A
Project Report
On

"Design and Development of Variable Flow Sprayer for Agriculture Application"

submitted to

Sant Gadge Baba Amravati University,
Amravati (M.S.) 444 602

in partial fulfillment of the requirement

for the degree of

BACHELOR OF ENGINEERING
in
MECHANICAL ENGINEERING

by

Mr. Ritesh Hinge
Mr. Varad Sovale
Mr. Hrishikesh Hulke
Mr. Gaurav Jadhao
Mr. Angad Sarokar

under the guidance of

Prof. C.V.Patil

Department of Mechanical Engineering
Shri Sant Gajanan Maharaj College of Engineering
Shegaon-444203 (M.S.)
(Recognised by AICTE, accredited by NBA, New Delhi, NAAC, Banglore & ISO 9001:2000)
www.ssgmce.ac.in

2022 - 2023

A
Project Report
on

"Design and Development of Variable Flow Sprayer for Agriculture Application"

submitted to

Sant Gadge Baba Amravati University,
Amravati (M.S.) 444 602

in partial fulfillment of the requirement

for the degree of

BACHELOR OF ENGINEERING
in
MECHANICAL ENGINEERING
by

Mr. Ritesh Hinge

Mr.Varad Sovale

Mr. Hrishikesh Hulke

Mr. Gaurav Jadhao

Mr. Angad Sarokar

Under the guidance of
Prof. C.V.Patil

Department of Mechanical Engineering
Shri Sant Gajanan Maharaj College of Engineering
Shegaon-444203 (M.S.)
(Recognised by AICTE, accredited by NBA, New Delhi, NAAC, Banglore & ISO 9001:2000)
www.ssgmce.ac.in

2022 - 2023

Department of Mechanical Engineering
Shri Sant Gajanan Maharaj College of Engineering
Shegaon, Dist- Buldhana – 444203, M.S., India
(Recognized by A.I.C.T.E, Accredited by N.B. A. New, Delhi)

Certificate

This is to certify that the project report entitled **"Design and Development of Variable Flow Sprayer for Agricultural Application"** is hereby approved as a creditable study carried out and presented by

Ritesh Hinge	(PRN: 193120223)
Hrushikesh Hulke	(PRN: 193120324)
Varad Sovale	(PRN: 193120205)
Gaurav Jadhao	(PRN: 203120426)
Angad Sarokar	(PRN: 193120204)

in manner satisfactory to warrant of its acceptance as a pre-requisite in a partial fulfillment of the requirements for the degree of Bachelor of Engineering in Mechanical Engineering of Sant Gadge Baba Amravati University, Amravati during the **Session 2022-23.**

Prof. C.V. Patil
Guide
Mechanical Engineering Department
SSGMCE, Shegaon.

Prof. C. V. Patil
Project Coordinator
Mechanical Engineering Department
SSGMCE, Shegaon.

Dr. S. P. Trikal
Professor and Head
Mechanical Engineering Department
SSGMCE, Shegaon

Dr. S. B. Somani
Principal
SSGMCE, Shegaon.

Acknowledgement

It is our utmost duty and desire to express gratitude to various people who have rendered valuable guidance during our project work. We would have never succeeded in completing our task without the cooperation, encouragement and help provided to us by then. There are a number of people who deserve recognition for their unwavering support and guidance throughout this report.

We are highly indebted to our guide **Prof.C.V.Patil** for his guidance and constant supervision as well as for providing necessary information from time to time. We would like to take this opportunity to express our sincere thanks, for his esteemed guidance and encouragement. His suggestions broaden our vision and guided us to succeed in this work.

We are sincerely thankful to **Dr. S P Trikal** (HOD, Mechanical Department, SSGMCE, Shegaon), and to **Dr. S B Somani** (Principal, SSGMCE, Shegaon) who always has been kind to extend their support and help whenever needed.

We would like to thank all teaching and non-teaching staff of the department for their cooperation and help. Our deepest thank to our parents and friends who have consistently assitted us towards successful completion of our work.

– Projectees

Ritesh Hinge

Varad Sovale

Hrishikesh Hulke

Gaurav Jadhao

Angad Sarokar

Abstract

Agriculture is India's economic engine. In order to protect crops from becoming rotten and contaminated by harmful organisms including fungi, bacteria, parasites, and insects, pesticides must be sprayed on the crops. At the moment, pesticide spraying is a manual process that uniformly covers a variety of crops with varying sizes and forms. Our farmers continue to spread the chemicals using an antiquated technique that damages their skin, requires a lot of time and effort, and involves carrying the chemicals on their backs and using their hands. So, our goal is to make the pesticide application process simpler. Considering that herbicides are sprayed, installing a removable farmer will only need to drive the cart with simple operation and spray a variable amount of pesticide based on the form and size of crops as a result of the introduction of a detachable setup for pesticide spraying.

CONTENTS

List of Figures

CHAPTER 01

INTRODUCTION

Chapter 1

INTRODUCTION

1.1 Overview

Agriculture plays a vital role in sustaining the global population by providing food, fiber, and other essential resources. However, crop production faces numerous challenges, including pest infestations that can cause significant yield losses. To combat pests effectively, farmers rely on pesticide application using sprayers. Traditional pesticide sprayers often suffer from limitations such as inefficient and imprecise application, leading to excessive pesticide use, environmental pollution, and reduced effectiveness.

Effective pesticide application is crucial for maintaining crop health and maximizing yields. Pesticides are used to control pests, diseases, and weeds that can damage crops and reduce productivity. However, improper application can result in under-dosing, leading to inadequate pest control, or over-dosing, causing environmental pollution and potential harm to non-target organisms.

Conventional pesticide sprayers often lack the flexibility to adapt to varying crop conditions and terrain characteristics. They typically operate at a fixed flow rate, delivering a constant amount of pesticide regardless of the specific requirements of the crop or the severity of pest infestation. This one-size-fits-all approach leads to inefficient use of resources, excessive pesticide wastage, and increased production costs for farmers.

To address these limitations, the design and development of a variable flow pesticide sprayer have gained attention. By incorporating adjustable flow rate systems and intelligent sensing technologies, these sprayers offer enhanced operational control and optimized pesticide distribution. The ability to modulate the flow rate allows farmers to tailor the amount of pesticide applied to the specific needs of the crop, resulting in efficient resource utilization and reduced environmental impact.

1.2 Status of Agriculture in India

India is predominantly an agricultural based country with approximately 75% of population of India is very much dependent on farming either directly or indirectly.The farmers have been using the same methods and equipment for ages for examplethe seed sowing, spraying, weeding etc. operations are carried out by same techniques. There is need for development of an effective spraying machine for increasing productivity levels. Most of the late developing countries of Asia have the problem of higher population and low levels of land productivity as of compared to the developed nations. One the main reasons for lower productivity isinsufficient power availability for the farms and very low levels of farm mechanization. This is especially true for India.

1.3 Mechanism of Agriculture

It is now accepted all over the world that in order to meet the food requirements of growing populations and rapid industrialization, the modernization of agriculture is indispensable. It is said that at many farms, production suffers due to no use of farm fertilizers or correct time pesticides and insecticides or improper application of these at required destination area of the affected crop. Mechanization enables conservation of inputs by precision in metering and ensuring better distribution, reducing the level of quantity required for the best response and prevention of loss or wastage of inputs applied. The Mechanization reduces the unit costs for the production by the high level of productivity and by input conservation.

Agricultural equipment's and machinery program of the governments has been one of selective mechanization with a view of optimizing the use of human, animal and other source of power. In order to meet requirements, steps are taken to increase availability of implement, irrigation pumps, tractors, power tiller, combine harvesters and other power operated machines and also for to increase the production and availability of improved animal driven implements. Special emphasis was given on the later as more than the 70% of the farmers fall in small and, marginal categories.

It is usually said that mechanization of small farms is difficult. But in Japan having average land holding even smaller of than ours, with proper mechanization has led agriculture to greater heights. In order to minimize the drudgery of the small farmers, to increase efficiency and save the farmer time which is taken for the taking up of

additional supplementary and generating activities, also for use of modern time saving machines or implements of appropriate size needed to be suitably promoted therein.

The nature of agriculture, does not admit of so many subdivisions of the farm labor, nor of so complete a separation of the one business from another, as in manufactures. It is impossible to separate so entirely the business of a grazer from that of the corn-farmer as the trade of the carpenter is commonly separated from that of smith. Spinner is almost always distinct person from the weavers; but the ploughman, the harrower, the sower of the seed, the reaper of the corn, are often same. The occasion for those different sorts of labor returning with the different season of the year, it is impossible that one man must be constantly employed in any one of these. This impossibility of doing so complete and an entire a separation of all the different branches of labors employed in the agriculture is the reason why the improvement of productive powers of labors in this fields does not always keep pace with their improvements in manufactures.

1.4 Agriculture and Economy

Agriculture plays a significant role in the Indian economy. It is one of the primary sectors contributing to the country's GDP, employment, and food security. Agriculture remains a crucial sector in the Indian economy, contributing to GDP, employment, food security, rural development, and exports. While the sector faces challenges, efforts are being made to modernize and transform Indian agriculture through policy reforms and technological advancements**.**

1.5 Problems with current pesticides sprayer

The current pesticide sprayers used in agriculture face several challenges and limitations. Here are some common problems associated with them:

1. Inefficient Application: Traditional pesticide sprayers often suffer from inefficient application, leading to uneven coverage and wastage of pesticides. Improper droplet size, nozzle selection, and calibration can result in over-application or under-application of pesticides, affecting their effectiveness and leading to environmental concerns.
2. Operator Exposure and Safety: Manual pesticide spraying puts operators at risk of direct exposure to toxic chemicals. Without proper protective gear and training, they may experience health hazards, including skin irritation, respiratory

problems, and long-term health effects. Operator safety is a significant concern with conventional sprayers

3. Maintenance and Cost: Maintaining traditional pesticide sprayers can be time-consuming and costly. Components such as nozzles, pumps, and filters require regular cleaning, replacement, and calibration to ensure optimal performance. Additionally, the cost of purchasing and maintaining sprayers can be a financial burden for small-scale farmers.

4. Lack of Precision and Targeting: Conventional sprayers often lack precision and targeting capabilities, leading to indiscriminate spraying and unnecessary pesticide use. This can result in higher costs, environmental damage, and potential negative effects on beneficial insects and organism

1.6 Objectives

1. Decrease the operational cost by using new mechanism.
2. Work reliably under different working conditions.
3. Decrease the cost of machine
4. Decrease labor cost by advancing the spraying method.
5. To increase efficiency of sprayer
6. To decrease the operational cost by using new mechanism.
7. To remove backpack and foot spraying techniques
8. To reduce labor cost by advancing the spraying method. 11.To save thetime of the farmers
9. Machine can be operated in small farming land (5 acre).
10. Making such a machine which will be able to perform both the operations (spraying).

CHAPTER 02

LITERATURE REVIEW

Chapter 2

LITERATURE REVIEW

In paper 2.1 Real – time nozzle flow uniformity when using automatic section control on agricultural sprayers

The study conducted by Sharda, Fulton, McDonald, and Brodbeck (2011) aimed to investigate the real-time nozzle flow dynamics and uniformity when using automatic section control (ASC) on agricultural sprayers. ASC technology, which involves the automatic ON/OFF control of boom-sections or nozzles based on GPS positioning, is adopted by farmers to improve productivity, reduce overlap, and minimize input usage, thereby saving costs and minimizing environmental impacts.

The researchers conducted tests using an 18.3-meter sprayer equipped with individual nozzle and boom-section control. Pressure sensors were randomly mounted across the boom to measure nozzle pressure, which was then converted to nozzle flow rate. The study evaluated the response of the system in managing real-time nozzle off-rate (difference between actual and target flow rate) and flow uniformity across the boom when the sprayer moved out of point rows into a no-spray zone and then reentered the spray zone.

The results indicated that the nozzle flow rate settling time (time taken to stabilize after changing flow rates) varied from 0.4 to 14.4 seconds, and the nozzle off-rate ranged between 36.6% and +28.7% for tests involving 70° point rows. When exiting point rows, over-application occurred, while reentry resulted in under-application during flow-compensated tests. Nozzle flow uniformity was more than 50% for a short duration (less than 1.0 second) during reentry into point rows.

In paper 2.2 Design of Sprinkler for Agricultural Purpose;Agriculture is the primary source of livelihood for about 60% of the total population of India. Agriculture is the backbone of Indian and contributes 16 to 17% for GDP. Crop yield is reduced by mainly due to attack of pests, diseases and weed. Chemical control is the popular method adopted for controlling most insects, weed and diseases. The chemicals are applied either by spraying or sprinkling on the crop with help of pump or dusting. Spraying is one of the most effective and efficient techniques for applying spray liquid to crops in

order to protect it. The design is based on the trolley operated system by this we can reduce work and time consumption. As farmers are still using the same old method to spray pesticide, it might have a lot of side effects like skin disease and also eye irritations, it also have some serious health effects like cancer, asthma and allergies. So, with the help of this sprinkler farmers can easily spray pesticides and also spread manure with less labour cost as there is no need of more labours, and time consumption is less. This multifunction device will come in handy that can be put to use in different spraying stages of farming as per process requirement. So we have designed a pesticide spraying machine which will not only increase productivity but also will reduce the effort of the farmers. The machine will save the time of the farmer as well as efficiency in spraying. This model carries multi nozzle pesticides sprayer pump which will perform spraying at maximum rate in minimum time. Constant flow valves can be applied at nozzle to have uniform nozzle pressure e. Owing to concern towards protecting environment from pollution by excessive use of pesticide and to economies the spraying method suitable alternative should be identified. In India, diverse farm mechanization scenario in country due to varied size of the farm holdings and socio-economic disparities. Most of farmer in India are small and marginal land holder. The spraying operation done by sprayer which consumes more time and energy. Tractor operated sprayers are difficult for adaption by the farmer due to existing cropping patterns, available field size, field condition during the rainy season. To overcome these problem Pesticides sprayer is a good idea while it can be used easily on fields without any difficulties as tractors and other sources cannot be moved on fields during rainy season, this Pesticides machine can be used easily at any time.

2.3Application of variable spray technology in agriculture

The article you provided is titled "Application of variable spray technology in agriculture" and was published in the IOP Conference Series: Earth and Environmental Science in 2018. It was written by Hongbin Dou, Chengliang Zhang, Lei Li, Guangfa Hao, Bofeng Ding, Weike Gong, and Panlin Huang.

The article discusses the principle, characteristics, and application of variable spray technology in agriculture. It highlights the advancements made in target detection, automatic control, and spray application. The paper mentions different technologies used in target detection, such as real-time sensors and geographic information

technology. It also discusses control technologies including pressure control flow regulation, PWM control flow regulation, and liquid chemical concentration mixed regulation system. Additionally, the article covers the research and application of variable nozzles in spray technology.

The authors emphasize the benefits of variable spray technology, such as increased pesticide utilization, reduced pesticide residues, real-time adjustments based on environmental factors, cost savings, and high compatibility. The article provides examples of studies that have utilized automatic target spray technology based on real-time sensors and geographic information technology.

As one of the representatives of precision agriculture, variable spray technology has made great progress in the development and application of technology in recent years. This paper describes the principle and characteristics of variable spray technology, and outlines the development results of variable spray technology in target detection, automatic control, and spray application. In terms of target detection technology, automatic target spray technology based on real-time sensors and automatic target spray technology based on geographic information technology are introduced; In control technology, pressure control flow regulation technology, PWM control flow regulation technology and liquid chemical concentration mixed regulation system are described. In the field of spray technology, it mainly describes the research and application of variable nozzles and forecasts the application prospect and development direction of variable spray technology.

This technology aims to improve the precision and efficiency of pesticide application by adjusting the spray volume in real-time according to different crop targets. Variable spray has several characteristics and potential benefits, such as increasing pesticide utilization, reducing pesticide residues, real-time adjustment based on changing factors, cost-saving, and high compatibility.

The research mentioned various studies related to variable spray technology. Some of these studies focused on detection technology using sensors, such as laser, ultrasonic, and camera, to automatically detect and identify targets for precise spraying. Other studies explored the use of geographic information technology, such as GPS and GIS,

to develop systems that integrate field data, map information, and decision support for accurate positioning and quantitative management.

Additionally, the control technology for variable spray was discussed, including pressure flow control and pulse width modulation (PWM) control flow. Pressure adjustment allows for flow regulation by adjusting the pressure of the liquid medicine, while PWM control involves rapidly switching on and off electronic actuators to control flow.

In addition to the fact that industrial and service sectors have developed far more rapidly than agriculture in our nation, farming is still done in the traditional manner. They are typically carried out with the aid of our project, which is expensive for farmers with modest farming lands. In order to resolve these issues, we worked to find solutions and created equipment that would be useful to farmers when spraying crops.

CHAPTER 03

METHODOLOGY

Chapter 3

METHODOLOGY

In addition to the fact that industrial and service sectors have developed far more rapidly than agriculture in our nation, farming is still done in the traditional manner. The labor-carrying backpack type sprayer has historically been used for spraying, which demands more human effort. They are typically carried out with the aid of our project, which is expensive for farmers with modest farming lands. In order to resolve these issues, we worked to find solutions and created equipment that would be useful to farmers when spraying crops

Data gathering methods include literature surveys, user studies, and market analyses using surveys, videos, and other methods like observation.

In this process is carried out by the take several steps :

Step1- Firstly sensors is use to collecting the data for environment.

Step2- After collecting the data is transfer to the controller and controller control the flow as usually .

Step3 – It can control the flow of the nozzle and variable flow are produces . Step4- In this project , Sprayer Pump can be manually operated ,if we want the higher pesticide flow then press the 3 switch button in ON mode and so on . PDS would be produced by ranking the features in the QFD according to the user needs and related technical requirements. Digital modelling and sketching would be used to create concepts .Make some doodle sketches, then five concepts and a digital model will be produced utilizing CATIA software and have intricate features. concept assessment and Using a weighted ranking system, the winning concept was chosen. A working prototype with specific features would be created, and feedback would be gathered.

3.1 COMPONENTS:

1.NOZZLE (Flat Type) : It is a device which converts the pressure energy of fluid into kinetic energy, spray nozzle is a precision device that facilitates dispersion of liquid into a spray. Nozzle is used for purpose to distribute a liquid over an area. Nozzles

break the liquid into droplets, form the spray pattern, and propel the droplets in the proper direction. Nozzles determine the amount of spray volume at a given operating pressure, travel speed, and spacing. The proper selection of a nozzle type and size is essential for proper pesticide application.

The nozzle is a major factor in determining the amount of spray applied to an area, the uniformity of application, the coverage obtained on the target surface, and the amount of potential drift.

Fig1 Nozzle

Nozzles break the liquid into droplets, form the spray pattern, and propel the droplets in the proper direction.

Nozzles determine the amount of spray volume at a given operating pressure, travel speed, and spacing. So, We are using flat type nozzle as it covers more area and more amount of flow.

Flat spray nozzles produce small- to medium-sized drops forming a flat or sheet-type spray pattern that's typically used in manifolds and headers.

Flat type nozzle is mostly used as it covers more area & also Inexpensive than other types of nozzle.

Flat Nozzle styles include threaded, flanged and quick-connect.

2.PUMP: It consists of piston and cylinder arrangement; it has a lever to operate the motion of piston in reciprocating direction. The pump generates the pressure of 2 bar and discharge.

Fig.2 Pump

Max Pressure: 80PSI

Max Flow: 4LPM

3. BATTERY: A battery is a device used to power electrical equipment that consists of one or more electrochemical cells with external connections.

Brand :- okaya

Specification :- 7.2 ah

Battery type :- smf

Warranty :- 1year

Fig.3 Battery

4.WHEEL: A circular component designed to rotate on an axle bearing is referred to as a wheel. In the wheel and axle, one of the six simple machines, the wheel is one of the essential parts. When wheels and axles are used together, large things can be transported

or moved more readily while bearing a load or carrying out work in machines. It is employed while moving a car from one location to another.

5.FRAME: A frame's primary job is to support the weight of the entire assembly, so it must be sturdy enough to do so. Mild steel was used to build the frame, which is made of square pipe.

Fig.4 Frame

6.ARDUINO: The Arduino UNO is an ATmega328P-based microcontroller board. It contains 6 analogue inputs, a 16 MHz ceramic resonator, a USB port,a power jack, an ICSP header, and a reset button. It also has 14 digital input/output pins, six of which can be used as PWM outputs.

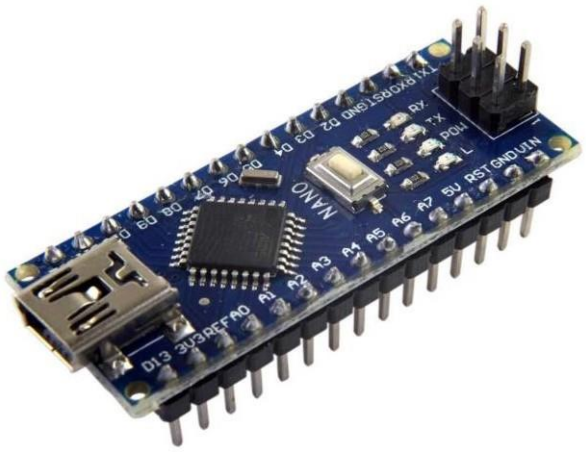

Fig.5 Arduino

7. SENSORS: Automatic target identification orchard sprayers now use infrared device detection technologies to identify targets and automatically regulate the spray system. Compared to ultrasonic sensors, infrared sensors are more affordable and respond more quickly (US). The infrared sensor performs better inside than outside.

Whether an object is light or dark depends on the sort of thing that has to be detected by the infrared sensor.

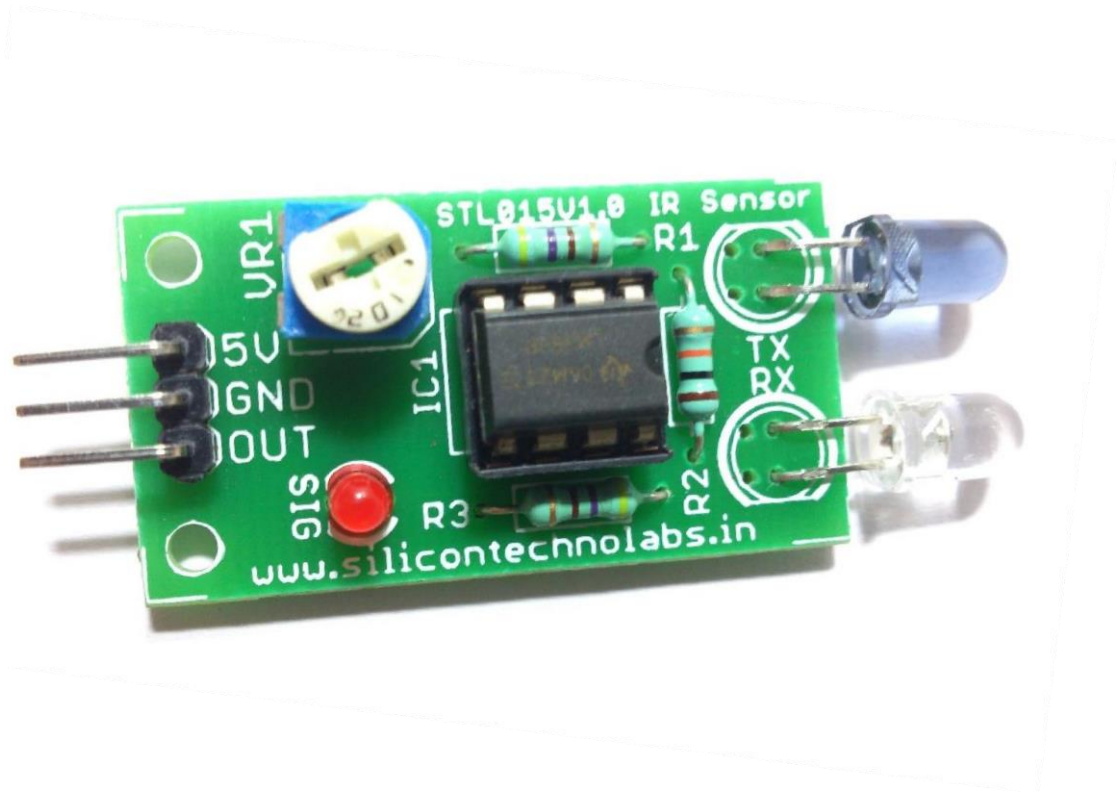

Fig.6 IR Proximity Sensor

CHAPTER 04

FABRICATION

Chapter 4

FABRICATION

Steps Involved In Fabrication:

Step:1 Raw Material:

Fig.7 Iron Rod

Fig.8 Bearing

Fig.9 Pipe

Step:2 Operations:

Fig.10 Welding

Step:3 Assembly:

Fig.11 Assembly

Fig.12 Assembly of Components

Step:4 Finishing:

Fig.13 Finishing

Step:5 Final Model:

Fig.14 Final Model

CHAPTER 05

CONCLUSION

Chapter 5

CONCLUSION

The tools were specifically created for farmers with small farms, say 5 to 6 acres. It can be used for both spraying and weeding at the lowest possible cost to the farmer, allowing him to afford it. When used for weeding, the equipment will work better if the soil is damp since the weed cutter can more readily penetrate and dig out the weeds. This will make the weeding process go more quickly. When operating on a smooth surface or one that is less uneven, the equipment will function better. It will also work better when used on crops that are close in height to one another and when there is less space between them. Since there is no longer a need to carry the tank on one's back and solder, the back discomfort issue has been solved by the suggested model. There are more nozzles available, covering a larger area of spray in less time at a faster rate.

A well-adjusted crop facility in the model helps to reduce the overuse of pesticides, which lowers pollution. In the field, hollow cone nozzles that were imported should be employed for improved performance. There is no longer a muscular issue, and using the lever is unnecessary. One pump can be used for several different crops. We discovered after a trial that using a push-type machine is simple for most people. Following a test, we have discovered that one finds it simple to operate.

CHAPTER 06

FUTURE SCOPE

Chapter 6

FUTURE SCOPE

Future agricultural technology applications for the mechanized agriculture sprayer vehicle are possible.

1.Electrical power loss can be prevented by using an electrical system to drive the vehicle.

2.The system has the ability to be modified into a multifunctional device that can perform more than two tasks at once.

3.The mechanized agriculture sprayer vehicle trolley wheels can be improved further to allow for operation on rough terrain.

4.Because it has the capacity to accommodate one, you can utilise a weeder and cutter mechanism. It may have a place for carrying agricultural tools and equipment.

REFERENCES

References:

[1] Lakshminara Simha N “Design and Development of Trolley type Agrochemical Sprayer” Researchgate 326156341,pp 2465-3289

[2] Hongbin Dou, Chengliang Zhang a , Lei Li, Guangfa Hao, Bofeng Ding , Weike Gong, Panlin “Application of variable spray technology in agriculture” doi:10.1088/17551315/186/5/012007

[3] Mansoor Alam, Muhammad Tahir Khan ,Muhammad Roman, Muhammad Tufail, Muhammad Umer Khan “Real Time Machine Learning Based Crop/ Weed Detection and Classification For Variable Rate Spraying In Precision Agriculture” 978-1-7281-6788,2020,IEEE, pp 273-280

[4] Aishwarya.B.V,Archana.G, C.Umayal “Agriculture Robotic Vehicle Based Pesticide Sprayer With Efficiency Optimization” 978-1-4799- 7758-1,IEEE,2015,pp 59-65

[5] Bhavani Shankar Y,Cariappa A.B, “Design of Sprinkler

For Agciculture Purpose”DOI 10.17148/IARJSET.2021.8698,pp 565- 567