

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 7, Issue 6, June 2018

Agriculture Management System Using Internet of Things

Harikrishnan V S¹, Shruthi K²

U.G. Student, Department of Computer Science and Engineering, Siddaganga Institute of Technology, Tumkur, India¹

Assistant Professor, Department of Computer Science and Engineering, Siddaganga Institute of Technology,
Tumkur, India²

ABSTRACT: The proposed system is an IOT device which serves as a tool for easy and self-reliance farming. The proposed system has three major components, namely, the Node, the Control Station and the Base Station. The Node which is equipped with sensors, senses the farm soil conditions and sends that data to the Base Station. The Base Station which receives the data from the Nodes, stores them in a database and processes this data and sends control signals to the Control Station. The Control Station has actuators which actuate the control signals received from the Base Station. The proposed system's remote control functionality serves as very helpful tool for farmers with vast land areas.

KEYWORDS: IOT, Node, Control Station, Base Station.

I. INTRODUCTION

The proposed system is an IOT (Internet of Things) device which comes as a solution to most of the problems faced by the domain of agriculture. It comes in as a boon for the farmer and the agriculture enthusiasts' community to help keep their plants healthy and productive. It is aimed at keeping the plants safe, healthy and thus, reducing the rate of risk.

India is an agricultural country and stands second in world population. So it's high time, a scientific, easy and affordable product enters the market. The present day food industry is being looked at with fear because of the adulterants and the unhealthy processing and crop cultivation techniques employed. The proposed system comes as a tool for self-reliance farming. So, with the proposed system you decide your lifestyle.

The unscientific farming techniques will lead to infertility of the farm soil. Soil loses its nutrients level due to over or under irrigation. The proposed system monitors the soil conditions and acts accordingly.

The Internet of Things is a system of interconnected computation devices which are connected either wirelessly or with wire and are identified with unique identifiers. A Thing is a device in the network which does the computation like sensing, analysing, classifying etc. the information given as input.

Raspberry Pi operates as a Thing in the proposed IOT System which receives and sends the farm condition data to the cloud.

II. RELATED WORK

A. Microsoft FarmBeats^[1]

An IoT system that incorporates sensors and drones. Some of the research contributions are:

- Techniques are employed to merge ground sensor data with drone imagery.
- TV White Spaces based long range sensor networks are exploited for communication in the farms.

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- Drone flights are automated in the farms.
 - Drone battery life is improved.
 - An IoT gateway device for agriculture.
- B. Internet of tomatoes by Analog Devices^[2]
- A full-fledged sensor-to-cloud solution that will enable farmers to take appropriate decisions throughout the growing cycle, in turn, improving quality, income and environmental outcomes.
 - Developed a platform-based sensing, processing and communications solution that can precisely measure environmental data – temperature, humidity and ambient sunlight – which contribute to growing a good quality tomato.
 - This solution will monitor the farm conditions and keep tomato farmers informed of real-time conditions and variation trends.
- C. IEEE Paper published in 2013 IEEE 16th International Conference on Computational Science and Engineering^[3]
- Presents the IoT-based agricultural production system for bringing equilibrium to the supply and demand of agricultural products while developing the farm conditions sensors and prediction system for the growth and production quantity of crops.
 - Presently, the demand by consumption of agricultural products could be predicted quantitatively; however, the change of harvest and production could not be predicted by the change of farm's cultivated area, weather change, etc.
 - To overcome it, this paper aims at developing an IoT system to monitor and analyse the crop environment, and the method to improve the efficiency of decision making algorithms by analysing harvest statistics.
- D. Environmental Monitoring Using Wireless Sensor^[4]
- The project aims at building a scalable system that can be used on universally monitor the conditions of the farm in each environment. Raspberry-pi and sensors collect all the real-time data from environment and this real-time data is fetched by the web server and display it. User can access this data from anywhere through Internet.
 - Raspberry Pi functions as a base station which links the number of sensor nodes distributed over the area via Zigbee protocol.
 - In this wireless sensor network system, the sensor nodes sense the data from the sensors and the whole data will be stored in base station and the stored data will send to the cloud and the client can visit the base station remotely via (website) Ethernet.
- E. Review on IOT for Indian Farmers^[5]
- India is a land of versatile soils and different weather conditions. Due to unpredictable weather conditions and without proper weather forecast, Indian farmers face problems such as damage of the already grown crops in their field.
 - Indian farmers lack sufficient know-how about their farm soil. Due to variations in the structure of soil because of different weather condition, farmers are unaware of the most suitable crops for their farm lands.
 - An IoT system is used for solving the above mentioned issues for Indian farmers. The solution proposed for this will report any precautionary steps to be taken for farmers using a centralized base station which analyses the data and notifies farmer.

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III. IOT IMPLEMENTATION

The Nodes in the proposed system farm send the soil condition information to the Base Station over GSM. The Base Station performs analysis to infer control actions based on the data sent from the Nodes. The control signals are sent over GSM to the Control Systems which actuate those signals by opening a water valve, switching on the electric fence system etc... The communication between the Base Station and the user happens over the internet where the user is provided with a web interface (dashboard). The live feed of soil conditions are monitored on the dashboard (accessed via phones, laptops etc.). Consider a farm growing onions. A plant profile (here, onions') can be fed into The proposed system which constantly monitors the soil conditions through its Nodes and maintains them accordingly with the help of the Control Systems. The Base station which has the plant profile compares the moisture content in the soil with the required moisture threshold and if the moisture content is less than the threshold, turns on the irrigation system (eg. Sprinklers, drip irrigation system etc.) using the Control Systems. The Nodes can also monitor the acidity of the soil and fertilizers can be supplied accordingly. The Base station, Nodes and the Control Stations can be powered by solar cells which is clean and efficient.

IV. DESIGN AND IMPLEMENTATION

A. AgerSense Node

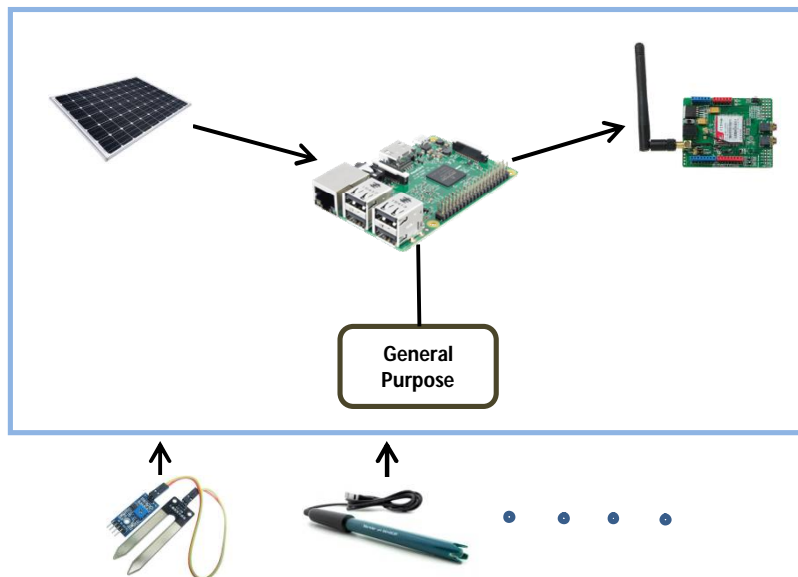


Figure: 1

The farm is equipped with the Nodes (Figure: 1) which keep a constant watch on the plants and send information to the Base Station (explained in the following section). In a Node, Raspberry Pi is linked to sensors like humidity (moisture), temperature and pH sensors. It takes in the data sensed by the sensors and sends them to the Base Station through a GSM module. A Node can be powered by solar energy which is clean, efficient and independent.

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B. AgerSense Control Station

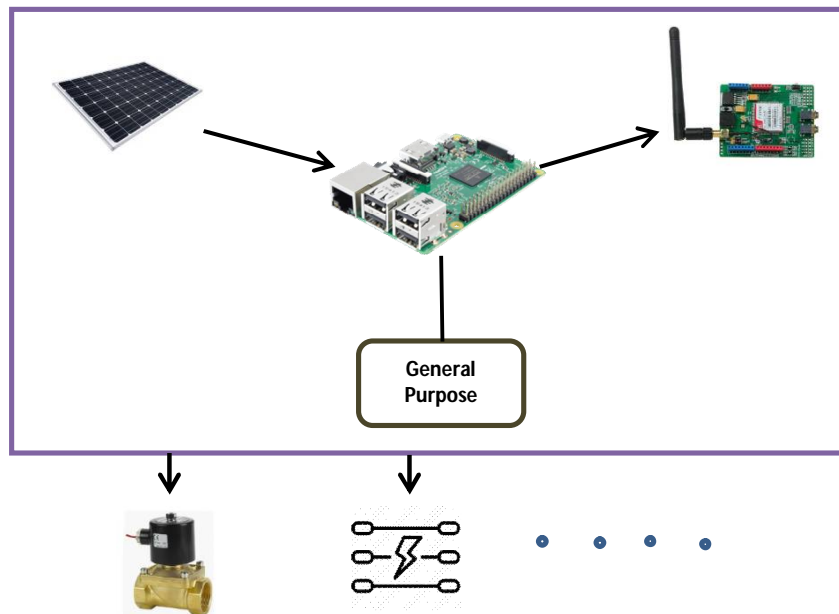


Figure: 2

The Control Station (Figure: 2) is instructed by the Base Station to perform actions like opening the solenoid valve, turning on the electric fence system etc... The System is equipped with a Raspberry Pi which is connected to actuators like solenoid valve etc... and it receives the control instructions through a GSM module. It can be powered by solar energy which is clean, efficient and independent.

C. AgerSense Base Station

The Base Station hosted on cloud (AWS cloud) which receives the data regarding the farm conditions from the AgerSense Nodes. It processes and analyses this raw data and compares it with threshold values (for example Soil moisture values) and sends control signals to the Control Stations

V. RESULTS AND DISCUSSION

- Unlike traditional farming techniques, AgerSense provides specific details regarding the soil conditions like soil moisture, pH etc.
- Unlike traditional farming techniques, AgerSense provides farmers a graphical plot of farm condition variations.
- Unlike traditional farming techniques, AgerSense provides remote control functionality and does not demand farmer physical presence for irrigation.
- AgerSense provides a personal profile for each farmer.

AgerSense helps to limit water wastage by providing the exact amount of water required by a specific plant/crop. It also cuts the expenditure involved in hiring labourers. AgerSense is a low cost and affordable setup. AgerSense system can be programmed to suggest feasible crops for the existing soil conditions, thereby helping the growers. It helps a person even with limited agriculture knowledge to have a good yield despite his/her lack of experience. In a green house, where human intervention is not generally preferred, AgerSense comes to the rescue. Farmers, instead of spending a

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major part of their time working in the farms, can devote their time in improving their know-how of the science behind crop cultivation.

5.1 Features Comparison

Features	AgerSense	Traditional Farming
Graphical Plot	Yes	No
Moisture Monitoring	Yes	No
Scope for data accumulation	Yes	No
Need for physical presence	No	Yes

Table 5.1: Features Comparison: AgerSense vs Traditional Farming

5.2 Crop Yield Comparison

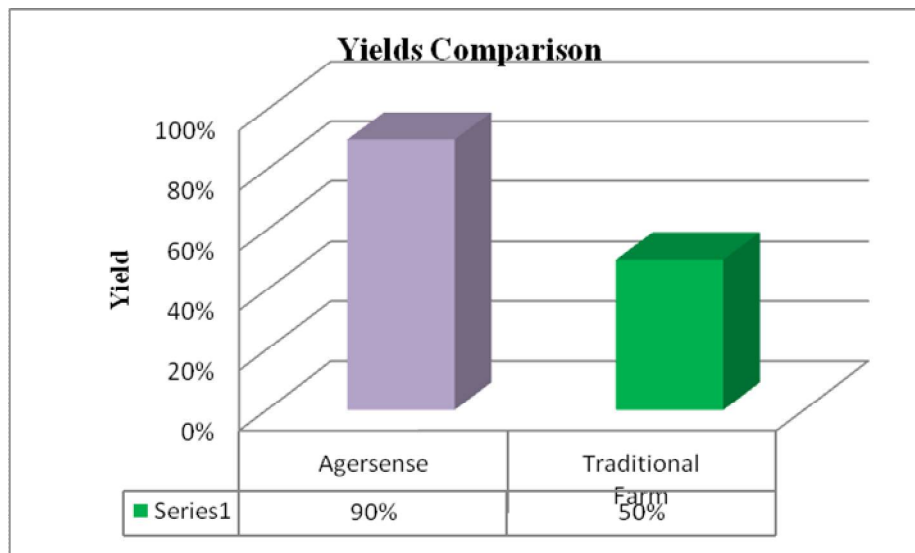


Figure: 3 Yields Comparison

Figure 3 shows the difference between the yields in an AgerSense farm and traditional farm.

5.3 Soil Condition Plot

Figure 4 shows the variation of soil moisture with respect to time.

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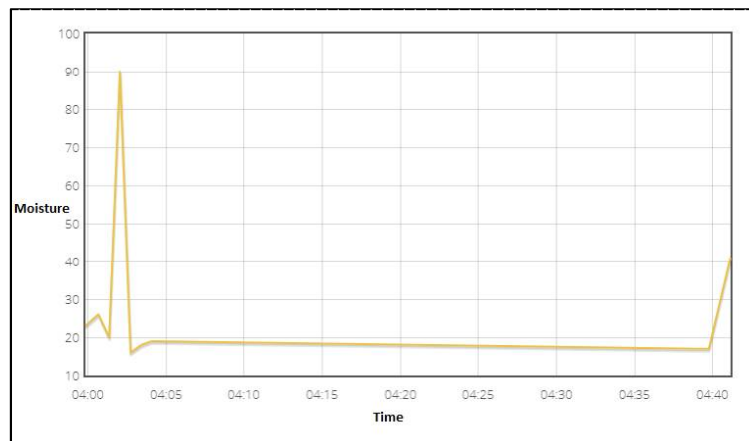


Figure : 4 Soil Moisture vs Time Plot

VI. CONCLUSION

The proposed system helps to limit water wastage by providing the exact amount of water required by a specific plant/crop. It also cuts the expenditure involved in hiring labourers. It is a low cost and affordable setup. It can be programmed to suggest feasible crops for the existing soil conditions, thereby helping the growers. It helps a person even with limited agriculture knowledge to have a good yield despite his/her lack of experience. In a green house, where human intervention is not generally preferred, this proposed system comes to the rescue. Farmers, instead of spending a major part of their time working in the farms, can devote their time in improving their know-how of the science behind crop cultivation.

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