Smart irrigation system

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Abstract

1. What is the problem you are trying to solve?

Improper methods in irrigation causes a lot of problems for example reduction in the crop yield and reduce the fertility of the soil.

2. Why is this problem important, and to whom?

This is leading to a decrease in the income of the farmers and affecting the food supply.

3. What is your solution to this problem?

Creating the smart Irrigation system that is using the latest technology including but not limited to Artificial intelligence, Image processing, Internet of Things. That will help in proper scheduling considering various environment parameters.

4. What are the supporting results you have to show that your solution can solve this problem?

The prototype of the proposed idea includes sensing of fields parameters, with the help of solar energy harvesting in IIT JAMMU Campus

1 Introduction

Over-irrigation causes time loss, water loss, nitrogen and another micronutrient leaching, and increased pumping energy demand. Over-irrigation also contributes to an increase in the nitrogen requirements for crops, fertilizer expenditures, and nitrogen losses to groundwater.

Also, we have to consider the damages that the birds and animals do in the crop fields (As much as 40 per cent of the world's agricultural crops are lost to pests each year).

This system has three main components:

1. Data Collection through Sensors and Image Processing: These sensors will be placed in various fields equipped with solar panels and don't require any additional power supply to operate(assuming sufficient sunlight is provided).

The camera will be placed in the field, covering a wider area and reducing the number of sensors that should be placed in the field. Through image processing along with a soil moisture sensor in standby mode to collect the soil moisture below and above the sub-canopy level.

The irrigation schedule will be based on the parameters received from sensors, image processing and rainfall precipitation(through the weather API).

The prototype of the proposed idea includes sensing field parameters with the help of solar energy harvesting in IIT JAMMU Campus

2. Animals and Bird detection: The camera will detect the birds and animals in the field. The speaker will release a specific sound at a certain frequency to repel that bird or animal without physically harming them.

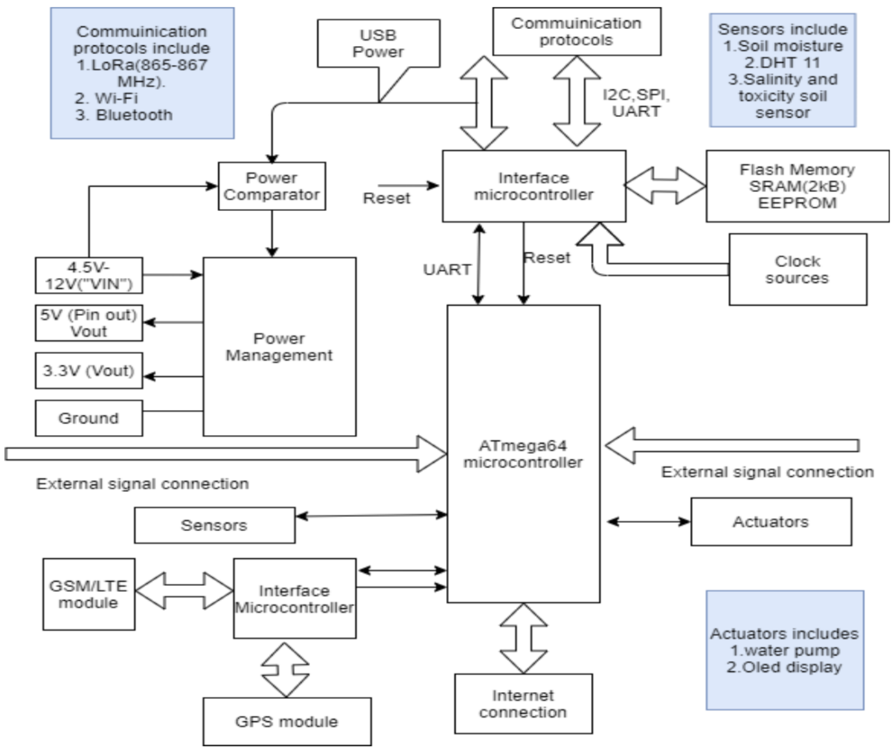
3. Cloud Computing: The data that will be collected through the sensors and image processing will be saved over the cloud via the IoT communication protocols/ cellular networks, It provides remote access of all the sensed parameters in a single platform either using a Web application or mobile application.

2 Goals

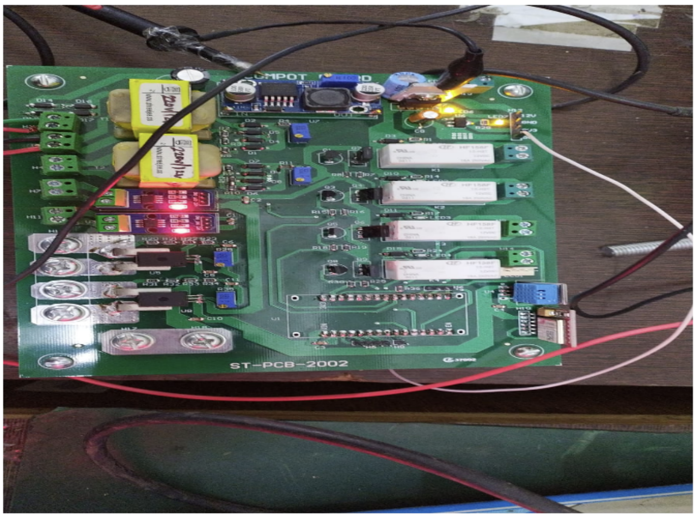
- Create a system this is self-sufficient in terms of energy consumption by using solar harvesting.
- Scheduling smart Irrigation by considering various environment parameters like rainfall, and sun power received
- Measuring the NPK value of soil to provide required content to the soil in a timely manner to increase output.
- Safeguard crops from insects and birds using image processing.

3 System Architecture and Design

Describe the system architecture in the sub sections of this section.



3.1 Hardware



Component/Device	Use
ESP32 - CAM	We used this device for capturing images
ESP32	We used this device to collect and send soil moisture sensor to esp32-cam
Soil moisture sensor	We used this device for the Measurement of soil moisture
Solar cell	We used this device to receive solar energy
Stepper motor	We used this device to rotate the solar cell according to the light received
LDR sensor	We used this device for the measurement of light falling over the solar cell
Power supply module	We used this device to convert 9v voltage to 5v voltage
Xculma ftdi ft232	We used this device as a Serial adapter for esp32-cam

Write a few sentences on how you integrated these components and if possible include some figures for the schema.

3.2 Software

You can follow the template used for the hardware in this section.

- Framework for deep learning model: PyTorch

4 Addressing Challenges

Please provide a list of challenges, and how did you address each challenge when building this system.

1.Solar panel: A pcb was designed to supply power to the circuit.

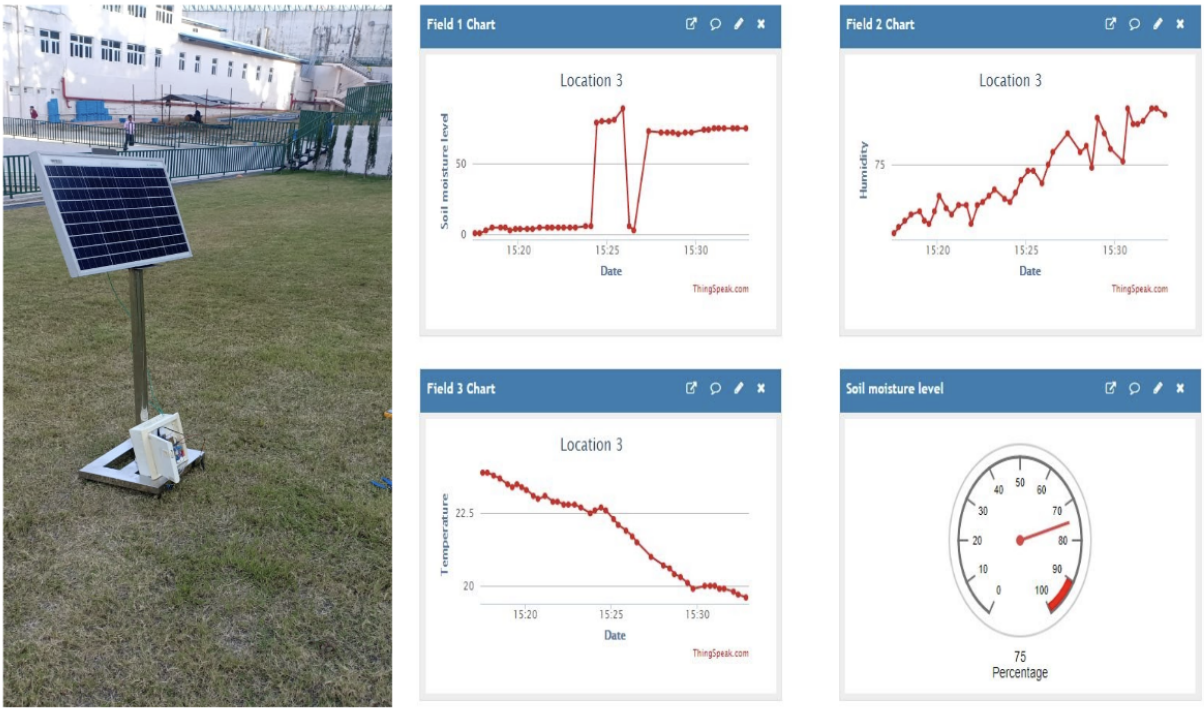
2.Data Collection: Two different esps were used, esp-cam has sd card, where image is being stored after getting triggered by the esp32 with soil moisture sensor.

3.Model to predict soil moisture: The model has inceptionv3 backbone.

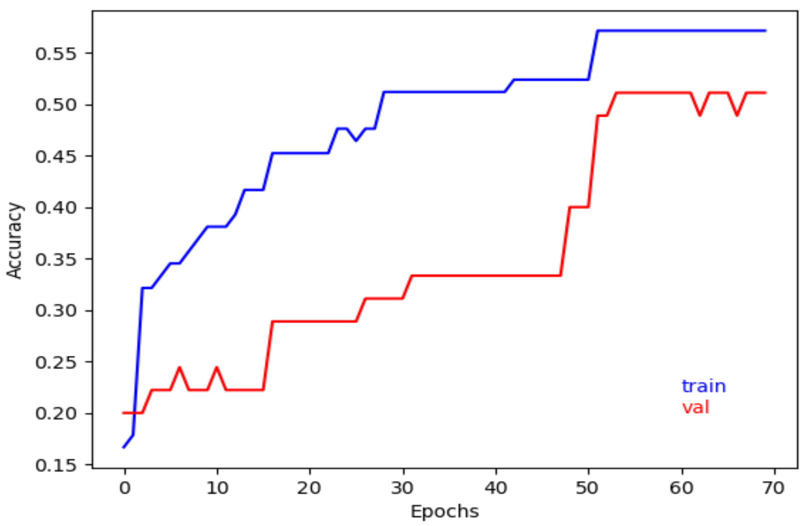
4. Irrigation Scheduling: We are using our data to schedule irrigation. SVM is used currently to predict the scheduling from the data collected from he sensors.

5 Performance Evaluation and Testing Results

A pcb was designed to manage the solar panel. The below image shows different parameters obtained from the pcb, these parameters are soil moisture, temperature, humidity and soil moisture level.l



The images are classified into three categories, (high moisture, medium and low moisture). The metric is the number of images correctly predicted by the model divided by the total number of images. This accuracy is plotted for both training and validation dataset. The figure below shows the results.



We achieved an overall accuracy of 0.53 on the validation dataset. The split was 70:30 for training and validation.-

6 Concluding Remarks and Avenues for Future Work

We are further planning to increase the number of images in the dataset, it is currently 100 under same conditions. We are planning to add more variations to the images, change lightning, soil type etc. The approach is completely solar-based. Our solution incorporates different cross-domain models. The prototype developed at the campus is able to use the solar energy to power up different sensors. Further our inception backboned architecture is able to provide accuracy of 53% for the prediction of soil moisture from the image.

7 Availability

Github link : https://github.com/light23-i/Smart-irrigation-system