Automated Irrigation System: A Modern Approach to Farming

Ramesh was seating under a tree in his father's farm. There are many such trees, purposefully planted to save the crops from the scorching sun. These trees are known as shading trees. The farming area is being sowed with seeds. In a few days, saplings will come out, followed by harvesting. The workers are watering the land manually. Haria, Ganesh, and Rahim. There are four more of the workers; but they have gone to their home town for long and are not back yet. Ramesh could see his father coming towards him from the other end of the farm. He could see the worry in his father's face from distance. Ramesh know, his father is worried about the absence of the workers. He stood up, as his father approached nearby.

"Ramesh, can you bunk school for two days and help me in the farm?"

"Of course baba!"

"That's a respite! Thank you"

His father turned back and headed towards the workers.

Ramesh could figure out that it's not respite yet for his father, despite of whatever he said. He knows, father will not be at ease till all the workers are back. The watering process of the field is hindered due to their absence.

What if, the process of watering the field could have been automated? That would remove the problem of worker's absence, once and for all. Thought Ramesh. He need to talk to Jatin Sir, his science teacher, now!

When Ramesh reached Jatin Sir's house, he could see Sir to be busy fixing an old transistor radio.

"Hey, Ramesh! What made you give a visit at this hour in a Sunday?"

"Sir, I need your help."

"Be seated first".

Listening to Ramesh's problem, Jatin Sir gave a smile.

"Take me to your father's farm."

On reaching the farm, Jatin Sir observed the entire field carefully. It appeared to Ramesh that Sir was observing the shading trees with equal carefulness, as he was observing the other parts of the field.

"Sir, is there something specific you are looking for, in these trees?"

"Yes son! Automating the irrigation alone won't solve your problem."

"Why Sir?"

"Let me explain. The watering of the land should be done as per the water requirement of the soil, right?"

"Right Sir"

"Water requirement cannot be same for this entire stretch of land. For example, the soil right under this tree is getting less of sunlight as compared to a portion of the farm, which is uncovered."

"Absolutely true Sir."

"But when you manually water the field, most of the time, you water every part of the field equally. Am I right?"

"Shouldn't we do that, Sir?"

"What do you think? If we overwater a patch of land, it might be bad for crop health. Therefore, we should have a mechanism to know the water requirement for different parts of this farm. Larger the farm size, more heterogeneous will be the water retaining capacity of the soil, for different parts of the farm. Therefore, different parts of the farm would have different water requirement, and they should be watered accordingly. Moreover, different crops have different watering requirements."

"Correct Sir! But how do we get to know the exact water requirement for different patches of the land. Haria, Ganesh, and others have been watering the land based on their experience."

"True, but what if, tomorrow someone like you and I are asked to water the land? We hardly know the difference in water requirement between cereals and flowers. Moreover, manual irrigation can never match an automated one. Precision agriculture is an all new branch that addresses all these concerns. Through precision agriculture, we can know the exact water content and requirement for a given patch of land and therefore can water as per requirement through automated irrigation technique."

"Could you explain in bit more detail, Sir?"

"Wait a while."

When Ramesh called his father, he saw Jatin Sir to be searching for some content in his smart phone.

After the initial greetings, Jatin Sir showed Ramesh and his father the following drawing in his smart phone.

Figure 1. Logical diagram for automatic irrigation system [1].

"Look at this figure. Consider the green parallelogram to be your farm. This figure is from a research paper by two of my friends [1]. To address this problem of varying soil moisture level, they suggested to logically divide the farmland into small rectangular patches. The size of the patches is best suited to be of 30m x 30m dimension. Could be more. Doesn't matter much."

"Sir what are the blue dots within each patch?"

"Good question! These dots are the humidity sensors. These sensors will keep monitoring the relative humidity of the patch, they are placed in. In scientific term, we will call them as nodes. You see, every crop has a specific water requirement. Based on that, it is possible to set the humidity threshold in each of the nodes. Relative humidity of a patch of land is actually the measure of the water level in that patch. The moment humidity in a specific patch goes below the specified threshold, the node in that patch will report the matter to one of the four sinks placed at the four corners of the field."

"What is a sink, Sir?"

"Well, you can consider them as the stations, from where automated irrigation can be initiated. The number of sinks can be as low as 1."

"You mean Sir, only those patches will be watered where water level has gone down below the specified threshold?"

"Correct!"

"Now I see, how much water we can save this way!" Ramesh was elated.

"Absolutely! You only end up watering those patches, where water level is below required threshold, and not the entire field! When the water level of the patch under consideration comes back to normal, you stop watering the patch. And the entire process is automated. Isn't that amazing, Ramesh?"

"It is, Sir! I bet!"

"So to start with, you need to create a POC, or proof of concept. That is, a miniature working model for the entire farm."

"If you could explain a bit more, Sir."

"Sure. You can create a POC for the plants you have at home. All you will need is the following components for creating a POC:

Arduino Uno

Soil Moisture sensor

Bread board + cables

Cables - [40x male to male], [40x female to female 20cm option]

12v power supply

Hose for irrigation
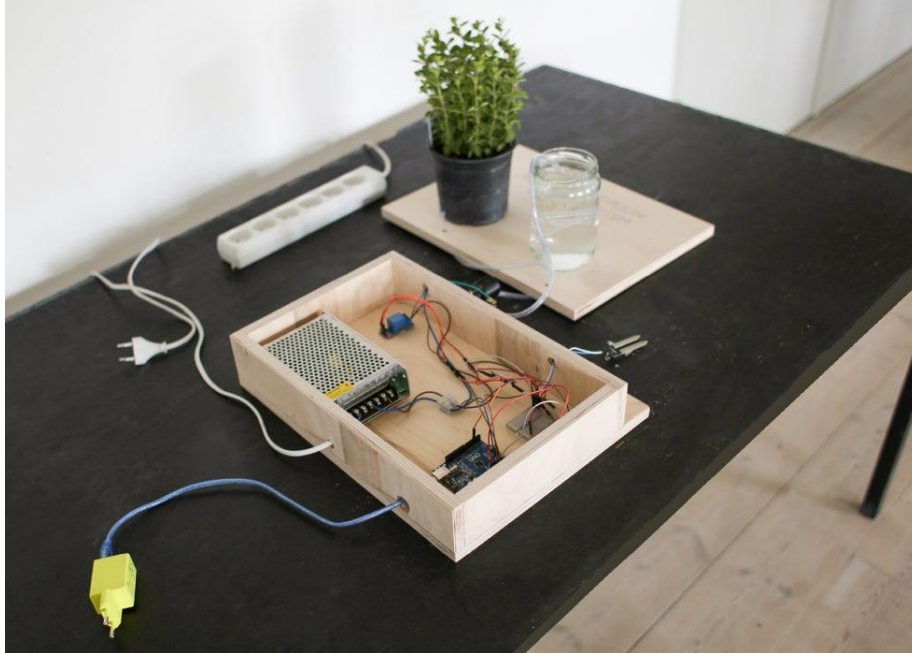
Chocolate block connector

Vessel for water

Figure 2. Arduino based automated plant watering system (Picture courtesy: https://www.instructables.com/Arduino-Plant-Watering-System/)

After you have the necessary components, you need to write a very small program for Arduino and connect it with other components. Don't worry, I will give you the necessary circuit diagram and the program too [2]. If it works, then you may think of revamping your entire farm."

Ramesh's father was listening all this while. He looked up and said, "If the farm is fully automated, I can save a lot on labour charges and cost of water."

"I bet you will."

Jatin Sir winked and headed towards home.

"It was a great help, Sir! I will try to make it and show you the POC."

References:

1. Ghosh, K., & Sharma, S. (2021). Fermat Point-Based Wireless Sensor Networks: A Default Choice for Measuring and Reporting Farm Parameters in Precision Agriculture. *Smart Agriculture Automation Using Advanced Technologies: Data Analytics and Machine Learning, Cloud Architecture, Automation and IoT*, 141-150.
2. https://www.instructables.com/Arduino-Plant-Watering-System/)