Automation in Agriculture and IoT

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Abstract—**We are living in a world of digitization. Almost everything around us is touch by digitisation. The role the Technology has to play in agriculture sector is becoming more and more visible day by day. Since year of its inception communication has played an important part in agriculture, it was not just limited to in area of crop diagnostics but it has played pivotal role in the modification of age old agricultural practices. One can also witness development in various methodologies and technologies being used in the agricultural system. On the contrary, the agriculture sector in India is witnessing losing ground every day that has affected the production capacity of the ecosystem. There is an emerging need to solve the problem in the said domain to restore vibrancy and put it back on higher growth. A large-scale agricultural system requires a lot of maintenance, knowledge, and supervision. In the given paper we are aiming to automate the Maintenance, Control of Insecticides and pesticides, Water Management and Crop Monitoring.**

Keywords-Internet of Things; Smart Farming; Efficiency; Productivity; Automation

I. Introduction

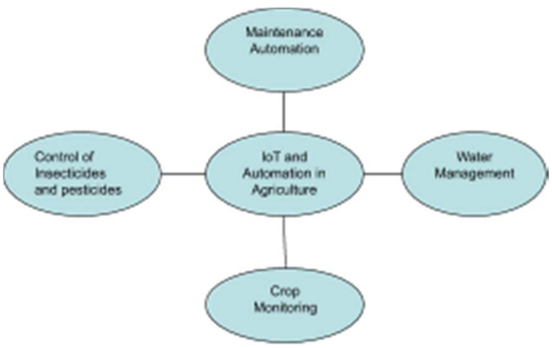

FIGURE 1 - IOT IN AGRICULTURE AND ITS ASPECTS

The role of Technology in agriculture sector is becoming more and more visible. There is a development in various methodologies used in the agricultural system in this paper we are showcasing the current developments and the future scope in agricultural Technologies through IoT and automation A large-scale agricultural system requires a lot of maintenance, knowledge, and supervision. In the given model we are aiming to automate the following garden processes.

A. *Internet of Things, Automation and Agriculture*

IoT and automation intertwine to build some of the most efficient and cost-effective solutions to human problems. According to Gartner IoT sector alone Is expected to be worth around 457 billion dollars in 2020 [9]. IoT technology and automation is efficient due to the given reasons.

- Connectivity to a diverse range of devices – From Android and iOS-based mobile, tablet and TV devices to standalone devices IoT can be connected to almost anything that can be connected and interfaced from the internet.
- Minimizing human labor – Automation can help the minimization of human resource and human error.
- Quick Access – Crop and soil health can be remotely monitored through any device and at any region.
- Time Efficient – Automatic report generation and remote monitoring can save time and effort from farmers.
- Efficient Communication – Using Android and iOS app platform a community of farmers, students and enthusiasts can share their work and new methodologies for agricultural growth.
- Analytics – Wide range of analysis can be done including avg. rainfall, soil health gradient.

II. Current Implementations

Substantial advancements in the domain of agriculture automation has been surveyed.

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- In Survey of Drones for Agriculture Automation from Planting to Harvest[10] one can observe the use of Robotic Process Automation (RPA) , image processing, pattern recognition and machine learning in order to achieve automation in case of large scale farm lands the paper also discusses about Precision Agriculture providing high quality crops.
- In Advances in greenhouse automation and controlled environment agriculture: A transition to plant factories and urban agriculture[11] one can understand how a combination of environmental conditions interplay in optimal growth of plants in different setups.

Above papers share a common limitation. Implementation(s) shared are not lack reliance and are less aware. for example in case of error at any node of the workflow cannot be detected or rectified.

III. Advancements

In this paper we are willing to automate the rectification process of any error occuring at any node of the existing automation system by extending the workflow which helps standalone systems to thrive without any human intervention. we have also implemented workflows that tend to increase the level of automation in the system.

IV. Requirements

B. Electronic components

- Arduino UNO – The Arduino UNO is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output pins that may be interfaced to various expansion boards and other circuits. The board will be used for primary interfacing of the devices.

FIGURE 2 - ARDUINO CIRCUIT

- 16x2 Liquid Crystal Display – Will be used to visualize the data locally it will help to operate the device standalone

FIGURE 3 - 2X16 LIQUID CRYSTAL DISPLAY

- pH Sensor – The sensor will get readings from the soil and will track the health of the soil. pH readings can help us find the efficiency or deficiency of pesticide or fertilizers.

FIGURE 4 - PH SENSOR

- DHT11 – Temperature and Humidity Sensor Temperature and humidity can immensely affect the growth of plants the given sensor keeps a track of the temperature and humidity in the crop field a separate mechanism can be developed to regulate the temperature in case the farming is done in the closed environment.

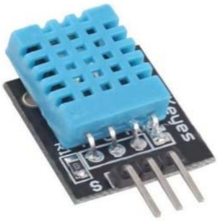

FIGURE 5 - DHT11 SENSOR

- Soil moisture sensor – This can be used to monitor the moisture level in the crop. It is based on Ohm's law and uses resistance between the poles in order to calculate the moisture of the soil.

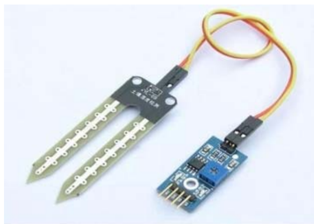

FIGURE 6 - SOIL MOISTURE SENSOR

- GSM module is used for connecting the device to another GSM device enabling IoT connectivity and remote monitoring – This module will send data to the registered set of devices and cloud for analytics.

FIGURE 7 - GSM MODULE

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III. Schematic

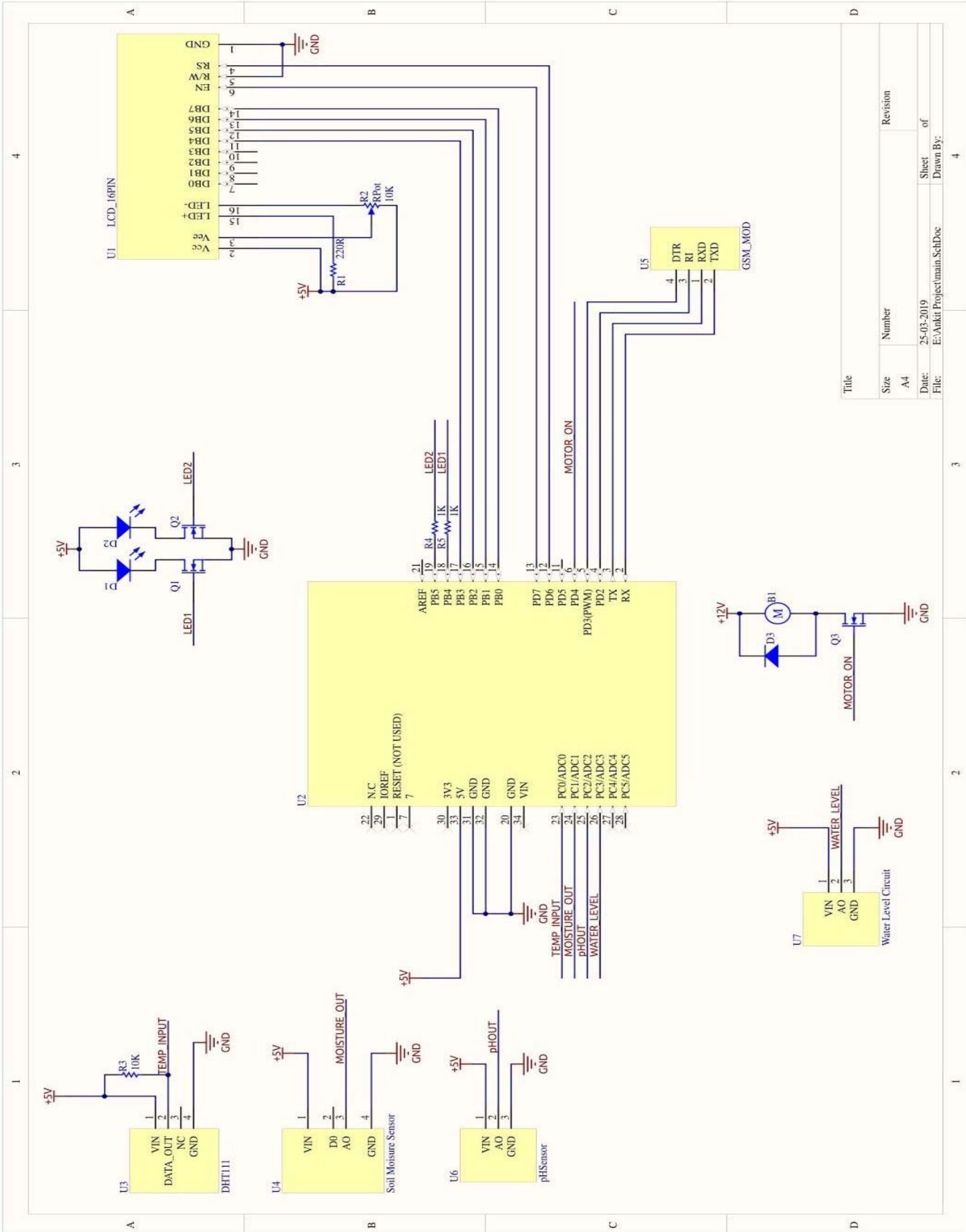

FIGURE 8 - SCHEMATIC

IV. WORKING OF DEVICE

The schematic in figure 8 represents the irrigation automation system. In this system, MOISTURE_OUT ports in soil moisture sensor are used to measure the soil moisture by calculating the potential difference between soil. the output from the soil moisture sensor is connected to the microcontroller. If the potential difference is less than the threshold value microcontroller is connects to the pump via a relay which can be used to irrigate the soil.

C. Output

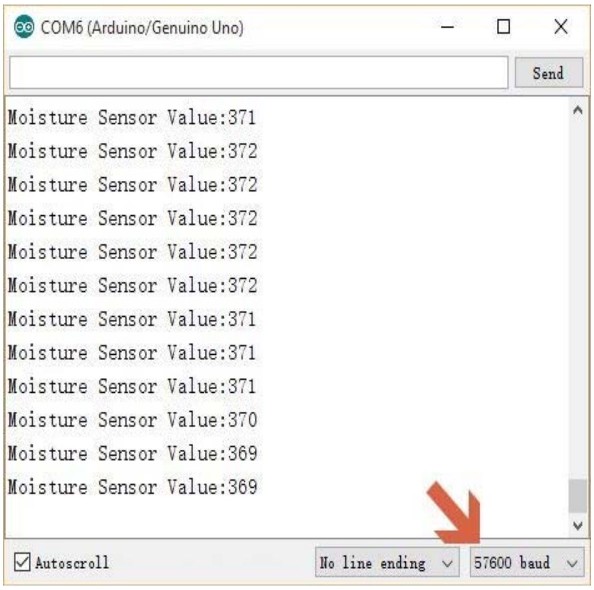

FIGURE 9 - MOISTURE VALUES FROM SOIL

Figure 9 depicts the output readings received from the soil moisture sensor the given readings can be calibrated and mapped with different plants/crops during programming of a given standalone module. These readings can be used further as a threshold value in the workflow. The threshold value varies according to the specimen used.

Figure 10 depicts workflows associated with the water management system.

- The system first checks the moisture of the soil.
- If the moisture is less than the threshold value then the irrigation system is checked.
- If the irrigation system is not working then the farmer and the service team is informed about the issue and necessary actions are taken to fix a system.
- If the irrigation system is working normally then the water level at the reservoir is checked.
- Is the water level is low then the farmer and servicing are informed about the situation and water in the tank is leveled.
- If the water level is sufficient then crops are irrigated.

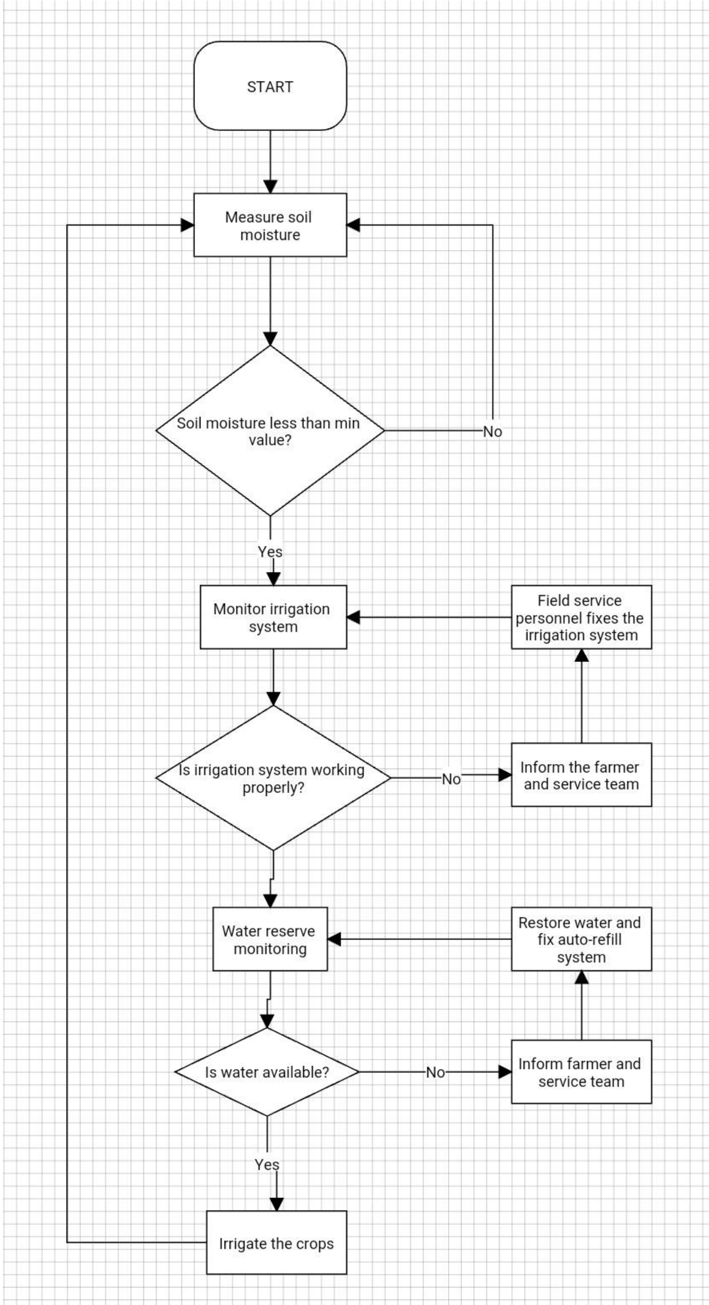

FIGURE 10 - FLOWCHART FOR IRRIGATION AUTOMATION

The workflow in figure 11 represents automation of soil care and fertilizer deficiency detection.

The process runs into stages the first stage checks if there is an efficiency of deficiency of any given fertilizer the second stage checks which fertilizer, explicitly, is causing that issue.

There are two types of sensors incorporated to perform this workflow. The first set of sensors monitor the pH value of the soil along with sensors for nutrients check which monitor the composition of the soil. The second set of sensors monitor the deficiency/excessiveness of a given fertilizer.

before the pump is started the water level at the reserve is checked. If the water level is less than the threshold value then the irrigation operation is aborted. Farmer and service team is notified. Once the reserve is refilled then workflow proceeds further.

The device runs several workflows in order to perform various tasks that are associated with the feature which leads to the complete automation of the feature this reducing human intervention. Such workflows can be used to automate the requirement of the crops.

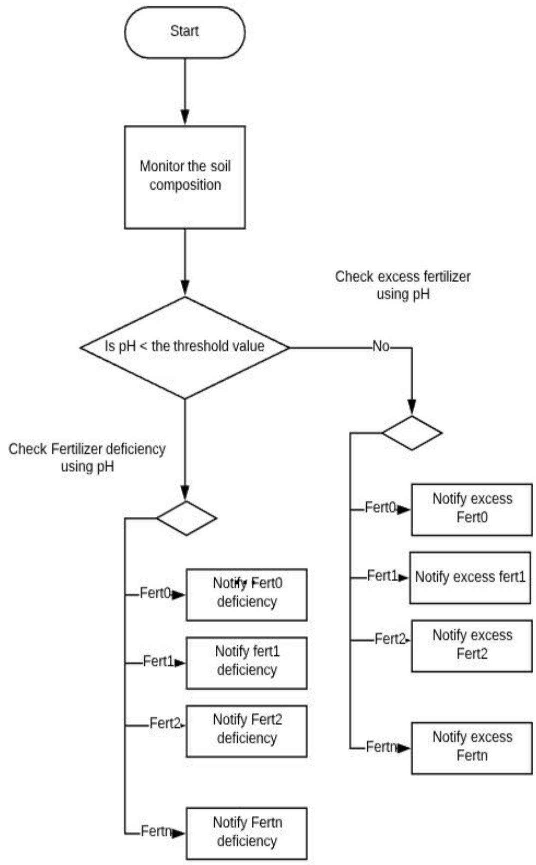

Figure 11 - Flow-chart for soil care and fertilizer deficiency/efficiency detection

V. Conclusion

Agriculture had played a major role in India's economic growth since then and continued to be there in the future. The farmers, on the other hand, are facing challenges in different phases of agriculture. The given paper tries to resolve problem using IoT and automation which can manage most of the agricultural work and the farmers can strategize which crops to grow according to the market rather than spending most of the time in crop maintenance and production it can also help farmers give more time to their personal life hence increasing the average social standard of the society

VI. Future scope

Agriculture automation can be amalgamated with future agriculture systems such as hydroponics[6], aeroponics[8] or aquaponics[7]. we can plan to build an autonomous agriculture system in future which will not require any human intervention and the crops can be sown cultivated and harvested without human intervention.
Also, the crops grown using this mechanism will grow much faster and will be organic.
One can imagine a huge building with vertical farms operating autonomously, growing crops and supplying oxygen to the entire city. Analytics can help identify which crops to grow according to the demand.

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