DESIGN AND FABRICATION OF SMART LAWN MOWER WITH WATER SPRINKLER ROBOT

A PROJECT REPORT

Submitted by

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in partial fulfillment for the award of the degree

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in

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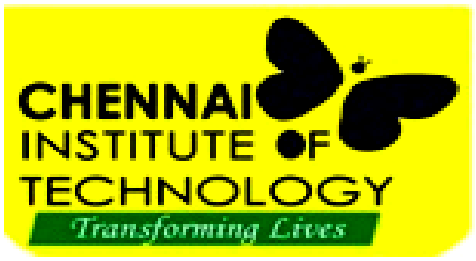

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ABSTRACT

Internet of things (IOT) is the new technology which is used to drive automated grass cutting machine. It is a conventional approach for cutting the grass of the lawn using remote operated device so as to avoid the hazards of horny grasses which can harm humans and provide scratches on exposed body parts and even some times cloth gets stuck in these. The lawn Mowers which are available at present in market are bulky, costly and most of them are powered by gas engine and Internal combustion engine which is surely a threat for the environment ,and another issue rises up when we water the garden, it is very time consuming and also laborious. There is a fundamental need to develop such environmental friendly lawn mower that can cut the grass in an efficient way and also water the lawn at the same time. This paper presents the study of various parameters such as blade cutting speed, turf quality, battery life span along with the design analysis of lawn mower. Here an approach of an autonomous lawn mower is proposed which can minimize the physical effort in cutting the lawn by eliminating the need to follow behind the mower and also helps us to make the environment pollution free and safe. The results show that the cutting speed action of blade has an important impact when it strikes the grass.

Keywords: Arduino UNO, Design Analysis, Rely Module, Bluetooth Module, Water Sprinkler.

SYNOPSIS

CHAPTER NO.	TITLE	PAGE
	ACKNOWLEDGEMENT	
	ABSTRACT	
	SYNOPSIS	
	LIST OF FIGURES	
1	**INTRODUCTION**	**1**
	1.1 Overview Of The Project	1
	1.2 Purpose Of Integrating Lawn Mower With Water Sprinkler	2
	1.3 Different Methods To Implement	3
	1.3.1 Autonomous Robot	3
	1.3.2 Remote Controlled Robot	5
	1.3.3 Hybrid Robot	6
	1.3.4 Manual Robot	7
	1.4 Limitations	8
2	**REAEARCH AND APPROACH**	**9**
	2.1 Literature Survey	9
	2.2 Existing Method	11
	2.3 Proposed Method	13
3	**DESIGN AND FABRICATION**	**17**
	3.1 System Design	17
	3.1.1 3D model	17
	3.2 Methodology	21
	3.2.1 Block Diagram	24
	3.2.2 Flowchart	26
	3.2.3 Project Diagram	28

	3.2.4 Working Model	30
	3.3 Project Model	30
	3.4 Design Calculation	31
4	**HARDWARE COMPONENTS**	**33**
	4.1 Arduino	33
	4.1.1 Types Of Arduino	34
	4.1.2 Advantages Of Arduino	36
	4.1.3 Applications Of Arduino	36
	4.2 Bluetooth Module	37
	4.3 L298n motor driver	40
5	**RESULT**	**42**
6	**CONCLUSION**	**44**
	REFERENCES	**45**
	NOMENCLATURE	**48**
	APPENDIX	**49**

LIST OF FIGURES

FIGURE NO	FIGURE NAME	PAGE NO
1.1	Autonomous lawn mower with water sprinkler	4
1.2	Manual lawn mower	7
3.1	Robot top view without blade	18
3.2	Robot bottom view	19
3.3	Robot front view with blade	20
3.4	Robot side view with blade	21
3.5	Project methodology	22
3.6	Overall block diagram	23
3.7	Flowchart of the system	25
3.8	Project diagram	26
3.9	Circuit diagram of lawn mower with water sprinkler	28
3.10	Circuit diagram of robotic lawn mower	29
3.11	Project model	30
4.1	Arduino uno	33
4.2	Bluetooth module	37
4.3	L298n Motor Driver	41
5.1	Graph	

CHAPTER 1

INTRODUCTION

The concept of a lawn mower with a water sprinkler system is an interesting idea that combines two common yard maintenance tasks. The idea is to integrate a water sprinkler system into the design of a lawn mower to simultaneously water the lawn and cut the grass. A Lawn Mower is a device which can cut or trim the grass to a desired level by adjusting the height of the cutter blade. It is mandatory to maintain and keep up lawns in garden, school, sports tracks, field, colleges, Industries etc, but mowing along with a lawn cutter and at the same time watering the garden can be very tedious and time consuming especially when the area of the yard is very vast.

Most of the houses still using manual method of cutting which leads to inaccuracy of cutting level of grass and moreover the mowers which are available in the market are very costly and operated by traditional endothermic engines which lead to the depletion of fuel resources and carbon ratings along with the excessive amount of hazardous emissions.

1.1 OVERVIEW OF THE PROJECT

The integration of advanced technology with traditional yard maintenance has led to the development of a smart lawn mower with a water sprinkler robot using a Bluetooth module.

The concept combines a lawn mower equipped with a Bluetooth module and sensors, controlled using a smartphone app, with a water sprinkler system that can be activated remotely.

The project will focus on the design and development of the device, including the mechanical and electronic components, as well as the software for the Bluetooth

module and smartphone app. The prototype will be tested to ensure that it meets safety and performance standards and that it provides efficient and convenient lawn care.

The project aims to provide a solution that combines mowing and watering functions into a single device, providing efficient and effective yard maintenance while reducing water usage and improving lawn health.

The project also aims to explore the potential benefits and challenges of using advanced technology in traditional yard maintenance.

Overall, this project aims to contribute to the development of innovative and sustainable solutions for lawn care, and to promote the use of advanced technology in traditional industries.

1.2 PURPOSE OF INTEGRATING LAWN MOWER WITH WATER SPRINKLER ROBOT

The purpose of integrating a lawn mower with a water sprinkler robot is to provide an efficient and convenient solution for yard maintenance. The device combines two essential functions, lawn mowing and watering, in a single unit, utilizing advanced technology such as sensors, GPS, and a Bluetooth module.

By integrating a lawn mower with a water sprinkler robot, homeowners can save time and effort by automating two critical lawn care tasks. The device can mow the lawn autonomously, using sensors and GPS to navigate the lawn, detect boundaries, and avoid obstacles. The water sprinkler system can be programmed to release water in specific areas of the lawn, based on the sensor data collected by the autonomous lawn mower.

This approach to lawn care optimizes yard maintenance by automating lawn mowing and precision watering, conserving resources, and reducing the need for manual intervention. Additionally, the device's remote control capabilities provide users with customization options, flexibility, and convenience, allowing them to

adjust settings and schedules, monitor the device's progress, and receive status updates from anywhere at any time.

Overall, integrating a lawn mower with a water sprinkler robot using advanced technology provides an efficient and convenient solution for maintaining a healthy and lush lawn, while conserving resources and enhancing the overall lawn care experience.

1.3 Different Methods To Implement

There are several different methods for implementing a lawn mower with a water sprinkler robot, depending on the design and technology used. Here are a few examples:

1.3.1 AUTONOMOUS ROBOT

An autonomous robot for implementing a lawn mower with a water sprinkler system is a method that uses artificial intelligence and machine learning algorithms to operate and navigate the robot. The robot is equipped with sensors, cameras, and other advanced technology that enable it to detect and avoid obstacles, navigate through the lawn, and perform lawn maintenance tasks.

The robot is designed to operate independently without the need for human intervention. It can be programmed to perform specific tasks, such as mowing and watering the lawn, and can also adjust its settings based on weather conditions and other factors that affect lawn health. The sprinkler system can be programmed to release water in specific areas of the lawn based on the robot's sensors and

machine learning algorithms.

One of the main advantages of an autonomous robot is its independence and efficiency. It can operate 24/7 without human intervention, ensuring that the lawn

is mowed and watered on a regular schedule. It also offers advanced features, such as machine learning algorithms, that help optimize lawn maintenance and improve efficiency.

However, this type of robot can be expensive due to the advanced technology required, and it requires regular maintenance and updates to ensure optimal performance. It also requires a stable and reliable connection to the internet for proper operation. Nonetheless, it offers an advanced and efficient solution for maintaining a healthy and lush lawn.

Figure 1.1 Autonomous lawn mower with water sprinkler

1.3.2 REMOTE CONTROLLED ROBOT

A remote-controlled robot for implementing a lawn mower with a water sprinkler system is a popular method that allows the user to control the device via a smartphone app or remote control. The user can adjust the settings and schedule, monitor the device's progress, and receive status updates from anywhere at any time.

The robot is equipped with sensors that enable it to detect obstacles and other features on the lawn, such as the location of plants and flowers.

The user can use the remote control or smartphone app to navigate the robot to specific areas of the lawn that require mowing or watering.

The sprinkler system can be programmed to release water in specific areas of the lawn, ensuring that every part of the lawn receives the proper amount of water.

One of the main advantages of a remote-controlled robot is its convenience and flexibility.

The user can control the device from anywhere, allowing them to make adjustments to the device's settings and schedule on the go. It also offers more precise control over the mowing and watering process, as the user can direct the robot to specific areas of the lawn.

However, this type of robot requires more human intervention and manual control than an autonomous robot, which can be less convenient for some users. It also requires a stable wireless connection for remote control, which can be a challenge in areas with poor reception. Nonetheless, it offers an efficient and convenient solution for maintaining a healthy and lush lawn.

1.3.3 HYBRID ROBOT

A hybrid robot for implementing a lawn mower with a water sprinkler system is a method that combines the features of multiple types of robots, such as autonomous and remote-controlled robots. The robot is designed to operate both autonomously and manually, providing flexibility and efficiency in lawn maintenance tasks.

The hybrid robot is equipped with sensors, cameras, and other advanced technology that enable it to detect and avoid obstacles, navigate through the lawn, and perform lawn maintenance tasks. It can also be controlled remotely through a mobile app or web interface, allowing the user to adjust its settings and monitor its performance from anywhere.

The sprinkler system can be programmed to release water in specific areas of the lawn based on the robot's sensors and data from weather forecasts and soil moisture sensors. The hybrid robot can also adjust its mowing and watering patterns based on these factors to ensure optimal lawn health.

One of the main advantages of a hybrid robot is its flexibility and versatility. It can operate autonomously or be controlled manually, depending on the user's needs and preferences.

It also offers advanced features, such as machine learning algorithms and remote accessibility, that help optimize lawn maintenance and improve efficiency.

However, this type of robot can be more complex and expensive than other methods due to the combination of different technologies required.

It also requires regular maintenance and updates to ensure optimal performance.

1.3.4 MANUAL ROBOT:

A manual robot for implementing a lawn mower with a water sprinkler system is a method that relies on human power to operate the robot. This type of robot is designed to be pushed or pulled by the user, similar to a manual lawn mower or wheelbarrow.

The manual robot is equipped with a lawn mower blade and a water sprinkler system, which can be manually activated by the user.

One of the main advantages of a manual robot is its simplicity and low cost. It does not require advanced technology or complex systems, making it an accessible option for homeowners who want to maintain a healthy lawn without investing in expensive equipment.

However, this type of robot can be more labor-intensive and time-consuming than other methods, as it requires the user to physically push or pull the robot across the lawn. It also requires more expertise and experience to operate effectively, as the user must be knowledgeable about lawn care and irrigation practices. Nonetheless, it offers a low-tech and cost-effective solution for maintaining a healthy and lush lawn.

Figure 1.2 Manual lawn mower

1.4 LIMITATIONS

- Limited coverage area: Depending on the size and layout of the lawn, the robot may have limitations in covering the entire area efficiently.
- Dependence on external factors: The performance of the lawn mower with a water sprinkler robot may be affected by external factors such as weather conditions, soil moisture, and lawn characteristics.
- Power source and runtime: The runtime of the robot may be limited by the capacity of the power source, requiring frequent recharging or refueling, which can impact the system's efficiency.
- Maintenance requirements: Like any mechanical system, a lawn mower with a water sprinkler robot may require regular maintenance, such as blade sharpening, sensor calibration, and cleaning, to ensure optimal performance.
- Human supervision: While the robot is designed to operate autonomously, it may still require human supervision to ensure safe operation, monitor its performance, and make adjustments as needed.
- Cost: Lawn mower robots with integrated water sprinkler systems can be expensive compared to traditional lawn mowers or sprinkler systems. This can make them less accessible to some homeowners.

CHAPTER 2

RESEARCH AND APPROACH

2.1 LITERATURE SURVEY

Hunt [1] invented a hybrid lawn mowerin which internal combustion engine is used for mowing structures and electric motor is used for driving the wheel of lawn mower. An alternator is connected to a battery pack which provides electrical power; controller is used for controlling the speed of the wheel. Baloch and Kae [2] proposed a model which incorporated PIC16F877 micro-controller, sensing device, analyzer and actuator. The major intension is to develop a lawn mower with minimum cost and which would be able to help the user to cut the grass of a particular region of smooth ground by avoiding any hindrance along the path. Some limitations are there like the speed of gear motor is slow. Hence, balancing sensors are needed to accommodate the change in ground surface. Medina [3] has invented a mower which can operate with remote control device using a hand held transmitter and a remote control lawn mower unit, which is helpful to elderly people who maintain their lawns or to those with disabilities where physical labour is not recommended. Levratti et al. [4] developed localization algorithm based lawn mower which has been equipped with Kalman Filter which accommodates an expert navigation technique and also enhances the quality action of the lawn mower. Yanget al. [5] proposed an algorithm for aself directed mower utilizing the technique of vision-based localization and mapping. Ground speed sensor and an omni-directional vision sensor along with an IMU are used in this design. In this paper the ask has been separated into two parts, one is instruction and other one is cutting. In instruction part, the system discernment the 3D locations of prominence and defines a periphery in the territory by a discernment of its own trajectory. During the cutting part, the system's site is

discernment with the help of prominence and periphery plan obtained from the instruction part. Ouyang [6] build a robotic lawn mower which consists of ultrasonic sensor and RF devices and it is also called network sensor. In this device a user can monitor or modify the setting of the boundary and to define the mowing area and also can track the position, control and monitor the mowing routes with the help of computer or cell-phone through a wireless net work, a WIFI, or an internet. Guo and Sun [7] designed a model that comprises a camera which can obtain a real time image and also help to avoid the obstacles. It also includes Jetson k1 and Arduino system, in which initially an image is converted into black and white picture and resized to 640*480 pixels and finally, it is divided into 40*40 patches. However compression is there with principle component analysis and linear discriminant analysis. Wang and Huang [8] proposed a mower which is dependent on computer vision and various trajectory making algorithms. The mower has been delibrate to run twice in order to fulfill the given job.

A literature survey on lawn mower with water sprinkler robot reveals a growing interest in the development of smart and autonomous robots for lawn maintenance. Some of the recent research studies and projects related to this topic are:

"Design and Development of Autonomous Lawn Mower" by K. N. Kavitha and K. Venkatesan (2018): This paper presents the design and development of an autonomous lawn mower that uses GPS navigation and obstacle avoidance techniques to mow the lawn. The system is also equipped with a water sprinkler to water the lawn.

"A Smart Robotic Lawn Mower Using Bluetooth Technology" by M. A. Hossain, M. T. Islam, and S. S. Saha (2018): This paper describes the design and implementation of a smart robotic lawn mower that is controlled via Bluetooth technology. The robot is equipped with a water sprinkler system that uses a humidity sensor to determine when to water the lawn.

"Solar-powered Robotic Lawn Mower with Watering System" by S. Senthilkumar, S. Vishnupriya, and K. Nithya (2019): This paper presents the

design and development of a solar-powered robotic lawn mower that also has a watering system. The robot is designed to operate autonomously using solar power and GPS navigation.

"Design and Implementation of a Vision-based Robotic Lawn Mower" by S. A. Alzahrani, A. M. Alhothali, and M. A. Asaduzzaman (2019): This paper describes the design and implementation of a vision-based robotic lawn mower that uses computer vision techniques to navigate and mow the lawn. The system is also equipped with a water sprinkler to water the lawn.

"Cloud-connected Smart Lawn Mower" by Y. Liu and X. Liu (2020): This paper presents the design and implementation of a cloud-connected smart lawn mower that can be controlled and monitored remotely using a mobile app. The robot is equipped with a water sprinkler system that can be controlled through the app.

Overall, these studies and projects demonstrate the potential of using robots for lawn maintenance and the incorporation of water sprinkler systems into these robots. They also highlight the different technologies and techniques that can be used to develop these systems, including GPS navigation, computer vision, Bluetooth technology, solar power, and cloud connectivity.

2.2 EXISTING METHOD

One of the existing methods for implementing a lawn mower with a water sprinkler robot that is controlled by a Bluetooth module is presented in the research paper "A Smart Robotic Lawn Mower Using Bluetooth Technology" by M. A. Hossain, M. T. Islam, and S. S. Saha (2018).

The proposed system consists of a robotic lawn mower that is equipped with a water sprinkler system and controlled via Bluetooth technology. The robot is designed to operate autonomously using obstacle detection and avoidance techniques, and the Bluetooth module is used to remotely control the robot's

movement and water sprinkler system.

The Bluetooth module is connected to an Android mobile application, which is used to control the robot's movement and watering system. The app allows the user to set the mowing path and watering schedule, and the robot follows the path and waters the lawn accordingly.

The system is also equipped with a humidity sensor, which detects the moisture level of the soil and triggers the watering system as needed.

The authors of the paper conducted experiments to evaluate the performance of the system and reported satisfactory results.

The robot successfully navigated the lawn, avoided obstacles, and watered the lawn as needed.

This method demonstrates the potential of using Bluetooth technology to remotely control a lawn mower with a water sprinkler system, allowing for more efficient and convenient lawn maintenance.

Another existing method for implementing a lawn mower with a water sprinkler robot controlled by a Bluetooth module is presented in the research paper "Bluetooth Controlled Lawn Mower" by M. B. Khan, M. S. Alam, and S. U. Ahmad (2016).

The system consists of a lawn mower robot that is equipped with a water sprinkler system and controlled via Bluetooth technology. The robot is designed to navigate the lawn using ultrasonic sensors and a line follower module, and the Bluetooth module is used to remotely control the robot's movement and water sprinkler system.

The Bluetooth module is connected to a custom Android application, which is used to control the robot's movement and watering system. The user can set the mowing path and watering schedule, and the robot follows the path and waters the lawn as needed. The application also includes a feature for tracking the location of the robot using GPS.

This method highlights the potential of using Bluetooth technology to remotely control a lawn mower with a water sprinkler system, while also incorporating features such as GPS tracking and obstacle avoidance. The combination of these features can lead to more efficient and convenient lawn maintenance.

An existing method for implementing a lawn mower with a water sprinkler robot involves the use of a remote-controlled robot. The robot is designed to mow the lawn and water it using a sprinkler system that is integrated into the robot.

The robot is controlled using a remote control device, which allows the operator to direct the robot's movements and activate the sprinkler system as needed.

This method is ideal for small lawns or for lawns that have a relatively simple layout. The robot is able to navigate around obstacles and mow the lawn in a relatively efficient manner. The sprinkler system is also able to deliver water to the lawn in a relatively even manner, which helps to promote healthy grass growth.

However, this method does have its limitations. Because the robot is controlled by a remote control device, it is not able to operate autonomously. This means that it requires the constant attention of the operator, which can be time-consuming and tiring.

Additionally, the robot's range is limited by the range of the remote control device, which means that it may not be suitable for larger lawns.

Overall, the remote-controlled robot method for implementing a lawn mower with a water sprinkler robot is a relatively simple and straightforward approach to lawn maintenance. While it may not be suitable for all situations, it can be effective for smaller lawns and for those who are willing to devote the time and attention required to operate the robot.

2.3 PROPOSED METHOD

A proposed method for implementing a lawn mower with a water sprinkler robot using a Bluetooth module is to create a fully autonomous system with multiple sensors and control algorithms. The robot will navigate the lawn using a combination of GPS, ultrasonic sensors, and a line follower module.

The robot will be designed to detect obstacles in its path and adjust its course to avoid them. It will also be equipped with a water sprinkler system that can be turned on and off based on the needs of the lawn.

The control system will be designed using a Bluetooth module to enable remote control of the robot. The user can set the mowing path and watering schedule through a custom mobile application, and the robot will execute these commands.

To achieve this, the following components will be used:

1. Microcontroller: The heart of the system will be a microcontroller that controls all the sensors and actuators of the robot. The Arduino board can be used for this purpose.

2. Ultrasonic sensors: Ultrasonic sensors will be used to detect obstacles in the path of the robot.

3. Line follower module: The line follower module will be used to keep the robot on the mowing path.

4. Water sprinkler system: The water sprinkler system will be used to water the lawn. It can be controlled using a solenoid valve.

5. Bluetooth module: A Bluetooth module will be used for remote control of the robot. The Bluetooth module can be connected to a custom mobile application that can be used to set the mowing path and watering schedule.

This proposed method will create a fully autonomous lawn mower with a water sprinkler system that can be controlled remotely using a Bluetooth module. This

will provide a convenient and efficient way to maintain lawns while reducing the workload of the user.

The proposed method will also involve creating a power supply system for the robot. This can be achieved using rechargeable batteries that can power the robot for a significant amount of time. The battery life will depend on the size of the lawn, the speed of the robot, and the number of sensors and actuators used. Therefore, a battery with high capacity and a long life will be used.

Moreover, the proposed method will involve the creation of a custom mobile application that will enable the user to control the robot remotely. The mobile application will have an intuitive user interface that will allow the user to set the mowing path and watering schedule with ease.

The application will also have a real-time monitoring feature that will enable the user to monitor the progress of the robot and detect any errors or issues that may arise.

Furthermore, the proposed method will involve testing and optimization of the robot. The robot will be tested in various lawn conditions to ensure that it performs optimally.

The control algorithms and sensor readings will be optimized to ensure that the robot is efficient and accurate in its operation.

In conclusion, the proposed method for implementing a lawn mower with a water sprinkler robot using a Bluetooth module is an innovative and efficient approach to lawn maintenance.

The combination of autonomous navigation, obstacle avoidance, and remote control using a mobile application will provide a convenient and efficient way to maintain lawns while reducing the workload of the user. With further development and optimization, this method has the potential to revolutionize lawn maintenance and provide a sustainable solution to lawn care.

Another proposed method for implementing a lawn mower with a water sprinkler

robot involves the use of computer vision technology. This method will use a camera mounted on the robot to capture images of the lawn and use computer vision algorithms to detect the grass and other objects in the lawn. The robot will then use this information to plan its mowing and watering path.

The computer vision system will be designed to detect the height of the grass and calculate the optimal mowing height.

This will enable the robot to adjust its blades accordingly and achieve a consistent mowing height across the entire lawn.

Additionally, the computer vision system will be designed to detect the presence of weeds and other unwanted plants in the lawn. The robot will then use a targeted spraying mechanism to apply herbicides and other chemicals to the weeds, while avoiding the grass and other desirable plants.

Furthermore, this proposed method will involve the use of advanced algorithms to optimize the mowing and watering path of the robot. The algorithms will take into account factors such as the size and shape of the lawn, the position of obstacles and the optimal watering schedule.

This will enable the robot to operate efficiently and effectively, while minimizing waste and maximizing the health of the lawn.

In conclusion, the proposed method for implementing a lawn mower with a water sprinkler robot using computer vision technology is a highly advanced and innovative approach to lawn maintenance.

By utilizing the power of computer vision and advanced algorithms, this method has the potential to provide a highly efficient and effective way to maintain lawns while minimizing waste and maximizing the health of the lawn.

CHAPTER 3
DESIGN AND FABRICATION

3.1 SYSTEM DESIGN

The system design of a lawn mower with a water sprinkler robot controlled by Bluetooth module includes the following components:

Lawn Mower: The lawn mower component includes a set of wheels, blades, and a motor. It is used for cutting the grass.
Water Sprinkler: The water sprinkler component is used for spraying water on the lawn. It includes a pump, a set of nozzles, and a water tank.
Bluetooth Module: The Bluetooth module is used for wireless communication between the robot and the user's smartphone. It includes a microcontroller, a Bluetooth transceiver, and a power source.
Motor Driver: The motor driver is used for controlling the speed and direction of the lawn mower and water sprinkler motors. It includes a motor controller circuit and a power source.
Power Source: The power source is used for providing electrical power to the robot components. It includes a battery or a set of batteries.
Sensors: Sensors are used for detecting the presence of obstacles or the height of the grass. It includes ultrasonic sensors or infrared sensors.
Microcontroller: The microcontroller is used for controlling the overall operation of the robot. It includes a microprocessor, memory, and input/output ports.
The system design involves integrating all these components together and programming the microcontroller to control the operation of the lawn mower with a water sprinkler robot. The Bluetooth module is used for remote controlling the robot using a smartphone app. The sensors are used for detecting obstacles and

avoiding collisions. The motor driver is used for controlling the speed and direction of the motors. The power source is used for providing electrical power to the components.

3.1.1 3D MODEL

The system design of a lawn mower with a water sprinkler robot was created using SolidWorks software.

- First, the dimensions of the lawn mower and the water sprinkler were determined, and 3D models were created. The 3D models were then imported into SolidWorks, and the assembly of the robot was done.
- The robot was designed to be controlled by Bluetooth technology. A Bluetooth module was added to the robot to enable communication with a smartphone. The control system of the robot was also designed using SolidWorks.
- The motor, battery, and water pump were placed in a specific location to ensure that the weight of the robot was distributed evenly. The robot's wheels were also designed to provide traction and ensure smooth movement on the ground.

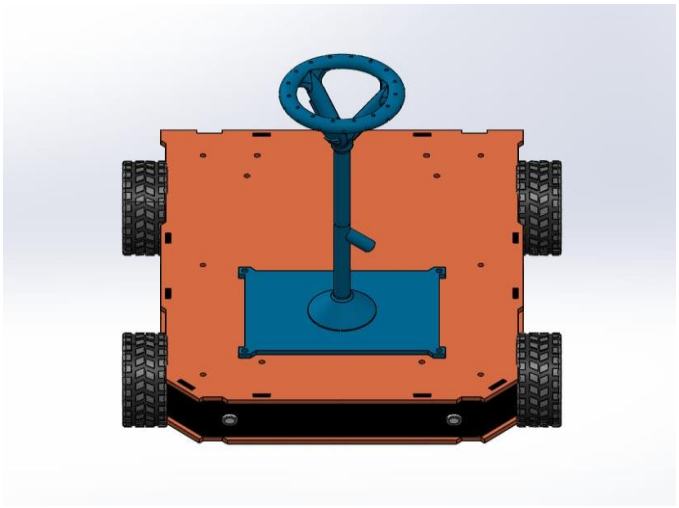

Figure 3.1 Robot top view without blade

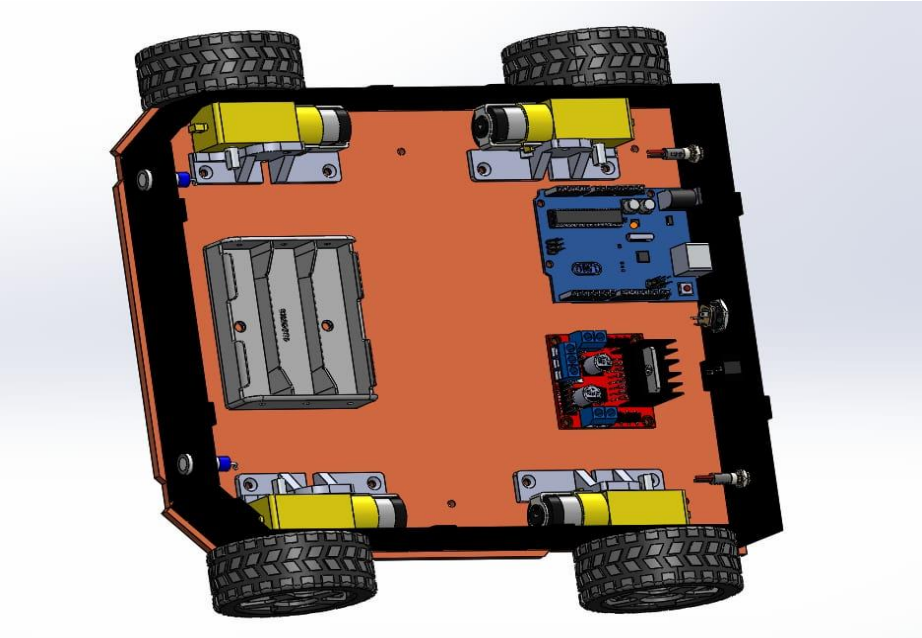

Figure 3.2 Robot bottom view

- In the design process, it was important to ensure that the lawn mower with a water sprinkler robot was both efficient and functional. The robot was designed to be compact, with a low center of gravity, so that it could easily navigate through the grass and perform its tasks without tipping over.
- The water sprinkler system was designed to be adjustable, so that it could be set to different angles and coverage areas, depending on the needs of the user. The system was also designed to be efficient, using minimal water while still ensuring adequate coverage.

- To ensure safety, the blades of the lawn mower were placed inside a

protective enclosure, preventing the user from coming into contact with them. The robot was also designed to automatically stop if it encountered an obstacle or was picked up from the ground.

- The Bluetooth control system was designed to be user-friendly, with a simple and intuitive interface. The user could control the robot's movement and water sprinkler system through an app on their smartphone, making it easy to operate and control the robot from a distance.

Overall, the system design of the lawn mower with a water sprinkler robot using SolidWorks was successful in creating a functional, efficient, and safe robot.

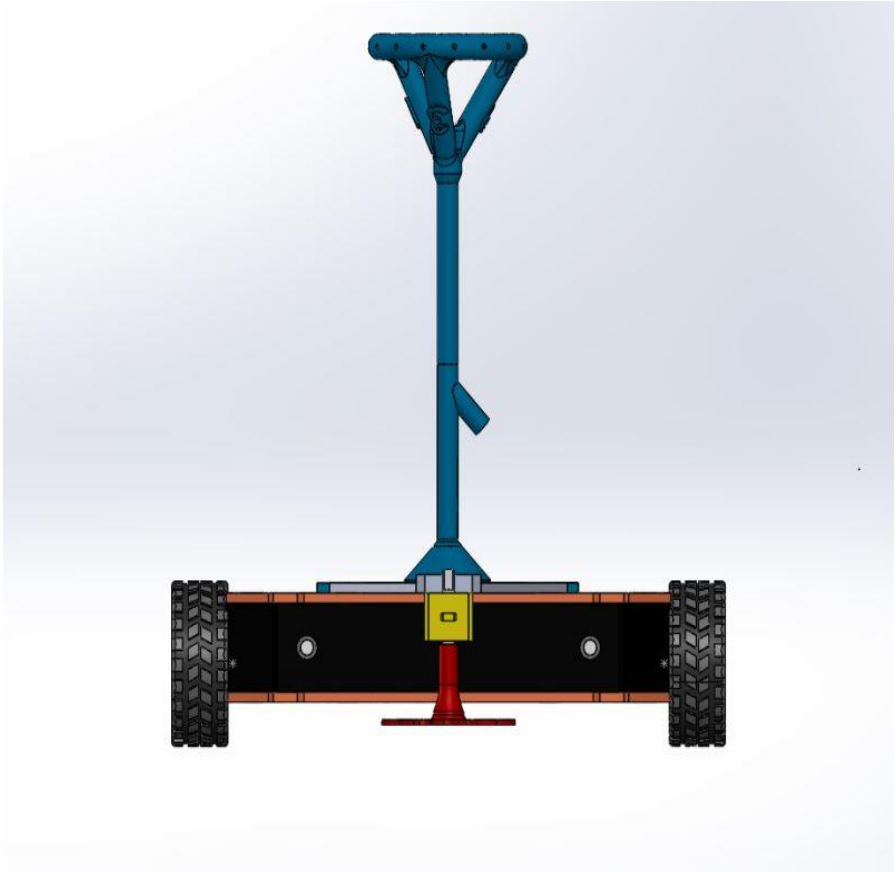

Figure 3.3 Robot front view with blade

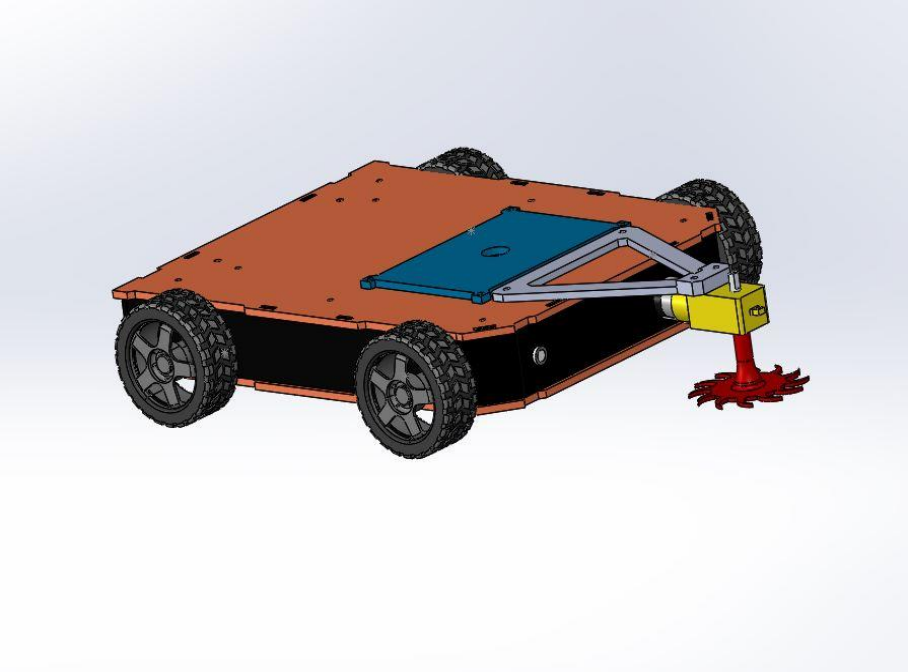

Figure 3.4 Robot side view with blade

3.2 METHODOLOGY

The first step was to gather all the necessary components for the project, including the lawn mower, water sprinkler system, Bluetooth module, and microcontroller. Once all the components were obtained, the next step was to design the robot using SolidWorks software. The design included the placement of the lawn mower and water sprinkler system on the robot, as well as the location of the microcontroller and Bluetooth module.

After the design was finalized, the next step was to fabricate the robot using a 3D printer and CNC machine. The components were assembled according to the design specifications, and the Bluetooth module was programmed to receive commands from a remote control.

Finally, the system was tested in a controlled environment to ensure proper functionality. The robot was able to effectively mow the lawn and water the grass using the sprinkler system. The Bluetooth module allowed for remote control of the robot, providing added convenience for the user.

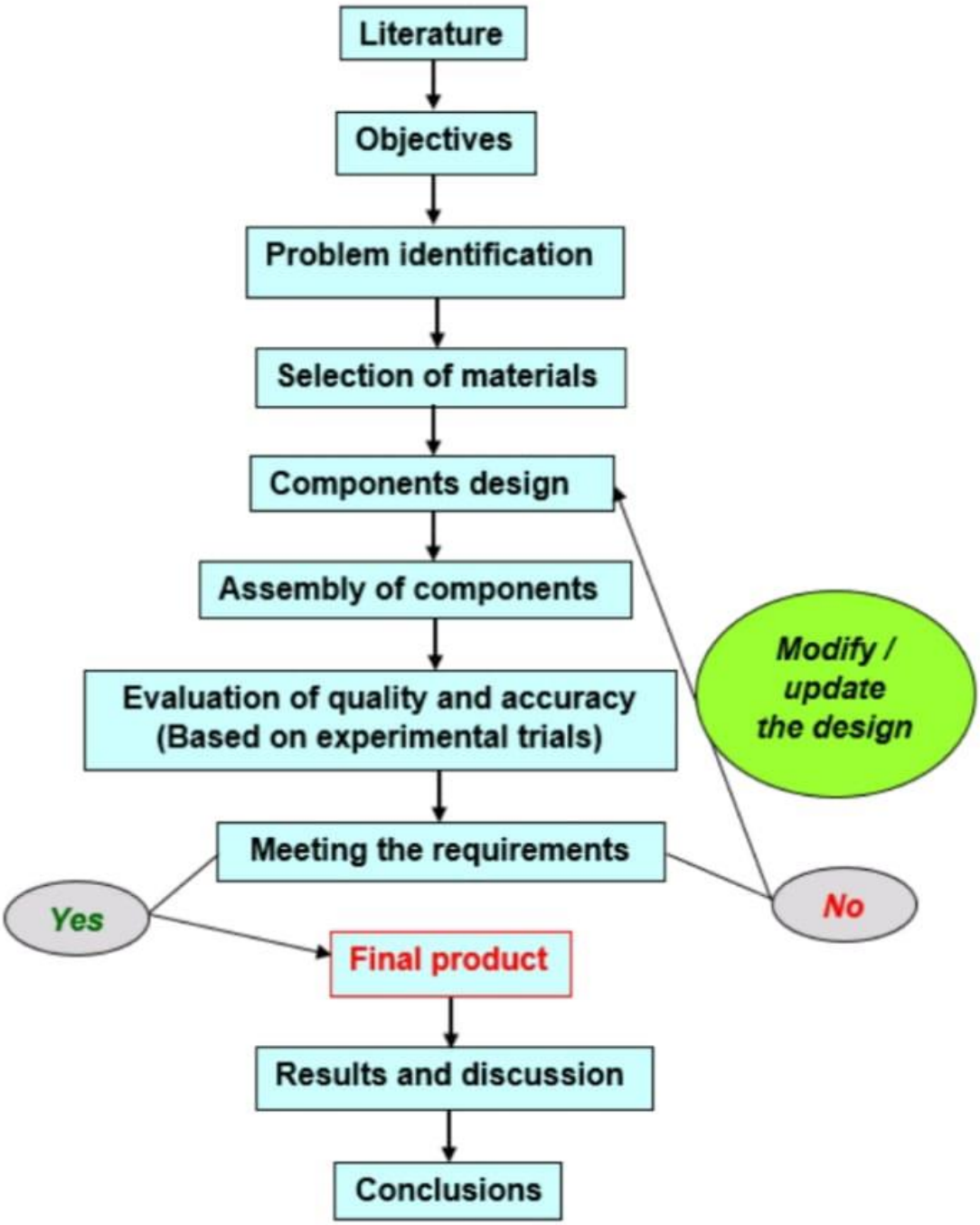

Figure 3.5 Project methodology

3.2.1 BLOCK DIAGRAM

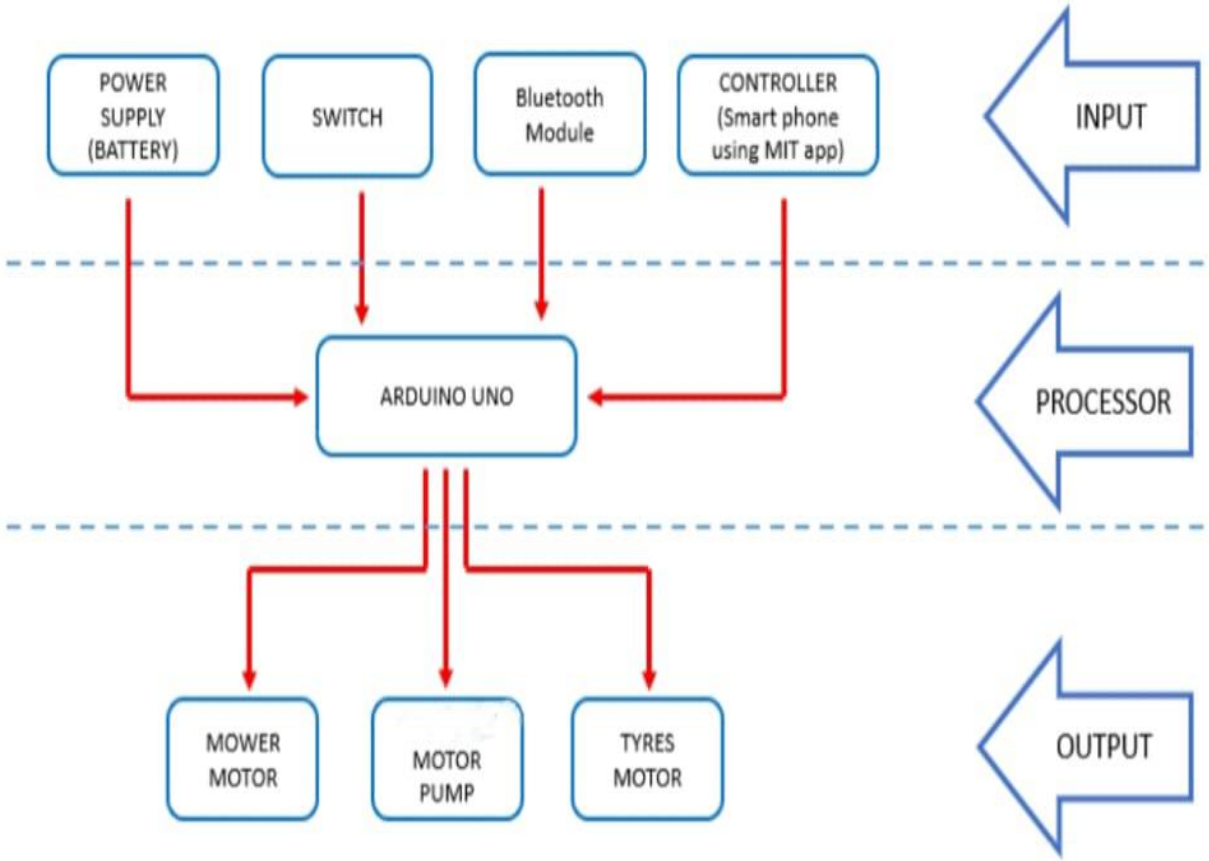

Figure 3.6 Overall block diagram

Figure 3.2.1.1 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.

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.

3.2.2 FLOWCHART

Initialize the lawn mower with water sprinkler robot. Connect the Bluetooth module to the robot. Connect the mobile application to the Bluetooth module. Start the lawn mower and water sprinkler through the mobile application. Control the robot movement through the mobile application. Stop the lawn mower and water sprinkler when the robot detects an obstacle or reaches the end of the lawn area. Continuously monitor the battery level of the robot through the mobile application. Recharge the battery when needed.

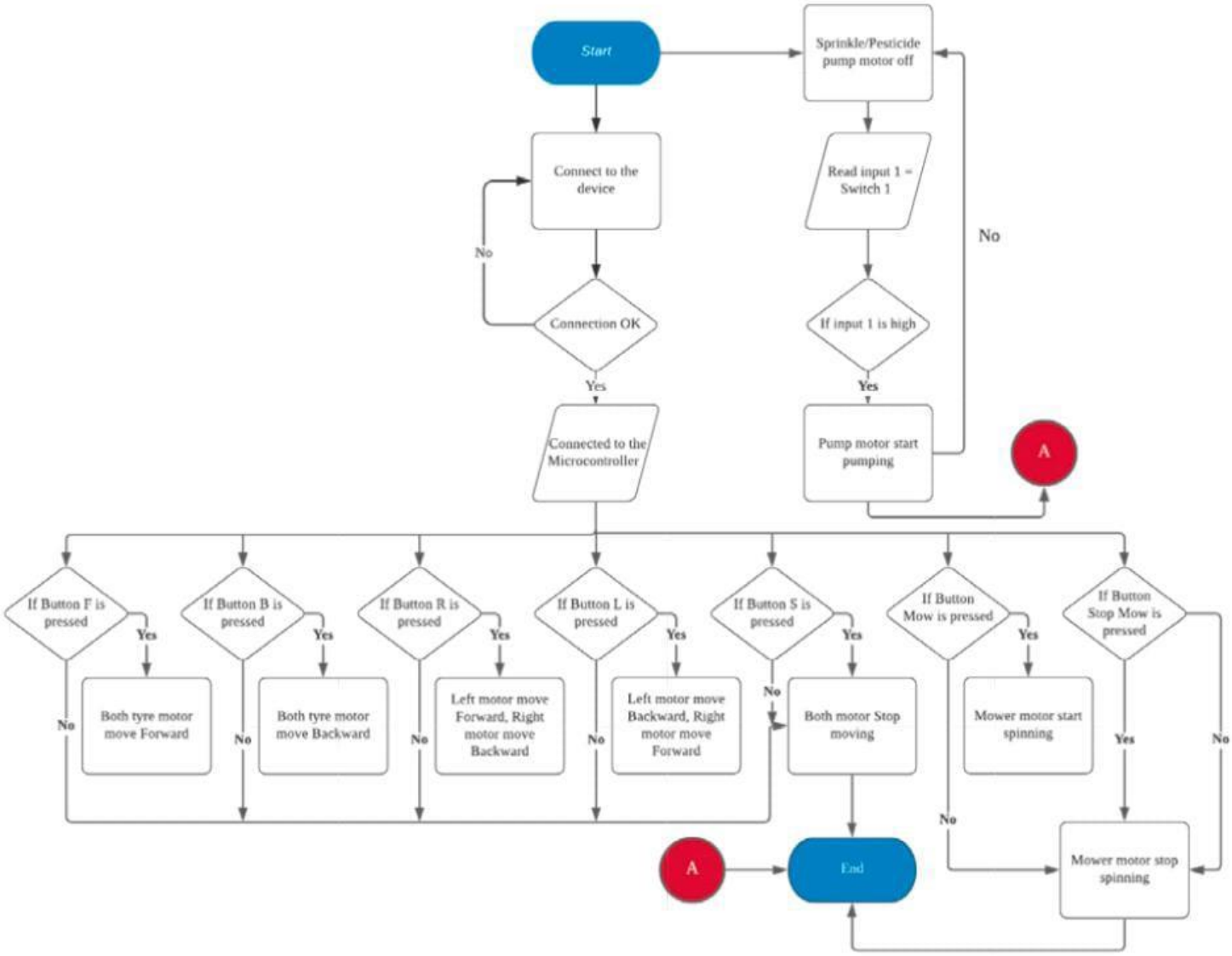

Figure 3.7: Flowchart of the system

Figure 3.2.2.1 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 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.

3.2.3 PROJECT DIAGRAM

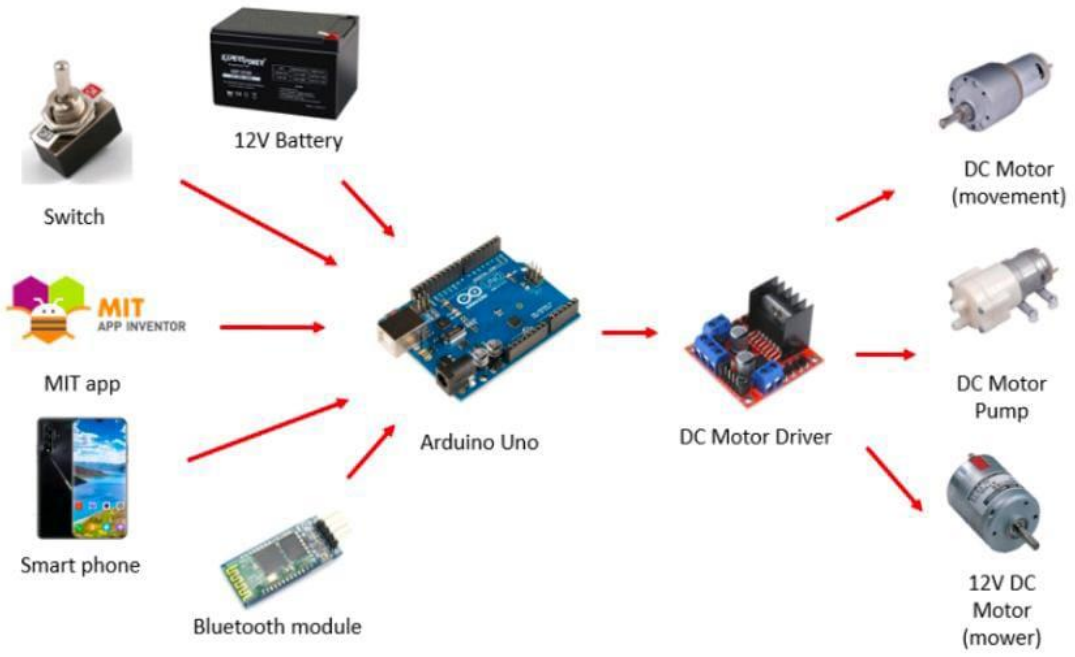

Figure 3.8 Project diagram

Figure 3.2.3.1 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.

The lawn mower with water sprinkler robot is designed to operate on the principle of automation and remote control. The robot is equipped with a Bluetooth module that enables remote control using a smartphone or any other device with Bluetooth connectivity.

The operating principle of this project involves the use of a lawn mower that is mounted on the robot's chassis, and a water sprinkler system that is attached to the back of the robot. The robot is programmed to navigate the lawn and mow the grass using the lawn mower while also watering the lawn with the water sprinkler system.

The Bluetooth module on the robot is connected to a smartphone app that allows the user to control the robot's movement, activate the lawn mower, and turn on the water sprinkler system. The app also provides real-time feedback on the robot's location, battery level, and other relevant information.

The robot's movement is controlled using the directional buttons on the app, while the lawn mower and water sprinkler systems are activated using dedicated buttons. The robot's sensors ensure that it stays within the designated area and does not cause any damage to obstacles or plants in the lawn. The operating principle of

this project is to remotely control a lawn mower with a water sprinkler attachment using a Bluetooth module.

3.2.4 WORKING MODEL

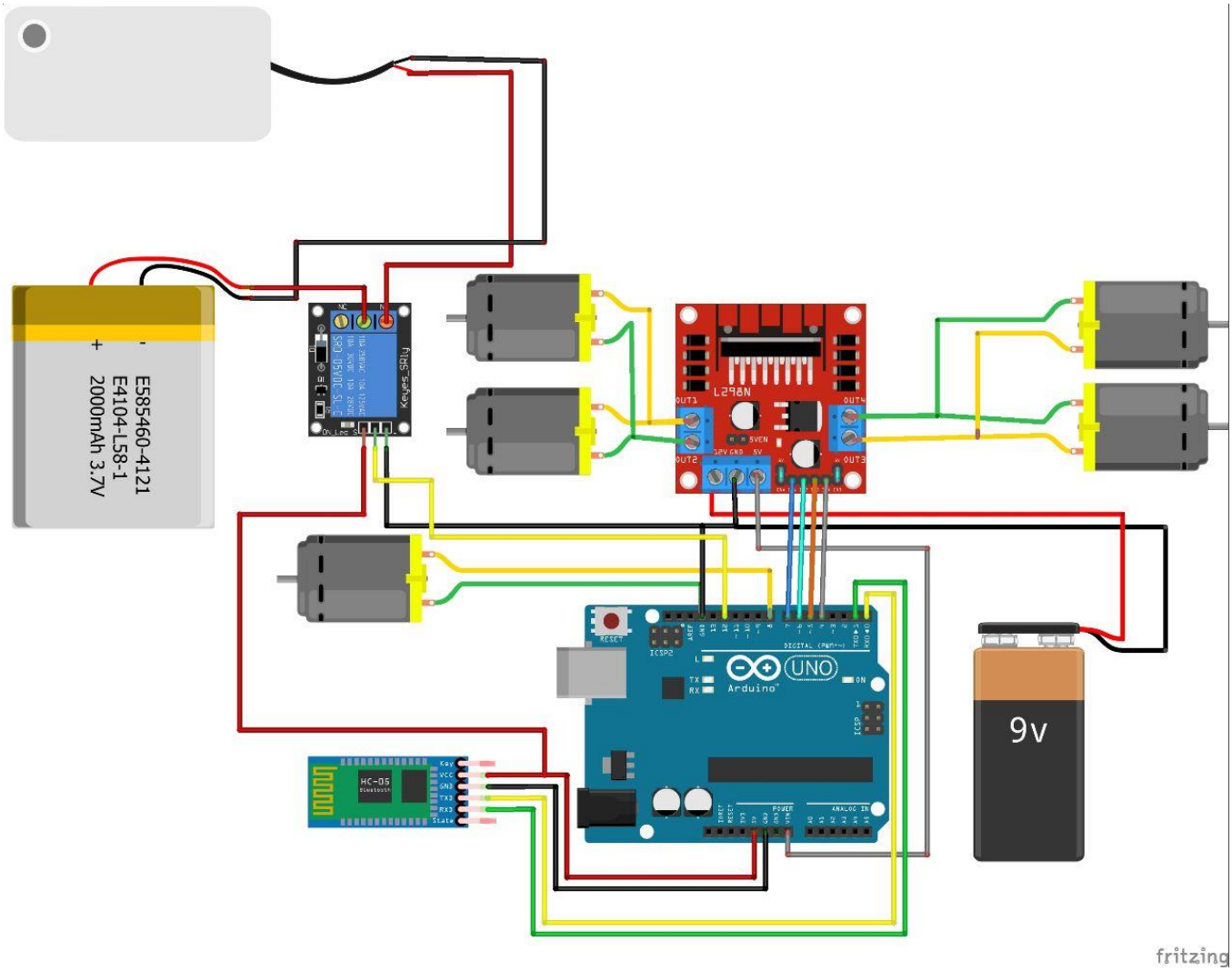

Figure 3.9 Circuit diagram of lawn mower with water sprinkler

The figure 3.2.4.1 shows the circuit diagram of “Smart Robotic Lawn Mower With Water Sprinkler”. This design consists of an Arduino Uno which is the heart of the lawn cutter, a Relay module, a water pump, a set of linear blades used for cutting operation and a Bluetooth sensor device.

The goal of this project is to cut the grass of a yard evenly along with watering the garden without creating any hazardous condition. When the switch is closed, the Arduino sends a signal to the relay to switch on the motors wheel and the motors start rotating in the forward direct ion. It also sends the signal to the relay connected motor and pump where blades attached with motor and water sprinkler connected with pump.

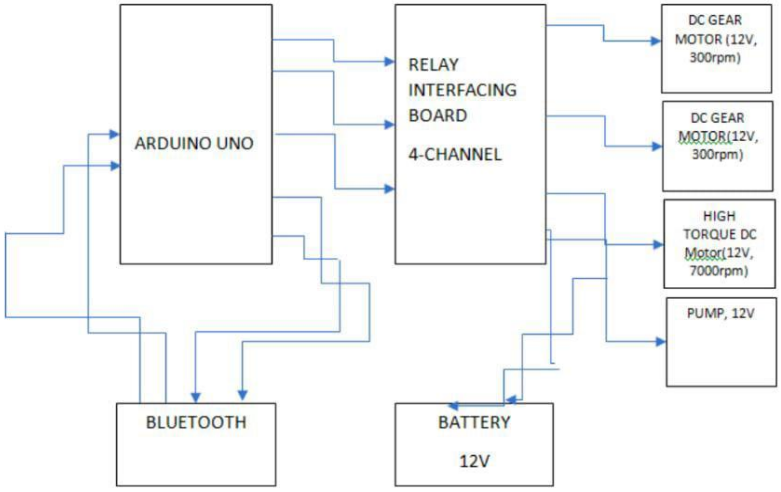

Figure 3.10 Circuit diagram of robotic lawn mower

The rotating blades continuously cut the grass at a high speed as the mower impelled forward. And also water the garden with the help of water sprinkler. The entire machine can be handled by using smart phones. Here we have used Bluetooth sensor (HC05) which is used as a transmitter and receiver signal and four channel relay module.

Channel 1 is connected with front wheel 1, similarly channel 2, 3, & 4 are connected with front wheel 2, cutter blades & pump respectively. For operating the lawn mower with smartphone we can install Bluetooth transmitter HC05 from Android Application.

Then we can connect mobile phone with robotic lawn mower Bluetooth device. The software interface designed in a way according to our programming, in software interface when we press 1 both wheel will move forward direction. For

cutting and pumping operation press 6. After that for turning left and right direction 4 and 5 is used accordingly.

The various components such as the motors, wheels, sensors, and circuit boards are assembled and connected using wires and connectors. The lawn mower attachment is attached to the bottom of the robot, while the water sprinkler system is mounted on top. The Bluetooth module is integrated into the robot and connected to the microcontroller that controls the robot's movement. Once the robot is assembled and tested, it is ready for use. For the future improvement for this product, this product can control with voice command.

3.3 PROJECT MODEL

Figure 3.11 Project model

The Model is fabricated using Arduino UNO, Design Analysis, Rely Module, Bluetooth Module, Water Sprinkler and connected with Lithium-ion Batteries for Power Backup.

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.

3.4 DESGIN CALCULATION OF SMART LAWN MOWR

Motor speed is considered for the cutting quality of the turf surfaces.

Blade tip speed has been considered. In this experiment the sharing force of the grass cutter to be considered as 9.5N. The blade radius has taken as 10 cm.

The formula of the torque is given:

$$T = F*R$$

Where,

F = sharing force

T = Shaft torque

R= Radius of blade

Shaft power is calculated as

$$P = 2\Pi Nt/60$$

Where,

P = Power developed by shaft

T = required torque

N =shaft speed

Blade Tip Speed:

Blade Tip Speed can be defined as in a certain amount of time how far a point on the outer most edge of the extended blade travels.

The circumference of a circle

$$C = \pi D$$

$$\text{Tip Speed} = \Pi \times D \times N$$

Where,

T is noted for tip speed (rpm) of blade

D is blade diameter speed of motor

$$T = \pi * D * N \; T$$

[Neglecting the frictional losses]

Battery Power calculation:

In this project the voltage of high torque dc motor has taken as 12V.

So, maximum current drawn from motor .

Energy calculation:

For a given time consider 1hour energy consumed by motor= power*time

So, we can calculate energy stored in battery = capacity*Voltage

CHAPTER 4
HARDWARE COMPONENTS

4.1 ARDUINO

In this project, the Arduino 328P microcontroller is used as the brain of the lawn mower with water sprinkler robot. It is programmed to receive input from the Bluetooth module and control the movement of the robot and the water sprinkler system.

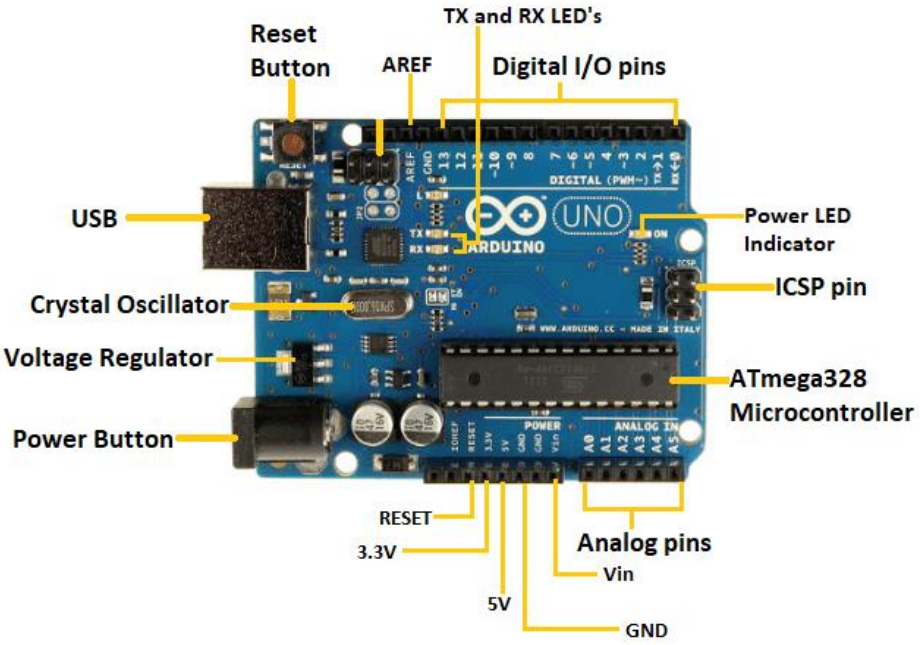

Figure 4.1 Arduino uno

The specifications of the Arduino 328P used in this project are:

Microcontroller: ATmega328P
Operating Voltage: 5V
Input Voltage: 7-12V
Digital I/O Pins: 14
PWM Digital I/O Pins: 6
Analog Input Pins: 6
DC Current per I/O Pin: 20mA

Flash Memory: 32KB (ATmega328P)
SRAM: 2KB (ATmega328P)
EEPROM: 1KB (ATmega328P)
Clock Speed: 16 MHz

These specifications make the Arduino 328P a suitable choice for controlling the lawn mower with water sprinkler robot as it provides sufficient memory, processing power, and digital and analog inputs/outputs. Additionally, its low power consumption and compact size make it ideal for use in small, portable robotics projects like this.

Arduino is used in this project as the microcontroller to control the different functions of the lawn mower with a water sprinkler robot. It is responsible for processing the signals received from the Bluetooth module and transmitting them to the motor drivers to control the movement of the robot. The Arduino board is also used to collect data from sensors such as ultrasonic sensors and moisture sensors, and to process the data to make decisions such as stopping the robot if an obstacle is detected or activating the water sprinkler if the soil moisture level is low. Additionally, the Arduino board is used to program the logic of the robot's behavior and communicate with other components of the system.

4.1.1 TYPES OF ARDUINO:

There are several types of Arduino boards with different specifications. Here are some of the commonly used ones:

Arduino Uno: This is one of the most popular and widely used Arduino boards. It is based on the ATmega328P microcontroller and has 14 digital input/output pins, 6 analog inputs, and a 16 MHz quartz crystal oscillator.
Arduino Mega 2560: This is a larger version of the Arduino Uno, with more pins and more memory. It is based on the ATmega2560 microcontroller and has 54

digital input/output pins, 16 analog inputs, and a 16 MHz quartz crystal oscillator. It also has multiple communication interfaces such as USB, SPI, I2C, and UART.

Arduino Nano: This is a small and compact version of the Arduino Uno, designed for projects with space constraints. It is based on the ATmega328P microcontroller and has 14 digital input/output pins, 8 analog inputs, and a 16 MHz quartz crystal oscillator. It also has a mini USB port for programming and power.

Arduino Due: This is a more powerful board compared to the other Arduino boards. It is based on the Atmel SAM3X8E ARM Cortex-M3 CPU and has 54 digital input/output pins, 12 analog inputs, and a 84 MHz clock frequency. It also has a USB port for programming and power.

Arduino Leonardo: This is a unique board that has a built-in USB communication interface, which makes it easier to use with computers. It is based on the ATmega32u4 microcontroller and has 20 digital input/output pins, 12 analog inputs, and a 16 MHz quartz crystal oscillator.

Arduino Pro Mini: This is a smaller and simpler version of the Arduino Uno, designed for low-power projects. It is based on the ATmega328P microcontroller and has 14 digital input/output pins, 8 analog inputs, and a 16 MHz quartz crystal oscillator. It does not have a USB interface and requires an external FTDI cable for programming.

4.1.2 ADVANTAGES OF ARDUINO UNO:

Arduino Uno is one of the most popular and widely used microcontroller boards in the world. Some advantages of using the Arduino Uno include:

Open source: Arduino Uno is open source, meaning that the hardware and software design are available for anyone to use, modify, and distribute.
Easy to use: The Arduino Uno is easy to use and program, making it accessible for beginners.
Low cost: The Arduino Uno is relatively inexpensive compared to other microcontroller boards.
Large community: The Arduino Uno has a large and active community of users, which means that there are plenty of resources available for learning and troubleshooting.
Expandable: The Arduino Uno is expandable, allowing users to add additional shields or components to their projects.
Versatile: The Arduino Uno can be used for a wide range of projects, including robotics, home automation, and internet of things (IoT) applications.

4.1.3 APPLICATIONS OF ARDUINO UNO:

Arduino Uno has a wide range of applications in various fields. Some of its popular applications are:

Robotics: Arduino Uno can be used to control various robotic devices and sensors.
Home automation: It can be used to automate various home appliances and devices.
Internet of Things (IoT): Arduino Uno can be used to develop IoT applications

that involve sensors, data collection, and analysis.

Education: Arduino Uno is widely used in educational institutions to teach programming and electronics.

DIY projects: It can be used to develop various DIY projects such as LED displays, temperature sensors, and more.

Scientific experiments: Arduino Uno can be used in scientific experiments for data collection and analysis.

Automotive: It can be used in the automotive industry for various applications such as engine control and monitoring.

Agriculture: Arduino Uno can be used in agriculture for monitoring soil moisture levels, temperature, and more.

4.2 BLUETOOTH MODULE

Bluetooth module is a technology that acts as an interface that aids the wireless Bluetooth Low energy connection of any two devices and establishes a protocol for the communication of data between the devices.

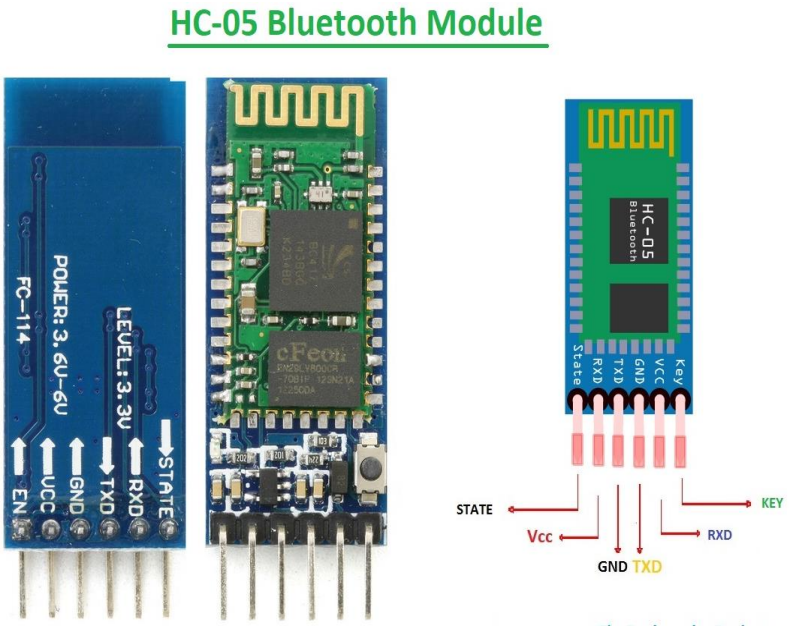

Figure 4.2 Bluetooth module

Bluetooth protocol: Bluetooth Specification v2.0+EDR.

Frequency: 2.4GHz ISM band.

Modulation: GFSK(Gaussian Frequency Shift Keying).

Emission power: =4dBm, Class 2.

Sensitivity: =-84dBm at 0.1% BER.

The Bluetooth module used in this project is the HC-05, which is a v2.0+EDR (Enhanced Data Rate) module. It has a maximum data transfer rate of 2.1 Mbps and operates on the 2.4 GHz ISM (Industrial, Scientific, and Medical) band. It has a range of up to 10 meters and supports both the master and slave modes of operation. The HC-05 is widely used for wireless communication in various projects, including robotics, automation, and IoT applications. In this project, the HC-05 module is used to enable Bluetooth communication between the user's smartphone and the lawn mower with water sprinkler robot.

TYPES OF BLUETOOTH MODULE:

There are several types of Bluetooth modules available in the market, each with its own set of features and capabilities. Some of the common types of Bluetooth modules are:
HC-05: This is a commonly used Bluetooth module that is easy to use and has a range of up to 30 feet. It can be easily integrated with microcontrollers like Arduino and Raspberry Pi.
HC-06: This is another popular Bluetooth module that is similar to HC-05 but has a slightly lower price point. It can be used for simple wireless data transfer and has a range of up to 30 feet.

HM-10: This Bluetooth module is commonly used in IoT applications and has a range of up to 100 feet. It is more expensive than HC-05 and HC-06 but offers additional features like BLE (Bluetooth Low Energy) support.
CC2540: This is a Bluetooth Low Energy (BLE) module that is commonly used in wireless sensor networks and wearable devices. It has a range of up to 100 feet and supports both BLE and Bluetooth Classic modes.
RN42: This is a high-performance Bluetooth module that has a range of up to 100 feet and supports both Bluetooth Classic and BLE modes. It is commonly used in industrial and commercial applications.
RN52: This is another high-performance Bluetooth module that supports both Bluetooth Classic and BLE modes. It has a range of up to 100 feet and is commonly used in audio and automotive applications.

Each of these Bluetooth modules has its own set of advantages and disadvantages, and the choice of module depends on the specific requirements of the project.

ADVANTAGES OF BLUETOOTH MODULE:

Wireless Connectivity: Bluetooth modules provide wireless connectivity and making it easy to use and convenient to connect.
Low Power Consumption: Bluetooth modules use low power consumption technology, allowing them to run for extended periods without the need for frequent battery replacements.
Easy to Use: Bluetooth modules are easy to use and can be set up with minimal configuration, making them ideal for novice users.
Cost-Effective: Bluetooth modules are cost-effective, making them an affordable solution for wireless communication needs.

APPLICATIONS OF BLUETOOTH MODULE:

Wireless communication: Bluetooth modules can be used to enable wireless communication between devices, such as smartphones, tablets, computers, and IoT devices.
Home automation: Bluetooth modules can be used in home automation systems to control various devices, such as lights, appliances, and HVAC systems, using a smartphone or tablet.
Wearable devices: Bluetooth modules can be used in wearable devices, such as smartwatches, fitness trackers, and health monitors, to enable wireless communication with smartphones or other devices.
Automotive: Bluetooth modules can be used in cars to enable wireless communication between the car's entertainment system and mobile devices, such as smartphones and tablets.

4.3 L298N MOTOR DRIVER

The L298N motor driver is a popular dual H-bridge motor driver IC that can drive both DC and stepper motors. It has two enable pins that can be used to control the speed of the motors and can handle up to 2A of current per channel.
It is commonly used in robotics and other projects that involve motor control.

Specifications:
Current Sense for each motor.
Heatsink for better performance.
Power-On LED indicator.
Double H bridge Drive Chip: L298N.
Operating Voltage (VDC): 5~35
Peak Current (A): 2

Continuous Current (A): 0-36mA

No. of Channels: 2

Over-Current Protection (A): Yes

Thermal Protection: Yes

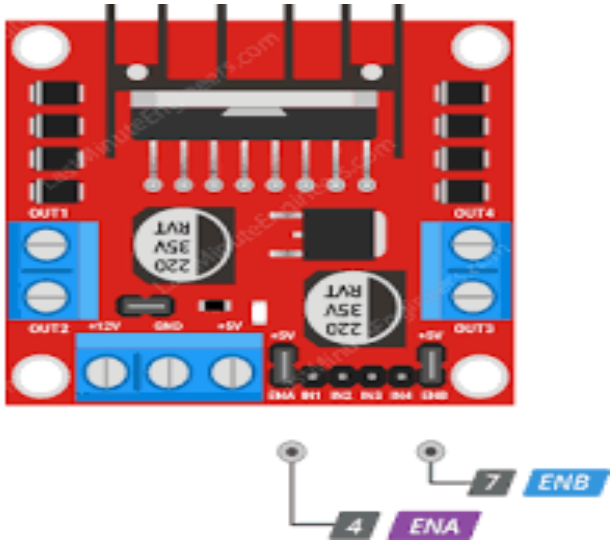

Figure 4.3 L298n Motor Driver

CHAPTER 5

RESULT

The system of autonomous lawn mower considers the time and distance cover by the lawn mower in a flat playground. Three factors are considered when it moves in forward, backward and turns the direction. Figure (5.1) shows the distance cover by a mower in given time:

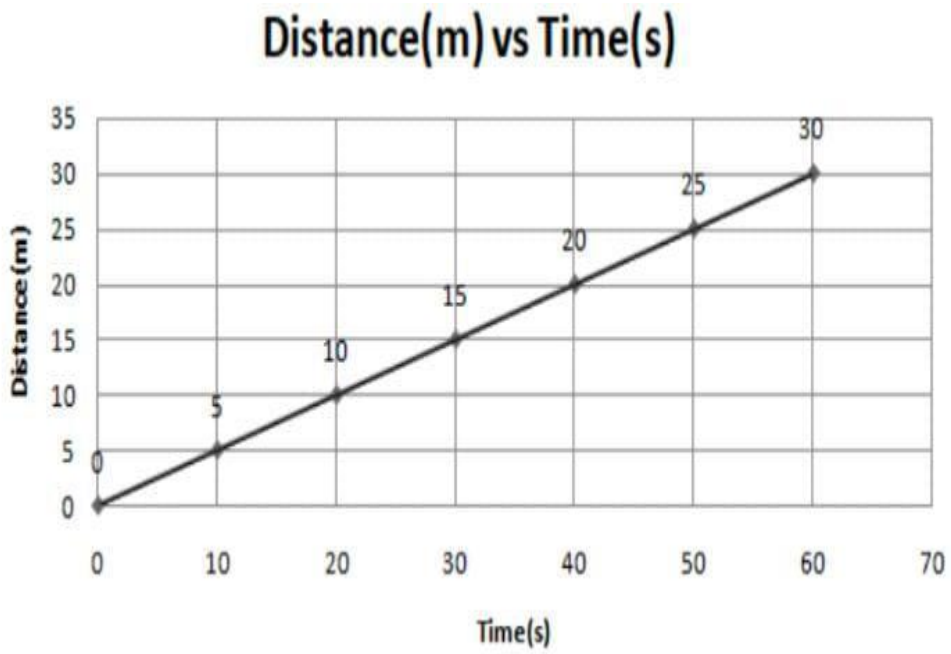

Figure 5.1 Graph

The graph fairly demonstrates that when the time is increasing the area distance covered by the lawn mower is also increased. That means when the mower is passing through a particular area it will cut the grass along with water the garden in a given time.

During the process of implementation of this robot, several difficulties and factors associated with the plan, various equipments and their application were faced. In this section, accomplishment of the proposed mowing robot is apprises in the form

of direction control of robot with mobile phone, level of mowing and water sprinkle accuracy.

Water sprinkler is attached at the back side of the mower which is further connected with pump. And the pump is attached with a water tank, where water has been stored. When the switch of the pump is ON water will be going through the pipe to water sprinkler.

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.

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.\

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.

CHAPTER 6

CONCLUSION

The developed automated mechanism proved to be advantageous in terms of four considered attributes, mainly blade cutting speed, turf quality, battery life span and the design analysis of lawn mower. The model could be carried commercially a minimal amount of operating cost and production. Thus, the lawn of the very vast field can be mown easily without human effort. It is much portable and can be directed with smart phone so, one can easily operate it with their hand set. The gist of this job is, it can cut the grass of a specific area of flat land and also water the garden along the way. If we want only cutting action, we must have to turn off the switch of pump, in that case cutter blade switch should be on. This project is environmentally safe because it has been operated by an electric battery and an electric motor and also easy to carry at any place. In future more research would be possible to control the lawn mower with voice command. Depends on the atmospheric situation of soil and grass the lawn mower mobilized with temperature and humidity sensor to get the rate of the humidity and temperature of a desired territory.

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NOMENCLATURE

F : Sharing Force

T : Shaft torque

R : Radius of blade

P : Power by Shaft

N : Shaft Speed

D : Blade diameter

C : Circumference of circle

APPENDIX

The program is used to run the logics and control motors are mentioned below:

```
#define in1 5
#define in2 6
#define in3 10
#define in4 11
#define light_FR  14    //Plant Cutter  pin A0 for Arduino Uno
#define horn_Buzz 18    //Sprinkler       pin A4 for Arduino Uno
int command; //Int to store app command state.
int Speed = 204; // 0 - 255.
int Speedsec;
int buttonState = 0;
int lastButtonState = 0;
int Turnradius = 0;
int brakeTime = 45;
int brkonoff = 1; //1 for the electronic braking system, 0 for normal.
boolean lightFront = false;
boolean lightBack = false;
boolean horn = false;
void setup() {
pinMode(in1, OUTPUT);
pinMode(in2, OUTPUT);
pinMode(in3, OUTPUT);
pinMode(in4, OUTPUT);
pinMode(light_FR, OUTPUT);
pinMode(light_FL, OUTPUT);
pinMode(light_BR, OUTPUT);
```

```
pinMode(light_BL, OUTPUT);
pinMode(horn_Buzz, OUTPUT);

Serial.begin(9600);  //Set the baud rate to your Bluetooth module.
}

void loop() {
if (Serial.available() > 0) {
command = Serial.read();
Stop(); //Initialize with motors stoped.

if (lightFront) {digitalWrite(light_FR, HIGH); digitalWrite(light_FL, HIGH);}
if (!lightFront) {digitalWrite(light_FR, LOW); digitalWrite(light_FL, LOW);}
if (lightBack) {digitalWrite(light_BR, HIGH); digitalWrite(light_BL, HIGH);}
if (!lightBack) {digitalWrite(light_BR, LOW); digitalWrite(light_BL, LOW);}
if (horn) {digitalWrite(horn_Buzz, HIGH);}
if (!horn) {digitalWrite(horn_Buzz, LOW);}
switch (command) {
case 'F':
forward();
break;
case 'B':
back();
break;
case 'R':
left();
break;
case 'L':
right();
```

```
break;
case 'I':
forwardleft();
break;
case 'G':
forwardright();
break;
case 'H':
backleft();
break;
case 'J':
backright();
break;
case '0':
Speed = 100;
break;
case '1':
Speed = 140;
break;
case '2':
Speed = 153;
break;
case '3':
Speed = 165;
break;
case '4':
Speed = 178;
break;
case '5':
```

```
Speed = 191;
break;
case '6':
Speed = 204;
break;
case '7':
Speed = 216;
break;
case '8':
Speed = 229;
break;
case '9':
Speed = 242;
break;
case 'q':
Speed = 255;
break;
case 'W':lightFront = true;break;
case 'w':lightFront = false;break;
case 'U':lightBack = true;break;
case 'u':lightBack = false;break;
case 'V':horn = true;break;
case 'v':horn = false;break;
}
Speedsec = Turnradius;
if (brkonoff == 1) {
brakeOn();
} else {
brakeOff();
```

```
}
}
}

void forward() {
analogWrite(in1, Speed);
analogWrite(in3, Speed);
}

void back() {
analogWrite(in2, Speed);
analogWrite(in4, Speed);
}

void left() {
analogWrite(in3, Speed);
analogWrite(in2, Speed);
}

void right() {
analogWrite(in4, Speed);
analogWrite(in1, Speed);
}
void forwardleft() {
analogWrite(in1, Speedsec);
analogWrite(in3, Speed);
}
void forwardright() {
analogWrite(in1, Speed);
```

```
analogWrite(in3, Speedsec);
}
void backright() {
analogWrite(in2, Speed);
analogWrite(in4, Speedsec);
}
void backleft() {
analogWrite(in2, Speedsec);
analogWrite(in4, Speed);
}

void Stop() {
analogWrite(in1, 0);
analogWrite(in2, 0);
analogWrite(in3, 0);
analogWrite(in4, 0);
}

void brakeOn() {
//Here's the future use: an electronic braking system!
// read the pushbutton input pin:
buttonState = command;
// compare the buttonState to its previous state
if (buttonState != lastButtonState) {
// if the state has changed, increment the counter
if (buttonState == 'S') {
if (lastButtonState != buttonState) {
digitalWrite(in1, HIGH);
digitalWrite(in2, HIGH);
```

```
digitalWrite(in3, HIGH);
digitalWrite(in4, HIGH);
delay(brakeTime);
Stop();
}
}
// save the current state as the last state,
//for next time through the loop
lastButtonState = buttonState;
}
}
void brakeOff() {

}
```