fusion 360 software for better understanding of the desired design.

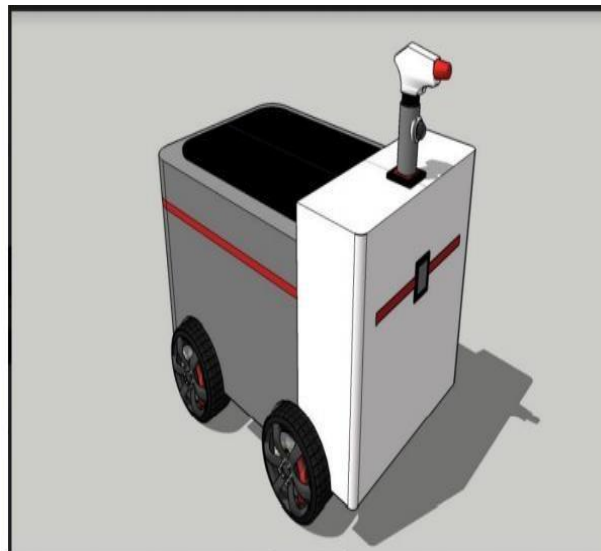### 3.2 3D Model Of Robot (Software Fusion 360)

Figure 4: Raw Concept Of Robot

As from above Fig 4, the actual concept of design which tends to be the length, breadth and width of the materials used which ended up in as 470mm*300mm*250mm.The above model is a raw design which shows the actual concept of the robot. This design was made in fusion 360 software.

Figure 5: Nozzle, Camera Mount And Wheels

In Fig 5, it shows the web camera mounted to the pipe which helps to transfer live images of the plant to the Pc using Bluetooth and the tires used of 3-inch width with better friction and preferable for all weather environment.

Figure 6: 3D View Of Robot

In Fig 6. shows the final design which has been done in fusion 360 software after a final cut and the design shows the final design concept for the project with shaded designing and frictionless tires for the stability and durability of the project.

4. Design Analysis (Software-Fusion 360)

As it is finished with designing part and calculations, it has to conclude the project with analyzing part that makes the important factor as it decides whether the material used is capable enough to bear the curb weight and the load exerted on it. Here the analyzing part is done in three different phases as we take the body first then check the stress, strain and displacement of the body then moving towards the tank capacity as it is one of the major parts carrying pesticide of 1 liter around 10N of force will be exerted.

The analysis work has been done in fusion 360 software. The material used here for analyzing is **aluminum** 1100 in which we have taken two analyzing part which is for the tank and for the chassis part of the robot.
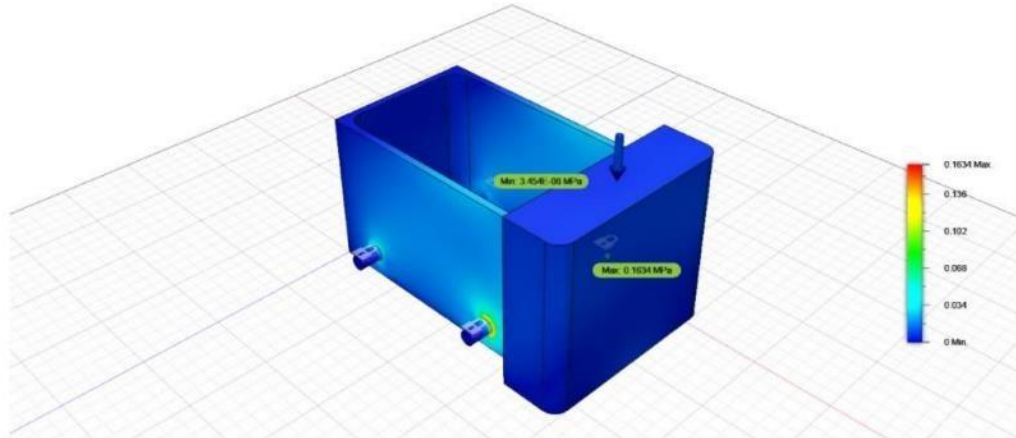
4.1 Analysis On Tank

Figure 7: Stress Analysis Of Tank

In above fig. this stress analysis it shows the amount of stress it is been exerted into the tank; the material used is aluminum sheet1100 for the chassis of robot. Here the amount of load exerted is 10 N which shows the amount of stress on the tank of the robot.
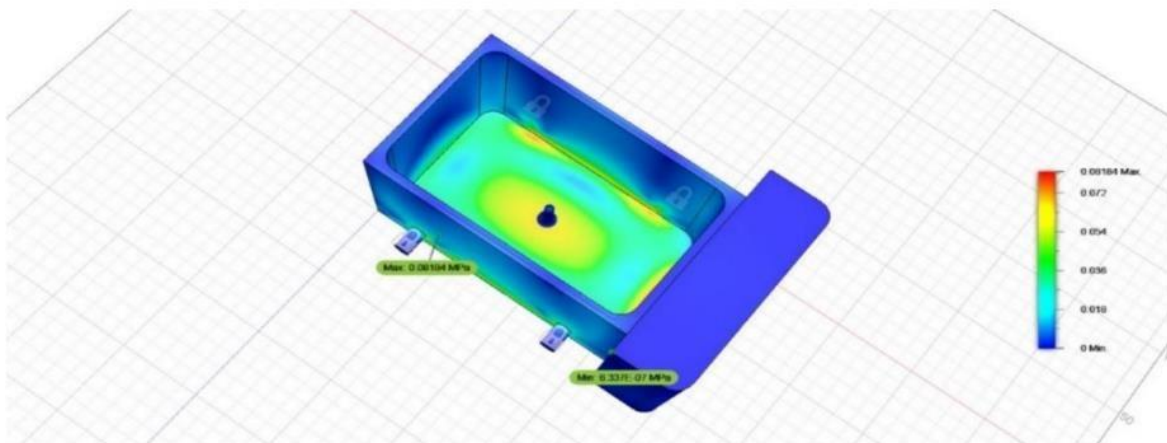

Figure 8: Strain Analysis Of Tank

Here in above fig 8. the amount of strain which means the ration of change of length to original length when an external force is exerted. In the above figure we can come to a conclusion that the strain analysis shown is the force that is around 10N of force is exerted which resulted in capability of material of robot tank.

Table 2: Stress&Strain Analsysis

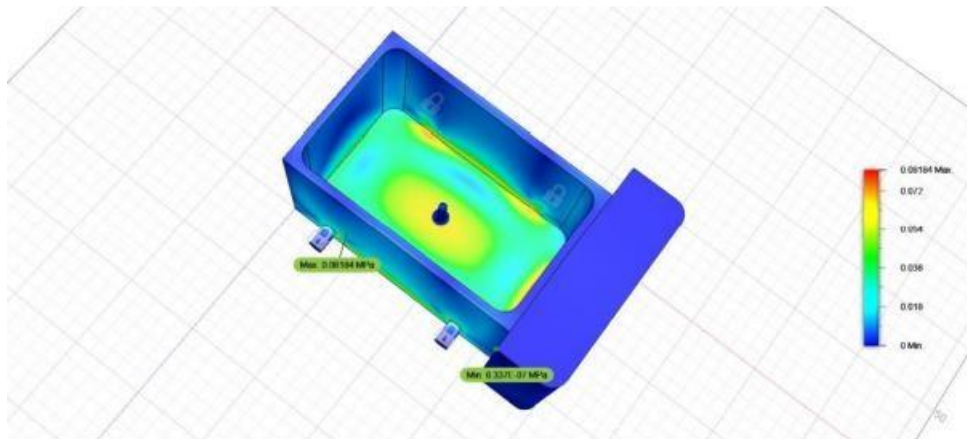| NAME	TYPE	MIN	MAX
STRAIN 1	VON: von Mises STRAIN	0.1634 Mpa	3.454E-06Mpa
STRESS 1	VON: von Mises STRESS	8.431e-11Mpa	4.216E-06

4.2 Analysis On Robot Chassis

Figure 10: Stress Analysis Of Robot Chassis

As the total body weight of the robot is around 13.63 kg as per the calculations here, we can understand the stress given to the body when load is applied as per the above fig 10, it has exerted a force of 130 N that has made a pretty good impact on the body chassis.
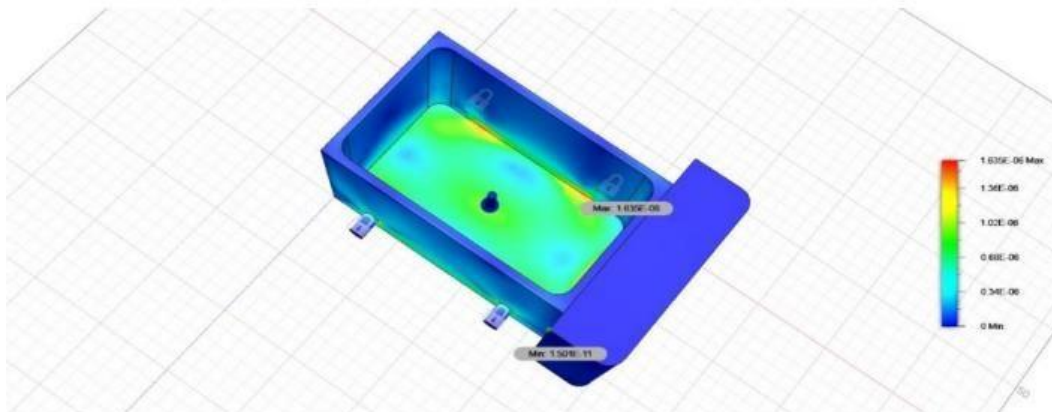

Figure 11: Strain Analysis Of Robot Chassis

In the above fig. shows the amount of strain which means the rate of change of ratio to length to original length when force is exerted as we can see the amount of deformation occurred when force or load is applied to the given chassis of the robot body.

The final analyzing part shows the effectiveness of aluminum material for the chassis part as it has good machinability and formidability which helps for the effectiveness of the robot body. The load was given in appropriate manner which helped for the analysis part of the body that it can resist the load as it takes load in tank and load exerted in robot body where stress, strain and displacement of it with showing the perfect deformation part of it.

Table 2: Stress & Strain Analsysis

NAME	TYPE	MIN	MAX
STRESS 2	VON: von Misses Stress	0.08184MPa	6.337E-07Mpa

STRAIN 2	Von: von Misses Strain	1.501E-11	1.635E-06

6. Conclusion And Future Work

Pest detection is a vast field in near future different types of technology and advance level of pest detection can be taken out as it has vivid field of knowledge which will lead to an advanced level of agriculture society. It will help in enhancement of agro-robot which will help in future wellbeing of our country as farm land is being decreasing due to increase in population which may need new methods and technology to overcome such situation in near future. Pest is an important factor which kills the plants and crops and even damages human health efficient way of spraying and new kind of technology will help to a modern way of Agri culturing technique. Pest detection in near works will have an advanced level of image processing technique and various types of sensors like gas sensors which will be a breakthrough to the field of agriculture in near future.

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