Devices and Electronics Lab (EE 340L) PROJECT

Cooling System

Ghulam Mustafa Bashir 21100182
Muhammad Turab 21100293
Zain-Ul-Abidin 21100077

Fall 2019-20

DEPARTMENT OF ELECTRICAL ENGINEERING
LAHORE UNIVERSITY OF MANAGEMENT SCIENCES
LAHORE

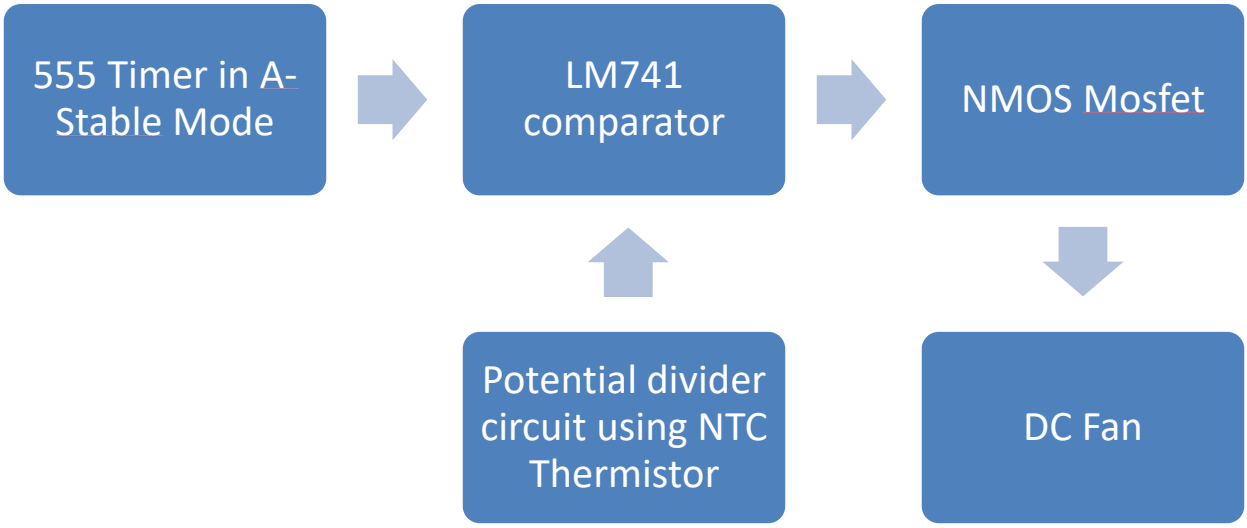
Problem Statement

There are many situations where extreme temperatures might slow down productivity or may even be dangerous. In such cases cooling systems come in handy absorbing heat and dispersing it elsewhere thus creating an artificial ambient temperature.

Proposed Solution

We will be designing a circuit that varies the speed of a DC fan depending upon the temperature in real time. To collect data about the surrounding temperature we will be using an LM35 temperature sensor. This will give us a small voltage output that linearly with temperature.

BLOCK DIAGRAM

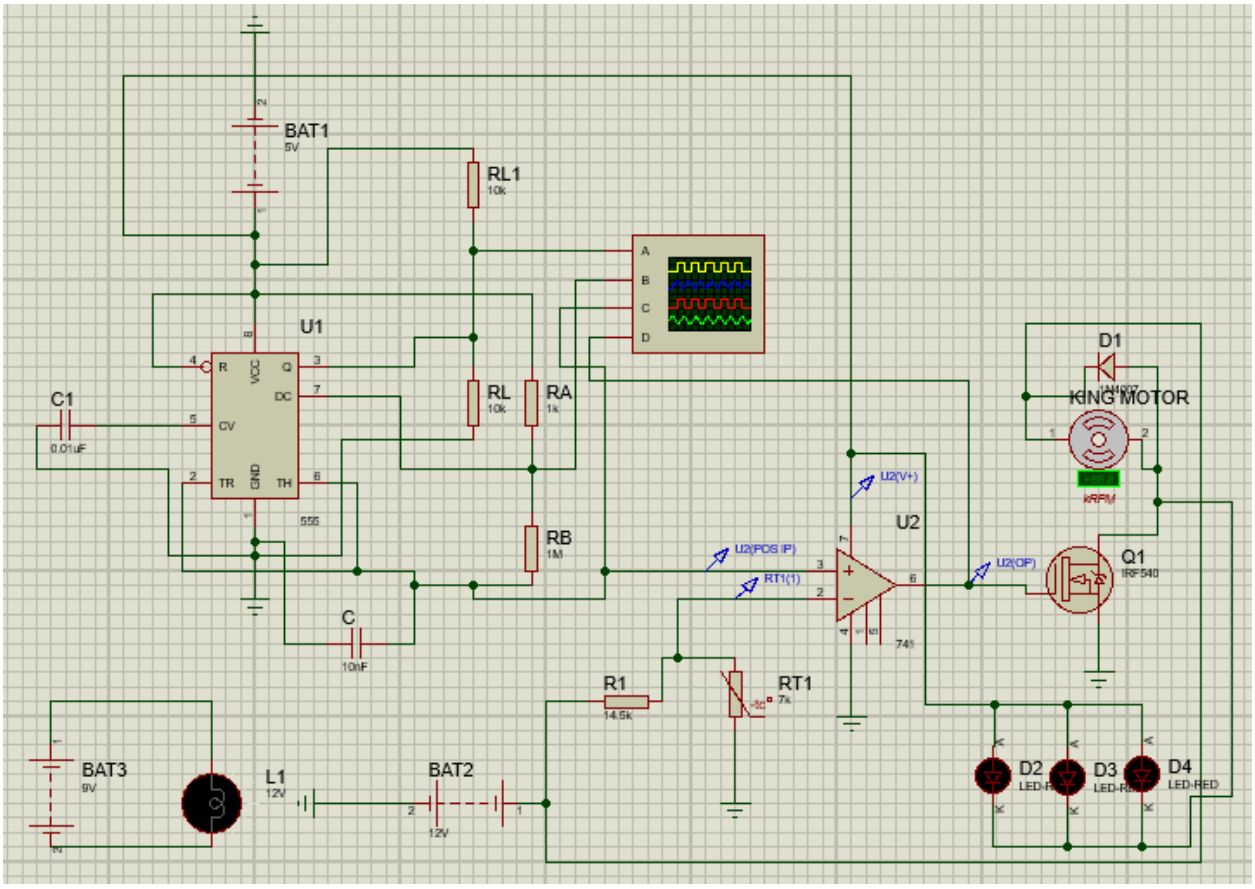


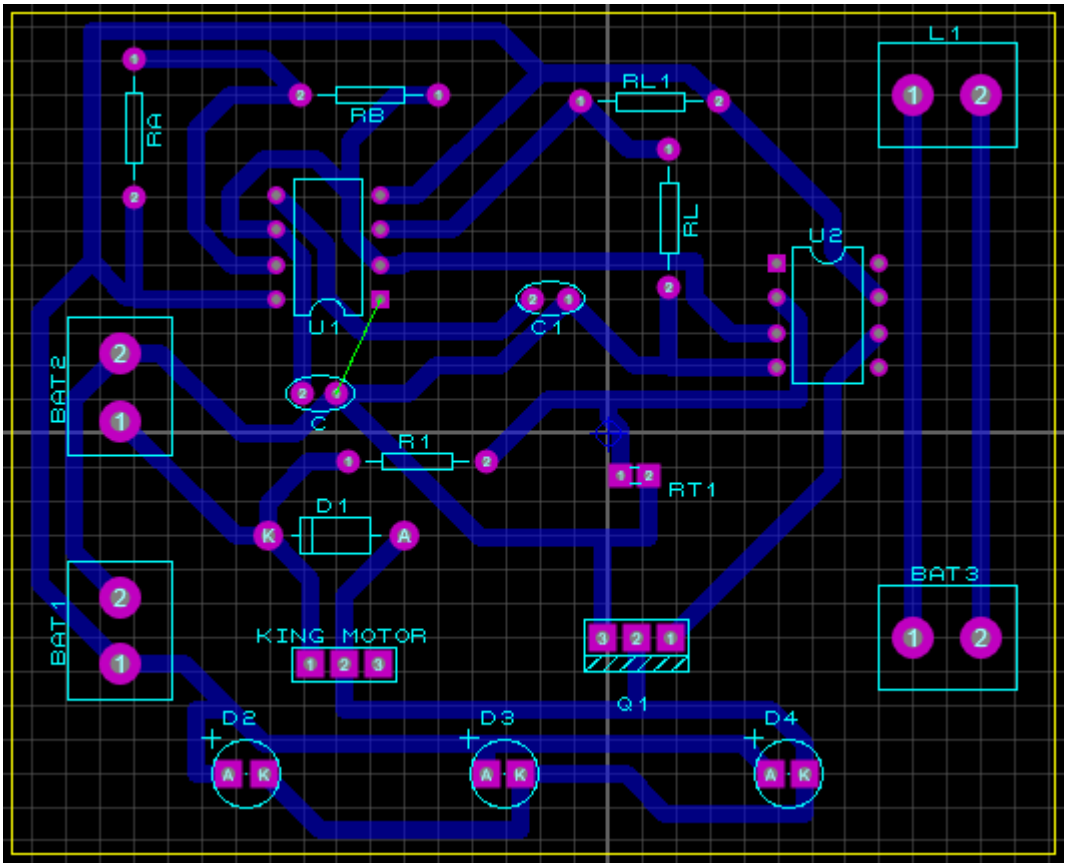
METHODOLOGY

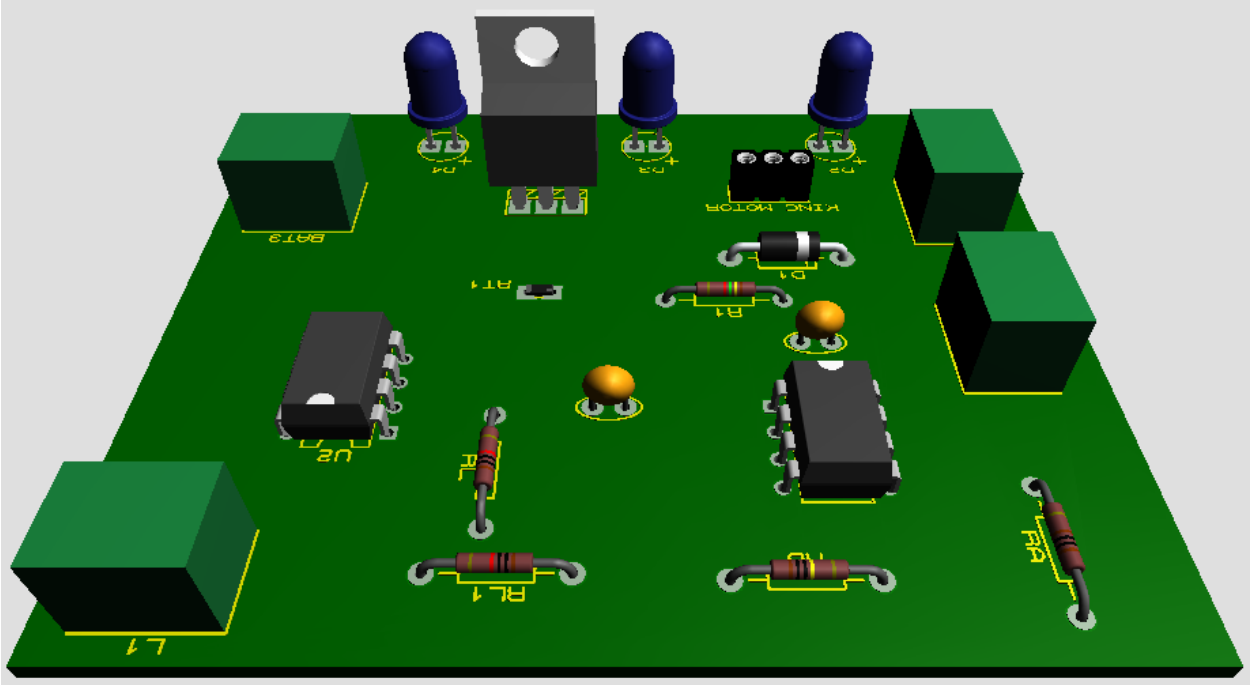
We operate the 555 timer in A-Stable mode. In A-Stable mode, the 555 timer acts as an oscillator that generates a square wave and a triangular wave. The frequency of the wave can be adjusted by changing the values of two resistors and a capacitor connected to the chip. The varying triangular wave is fed into a 741 comparator where it is compared against a reference voltage. The comparator provides either +5 Vcc or ground voltage depending on the result of the comparator thus making a square wave. The reference voltage is provided by a potential divider circuit consisting of an NTC thermistor paired with a resistor. The reference voltage therefore changes exponentially with change in temperature. This affects the duty cycle of the output of the comparator in effect creating a pulse width modulated wave. This wave is finally led to the gate of an NMOS Mosfet. A DC fan is attached to Vcc at one end and the drain of the Mosfet at the other end. The source is grounded. As the duty cycle of the comparator output varies so does

the speed of DC fan, in essence creating a temperature controlled fan. We faced the issue of getting no visual feedback from the PCB and therefore we incorporated LEDs into our circuit to solve this issue. The LEDs would light up sequentially to indicate the increase in temperature. These LEDs worked in tandem with the DC Fan providing linear feedback as the temperature increased.

Project Outcomes




L1
RL1
RB
RA
RL
U2
U1
C1
C
BAT2
R1
RT1
D1
BAT1
KING MOTOR
BAT3
Q1
D2
D3
D4



Societal Relevance

There are many situations where extreme temperatures might slow down productivity or may even be dangerous. In such cases cooling systems come in handy absorbing heat and dispersing it elsewhere thus creating an artificial ambient temperature. These systems have uses ranging from households to manufacturing plants and everything in between. A cooling system might be a simple DC fan or a highly complex cooling mechanism incorporating several factors depending upon the purpose. In our case we will be designing a temperature-controlled DC fan.

DETAIL OF COMPONENTS

Sr. No.	Description	Specification	Availability in the Lab	Quantity
1	**Resistor**: (1KΩ 2pcs,10KΩ 2pcs,10KΩ (Variable) 1 pc)	(all ¼-watt, ± 5% Carbon)	Yes	5
2	**Capacitors**: 10nF (electrolytic) (2 pcs) 100nF (electrolytic or ceramic) (2 pcs)	(50 volts rated)	Yes	4
3	**Semiconductor Devices:** Diodes(4 pcs) Mosfet(2 pcs)	Diode 1N4007 LEDs Mosfet (20 Volts 200mA rating)	Yes	6
4	**Integrated Circuits:** Op-Amp(1 pc)	Op-Amp IC LM 741 Timer 555	Yes	3

	Timer IC(1 pc) Temperature Sensor(1 pc)	NTC Thermistor		
5	**Motors**	12V DC Fan	Yes	1

Future Work

- Using a better method of generating a reference voltage that allows us to generate a larger range of variation. Right now our circuit operates in the range of 30 degrees to 50 degrees.
- Using a more sensitive and linear instrument to take our input instead of an NTC Thermistor which has a nonlinear property.
- Using a more powerful data processing system in place of a 555 Timer. We could instead use a microcontroller for greater flexibility and reliability when analyzing data.

PROBLEMS FACED DURING COMPLETION OF PROJECT AND THE LAB AS A WHOLE

- We were aiming to directly achieve the PWM using the 555 Timer, a few diodes an NTC thermistor and a PTC thermistor. Since the NTC thermistor and PTC thermistor did not operate in the same temperature range and we were unable to interface the two together.
- We used an NTC thermistor as our temperature sensor building a potential divider circuit. This however gave us a miserly temperature range of just 20 degrees Celsius.
- We used a 5V bulb as our heating element. This did not provide sufficient heat to test out the complete temperature range.
- Several of our components required different voltages and high currents including the DC fan and the heating bulb which forced us to use separate voltage sources.