Off-Grid Solar Power Management with Agricultural IOT System

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Abstract.

Recently over time the climate change and rainfall patterns have been changing rapidly and becoming unpredictable for growing crops in farm fields. As a result of this in recent times, clever climate systems called smart agriculture have come into the picture and many Indian farmers are slowly adapting to smart agriculture due to its advantages. Smart Agriculture is a method where the manual process is automated with the help of information technology integrated with IoT. IoT is being widely used and the scope for it is being drastically increased in the areas of wireless environments. Usage of smart sensors and wireless networks merging with IoT technology have led to different models of smart agriculture used in different conditions to support sustainable agriculture. The whole model is merged with internet and wireless communication leading to the Remote Monitoring System being introduced and proposed. The main objective of smart agriculture is to collect all real time values from the sensors for agricultural production areas which will make it easy for the user to control the farm using an android application which will be electricity efficient in operating the motor with all the crucial notifications included in the application about the farm field. As compared to previous models our model fills a gap of efficient electricity usage which is not implemented in previous models.

Keywords. IoT, Smart agriculture, Smart electricity usage , Irrigation , Frontend , Automation , Wireless sensors.

1. Introduction

Agriculture is one of the significant sources of livelihood in India. Over the past decade, we've seen that there hasn't been any sizable crop development in the agricultural sector. A primary cause of this is contaminated waters, low soil fertility, misuse of fertilizers, unpredictable climate change, and many more. Our concern is to solve these problems by introducing the inventions in agriculture using IoT named Smart agriculture via wireless sensors and networks. Smart agriculture using IoT has the potential to improve and revolutionize agricultural development, which can contribute significantly to sustainable agriculture in the long run. The Internet of Things (IoT) includes three-phase systems, the vision layer, network layer, and application layer. The visual layer includes sensor motors and Information and Communications-enabled (ICT) devices. Sensor motors are the building blocks of sensory technology including sensors and a network of sensors used to collect real-time information. Network coverage is the IoT infrastructure for universal service access. It guides the integration of the visual layer and the application layer. An application layer is an interface that integrates IoT with industry-specific technology. The internet of things has worked in many industrial areas, such as smart agriculture, smart trafficking, pollution intelligence monitoring, transportation, and health care, and much more. Among them, agriculture is one of the most crucial areas for millions of people.

2. LITERATURSE SURVEY

This section discusses the relevant technologies that can be used by researchers who have attempted to address the implementation of Smart Agriculture. India constitutes over 60% of its land for agricultural practices with an arable land of 159.7 million hectares making it the second-largest country for Land area for Agricultural practices. Even so, in the past 5 years, there has been a total loss of 35.54 million hectares of cropland due to unstable climatic conditions and human error.

This paper, describes a very well proposed model which consists of many analysis sections for an overall framework for advanced agriculture with the help of Integrated Circuits and Sensors and finally robotics for fruit picking and irrigation but, the approach had its limitations such as model accuracy and security of the data. Their main focus was cost-effectiveness but the introduction of robotics, it makes a toll on their overall capital. [1]

This particular paper focuses on predicting the irrigation requirements using the ground hardware components such as soil, humidity, and environmental conditions. The paper proposes a smart model which considers all sensed data, process the data, and predicts the output on irrigational parameters. All the sensor values are stored in the cloud and accessed by multiple web applications which provide real-time information on all the collected values. The results provided by the model is highly accurate and highly encouraging.[2]

This particular paper proposes to develop a smart agricultural model where the irrigation of the crops is controlled by a web application based on the reading of the wireless sensor networks. This model mainly contains three main components which are hardware, web application, and mobile application. The hardware component mainly has two sensors, soil and moisture sensor which is used to send real-time values of the crops to the mobile, and a web application which is used to smartly irrigate the farm field. The major drawback of the model is there is no efficient usage of electricity usage leading to an inefficient model.[3]

This particular paper explains the importance of wireless sensors and sensors' future scope for IoT in agriculture and all the problems expected to be faced in connection and merging these technologies with

3. OBJECTIVES

Technology and IoT have the potential to transform agriculture in many fields.

- Data, tons of data, compiled by smart agricultural sensors to better improve future decisions using AI & ML

4. METHODOLOGY

A. *Sensors used to collect data:*

Farm fields may have different crops growing at the same time at different parts of the agricultural land. In the farm field mainly 2 main sensors are fitted and being used in the project namely DHT22 sensor which is the Temperature sensor and Humidity sensor for getting environmental condition and Moisture Sensor measurements into the real time input to the back-end server. The sensors are directly connected to the main microcontroller ESP82. ESP32 microcontroller is low cost and low power using a microcontroller which includes integrated Wi-Fi for additional functionalities and better usage of microcontroller. The real time sensor values are fetched and uploaded to the backend server which can be further processed for useful decisions and processes.

B. Data collected stored at back end:

Here the real-time values which are collected by the sensor are being stored over cloud. The data from the cloud can be used at any time using different devices and applications to process the data. The data is stored in a Cloud server known as Blink backend server.

C. *Frontend used to display the data*:

The clients are given access to the system with an user-friendly and easy to operate application or a website through which the user can completely see all previous inputs from the bink server and completely control the farm field. The real time data are accessed from the app servers and are being processed and presented in a very meaningful pictorial and graphical standard which is easier to understand the condition of the crops. The clients are given the frontend which is given by blink server which is a very reliable and secured third party framework which supports all kinds of major frontend languages like html, css and all kinds of latest frameworks.

D. *Solar panels for smart electricity usage*:

Additionally 6 small solar panel is connected to a battery to convert solar energy to electrical energy and connected to the farm field which can be used to power up the whole motor for complete irrigation and can be helpful in providing electricity for the whole farm house.

E. *Smart agriculture model with efficient electricity usage*:

This proposes a smart agriculture model for irrigation of crops using solar power energy leading to efficient usage of electricity without paying bills of electricity. As a result, it will help a million of farmers to make use of smart agriculture which can turn huge profits during a short time and less investment.

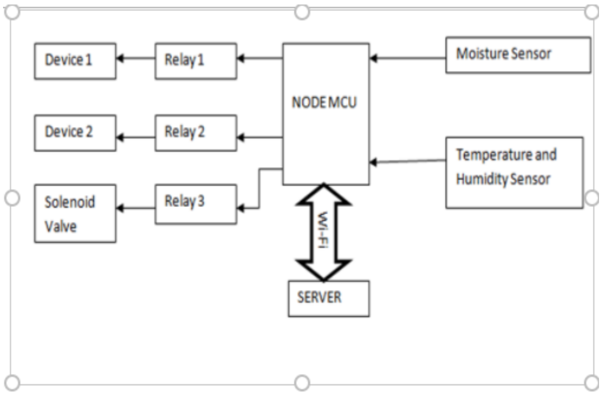

Fig.1: overview of working of model

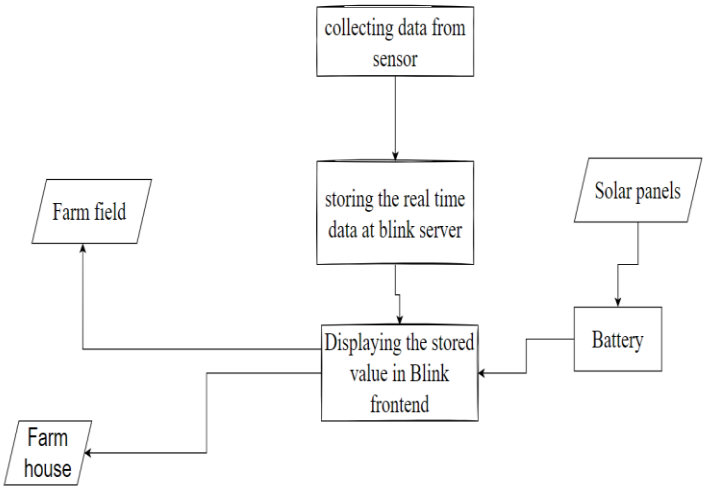

Fig 2: The whole flowchart of working of the model.

5. IMPLEMETATION

1. Components required: -

ESP82 or sometimes called NODEMCU is a very reliable, secured, easy to use and popular microcontroller used in many prototypic concepts and sometimes in industrial standards. The main implementation of the project is as follows: -

i. The user is given a blink front end website which is user friendly and easy to operate through which the whole Farm can be controlled.
ii. The sensor values can be stored and used for decision making so that the user will get the productivity out of the best.
iii. The whole scenario can be divided into two different modes one as manual and one is automatic, over the manual the irrigation can be done manually based on the real time values of the sensors or in the automated method the irrigation system will be automatically powered on when the particular threshold value is crossed.
iv. In Automatic mode the complete control is given to the controller itself so much less responsibility is removed from users.
v. From the app the user can have access to other devices in or out of the farmhouse. Ex: Lights, Actuators. Components Used in the prototype are:
    - NodeMCU (ESP8266)
    - Soil-Moisture sensor
    - DHT11 sensor
    - Relay Module
    - Water Pump
    - Green Led with resistor
    - 12V supply for pump

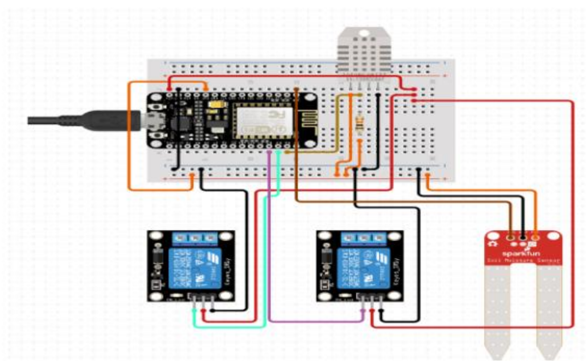

Fig.3 Sample connections to the Nodemcu.

2. Snapshots:-

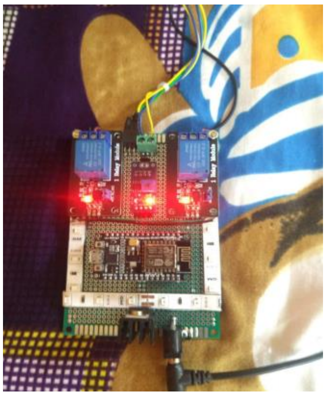

Fig.4: Photo of the working of Arduino Chipset

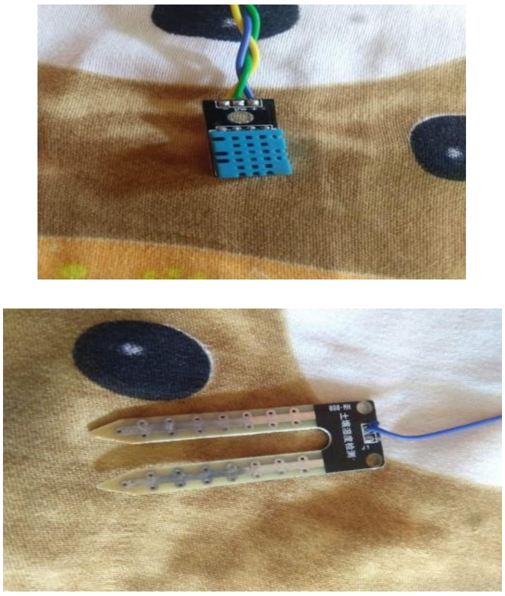

Fig.5: Humidity Analyzer (*Top-one*), Soil Moisture Sensor (*Bottom one*)

6. EXPERIMENTAL RESULTS

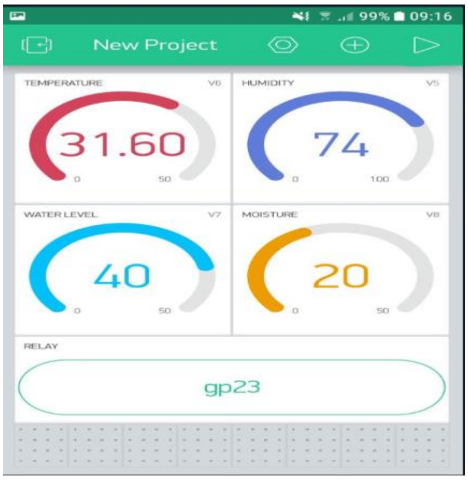

Fig 6: Real time values of the sensors

In the above fig (fig 6) the blink frontend application is displaying the real time values of the following Temperature, Humidity and Moisture Sensors .

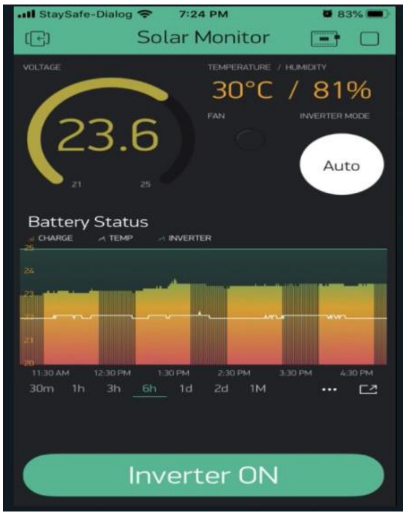

Fig 7: Real time battery status.

In the above figure (fig 7) , Real time battery status is being displayed in the blink frontend application and can be used to turn on/off the motor for the irrigation which is available in auto and manual mode . In auto mode the motor is started automatically after crossing the threshold value and in manual we can turn the motor on/off manually.

7. Conclusion

This project proposes a smart agricultural model with integration with IOT. IOT has always been the top priority and importance in the field of agriculture. Previous farmers have grown a lot of crops over centuries due to which the farmers had a nice idea about all conditions to make maximum profit from crops but due to rapid and undesirable climatic changes and soil changes have made a tough challenge for the farmers to grow crops. Through the approach given in this paper the new adoption of smart agriculture with smart electricity usage with help of solar panels will help farmers to adapt to the undesirable changes and to get maximum benefit out of the crops. This is a crucial and challenging task which requires a lot of knowledge to predict the climatic changes in different contexts and over different farmlands. This model of smart agriculture will help the farmers in every aspect to get maximum yield with smart electricity and smart irrigation with less human introversion.

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