Chapter 3
Modelling a Temperature Based Speed Control of a Fan

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3.1 Introduction

Nowadays, the major problem each country near the equator experiences for three-quarters of the year is heating. Every home has different types of cooling appliances to reduce the heat within their houses. But there are two main cooling appliances which are the ordinary fan and air conditioner. The ordinary fans are still at their earlier ages and are not being innovated as any other appliances that are in the present technological world. Air conditioners are smart and being innovated but they require a lot of money to buy, fit and maintain throughout meanwhile suffering higher power consumption (Saad et al. 2014).

The only viable solution for a cheaper cooling appliance, which consists of more technologically advanced features, is to introduce an automatic fan throughout this research. This automatic fan consists of a variable number of technologically advanced features to the present day which enables it to use the Arduino component to work together to provide the users with a better experience of using the fan. Furthermore, with the use of the mobile application, the fan was enabled to be controlled with a simple tap. This fan was designed for a broader area of users which helped both normal individuals and people with disabilities to interact with the fan with more ease.

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3.2 Literature Review

There has also been discussion on the basic concept of some related theories and frameworks for this project such as monitoring system, potential software, and component unit. This chapter will review the existing system that has been developed and has similarities with the modelling a temperature-based speed control of fan project.

3.2.1 Development of an Automatic Person Detection Systems to Control an AC Fan and Room Lights

In this paper, the microcontroller 16F887A and IR sensor are used in controlling the fan and lights. When a person is entering the room, he or she will be detected by an IR sensor. Then, the microcontroller will turn on the fan and the lights. The microcontroller also can control the temperature environment. When the fan is on, the microcontroller will check the temperature. In case the temperature increases the speed of the fan will increment in the same manner (Mishra et al. 2013).

3.2.2 Automatic Temperature Controlled Household Electric Ceiling Fan

According to this paper, the electric ceiling fan is controlled by the microcontroller of the Arduino Uno by applying the pulse width modulation (PWM) technique for changes in the fan speed. There are two types of sensors. The PIR sensor is used for detecting the human movement and functioning to switch on the fan. Meanwhile, the LM35 sensor is used to check the environment temperature. In Arduino Uno, a PWM is set accordingly to control the speed based on the temperature changes detected by the LM35 sensor (Oduah 2017).

3.2.3 Smarty Smart Fan

A Raspberry Pi and Arduino Uno were used as a microcontroller in this system. The temperature is checked by using the DS18B20 digital temperature sensor (Supunya et al. 2016). The operation of the system consists of three modes, i.e. normal mode, auto mode, and security mode. The system can be controlled by using a smartphone.

3.2.4 Modelling and Simulation of a Microcontroller Based Temperature Control in a Ventilation System

The operation of this system used a microcontroller and LM35 temperature sensor. The temperature sensor detected the temperature of the environment. The microcontroller controlled the temperature by using the PID controller algorithm to convert the temperature to the desired electrical current that controls the fan. Then, the PWM will drive the relay to switch on and off the fan (Akpado et al. 2013).

3.2.5 Temperature Based Speed Control a of Fan by Using an Arduino

The temperature based speed control of fan using an Arduino is an innovation established in 2019 which developed the automatic fan speed control by the temperature. An Arduino-based temperature control fan is implemented. Thus, the speed of the fan is being controlled by using the PWM and the temperature is sensed by the DHT22 temperature and humidity sensor (Venkat and Kumar 2020).

The main idea for this project is to control the speed of the fan automatically by the sensor. This project uses the technique of PWM towards controlling the speed of fan using the sensed temperature. The system is working properly. Hence, the surrounding temperature will decide the speed of the fan and the user will not require to switch the fan speed manually by using the toggle button.

3.2.6 The Development of Arduino Based Automatic Fan Control System Using PIR Sensor

This project was invented in August 2019 by Ayesha Siddika and Sayeda Farzana Nasrin from the World University (Siddika and Farzana Nasrin 2018). Everyone already knows that today's technology requires an automatic system that easily helps the user. This project provided two functions to help the user. The first one is that this project uses human detection to switch on the fan rather than using the toggle button. Another function is to control the speed of a fan concerning the temperature set. This project uses the PIR sensor to switch on the fan and the LM35 temperature sensor to distinguish the encompassing temperature and control the speed of the fan.

The temperature sensing element was rigorously chosen to determine the room temperature, and the motion sensor is used to sensing the human movement to switch on/off the fan. Besides, the Arduino had been customized to manage the speed of fan. Therefore, the Arduino was with success programmed using C/C++ language to check the temperature in degree centigrade and control the speed of fan then to display the room temperature value on the LCD.

Moreover, the speed of the fan can mechanically increment if the temperature area is inflated. In conclusion, the system that was designed during this work was perform all right, for any action and may be classified as automatically management.

3.3 Methodology

Figure 3.1 shows the block diagram of the project which comprises of three different stages, i.e. input, process, and output. The main components involved are the DHT11 temperature sensor at the input phase. This project uses the DHT11 as the temperature sensor. The main component in the process phase is the NodeMCU ESP8266. The NodeMCU microcontroller is considered the main heart of the system.

A few components used at the output stage are the liquid crystal display (LCD), the 4 channel relay module and the light-emitting diode (LED). In the final phase, the output, every input received will be changed into output. The LCD module is used to show the surrounding temperature and the speed of the fan.

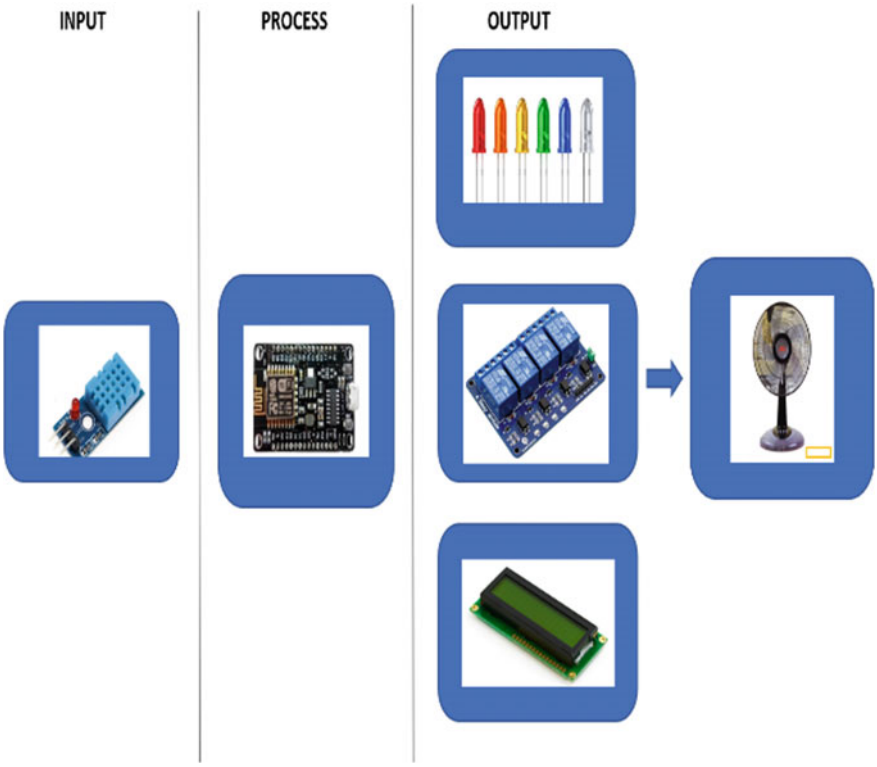

Fig. 3.1 Block diagram

Besides, the process created by the NodeMCU ESP8266 will be displayed through the application on the mobile device. The LED will show the output differently depending on the input it receives. In this project, a LED is used to act as an indicator to show the changes of fan speed. As an example, the green LED indicates the low speed of the fan, the yellow LED indicates the medium speed of the fan, and the red LED indicates the high speed of the fan. Last but not least, the relay 4 channel module is used in this project to replace the toggle speed button of a table fan.

Figure 3.2 shows the flowchart of the process of this project. Firstly, the system is initialized by the input and output of the project. Then, the NodeMCU ESP8266 and DHT11 is on simultaneously. If the DHT11 is detecting the temperature it will automatically switch on the LED and display it on the mobile phone. However, the process will be going on until the temperature is detected. Figure 3.3 shows the connection of the components and devices in the project.

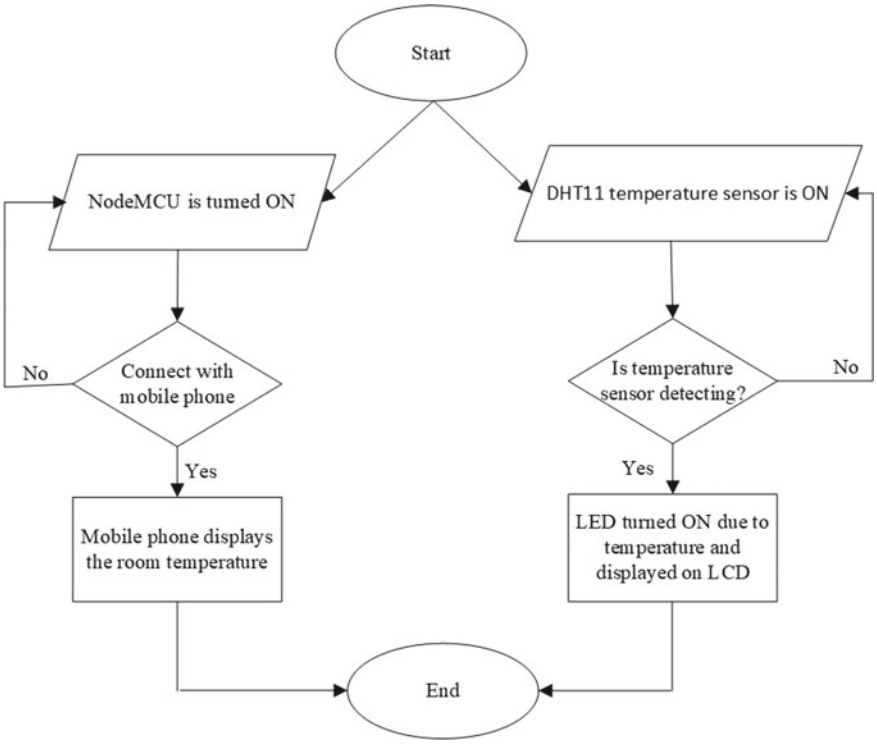

Fig. 3.2 Flowchart

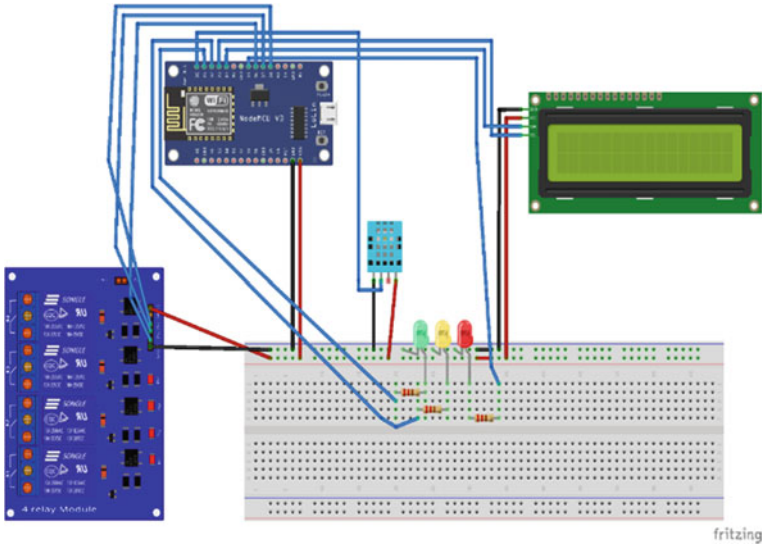

Fig. 3.3 Circuit diagram

3.4 Results and Discussion

Figure 3.4 shows the location of the temperature sensor DHT11 at the packaging of the project. The function of the temperature sensor detection system is to sense the changing of the surrounding temperature in various weather conditions. The temperature detected by the DHT11 temperature sensor will be converted into an analog signal. The analog signal will be converted into a digital signal by using ADC.

The value of the surrounding temperature that is being detected will be displayed on the liquid crystal display (LCD) as shown in Fig. 3.5. This temperature sensor detection system enables the fan to change the speed automatically based on the surrounding temperature. The speed monitoring system consists of 16 × 2 the LCD

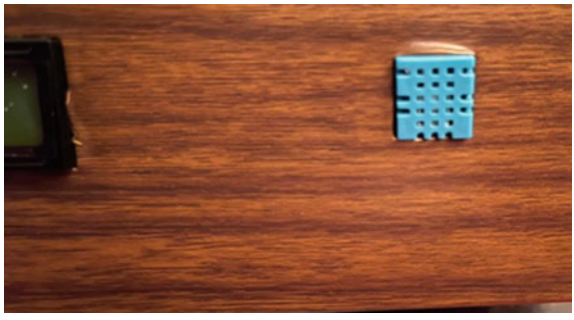

Fig. 3.4 Temperature sensor detection system

Fig. 3.5 Speed and LED monitoring system

Fig. 3.6 LCD display when detected changing of temperature and speed of fan

display and LED light as the output from the temperature sensor. Figure 3.5 also shows that LED will be turned 'ON' due to the speed and temperature that have been set.

Figure 3.6 shows the LED display and the three LED light of three conditions of temperature measures. For the low temperature, the speed of the fan is set to number one with the green LED light. For the medium temperature, the speed of the fan is number two with the yellow LED light. Finally, if the temperature displayed is high, it will change the speed of the fan into number three with red the LED light.

3.5 Conclusion

An efficient, cheap, automated temperature-controlled fan has been designed and built in this project. The fan blades running velocity automatically adapts to the ambient temperature with the useful resource of the temperature sensor which controls the fan regulator. A fan speed regulator controls the speed of an electric fan as needed by users that used embedded technology to control the system efficiently and reliably. As we already know, the current stand fan models in the market mostly need users to physically press the desired speed of the fan despite the temperature in a specific room.

This innovation focused on overcoming the demanding situations posed through the traditional table fan requiring that one wishes to be at alert all instances to switch the fan in reaction to unexpected unwanted fluctuations in the temperature of the environment. Such unexpected changes in temperature might also additionally rise because of changes in weather conditions due to rain, harmattan, heavy sun, wind, and others.

The constructed automatic temperature-controlled table fan is efficient and comparatively cheap. The mobile application system also proposes to send orders to operate the fan as ON or OFF from a distance. The automatic temperature-controlled fan is a welcome improvement inside the era in the industry nowadays and is predicted to replace the traditional manually regulated household electric powered fan as soon as it is produced commercially.

In a nutshell, the new design of fan reduces the power consumption when the speed of the fan is controlled automatically with the changes of the temperature state. The method of speed control of the fan seems to be suitable for the modern lifestyle where the manual traditional speed control regulator system is replaced with the self-regulatory mechanism. Finally, temperature-based automatic control systems are fitting for implementation of the internet of things (IoT), where real-life problems can be solved with the design of intricate electronic circuits.

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