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AUTOMATED GRASS CUTTER USING VOICE RECOGNITION

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ABSTRACT

Grass cutter is one of the significant home appliances especially among the country side. The existing grass cutter machine in agriculture field usually using kerosene as their fuel source to operate the machine. However, by using fuel source, combustion process will occur and will pollute the environment with toxic gas which can lead to thinning of ozone layer and disease. Moving to improvement of grass cutter machine, we can conclude that with the improvement of the machines comes greater prices. This will make the people comes hard to buy the expensive one. Due to the high price, many people will buy the cheaper machines which they can afford. This can be seen easily in Malaysia where we can see many people will use the string trimmer to cut the grass. The string trimmer is a semi manual machines which requires humans to use it to cut the grass. The machines are quite heavy and after a period of time using the machines; it will lead to shaking and back-ache of the user. This will lead to serious safety issues. The idea of controlling a grass cutter machines is quite simple with the use of Arduino and some electrical devices. The grass cutter machines are control by Arduino which control the directions to moves forward, backward, right, left and stop. The control of direction is being help with the use of L298N motor driver which receive the signal from the Arduino to control the direction of the motor. Besides, it uses a simple voice recognition that all user can get from Google Play store to communicate with the grass cutter machines. The motor has two roles in this system which is to control the direction of grass cutter and also the cutting process of the machines. At last, the goal of creating this grass cutter machines are to create a low cost machines where all people can buy it thus preventing a health issues to the user and also creating a low budget grass cutter machines where all user can afford.

Keywords: automated, grass cutter, voice recognition.

INTRODUCTION

This project is a study about the design and improvements of a grass cutter technology. The function of this machine is to cut grass especially at houses, garden and sport field. The idea of this project is to combine a programmable function to a robotic car in order to create a controllable grass cutter. There are several criteria in engineering aspects that must be considered to develop a prototype of this machine. The title of this project is called automated grass cutter using voice recognition. This machine can be classified into two main part which is making an automated grass cutter and the other part is controlling it using Bluetooth low energy concept. This machine is also designed by reviewing a few aspects such as durability and suitability of this machine for the grass type in gold field or gardens. The first step that need to be take in order to build this machine is by designing the body of this machine using adobe illustrator or AutoCAD. The simulation of this machine can be run using proteus software in order to check the connection between microcontroller and output devices. After the connection is verified, then the microcontroller can be implemented to the machine as a completed design. At the end of the research, the result of analysis of the structure will be discussed for the design selected.

GRASS CUTTER

There are several type of grass cutter that existed since a long time ago. Due to the advance of human technology, there are two main concept of grass cutter which is manual and automated. Referring to the technology of grass cutter, there are two types of manual grass cutter which is semi-manual grass cutter and fully manual grass cutter. Semi-manual grass cutter also called manual grass cutter machines. The manual grass cutter machine works using kinetic energy produced by the user by mechanical concept. Example of semi-manual grass cutter is a grass trimmer. It uses petrol to supply power to the machine in order to turn the blade cutter or the monofilament line. However, it was designed as a handheld device which requires a human body to operate it. Thus, it referred as a semi-manual grass cutter. Example of fully manual grass utter is a scythe or a sickle. This type of grass cutter does not have a machine mechanism attach to it and it requires full workforce from the human body. Thus, it has a toll on the user.

The automatic grass cutter can be classified in two types in terms of power supply which is supply by electrical motor or combustion engine. The machines that use electrical motor usually is small in size and fully automated that uses sensor to detect the grass that need to be cut. This device that acts as a robot that only exists to cut the grass is powered by battery. Nowadays, there are

many machines that used electronic board to program a machine for their processing systems are also called intelligent technology. However, machines that used petrol as to run the machine is usually large in size and it running in single ride mechanical machine.

Microcontroller

Microcontroller is a small integrated circuit that acts as a microcomputer. It is used to give and store functions. Besides that, it is also used to control product and devices remotely such as microwave, industrial automation and aerospace industry [1]. There are many types of microcontroller that is being used nowadays such as Arduino, sk40c and etc. However, they are low in cost which is good for practical works.

Most of the common microcontroller that being used is PLC (Programmable Logic Controller) and PIC (Peripheral Interface Controller). The input information is being stored and processed according to the program instructed and executed as an output. Techopedia.com states that Peripheral Interface Controller (PIC) is a type of microcontroller component that is used in the development of electronics, computers, robotics and similar devices. The PIC was produced by Microchip Technology and is based on Harvard Computing architecture, where code and data are placed in separate registers to increase input/output (I/O) throughput. Besides that, PIC is also known as a programmable interface controller (PIC) and programmable intelligent computer (PIC).

The PIC was developed to improve the performance of standard I/O operations from a computer peripheral devices. The PIC itself stands for small size pc that has the ability to store memory and instructions in order to create a task. A PIC has been design to have a built in memory, data bus and microprocessor for processing all I/O operations. The built in memory are consists of temporary and permanent memory which is random access memory (RAM) and erasable programmable read-only memory (EPROM). Besides, it also contains a flash memory which is used to perform multiple task such as READ, WRITE and ERASE functions. Table-2.2.2 below shows some of PIC microcontroller features:

Table-1. PIC microcontroller features.

	Features
1	Digital Input Output (I/O) ports
2	On-chip timer with 8-bit prescaler
3	Power-on reset
4	Watchdog Timer
5	Power saving SLEEP mode
6	High source and sink current
7	Direct, indirect and relative addressing modes
8	External clock interface
9	RAM data memory
10	EPROM or Flash program memory

When choosing a suitable type of PIC microcontroller, there are many criteria that are considered to be taken such as:

a) Number of I/O pins required
b) Required peripherals (e.g., USART, USB)
c) The minimum size of ram
d) Speed
e) Physical size
f) Cost

Based on the research, PIC16F877 was considered to be the most suitable microcontroller to be used in a project. This microcontroller is a 40-pin device and one of the most popular microcontroller that being used for complex operation. The device offers 8192×14 flash programmable memory. It used Assembly language and c programming as their programming languages.

METHODOLOGY

The hardware development of this project is consists of mechanical, electrical and software part. All three parts must be combined in order to develop a successful and working machine. The mechanical part consists of type of motor used in order to move the machine. The second part is electrical part which the circuit created is used in order to control the fundamental controlling system that involves Arduino and Bluetooth module. Lastly, the software part consists of software that involved to create and simulate the project design.

DC Motor

DC motor with high speed is choose to be the motor that control the rotation for the blade. This is because the blade need to has a higher RPM (rotation per minute) to cut the grass uniformly. When choosing the high speed motor, the torque of the dc motor is lower. This is because the relationship between speed and torque is inversely proportional.

Figure-1. DC motor.

Bluetooth HC Module

HC-05 is a Bluetooth module that is used as an interface that connect the Arduino board and the user voice in order to control the direction and movements of the system. It is referred as an easy to use Bluetooth SPP (Serial Port Protocol). This Bluetooth module has the ability to act as master and slave mode in a communicating system.
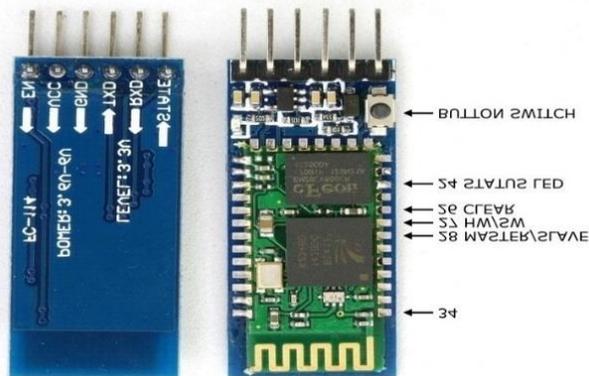

Figure-2. HC-05 bluetooth module.

Motor Driver L298

L298 is a motor driver that allows us to control motors with an arduino board. One unit of this motor driver module can control the speed and direction of two dc motor.

Besides that, it is also quite cheap thus many inventor likes to use this module as a solution to control their motor speed. Thus, the library is easy to find in the internet. It used a H-bridge concept to change the relay in the circuit, thus changing the speed and direction of the motors.

Figure-3. L298 motor driver.

Software Development

Software development involved in the development of this project design is Proteus. Proteus is a software that is compulsory in order to test the circuit simulation to ensure the circuit design is a success.

Basically Proteus is a software to design and simulate a certain circuit based on a project. Proteus consists of two part which is ARES and ISIS software. ARES is a software that is used to design a PCB of a circuit. It has the ability to view the PCB and components involved in a 3D view. However, ISIS is used to draw a schematic figure and simulate the circuit. The simulation will give a real time simulation access to the user. Figure-4 and Figure-5 below will show the icon of the ISIS and ARES software with the circuit diagram created sing ISIS.
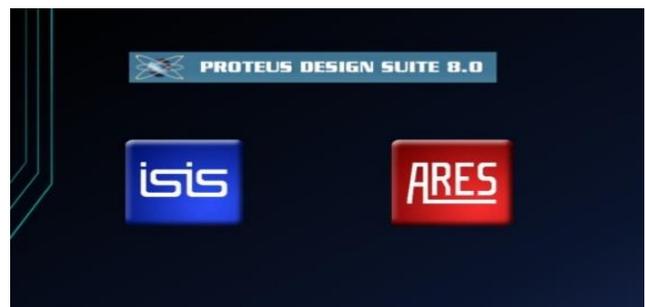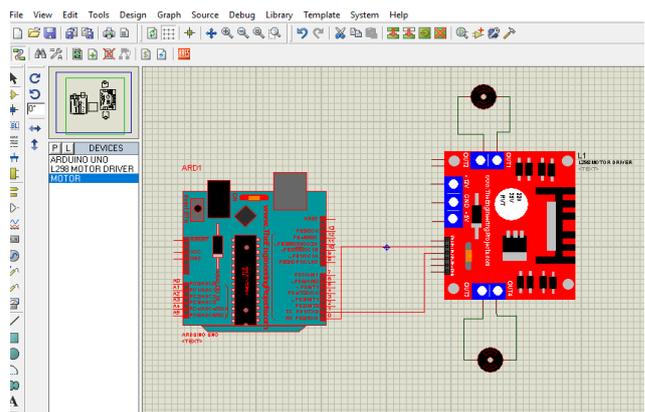

Figure-4. ISIS and ARES software.

Figure-5. Circuit diagram.

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Conceptual Design

The conceptual design of the automatic grass cutter machine is shown from the sketch. The design consists of the body of the machine that are attached with the components.
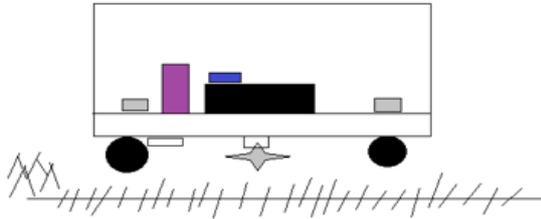

Figure-6. Sketching of Automatic Grass Cutter Machine.

Where,
Black rectangle   = Arduino Uno board
Blue box   = Bluetooth module
Purple box   = power supply
Silver box   = dc motor
Silver Star   = blade cutter

Programming the Arduino Microcontroller

The sixth stage is programming of the Arduino board. As illustrated in Figure-7 shows the flow chart on how the machine works. When the user said 'Start' the blade cutter and the machine will on. When command 'forward' is given, the machine will start cutting the grass in forward direction. The machine will move forward until command 'right/left' is given in order to move the machine in any direction. The machine will keep moving and cutting until command 'stop' is given by the user.
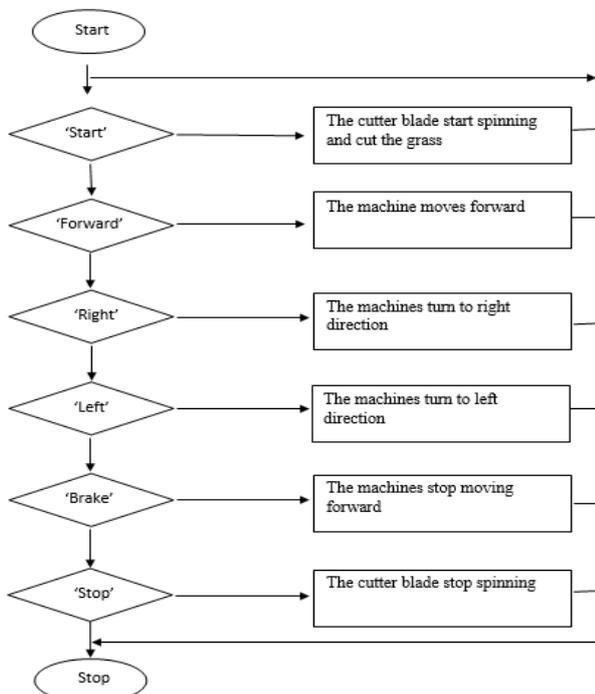

Figure-7. Flow chart programming of Arduino.

RESULT AND DISCUSSIONS

A simple sketch or design must be drawn in order to give us a view of expected products. Solidworks has been proven as one of the most popular designing software among the engineers. By using 3d designing features in solidworks, it can give a better measurement and planning on how to construct the machine.
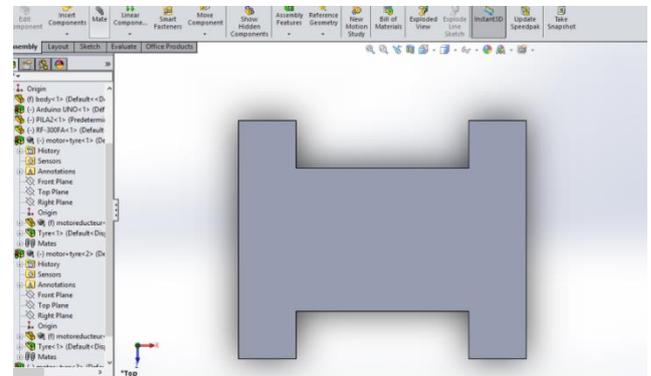

Figure-8. Constructing base for grass cutter machine.

To draw a base that will be used to assemble of our project materials. After installing the solidworks, choose new project icon in order to draw a new sketch of 3d diagram. After that, we choose top plane which gave us more clear view on how we want our base to look like. After the drawing is done, dimension is set to give the object to give it accurate measurement.

After first part is done, we moving in to another part which is assembling the base with another material such as Arduino, Bluetooth module and L298n motor driver. However, there's a simpler method besides drawing all the components. Thus, all the drawing for the components can be downloaded from solidworks website from the internet. After downloading all the components involved, we can assemble the entire component to the to the base to create the exact design as we want.
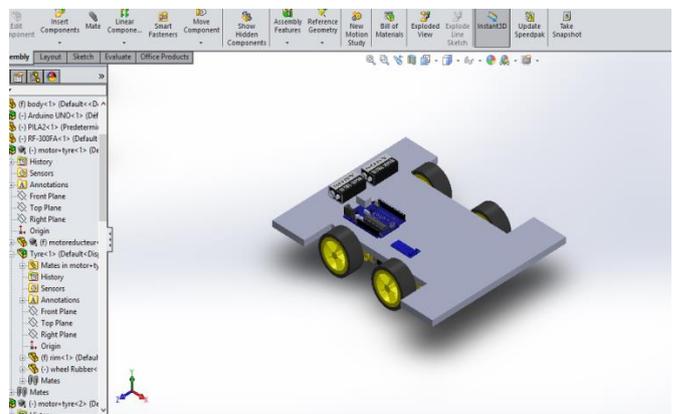

Figure-9. Completed drawing.

Arduino

After the construct and assembled works is done, we move to the controlling part which controls the machine using Arduino. Basically, the Arduino controls all

part of this machine such as moving the wheels, direction and turning on the blade cutter. Thus, a coding must be implemented to the machine.

Coding

Based on our project, we need the machine to move right/left and forward/backward. The easiest way to control the direction of the motor is using the concept of H Bridge in the l298n motor driver. Besides we need to use the Bluetooth module in order to communicate with the machine remotely. Based on the coding shows that after declaring the input of the motor on Arduino, we can use the H-bridge to control the direction. After the forward/reverse and right/left movement has been established, we now can move on how to control the cutter remotely. In this design, the motor that used to cut the grass is using an external power supply in order for it to move at high speed at all times. However, by using an external supply than Arduino, we need another way in order for it to communicate with the Arduino. Thus, using relay is the best way for controlling the cutter. The Arduino just need to send signal to the relay and the relay will control the flow of the power supply to the cutter.

Analysis

Based on this project there are certain analysis that are going to be observe. Firstly, we are going to use only one blade to cut the grass on a grass field. After that, we changed the blade type into a two blade method and string method to see which one of this method is the best.
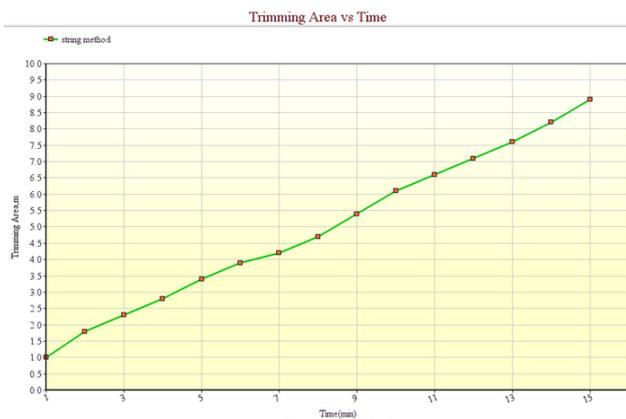

Figure-10. Result of trimming area vs time for string method.

The result shows that by using the string method the increment of trimming area is quite low. It increases from giving trimming area from 1.0 to 1.8 and to 2.3. This is because the string does not have the optimum speed to cut the grass because it does not have a powerful motor such as a semi manual string trimmer. The motor that being used as a pivot to cut the grass operate on 12v power supply, thus cannot give the optimum speed to use the string method.
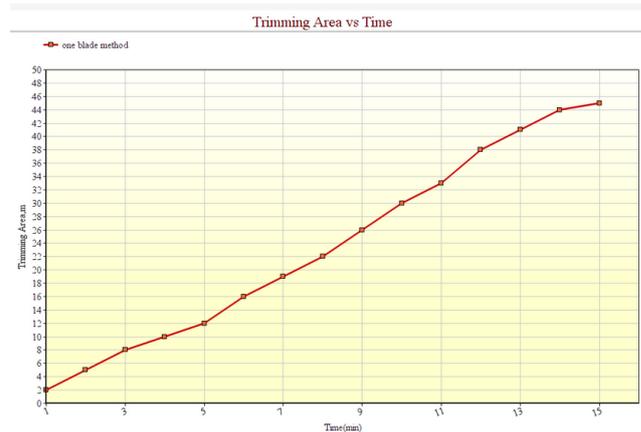

Figure-11. Result of trimming area vs time for one blade method.

The result shows that by using the one blade method the increment of trimming area is quite good. The trimming area seems increase from 2m to 5m and 8m. The process of cutting the grass went smoothly because the blade attached to the motor is sharp. Besides, the motor that act as a pivot operate at 12v power supply, which runs the motor at full speed at 3800 rpm. With combination of a high speed motor and sharp blade, the process of cutting the grass gives good results. However, at minutes10 the cutting process began to slow down because the machines encounter a rock in the trail which slows down the movement of the machines.
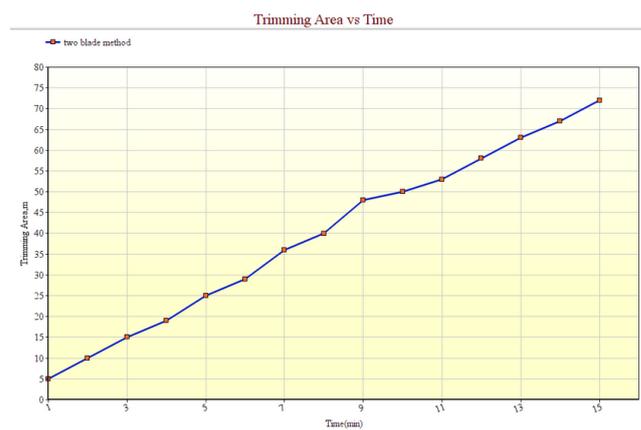

Figure-12. Result of trimming area vs time for two blade method.

The result shows that by using the two blade method the increment of trimming area is better than one blade and string method. The result shows that the trimming area increase from 5m to 10m and to 15m. Basically, the fundamental of operating in one blade method and two blade method is the same, the only differences is using two set of motor to use two blade in order to cut the grass. Thus by having a two blade to cut the grass, the trimming area is widening.
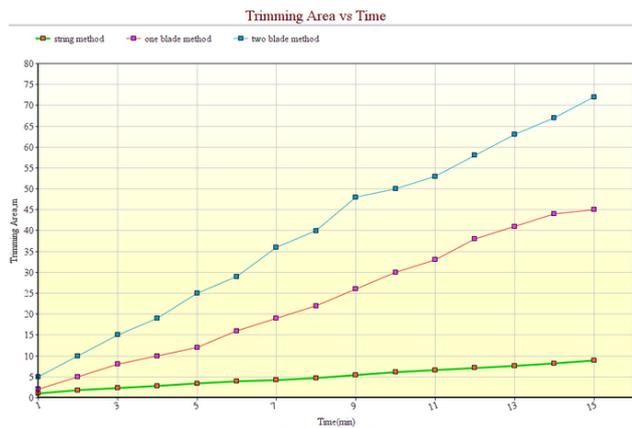
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Figure-13. Efficiency of three cutting methods.

Based on the experiment that has been conduct, the one blade method is quite efficient in its trimming operation. This is because the blade is quiet sharp thus making the job easier. Using the String method gives us a low efficiency; this is because when using a dc motor, it cannot rotate as fast as a manual string trimmer machine thus giving us a low efficiency. The Two blade method gives the best efficiency result among the three methods. The cutting experiment went well same as the one blade operation. However, by having two blades, the grass is cut better than one blade method.

After evaluating the effectiveness using a string method, we decide to not use the string method because it is not efficient. It gives a low efficiency while having the same battery consumption as single blade method. The Two blade method is the most expensive among the three methods. This is because it needs a two dc motor operating as a pivot to move the blade. The price of a dc motor for high speed is quite expensive, by having a requirement of two dc motor has made the two blade methods the most expensive among the three methods. However, even it is much more expensive; it is the most efficient method to cut the grass.

CONCLUSIONS

This grass cutter machine has been successfully tested and showed that by using voice commands, it improved the problems faced by the user which requires the user to manually operate the machine. Besides, this machine is built using a cheap and low cost part which all range of user can afford to buy it.

ACKNOWLEDGEMENT

REFERENCES

[1] Gunther G., Bettina W., Tyler R. and Mike S. 2017. Introduction to Microcontrollers. Auburn University.

[2] Peripheral Interface Controller (PIC). https://www.techopedia.com/definition/29134/peripheral-interface-controller-pic

[3] Palve S. V., Panchal K., Chipkar R., Patil A. and Sonawane G. L. 2016. Solar powered automated grass cutter machine. Science Technology and Engineering. 2, pp. 576-580.

[4] Semi-Automated M. C. Conceptual Designs towards Developing Mechanically Controlled Semi-Automated Grass Cutter.

[5] Ulhe P. P., Inwate M. D., Wankhede F. D. and Dhakte K. S. 2016. Modification of solar grass cutting machine. Int. J. Innovative Res. in Sci. and Technol. 2(11).

[6] Alam M. A. M. T. A. J., Singh V. V. and Yadav V. IOT based grass cutter with solar pannel. Int. J. Sci. Eng. 778, pp. 1089-1095.

[7] Khillare S. R., Morey D. P., Ghoti B. A., Thorat S. S., Pimple S. D. and Sharma M. O. 2020. A Review of Fully Automated Grass Cutter Using Solar Power. International Journal of Research in Engineering, Science and Management. 3(7): 108-111.

[8] Stovall D. R. 2015. Rail-mounted automated grass cutter. U.S. Paten. t. 9, 119, 343.

[9] Dalal M. S. S., Sonune M. V. S., Gawande M. D. B., Sharad M., Shere B. and Wagh M. S. A. 2016, April. Manufacturing of solar grass cutter. In National Conference CONVERGENCE (Vol. 2016, pp. 06th-07th).

[10] Haris M., Tabassum N., Hammadud din Babar B. H., Khan S., Khan Z. and Omran A. A. B. 2019. Semi-Automatic Grass Cutter Machine. Journal of Multidisciplinary Approaches in Science. 6(1): 35-44.

[11] Gunther G., Bettina W., Tyler R. and Mike S. 2017. Introduction to Microcontrollers. Auburn University.

[12] Mukhtar, M. F., M. I. F. Rosley, A. M. H. S. Lubis, N. Tamaldin, M. S. F. Hussin, A. A. M. Damanhuri, K. A. Azlan, and N. H. Hanizat. "Development of River Trash Collector System." In Journal of Physics: Conference Series, vol. 1529, no. 4, p. 042029. IOP Publishing, 2020.