1 Introduction

The room temperature control system is designed to control the temperature and lighting conditions inside the room automatically. PID control technology is used to control the temperature. This kind of system increases efficiency and maintains comfort.

The following systems are used to control the temperature

1. DC fan speed control – controlled by PWM signal (L2988N motor diver)
2. AC Fan speed control – phase control circuit using triac

In this project, an LDR sensor is used to measure the ambient light level based on its reading to adjust the lighting condition inside the room. Two IR modules are used as a way counter to count the people who come in and go out of the room. This module helps to maintain the people count correctly inside the room. If people count greater than one, they only move the systems lighting and the temperature control activate and save energy.

There are two button switches to set the desired temperature inside the room one button for incrementing the temperature level and another button for decreasing the temperature. If the set temperature value is greater than the room temperature value only the temperature control system is turned ON.

AC System

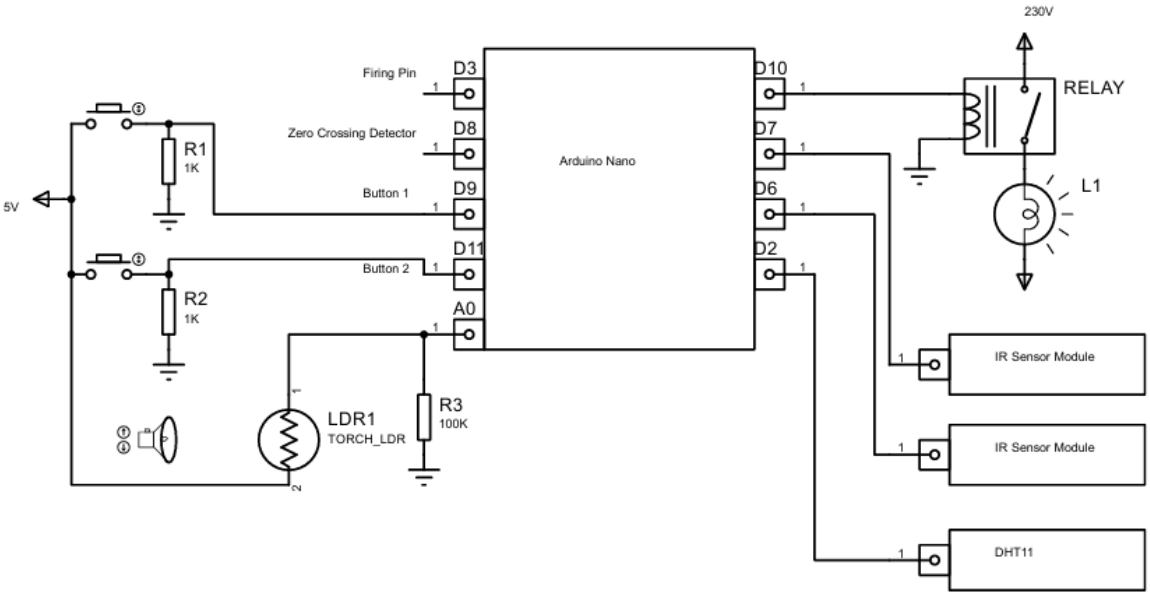

Figure 0.1: AC system

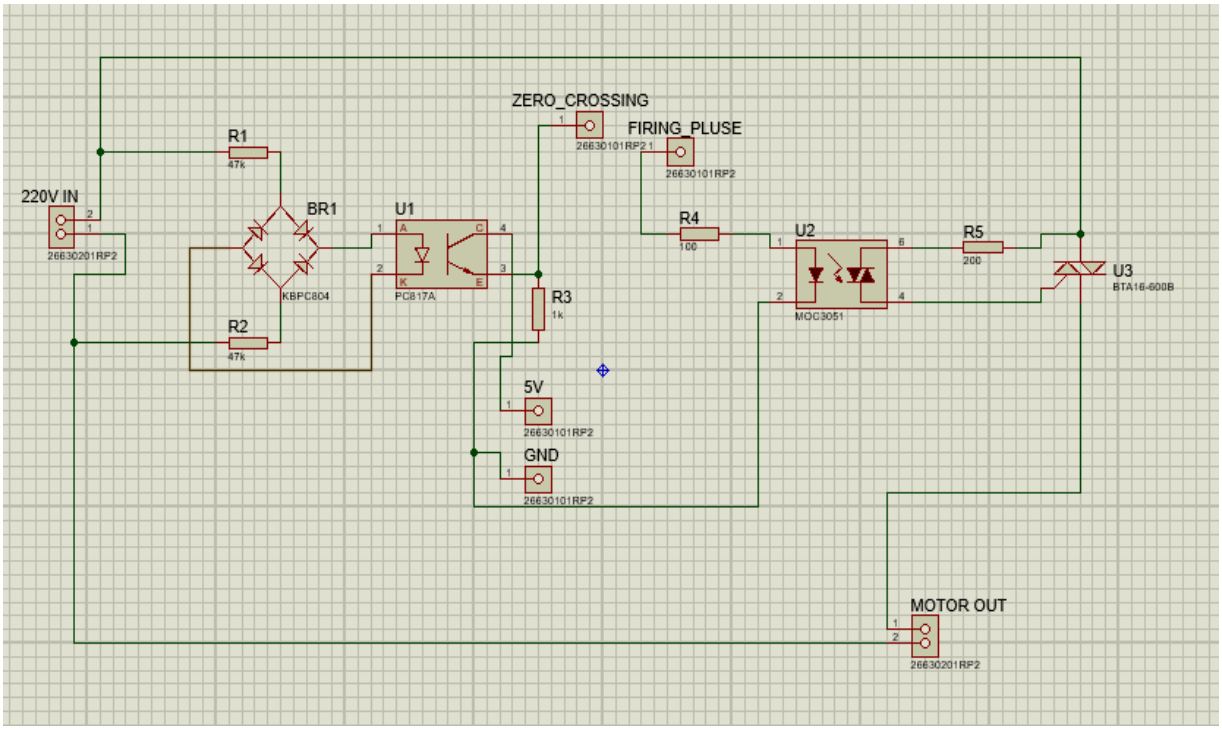

Figure 0.2: Ac motor speed controller circuit

Block Diagram of Speed Controlling

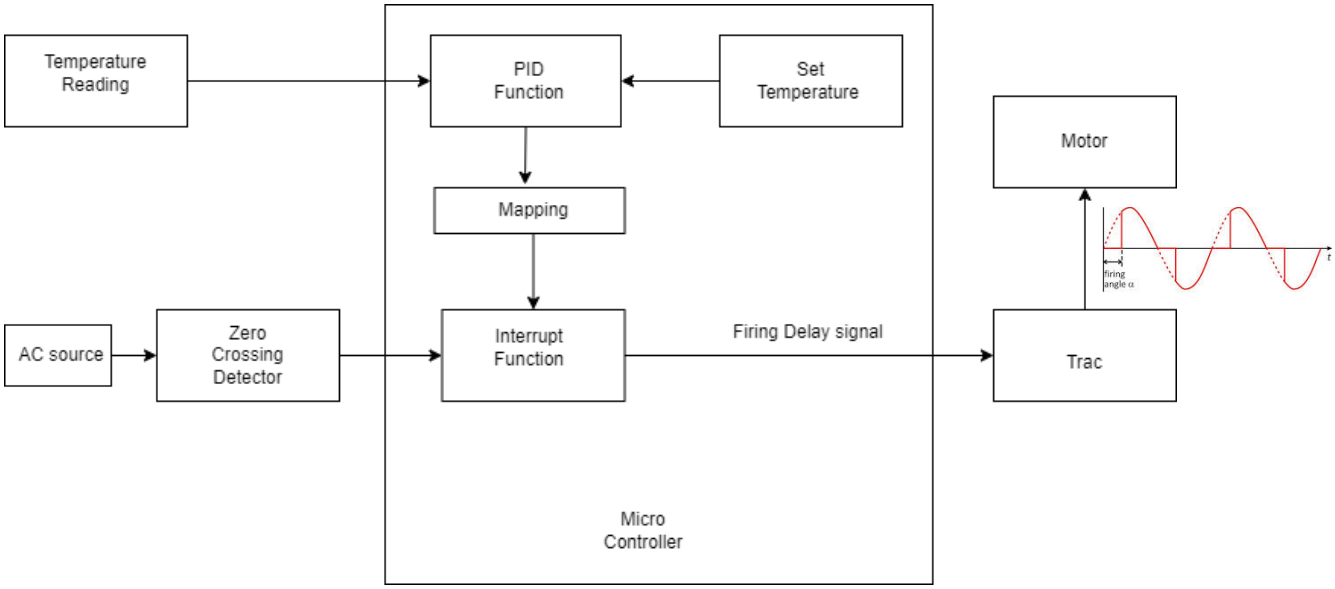

Figure 0.1: Block Diagram of Speed Controlling

Above this block diagram related to the AC motor speed control system describes the functionality. There is the PID function inside the Arduino code which is fed with set temperature and the current temperature. Based on the error between those temperate values and PID constant with generates a value and that value is going through the mapping function which maps PID outputs between the range of zero to 10000 ms which is used as a firring delay to the tract.

There is an interrupt function which is called at zero crossing of every cycle of utility supply AC current. Zero crossing is detected by the zero-crossing circuit which is designed with a full bridge rectifier and optocoupler its output is fed into an Arduino interrupt pin. After calling this interrupt function it delays the mapping function amount of time and gives the firing signal to triac driver. It drives triac. Based on the delay the output waveform can be changed as shown in the above figure 0.1. delivered voltage and the power to the motor can be controlled by the firing delay and speed can be controlled.

The optocoupler and the triac diver optocoupler are used to isolate the AC side voltage and DC side voltage which ensures leaking high voltage into the microcontroller and deals with low voltages and processes the inputs to the Arduino safety

DC System

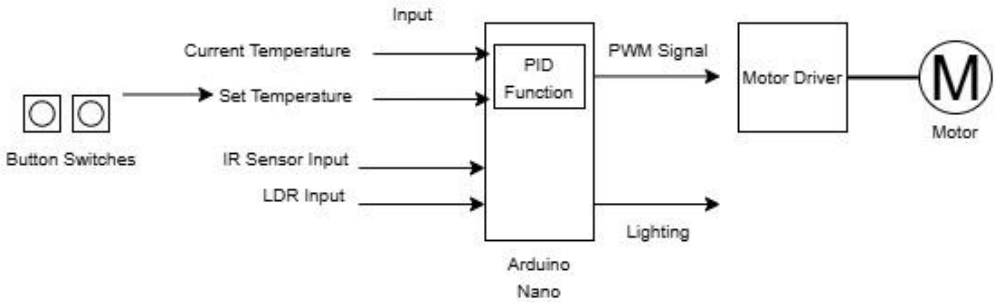

Figure 0.2: functionality of dc motor temperature system

In this system all the functionalities are the same as the AC system except motor diver circuit and motor speed is controlled by PWM signal which is given by PID function based on temperature difference between set temperature and room temperature and PID constant values.

Preliminary Results, Observations, and Challenges

During testing, A few problems were found in the system. At low speed, the DC fan makes a humming noise. Proper filtering is needed to minimize this. Also, the fan does not change speed smoothly. It works in steps, not gradually. It may be a distraction for people inside. Another problem is that if the room temperature is very different from the set temperature, the fan cannot reach the target temperature properly.

Also issues with the IR sensors used to count people were found. When two or more people enter or leave the room at the same time, the sensors do not count correctly. This gives the wrong number of people in the room. Since the system only works when people are inside, this causes problems with temperature and light control.

The lighting system also shows some flickering. When the light level is close to the limit, the light turns on and off frequently. This can be uncomfortable.

Proposed Improvements

To fix the people counting issue, we can place the IR sensors closer to each other. We can also make the sensors react for a shorter time to avoid wrong counts. But even with these changes, IR sensors are not always accurate.

A better way is to use **image processing**. By using a camera and computer vision, the system can detect and count people more correctly. This is helpful when many people enter or leave quickly.

For the lighting issue, we can place the LDR sensor in a better spot to get more accurate readings. Also, using two light level limits (one to turn the light on, and another to turn it off) will help reduce flickering.

These changes can make the system more accurate, save more energy, and give better comfort in the room.