Progress Report

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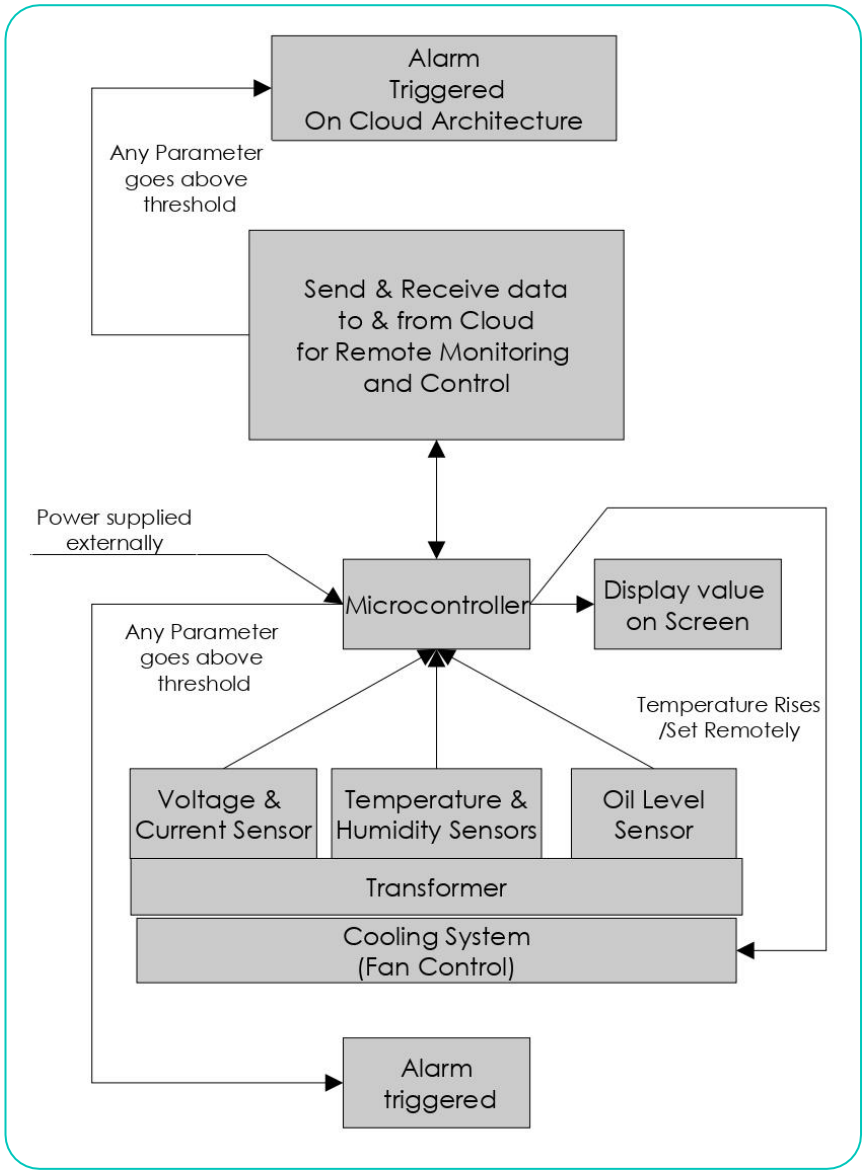
Topic:

Remote monitoring and control of cooling system for an oil cooled transformer

Abstract

- Develop a low-cost monitoring system for distribution transformers which can be extended to power transformer with some limitations in monitoring capabilities
- Use multiple sensors to measure various parameters.
- Feed data into a microcontroller
  - To process signals and display the data
  - Trigger alarm on crossing thresholds
  - Control fan automatically and remotely
  - Log data to cloud for remote monitoring, data analysis, predictive maintenance

Block Diagram

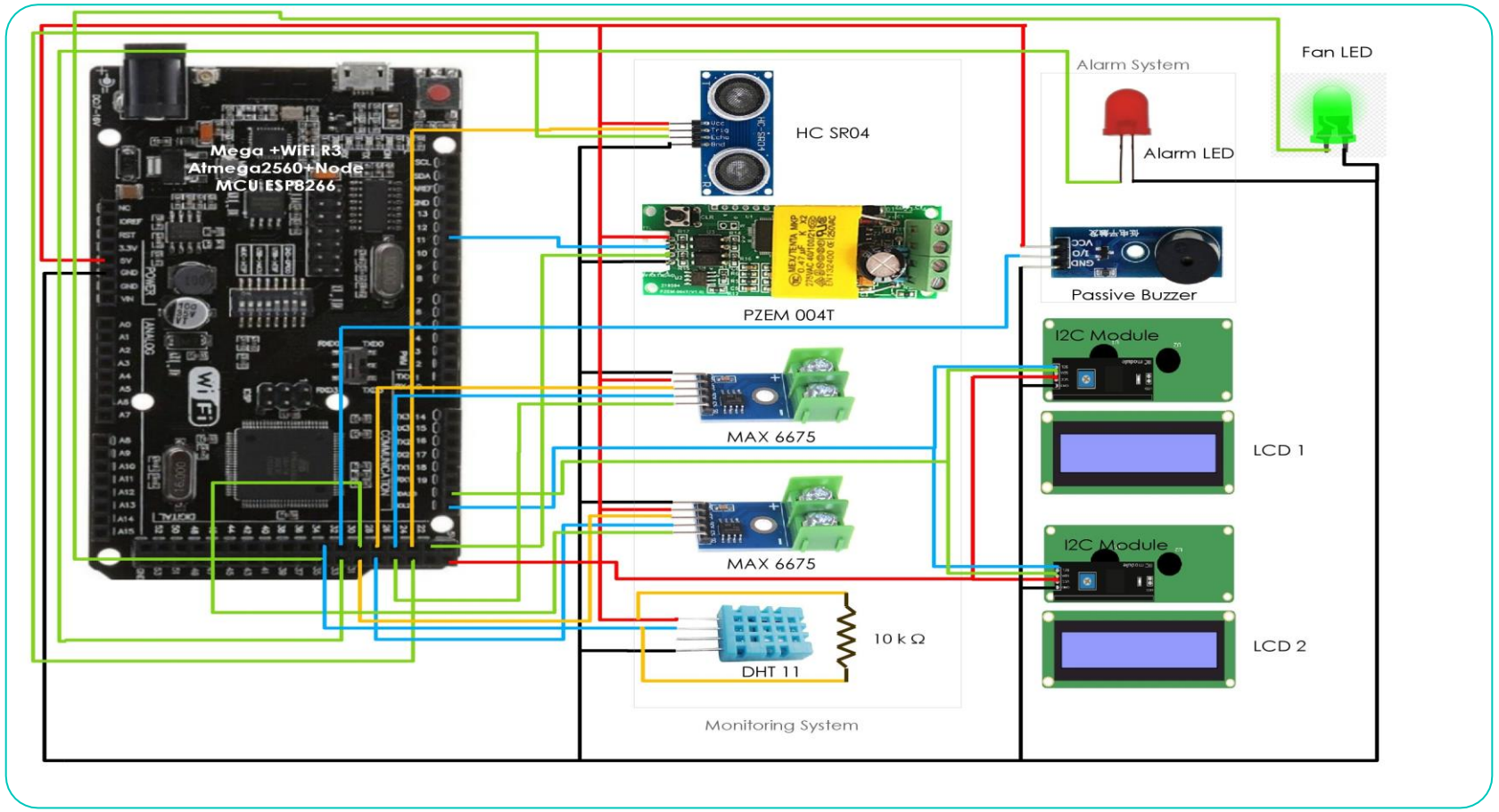


A Brief Overview of Previous Work

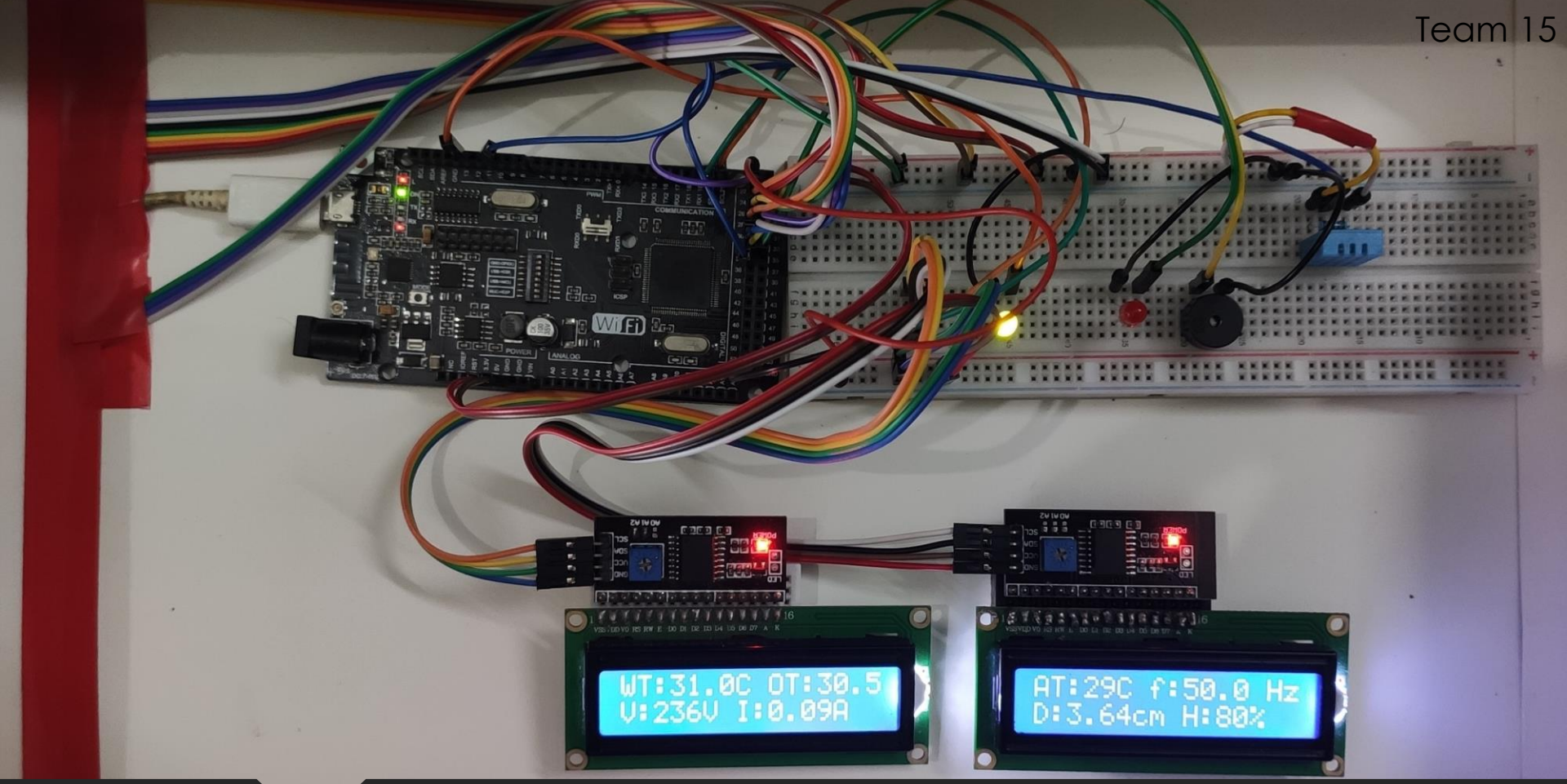
- Learnt about which parameters to be monitored and found out how change in the parameters affect the functioning and health of the transformer
- Learnt how those parameters can be measured effectively and accordingly chosen different sensors.
- Learnt about different cooling mechanism of transformer and narrowed down the focus on ONAF/OFAF type of transformer.
- Developed a block diagram of the system.
- Learnt programming the Arduino (the microcontroller) and how to integrate the sensors with the Arduino.

A Brief Overview of Previous Work(Contd.)

- Researched and learnt about the different aspects of remote monitoring. Selected ThingSpeak as our remote monitoring server.
- Configured and setup the remote server.
- On the basis of these works , we continued to further develop our project this semester.

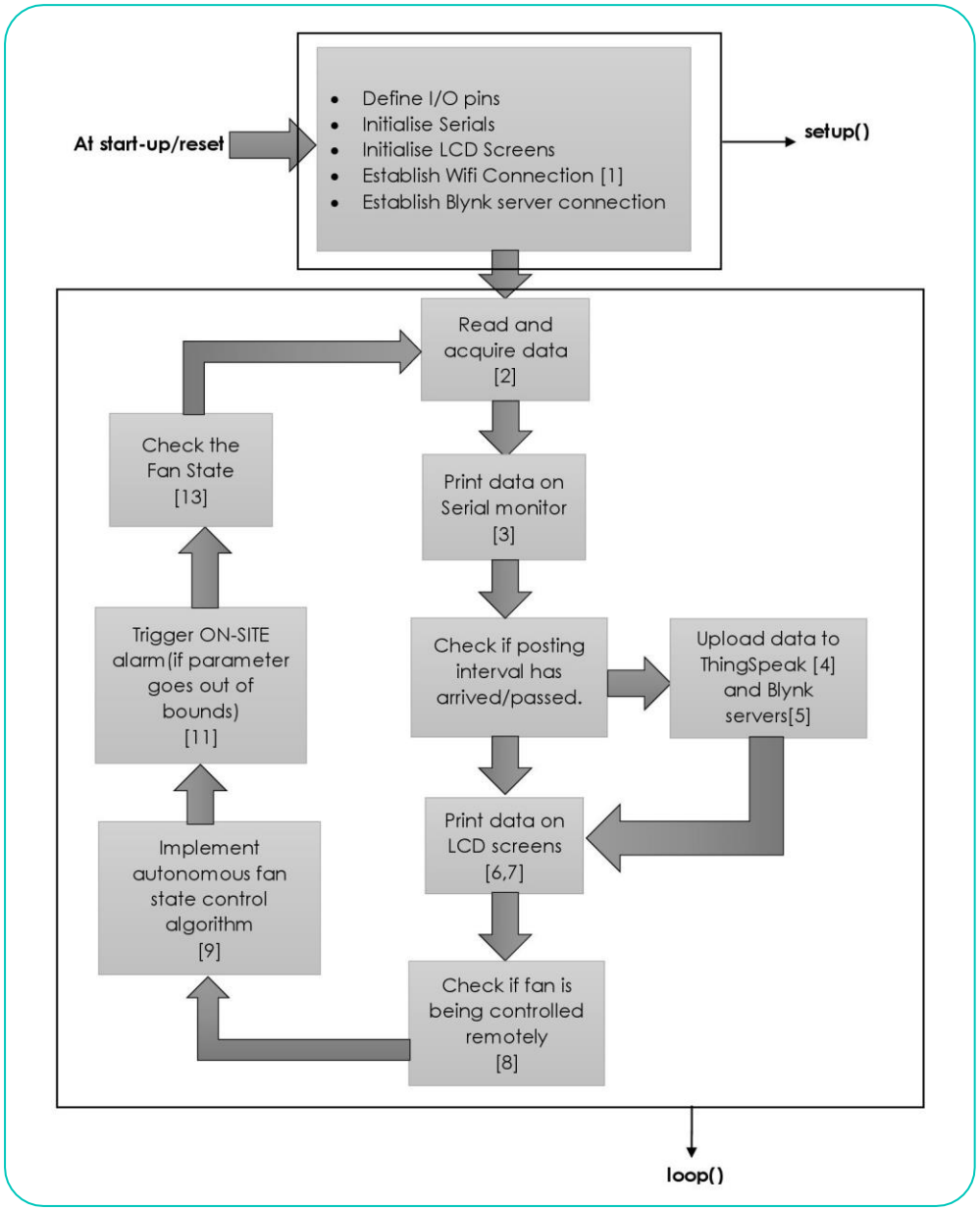


Final Connection Diagram



Prototype Built

Flowchart of Code Algorithm



ThingSpeak Server

- ThingSpeak has been chosen as the Remote Monitoring Cloud server.
- ThingSpeak is an *"IoT analytics"* platform service that allows us to aggregate, visualize, and analyse live data streams in the cloud.
- It can receive data up to 8 data fields, was compatible with our microcontroller, was easy to interface.
- With MATLAB analytics inside ThingSpeak, we can write and execute MATLAB code to perform pre-processing, visualizations, and analysis.
- We were able to send the parameter values to a private channel in ThingSpeak and visualise the data.
- Since ThingSpeak does not have the necessary features required to communicate instructions back to the microcontroller, we could not use it as a remote control cloud server.

ThingSpeak Interfaces

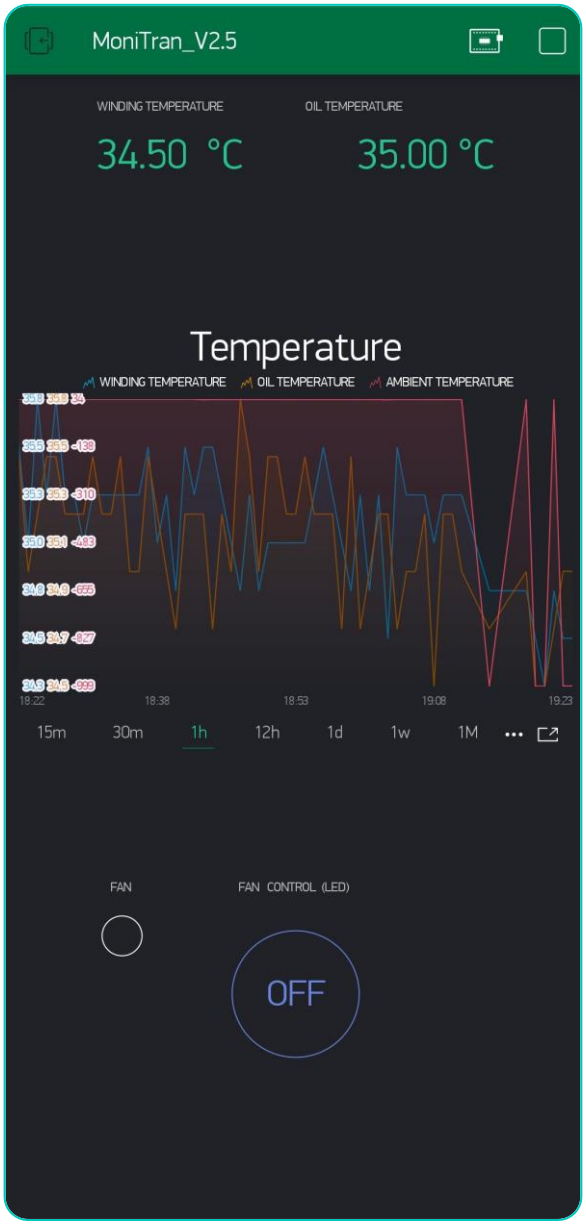
PC Dashboard

Mobile Interface

Blynk Server

- We have chosen Blynk as our Remote Controlling Cloud Server.
- Blynk is a hardware-agnostic IoT platform with white-label mobile apps, private clouds, device management, data analytics, and machine learning.
- It was one of the few platforms that was compatible with our microcontroller board.
- We were able to send the critical data necessary (oil, winding, and ambient temperature) to monitor and let the user decide the fan state and control it correspondingly with an approximate latency of about 10ms.
- We also were able to indicate the fan state on the platform.

Blynk Dashboard



Demonstration Video (Proof of Concept)

Conclusions

- The practical implications of the different parameters (temperature, humidity, oil level, voltage, current, power) on transformer health and its life assessment is understood.
- A prototype was built based on the block diagram and the microcontroller was successfully integrated with all the sensors.
- To program the microcontroller, code of 382 lines was developed.
- The cloud servers (ThingSpeak and Blynk) were configured and were connected with the system.
- All the parameters can be observed in near real time in visual charts and the data is stored in the cloud servers.

Conclusions (Contd.)

- We have effectively made a data acquisition system which enables us to –
    1. Build datasets and algorithm for predictive maintenance
    2. Detect transformer failure
    3. Help in transformer life assessment

- Additionally, a provision to control the state of the cooling fan is made (either automatically or remotely). For automatic control, an algorithm is proposed based on temperature parameters, load and predictive analysis of previous load pattern.

- Thus, if implemented in large scale , the system has potential to bring reliability and efficiency in power distribution system by optimising transformer operation and thus reducing service downtime.

Thank You.