Lightning Talk: Design

Group 9
Chye Stecher, Josh Vrenick, Keegan Kraft , Matthew Dobrzynski, Taylor Semple, Anthony Ruffalo

Area	Description	Examples
Public health, safety, and welfare	This project will aid in providing consistent power to those who need it. Will ensure that services and safety depending on reliable energy will indeed get that energy safely.	Hospitals will get the power they need to ensure they can provide healthcare as normal. Water plants will be able to process water as normal.
Global, cultural, and social	Infrastructure in areas of the world where consistent power delivery may not be the norm would be affected by this project.	If a transmission line goes down in a grid, it would help pin-point where the faulty line is and what kind of problem may have occurred. Helping get the grid back and running as quickly as possible.
Environmental	Being able to determine where a fault is occurring and what kind of fault is occurring. Being able to shut off the transmission of power when a fault occurs so there isn't any power loss to ground so there isn't any waste of the resources used to generate power.	Our product should decrease the amount of energy lost when a fault occurs in a transmission line. This will then reduce the amount of production of energy to make up for the energy lost. This will then save the transmission company's money which may then get used to convert away from nonrenewable resources.
Economic	If transmission utility companies can save the amount of power that's lost due to faults then they won't be losing money from the loss of power. This will then make it so the price to have electricity won't increase for the consumers.	Since our project is mostly software oriented and doesn't have many hardware requirements it will be very affordable since it shouldn't cost really anything for the target users. It will also reduce the amount of energy lost in a fault which will save the target users money since they won't be wasting the energy they are producing.

Prior Work/Solutions

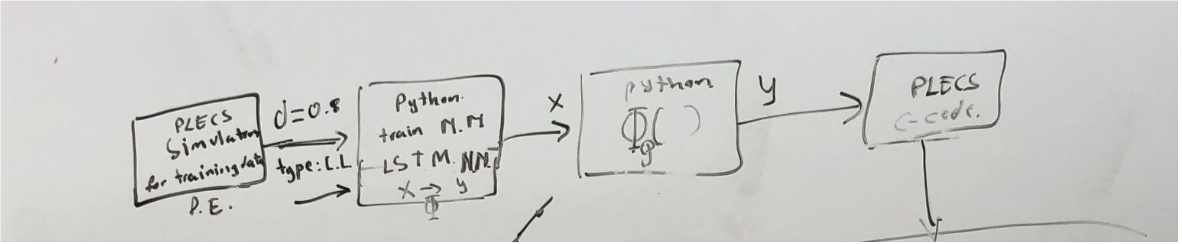
- Fault detectors already exist, though they detect faults by measuring resistance on the line

	Current Method	Our Method
Fault Detection	Measures line resistance	Uses neural network to compare waveforms
Fault Analysis	Can only tell if **a** fault occurred	Can tell if a fault occurs, and what type of fault
Fault Location	“Rough idea” of where fault is located	Pinpoint where the fault is along the line (with 98% accuracy)

Design Decisions

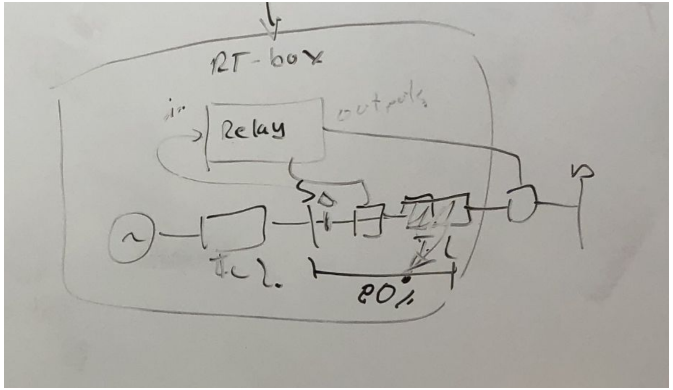
1. The first key design decision is what criteria we will use to train the neural network to properly detect faults and where they happen. Due to the nature of the data we will need to work with, much of this will rely on how we use the voltage and current in the three-phase system to determine if there is a fault, where it is happening, and if we should trip the line.
2. The second key design decision that has been made is the type of neural network we will be making. As decided by the client and advisor, we will be creating a Long Short-Term Memory neural network that will take in the current and voltage over a section of time and decide if there is a fault, where the fault is occurring, what type of fault there is, and if the circuit should trip.
3. The third key design decision that will need to be made is the sample size of the data. This decision will depend on the consistency of the simulation data we retrieve and all the points we wish to test within our simulated system. Based on where we want to test faults, what faults will occur, the voltage and current of the system, how long the lines will be, and how many times we feel we need to run the simulation will determine how much data we will be using to train our AI.

Proposed Design



- Our current method involves us creating a simulation in PLECS with all the appropriate simulink-like components. From here, we can use Python to train a neural network - of which we have several options - to identify the fault and produce a function that will take the waveforms as inputs and derive an output. With this output, we can determine the best course of action that should be taken (ie. open or close the circuit breaker). Once we have this function, we can plug it into a C-code to use in PLECS. Running the model should then produce the results we have been looking for.

Proposed Design



- Our design will operate in the real-world by being attached to a transmission line of some length. This small box is meant to be attached with a CT to read the voltage and current waveforms. It will then look at the data that it is fed to teach itself when to open the breaker that it is connected to.
- The current design would satisfy all requirements by being able to open a circuit breaker if a fault is detected.

- Only concerns are being able to accurately produce a function from available data.
- False positives may lead to a function that is not accurate and will not operate correctly.
- We have questioned our advisor and will continue to research options to lessen this concern.