## **Project Names**

The More You Know, The More You Grow

## **Team Questions**

**Describe the team composition and skills to achieve this project.**

Shivam Gupta is currently a mechanical engineering student working in a manufacturing sustainability lab and has working knowledge of manufacturing processes and solid model designing. He has also worked with programing and integrating sensors with Arduino using C programing language in his coursework (EME 5). He also has hands on experience with milling machines, lathes, drills and 3D printing which he will use in this project to make a design and create it using metal fabrication and other manufacturing processes.

Matthew Sam is a Neurobiology, Physiology and Behavior student currently an interning at a physical therapy outpatient clinic in South Davis and interacts with a diversity of patients. He is familiar with basic plant anatomy, and has taken Introductory Plant Biology at UC Davis (BIS 2C), as well as AP Environmental Science in high school. In high school he planted morning glory, a vine plant within the convolvulaceae family, where he successfully contributed to the biodiversity within the Lowell High School's garden. The knowledge of plant anatomy will allow him to contribute to this sustainable plant research project. In addition, he has experience using linear regression through R Studio.

Viktoria Haghani works in a lab concerning small-scale urban agriculture, and actively interacts with farms and farm owners. She also has experience with different farming techniques and irrigation systems, as she presented a pitch proposal for an agricultural irrigation-related project during the 2016-2017 school year through Net Impact, and received funding for her project. Additionally, she's familiar with R Studio and LaTeX coding.

Diwash Shrestha is currently a biochemistry student. He has three years of experience with gardening tomatoes, spinach, and bell peppers and one year of experience programming in the Python language.

## **Project Details**

**Describe the overall goals of the project.**

The purpose of the project is to develop a decision-making tool that is able to determine the most appropriate time to water plants, and the amount of water that should be given to each respective plant. This tool will be based on the data collected from the specific plant species, soil composition and properties (i.e. field capacity, yield threshold deficit, permanent wilting point), environmental conditions, such as humidity and temperature, and the data provided by soil sensors.

**How will the project be implemented? Please provide a timeline detailing steps and deliverables in as much detail as possible.**

The initial phase would be to design a model for the irrigation system using 3D solid modeling using Computer Aided Design software Solidworks. From there we will integrate a control system into the model. The control system will be mainly composed of Raspberry Pi or Arduino, depending on the type of functions and processing type we desire. The work on this model should be completed by end of March 2018.

Once the model is created we will fabricate the parts necessary or buy the components needed for the hardware. After all the hardware is procured, we will start assembly of the basic irrigation system using sprinkles and drip systems. Lastly we will test this system on a field and record the results. This process should be complete by April 20th, 2018.

After creating the hardware, we will create a decision making application using the data on evapotranspiration for specific plants, the soil properties (i.e. field capacity, yield threshold deficit, permanent wilting point), environmental conditions, such as humidity and temperature, and the data provided by soil sensors. The application will analyze the data on these properties and will be able to make an effective decision on when to water the plants. We expect this to be done by the 10th of May 2018.

Once we have created the application for this irrigation system, we will field test this on a field using specific parameters. We will record the results and accordingly adjust and improve the program to make the irrigation system operate more precisely. This will be our experimental stage as we will be conducting experiments with the system and obtaining as much data as we can get to further enhance the efficiency of our system. This process will be conducted in May and June and continued until the date of showcase.

**How does your project address "tech for social good" (i.e., healthy, sustainable, connected, and equitable livelihoods)?**

As we have observed in the past, California has had severe droughts and most of the water during that time is used for agriculture. Our goal of this project is to create a model that can use a decision making application to create variable rate irrigation, which will in turn directly leads to conservation of water when compared to normal irrigation systems. The project also addresses the need for sustainability in irrigation systems, and how they can be more water efficient when integrated with technology. Another important concern our project addresses is the use of water with easily accessible small scale urban farming and how the methods for urban farming can be made better.

**What are the quantitative and/or qualitative metrics to measure success of your project?**

To measure the success of the project, we will compare it to the “standard” irrigation system available in the market . We will measure the amount of water that a normal irrigation system needs for a testing field and then compare it to our own experimental irrigation system. The values used to find the efficiency of our system would be the water used for each plant and comparing it to the amount of water used of each plant with normal irrigation system. We will also compare the ability to maintain field capacity for specific plants with our system and a normal irrigation system.

To compare the yield of our system we will use two experimental models with grass. One of the models we will be using is our controlled system and the other will be given water using the normal irrigation system. After a certain period of time we will then compare the growth of the grass from the two setups by comparing the amount of biomass, height, and pH from both conditions to find the range of efficiency with our model.

**How will you measure the social good benefits?**

Socially beneficial aspects will be measured through the amount of water saved by using our automated precision irrigation system when compared to the normal irrigation systems. The amount of water saved will then be used to calculate how much water can be saved if our model is implemented on a large scale, and how it affects the groundwater level in the long run.

**What is your plan for publicizing your project? Do you have any specific outreach goals?**

We plan to publicize this model by showing its efficiency on the small scale and then use this to setup a larger scale model with the help of UC Davis student farm. Following the data collection for the test trial, we will try to pitch our model to local small-scale urban farmers in Yolo County. Our goal for outreach is to show small-scale farmers how using and integrating technology with irrigation systems can be useful in saving water and how it affects the growth of plants. We also plan to show how this model will help in sustaining the groundwater level in California.

**Does your project address diversity and inclusion in tech? If yes, please describe**

Our project tries to include diversity as we are trying to create a model that helps small-scale urban agriculture learn more about using technology in their irrigation systems. The model we create will take into consideration the general knowledge a farmer has.The model is meant to be user-friendly and accessible for any farmer to easily learn more about, and implement the our irrigation model on a larger scale. This will further lead them to make changes to model or try to create their own models which can be implemented on their farms using our decision making control system.