SOLAR BASED IOT PLANT MONITORING AND CONTROLLING SYSTEM IN BIO-AGRI ENVIRONMENTS

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Abstract - India is a cultivated country and about 70% of the population depends on agriculture. Farmers have large range of diversity for selecting various suitable crops and finding the suitable pesticides for plant. IOT is a revolutionary technology that represents the future of computing and communications. Sensor technology has also been advanced and many types of sensors like environmental sensors are developed and used in applications as per the need. Smart Agriculture is an approach for design of Internet of Things based Plant Monitoring system, Green Agriculture Farming. Smart Agriculture traceability system in agricultural IOT. In addition, it discusses the application in the processes of planting, logistics, and consumer. Then some existing problems can be analyzed. Finally, this is automatic plant monitoring system and controlling over production yield in system has recently attracted tremendous interest due to the potential application in emerging technology.

Key Terms: IOT, Solar Energy, Plant Monitoring and Controlling, Bio-Agri Environment

1. INTRODUCTION

With the development of agriculture in modern society, IOT has been the significant means to reduce costs, improve efficiency and achieve intelligent in the field of agriculture. In recent years, the progresses have been made in data collection and transmission, intelligent processing and application service in agricultural IOT. For example, the quality of agricultural products can be improved by collecting and analyzing the variable of soil and air, monitoring the growth of products, balancing the irrigation and fertilization. Additionally, tracing the quality of products can achieve the push service in the rural information platform. This can bring tremendous benefits for agriculture. More importantly, this technique is used to enhance the performance of existing techniques or to develop and design new techniques for the growth of plants. The plant monitoring system is helpful for watering the plants and to monitor few parameters for growth of plants. This system is very used in few areas like nursery farms and in agriculture [1].

The agricultural industry is related to the development of rural economic and social stability. The issues about the quality of vegetables have aroused the concern in the public. In the year 2010, the notice of "about meat and vegetables circulation tracing system construction pilot instruction opinion", from the ministry of commerce and finance claimed that put more effort to resolve the problem of tracing the resource of meat and vegetables can reduce the customers' anxiety to the quality of food [2]. New technology in agricultural IOT such as data collection, RFID, ZigBee, and GPRS can be used to recognize the e-mark on the vegetables. Reader can record the information of vegetable in the links of producing and logistics. Through the internet and computer, the traceable network of quality of vegetable can be builded so that explicit the responsibility of vegetable traceability system to improve the supervision and public service. This can produce larger social benefits and economic benefits [3].

2. RELATED WORK

According to Subhanshu Gupta and Ajay Mudgil they proposes and present a scientific workflow framework that supports streams as first-by Advancement in technology is changing the world at great pace. New methods and systems are being developed throughout the world in different application areas. This advancement can prove as a boon to agriculture industry to meet the increasing demands of food and fodder around the world. This paper proposes a non-contact plant growth monitoring system using infrared sensors [4]. The proposed system measures dimensions of the plant by using an infrared sensor, and generates maximum height, width and diameter of the stem of the plant as plant growth parameters, using measured data. Once the growth parameters are measured, they are transmitted to a remote server/user by using GSM technology. The proposed plant growth monitoring system has been implemented by designing a automated scanning system. Finally, the system performance is compared and verified with the measurement data that have been obtained by practical field experiments [5].

IR technology can be used effectively for object detection and ranging up to some distance and is very helpful in non-contact plant monitoring systems. IR technology uses a pair of transmitter and receiver unit for detection and ranging. When the Infrared rays, transmitted from an IR transmitter falls on an object a portion of it get absorbed and the rest of the light is reflected back. The amount of reflected radiations can be measured by IRreceiver. The amount of radiation reflected back to IR receiver depends on the distance of the object from thereceiver [6].

By measuring the amount reflected radiation, presence as well as the distance of an object in front of thesensors can be estimated. If an IR sensor (IR transmitter and receiver pair) is made to scan a particular area ofinterest, an approximate sketch of the object in front of the sensors can be obtained by just mapping, thosecoordinates of the area where the object detection was found. This map can be used to find the dimensions likeheight, width of the object. For example if an area space is considered as a matrix with a defined number of rowsand column with constant distance between them say 0.5 cm and each point in the matrix is filled with one or zerodepending on weather an object is present in front of that space in a defined range, a bit map can be generated asshown in figure 1. Here the grey shaded regions are one and other is zero [7]. As it can be seen from the figure anapproximate shape of the object was captured. By counting the number of ones in different rows and column heightwidth of the object can be calculated. As can be seen from the figure1 the eight row of column one has first one,this column number when multiplied by the step size i.e. spacing between the columns, gives the height
of the object in that row.

1)Growth is a phenomenon of irreversible increase in size of tissues and organs as well as weight,. The overall plant growth stages can be summarized as follows: fertilization → gemmule → seed → germination → seeding → growth→ flowering → fruit → aging. [8]. The growth characteristics of plants vary depending on the type of plant. Generally, plant growth is measured as increase in size of plant height, width, roots, stems, leaf area, leaf fat, stemcross section and so on.

2) Visual monitoring of the plant growth as a mean of identifying the health status of individual plant or plantation crop has been undertaken widely throughout the world. This however depends on the human

judgment and subtlechanges are not readily identifiable by the human or identified too late. So a continuous growth monitoring system isrequired that is precise, cheap and user friendly. Also there is a need of remote data transfer as the data processingsites are usually far away from the fields/farms and collecting data by manually approaching each test site isimpractical [9].

This paper presents design and development of a new real-time non-contact plant growth monitoring system basedon the wireless technology to automate the plant growth measurement process. The system was implemented for aplant and the system performance was verified by comparing the results with the data obtained from the practicalfield experiments.

3. PROPOSED MODEL

The project has the following advantages altogether and supported by Technologies such as IOT/Drone/Data Analytics/Image Processing, Monitor plant growth, Check efficient soil moisture, Remotely irrigating system, Monitor nutrients in soil, Pest control system, Crop Protection. The system is a suitable solution for people who love and want to look after plants in their house but very busy in daily jobs to do that. Growing plants requires time and effort in order to be successful because there are some regular things to do like watering them every day. People sometimes forget to take care of their plants. Also, some people travel a lot and spend less time in their house. In this context, they generally ask for help to look after their houseplants otherwise they simply give up having them. Planto-Fi, it can help those people with doing regular things for plants. and monitor the plant monitoring antonymous system. Also, because it can be Controlled Remotely, Plant Owners Can Interfere The Watering Process Easily When Needed, Crop get protected in field of harvesting, Nutrients required for plant get identified.

3.1 Smart Planting Using IOT

The management mode of information and traceability can be used in the links of planting, logistics and consumption. In the planting link, this can trace the information of seed treatment, cultivation management (irrigation, fertilization, medication). To track and monitor plant growth system remotely with help of solar energy .we cannot always monitor the plant growth in our busy schedule. This technology inbuilt by using IOT technologies. It helps to save energy consumptions since its eco-friendly to environment. It does not depend upon man power to irrigate the plant. It detects the soil fertility water level in soil and irrigates the pot and also maintains the plant growth and nutrients in soil and send the requirement to planter for weeds require for growth. It is sensor based system help for plant sectors like agriculture and crop cultivation get easier to farmer for crop yield. To control the pest in field and identifies and send sms/warning signal for farmer to use insecticides

Remote plant watering and monitoring system can help people with growing and monitoring it. As the system is remotely controllable, the owner can moderate the watering according to the atmospheric conditions existing at that point of time. Remote plant watering and monitoring system waters the plant, monitors the temperature and humidity of the surroundings, measures moisture of the soil and estimates the amount of water required for the plant and waters the plant remotely.

It further stores all data in Dynamo DB through AWS IoT. The data so collected is visualised using graphs and charts to give a better understanding of the plant‟s life and watering statistics to the user. All the sensors, actuators and water pump are controlled by Raspberry Pi running a nodejs application. For this requirement, the proposed system prefers to use Johnny-Five library. To communicate with Amazon Web Services, the authors used AWS IoT SDK for javascript.

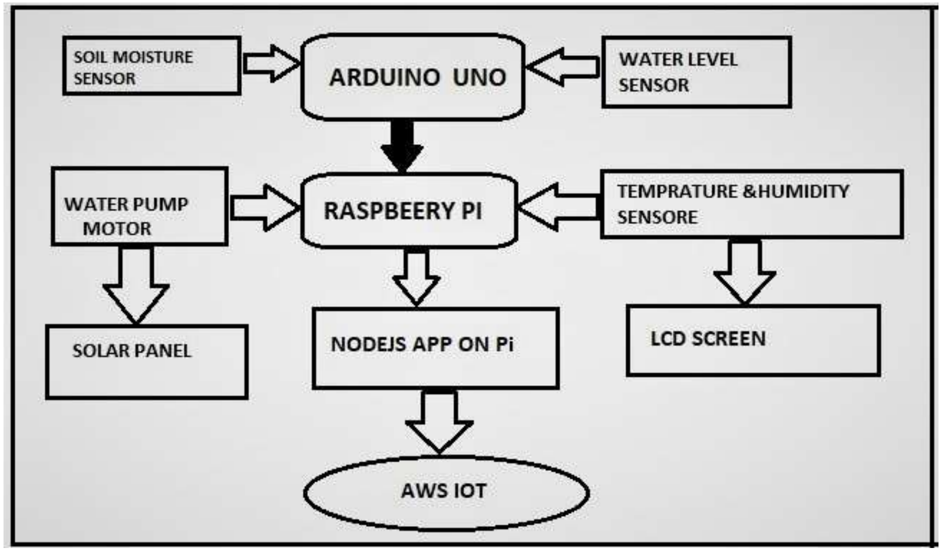


Figure 1: IoT based Planting System

3.2 . Situation of construction of traceability system construction of Plant Monitoring System In Solar Cells

Traditional Environmental Monitoring System mainly relies on the cable sensor network environment monitoring system. The data transmission relies on conductive medium which is poor mobility and not suitable for maintenance. In order to resolve these problems, designed the Technology enbuilted autonomous monitoring which use the IoT Vertical Kit and Arduino board &Rassperry Pi, AWS IOT . This planting is systemic, stable and cheap. In addition, it has reserved wireless expansion port , which can effectively monitor the temperature , humidity, irrigation and pest control. The designed plant monitoring system based on the Wireless Sensor Network.

This system consists of sensor node, ZigBee wireless network technology and the composition of collection terminal, which is secure and stable in terms of This platform can use sensor to transfer the parameters (temperature, humidity, light intensity, soil PH, CO2 concentration, etc.) from plant to the communication module, then to the M2M platform through GPRS network. If the parameters have reached the threshold value of warning , the alarm will be generated. Through the SMS alarm and remote control can manage the plant effectively and scientifically. Global ***IoT*** in Agriculture Market to Reach $28.65 Billion by 2023. Over the last decade, the global agricultural industry has witnessed a massive transformation owing to the increasing demand for sustainable farming practices. Rising global population and high-income growth have resulted in growing concerns of food security across the world. Various agricultural start-ups and technology innovators are developing numerous sustainable farming systems.

Figure 2:Web interface of the Remote plant watering and monitoring system based on IoT

- ✓ Cost Effective: The product can be cost effective with latest design technologes that makes it easy for the customer to buy it and use it
- ✓ Energy Efficient: Using Solar Power for operating and running, it makes energy efficient one.
- ✓ Self-Monitoring: Watering, Pest Control, Disease prediction can be found and intimated through self-monitoring mode.
- ✓ Automation, Less in man power: Through complete automated mode, it takes less man power to operate and monitor.
- ✓ Use Of Technology Such As Drone Tech, AWS IOT, Sensors And Solar Make This Project Reliable And Availability Of Such Technologies Also Makes It Viable For Scalability.

Plants are unique organisms that can absorb nutrients and water through their root system, as well as carbon dioxide from the atmosphere. Soil quality and climate are the major determinants of plant distribution and growth. The combination of soil nutrients, water, and carbon dioxide, along with sunlight, allows plants to grow. In order to develop into mature, fruit -bearing plants, many requirements must be met and events must be coordinated.

• Preparing Ardino • Preparing Raspberry Pi • Preparing Nodejs App on Pi • Energy generated by solar cells(solar panel) • Running Web Application	• IOT based application • Running throughout Web application	1. Raspberry Pi 1 Model B 2. Arduino UNO 3. DHT11 Temperature & Humidity Sensor 4. YL-69 Soil Moisture Sensor 5. Water Level Sensor 6. Standard LCD 16x2 7. Water Pump Motor 8. 5V Relay 9. 4xAA battery holder 10. Flying camera Drone with Wi-Fi 11. Solar panel (Childplaymate 1.5W 12V)

Table 1: Components, Methods and Technology in our proposed model

Step 1: *Initializing Dynamo DB* Dynamo DB stores the data collected by sensors. Go to Dynamo DB website. Create a new table with the following attributes: Table Name: remotewater_sensor_data Partition Key: key Click „Add Sort key", add timestamp Step 2: Data type of key and timestamp must be String. *Initializing AWS IoT* Open a web browser and go to AWS IoT Console Page. Follow the steps below: Create a „thing" with the name „raspi-water-pump" Create a new policy with the name pump-policy, Action iot:*, resource *. Select Allow, click „Add statement" and then click „Create". Create a certificate by using„one-click certificate create". Download the public key, private key, and the certificate. Step 3: Select the created certificate and Perform the following procedure: Click „Actions"> Activate button the certificate Click „Actions"> Attach a policy and name it as „pump-policy"which was created and click „Attach". Click „Actions"> Attach a thing with the name„raspi-water-pump", Click „Attach". Step 4: Create a „rule" with the following values: Name:storeInDynamoDB Attribute: * Topic Filter: sensor/data Choose an action: „Insert message into a database table" Table name:remotewater_sensor_data, Hash key value: ${topic()} Range key value: ${timestamp()} Role Name > Click „Create a new role". Click „Allow" button from the next page that will open up and select it from Role Name dropdown

Table 2: NodeJs Script for Implementing Proposed system

Step 1: *Initializing Arduino* The values received from Water level sensor, and soil moisture sensor are analog. Connectingthem directly to Raspberry Pi can be inefficient, hence we prefer to use Arduino to inputanalog values from these sensors and then send them to Raspberry Pi as digital values. Raspberry Pi updates the Arduino source code. Connect the Arduino to PC and upload Standard Firmata. Step 2: Procedure to upload Standard Firmata: Open Arduino IDE on your PC Go to File > Examples >Firmata>StandardFirmata Upload sketch to Arduino (Ctrl+U) Step 3: *Initializing Raspberry Pi* Connect Raspberry Pi withLCD screen, DHT11 temperature & humidity sensor and relay to switch water pump. Connecting DHT11 temperature & humidity sensor to Raspberry Pi, Connecting LCD Screen, Connecting Relay to switch Water pump, Connecting solar panel Connecting the battery and relay to the water pump, Out of the two wires present on water pump, one must bewired to relay, the other with battery pack cable.
A.Output in DynamoDB table Run the nodejs application on Raspberry Pi to collect sensor data and control the water pump remotely. Internet connection to the Raspberry Pi is necessary.

B. Output on web application The web application visualizes the data present on Dynamodb table by using charts. It can be also done by using AWS platform onlinedb.The web application can also control the water pump remotely. Whenever the user clicks „Start" or „Stop" button, it registers an event to AWS IoT platform. Raspberry Pi inputs this event and processes itstarts or stops the pump as per the user action

Table 3: IoT Implementation and Results

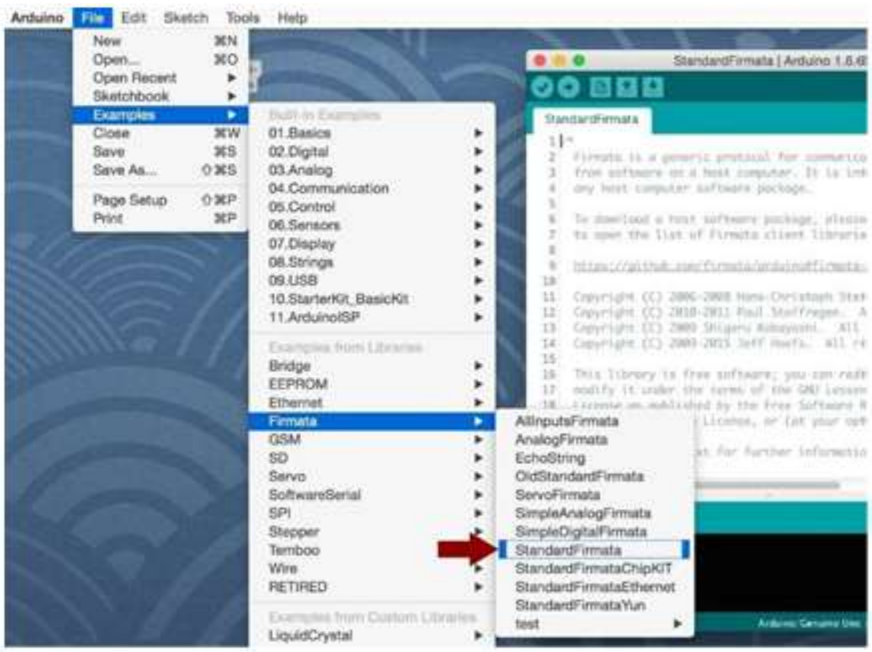
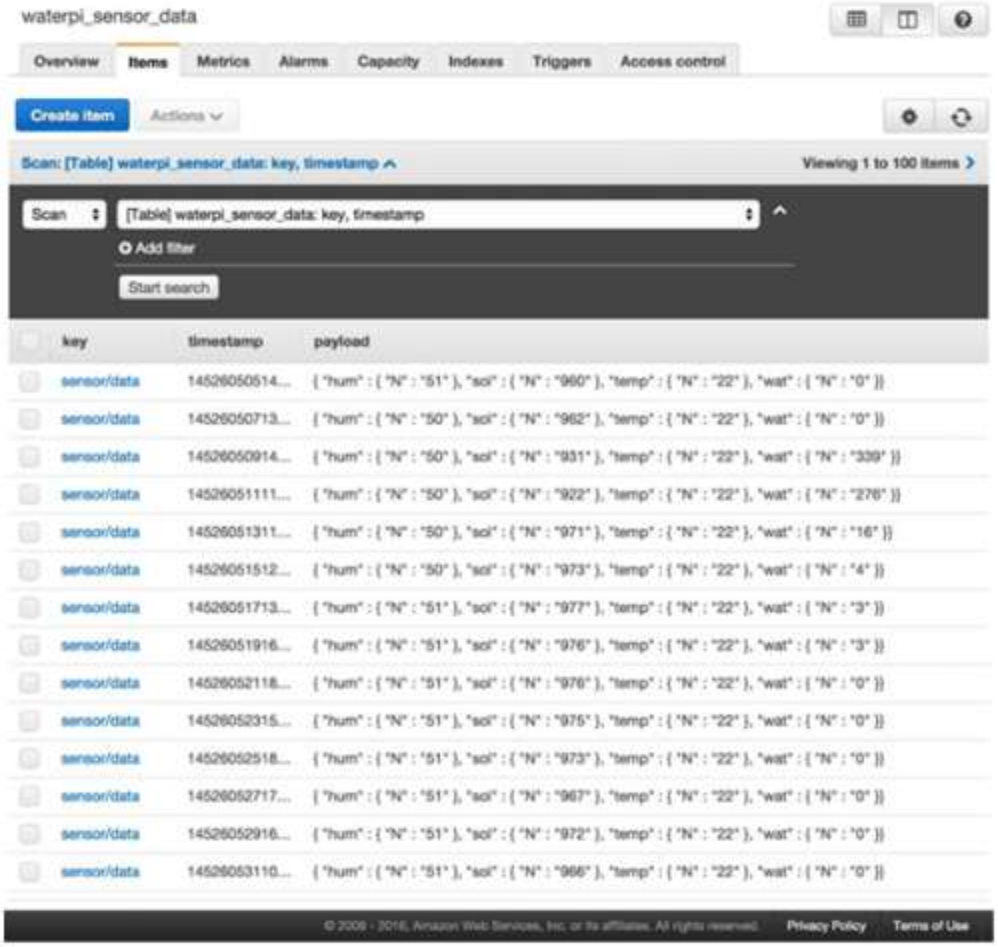


Figure. 2: Standard Firmata example on Arduino IDE



key	timestamp	payload
sensor/data	14526050514...	{ "hum" : { "N" : "51" }, "soi" : { "N" : "960" }, "temp" : { "N" : "22" }, "wat" : { "N" : "0" }}
sensor/data	14526050713...	{ "hum" : { "N" : "50" }, "soi" : { "N" : "962" }, "temp" : { "N" : "22" }, "wat" : { "N" : "0" }}
sensor/data	14526050914...	{ "hum" : { "N" : "50" }, "soi" : { "N" : "931" }, "temp" : { "N" : "22" }, "wat" : { "N" : "339" }}
sensor/data	14526051111...	{ "hum" : { "N" : "50" }, "soi" : { "N" : "922" }, "temp" : { "N" : "22" }, "wat" : { "N" : "276" }}
sensor/data	14526051311...	{ "hum" : { "N" : "50" }, "soi" : { "N" : "971" }, "temp" : { "N" : "22" }, "wat" : { "N" : "16" }}
sensor/data	14526051512...	{ "hum" : { "N" : "50" }, "soi" : { "N" : "973" }, "temp" : { "N" : "22" }, "wat" : { "N" : "4" }}
sensor/data	14526051713...	{ "hum" : { "N" : "51" }, "soi" : { "N" : "977" }, "temp" : { "N" : "22" }, "wat" : { "N" : "3" }}
sensor/data	14526051916...	{ "hum" : { "N" : "51" }, "soi" : { "N" : "976" }, "temp" : { "N" : "22" }, "wat" : { "N" : "3" }}
sensor/data	14526052118...	{ "hum" : { "N" : "51" }, "soi" : { "N" : "976" }, "temp" : { "N" : "22" }, "wat" : { "N" : "0" }}
sensor/data	14526052315...	{ "hum" : { "N" : "51" }, "soi" : { "N" : "975" }, "temp" : { "N" : "22" }, "wat" : { "N" : "0" }}
sensor/data	14526052518...	{ "hum" : { "N" : "51" }, "soi" : { "N" : "973" }, "temp" : { "N" : "22" }, "wat" : { "N" : "0" }}
sensor/data	14526052717...	{ "hum" : { "N" : "51" }, "soi" : { "N" : "967" }, "temp" : { "N" : "22" }, "wat" : { "N" : "0" }}
sensor/data	14526052916...	{ "hum" : { "N" : "51" }, "soi" : { "N" : "972" }, "temp" : { "N" : "22" }, "wat" : { "N" : "0" }}
sensor/data	14526053110...	{ "hum" : { "N" : "51" }, "soi" : { "N" : "966" }, "temp" : { "N" : "22" }, "wat" : { "N" : "0" }}

Figure .3: Sensor values on DynamoDB table and Results

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5. CONCLUSION

Along with the comprehensive work of safe traceability of the quality of planting in our country, many cities have implement the traceability management platform. Diversified electronic tag has set up a platform for safe traceability of the quality of agricultural products and a logistics distribution system, realizing the tracking and tracing of safe traceability of the quality of agricultural products.It help track the plant growth in each stage and also help to irrigate plant remotely by using solar energy hence energy conserved. Monitor growth and requirements for plant also satisfied and keep plant grow healthy. By this project have successfully demonstrated the practical implementation of Remote plant watering and monitoring system based on AWS IoT and save electricity.

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