İZMİR KATİP ÇELEBİ UNIVERSITY
FACULTY OF ENGINEERING AND ARCHITECTURE
DEPARTMENT OF MECHATRONICS ENGINEERING

FACULTY OF ENGINEERING AND ARCHITECTURE

MECHATRONICS ENGINEERING

INTELLIGENT CONTROL SYSTEMS

FINAL PROJECT

AYANA TLEULENOVA

160412059

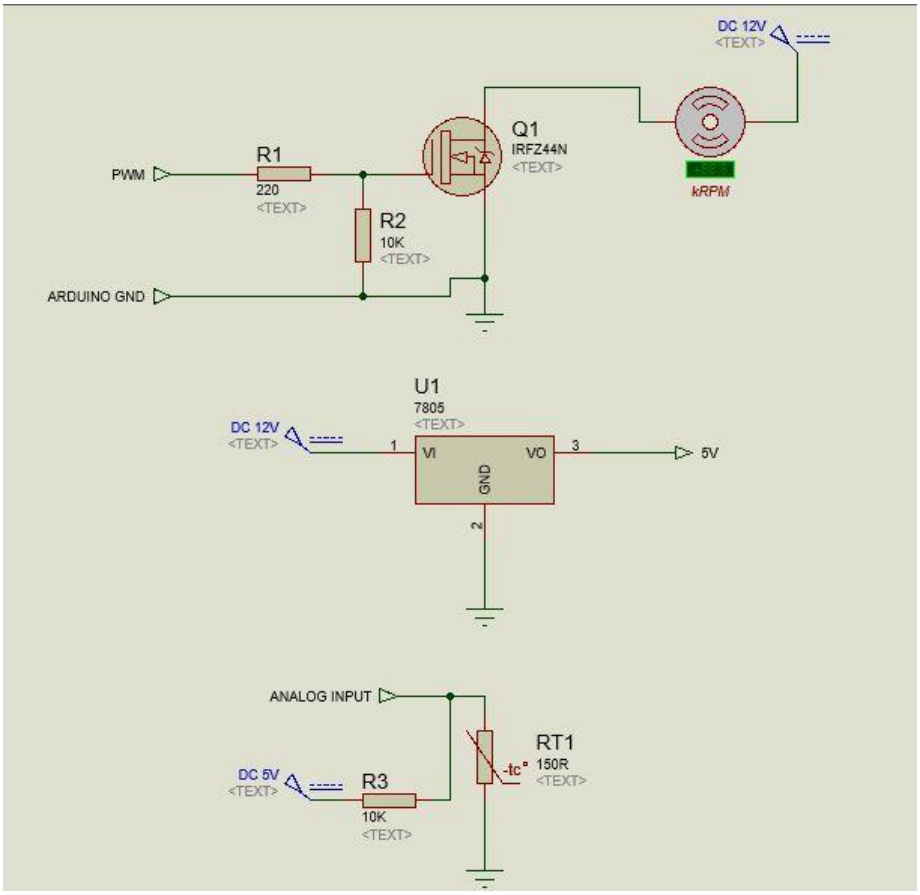
Abstract:

This project presents how to control the temperature of an integrated circuit which is self-heated with the current flowing through. It`s an example of cooling system, and fan has to arrange PWM and change speed according to the temperature and voltage parameters. So, it means there is 2 inputs and 1 output, which will be used for defuzzyfication Mamdani methof and Rulebase.

Procedure:

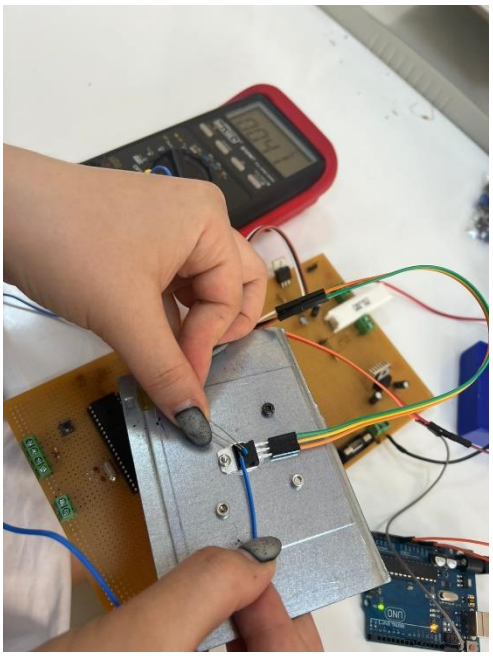
Parameter that was given to me: 12V, 50°

Here is our circuit design:



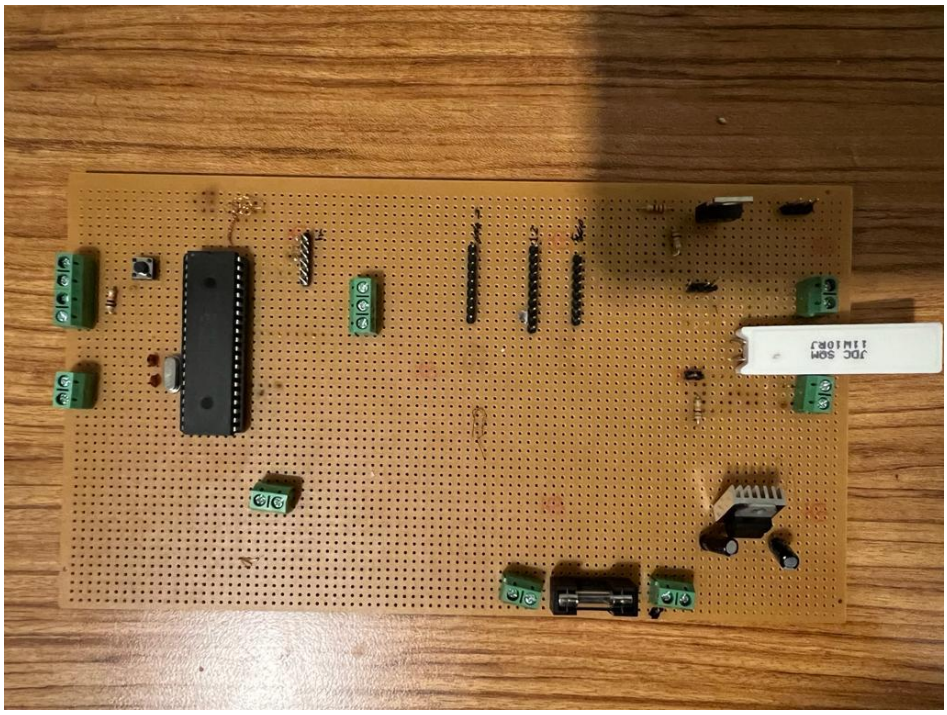
İZMİR KÂTİP ÇELEBİ
UNIVERSITY
FACULTY OF ENGINEERING
AND ARCHITECTURE

Firstly, we built circuit that was needed for this procedure. We used metal plate with 0,5 mm thickness and mounted voltage regulator. NTC sensor and digital Multimeter with TMP were used to measure temperature. After that, we calibrated our parameter values.

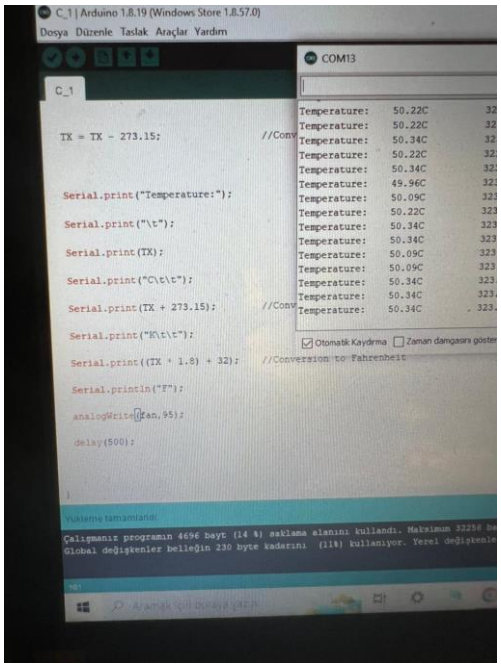


As soon as we gave voltage to the circuit Voltage Regulator 7805 started to heat. Moreover, we used ThermalPad to get better measurements.

Here is our circuit:



So, in order to keep 50° for me, I need PWM around 95:



Methodology:

Defuzzification is the process of producing a quantifiable result in crisp logic, given fuzzy sets and corresponding membership degrees. There are many defuzzification methods, I used center of gravity. My range is from 40 to 80.
Inputs:

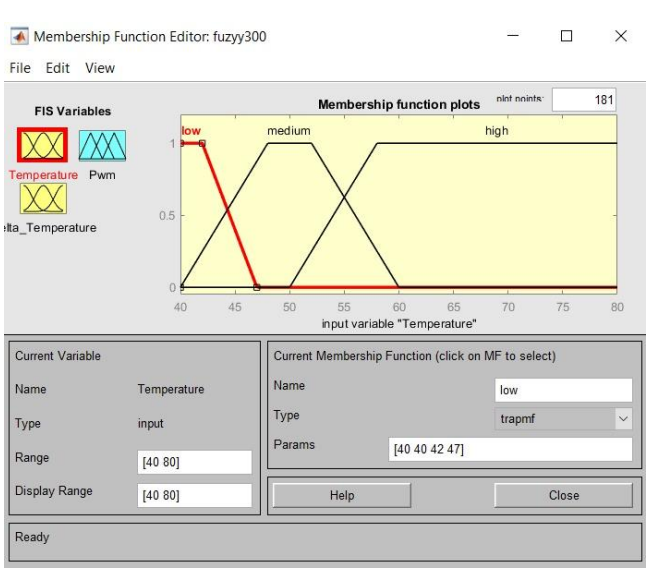
1. Temperature (High, Medium, Low)
2. Delta Temperature (Negative, Stable, Positive)

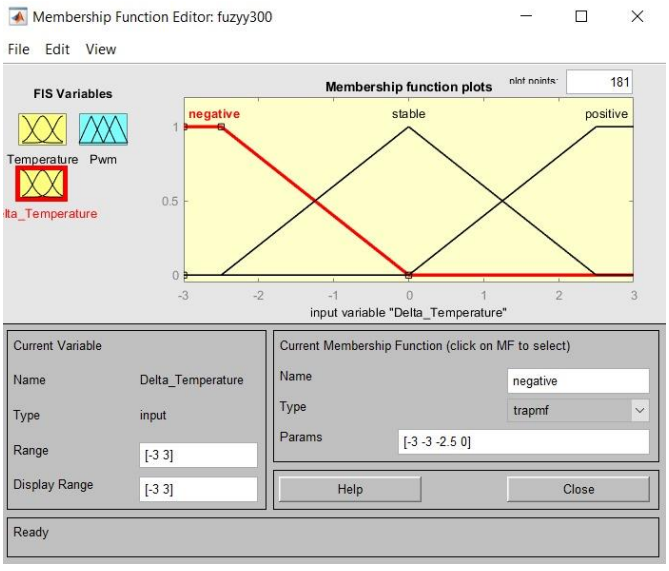
Output:

1. Fan Speed-Pwm (Off, Slow, Average, Above-Average, Fast)

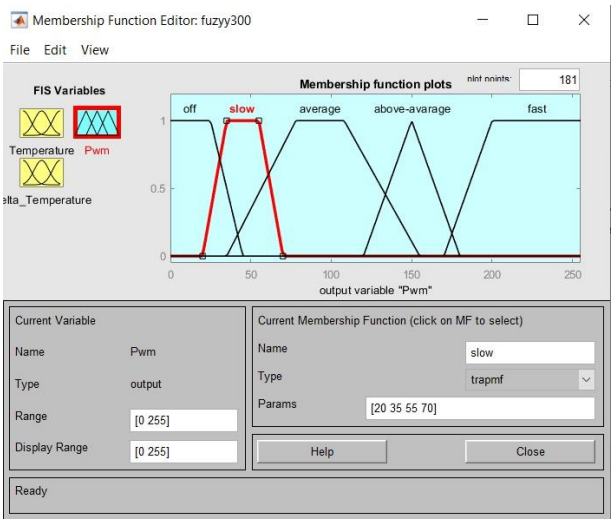
Once the current values of the input variables are fuzzified, the fuzzy controllercontinues with the phase of deciding what actions to take to bring the temperature to its setpoint value.

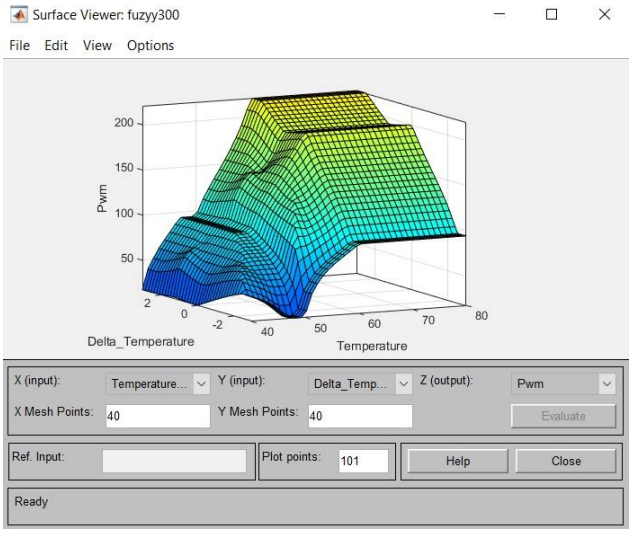
Due to this PWM value, I created my Fuzzy representation:





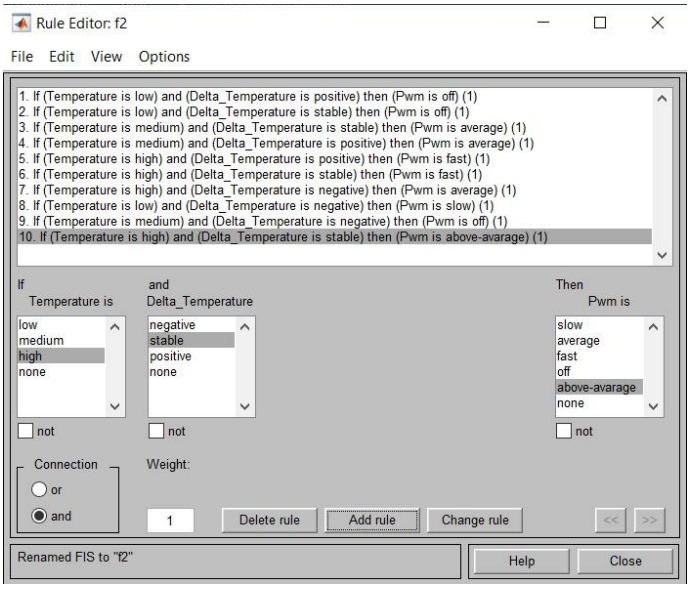
I decided to create 5 Memebership Functions, so that my system works better and in order to see more range values. Also, I obtained smoother 3D surface view.

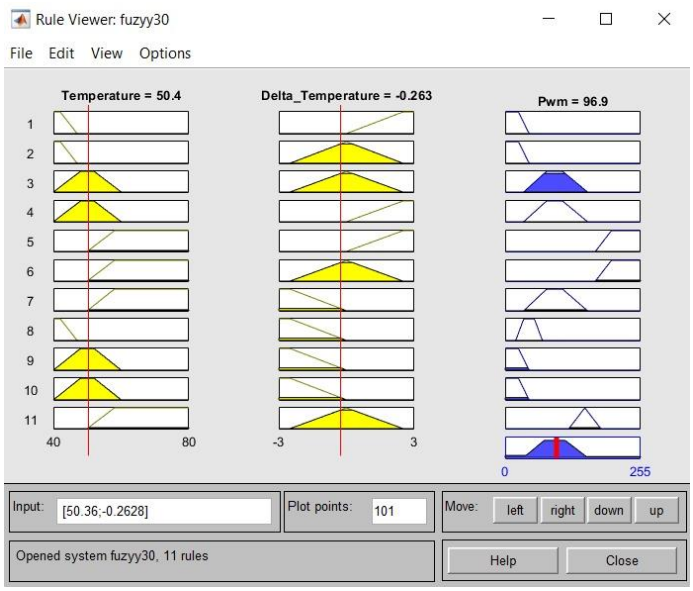




In a Fuzzy Logic, a rule base is constructed to control the output variable. A fuzzy rule is a simple IF-THEN rule with a condition and a conclusion.

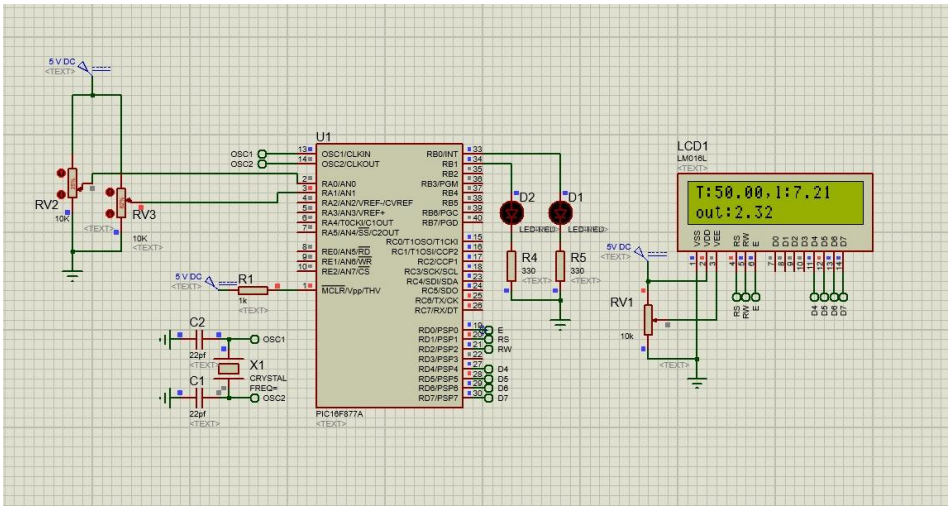
According to my Rule Viewer, I need Pwm around 96 to keep temperature at 50°





Furthermore, after creating my Matlab Fuzzyfication, I took the Fistlookup.m file, which was shared with us, and run it with my Matlab fuzzy.There were matrix values appeared on the workspace, so I took those values and put them into the fuzzy.c simulation draft code which was also shared with us. After that I used those matrix values to replace in PIC Complier, so that I can use it after for Proteus simulation.

Here is my simulation from Proteus:



Conclusion:

At the nutshell, I would like to admit, that in this project we used all theoretical knowledges that we learned in the class and used in practice. From my point of view, it also taught us how to make your system work smothier and automatically by using defuzzyfication. We had a big problem in the beginning with heating our plate. However we fixed it with cutting our plate, Thermal Pad for NTC and some insulation. Moreover, I would like to admit, that NTC sensor is very sensitive, and we were obtaining different results depending to area around us.

In this project, I had the chance to better understand the working principle of fuzzy logic controls and try them. I also learned the use of fuzzy logic controls from the matlab program.