Journal of the Nigerian Association of Mathematical Physics
Volume34,(*March, 2016*), pp 267 – 270

Adaptive Room Temperature Control System

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Abstract

The advancement in technology has resulted in the innovation of smart homes. This research aims to design and fabricate an adaptive room temperature control switch. In this work, a motion and temperature sensors mounted in a room sense the presence of human being and temperature respectively. The information from these sensors is used to switch on and control the speed of a fan in that room. This work was implemented using PIC16F8FFA microcontroller with LM35 temperature and motion sensors. The presence of the human being sensed by motion sensor was combined with that information from the temperature sensor by the microcontroller to switch on the fan. With the help of relays connected to the fan regulators, the speed of the fan rotation responded to a stepwise changed in temperature between 25^{oC} and 28^{oC}.

1.0 Introduction

Over the last decade, advances in digital electronics have made computers smaller, cheaper and faster. Throughout this revolution, other advances in technology such as smart home also play an important role towards better life in the future [1].With the recent advancement in technology, intelligent systems are introduced every day. There is an increase in the demand of cutting edge technology and smart electronic systems. Modern electronics have provided consumers with the ability to remotely control a variety of household appliances[2].

A lot of efforts have been made in controlling the appliances in the home remotely. In [3], the author designed and developed a microcontroller based automatic switch for home appliances in which passive infrared sensor and temperature sensor are th e key equipment. The design of automatic cooling systems was carried out in [1, 2, 4, 5]. In [6-8], the design of circuits that a utomatically control the speed of fan were proposed. None of these works used a combination of motion and temperature to d etermine the presence of human being in an environment before automatically switching on fan and controlling its speed of r otation based on the change in temperature.

This research presented the design and construction of an adaptive room temperature controlled circuit which can be used to automatically switch on and control the speed of a fan in the room.A motion sensor was used to detect the presence of human being while temperature sensor (LM35) sensed the temperature changes in the room. The temperature of the room was displayed on the Liquid Crystal Display (LCD). A microcontroller combined the information from both sensors to switch on and control the speed of the fan. The project is aimed at constructing an intelligent circuit that will sense/detect the presence of human beings and temperature changes in a room as well as switch on and control the speed of the fan in that room.

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2.0 Materials and Method

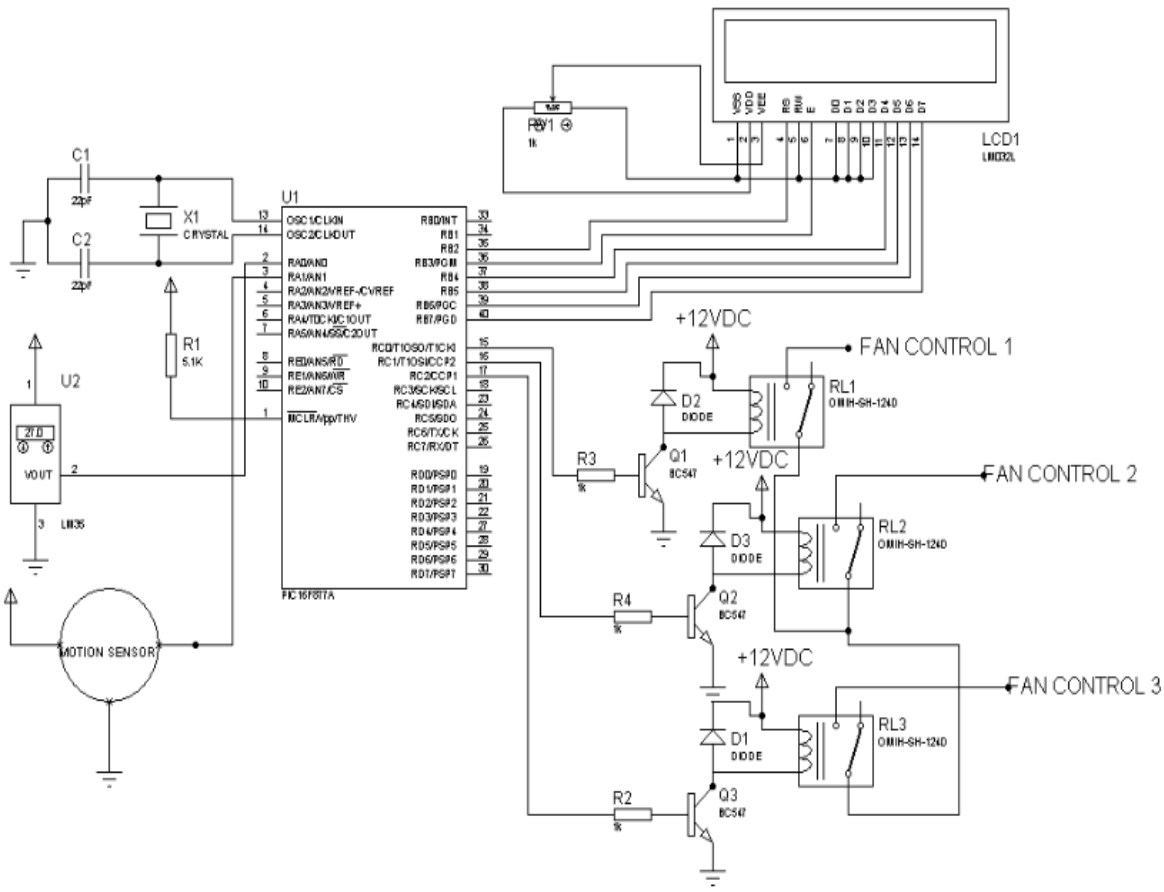

Fig 1: Complete Circuit diagram of the system [3]

Figure 1 showed the complete circuit diagram of the system. It is divided into three main stages; the power supply, the sensors and the microcontrollers

2.1 Power Supply

The power supply consist of a step down transformer which was used to convert 230V, 50 Hz AC voltage to 12V AC, 50 Hz. This 12V AC voltage is delivered to the bridge rectifier, which convert it into 12V dc. A voltage regulator (7805) was used to convert the 12V dc into 5V dc which was needed by the microcontroller

2.2 Sensors

A sensor is an electronic device that detects changes or events in an environment and transforms them into an electric signal[8]. In this work, the motion sensor detects the presence of human being in the room, transformed the information into electrical signal which was fed to pin 3 of the microcontroller (Fig. 1). Also the temperature sensor (LM35) details the temperature, converts it into an electrical (analog) signal and then fed into the microcontroller through Analog –To-Digital (ADC) Converter. The analog signal was converted into digital format by the ADC. The sensed and set values of the temperature are displayed on the 16x2-line LCD.

2.3 Microcontroller (PIC16C16877A)

Microcontroller essentially consists of Central Processing Unit (CPU), timers and counters, interrupts, memory, input/output ports and (ADC) on a single chip. With all these integrated in a single chip the size of the control board of microcontroller is reduced and power consumption is low[6, 9]. The microcontroller was programmed in C language. Three of the output pins (15, 16 and 17) of the microcontroller were connected each to a relay which was attached to each of the fan regulators. In this project, a fan that has three regulators was used.

3.0 Results and Discussion

In implementing the system, the whole subsections as described in the system design was implemented on a single Printed Circuit Board (PCB). The PCB was implemented using the toner transfer method. Proteus; a type of software that has both the schematic and the PCB side was used to draw the design of the circuit diagram.

When the presence of human being is detected in the room, the microcontroller compares the room temperature with the set minimum temperature (in the case 25^{o}C). If the room temperature is more than the minimum temperature programmed in the microcontroller, the microcontroller triggers the relay attached to the regulator that has lowest speed. This automatically switches on the fan and the fan blows at minimum speed. When the temperature of the room increases and it is above a certain set value (in the case 26^{o}C), the microcontroller triggers the relay attached to the regulator that has higher speed. This automatically increases the speed of the fan. As the temperature increase more than 28^{o}C, the relay with highest speed is triggered and this changes the speed of the fan to the highest speed. When the motion sensor senses that there is no human being in the room, this information is sent to the microcontroller, then, the microcontroller immediately cut off the voltage sources to all the relays. This deactivates the relays and eventually results in turning off the fan completely.

In conducting the system testing, it was observed that the movement of human being in the room together with increase in temperature resulted in a change in the speed of the fan. This showed that the microcontroller coordinated the information received from both sensors effectively. Furthermore, when there was no movement in the room and the temperature was made to increase, it was observed that the fan did not switch on.This enables the system to save energy. Finally, when there was movement in the room but the temperature was made to be lower than 25^{o}C, it was observed that the fan did not switch on.This is so because when the temperature of the room is less than normal room temperature, there is no point switching on the fan.However, it was observed that the fan switched off automatically when there was no more movement in the room but somebody was still present in the room and the temperature was above the minimum set temperature. It was therefore concluded that, the sensitivity of the system can be enhanced if a combination of entrance monitor counter and motion sensor can be used for human being detection.

4.0 Conclusion

An adaptive room temperature controlled circuit was designed, constructed and incorporated into a fan switch. This circuit used microcontroller and two sensors to control the speed of the fan. The result showed that the speed of the fan responded very well to increase in temperature but the sensitivity can be enhanced by using the combination of entrance monitor counter and motion sensor to detect the presence of human beings in the room.

5.0 References

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