DESIGN AND MANUFACTURING OF SMART SOLAR GRASS CUTTER AND PESTICIDE SPRAY MACHINE

Prajwal Mahajan[1], Vishal Dhas[2], Jayesh Kotkar[3], Prasenjeet Kamble[4], R.T. Dhanoore[5]

[1]*U. G Student Mechanical Department, JSPM's Imperial College of Engineering & Research, Pune, India.*
[5]*Assistant Professor, Mechanical Department, JSPM's Imperial College of Engineering & Research, Pune, India*

Abstract

Nowadays grass cutter machines are becoming very popular today. Pollution is manmade, which we can be seen in our daily life. In old model of grass cutter IC engine was used and hence because of its environmental impact pollution level rises IC engine driven cutter is more costly. Maintenance of such conventional machine is more. There are many types of pesticides sprayer are available in India. But mostly used sprayer is backpack type sprayer which is used by farmers because it is cheaper, easy to use and main thing about it is less costly, but it requires lot of time. Also, the farmer which is spraying pesticides is affected by it as it is harmful to human health and human also affect by the lumbar pain due to weight of equipment. To avoid these drawbacks, we plan to build new type of grass cutter which runs on solar energy and this model spray pesticides. The aim of our project is to make the grass cutter which operates on solar energy hence save the electricity and reduces manpower. In our project we use microcontroller for controlling various operation of grass cutter. Also, the grass cutter has obstacle sensor for obstacle detection. Grass cutter operates automatically hence it does not require skill person to operate. The main aim of our project is to design and develop solar grass cutter with pesticide spray machine. The 3 D model is drawn. All the parts are manufactured and then assembled together and then the testing of model is carried out.

***Keywords*- Arduino UNO R3, Ultrasonic Sensor, DC Motor, Bluetooth, Relay Module, Solar Panel.**

INTRODUCTION

An agricultural robot is a robot deployed for agricultural purposes. The main area of application of robots in agriculture today is at the harvesting stage. Emerging applications of robots or drones in agriculture include weed control, cloud seeding, planting seeds, harvesting, environmental monitoring and soil analysis. According to Market Research Engine, the agricultural robots market is expected to reach $75 billion by 2025 .Fruit picking robots, driverless tractor / sprayers, and sheep shearing robots are designed to replace human labour. In most cases, a lot of factors have to be considered (e.g., the size and colour of the fruit to be picked) before the commencement of a task. Robots can be used for other horticultural tasks such as pruning, weeding, spraying and monitoring. Robots can also be used in livestock applications (livestock robotics) such as automatic milking, washing and castrating. Robots like these have many benefits for the agricultural industry, including a higher quality of fresh produce, lower production costs, and a decreased need for manual labour. They can also be used to automate manual tasks, such as weed or bracken spraying, where the use of tractors and other manned vehicles is too dangerous for the operators.The mechanical design consists of an end effector, manipulator, and gripper. Several factors must be considered in the design of the manipulator, including the task, economic efficiency, and required motions. The end effector influences the market value of the fruit and the gripper's design is based on the crop that is being harvested.

1.1Demand in the market

There are concerns over the amount of labour the agricultural sector needs. With an aging population, Japan is unable to meet the demands of the agricultural labour market. Similarly, the United State currently depends on a large number of immigrant workers, but between the decrease in seasonal farmworkers and increased efforts to stop immigration by the government, they too are unable to meet the demand. Businesses are often forced to let crops rot due to an inability to pick them all by the end of the season. Additionally, there are concerns over the growing population that will need to be fed over the next years. Because of this, there is a large desire to improve agricultural machinery to make it more cost efficient and viable for continued use.

1.2Current applications and trends

Much of the current research continues to work towards autonomous agricultural vehicles. This research is based on the advancements made in driver-assist systems and self-driving cars.

While robots have already been incorporated in many areas of agricultural farm work, they are still largely missing in the harvest of various crops. This has started to change as companies begin to develop robots that complete more specific tasks on the farm. The biggest concern over robots harvesting crops comes from harvesting soft crops such as

strawberries which can easily be damaged or missed entirely. Despite these concerns, progress in this area is being made. According to Gary Wishnatzki, the co-founder of Harvest Croo Robotics, one of their strawberry pickers currently being tested in Florida can "pick a 25-acre field in just three days and replace a crew of about 30 farm workers". Similar progress is being made in harvesting apples, grapes, and other crops. Another goal being set by agricultural companies involves the collection of data. There are rising concerns over the growing population and the decreasing labour available to feed them. Data collection is being developed as a way to increase productivity on farms. Agri Data is currently developing new technology to do just this and help farmers better determine the best time to harvest their crops by scanning fruit trees.

LITERATURE SURVEY

As India is agriculture-based country and 70% people do farm and related work. Agriculture is required to be boomed to enhance the Gross Domestic Product (GDP) of the country by improving the productivity. The productivity of the crops can be increased with the help of pest control. Pesticide spraying is the necessary procedure in cultivation of the crops. The present idea deals with the designing and fabricating a pesticide sprayer which will be useful and affordable to the farmers which will assist to increase the productivity of crops. Though this project an attempt has been done to improve the method of spraying the pesticide that will enhance the productivity and increase the farmer's income. 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.

The motive behind developing this equipment is to create mechanizations which will help to minimize effort of farming. It is suitable for the spraying at minimum costs for the farmers so that he can afford it, of the many products available. It is most important to select the most. Efficient and easy type for your particular needs, whether if it is for applying insecticide fungicides, weed killer, liquid fertilizers or wettings agents. For example, lawn sprayers are made especially for the applications of liquids material to the lawn area. So, considering the above points related to spraying the project work is focused upon to design and to fabricate such equipment which will be able to perform spraying operation more efficiently and also will result in low cost. A current trend in the agricultural area is the development of mobile robots and autonomous vehicles for precision agriculture. One of the major challenges in the design of these robots is the development of the electromechanical components. This platform has as main characteristics four-wheel propulsion and independent steering, adjustable gauge, ground clearance of 1.80 m, diesel engine, hydraulic system, and a CAN-based networked control system. The aim of this work is to describe the project of an experimental platform for data acquisition in field for the study of the spatial variability and development of agricultural robotics technologies to operate in agricultural environments. This proposal is based on a description of the design process and definition of the design parameters utilized.

PROBLEM STATEMENT & OBJECTIVES

The past technology of grass cutting is manually operated by the use of hand devices like scissor, these results into more human effort and more time required accomplishing the work. Also, in old methods lack of uniformity of the remaining grass. Also due to the use of engine powered machines increases the air and noise pollution also this grass cutter require maintenance. In our project we combine grass cutter and spray pesticides which is operated by solar panel.

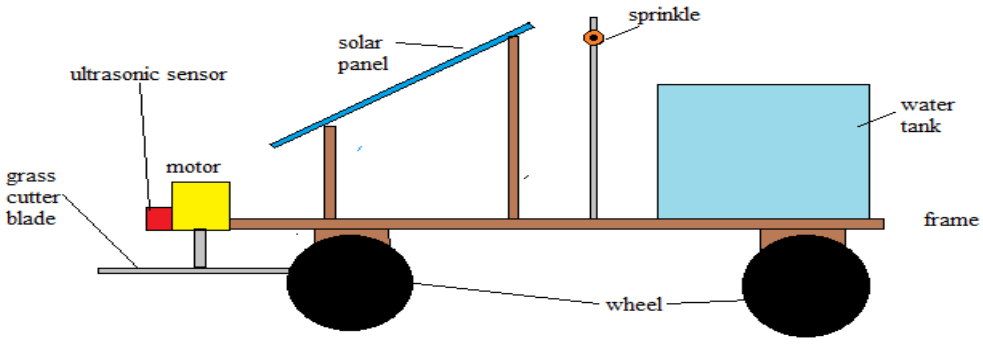
Objective

The objective of our project is to design and automatic grass cutter and spray pesticide which operates on solar energy and avoids the drawback of old lawn mowers. The purpose is to avoid energy crisis in India and reduces the human efforts, operating cost and maintenance cost. Also, this machine keeps the environment clean and healthy.

METHODOLOGY

Step 1: - We started the work of this project with literature survey. We gathered many research papers which are relevant to this topic. After going through these papers, we learnt about grass cutter and pesticide spray machine.
Step2: - After that the components which are required for my project are decided.
Step 3: - After deciding the components, the 3 D Model and drafting will be done with the help of CATIA software.
Step 4: - The components will be manufactured and then assembled together.
Step 5: - The testing will be carried out and then the result and conclusion will be drawn.Procedure manage the spinned words as you want.

Block diagram



WORKING

In the solar operated grass cutter and pesticide sprayer mechanism, Blades and sprinklers are being operated by using commands provided to Arduino circuit in turn the Arduino circuit controls the Blade motor and water pump accordingly. Ultrasonic sensor is provided at the front to avoid any kind of accident caused due to the cutter blade. Ultrasonic sensors senses the signal and transfer those signals to Arduino circuit and which in turn stops the cutter motor.

In this project the main part is the Arduino UNO R3 which control the all assembly of project. The Arduno connections are connected to 4 Channel Relay Module and Bluetooth device. The Relay Module is connected to motor, pump and ultrasonic sensor. Here the Relay Module is used for switch ON or switch OFF operation. The working principle of the relay module is to getting input command from arduino and showing the output by switch on or switch off the motor, going upward and backward or stop the model. The Bluetooth device is connected to arduino for wireless connection. The mobile device which is connected wirelessly to arduino by using Bluetooth. The user is with the controller, the user has to select that in which mode the system has to operate either it is in manual mode and the auto mode in manual mode the user has to decide that where tomove robot but in auto mode the robot will decide that where it wants to go . By using ultrasonic sensor the robot will move. The battery is source part for the project the battery is supplying the 12v dc for the motor and pump. The Charged on the solar plate once the battery is fully charged the robot will move properly. Also the second application is the pesticide spreading here we use the 12v dc operated pump with the 1.5m length pipe and the spreading nozzle is connected at the one end of the pipe. For supplying water to the and storing pesticide we use the water tank of 10 liter. Bluetooth device used here has the range of 300ft(100m). In this range the user has to give instruction to the machine.

5.1 Arduino UNO R3

Arduino is an open-source hardware and software company, project and user community that designs andmanufactures single-boamicrocontrollers and microcontroller kits for building digital devices and interactive objects that can sense and control both physically and digitally. Its products are licensed under the GNU Lesser General Public License (LGPL) or the GNU General Public License (GPL), permitting the manufacture of Arduino boards and software distribution by anyone. Arduino boards are available commercially in preassembled form or as do-it-yourself (DIY) kits. Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analogy input/output (I/O) pins that may be interfaced to various expansion boards or breadboards (shields) and other circuits. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers. The microcontrollers are typically programmed using a dialect of features from the programming languages C and C++. In addition to using traditional compiler toolchains, the Arduino project provides an integrated development environment (IDE) based on the Processing language project.

Fig.1 Arduino UNO R3

5.2 Ultrasonic Sensor

An ultrasonic sensor is an instrument that measures the distance to an object using ultrasonic sound waves. An ultrasonic sensor uses a transducer to send and receive ultrasonic pulses that relay back information about an object's proximity. High-frequency sound waves reflect from boundaries to produce distinct echo patterns. Ultrasonic sensors work by sending out a sound wave at a frequency above the range of human hearing.

Fig. 2 Ultrasonic Sensor

5.3 Relay Module

The 4 Channel Relay Module is used in the model. The 4 Channel Relay Module is a convenient board which can be used to control high voltage, high current laod such as motor, solenoid valves, lamps and AC load. It is designedvto interface with microcontroller such as Arduino, PIC and etc. The relays terminal (COM. NO and NC) is being brought out with screw terminal. Simply the relay module is used for switch ON or switch OFF operation. A Relay is a simple electromechanical switch. While we use normal switches to close or open a circuit manually, a Relay is also a switch that connects or disconnects two circuits. But instead of a manual operation, a relay uses an electrical signal to control an electromagnet, which in turn connects or disconnects another circuit. Relays can be of different types like electromechanical, solid state. Electromechanical relays are frequently used.

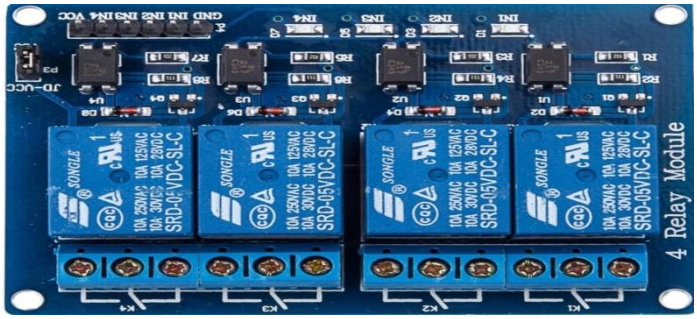


Fig. 3 Relay Module

5.4 Solar Panel

A solar panel works by allowing photons, or particles of light, to knock electrons free from atoms, generating a flow of electricity. Solar panels actually comprise many, smaller units called photovoltaic cells. (Photovoltaic simply means they convert sunlight into electricity.) Many cells linked together make up a solar panel. Each photovoltaic cell is basically a sandwich made up of two slices of semiconducting material, usually silicon the same stuff used in microelectronics.

Fig. 4 Solar Panel

5.5 Bluetooth Module

This research uses an Arduino, HC-05 bluetooth module to transfer the command from android smart phone to the system. This HC-05 blurtooth module is mounted on the system along with some relays. Initialy user connect its smart phone with this module. After a successful connection user can provide the desired direction change command to the system from maximum 10-meter distance. Also, user can switch ON and OFF the grass cutter through its mobile using the android application.

HC-05 bluetooth module is mainly used for short-range wireless connectivity. This is economical and durable module as compared to other existing Bluetooth modules.

Fig. 5 HC-05 Bluetooth Module

SCOPE

- As this is prototype when we go for large scale production it will increase atomization of agriculture.
- When we improve the storage capacity and use different cutters, we can cut different types of grass.
- From future point of view this machine can be made completely automated, which make this completely smart.

CONCLUSION

- In this semester we have successfully designed the CAD model using CATIA V5 R20 software and selected the material required and also done all the required calculation for this.
- By doing this project we conclude that ,we can reduce the human efforts and this will be helpful for farmer . As it is operated on solar energy so the it is best application that does not effects on environment.
- This project work has presented progress towards achieving a future precision autonomous farming system. This system is designed to help farmers in reducing their time and energy spent for pesticide spraying and weed cutting. This system can be operated on +12V rechargeable battery. This system will reduce labor problem in future. So, this system will be the best replacement for currently used systems like hand sprayers and tiller mounted sprayers.

REFERENCES

[1] "Agricultural robots for field operations: Concepts and components" Avital Bechar, Clement Vigneault Institute of Agricultural Engineering, Agricultural Research Organization, The Volcani Center, Bet-Dagan, Israel.

[2] "AGRICULTURAL ROBOT" Kavita Zole1, Sanghasevak Gedam2, Aditya Dawale3, Kiran Nikose4, Jayant Hande Research Student, Dept. of ETC, Priyadarshini J L College of Engineering Nagpur, Maharashtra, India.

[3] "HRI usability evaluation of interaction modes for a teleoperated agricultural robotic sprayer" George Adamidis, Christos Katsanos, Yisrael Parmet, Georgios Christou, Michalis Xeons, Thanasis Hadzilacos, Yael Edan.

[4] "Design and Development of Multipurpose Pesticides Spraying Machine" by Shailesh Malonde Dept. of mechanical Engineering, Trinity Academy of Engineering, Pune, Maharashtra, India.

[5] "Application of systematic methods in the electromechanical design of an agricultural mobile robot" Rubens Andre Tabile, Eduardo Paciencia Godoy, Giovana Tripoloni Tangerino, Arthur José Vieira Porto, Ricardo Yassushi. Inamasu, Rafael Vieira de Sousa.

[6] "Solar powered automatic grass cutter and pesticide spreading robot" by Argade Pratik Pralhad, Bhosale Swapnil Bhagwan, Khadke Sagar Subhash, Phadtare Nikhil Vijay , Prof.Kale R.U5;B.E ,Dept. of E&tc Engineering, S.B. patil college, Indapur, Maharashtra, India.

[7] "Design, development and fabrication of agricultural pesticides sprayer with weeder", International Journal of Applied Research and studies, pp. 1-8. Laukik P. Raut, Smit B. Jaiswal, Nitin Y. Mohite. (2013, Nov.)

[8] "Robotic Agriculture Machine, International Journal of Innovative Research in Science", Engineering and Technology, Volume 3, Special Issue 4, Gholap Dipak Dattatraya1, More Vaibhav Mhatardev, Lokhande Manojku-mar Shrihari, Prof. Joshi S.G April 2014.

[9] "Design and Fabrication of a Solar Sprayer" National Conference on Innovative Trends in Science and Engineering, K. Sowmya, M. Malath, May 2017.