Team ID: MULT61
Schools: Eldorado High School, NexGen Academy
Area of Science: Botanical Science
Project Title: The Farmer in the Miniature Dell
Mentors: Patty Meyers, Neil Haagenson, Suzy Andrego
Sponsor Teacher: Karen Glennon, Sharee Lunsford, Patty Meyer
Team Members: Savannah Phelps, Reyanna Fromme, Isabella Montoya

Problem Definition:

Our project is about making the idea of optimized farming mathematical, accessible, and accurate. Farming is a essential facet of society, and up and coming farmers are especially in the spotlight. The 2014 Farm Act highlights this with its increased funding for beginning farmers and ranchers, its raised acreage allowance, and its funding of a new program to help veteran farmers and for "socially disadvantaged" farmers.

Recently, the market for greenhouse-grown tomatoes has boomed because of the increased functionality. From the USDA funded magazine, Amber Waves: "Seasonality is a major factor shaping the North American fresh tomato industry. Consumers increasingly demand a steady year-round supply ... of tomato products. … Greenhouse supplies vary over time and across geographical regions, and marketers often try to extend their seasons to periods typically marked by lower tomato production and higher prices, … . The result has been the development of an integrated North American greenhouse tomato industry that can provide the variety of tomato products that consumers demand throughout the year."

If optimized farming such as greenhouse or micro farming were utilized, tomato production would rapidly increase. Our project will help provide a bridge for new or small-scale farmers to optimize their farms to the best of their ability and thus grow more and better produce.

Problem Solution:

Our project will be an interactive model in which farmers can adjust sliders that control variables relating to sungold tomato growth (such as light, watering, nutrient broadcasting, pollenation, tobacco content, etc.). When the farmer does this, a rough physical 3D image will be displayed, which will give an idea how the variables' adjustment impact the plant. Plant information will also be displayed, included estimated dimensions and the FAO's Standard for Tomatoes quality classification.

To accomplish this, we will find information online and in studies completed in New Mexico about tomato growth with adjusted conditions. Then we will compare that data to data collected by monitoring a sungold tomato plant our mentor is growing locally.

We will compile a list of "optimums" and "extremes" for plant growth. This list will have a number or description for each variable that majorly affects tomato growth that when used, produces either the best, or the worst crop on either end of the spectrum. We believe that for almost every variable there is a bell-curve. At the top is the variable setting for maximization, and at either end (giving the plant too much or too little) the growth minimized.

Next, we will code a program in Python (dubbed the “iteration machine”) that can estimate the bell-curve and fill in all the data points. This information will then be converted into sliders, which display the data points.

Finally, each variables' data points will be connected to a visual and informational output. This will be our final model. It will be in the form of a series of sliders labeled with variables next to a viewing screen with a basic 3D illustration of the tomato the sliders inputs will produce. We will use a Python plugin called vpython to create the 3D images.

Expected Results:

We will, in the end, have a Python program in which you can graphically adjust variables (such as watering, nutrient broadcasting, temperature, tobacco content, pollination method, planter material, and light exposure) and receive a visual representation of what these variables’ adjustment will do.

If this project is done correctly, a beginning farmer who may not have the resources needed to meet the optimum values for growth-affecting variables could adjust the sliders to replicate his/her set up and see if their tomatoes will meet the quality and quantity they need to be successful. In short, our project will predict the future of a sungold tomato plant based on the variables affecting it.

From a USDA Economic Brief: “For 35 studies published over 1965-2005 that were reviewed by Professors Wallace Huffman (Iowa State University) and Robert Evenson (Yale University), the median estimate of the social rate of return was 45 percent per year. As a rough approximation, this implies that each dollar spent on agricultural research returned about $10 worth of benefits to the economy.”

This means the more we study and develop agricultural efficiency, the better the system becomes, eventually leading to a drastic increase in revenue. We plan to briefly verify our results with our experienced mentor who has years to experience observing sungold tomato growth.

Progress to Date:

After, kickoff we focused on finding information for our project. This included looking for online resources, articles, and mentors that could set our project in the correct direction. After doing extensive research on tomatoes in general and drafting our project, we came to realize a vital flaw.

We discovered that our end result could theoretically just be easily found in a couple web searches. Because of this, one of our mentors suggested we view our project more in the light of cementing previous knowledge graphically into one resource, rather than discovering something unknown.

We have met with the former president of the New Mexico Garden Clubs Inc. Suzy Andrego, who gave us a wonderful insight into what all goes into growing the best possible plant, and shared some of her technical gardening expertise. She has also made arrangements to document the growth of a sungold tomato she will plant from a seed, and monitor her greenhouse’s conditions. We will be using this data to validate the information we find in publications. From her, we began to see how broad and beneficial our project could be. She answered many questions we had that we had not known before.

We have completed research and found numerous local websites giving growth recommendations. We have seen and cited studies done on tomato sales and read book excerpts on the history of tomato growing and their needs in modern times.

We have begun learning Python online and searching for a mentor to complete the modular program.

Citations:

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