# DESIGN AND DEVELOPMENT OF REMOTE-CONTROL GRASS CUTTER (RCGC)

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**ABSTRACT:** Grass cutting commonly requires manual work that consumes time and skill to have a better cutting process. The aim of this project is to create a cutter that is lightweight, simple to use, and easy to maintain. The grass cutter machine is operated by humans with minimal interaction, under suitable circumstances, in order to minimize exposure to vibration and noise. It is an automated system for grass cutting handling operations. The absence of petrol operation is one of the advantages of this cutter machine, which introduces the use of an electric battery. Wheels, motors, control systems, and motor DC are part of the remote-control grass cutter (RCGC) integrated system. This machine's construction provides an environmentally friendly and cost-effective solution. In addition, the body that covers the cutting area can improve safety while the machine is in operation.

**KEYWORDS**: *Remote-control grass cutter (RCGC), motor, user safety, pollution*

## 1.0 INTRODUCTION

Grass cutter have been popular and a common machine used in our daily life. The conventional grass cutter with rotary blade handle by human normally used for grass furnishing during gardening or in agriculture. The grass cutter used to trim long grass and short grass at the user desired height fast and effectively. 70% of the people of Malaysia cut their lawns using fuel-powered grass cutter [2,6]. Nevertheless, this cutter generates pollution that could compromise user health, expensive running and maintenance costs, and uses a lot of human energy. Otherwise, a high speed of rotation of cutting blades will generate small particle to harm the users while operate the machine.

Traditionally, it takes a lot of human skill, time and effort to operate a fuel-powered grass cutter. Users need to be proficient enough to use the machine safely and accurately, especially in challenging reaching areas. Prolonged used can cause serious health issues such as grip strength, decreased hand sensation and dexterity, finger blanching or 'white fingers' and carpal tunnel [1].

It takes a lot of human energy to physically control the cutter, control the vibrations. Hand control grass cutter using rotating blades to cut grass give uneven grass height. Normally, the user is often in charge of controlling the cutting height, which can lead to some variance in the height of the grass. Otherwise, grass cutter has caused air and noise pollution, particularly in urban areas. The utilization of engine-powered machines exacerbates issues related to air pollution, noise, and necessitates regular maintenance [4].

Nowadays, human reliance on an autonomous concept has been developed rapidly. Technology is helping the human being to work less however receiving more outputs, save their time and ease their works [3]. Therefore, the development of remote-control grass cutter (RCGC) incorporates with technology that can be controlled remotely using a remote control. This wouldn't need much effort as it is needed in the traditional manual grass cutter [5].

This project aims to design and fabricate a user-friendly RCGC that is portable, easily maintained, and operated machine. It can be controlled by a person from a distance within a

suitable range by just giving directions of movement to the machine through a simple remote control [2]. It can save especially on labor cost. Furthermore, the introduction to the usage of electrical charge battery to eliminate the combustion of fuel while operation.

## 2.0 METHODOLOGY

The development of the remote-control grass cutter (RCGC) construct based on 3 specific design criteria including (1) able to cut even grass height from the surface, (2) able to reduce pollution caused by grass cutter, and (3) can be operate by younger and elder. The safety of the grass cutter was also considered during the development stage.

The component breakdown of the machine design concept that has been selected is illustrated in Figure 1. Morphology chart (MC) has been used as a tool that offer various solution to develop product. Each solution represents a potential product concept to help in visualizing numerous possibilities and variety of ideas in development of RCGC. After that, a definite design was chosen and drawn using Inventor CAD software.

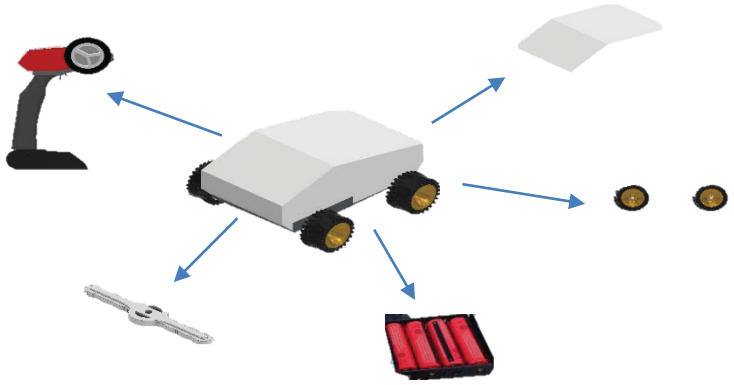

Figure 1: Component Breakdown Design Concept

An overview of the electric components and their functional connections can be seen in the schematic block diagram. Figure 2 shows a diagram of the circuit used to regulate the operation of the grass cutter. The remote will transmit a signal to the RF receiver, which will then be powered by the battery to activate the microcontroller. This will enable the motor to rotate the wheels and cutting blade.

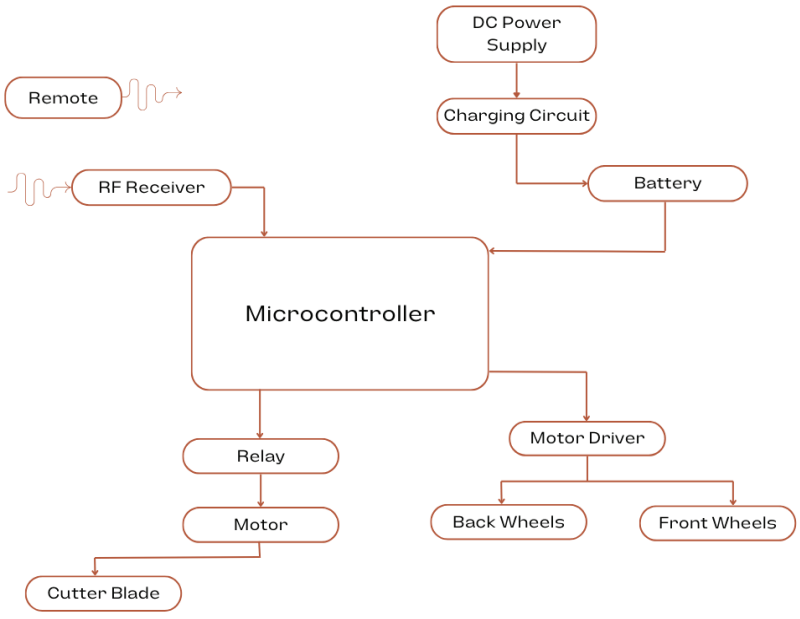


Figure 2: Block Diagram of Remote-Control Grass Cutter (RCGC)

Below is a list of the components used in the construction of the RCGC. The table identified as Table 1 provides a list of the functions and descriptions of the parts.

Table 1: List of components for remote-control grass cutter (RCGC)

| Parts | Function | Descriptions |
|---|---|---|
| Power Source | Supplies power to the entire system. | Rechargeable 14.8V, 6800mAh battery |
| Cutting Mechanism | The actual blades or cutting system. | Rotary blades 13cm length |
| Chassis | The internal frame that supports the entire machine. | Mild steel |
| Motors | Drive the wheels | 12v with 45rpm |
| Motors | Drive cutting blades. | 12v with 1000rpm |
| Remote Control Interface | The user interface for controlling the grass cutter. | Pistol remote control |
| Navigation System | Guides the movement of the grass cutter. | Infrared Sensor |
| Casing Material | Material use as protection or a structural support for the grass cutter | Aluminum |

## 3.0 RESULT AND DISCUSSION

### 3.1 Design of the Remote-Control Grass Cutter (RCGC)

RCGC divided into electrical and mechanical components that will support the functionality of the machine. When a blade is used to perform a cutting action, the electrical energy that is stored in the battery is transformed into mechanical energy. While the alternator makes use of the mechanical power to continuously recharge the battery while it is operating, the electric circuit is responsible for ensuring that electricity is transferred from the battery to the motor so that it can be used. Figure 3(a) illustrated the final product of the RCGC whereas figure 3(b) shows the controller to move the grass cutter. Product has been tested in actual field to monitor the functionality of the cutting blade and the control system. The RCGC components assembled without cover as shown in figure 3(c).

Figure 3(a): Final product


Figure 3(b): Remote Control

Figure 3(c): Assembled product

### 3.1 Calculation on Battery Operating Time When Fully Charged

The shearing force of most annual and perennial grasses found on most lawns in usually between 9.2N -11.51N [7]. In this study, assumption of force required by cutting blade to shear the grass is F = 9.5N has been used to analyze RCGC battery consumption when fully charge operated.

Calculation of power generated from the motor.

$$T = F \text{ x } R$$
$$T = (9.5)(0.065) = 0.6175 \text{ Nm} \quad (1)$$

where,
T = shaft torque and R = Radius of cutting blade = 6.5 cm.

$$P = 2\pi NT/60$$
$$P = \frac{2\pi(1000)(0.6175)}{60} = 64.66W \quad (2)$$

where,
P = Power developed by shaft; T = torque required; and N = shaft speed in rev/min = 1000 rpm.

Calculation of power generated in one charge of battery. As the voltage of one battery is 3.7V, 4 pieces battery used in series arrangement produced 14.8V of battery voltage.

$$\text{Battery power, } P = V \text{ x } I$$
$$P = (14.8)(6.8) = 100.64 \text{ watt} \quad (3)$$

Therefore,

$$\text{Battery cycle for on charge} = \frac{\text{power generated by battery}}{\text{power of motor}}$$
$$\text{Battery cycle for on charge} = \frac{100.64}{64.66} = 1.56 \text{ hours} \quad (4)$$

According to Figure 4 below, five tests have been carried out in order to determine the number of hours that the grass cutter's battery can remain completely charged. It is clear that there are five potential outcomes based on uncertain factors such as the movement of the grass cutter. Due the inconsistent movement was the cause of the different battery working times.

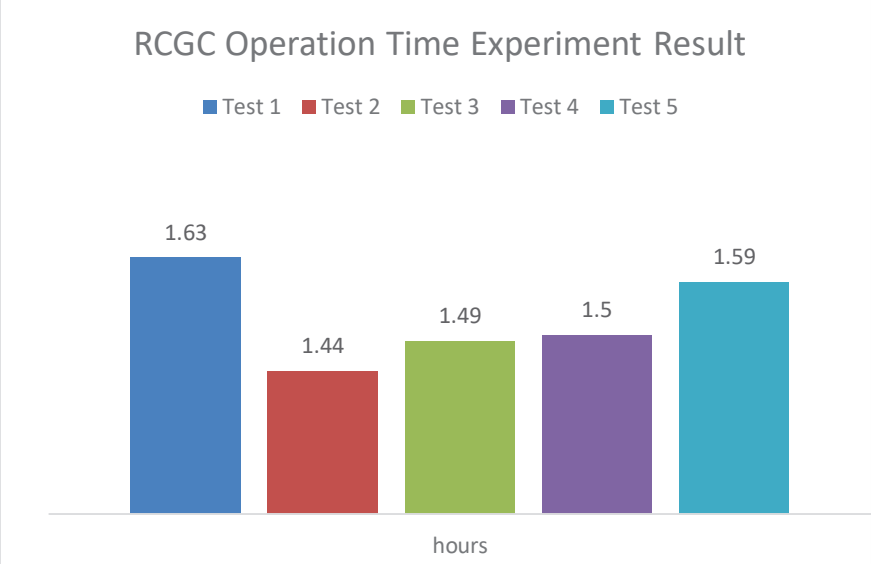


Figure 4: RCGC Operation Time Experiment Result

## 1.0 CONCLUSION

In conclusion, the RCGC was successfully fabricated. The grass cutter remotely controls to reduce human interfere to eliminate user exposure to the hazard, such as vibration and noise during the cutting process. The battery powered, rechargeable makes the cutter eliminates the fuel consumption to reduce the air pollution. No engine combustion happened that improved environmental impact as well as human health. As a result, the remote-control grass cutter (RCGC) can serve as an effective replacement to conventional fuel grass cutters. The automated system in the machine making it suitable for operating at even surface to ensures consistency in cutting efficiency.

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