Farmers Assistant Innovation and Resolution Web Server based plant monitoring for smart Irrigation

Pushan Kr. Dutta , Akshay Vinayak, Simran Kumari

Abstract: In this study, we propose a simple and efficient, low-cost power controlled embedded system for smart agriculture implementing portable user-driven models for Internet of Things tools and sensors that provides agriculturists ecologically suitable means to use viable resources like pesticides and water in a regulated manner in the farming land. Our proposed work uses soil moisture sensor to sense the moisture conditions of the soil. Based on moisture sensor values, a water pump is connected to be switched on and off automatically. The proposed Farmers Assistant Innovation and Resolution system monitors the environmental aspects such as the soil temperature, moisture, amount of light the plant exposed to pH of soil using Internet of Things and then formulates the different resolution techniques for soil health monitoring and innovation approaches in plant growth. This system is more competent as an automatic irrigation system playing its role in irrigation of field. The system is also capable of removing pests if and when necessary with the aid of image processing technique. At the same time, using GSM, the Node MCU forwards message on farmers mobile about pump status. The micro controller receives the pump status, moisture condition of the soil and moisture and temperature in air or enclosed region and provides this information over a data acquisition device. The system can be utilized in varied domains by regulating the voltage necessary including mobile phone charging, access drip irrigation and also weather data monitoring and irrigation facilities.

Index Terms: Internet of Things (IoT), agriculture, moisture, automatic irrigation, moisture sensor, temperature sensor, PH sensor, light intensity sensor.

I. INTRODUCTION

In India, agriculture assumes an imperative part to advancement of nation as our economy for the most part in light of it. India positions second worldwide in cultivate yield. However, with increase of population in urban and semi-urban townships, most of the ground water resources have depleted due to mismanagement water conservation and planning. As most of the fresh water supply is to be provided to households, the critical factor for the farming is facing difficulties to manage sufficient supply of water. As the rural households require water, carrying sufficient water from rivers and water shortage, the Government has to apply fast track agro-based automation for water supply for irrigation that will suffice the need to make legitimate utilization of rural water supply use and coordination that will stop squandering of water resorvoir to huge extent.

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Pushan Kumar Dutta, Faculty Member of School of Engineering and Technology, Amity University Kolkata, India.

Akshay Vinayak, computer science undergraduate student in third year of the Computer Science and Engineering department of Amity University Kolkata, India.

Simran Kumari, computer science undergraduate student in third year of the Computer Science and Engineering department of Amity University Kolkata, India.

With the expansion of Social schemes on rain water preservation focused on water conservation and drainage, it has turned out to be vital to manage on the utilization of water using electronic equipments and instrumentation in places where it is not possible to manage water using electric power resources. In order to address this issue smart agricultural application and tools are being utilized to a great extent in irrigation to optimize use of water by adopting sensor base irrigation system. Soil moisture sensor base irrigation system ensures proper moisture level in the soil[1] for growing plants in all season. In this system, sensor is sensing the moisture content of soil and accordingly switches the pump motor on or off. Soil moisture sensor is used to detect the soil condition whether the soil is wet or dry. If soil is dry, the pump motor will pump the water till the field is wet which is continuously monitored by the micro-controller. The main advantage of soil moisture sensor is to ensure accurate measurements and farmer doesn't have to visit his farm to operate the pump. In reference to [2], [3], WSN is made possible with the help of built-in ESP8266-NODE MCU microcontroller. This board is used here for its greater cache memory and storage capacity. The board is capable of detection, transmission, and receiving signals and establishing a connection between all the other modules. The former modules are sued for detecting the correct readings by making the use of sensing circuits that are built for this purpose. The circuits that are used here for different purposes are a capacitive temperature sensor (water resistant) for the detection of soil temperature, Light intensity sensor for the number of light plants are exposed to, a Moisture sensor for sensing the amount of moisture content of the soil, and pH sensor [4], [5], for maintaining the pH of soil. In reference to [6], the circuit readings and the pattern of plant growth are recorded with the help of image processing technique and the plant growth is then monitored. The readings and the plant growth are processed [7] and is sent to the receiver module which is capable of displaying it to the interface that makes it easier for the user to know about their plants growth. Phase three then comes to underplay, in reference to [8], the programming is done such that it detects the amount of moisture and checks whether the moisture threshold exceeds the certain pre-defined threshold or not. In reference to [9], [10], on detecting the change in readings, the pump is automatically switched ON by the system and the respective field is irrigated for a certain amount of time and then shut down immediately. It ensures that the amount of time the pump is switched on soil is completely wet and the threshold of moisture goes up. This is the most crucial part of the project where the growth of the plant [4], [11] along with pest control is being monitored and data is analyzed accordingly. Here plants images are clicked from day 1 when the plant was sown. We have used Photometric Image Analysis Method and Lagrange's Mean Interpolation algorithm for the relative growth of the plant. The logbook for images of the plants was used here for analyzing the growth of the plants. This work is an application development done in college project. In the proposed work, done we had first collected all the necessary components and then used a solar panel to drive a battery for charging. The light dependant resistors were not connected although in the proposed study, we proved using electrical output. After this work, we connected the DWT11 sensor for moisture and humidity analysis and the soil moisture sensor interfaced with the GSM relay to calculate the output. The Raspberi pi device had been also attached with the arduino to collect serial port data information for moisture and humidity mapping of the soil and ground as shown in fig 1.

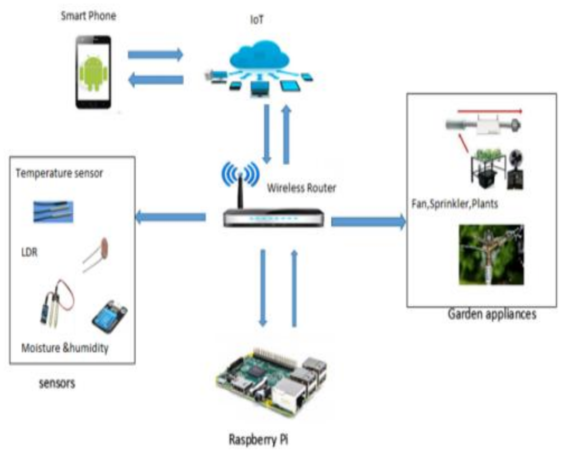

Fig 1: Schematic Diagram of different parts of the Circuit

The made system keeps the track of plants growth also making it easier for the planters to automatically irrigate the field and also detect the pests if and when necessary. The primary objective of the present project is to provide a novel means of the plantation and help planters reduce their workload. The following functions should be carried out by the smart system: 1. Monitor the amount of soil water available to plants on a continuous basis (this is usually done using a sensing system).

Fig. 2.A. Image of the plant in front of white paper ab 2.B. Converting into Grayscale image e

processing, first, the images are snapped with a help of a camera keeping a white background and then the image is converted to a grayscale format then further implementing Photometric Image Analysis the Adaptive Mean Thresholding is taken out and finally, Adaptive Gaussian Thresholding is taken out. After completing these steps, the polarized image is augmented into array format and Lagrange's Mean Interpolation algorithm is applied to the image to find out the growth of the plant. In the same way when all the plants' images are taken and daily analysis is done the non-familiar structural orientation of plants such as eaten leaves, irregular growth etc. are dealt with pest detection and control.

II. RELATED WORK

A similar research work was done in a tomato greenhouse on the south of Italy by Mancuso et all [12]. The air temperature, relative humidity and soil temperature are measured using Sensicast devise with wireless sensor network. Web-based plant monitoring application has also been developed. The Greenhouse user can read the measurements over the Internet. If some measurable variable changes rapidly, then an alarm will be sent to the owner‘s mobile phone by SMS or GPRS. In one minute interval, the bridge node gathers data from other sensor nodes to transmit the measurements of temperature and relative humidity. Smart plant monitoring, research was done by Teemu Ahonen et al [13] for a smart farming system (AgriSys) that can analyze and interfere with an environment to maintain its adequacy[14]. The system has an easy-to-upgrade inferential rules bank to control the agricultural environment. AgriSys focuses primarily on inputs such as temperature, humidity and pH. Furthermore, the system addresses desert-specific challenges such as dust, infertile sandy soil, and constant wind. To communicate sensor data to a nearby mobile phone, Bluetooth communication is used [15].

The sensors when operated the output or the data set that we received was uploaded over the server. This was done so that the data related to the growth of the plants can be analyzed from any corner of the world and certain suggestion can be delivered looking into the kind of data we receive for a bunch of plants such that the growth does not alter or modify due to the environmental conditions as shown in figure 3.

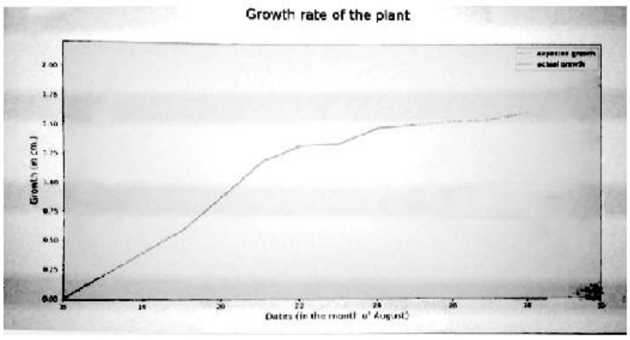

Fig 3: Graph showing the growth of the plant based on dryness

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The BT Terminal mobile application was used at the end of the mobile phone to receive device data. A USB power supply is used to power the microcontroller board in the graphic displayed. However, a DC supply consisting of two AAA cells was used during actual field testing. A standby mode built onto STM32 firmware has been used to improve the equipment's power efficiency [16]. In this structure, ground pH, moisture and temperature measurement was

Fig. 4a. A. Before retrieving and receiving the data

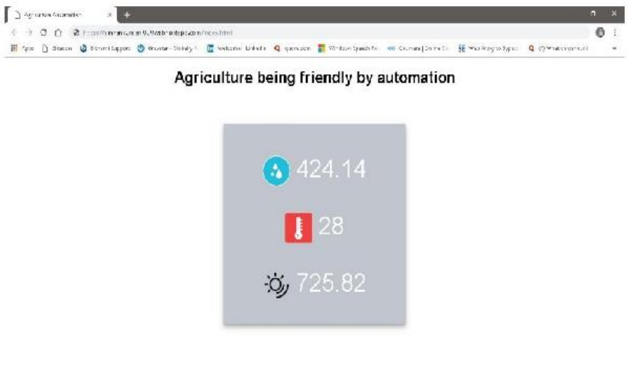

Fig. 4b. A. after retrieving and receiving the data

presented with Internet of things-based system. Senor designs for pH, moisture and temperature were successfully implemented and also tested for proper functioning. Bluetooth is used to communicate with the smart phone of a farmer. On STM32 the whole system was developed. 6LoWPAN is integrated for further precedence in networking. A website is created to upload sensor data into the cloud as shown in figure 4A and figure 4B.

III. I IoT BASED SMART AGRICULTURE MONITORING SYSTEM

The proposed system makes use of NODE MCU 1.0 (Fig. 5.) which is the microcontroller for this project. For increasing its analog pin outs 16x multiplexer is also added so that more numbers of sensors can be connected on board. The microcontroller is coded that way that it can handle all sensors and will be capable to send data to the server. In addition, for controlling the pump with this microcontroller a relay board is attached to one of the analog pins to obtain the major output of currents so that automatic irrigation is made possible. With that of the help of a Raspberry Pi console, we design plant monitoring and smart gardening system using IoT. With the help of sensors such as humidity sensor, moisture sensor, LDR, temperature sensor interface with the Raspberry Pi board, all parameters of the garden such as temperature, humidity, moisture, light intensity are controlled. We simply attach this system water valve to a hose, making it the simplest watering system ever. It allows switching on or off based on the sensor reading and gives the plant an accurate amount of water they need. This system is also designed to display various charts based on the reading of the sensor and the graph is plotted to monitor the growth of the plant.

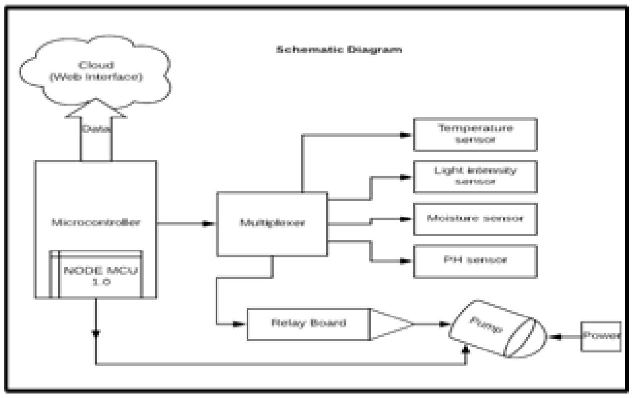

Fig 5: Schematic diagram of the different sensors implemented

Sensor for monitoring soil moisture measures the volumetric current of soil water. Soil moisture sensor indirectly measures the volumetric water content by using some other soil properties, such as electrical resistance, dielectric constant, or neutron interaction, as a proxy for the moisture content. The sensor collects all the data and refreshes the value every 2 minutes. All sensor data are stored and sent to the mobile app as well as to the windows application[17]. There is also regular checking of plant watering which can be done manually or automatically. It integrates Android, Windows, Raspberry Pi, Iot to work together to achieve the goals of the system[18].

The system helps save water, the utility bills, and also achieves the plant's water requirement. The user can also use the application to manually control the water valve. Thus the user can water the plants from anywhere and pour on the plants. Connect directly this system water valve[19] to a hose, making it only the simplest watering system ever.

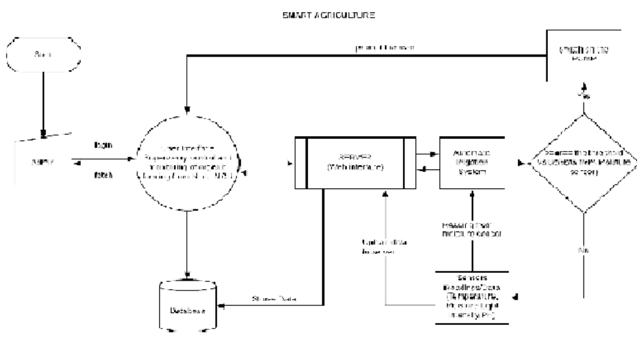

Fig.6:Flowchart of the working of the system.

The sensor collects all the data and every 2 minutes refreshes the value. All sensor data is stored and disseminated to both the mobile app and the windows app. Plant watering is also regularly checked and can be done manually or automatically[20]. It integrates Android, Windows, Raspberry Pi, Iot to collaborate to achieve the system's goals. In future aspects, we can develop a robot with WSN- wireless sensor network, ESP8266 - WIFI shield, NODE MCU- microcontroller with characteristics of Arduino Uno with a greater number of GPIO pins that compares the color of the leaf to an already saved image of the leaf using digital image processing technique to determine if the plant is in good condition or if there is any other nutritional deficiency. This can be further developed by applying Machine learning, and System on chip.

IV. CONCLUSION

The proposed system helps the user to know about the plant growth, pest organization and detection, automatic irrigation and other environmental factors as well as generate graphs on the data collected from the growth of plants and help improve the growth cycle. Using IoT with the help of the Raspberry Pi controller, plant monitoring and smart gardening will bring more convenience and comfort to the lives of people to take care of their garden. The system is designed with the limitations of low cost. The ESP8266 module employed is considered more efficient and applicable than the Arduino microcontroller because it can be used simultaneously as a Wi-Fi station and access point AP. In this paper, on the justification of the ESP module, three different plant data are multiplexed.

On the basis of the Pie webserver, the realized data at three locations are shared and demonstrated in various aspec ts. Due to first-impact automatic and manual control point efforts, the environments of the proposed locations in the worst cases are kept in the desired position. The control action can even be done by the webpage server's administrator manually. Finally, the cost of design and application based on the ESP8266 Node MCU module is considered to be cheap compared to GSM, that triggers data and SMS messages control efforts.

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AUTHORS PROFILE

Pushan Kumar Dutta received his Ph.D. degree in Electronics and Tele-Communication Engineering from Jadavpur University, India, and Post Doctorate in Engineering from Department of Management and Technology Faculty under the Erasmus Mundus Leaders Fellowship from University of Oradea, Romania. He received the award for the best young faculty from Venus International Foundation for Research.. . He was a visiting faculty at the Directorate General Shipping for MEO Class 2 and 4 Officers at Merchant Navy for Marine Electrotechnology, a Research Fellow of INFP, Bucharest, Romania, a Research Fellow of IIT Roorkee, India, and a Visiting Research Associate of Geological Survey of India, India under the DRPC project for seismic analysis and Ministry of Earth Science, India. His research has been supported by group of research organizations and he is working for further design and development for implementing his research ideas and models.

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Areas of his research interests include Geophysical data analysis and inversion; optimization techniques, intelligent systems, remote monitoring, manufacturing and mechatronics. He is presently a Faculty Member of School of Engineering and Technology, Amity University Kolkata.

Akshay Vinayak, is a computer science undergraduate student in third year of the Computer Science and Engineering department of Amity University Kolkata. He has done internship in Tata-Technologies and also participated in coding competitions while pursuing engineering in computer and technical aspects, he has keen interest in the field of IoT and Machine learning.

Simran Kumari, is a computer science undergraduate student in third year of the Computer Science and Engineering department of Amity University Kolkata. She is a dynamic personality with IoT, Data Science & Machine learning Intermediate. Deep learning, AI,Blockchain and Quantum enthusiast.