

Mini Lawn Mower Using Smartphone

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Abstract: A lawn mower is a device that is used to cut grass on a lawn to the required height. The majority of the enormous, pricey, and polluting lawn mowers now on the market are powered by internal combustion or gas engines. The time-consuming and labor-intensive process of watering the garden presents another challenge. This invention concerns a machine that can cut the grass while misting it with water or a pesticide solution, all while being operated through smartphone. In order to reduce pollution, this design used a 12V rechargeable battery as its power source and an Arduino Uno as its CPU. MIT App Inventor was used to construct the smartphone application needed to operate this device. As a consequence of the studies that have been conducted, this device may be moved and the grass can be mowed and irrigated using a smartphone and a Bluetooth connection. However, this product can be used effectively on a lawn at home. This is as a result of the product's primary design focus being the backyard lawn. Due to its design, this innovation finds it difficult to mow other areas, such as a football field. This innovation is a tool that allows for smartphone-controlled lawn mowing and pesticide application. This will make it easier for the user to mow the lawn.

Keywords: Mower, pesticide, mini mower, mini control mower, sprinkler.

1.0 INTRODUCTION

A lawn mower is a machine for cutting grass. The basic or the old mower operate by the lawn mower blades are propelled forward by driving the mower forward. An electric motor or an internal combustion engine may also rotate the blades. There have been a numbers of lawn mower designs produced till this day. For example, is the push lawn mowers, which are suitable for smaller lawns, and ride-on lawn mowers, which can cut grass in larger lawns, these are examples of these designs [1].

There are also different criteria used to classify lawn mowers. For example, we can have reel lawn mowers with a horizontal axis that produce a clean cut by scissors action and are made up of blades on a rotating cylinder. The other one is rotary lawn mowers with a vertical axis based on the rotation axis of the blades. It is typically powered by internal combustion engines or electric motors, and are mowed by hand, with the engine only spinning the cutting blades [2].

Thus, the innovation is basically come from the idea of ride on lawn mower and the rotary mower combine together with additional feature to sprinkle water or pesticide base on the liquid provided in the tank. But this will be a small product and it has an additional feature which is it can sprinkle the pesticide as in its name "mini".

As the contribution in this innovation, this product can be controled using smartphone by using Bluetooth

connection. There is also an application created to be used by smartphone to control this product.

2.0 LITERATURE REVIEW

2.1 A Technical Review of Lawn Mower Technology

Dutta P.P. et. all have done this research in 2016. This report describes and evaluates various technology advancements that have resulted in more efficient and cost-effective lawn mowers. Solar energy, traditional electric, and internal combustion engines might all be used to power such a lawn mower. This study discusses the mechanisms used in the lawn mower device, the model design, and results found in numerous researches for each sort of energy source listed above. In some cases, two or more of these energy sources may be combined [1].

2.2 Design and Fabrication of Wireless Remote Controlled Lawn Mower

M.P. Nimkar et. all developed this project in 2017. This project is a summary and review of various technologies for producing a cost-effective and efficient lawn mower. Simple products like a 12V battery and a 12V motor are

also used in this project. This project can be a good example for the student to start their own project.[2]

The project about the wireless lawn mower. The model for this product is designed by using Catia v5 software. This product also use removable 12V battery that allow it to swap for a bigger or smaller battery depend on the size of the lawn. This product selection for the DC motor for the mower motor is based on the torque calculation that they have done. With the speed of 2000 rpm, the voltage of 12 volt and the power of 180 watt. Put that all in the torque equation, the torque produced is 0.862 Nm. Therefore, this product limitation is the power source use due to now, there is a solar powered function that can be add in this project.

2.3 Investigation On Autonomous Pesticide Spraying Robotic Vehicle In Agriculture Field

Mr. Manikandan Ganesan et. all have developed this report in early 2021. They devised a method of spraying the crops in less time and at a lower cost. It was also planned to construct an autonomous robot that could spray pesticides on crops without causing any harm to farmers. An autonomous robot is constructed in this article to save crops and pesticides. This autonomous robot is basically a small type of Rover.[3]

The robot is travelled and controlled by GPS and PX4 Autopilot system. The GCS program is used to set the operating waypoint for this robot, which is then sent to the robot through telemetry. This robot also used 12v rated gear motor to drive the vehicle. A sprinkler motor is nothing more than a motor that sprays pesticide. When the mission begins, the sprinkler is immediately activated since it is tied to the robot cars carrying pesticide containers.

2.4 Design and Fabrication of Autonomous Lawn Mower with Water Sprinkler

Himanshu Arora et. all have developed this project in September 2019. This project is based on a number of studies, including battery life span, turf quality, blade cutting speed, and lawn mower design research. With all of that, an autonomous lawn mower is proposed in this paper, which can save physical effort in cutting the grass by eliminating the need to follow after the mower, as well as contribute to a pollution-free and safe environment.[4]

The main component that is used in this project is Arduino Uno which operate as the brain for this product, DC metal gear motor for the moving tyre, high torque DC motor for the mower motor, and the DC motor pump for the sprinkler. This product also used Bluetooth Module to control the direction and the speed of the lawn mower. For the power supply, this product used Lithium Ion battery as the power source. For the future improvement for this product, this product can control with voice command.

2.5 Design and Construction of Automated Lawn Mower

Olawale O.E. Ajibola and Sunkanmi Olajide have develop this project in November 2019. This paper is about the construction and design of an automated lawn mower, which uses a linear blade propelled by a robotic car to cut grass automatically with little human intervention. This product use solar powered panel to power this devise and also to charge the battery.[5]

This product used Ackermann steering for the robotic car. It includes a proximity sensor that it utilises to detect and avoid things while moving. It can operate in semi-autonomous and fully autonomous modes with low operating costs, little risk to the operator's health, and no impact on the environment. The limitation that can be improve in the future is this product cannot cut the grass properly if the grass population at the working area for this product is very high. The suggestion for the improvement is to make the cutting blade adjustable.

3.0 METHODOLOGY

3.1 Overall Block Diagram

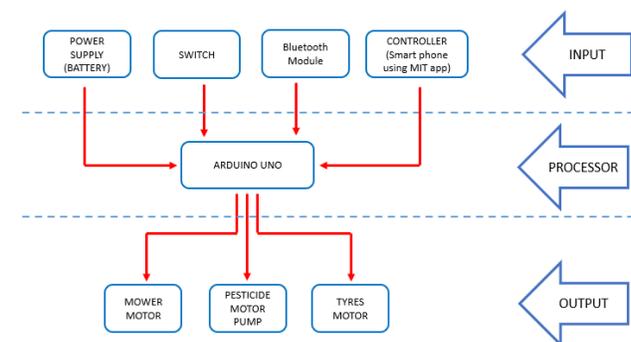


Figure 1: Overall Block Diagram

Figure 1 represents the role of the parts for the proposed project. It ensures the project is developed successfully. Block diagram consists of three main parts which are input, processor, and output.

For the input, this product use battery as a power supply. This product also use Bluetooth module to connect it with the controller which is smartphone and a switch as the button to operate the pesticide mechanism. The MIT app inventor will be used to develop the app that will control this product.

Next is the output, this product will use two 12V dc geared motor for the tire to move this product and 12V dc motor for the mower mechanism. And it also will use the 12V dc pump motor to operate the sprinkle or pesticide mechanism.

All of the input and the output will be connected to the main brain which is the processor that is the Arduino Uno.

3.2 Flowchart

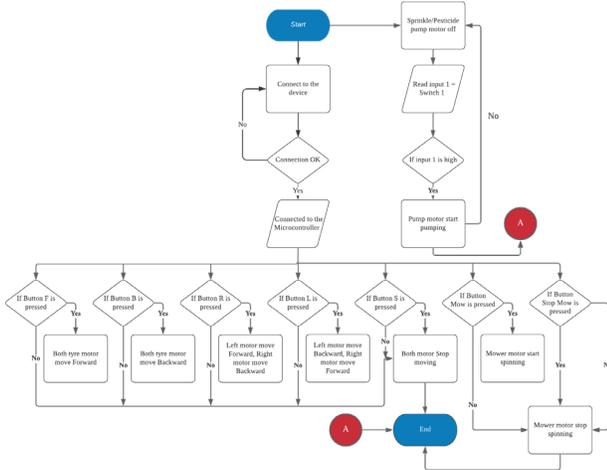


Figure 2: Flowchart of the system

Figure 2 shows that the flowchart for this innovation. For starter, this innovation will detect to connect with the device which is the smartphone by pairing it using Bluetooth. If it connected, then it will proceed to base on the input that given. Note that the red circle of A is the continuation flow between these two flowchart.

For movement command, if Button F is pressed, this product will move forward. If Button B is pressed, this product will move backward. Then if the Button R is pressed, this product will move to the right and if the Button L is pressed, this product will move to the left. Next is if the Button S is pressed, it will make this product to stop moving.

Other than that is, if the Button Mow is pressed, the mower motor will start spinning until the Button Stop Mow is pressed to stop the mower motor. Then for the pump motor, there will be a switch at the product. The pump motor will start operate if the switch is turn on and it will stop to operate if the switch is turn off.

3.3 Project Diagram

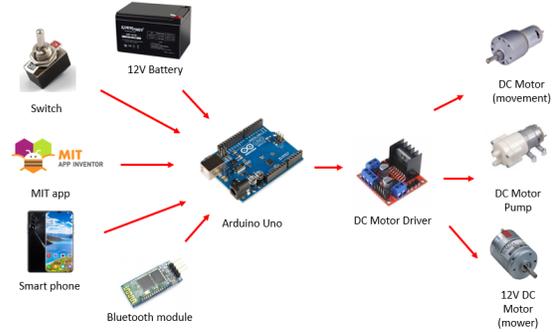


Figure 3: Project Diagram

Figure 3 show that 12V battery will be used as the main power supply. Then, the Bluetooth module is the connection source for the input which is the switch and the smartphone to be pair with the Arduino Uno. There is an application created for the smartphone to be used to operate this product using the MIT App Inventor. With all of the above, DC Motor Driver is used as a bridge between the controller and the DC Motor. This component basically will be use between the connection from the microcontroller which is Arduino Uno and the movement DC motor, mower DC motor and the pesticide DC motor pump. All of the motor in this product will operate based on what do we do with the application installed in the smartphone. For example, this product will move forward if the forward button (Button F) was pressed and the mower mechanism will start to operate if the Button Mower was pressed.

3.3 Design

3.3.1 Hardware design

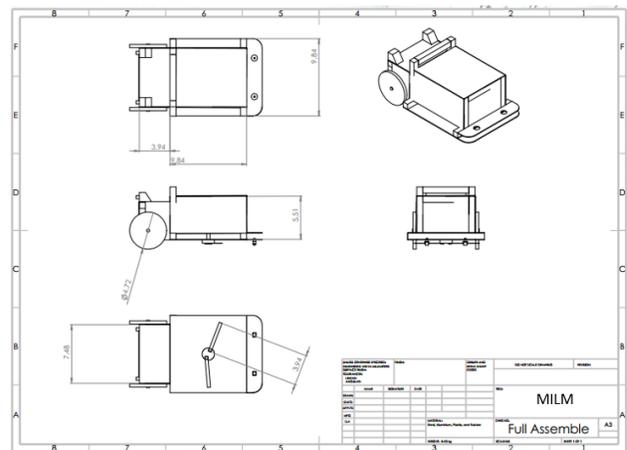


Figure 4: Project sketch of the Mini Lawn Mower Using Smartphone



Figure 5: Project 3D diagram

Figure 4 and Figure 5 is the early idea for this product. As shown, there is a few parts that is not a pointy surface, especially the front bumper. This is to avoid injury such as cut if this product bump into someone. The basic body dimension is 40cm length X 25cm width X 15cm height. This sketch will or not be finalize depends on the future idea cumulate for this project.



Figure 6: Actual design



Figure 7: Bottom view

This actual design was made based on the project sketch but with a little adjustment with the design. And the blade was used for the cutting mechanism for this product.

3.3.2 Software design



Figure 8: Application design of Mini Lawn Mower Using Smartphone

For this product's controller, the application was created using MIT App Inventor. This app must be installed in the smartphone and pair the smartphone with the product by Bluetooth to control the product in order to maneuver the lawn mower.

4.0 RESULTS

4.1 Table 1 show the result for experiment 1 which is can this innovation move properly between smooth surface and bumpy surface.

Table 1: Type of working surface

Type of working surface	Mobility
Smooth surface	Can move smoothly and properly
Bumpy surface	Can move but sometime get stuck if there is a hole or the bumpy is bigger



Figure 9: Bumpy surface



Figure 10: Smooth surface

The results of this innovation mobility on different surface conditions are shown in the Table 1 above. This product may travel freely on a standard smooth surface without difficulty or getting stuck. If the surface is uneven, it will be difficult for this product to move properly, and there is a potential that it will become stuck if there is a hole or anything similar. The motor will still be moving while stuck, that is because this product is not heavy enough to maintain the pressure of this product to grip the surface properly.

4.2 Table 2 show the result for experiment 2 which is the mowing efficiency between normal tall grass and aggressively taller grass.

Table 2: Grass Condition

Grass Condition	Mowing ability
Normal tall grass	Can be mow properly
Taller and hard stem grass	Cannot be mow because it will get stuck at the hard taller grass



Figure 11: Normal tall grass



Figure 12: Taller and hard stem grass

Table 2 shows the results of mowing ability at various grass conditions. We can observe that if the grass stem is not too thick, this product can cut it appropriately. Meanwhile, if the grass stem is too thick, the mower mechanism will become stopped because the mower motor is a speed kind of motor with a low torque. If the grass is excessively tall, this product will become stuck and will not be able to move at all.

4.3 Figure 13 show the result for experiment 2 which is how far this product can be control.

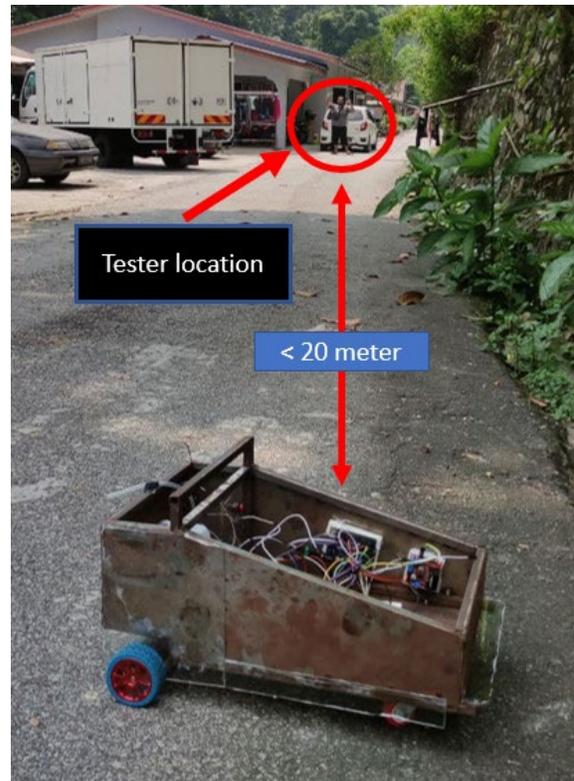


Figure 13: Distance for the tester and the product

As shown in Figure 13 above, the experiment to know how far for this product can be control using smartphone by Bluetooth connection have been conducted. With that experiment, we know that the distance this product can be

control by the smartphone properly is less than 20 meters. If the product is more than 20 meters from the smartphone, this product will stop moving.

5.0 DISCUSSION

Based on the results from the experiments, if the obstacle is not too great, this product can be used effectively. As a result, this product is intended for use on urban residential lawns. This is due to the fact that this is a small product. With that, this product is ineffective when applied on a larger field, such as a football field. That type of lawn will take a long time to complete the job.

If we want the mower mechanism to work in extreme grass conditions, the motor must be changed with higher torque and speed type of motor. In addition, the blade in the mower mechanism can be changed using a safer material such as cable tie.

6.0 CONCLUSION

The first objective of this project is to design a mini mower that can mow and sprinkle or pesticide the lawn. Next objective is to develop a prototype mower that can be control by using smartphone while mowing and sprinkle or pesticide the lawn and the last objective is to test and evaluate the innovation product functionality.

As for the first objective, this objective is based on the problem statement which is mowers are classified as dangerous products that must be used with caution and following proper instructions. Thus, the design of the mower has become a priority in order to make it much safer to operate and avoid any unnecessary incidents. Then, this innovation was developed based on the design that have been properly tuned to make this product can be control using smartphone.

Lastly, this innovation has been test to see if this project can operate properly which is can it be controlled by using smartphone to mow and pesticide or sprinkle the lawn. From the experiments that have been conduct, this product already achieved 90% of the objective because it can operate what I imagine it to operate.

To sum it up, this product is a mini or small control mower with additional feature which is pesticide or water sprinkler (based on the liquid contain in the tank). This product also can be control by smartphone via Bluetooth connection. This product basically a green technology product. This is because this product use battery as a power source to avoid the pollution such as air pollution that is provided by a certain product that use petrol fuel.

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