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Voice Based Controlling System for Home Appliances

Mok Wai Shan, Final Year Student
Faculty of Integrative Sciences and Technology
Quest International University Perak
Perak, Malaysia

Karna Vishnu Vardhana Reddy, Senior Lecturer
Faculty of Integrative Sciences and Technology
Quest International University Perak
Perak, Malaysia

Abstract:- In today's society, voice recognition system is a popular trend for home automation since the technologies are improved day by day. Voice recognition system for home automation able to provide an affordable and simple to implement. Voice recognition system is the process that a physical device able to control by recognize voice of the speaker. The main purpose of this system design is to provide an easy way for normal, handicapped and old aged person to control and operate the home appliances. Besides, it also targeted those people who seeking for luxury and sophisticated home automation. This project is proposed Geeetech voice recognition module which used to record and import the instructions or commands that used to control the basic function of the physical devices. With the help of Arduino Uno, the physical devices able to control through speaker's voice. Besides, this project also implemented as a wireless control system.

Keyword:- *Voice Recognition; Bluetooth; Arduino Uno.*

I. INTRODUCTION

A control system is a system of devices or set of devices that manages, commands, direct or regulates the behaviour of other device or system to achieve desire output. [1] The home automation have the similar definition with the control system which the home automation is controlling the home appliances by using the control system in either switch or remotely control.

In the modern and advance technology now a day, the home automation is widely used because using automation in home appliances will be more convenience to all the public. Most of the home appliances is using remotely control system now but there is a disadvantages for the remotely controlling system which the elder people is not convenience to control the home appliances due to illiteracy and having bad eyes sight. In addition, the remotely controlled system for home appliances is not convenience to use by the physical disabled people due to it is difficult for those people to pick up the remote control while the remote control is dropped on the floor. Besides, there is controlling system which using switch to control the home appliances. But this switch controlling system is not convenience for disabled people due to the switch normally will placed in very high position to avoid children to touch the switch. Because of this, it caused the disabled people not able to reach such high position.

Hence, the implementation of voice based controlling system for home appliances is very useful for those who are disable and elder people compared to the remotely controlled system. This is because the voice recognition technique able to reduce those problems that occur in remotely controlling system and switch controlling system.

The basic concept of voice recognition is function when a user speaks out instruction that being set in the system, the voice of the user will be captured through microphone and it acts as the input of the device. Once the voice being capture, the Analog-to-Digital (A/D) converter will be converted the analogue signal (voice) to digital signal (binary signal). Later, the input voice will be proceeded by the microcontroller and give the desired output. Fig. 1 shows the process of basic concept of voice recognition controlling system.

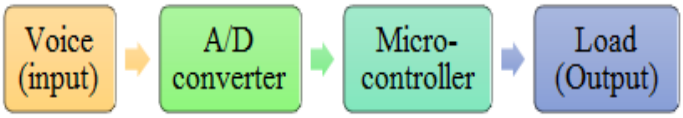

Fig 1:- Basic concept of voice recognition controlling system

In this project, the Geeetech voice recognition module, HC - 05 Bluetooth module and Arduino Uno are being choose as a part of components for the voice based controlling system for home appliances. The Geeetech voice recognition module is used to captured and record the commands or instructions that used to control basic operation of the home appliances. With the help of Arduino Uno, the physical device able to control by using voice of the user. For HC - 05 Bluetooth module, it used to implement the wireless communication which allows user to control the home appliance from far distance.

II. LITERATURE REVIEW

In 2014, E, A., & Jagadeeswari, M. developed a home automation system is being designed to control home appliances via voice command and the command send through by using mobile phone. The main objective of this home automation is to provide a wireless communication link of home appliances to remote user. In this system, it consist of two methods to control the home appliances which are use voice to text SMS (Short Message Service) and use mobile phone acts as remote control. This benefit of this system will provide to elderly, disabled people and those who are unaware of typing SMS (Short Message

Service). The system is controlled via an android OS (Operating System) based mobile phone which giving a voice command, then use mobile application to convert the voice into text using android intent API 2.01. After conversion, the commands generated are appended in SMS (Short Message Service) and send through GSM (Global System for Mobile Communication) network. Table 2.3 shows the voice commands that set by user and its related SMS (Short Message Service) that received. On the received end, the SMS (Short Message Service) command will be received by the PIC 16D877A Microcontroller through Bluetooth channel. After the microcontroller received the SMS (Short Message Service), it will send the pulse to the switching circuit which used to check the status of the appliances and send feedback to the user. The limitation of this system are the SMS (Short Message Service) not able to be sent where there is no network coverage at certain area and not able to connect Bluetooth caused the SMS (Short Message Service) from the user not able to be received by the microcontroller itself.

In 2014, Islam, M. M., & Chowdhury, M. H. developed a system which operated by an electronic device known as dual tone multi-frequency (DTMF) technology. Duel Tone Multi Frequency (DTMF) tone is used to identify which key is pressed in the keypad of cell phone. Keypad is used as password entry device. In this system, the cellular network communication network is used to control all home appliances wirelessly thus it able to control at any places. Once the user has send the command by dialling through their mobile phone, the home appliance can be control easily based on the necessity. The control of the home appliances is monitored by the user through their mobile phone. Another mobile phone is needed in the controlling device. First of all, someone has to give a call to the mobile phone near to the controlling device. This signal is received by the headphone jack connected with the mobile phone. When the user presses any key of his cell phone, the DTMF tone corresponding to that key is passed to the DTMF decoder circuit through the headphone jack. The DTMF decoder circuit filters the signal and gives the output to the microcontroller. The output will be send to the microcontroller according to the key pressed by the user. The micro-controller then sends the voltage to the relay and the relay is being switched and drives the different kinds of home appliances. If the user's mobile phone has no credit, this system cannot be operated due to the user no able to call the controlled mobile phone to perform the system operation.

In 2015, Kaphungkui, N. K. developed a system that controlled the home appliances through RF based remote system. From any places without line of sight (LOS) around the home, the RF based wireless remote control system able to change the state of the electrical appliances either in ON state or OFF state. The main objective of this system is to build the circuit without any programming skill and to make it work without line of sight (LOS) requirement by using RF technology. The home appliances able to control through switch pressing. Once the switch being pressed, the status of the home appliances able to change. For this system, it doesn't required any programming, it just need do some simple configuration for the decoder and encoder. Configuration is required because needed to setup the input and output channel for the system. With this system, it able to control the home appliances without line of sight (LOS) condition. This RF based home appliances control system is better than infra-red (IR) based control system because RF signal can travel a long range and its coverage area for operation is larger. As the RF signal is strong, it is more reliable than IR transmission.

In 2015, Sen, S., Chakrabarty, S., Toshniwal, R., & Bhaumik, A. developed a system which is microcontroller based voice controlled home automation system by using mobile phone. In this system, it enable users to have control to all appliances in the house with their voice by connecting smart phone and Arduino Uno broad through Bluetooth. Besides, the home appliances will be controlled by using the voice commend that send by the mobile phone via Bluetooth to the Arduino Uno. Before the commands being sent, the mobile phone required to search the Bluetooth of the device and connect it. After connected to Bluetooth, the voice recognizer in the mobile phone will be launched. It help to read the voice and converts the audio signal into a string. It will produced different value for each home appliances which will be sent to the Arduino Uno. After reading the received data, the data will be decoded and sends a signal to the parallel port which used to activate the switching circuit. The switching circuit will control the home appliance based on the decoded data. There are two limitation in this system which is the Bluetooth might be not able to be detected if the user is scanning the Bluetooth device in far distance. The Bluetooth device have certain range for detection, it only able to be detected less than 10m. The Bluetooth device is suitable for short transmission thus the closer the distance between the transmitter and receiver, the faster the signal able to transmitted or received. So, if the user is staying far away, the signal that send by user is very slow to receive by the receiver. This limitation can be overcome by using the Zigbee connection because Zigbee connection is more suitable for long distance compared to Bluetooth.

III. PROBLEM STATEMENT

Remotely controlling system in home appliances is not that useful for elderly and disable people. This is because they might be illiterate which they don't understand about the words that label in the remote control. Besides, if someone having eyes sight problem, they not able to read the small label that stick in the remote control. Thus, using voice controlling system will be the best way to solve those people and it able to make them control the home appliance more easily. Due to the physical device able to place in different height or position, the wireless voice controlling system is being implemented.

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IV. METHODOLOGY

Firstly, whole project is divided into two main groups which are software design and hardware design. The purpose of group separation are easy for time management and more organized for the tasks completion.

For software designing, it is more concern about the constructing flow chart of the system and the entire system design of voice based controlled home appliances. At the beginning of the project, a flow chart must be constructed. Flow chart is a representation the process flow of the system and it helps to determine which part of the process went wrong when problems occurred. Secondly, the system is designed by using simple circuit to test whether the system can be operated before schematic diagram design. Fig. 2 shows the block diagram of simple voice recognition controlled system.

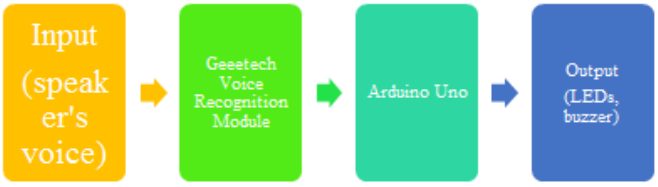

Fig 2:- Block diagram of simple voice recognition controlled system

At first, the user need to record the instructions for controlled the load into the Geeetech Voice Recognition Module and import it in order to make the instruction useful during the process. After that, connect the circuit based on the diagram shown in Fig. 3.

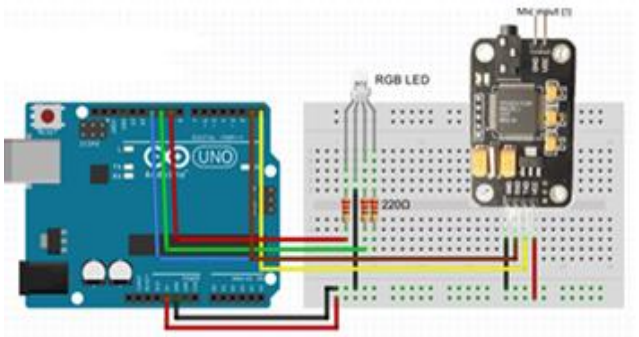

Fig 3:- Circuit diagram of basic voice recognition controlled system (C., & I. (2016))

Then, insert simple programming to toggle the LEDs light based on the instructions. The LED light will be turned on once the instruction that spoke by user is being detected by the Arduino Uno. Difference instruction will triggered different colour of LED as the output. After run through this simple construction, the schematic diagram can be designed.

After designed the schematic diagram, the user can be started to do coding for the Arduino Uno broad. Then, user can purchased the components either at electric shop or online shopping. When the user get the purchased components, user must be testing all the components to ensure there is no broken component available. This is helps to reduce the problem of purchased component broken and reduced the time for waiting warranty. Next, undergoes the PCB fabrication process after schematic diagram being designed. This process help to reduce the wiring disconnection process due to the connection will loosen if the components is not soldering on the board or improper soldering. Besides, the PCB fabrication also reducing the wire that used to interconnect between the components because too many wires will make the circuit become complicated and not easy to analyse the problems occurred.

Then, testing designed system with Arduino programming. If the system is worked, soldered the components in the PCB board. Else, troubleshooting the problems that occurred in the system and tried to solve the problems. After soldering and troubleshooting, implement the PCB board into the prototype and testing the system can be operated in the prototype or not. Finally, configure the Bluetooth devices in order to implement the wireless communication controlled system in this project. Undergoes testing process again once the prototype is connected with the Bluetooth modules. If the prototype is working through this wireless communication controlled system, the project is done. Else, analyse the problem for the Bluetooth configuration. Figure 3.0.3 shows the flow chart of the process that undergoes in this project. Fig. 4 shows the flow chart of how the system operated.

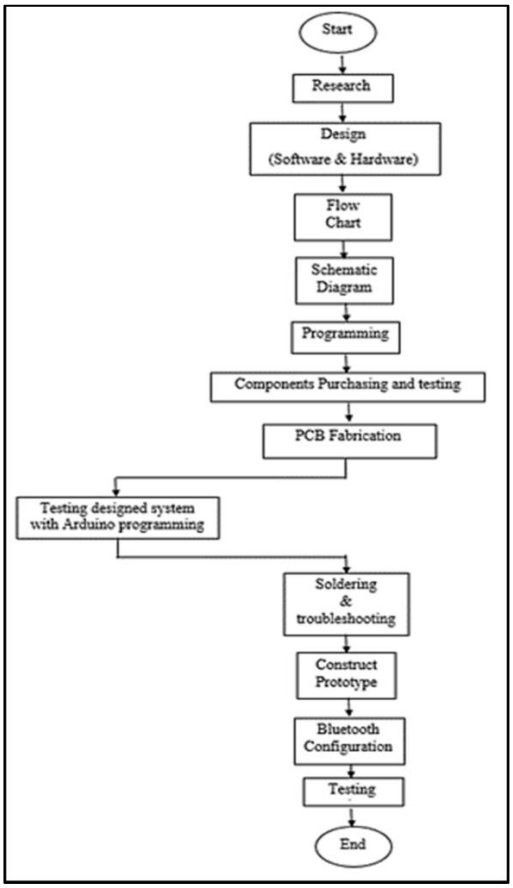

Fig 4:- Flow chart of the process that undergoes in this project

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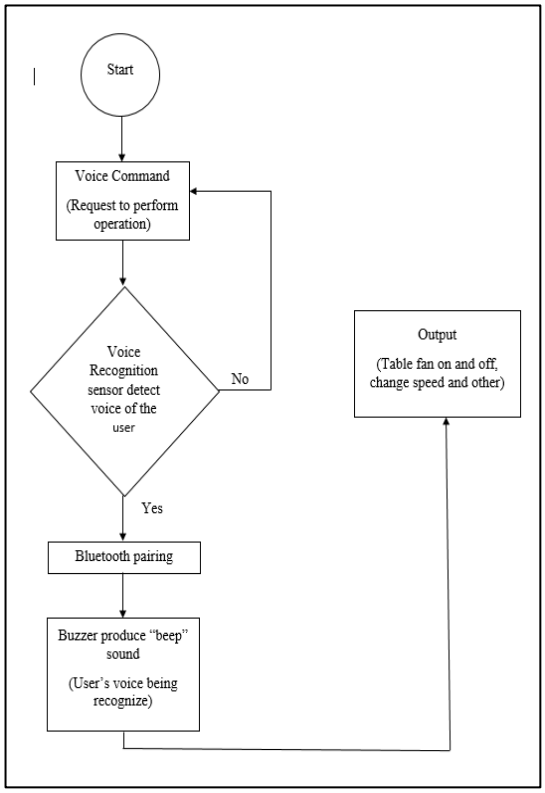

Fig 5:- Flow chart of how the system operate

Based on Fig. 5, it shows that the voice of user will be enter to the voice recognition module through microphone. When the voice recognition module detected the instruction, the instruction will be transmitted to the Arduino Uno board that available inside the physical device via Bluetooth. Before the user spoke the instruction, the Bluetooth needs to undergo pairing between two Bluetooth modules. If the Bluetooth modules are not able to be paired, the instructions will not be transmitted through Bluetooth. After enter to the Arduino Uno board, the instruction will be produced the output with "beep" sound. If there is any error in the instruction that received by Arduino Uno, the output is not able to be produced.

This two PCB boards are the most essential part of the system because this are the controller board that connect with the physical device and the Bluetooth module. Besides, both PCB boards is interconnected with each other. Fig. 6 shows the PCB board that connected with the physical device and the PCB board that connected with the Bluetooth module in Fig. 7. This two PCB boards design will be attached in the Appendix B and it designed by using EAGLE software which is a free license PCB design software.

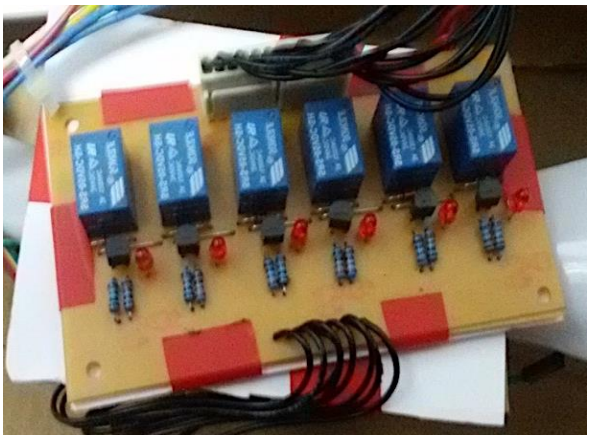
Fig 6:- PCB board that connected with the physical device


Fig 7:- PCB board that connected with the Bluetooth module

V. RESULT AND DISCUSSION

Voice based controlled for home appliances system model is successfully developed for simulation and testing. Fig. 8 and Fig. 9 shows a real photo of the Voice based controlled for home appliances system. Figure 4.0.1 is the voice controlled part which the user spoke the commands through the microphone and send to the Arduino Uno board that available in the physical device that shown in Figure 4.0.2 in order to perform the basic operations of the physical device.

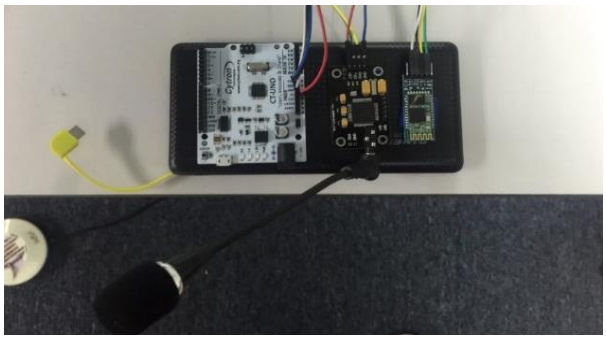
Fig 8:- Wireless controller for Voice based controlled for home appliances system

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Fig 9:- Physical device for Voice based controlled for home appliances system

The purpose of Voice based controlled for home appliances system model was design to implement an easy way to operate the home appliances for those who are physical disability, to reduce the inconvenience for elderly who might illiteracy and having bad eyes sight and to provide a healthy, luxury and comfortable lifestyle for user. In addition, wireless controlled system are being implemented by adding the Bluetooth modules. Because of the Bluetooth implemented in the physical device, the system able to control the physical device without any disturbance such as noise that given by the physical device. Table 4.0.1 shows the instructions that used to control the physical device.

Instructions	
Mode 1	**Description**
Fan ON	· Powered on and off the fan
Fan OFF	· Speak 2 times Fan ON also able to turn off the fan
Speed	· Speed changing · 1st time / default – low speed 2nd time – medium speed 3rd time – high speed
Timer	· Control the time that the fan should be turned on.
Mode 2	· Switch to mode 2
Mode 2	**Description**
Fan swing	· To control swinging of the fan
Oscillation	· Fan will move left and right
Sleep Mode	· Speed of fan will be spin for around 30 second then stop and spin again.
Mode 1	· Switch back to mode 1

Table 1:- Instruction table that used to control the physical device

Based on TABLE 1, it shows that the instructions are being separated into two modes which are mode 1 and mode 2. The separation of instruction is due to that the Geeetech voice recognition module only able to record 5 instruction in single group but there are seven instructions that required to control the physical device. Because of this, the instructions are being separated into 2 modes in order to perform all the functions that available in the physical device. The modes can be change accordingly with the condition of powered on the physical device.

- *Test the Voice based controlled for home appliances system without Bluetooth Implementation*

At first, the Bluetooth modules was not being included in the project. But once the project being build, a problem occurred which the sound from the physical device will caused the Geeetech voice recognition system detect wrong instruction and perform wrong operation of the physical device or no operation performed due to there are no instruction being detected. TABLE 2 shows the comparison between powered on the fan with fan spin at different area and the graph of comparison between powered on the fan with fan spin at different area is shown in Fig. 10.

In TABLE 2, it showed that the data for instruction detection are represented by two numbers which are 1 and 0. Number '1' represented the instruction being detected by the Arduino Uno. Else, the data will be represented by number '0' which the instruction cannot be detected by the Arduino Uno Board.

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Status of the device	Instructions detected					
	1st instruction	2nd instruction	3rd instruction	4th instruction	5th instruction	6th instruction
1st time testing: at quite area						
Powered on with fan spin	1	0	1	1	0	0
2nd time testing: at area with less people						
Powered on with fan spin	0	0	1	1	1	0
3rd time testing: at area with crowded people						
Powered on with fan spin	1	0	0	0	1	0

Table 2:- Comparison between powered on the fan with fan spin at different area without Bluetooth Implementation

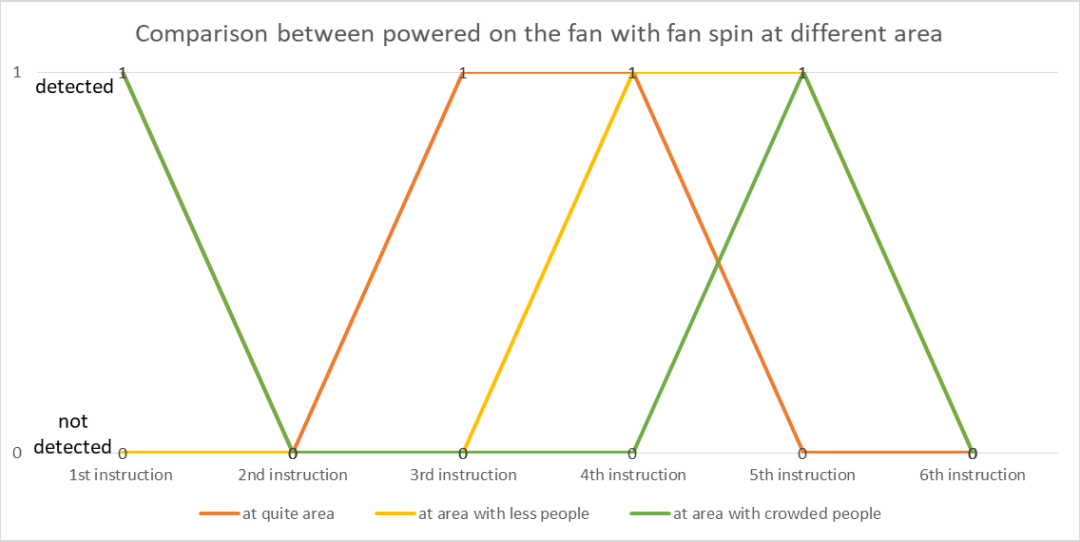

Fig 10:- Comparison between powered on the fan with fan spin at different area without Bluetooth Implementation

➢ *Test the Voice based controlled for home appliances system with Bluetooth Implementation*

Before implemented the wireless controlled system, the Voice based controlled for home appliances system will be affected by the noise not only from the physical device, it also affected by noise from the environment. Based on the second and third testing shown in TABLE 2, it shows that the noise from the environment is affected badly in Voice based controlled for home appliances system, it caused more than half of the instructions cannot be detected. In order to avoid the noise from physical device and environment, the wireless controlled system is being implemented by adding the Bluetooth module in the project. But the Bluetooth implementation will caused the same problem as well bit it only affected minor only. Once the user being block by some obstacles, it will caused the instruction being detected wrongly. TABLE 3 shows the comparison between powered on the fan with fan spin at different area with and without blockage and Fig. 11 shows the graph of comparison between powered on the fan with fan spin at different area with and without blockage.

Status of device	Instructions detected					
	1st instruction	2nd instruction	3rd instruction	4th instruction	5th instruction	6th instruction
1st time testing: at quite area without blockage						
Powered on with fan spin	1	1	1	1	1	1
2nd time testing: at area with less people without blockage						
Powered on with fan spin	1	1	1	1	1	1
3rd time testing: at area with crowded people without blockage						
Powered on with fan spin	1	1	1	1	1	1
4th time testing: at area with blockage						
Powered on with fan spin	1	1	0	1	0	0

Table 3:- Comparison between powered on the fan with fan spin at different area with and without blockage with Bluetooth Implementation

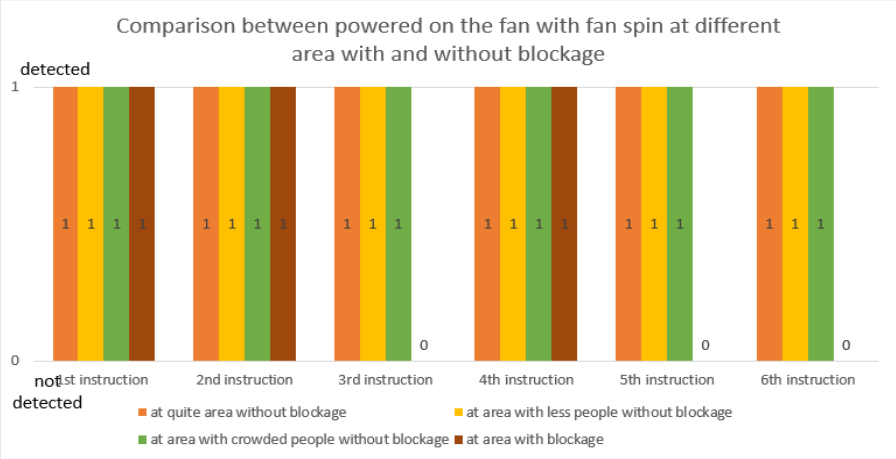

Fig 11:- Comparison between powered on the fan with fan spin at different area with and without blockage with Bluetooth Implementation

➢ *Problems Faced*

In this project, there is consist few disadvantages which the Geeetech voice recognition module is placed near to the physical device. Because of this, it will produce a lots of noise which will affected the instructions or commands that received by the Arduino Uno and it also caused the Arduino Uno might detected the wrong instruction or command that user spoke. In order to reduce this problem, the Bluetooth modules is implemented into the project. With this Bluetooth implementation, the user able to controlled the physical device from far distance without disturbance of noise.

However, this system cannot be controlled from very far distance which out of the range of the Bluetooth module. By applying the higher classes of Bluetooth module or replaced the Bluetooth module to Zigbee module, it able to reduce the problem occurring in the system. But for cost efficient, Zigbee module will be the wide choice for this system compared to the higher classes of Bluetooth module. Besides, the Voice based controlled for home appliances system also consists another problem which this system only can used by one person. This is because Geeetech voice recognition module is more focus on the pronunciation of the user. If both user able to have same pronunciation for the instruction, both of the user able to control the home appliances through voice controlled.

There are some problems occurred along the period of project which are the USB-to-TTL converter that used in voice recognition module is not applicable for window 10, difficult for recording the voice into the voice recognition module, both Bluetooth module not able to communicate with each other and no power supply voice recognition module and Bluetooth module. For USB-to-TTL converter problem, it able to solve by using Arduino Uno board to acts as the converter. User must be spoke clearly in order to solve the problem of difficult for recording the voice into the voice recognition module. For both Bluetooth module not able to communicate with each other, the user need to be reset both Bluetooth and adjusting the baud rate for both Bluetooth modules to 9600 in order to solve the problem.

Lastly. Using power bank acts as the external power supply to the CT Uno and connected both voice recognition module and Bluetooth module to the CT Uno in order to obtain the power.

VI. CONCLUSION

Voice based controlled for home appliances system is develop based on referring and modification to the proposed design by other researchers. The Arduino Uno is successfully fabricated and placed on the physical device even though the size of the Arduino Uno is quick big. The controlling commands or instructions are successfully recorded and imported into the Geeetech voice recognition module and Arduino Uno is acts as a processor that process the input that provided by the Geeetech voice recognition module and given out the output of the physical device.

Based on the result that obtained in this project, the first objective that stated in the previous section able to be achieved. This system able to be operate the home appliances for the physical disability people in an easy way. This is because the home appliances able to be controlled wireless through voice commands and this system able to be modified in order to fir for the upper limb disability people. Besides, this project also able to be achieved the second and third objectives that stated. This system able to perform the basic function of the physical device which to reduce inconvenience for elderly who might illiteracy or having bad eyes sight and able to provides luxury and comfortable lifestyle to the users. This voice controlling system able to be reduce the inconvenience for elderly who might illiteracy or having bad eyes sight because the instructions for this system able to be recorded difference language based on the setting of the user. Some more, it able to provide luxury and comfortable lifestyle for the public.

In this project, the Bluetooth modules are being implemented in the voice controlling system. The implementation of Bluetooth module able to allow the user to control the home appliances from far distance. With this implementation, the home appliances able to be controlled from far distance by physical disability people. This is a useful technology for the physical disability people instead of remote controlling system. The remote controlling system is not that useful for the physical disability people due to it difficult for disability people to pick the remote control once the remote control dropped to the floor and it difficult for the disability people to replace the battery because new batteries normally will be placed in high position to avoid children taking.

For future studies, it is recommended to change the Bluetooth module to zigbee module. This is because zigbee module have the larger range for transmission compared to the Bluetooth module so that the user able to control the home appliances from far distance without any mistake. Besides, the higher the classes of the Bluetooth module, the more distance can be covered. But due to the cost efficient, the higher classes of the Bluetooth modules are not take in the consideration.

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