Team 'The Sign' – Smart Environments

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1. Short description of your challenge/problem

We have identified the following problems that we aimed to solve with our irrigation system: water waste and the pesticide issue.

Many people are worried about whether their food had ever been touched by pesticides or other such chemicals and in some parts of the world it is almost impossible to find vegetables and fruits that are completely organic or that have never been touched by pesticides and insecticides. Having access to fully organic food is something everyone should benefit from, regardless of where they live or what their income is. One way to combat this is to encourage people to maybe grow their own food or buy from local markets and farmers. This way, people are more informed about their food and they can also support local businesses.

Moreover, another problem that comes up when using pesticides is the fact that it can create an imbalance in the eco-system which may not even get rid of the pests that affect the crops. Distancing ourselves from pesticides by being more mindful of where our food comes from is definitely something that needs to be tackled in the near future, in order to improve our health and lifestyle. One of the more harmful things to the environment is the chemicals included in the pesticides that are used on big farms, however small privately owned farms do not require the huge amount of pesticides that farms do, so our product offers a simple solution to this problem by allowing anyone to build their own garden and have the ability to not only help the environment but to have access to fresh vegetables and fruits that have not been tainted by the use of harmful pesticides.

The second main problem we have identified is water waste in agriculture. Often, water is used incorrectly when it comes to agriculture. With more and more people on earth and a rapidly advancing climate change, water management has become a big problem for farmers. Now you need to know how much water you need, if you need to water your crops or what crops you need to water. Either you water too much or too little. This not only wastes water, but it can also destroy the crops.

2. Short description of your solution

Our main focus when choosing a feasible solution was to make sure that the end-product will have an impact and that it covers several issues we want to address, such as cost-effectiveness and environmentally-friendliness. Another factor we took into consideration when making our choice was what we want our base product to be, based on our current technological skill set, and how we can improve it and enhance it in the future. Our main focus is making a base product that we can produce at a larger scale and that can be further upgraded.

The motivation for our choice consists of 2 main aspects: being cost effective and being environmentally friendly.

1) Cost-effective:

Our product is extremely cost-effective due to its general availability that stems from the materials we're planning on using. The product is based on open-source content, thus making it accessible to the general public.

The fact that the agriculture industry doesn't allow small farmers or businesses to develop leads to people lacking interest in the source of their food. By making our product accessible, we drastically reduce the unnecessary costs that come with having a personal garden. Moreover, we encourage people to become more involved when it comes to being informed about their food.

From a business point of view, being cost-effective is of utmost importance. Having a good idea isn't enough, we also need to know how to manage our resources in order to be able to further develop and evolve our product.

Our project's cost effectiveness will not only be beneficial for us, it will also have a positive effect on our customers.

2) Environmentally friendly:

This product would be able to give anyone the ability to own and maintain their own little farm or garden, even people that live in huge cities would be able to grow their own crops. This could help reduce pollution in many different ways, for example if everyone owns one of these little gardens the need for huge farmlands would decrease, since many people could provide themselves some of the most common vegetables, leading to the reduction of deforestation. Big cities usually lack the space to plant various trees, plants and flowers this leads not only to an aesthetic problem but to other more serious ones as well. More specifically due to the lack of greenery the production of CO2 remains unchecked since there is nothing to absorb it, but if everyone has their own small garden in their balcony or on their roof then that problem would be massively reduced and the air in large cities would be much cleaner and healthier. Also it is known that during the summer the heat is unbearable if you live in a big city due to the rooftops of buildings absorbing heat and light, then radiating it back into the area leading to many citizens using the air-conditioner almost non-stop, this indirectly harms the environment, since the electrical factories have to produce even more pollution during that time, to reduce the “heat island effect”, the plants that will be located in personal gardens around the city can absorb some of the sunlight and provide shade for the buildings, which also reduces cooling bills in the long run.

Lastly one of the more harmful things to the environment is the chemicals included in the pesticides that are used on big farms, however small privately owned farms do not require the huge amount of pesticides that farms do, so our product offers a simple solution to this problem by allowing anyone to build their own garden and have the ability to not only help the environment but to have access to fresh vegetables and fruits that have not been tainted by the use of harmful pesticides.

3. Short description of method and tools used (software, hardware)

The prototype of this project consists of a number of components:

- Sensor package;
- CPU & Processing unit to read data from sensors;
- Wireless communication component;
- User interface;
- 3D printed case;

a) Sensor Package

In order to acquire data from the plant and its environment, a sensor package is to be assembled: moisture sensor, PH sensor (stretch goal), Nitrogen sensor (stretch goal), Phosphor sensor (stretch goal).

The moisture sensor will be selected to be a low-cost solution. As both the scale and importance of the accuracy is not crucial and the economic resources available in the hobbyist sector is minimal. Therefore, the FC-28 moisture sensor is a solid option which is to be considered.

b) Processing unit

The Central Processing Unit for this project will be a raspberry pi 3B for a number of reasons: sufficient processing power, built in WiFi and Bluetooth transmitter/receiver, option for external memory addition, LAN port, widely used.

The Processing unit for the individual modules will be a NodeMCU v3 for a number of reasons: small size, low-cost, build-in wifi transmitter/receiver, right amount of processing power and memory.

c) Wireless communication
The wireless communication will be done with the build-in chips that are on the processing units. Furthermore, the Raspberry pi will most likely be connected via LAN to the router (for the prototype).

d) User interface
In order to inform the user that the plants ought to be watered, the system needs a User Interface to communicate that to the user. This will be done using a smartphone, as most households have at least one of these devices. It is planned to use a website instead of a Mobile app as it will be easier to implement for the prototype. If this product were to be finalized the app would be the better option.
The implementation of the website has already started, having three main pages planned out. The home page will include a menu at the top (with 3 buttons), a small window welcoming the user to the website, a button for quick access to the plant pots and a window that shows the weather forecast (we connected this option to a live weather forecast site for Enschede, which means that all the values are displayed in real time and are accurate). The 'My pots' page will also include the same menu at the top, along with information about each separate plant pot. Each pot has its own section with a small icon (which the user can choose) with the respective plant and with a few lines of information such as: name, moisture level, last time the plant was watered and when the crop was first planted. There will also be a moisture level bar (5 water droplet icons), that fills up/decreases according to the amount of water that the plant needs.
The third page is the 'Alerts/Notifications' page is for immediate alerts, such as plants that are extremely low on water or if a tank needs to be refilled.

e) 3D printed case

Our 3D printed case was designed by Konrad. Here is how he did it:

How did I make the 3D Model?
Because we wanted to have a product that involves already existing items, I first had to take measurements of all of them. Thankfully, Robin already did that.
Then, I started Fusion 360 where I can design using sketches and extrusions.
The first step was to add the given information into a sketch. In my car that was the position of holes in the Circuit boards of the sensor and the ESP. From that point, I could work around the whole item. I made sure that it looks nice and all the parts are covered.
Lastly, I tried to add our teams name and exported the files so they can be printed.

f) Data Collection
To collect all the necessary data, we will rely on several inputs. These will consist of databases, user input, and weather forecasts.
Firstly, databases will provide the backbone of our product. We will register the water needs of plants and the nutritional composition of the soil. For the future, we may also look into machine learning to improve our databases. The weather forecast for an area provides us with up-to-date information, whether we have to water the plant or not.
Lastly, having user input will provide a way to improve our databases as well as determine if we need to enable or disable features.

It would not make sense to use the weather forecast when your plants are inside. Our data acquisition plays together to provide the user with the best experience possible.

g) Data use / analysis

The Central Processing Unit in this design is a Raspberry pi 3. This CPU will also be physically connected to the database in order to keep everything centralized. All the individual NodeMCU modules will be connected to the CPU with a WiFi-connection. The CPU will store all the addresses as separate units and will add information such as the type of plant, it being indoors/outdoors and the type of soil. The CPU will be the decision center for the NodeMCU modules and will take most of the processing of the data. This is to make the separate modules as power efficient as possible (since they will most likely be running on batteries). Furthermore, the modules will ping the CPU every 5 to 10 minutes to communicate. Therefore, the WiFi modules don't have to keep running all day long, but just on certain intervals (saving a lot of power). In the android app a said CPU will be connected to the user. The CPU will act as the database and will send information to the app if it is asked to do so. Furthermore, the app can communicate to the CPU by giving custom commands, which it will act upon in the next cycle.

We decided to plant lettuce in our pot. Even though, lettuce is not a demanding plant one thing is crucial for its growth - water. Excess water in the soil causes the appearance of algae and lichen on the surface of seedling containers and the severity of soil-borne diseases. Insufficiency of water, however, generates a decrease in yield and deterioration of its quality. Moreover, fluctuations in the humidity of the substrate limit the uptake of calcium, and its lack in tissues causes a collapse of cell walls, leakage of milk juice and drying of the edges of the leaves. Consequently, providing the lettuce with the exact amount of water is essential. In our calculations, for the amount of water, we included the place of growth of this plant (indoor) as the air humidity indoors is lower than outside. Furthermore, the optimal soil pH for lettuce is from 6 to 6.5. The soil in our pot has a pH from 5.6 - 6.6, so it is almost perfect for this plant.

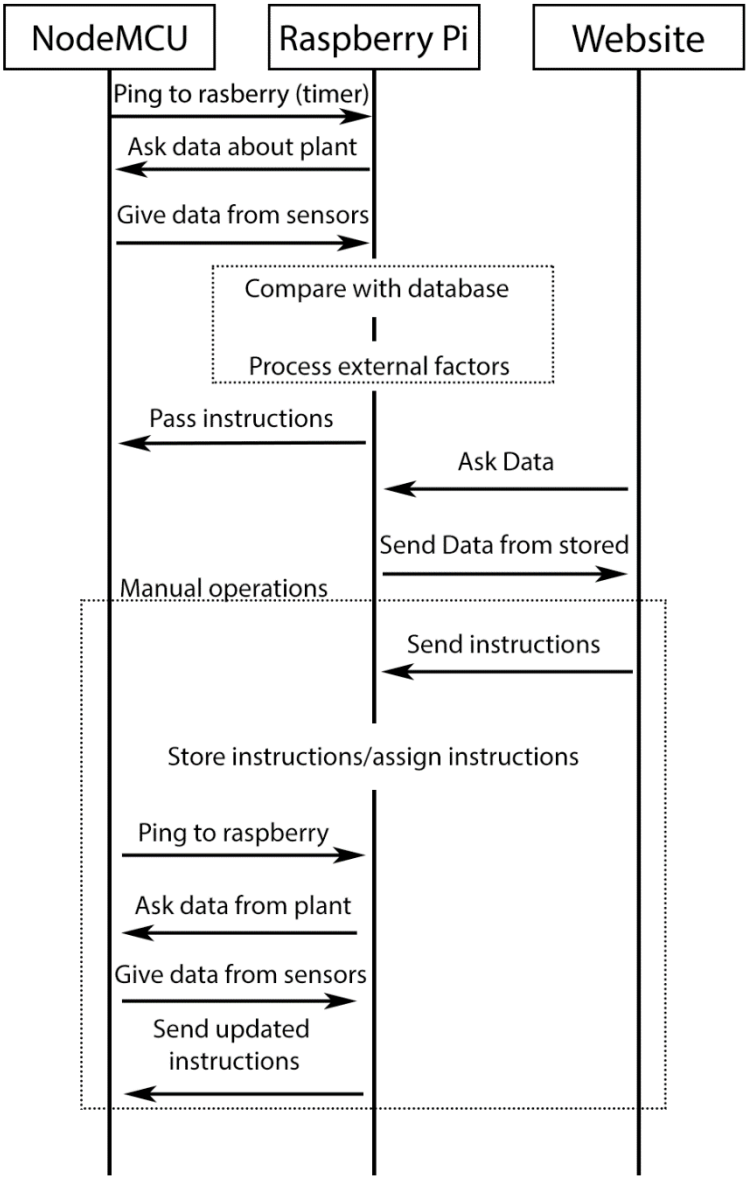
4. Short description of results/observations/data gathered/graphs

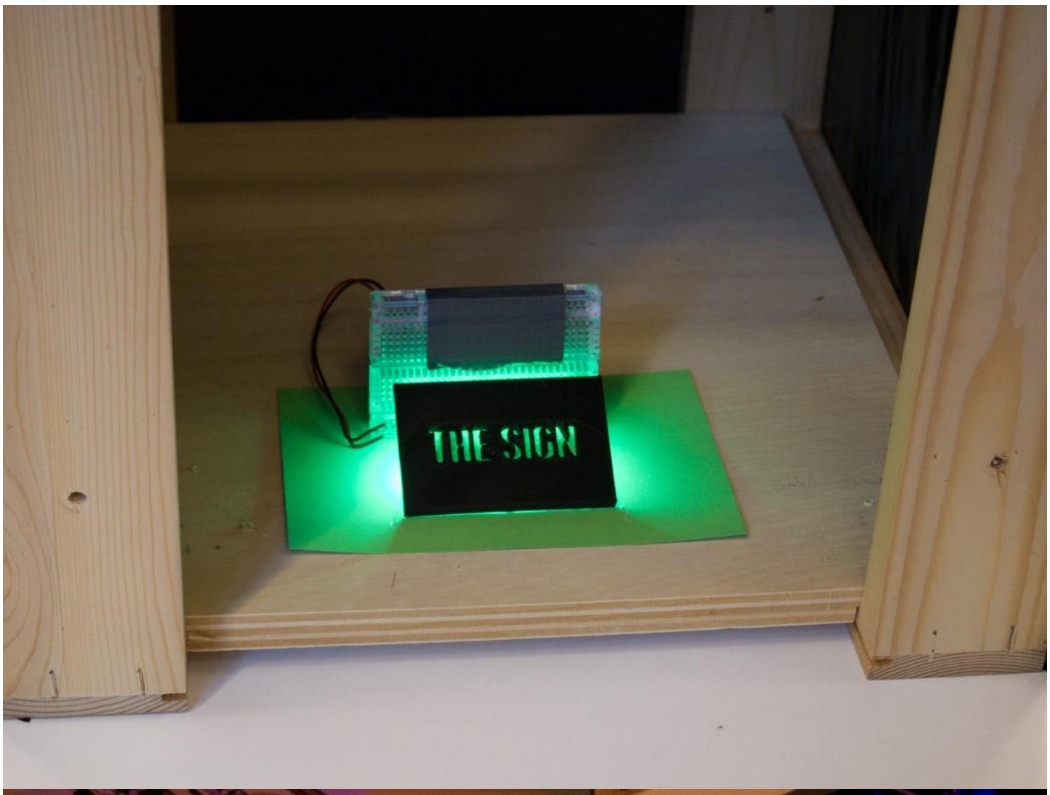
Our project's purpose was based around two main concerns: water waste and people not being informed about the quality of their food. Our irrigation system minimizes water waste drastically by collecting data from the moisture sensor. Our aim was to try to get make people aware of the importance of preventing water waste and our product does exactly that. Furthermore, we also cover the second part of our main purpose, which is providing a healthier, more sustainable option for people when it comes to bio-food.

In terms of functionality, we encountered some problems regarding the connectivity between the components. This happened because our prototype pumps were too weak for the system, so we had to use a more powerful pump, which was too difficult to connect to the Arduino board.

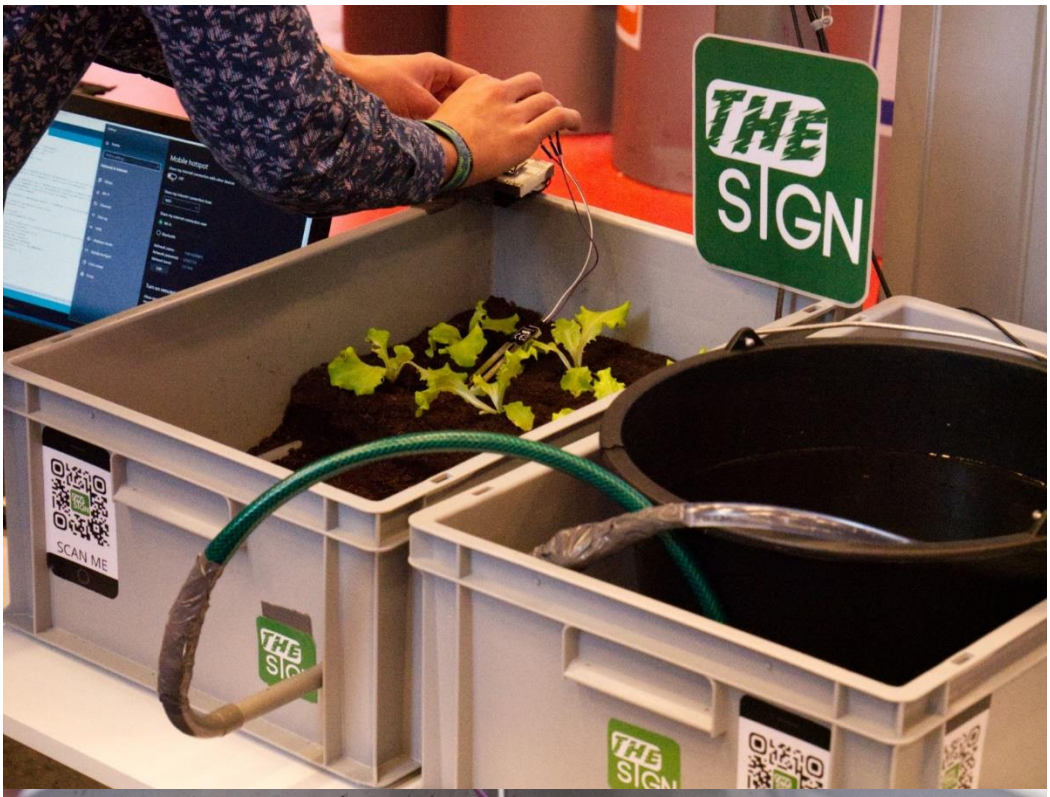
Another aspect we focused on was the promotional video for our product. Our cameraman, Konrad Rempe, put together scenes from our work process. The video has a time lapse of one of our work sessions, along with trips to construction stores, a lot of trial and error and the end result. The video truly encapsulates our journey as a team and showcases the amount of work we put in this project.

To conclude, the whole team is very happy with the development of the project and we are pleased to have a working prototype. At the end of the day our goal is to show the world that there is always an eco-friendly alternative. With our product, consumers will no longer have to worry about the quality of their fruits and vegetables. In the future, people no longer have to blindly trust corporations, they can actually take control and lead a healthy lifestyle.




THE SIGN


Robin, welcome back!
How are you today?
My pot(s)
About us
7°C
MacBook Air


THE SIGN
SCAN ME


THE
SIGN