Project Proposal Report

Team 20

Team Members

Eric Seitz, 2928468

Matthew Showers 2875255

An Huynh 2843661

Jorden Eli Gardner, 2840265

Kevin Dinh 2451012

Terrafarm - Machine Learning

TerraFarm is an automated self-enclosed hydroponic farm suited for small businesses and restaurants who wish to have fresh produce on hand without needing to have a traditional garden space.

Project Description (150-250 words)

· Why is the project being undertaken?

Automated operations have made large advances in the last few years, and people do not like to do anything by manually, especially farming. People usually like to grow plants as a hobby, but they do not always have time to take care of them. Therefore, Terrafarm has come up with an in-home solution in which you can grow productive plants in your own place to supply your needs with little or no effort.

· Describe an opportunity or problem that the project is to address.

This project has a lot of potential because it applies our modern engineering knowledge to something that we take for granted in our everyday lives, farming. The product will automate home grown produce via a hydroponic system. The system will monitor water, mineral, and sunlight intake of the plants and administer resources accordingly. There is a limitation for this project which is that the cost benefit analysis of the produce. It can be pricier than traditional farming. Therefore, the main customers of this project are non-farmers, but restaurant owners and people who love to grow organic products at home.

· What will be the end result of the project?

By the end of this project, we would create a real productive application and achieve more knowledge on machine learning. This could lead to more research into a mass production for in-home private individual use. Terrafarm could be a project that could revolutionize the way we eat. So, we think that this project has a good chance to be successful.

Project Milestones

- Semester 1:
    - Implementation Objective 1 (10/14/2019): Researching on simulation and database
    - Implementation Objective 2 (11/07/2019): Processing test data for desired outputs
        - e.g what the machine should do at a certain temperature range, moisture level, etc
    - Implementation Objective 3 (11/15/2019): Work with the other groups to integrate backend to frontend
    - Implementation Objective 4(01/02/2020): Storing input data from sensors in a database to be accessed by main computation
    - Documentation Objective 1 (10/26/2019): Gantt Charts for work plans by the end of October
- Semester 2:
    - Implementation Objective 1 (04/01/2020): Hashing out crop profiles with the simulation program and creating the database in AWS
    - Implementation Objective 2 (24/02/2020): Implement machine learning algorithms on the data collected
    - Implementation Objective 3 (09/03/2020): Integrate all components from all 3 Terrafarm teams
    - Documentation Objective 1 (06/04/2020): Work on presentation board

Project Budget

Software	Purpose	Cost
PCSE	Environment Simulator	Free
Python, PostgresQL	Programming	Free
AWS	Databasing	Free Tier
SciKitLearn	Machine Learning	Free
Github	Version control	Free

This project is going to use a free programming language such as Python and PostgresQl which means the cost for implementing is minimal. We are going to set up a database to operate the whole project, so we think that the cost for it should vary based on the type of database we want to use/set up. We are currently looking at using the free tier in AWS to get the project going. This will work for the preliminary stages of the project, but as it grows we will have to start paying for the Amazon services

Work Plan:

Research models and simulations - Eric

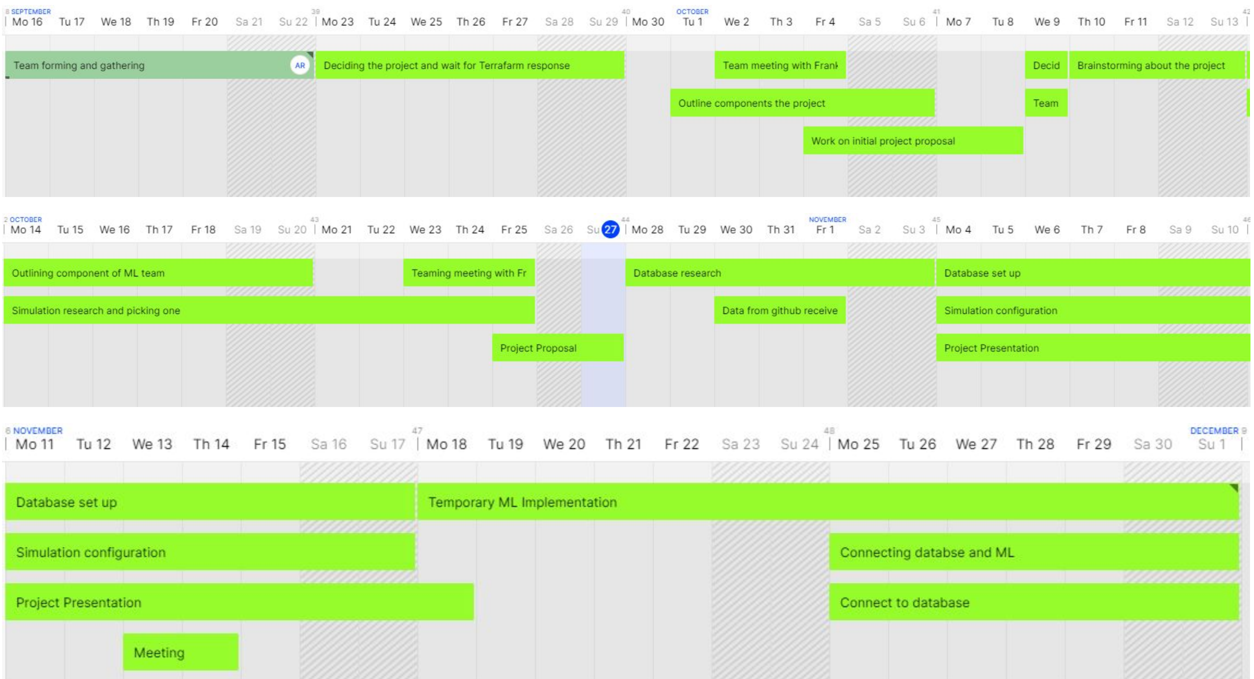
Machine Learning- Anh

Databasing -Matt/Eric

Integration/APIs - Kevin

Gantt Charts

First Semester



Second Semester

Preliminary Project Design

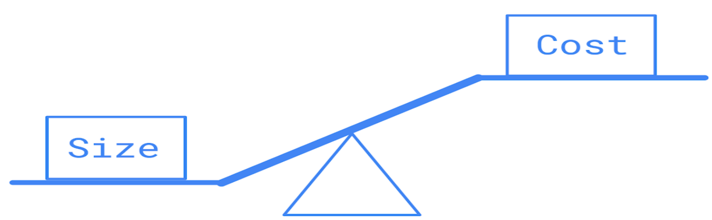
· **How the software works**

The machine learning algorithm is going to use data from the database to generate the best way to maintain and improve the growth of the plants. Then, the machine would send the optimized data back to the database so the operating system and user interface could use that data to do the job. The operating system would use the optimized data to decide how the environment is going to be generated. On the other hand, the user interface could show the optimized data to users and get input from users to store back to the database and help the operating system to perform the task.

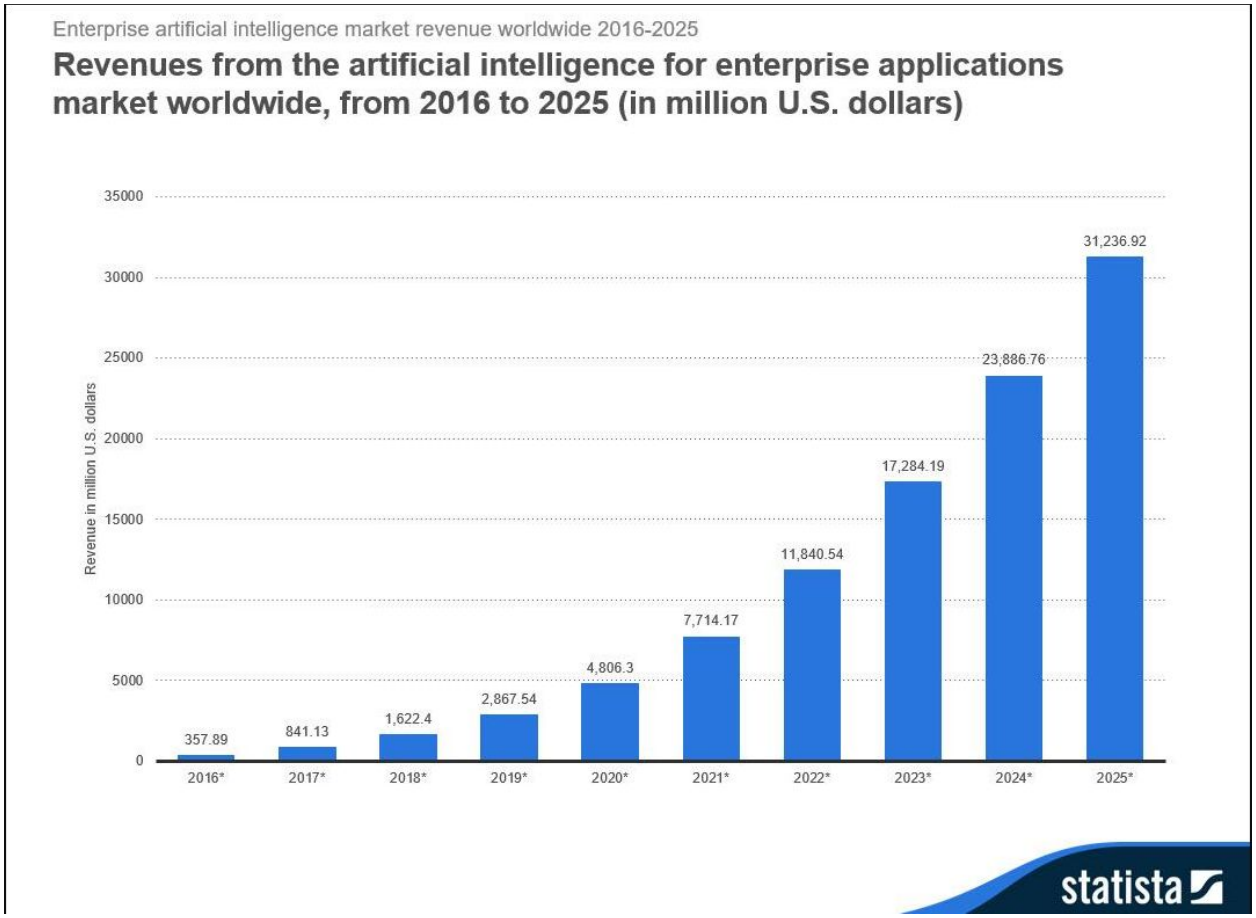
· **Design constraints (see BlackBoard under Assignments for a description of design constraints)**

Our biggest limitation is the ability to create a sizable product that can be used in-home. Most families already have many appliances such as refrigerators, freezers, washers and dryers, so adding another unit the same size would be cumbersome. Aiming for a unit that would be the size of any other household appliance would be the goal. The biggest problem with that is the crop yield would probably be small, but for a common sized family of four this would be realistically efficient. The other target group would be restaurants. Many restaurants would have larger spaces to hold the unit, so we might be able to tailor a different model to their needs. There are many large restaurants that could utilize this product or alternatively they could be customized and built on rooftops and we could integrate real sunlight and rain water into the machine. At an efficiency standpoint this idea would be the best. The even greater task would be creating a customized unit for each restaurant and house to maximize their wants and needs.

On top of making a sizable unit that would be convenient for households and restaurants alike, the cost benefit of a unit to be affordable to the average household or restaurant income would be another hard task to meet. Depending on each situation, a household or restaurant could spend less going out to get groceries at a store or the markets and making deals to get stuff as cheap as they could. As it is currently appliances can go for as low as one-hundred dollars. It would be incredibly difficult to create something that had a high production rate by the masses at an affordable price. The only positive side for our product is to grow produce that can be specifically tailored to one's taste or produce that can't be easily obtained in the area which they live. Also, restaurants can grow produce uniquely to them or if something is not in season they could simply turn the settings on the unit and produce them. There can also be an argument made about earth sustainability. The larger the population grows the more farming land will be needed to feed those people. If there was a product out there that would allow people to farm vertically we could save a plethora of space in the long run and people wouldn't have to travel to grocery stores or markets to get common produce.



A technical constraint that we have run into is the limitation of machine learning. Machine learning is still pretty young compared to the technology that has existed in today's age. Since, machine learning is still young databases haven't been largely developed especially to the customization that we are trying to achieve. That would take many years of data collection to see all the different effects that can be made with resource control. Although with the process and the success of our product we could build our own database and be a big proprietor of the data collection for crops and produce. Another issue that might come up in data collection is cost benefit analysis. In the world as we know there are many types of crops that can be grown and within those types they can have up to dozens of regional variations. The data might get out of hand if we have to build a database for each kind of type. Again, the cost for servers and storage might end up increasing the cost of the unit and making it even less affordable to our target audience.



Source: Statista

Another technical issue that may be concerning is the longevity of the technology. Machine learning is definitely a newer technology that is still in the process of becoming a common use thing amongst program developers. The use of deep learning and other AI technologies could become more popular and easier to utilize. With a small technology breakthrough machine learning could be obsolete and another technology would be more beneficial and efficient. Also, with GMOs and things like artificial meat that is catching on currently the market for artificial foods might sky rocket and the need for real foods might be a thing of the past. These things take a smaller amount of space and overtime have been quite affordable to the public. Some of these products are created directly from laboratories and do not require any time of organic products. The argument for our product here is the natural and organic procedure of the produce. If done correctly it can be very efficient and effective for a restaurant and household.

Since, the cost it takes to purchase this device could be a limitation when people are thinking about getting one. We need to persuade people why they need to purchase this product instead of using normal vegetables from the market. People can just go to the market and buy everything they need at a reasonable price. The only advantage about this is the minimum cost of transport. Since you grow your own products you do not really need to import/buy vegetables.

However, the cost that it needs to set up the environment for automated farming is still quite high.

Ethical Issues

This project would benefit our society as a whole on a small and large scale, but they also could be a problem at the same time. First, there are many restaurants who want to grow their own produce, because they want to control the quality and flavor of their vegetables. Our device would try to improve the quality of vegetables and safeness of products, because the restaurant would know where and how exactly how their vegetables were grown. However, by growing their own product, the product that restaurants purchased from market would slightly decrease by now, and could increase in the future. In addition, if automated farming would be popular in the future, the vegetable market would keep decreasing as a result.

Second, automated farming like Terrafarm could reduce the amount of workforce we need in traditional farming, and we could optimize the growth of the plant better. We cannot really replace traditional farming with automated farming currently, because we do not have enough space and technology to do so. Also, people are more comfortable with traditional farming. Although if the rate of automated farming keeps increasing in the next few years, traditional farming would be slowly replaced by automated farming. Unfortunately, farmers would need to change to adapt to it. It could be a serious problem if we do not plan ahead. Otherwise, automated farming would become more compact to save space and improve the living standard of people.

Intellectual Property Issues

Since, this is not the first automated farming unit, Terrafarm would not really have the rights to protect the uniqueness of the idea. They would have to face the future projects of other people with the same types of ideas. However, they could protect their own architect in design such as their device designs and ML algorithms, which would keep their uniqueness alive among other companies. Due to the short time of the project, Terrafarm wants to use an open source machine learning resources and then modify it to fit their purpose, which would not be effective when it comes to intellectual property. Terrafarm would need to put more effort on how to protect and defend themselves from other companies with the same idea. Automated farming is not a very popular thing and people tend to not focus a lot on it, so I think the chance that Terrafarm would get in this kind of trouble is very low, but they would need a contingency plan if something were to happen. Therefore, the only way that they could solve this problem is to try to set up their trademark as soon as they can for further developments.

Change Log

· Explain what parts of the Initial Project Description were changed and why

· 1-2 sentences per change

We did not know what the role that we would take with the Terrafarm project, so we did not come up with specific details in Initial Project Description. Therefore we updated a couple of things:

- We updated some details and dates from our milestones because we know the process of how to work with Terrafarm.
- We updated our project budget as well because we now know what we need for our part in the project.
- We finalized what we were doing with the database. There were some complications we ran into trying to find good libraries that would bridge the gap from Python and MySQL, but we couldn't find a great solution. We decided to go with PosgresQL for databasing instead. We are going with AWS, because they have a large amount of resources under the free tier.
- We switched from TensorFlow to Scikitlearn, because Scikitlearn is more suited for the project. Tensorflow is more image based and would take up a lot of space and resources.