*Goals and Objectives*

The goal of the project is to design and build a modular and scalable greenhouse unit. The unit will be comprised of integrated features including, but not limited to temperature and humidity sensors, LED grow-lights, misters, bubblers, soil moisture sensors, auxiliary heating, and remote data collection and transmission modules. The data gathered from the various sensors will be used to automate environmental controls that will establish a local environment most conducive to seed germination and plant growth. This data will also be presented on a user-friendly dashboard for trend tracking as well as real-time notifications. The modules will each have an identifier that will distinguish them in reporting. This is to demonstrate how the modules can each be part of a large-scale facility while providing the user with the means of quickly pinpointing areas of production that require maintenance or intervention.

The objectives may be classified broadly as hardware and software. The hardware build will necessitate a custom power supply that can be broken out from a 120VAC source into 3VDC, 5VDC, and 12VDC sources that will power the processing unit, sensors, and auxiliary units maintaining the habitat. The hardware will be integrated into a single, serviceable unit that can be line-replaced with a minimum of connections and fasteners. The objective is to make such a unit truly modular and able to be brought back on line with the least amount of downtime from the moment a fault notification is given with simple maintenance techniques.

The software objectives may further be subdivided into local and remote builds. The local software build will orchestrate the sensors and hardware within the greenhouse module, automating the systems necessary for maintaining the growth environment. The remote software build will provide the means for users to observe, track, and respond to the needs of the system and the plants. It will provide remote control and authority of each module in response to notifications provided by the system as well as independent control of each hardware element at the user’s discretion.

*Features*

The greenhouse module project will feature the use of the Raspberry Pi as the local processor and general I/O source for automation. It will also host the Node-Red platform for populating the user Dashboard. It will also provide the wireless connection and utilize MIT App Inventor allowing user interface with the module and its various sensor and hardware components for maintenance and diagnostics.

*Proposed Methodology*

* Following best practices, the construction of the module hardware will take precedence. The hardware such as the lights, fans, bubblers, and misters will be connected to the general buses and tested for functionality.
* Each sensor will be added and tested progressively and monitored for correct data.
* Software will then be written to harmonize the data and serve the purpose of maintaining the environment.
* A web-based dashboard will then be created to serve as a reporting tool for the gathered data.
* Software will be written to send notifications of meaningful data thresholds to a web-based messaging service.
* Software will be designed to communicate locally via Bluetooth to an Android-based device.
* The Android app will be expanded to allow control of module sensors and hardware.
* The Android app will be enhanced to receive module notifications on predetermined limits and events.
* Seeds will be started and growth will be monitored against control environment not using automation.
* Possible enhancement is the use of color/image sensors to evaluate health of plants.