

Executive Summary

In the world we live in, almost everything needs to be powered by electricity, and our daily lives are very dependent on that power. We need electricity to have light, power our machines that makes our daily jobs easier, and even for heating and cooling to survive in extreme hot and cold weather. All of this power is usually coming from a nearby substation that receives power from a power generating facility, It then steps up that power to high levels and distributes it to local communities.

The process of the power transmission is highly risky and every substation needs to be implemented with safety regulations to consider risks associated with a substation. After the pandemic, the online working environment is growing rapidly, and at this time, some countries require companies to have remote working environments as an option for employees. In a traditional substation, engineers are always looking for a new tool to control and monitor the operations of the substation without the need to be there in person as the risk for the employees in a substation is very high.

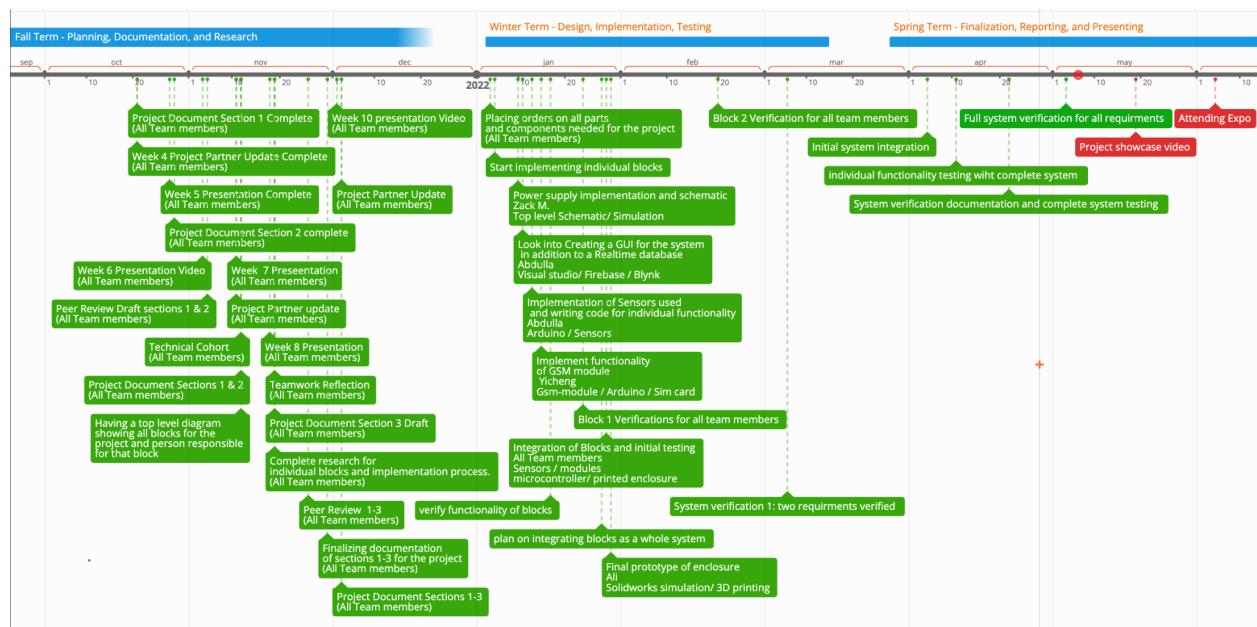
A solution such as designing a system that allows engineers working on the substation to monitor various parameters of the substation, enabling better access to multiple parameters at the same time would be very beneficial and efficient in such an operation. It also allows for easy remote control, so that any issues related to the monitored parameters can be dealt with from a distance when they are detected. We will also provide an alert function for the system, so that when the substation reaches a preset threshold, employees will be notified and the system will automatically stop the substation to assure the safety of the local communities and the components of the substation and employees there.

The objective of the project is to obtain remote control over electrical parameters such as voltage, current, etc. This can be achieved by using a GSM communication device to allow users to collect real-time values and the status of the power station through the network[1]. The user can send commands in the form of SMS messages to read the electrical parameters in addition to shutting off/on the substation Remotely using a dedicated GUI for that system. The system will also be capable of sending SMS alerts[2] whenever a risk is detected such as the voltage or current exceeding a predefined limit. Using this method rather than a web page to view the monitored values and control the operation would be more secure for some substations as the GSM module operates based on cellular connection such as 4G connection where a web page would require additional network implementation so that the substation is always connected to an online server. Online options such as a web page would have a larger risk of the attack of hackers where a GSM module would only receive commands and send data to a registered number because everything is hardcoded onto the hardware component and can't be changed online.

The project began by brainstorming and writing down all the blocks that are required to assemble the system, and it came down to 9 building blocks that are:

- Arduino (Brain of the system)
- Sensors (Voltage , Current)
- Sensors code
- GSM-module (hardware)
- GSM-module code
- Relay module
- Power supply (step down converter)
- GUI (Graphical user interface)
- Enclosure

Each team member was responsible for at least 2 blocks from the total 9 and had to implement and test that block separately for individual verification of functionality of that block before integrating the blocks together into a single working system. After the verification of the individual blocks, we were able to integrate all the blocks together to have a full working system. Issues such as combining the code for all the components and having proper wire connections for all the components were surfacing but the group was able to solve all the issues and complete the integration of the system. A key issues that we had was the sensor's code as it was allocating too much memory for arrays to store data from the sensors for returning an accurate reading and as a result, the arduino ran out of memory and did not function properly where the system had issues of not responding and printing false readings. This issue was resolved with allocating less memory for the sensors allowing enough for all the components needing it and we started seeing better results and functionality.



Some of the key lessons we have learned during the process of completing the project is that the most important thing to group work is communication. It was extremely important to have weekly meetings in person to discuss the progress and how everyone is doing because that helped in completing the project and discussing all the individual pieces of the project.

Additionally, even when every team member was responsible for an individual block of the project, it was still necessary for communication on how they would implement their block because this process made the integration of the full system easier as each member was expecting certain communication details and variables as inputs or output of their block.