Automatic Fan Speed Control Based On Room Temperature Using Arduino Mega 2560

Ahmad Mustaqim Bin Zayadi,
Faculty of Electrical Engineering, Universiti Teknologi Mara Shah Alam
Selangor, Malaysia
ahmadmustaqimzayadi94@gmail.com

***Abstract*— Automatic system is the compulsory to ease the people work in this modern era. All product used nowadays based on the automatic system. In this paper, present automatic fan speed control using Arduino Mega 2560. This paper show how the speed can be controlled and how to switch ON/OFF automatically. The speed controlled used Pulse Width Modulation technique to vary the speed fan according room temperature when motion sensor detect human in the room. DHT11 is ultra-low cost sensor to measure temperature and humidity surrounding. The heart in this project is Arduino Mega to execute all the function. Relation between voltage and duty cycle had been recorded to validate the speed of fan can be controlled.**

Keywords—fan speed, motion sensor, pulse width modulation, arduino mega 2560, room temperature.

1.0 INTRODUCTION

Fan is the compulsory home appliance to cool the airflow in the house. Nowadays, there are so many new development system fan according to the new technologies. Normally, cooling system use to cool the human body through three processes; convection, radiation and perspiration[1]. Besides that, electric fan is manually control by user to change speed whether cold or hot. New development of fan today mostly used remote control to ease the user change the speed from far, but then still the user need to change speed and switch ON/OFF manually. Automatic fan to control speed and automatic to ON/OFF the fan needed to give more reliable use fan in the modern life.

Based on the previous work, the references needed to complete all this task in this project. It important to generates the new idea with compare to the previous work completely done. Other than that, according to the work have been done before, latest technologies used in this project to solve problem faced at the present.

One of the study from the previous was room temperature based fan speed control system using pulse width modulation technique[2]. This previous project is use the temperature LM35 to detect the temperature at room. The simulation for this project used Proteus 8.0. The different with this project is the microcontroller used the in the project, they are used the MATLAB R2013a v1.8 to authorize the accuracy of the structure and at this project used the Arduino UNO.

Next study was implemented to create the automated fan to switch ON and OFF based on handclaps[3]. This project also to control speed of fan based on temperature sensor reading automatically. The handclaps functional automatically to switch ON and OFF by used Arduino UNO microcontroller. The system user must clap to ON the fan and to OFF the fan user must clap back. This project also used limit switch when user want to change the system to manual.

Next previous study, temperature based fan speed controller by Baiman Kr Pal and his team. This project to proof the microcontroller was main role to develop in the smart system nowadays. The main objective to also to control cooling system automatically based on temperature in the room. This system used Arduino UNO as the heart of this project where its executed all signal sent and produce the output to LCD and fan. After that, to control temperature this project used LM35 temperature sensor to measure temperature in the room[4].

Another more, from the previous study is about automatic fan speed control system using microcontroller that has a similarity with this project[5] . The project is use a LM35 temperature sensor to measure the temperature and display on the LCD the temperature and speed of fan. But in this project, they are used PIC16F877A microcontrollers to apply in this function and differences with this project that used an Arduino UNO to control a speed of fan, sound sensor circuit; temperature sensor circuit, LCD display and limit switch circuit. This previous project is just controls the speed of fan by current temperature and shows the speed of fan in rpm at LCD display. The another previous also used to be same as the project this the microcontroller used was different because this project used Arduino UNO[6].

Study from the Sushma Verma and his team, project automatic temperature controlled fan using thermistor[7]. The project is use a thermistor as sensor for read the current temperature. The concept is read the temperature from PC to control the speed of fan respectively increases and decreases by automatically. That not used any microcontroller to control the system.

Furthermore, the next project was temperature controlled DC fan were used ATmega8 microcontroller, temperature sensor (LM35), motor driver and DC fan which among all of them have specified task. In this project, used ADC pin to convert analog signal from temperature sensor to digital. The output of this project will function when the temperature over the temperature set in the programing, DC fan will turn ON[8].

Lastly, for the previous work from the project by Suraj Kaushik and Yuvraj Singh Chauhan [9] more likely as this project but used arduino UNO and DHT22 as the sensor to detect temperature surrounding. This project also to controlled the speed based on the temperature and used PWM technique. The system was more to used the IOT concept as the main purpose.

1.1 PROBLEM STATEMENT

In the modern era, microcontroller is the main component to develop some new system and electronic project. There are a lot types of microcontroller have been introduced to ease the people to control many task in one time, but then many people do not how to use the

conventional microcontroller. Besides that, it hard to program and the connection to circuit also difficult.

In addition, the manual fan also must be change to automatically. Speed control of the fan until this now has been used where the user must change manually to reduce or increase the speed. Other than that, the system to switch ON/OFF must change to automatically.

1.2 SCOPE OF STUDY

This study was done to control the speed of fan based on room temperature. The speed of fan control at 4 speeds conditions which are very fast, fast, medium and low. Besides that, this fan switch on by the motion. The motions sensor used are IR sensor and PIR sensor.

The limitation of this study is used 12VDC fan to control the speed. The fan chosen only to show the speed of fan can change automatically. After that, the limitation of this study to detect only motion to switch on the fan automatically.

1.3 OBJECTIVES

The main intention of this project is to design, develop and construct a small prototype of fan. This project to analyse the relation between temperature and speed of fan. There are three objectives to be achieved:

- To learn how to use Arduino Mega 2560.
- To develop fan automatically switch on and off based on the motion.
- To control speed of fan based on the temperature in the room.

2.0 METHODOLOGY

A. Introduction

Main part of the system is arduino mega 2560 as the microcontroller to control speed of fan based on room temperature and the ON/OFF of the fan automatically. Temperature and humidity sensor (DHT11) used to measure room temperature. Two types of infrared sensor used to detect the motion in the room which are infrared (IR) and passive infrared (PIR) sensors.

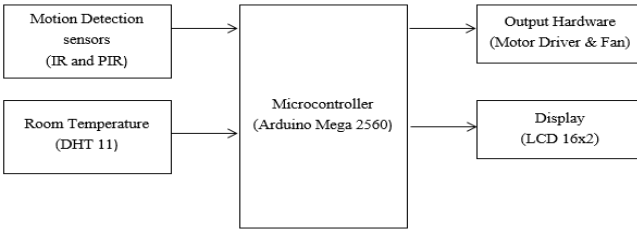

Fig 1: Block Diagram of the System

Arduino Mega 2560 acted as the processor and it interpreted the data from the input sensor. It then send the output to display in the LCD display. LCD became the output device that displayed the temperature, condition and speed of fan. Fan also became the output when the arduino send the signal from input sensor.

The control speed of fan tested using the PWM technique. This is a modulation by vary duty cycle to control the speed of fan precisely achieve[10]. The speed of fan based on 4 conditions. The conditions were being set in programing how fast the fan needed based on range temperature.

Table 1: Different speed were being set

Range of Temperature (°C)	Duty Cycle (%)	Speed
Above 35	100	Very fast
30 – 34	75	Fast
27-29	50	Medium
Below 26	30	Low

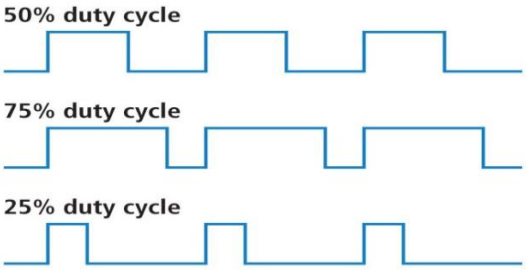

Fig. 2: Duty cycle for PWM

The different speeds of fan were tested with range temperature. The speed condition and temperature were display on LCD to show the current speed of fan and temperature. The duty cycle was tested using oscilloscope to prove the speed of fan change as in Figure 3(a). After that, the voltage also had been recorded based on the different speed of fan using multimeter as in Figure 3(b) then compare to the voltage using oscilloscope.

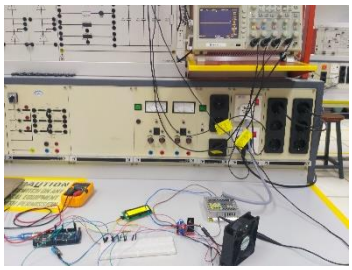

Fig. 3(a): tested duty cycle using oscilloscope

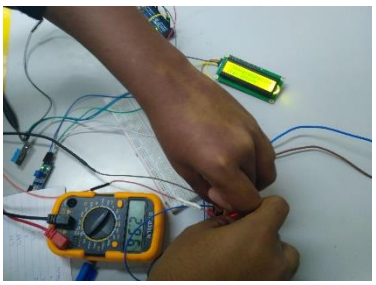

Fig. 3(b): measure voltage using multimeter

B. Flow of the system

Figure 4 below shows the overall function of the system. The system start with the motion has been detect. The two sensors have detected motion simultaneous to switch on the fan.

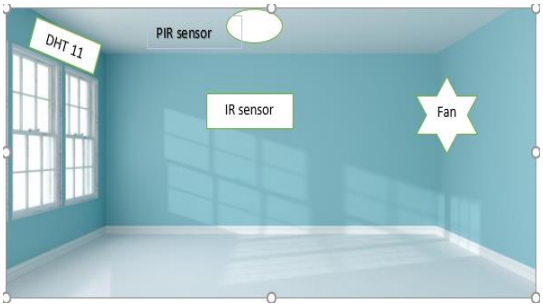

Fig. 4: Position of sensors

The sensors acted as the input as when the user enter the room. If there is data sense by the sensors, the signal will send to motor driver to switch on the fan. The temperature sensor also will read current temperature and display to LCD. Lastly, speed fan will be control according to current temperature.

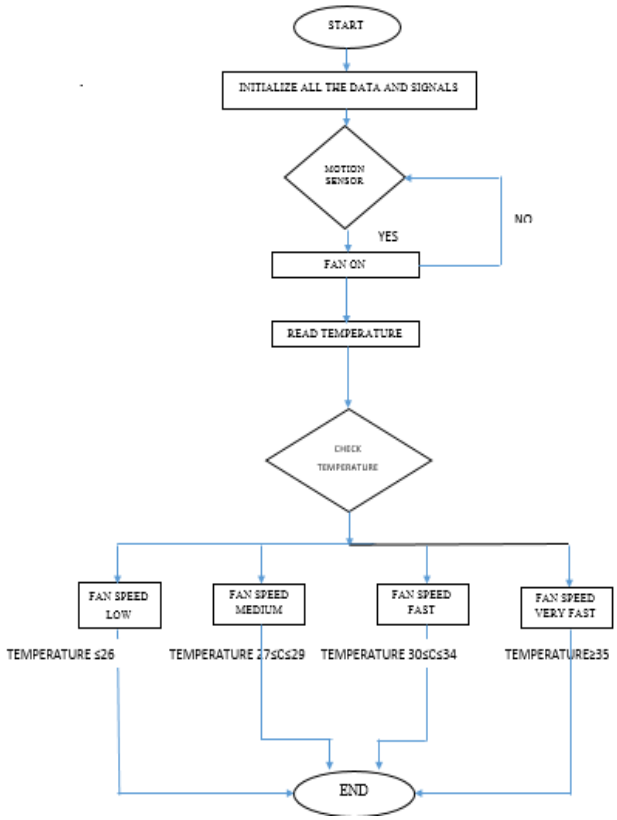

Fig 5: Flowchart of the system

C. Hardware Design and Schematic Diagram

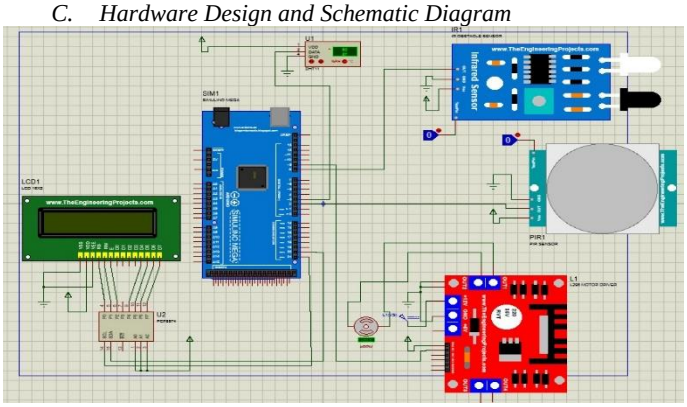

Fig. 6: schematic diagram of automatic fan using Arduino Mega2560

Based on Figure 6, show the schematic automatic fan using Arduino mega2560 as controller to control input and output. The connection all the sensors were connected at the digital pin. For the fan, motor driver L298N to convert the voltage from power supply and the Arduino Mega2560. To enable the motor driver controlled by Arduino connect to PWM pin. The 12V power supply used to switch on the motor driver was turn ON/OFF the fan. The LCD was connected to I2C module, then connection to Arduino Mega2560 used SCL and SDA pin to support the I2C communication with Arduino Mega2560.

4.0 RESULT AND DISCUSSION

The results presented in this section are about to prove the functionality of the sensors and to prove control speed according to temperature was success. Functionality of sensor basically based on observation and the data was recorded. The speed of fan has been compare between measure voltage and the actual voltage at the fan when the speed change based on temperature. Besides that, duty cycle also has been record use oscilloscope to check whether speed fan change according to the PWM value set.

A. Functionality of sensors

The tested was done by in the different temperature to see how the IR and PIR were function when the object enter the room. The functional of these two sensor can observe when the motion simultaneously between two of this sensor the fan switch on automatically. The data have been recorded in the Table 2 below;

Table 2: The functional PIR and IR sensor

TIME	IR Sensor	PIR sensor	Temperature	Fan Speed
22.10	Yes	No	32	NA
22.15	Yes	Yes	32	Fast
22.20	Yes	Yes	32	Fast
10:10	No	No	28	NA
10;15	Yes	No	29	NA
07:05	Yes	Yes	26	Low
07:15	No	Yes	26	NA

There measurement temperature using DHT 11 and digital thermometer to compare between these two. The measurement between these two sensor almost same but there have error at DHT 11 measurement. It shows the DHT 11 performed well. All the values were recorded in Table 3.

Table 3: temperature reading for DHT 11 and digital thermometer

DHT 11 (Deg C)	Thermometer (Deg C)
25	23.8
29	27.5
32	30.4
34	32.4
36	34.8

In the Table 3, there was ±2 [11] different in the measurement temperature between these two. There was a little error reading at DHT 11. The reading show in Figure7(a) temperature display on the LCD show the reading by DHT 11 and Figure 7(b) show the reading by digital thermometer in the room.

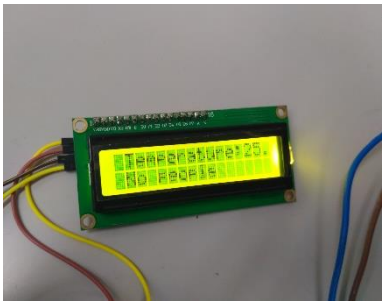

Fig 7(a): LCD display show the reading for DHT 11

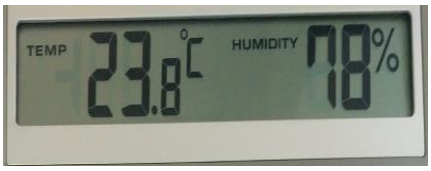

Fig 7(b): Digital thermometer reading

B. Temperature Vs Duty Cycle

Speed of fan had tested using PWM technique, PWM module was built in arduino mega 2560[12]. The value for PWM had been set in program to control speed according to temperature.

Table 4: Temperature and duty cycle table

Temperature (Deg ºC)	Duty Cycle (%)	Fan Speed
0	0	OFF
26	25	Low
29	50	Medium
31	75	Fast
34	100	Very Fast
36	100	Very Fast

.

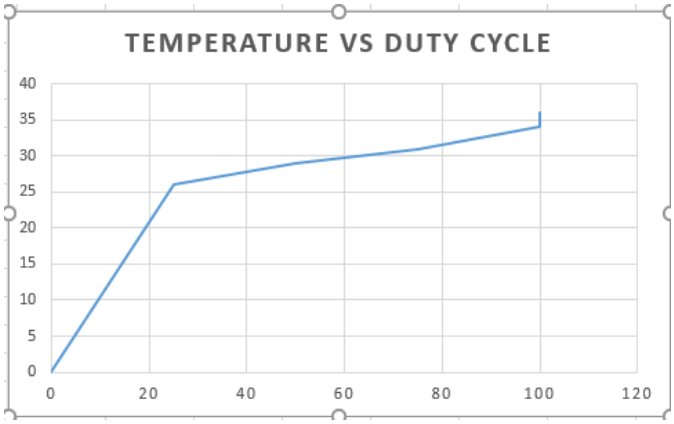

Fig 8: Temperature (Deg C) Vs Duty cycle (%)

The variation between temperature and duty cycle has been shown in Figure 8 and table 4. The graph shown temperature room directly proportional to duty cycle until reaches 100% the duty cycle will constant. It also shown speed of fan can be controlled accordingly to temperature

C. Duty Cycle Vs Voltage measured Vs Voltage actual

The changes also can be measure to prove the speed of fan can be controlled. The output voltage for different speed of fan was changes when the speed from low to very fast. It shown in the table 5. The measurement voltage was less than from the actual voltage but it still increases when the speed fan increase.

Table 5: Voltage reading between measure and actual

Duty Cycle (%)	Voltage Measure (V)	Voltage Actual (V)	Fan speed
0	0	0	OFF
25	2.96	2.95	Low
50	5.28	5.43	Medium
75	7.42	7.9	Fast
100	9.44	10.3	Very Fast
100	9.5	10.4	Very Fast

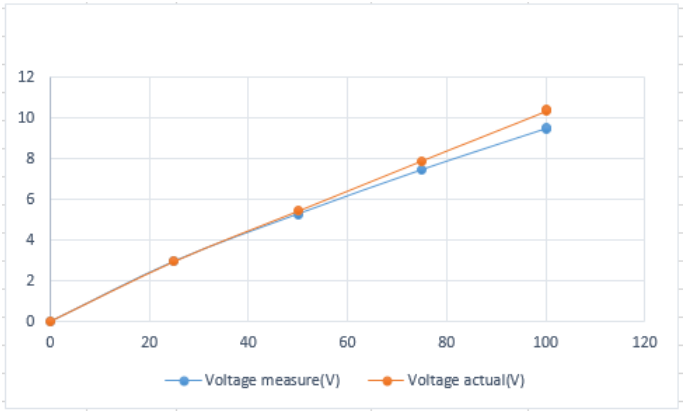

Fig 9: Voltage measure (V) Vs Voltage actual(V) Vs Duty Cycle(%)

This Figure 9, shown the relation between duty cycle and output voltage of fan. The graph shown duty cycle increase proportional to voltage. Then it also shown the different between actual and measurement voltage was not too far.

5.0 CONCLUSION AND RECOMMENDATIONS

Automatic fan speed controlled using arduino mega 2560 in this paper proposed. The system working successfully and all the requirement validated. The speed changed based on room temperature automatically and don't need to regulated manually. The various graph plotted to show varying relation between the different parameters. The functionality of the sensors working and interface with arduino mega properly. Overall of this paper based on the result have achieve the objectives to control speed of fan and to switch on the fan automatically using arduino mega 2560.

As the recommendation, for future this project must design this project with artificial intelligent (face recognition) to detect the user accurately and can work as the security system

6.0 ACKNOWLEDGEMENT

To author wish to acknowledge and thank to the final supervisor, Madam Zuriati Janin, for her guidance and constant supervision as well as for providing necessary information regarding the project and to the Faculty of Electrical Engineering, Universiti Teknologi Mara Shah Alam for their logistic support.

.

7.0 REFERENCES

[1] EREC, "Cooling Your Home with Fans and Ventilation," *Energy Effic. Renew. Energy Clear.*, pp. 1–8, 2001.

[2] V. Bhatia and G. Bhatia, "Room Temperature based Fan Speed Control System using Pulse Width Modulation Technique," *Int. J. Comput. Appl.*, vol. 81, no. November, pp. 81–86, 2013.

[3] D. Of, C. Fan, S. By, T. Sensor, and U. Arduino, "DEVELOPMENT OF CONTROL FAN SPEED BY AUTOMATIC," 2016.

[4] I. Engineering, "TEMPERATURE BASED FAN SPEED CONTROLLER," no. November 2017.

[5] K. Singh, M. Dhar, and P. Roy, "Automatic Fan Speed Control System Using Arduino," *Int. J. Nov. Res. Dev.*, vol. 2, no. 4, pp. 2456–4184, 2017.

[6] K. Singh, M. Dhar, and P. Roy, "Automatic Fan Speed Control System Using Arduino," *Int. J. Nov. Res. Dev.*, vol. 2, pp. 2456–4184, 2017.

[7] S. Verma, A. Das, S. Dey, and P. Chowdhury, "Automatic Temperature Controlled Fan Using Thermistor," pp. 5–9.

[8] S. Roll, R. Ashish, G. Roll, and T. Rourkela, "DC Fan using Microcontroller Temperature Controlled DC Fan."

[9] S. Kaushik, Y. S. Chouhan, N. Sharma, and S. Singh, "Automatic Fan Speed Control using Temperature and Humidity Sensor and Arduino," *Int. J. Adv. Res.*, vol. 4, no. 2, pp. 453–457, 2018.

[10] R. D. Damiani Jr. and S. R. Wessler, "An upstream open reading frame represses expression of Lc, a member of the R/B family of maize transcriptional activators," *Proc.Natl.Acad.Sci.U.S.A*, vol. 90, no. 17, pp. 8244–8248, 1993.

[11] F. A. Padovani, T. H. McMains, and M. R. Rowlette, "Temperature sensor," p. 8, 1994.

[12] R. Baxter, N. Hastings, a. Law, and E. J. . Glass, "[No Title]," *Anim. Genet.*, vol. 39, no. 5, pp. 561–563, 2008.