# Midterm Project Report

My project is a smart grid electrical system in the Unity game engine. The goal of this project is to simulate a real-world electrical system with fault tolerance. Right now, that is an item I am having trouble figuring out how to implement. I have a couple of ideas:

* Having power suppliers/consumers have an automatic switch so if one is not getting/receiving power it will immediately reroute that energy, so it bypasses that faulty component
* Have the batteries provide power if there is too much of a demand and not enough provided by the power suppliers such as if one went down.
* Failure Message system, have everything sent to the smart grid when something fails.

For most of these, I am torn whether having the failure methods being implemented in each component or having them all in the smart grid controller.

A screenshot of a computer

Description automatically generated

As you can see here, all my components have a parent class except the smart grid. It would be easy to implement a fault tolerance function to all components, but it might be easier to have each just send a message to the smart grid component and have it then handle the situation.

Now for the problems visually. Although I would like this project to be visually perfect, I am too new to Unity to really implement a well thought out layout. My original goal to have it in 3D and have a Unity canvas object that would visualize everything. I understand now how difficult that would be for me. Here is what I have now:

A screenshot of a computer

Description automatically generated

* Squares are the Houses, and the group is a neighborhood
* The big rectangle is the smart grid controller and what I hoped to be a visualization of how much energy is being produced and consumed. Still must figure out how to implement that in the project although not a priority now.
* The rectangle on the right is a factory and will use a lot of power.
* The capsules on the top are the batteries
* The triangles on the bottom are the power suppliers and are color coded.

This is a very simple visualization of the smart grid. I plan to only work on making these better after I have all the logic properly implemented.

A screenshot of a computer program

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This is the energy consumer parent code. All its methods are overridden by it’s children and send the results back from their children. If I intend to go with the fault tolerance for every component idea, I will add the basic method here and then implement each in the child class.

A screen shot of a computer program

Description automatically generated

This is the house class, child of consumer. Unity does not do constructors, so I initialize their variables in the start function. Not much to explain here since it is early in the project and right now, I have the smart grid class handling everything right now.

A screen shot of a computer program

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This is the powersupplier class, the parent, and the nuclear power class, a child. Same as the energy consumer class. This would also be one of the components I would add fault tolerance methods to.

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This is the code for the smart grid class. Right now, it has the receive energy function, send energy function, and receiveandsend energy function. The receive energy function calls for energy from the power suppliers and sends it back to the energy consumers. Any surplus will be sent to the batteries through the send energy functions. Right now, I do not have any fault tolerance on what to do if all the batteries are full other than send a debug.log that they are full. The receive and send energy functions does both previous functions and calls it every 2 seconds. The space to use the functions was used for testing.   
A screenshot of a computer program

Description automatically generated

This is what happens as soon as I execute the project. It shows how much energy is produced as it calls the sendenergy function from every power supplier. Then how much was consumed. The surplus was sent to the batteries. This is right now only used for testing, and I plan to have a more thorough approach to this later. Right now, it all works.

**Goals for the Future**

Right now my goals are:

* Figure out how to implement a full fault tolerance system
  + There are many methods I plan on adding and figuring out how much is too much is also a problem
  + Also if I should implement it into each component or in the smart grid
* Put more thorough methods in the smart grid to handle dispersing and storing the energy
  + Right now the functions are only good for testing to make sure every right function is called from the desired component and not the parent class.
* Update the visualizations
  + Right now the scene is very bare and nothing is really shown about what is going on underneath.
  + UI Canvas.
  + Lines that visualize the electricity going through the area and when there is a blackout or somewhere the energy is not reaching.