Design And Development Of Automatic Whiteboard Eraser For Effective Cleaning Mechanism using Internet Of Things (IOT)

Nurzaliza Ghazali
Politeknik Sultan Abdul Halim Mu'adzam Shah
nurzalizag@gmail.com

Ooi Kuan Zhe
Politeknik Sultan Abdul Halim Mu'adzam Shah
okuanz@gmail.com

Rosmani Ramli
Politeknik Sultan Abdul Halim Mu'adzam Shah
rosmaniramli4@gmail.com

Abstract
Most schools and educational institutions in Malaysia implement teaching and learning delivery using whiteboards during class or lecture time. Usually, the instructor must erase the writing on the whiteboard manually using an eraser to write something new. This causes them to need more time and energy to erase the whiteboard. Instructors who have a short medium height face the difficulty of erasing the writing written at the top of the whiteboard. This will weaken the body and affect health if prolonged. In addition, the problem of losing the eraser is also common. This will also cause the instructor to have to waste time finding an eraser or other tool to erase the whiteboard. This whiteboard eraser is designed in conjunction with the eraser to make it easier for instructors to erase the whiteboard by controlling the eraser using a smartphone that has the Blynk application. The findings from the production of this project show that the design and development of Automatic Whiteboard Eraser For Effective Cleaning Mechanism using Internet Of Things (IOT) can reduce the burden of users to erase the whiteboard and save more time and energy of instructors compared to the manual method used previously.

Keywords: whiteboard, eraser, IOT.

1.0 Introduction

Education is the lifeblood of a nation's civilization. It covers the process of teaching and learning to guide people towards the truth. The delivery of education must be in line with teaching and learning techniques. Once upon a time writing was done on sand, walls, slate made of wood, blackboards and more recently on whiteboards as well as electronic boards (Tsado Jacob, 2017). The use of chalk is not in line with evolution now because it can affect health because of the dust released. Therefore, the use of whiteboards has been widely adopted in various aspects apart from teaching and learning (Praveen. G, 2013).

This project is applied from observations based on the problems of some parties regarding the manual deletion of whiteboards. So, with that, came up with an idea to design a whiteboard project that has been completed with an eraser for use in schools, offices and other educational institutions. This project is designed as an innovation of the method of deleting whiteboards

more efficiently and effectively. The surface size of the whiteboard is 30 cm high x 60 cm wide and it is designed together with an eraser to make it easier for instructors to delete the whiteboard automatically by applying Internet of Things (IOT) technology. Using IOT, this whiteboard eraser can be controlled by a smartphone via the Blynk application.

This eraser is set on the edge of the whiteboard and has two modes. The first mode is that the eraser moves only once, i.e., the eraser moves from left to right and returns to its original place after being activated using a smartphone. The second mode is that the eraser moves continuously from left to right repeatedly. This eraser will not stop until the STOP button is pressed via the smartphone.

There are also START and STOP buttons on the side of the whiteboard in case you need to delete manually. To use it, the eraser needs to be activated by pressing the START button. Pressing the START button once will activate the first mode. While the second mode will be active if the START button is pressed continuously and not released.

2.0 Problem Statement

While conducting a class or lecture, the instructor will usually hold an eraser and erase the whiteboard normally. During the lecture/class, sometimes the instructor will move to the back of the class and need to go back to the front to clear the whiteboard. This situation causes the instructor to need more time and energy especially when having to erase at a frequent rate. Instructors who have a short medium height often face the problem of erasing the top of the whiteboard. They need to hold the eraser and step on the foot to allow them to erase at the top. This will to some extent weaken the body and affect health if prolonged. In addition, the problem of losing the eraser also often occurs because of being picked up by someone else due to the condition of the classroom door not being locked. This will also cause the instructor to waste their time finding an eraser or other tool to erase the whiteboard.

3.0 Objective/Research Question

The design and development of this automatic whiteboard eraser using IOT is a better method of erasing because it can be erased by simply pressing a button through the Blynk application on the smartphone. Through this method, the process of erasing the whiteboard will be easier because it can be controlled automatically using a smartphone and saves time and energy of the instructor during the lecture/class. With the availability of this eraser, medium-height instructors no longer face difficulty in erasing writing at the top as there is no need to hold the eraser. The design of the eraser that is affixed once with the whiteboard can overcome the problem of losing the eraser as well as solve the problem of wasting time to find the lost eraser. The production of design and development of teaching aids like this should be utilized to keep pace with the technology based on the 4.0 industrial revolution which emphasizes the aspect of automation by reducing dependence on manpower in one thing. This will become a common norm in the future as human daily affairs will be shared alongside the invention of technology to optimize human needs and comfort.

4.0 Literature Review

This project was created to provide a variety of options to users when deleting whiteboards, especially for instructors in educational institutions. Almost all educational institutions use whiteboards as teaching aids in the classroom or lecture room. The creation of the whiteboard was a revolutionary change in the history of human civilization that led to the development of society (Imam-Ul-Ferdous and A.H.M Fazle Elahi, 2014). There is a lot of research and testing that has been done for whiteboards over the years. Consequently, there are various variations in the creation of whiteboard surface cleaning.

The Automatic Duster as in Figure 4.1 is introduced as a whiteboard cleaning mechanism that cleans the entire board automatically by using a push button (Zentronic Studio, October 2018). The mechanical part will move the whiteboard eraser if the push button is pressed. The system uses a set of frames, motor drives, support rods and rollers to function. The system is designed to save a lot of unnecessary time and effort in cleaning the boards. It is designed to clean the board in less than half the time it takes to clean a blackboard / whiteboard as usual.

Figure 4.1: Automatic Duster

Along with the development of technology, remote control motorized eraser was invented where they were operated with the help of remote controls (Tsado Jacob, 2017). Figure 4.2 shows an eraser moving horizontally through a motor mechanism and erasing with the help of an eraser attached to it but unable to apply sufficient pressure to the whiteboard. This problem is overcome by using an eraser that is permanently mounted on a roller that will roll over the surface of the whiteboard (Puneet Mathur et. al., 2013). This Automatic Whiteboard Cleaner Using Microcontroller Based Rack and Pinion Mechanism uses a DC gear motor to move it and uses a rack and pinion gear system to move the eraser forward and backward. It uses one axis which is the X-axis to erase the entire whiteboard. Since this eraser takes a relatively long time to erase, it is overcome by using microcontrollers and sensors (Bhushan Tukaram Chougule and Puneet Mathur, 2014). The project also uses chains to improve the erasing process, but it produces too much noise (Simolowo and O. E., 2014).

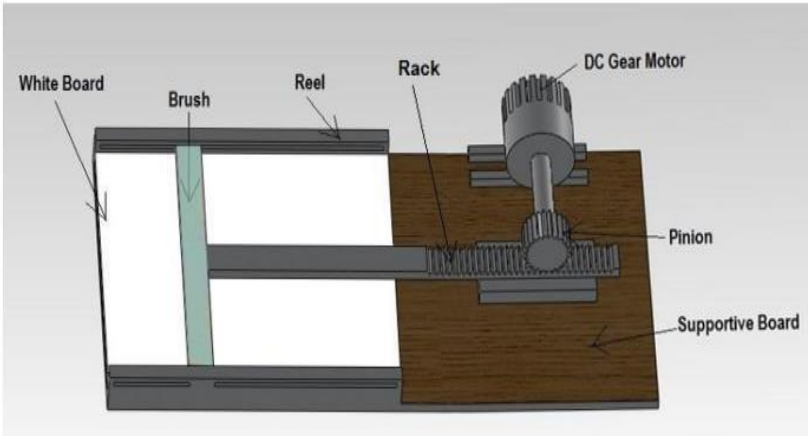

Figure 4.2: Automatic Whiteboard Cleaner Using Microcontroller Based Rack and Pinion Mechanism

There are also innovations that use robots as whiteboard erasers. Whiteboard Erasing Robot is a robot that can erase the surface of the whiteboard autonomously (Amanda Cilek, Becky Stern et al., 2015) as shown in Figure 4.3. The robot has been programmed and it can detect text on the surface of the whiteboard without involving a human interface.

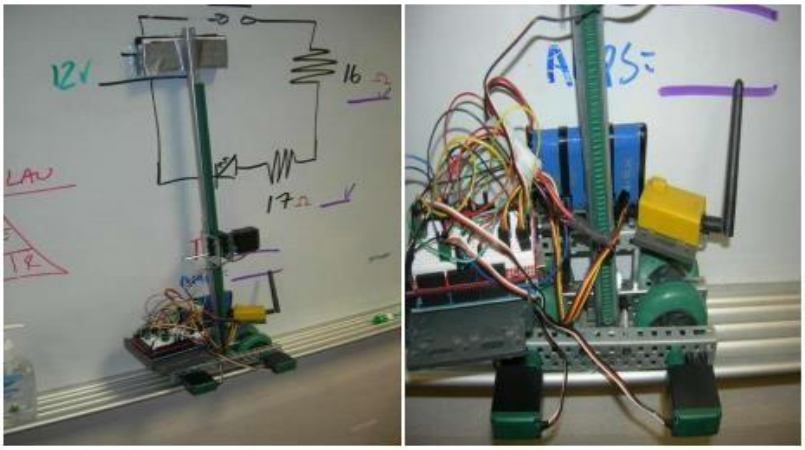

Figure 4.3: Whiteboard Erasing Robot

This robot works in 3 steps. First, the robot will look for writing on the surface of the whiteboard. It consists of 2 wheels that allow it to move along the X axis. For movement on the Y axis, the robot uses a slider to move up and down. At the end of the slider, there is an eraser attached to erase the whiteboard. Second, the robot will see the position of text written using a web camera connected to a computer control on the back of the whiteboard. The detected images will be processed using *RoboRealm* software (Amanda Cilek, Becky Stern et al., 2015). This software is used to find the centre of gravity of a text. The image colour will be converted to a black and white image using a gray-scale filter as shown in Figure 4.4. In the third step, the robot will move to the location and delete the detected text.

Figure 4.4: Gray-scale filter

5.0 Methodology

This IOT Automatic Whiteboard Eraser was produced to be one of the models of whiteboard eraser system that can benefit users more effectively than the existing system. This project is very suitable to be applied in all educational institutions as one of the alternatives to reduce dependence on manpower.

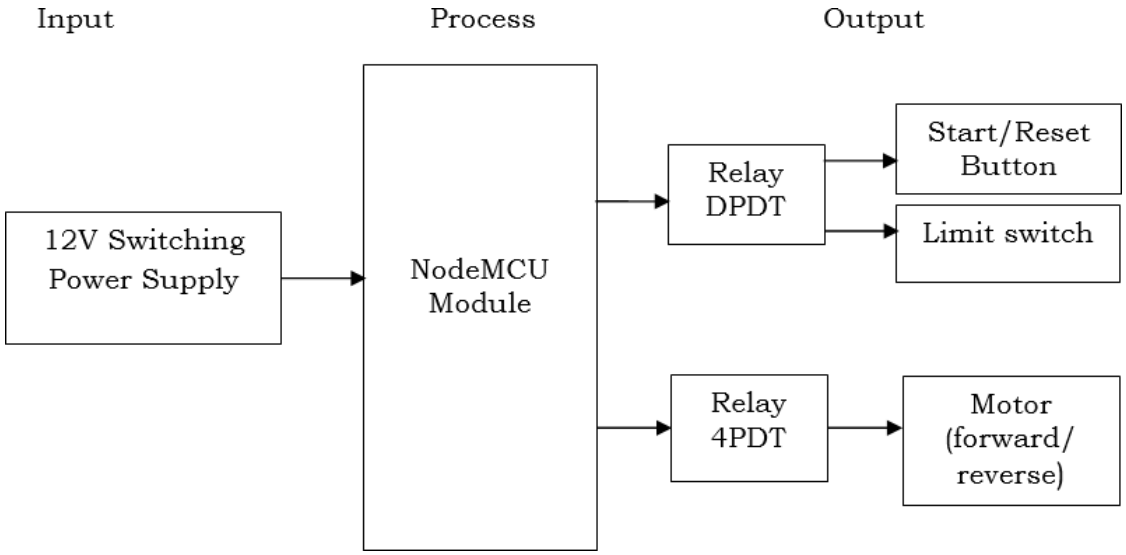

Figure 5.1: Block diagram

The project uses 240V AC as the power supply and converts the 240V AC to 12V by using a 12V switching power supply. This 12V is then supplied to a USB power adapter to supply 5V power to the NodeMCU connected to the relay. The relay then connects to the Start/Reset push button to allow the smartphone to control the eraser via the NodeMCU. Next, 12V is also supplied to the relay system which contains four-pole double-throw (4PDT) and double pole double throw (DPDT) relays. The 4PDT relay is used to control the movement of the motor (forward and reverse) and is connected to the DPDT relay. The DPDT relay is then connected to a permanent magnet motor. This type of motor is used because it is more powerful and can increase efficiency. The Start/Reset push button and the limit switch are connected to the DPDT relay. The Start button is used to start the motor eraser and the Reset button

is used to return the eraser to its starting point. The limit switch is used to detect the initial and final position of the eraser to achieve the purpose of the eraser moving back and forth.

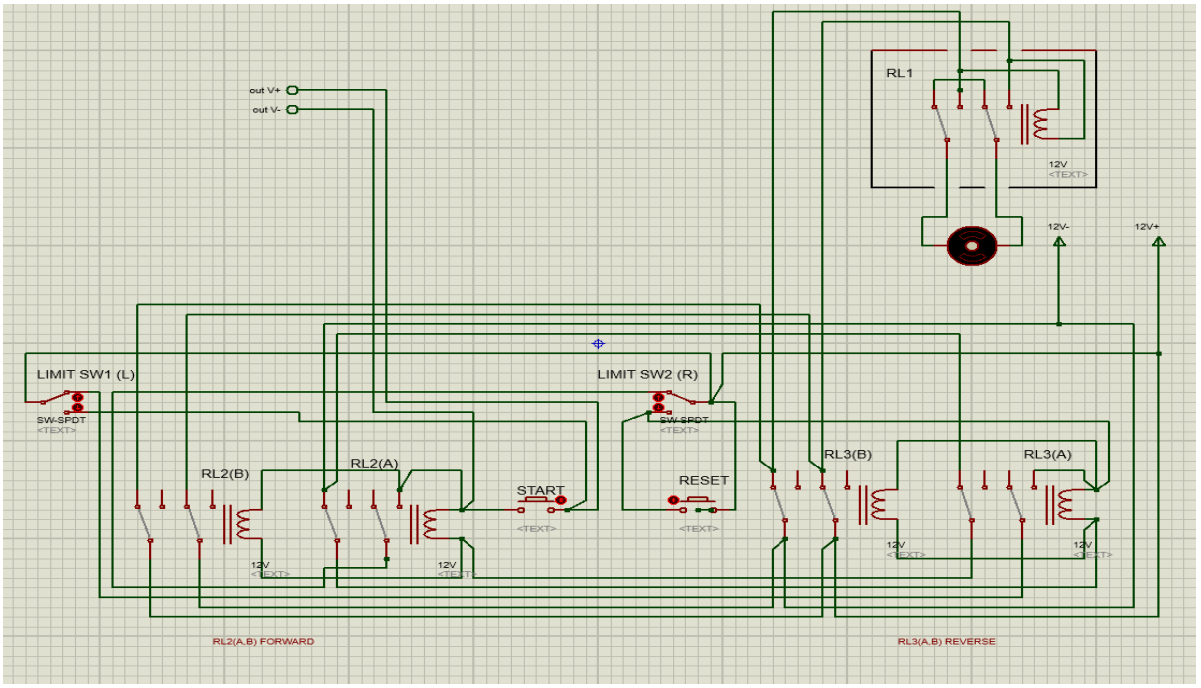

Figure 5.2: Proteus simulation circuit

Figure 5.2 shows a simulation circuit drawn using Proteus software. This simulation circuit is drawn with reference to the basic connections of each component such as relays, limit switches, start/reset push buttons, motors and many more. The connections between these components are combined to form a circuit according to the desired functionality. The use of this software can help to test the circuit drawn to work as it should or not.

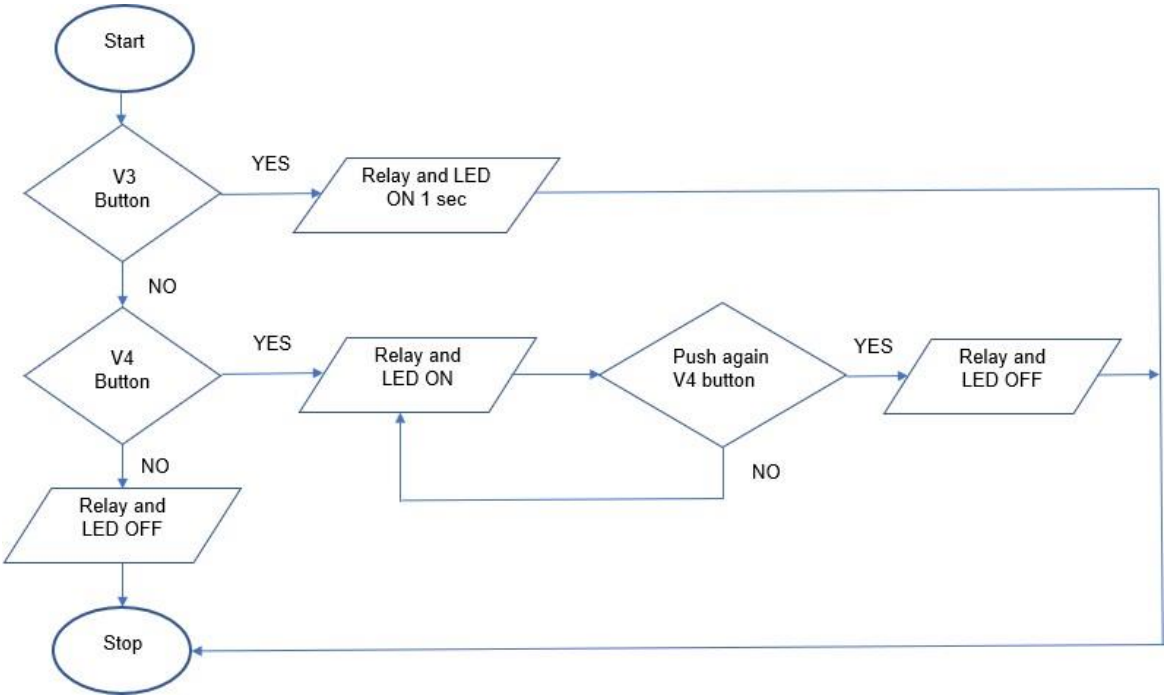

Figure 5.3: Programme flow chart

The sequence of the written program is according to the flow chart arrangement shown in Figure 5.3. Initially, if the V3 (one cycle) button is pressed, the relay and LED will open for 1 second. If the V3 button is not pressed, the relay and LED will not open. Next, if the V4 button is pressed, the relay and LED will open. The relay and LED will close if the V4 button is pressed again. If the V4 button is not pressed again, the relay and LED will not close. If both V3 and V4 buttons are not pressed, the relay and LED will not work.

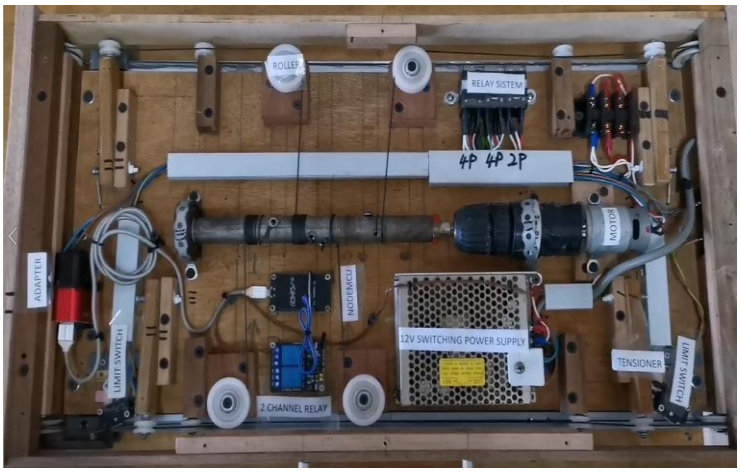

Figure 5.4: Internal connection of whiteboard eraser

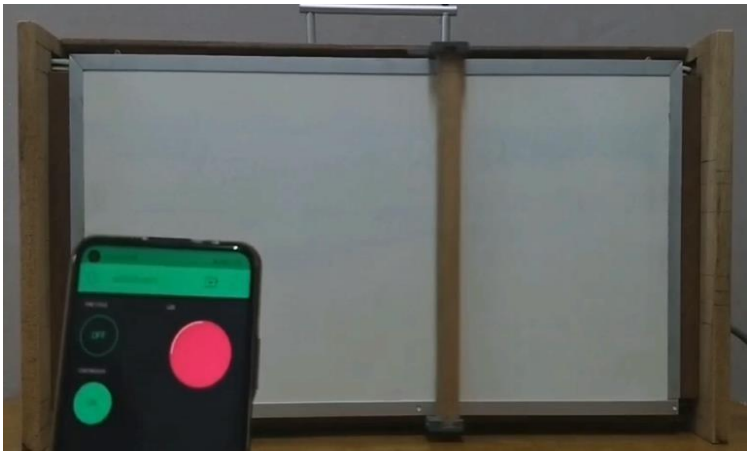

Figure 5.5: Blynk interface on smartphone and whiteboard eraser

Figure 5.4 shows the internal connection of a whiteboard eraser. The design refers to the simulation circuit tested from Proteus software. While Figure 5.5 is an overview of how this project is used in the lecture room. Only using the Blynk app installed in the smartphone can control the movement of the whiteboard eraser according to the user's wishes.

6.0 Discussion

The analysis made more emphasis on the functionality of the system in technical terms as this project is a real type of project. The first analysis tests on signal access between sender and receiver to enable the system to function. While the second analysis describes the ability of the eraser to erase the entire section of the whiteboard. The data analysis in Table 6.1 shows the results of distance testing to obtain signal notification between the smartphone and NodeMCU to enable control of the whiteboard eraser system. Based on the analytical observations, the movement of the eraser can be controlled starting from 10 to 38 meters only. For distances starting from 39 meters upwards, the eraser could not be controlled as it had exceeded the maximum level of signal detection between the smartphone and the NodeMCU. The use of Long Range (Lora) technology can be applied if it is necessary to increase the maximum signal detection distance in the future. This is because this Lora technology can detect signals over longer distances at a low cost.

Table 6.1: Analysis of signal detection distance testing between smartphone and NodeMCU

Signal detection distance between smartphone and NodeMCU	Analysis results
10-20 meters	Signal received
21-30 meters	Signal received
31-38 meters	Signal received
>39 meters	Signal not received

Table 6.2 shows the analysis of the testing of the part of the whiteboard that can be erased by an eraser. When a user activates a push button on a smartphone using the Blynk app, the eraser will move from left to right. This movement is guided by the selection of the first mode and the second mode as

described in the introduction section. The first mode is that the eraser moves only once, i.e., the eraser moves from left to right and returns to its original place after being activated using a smartphone. The second mode is that the eraser moves continuously from left to right repeatedly. The results of this experiment show that when the eraser moves to the left, middle or to the right, all writing or scratches on the surface of the whiteboard can be erased perfectly.

Table 6.2: Test analysis of erased whiteboard sections

Whiteboard section	Analysis results
Left	Can be erased
Middle	Can be erased
Right	Can be erased

7.0 Conclusion

With the result of this design and development of automatic whiteboard eraser using IOT, it will be easier for the teaching staff to erase the whiteboard more effectively than the usual method that has been practiced so far. The use of a smartphone with the Blynk application will make it easier for instructors to control the whiteboard eraser automatically while in the lecture room/classroom at a maximum distance of 38 meters. Therefore, it can save the time of the instructor because there is no need to move to the front of the lecture room/classroom to clear the whiteboard. In addition, this eraser can also overcome the difficulty of erasing the writing at the top for instructors with low medium height. This is because they no longer need to hold the eraser and erase normally. The common problem of eraser loss can also be dealt with effectively as this type of eraser is unlikely to be lost due to its design which is affixed once with the whiteboard and is large.

The project can function well and achieve the objectives that have been set. However, there are some things that can be improved in the future. Among the suggestions for improvement that can be made is to diversify the interface options between smartphones and NodeMCU such as using Bluetooth in addition to the use of Blynk applications only. Besides that, the addition of a sound sensor can also allow users to have more choices on how to control the whiteboard eraser.

References

Amanda Cilek, Becky Stern et al. (2015). Whiteboard Erasing Board. Retrieved from https://www. instructables.com/ Whiteboard- Erasing-Robot/

Bhushan Tukaram Chougule & Puneet Mathur. (2014). Automated Motorized Sensing Whiteboard: *International Journal Of Advanced Research In Engineering And Technology (IJARET), Vol. 5, No. 3*, pp. 155-163.

Imam-Ul-Ferdous & A.H.M Fazle Elahi. (2014). Development of an Automatic Board Cleaning system using Microcontroller: *International Conference on Mechanical, Industrial and Energy Engineering 2014* (ICMIEE: PI-140307), Khulna, Bangladesh.

Praveen. G. (2013). Microcontroller Based Automatic Electronic Duster: *Proceedings Of International Academic Conference On Electrical, Electronics And Computer Engineering*, pp. 10-13.

Puneet Mathur et al. (2013). Automated Motorized Whiteboard: *International Journal Of Engineering, Business And Enterprise Applications (IJEBEA), Vol.6, No.1*, pp. 01-04.

Simolowo and O. E. (2014). Preliminary Design of an Automated White Board Cleaner: *International Multidisciplinary Journal*, *Vol. 8 (2)*, No. 33, pp. 68-82.

Tsado Jacob. (2017). A Remote Controlled Motorized White Board Cleaner: *AU Journal of Technology*, *Vol.15, No.4*, pp. 273-280.

Zentronic Studio. (October 2018). *Automatic Duster*. Retrieved from http://zentronic.com.my/automatic-duster-project/