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Automated Irrigation System Based on Arduino Controller Using Sensors

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ABSTRACT: This paper presents that the Cultivation Management System mansion here is based on cloud. The architecture of system allows user to achieve the above mentioned activities in prearranged time so that farmers can examine their farm field data details from anywhere in between the range. Monitor system mainly consist Hardware module that situated in farm or farm field that has various sensors, devices, ICs for data transformation and transfer. Then Cloud implemented as Software as a Services (SaaS) so that the Android smart phone used as a remote control to make Arduino based automated irrigation system easy-to-use. The system design includes a soil moisture sensor placed in different direction of farm field that provides a voltage signal proportional to the moisture content in the soil which is compared with a predefined threshold value. On basis of this comparison result the appropriate data are fed to the ATMEGA-328" microcontroller which is on ARDUINO- UNO processor, which is linked by HC-05 module to an Android phone. Android phone allows the user to switched on/off the drive motor. System has a potential to be used in the real time precision agriculture application.

KEYWORDS: Arduino, SaaS, Cloud, ATMEGA-328, Sensors.

I. INTRODUCTION

India is mainly known for agriculture, and it can play vital role in economic growth and development. To become a farmer is not easy task. It is the science or practice of farming, including cultivation of the soil for the growing of crops. Cultivation is the process of trying to acquire or develop a quality or skill. Cultivation is most over and over again used to talk about the ways that farmers take care of crops. But although there are numerous factors always want to monitor depends on environmental conditions such as soil moisture, water level and temperature. Farmers need to keep the records of these environmental factors manually to cultivate crops properly. In general, agricultural lands are so far away from farmers home so farmers need to go there and analyze the soil, write the records of these environmental factors on paper which is so tedious work to maintain and remember it. Furthermore, farmers need to know about these factors for some period of time so that they can take appropriate actions such as to manage hardware (i.e. to switch on/o water motor), to spray pesticides, to keep records of factors; to achieve these activities farmer have to go to the farm field which is normally very far from farmers home and it causes inconvenience in hectic work. To avoid such burden from farmer, and to achieve such functionality farmers require a System which will be able to gather the information, from farm such as Temperature level, water level and soil moisture via various sensors. Furthermore, system should process this information to provide functionality to the farmers. To enable system accessible from anywhere it needs to be centralized and connected to Internet. Here, the concept of Cloud Computing come .Thus, to manage all these functions Cultivation Management System comes into picture.

This system allows farmers to view farm (or farm eld) information such as sensors values, devices connected, etc. Apart from this, system allows farmers to manage the farm hardware remotely such as to switch on/o bulb, to switch on/o motors, etc. with the help of microcontroller. All this information can be accessed via Android enable mobile phone, tabs, etc. by farmers.

Presented irrigation controllers be based on permanent schedule. Farmers, commercial and Municipalities owners of green areas typically place a watering schedule that involves particular days and run-times, and the controller executes the alike schedule regardless of the period or weather conditions. From time to time a technician may physically adjust the watering schedule, however such adjustments are usually only made a few times during the year, and are based

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upon the technician's perceptions rather than actual watering needs. Well-developed irrigation organize technology is based on day by day climate criterion and tangible water need of plant. In this technology irrigation occurs when the water is required by plant. It supplies only that amount of water to the plant as plant needs. b. In predictable irrigation organize technology, irrigation is made in the way in which huge amount of underground or facade water is wasted. In Well-developed irrigation control technology irrigation is done in a manner in which there is very little chance of water wastage. Manually work and wasting lots of time for it.

II. RELATED WORK

The proposed automatic irrigation system deploys the well-established combination of the android operating system and the Arduino Uno that are compatible in terms of providing a wireless remote control. the various sub-systems that are Arduno,sensors,motor and their interconnection that constitutes the automatic irrigation system. the sub-systems include the soil moisture sensor, Arduino Uno processor board, drive system that includes power controller, motor and irrigation pump, the Bluetooth module HC-05 and Android smart phone. The aim of this project is analyze the environmental factor in prescribed time and manage the water supply for proper cultivation of plants according, from anywhere without going to the farm through the Android smart phone. System has design to achieve the following properties:

- To increase the production by achieving the Proper cultivation.
- To analyze the environmental factors, the soil moisture, temperature, and man-age the water supply for proper cultivation of plants.
- To implement smart irrigation over the traditional one as it is very slow and unreliable for above steps.
- To achieve the above mentioned activities in prescribed time so that farmers can view their farm details from anywhere .
- To collect real time value of required environmental factor through various sen-sors and to take appropriate action according the condition of soil through the proposed system
- To implement cloud as Software as a Services so that user can access the infor-mation from anywhere within range and nally the Android application through user can monitor system and form details.

III. LITERATURE SURVEY

Experimental Investigation of Remote Control via Android smart phone of Arduino-Based Automated Irrigation System using Moisture Sensor. Author: A.N.Arvindan, Keerthika.D Year Of Publish: 2016 Conference: IEEE[1]

In this paper , the Android smart phone used as a remote control to make arduino-based automated irrigation system easy-to-use and an economical. The sys-tem design includes a soil moisture sensor that provides a voltage signal proportional to the moisture content in the soil which is compared with a prede ned threshold value. On basis of this compairision result the appropriate data are fed to the Ar-duino uno processor, which is linked by HC-05 module to an Android phone. Android smart phone allows the user easy remote control for irrigation system to switched on, o the drive motor. System has a potential to be used in the real time precision agriculture application.

A Low Cost Smart Irrigation Contol System. Author: Chandan Kumar Sahu, Pramitee Behra Year Of Publish: 20115 Conference: IEEE[2]

In this paper author present a prototype for fully automation accessing of irri-gation motor where Prototype includes number of sensor node placed in di erent directions of farm eld. Each Sensors are integrated with a wireless networking de-vice and the data received by the \ATMEGA-328" microcontroller which is on a \ARDUINO-UNO" development board. The RASPBERRY-Pi is use for send mes-sages through internet correspondence to the microcontroller process. The objectives of this paper were to control the water motor automatically and select the direction of the ow of water in pipe with the help of soil moisture sensor. Finally send the information(operation of the motor and direction of water) of the farm eld to the mobile message and g-mail account of the user.

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WSN based Temperature Monitoring for High Performance Computing Clus-ter. Author: D.Baghyalakshmi, Jenimah Ebenezer, S.A.V.Satyamurty Year Of Publish: 2011 Conference: IEEE[3]
In this paper an author have presented the implementation details of WSN based temperature monitoring application. The main feature of authors proposed network is to continuously monitor the temperature in the 128 node High Performance Computing Cluster for its smooth functioning. The wireless sensor node senses and transmits the current value of temperature to the base station. This paper explains about the various steps involved in the experimental implementation and maintenance of the temperature monitoring network for High Performance Computing cluster at Computer centre, IGCAR. The performance analysis of the network is also discussed.

Open source hardware based Automated gardening system Using lowcost Soil Moisture sensor. Author: A.K.Tripathy, A.Vichare, R.R.Pereira, V.D.Pereira, J.A.Rodrigues Year Of Publish: 2015 Conference: IEEE[4]
In this paper an authors proposed systems main aim is to implement a cost e ective automated gardening system. This system helps in solving the above problem by being e cient and using fewer resources. The system uses low cost e cient soil moisture, light and temperature sensors to decide when and how much water will be provided to the potted plants. Programming languages like embedded C and python is used to con gure the microcontroller. The data would be displayed through a GUI created using processing. The user will also be able to control the entire system remotely as well as monitor the sensor readings.

Mobile Application for Tracking Data from Humidity and Temperature Wearable Sensors. Author: Aileni Raluca Maria Year Of Publish: 2015[5]
This paper presents a mobile application for healthcare which process data from humidity and temperature sensors. The mobile app is based on cloud com-puting -SaaS (software as a service) cloud computing model. The cloud computing infrastructure based on sensors is used in this paper for deploying application which provides patients monitoring (moisture, temperature or blood pressure). The data is sent and stored in dedicated server for being analyzed later by doctors or caregivers. The advantages of sensor-cloud come also from using of PaaS (platform as a service) and IaaS (infrastructure as a service) models.

IV. PROPOSED SYSTEM MODEL

In this system, there are exist 3 entities:

1) WETHER CONTROL SYSTEM
2) SERVER USER

A. *The system will execute using below procedure:*
Shown in the figure the system consists of 5 main components which are explained below:

i. Arduino
The proposed system consists of an Arduino (microcontroller) which controls the various sensors with the help of relays and also helps in providing the data over the web. The data collected by these sensors will be available to any computing device (mobiles, computers) through a GUI interface and maintains a log of all the activities taken by the system[13]. The system can also receive any command from the device accessing it.

ii. Router
Routers have been used in the system to have an e cient transmission of data over the channel . The data is available to the user anytime and anywhere.

iii. Sensors
The system is having four sensors connected to the Arduino depending on the external factors they contribute to the plant growth. The sensors include soil moisture, temperature, light and water level sensors.

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iv. Electromagnetic valve

v. The solenoid

It is an electromagnetic part of a valve, comprised of a coil, core tube, core and enclosure. The selection of 2-way, 3-way and 4-waysolenoid valves, designed to handle the Most demanding uid control applications.

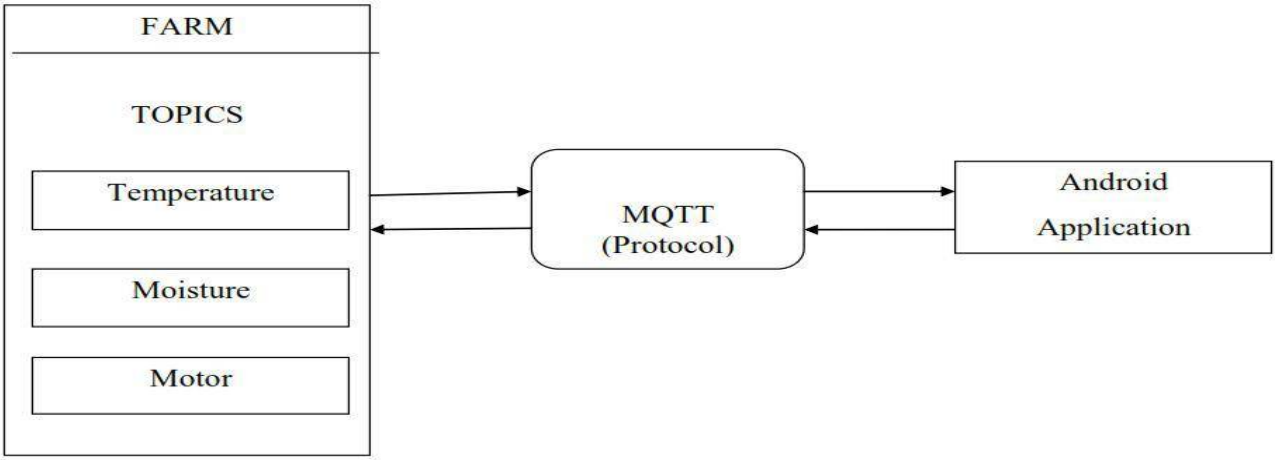

Fig1. Proposed System Architecture

Automatic Arduino Uno control System: Functioning:

The Arduino Uno board is loaded with a program using the Arduino Integrated Development Environment (IDE) software that reads the input value and compares it with the threshold moisture level value corresponding to the crop. If the value lies above the threshold value ,it implies that the soil is dry and the motor has to be switched ON to activate the irrigation pump and hence, water the soil. for values below the threshold value, the moisture content of the soil is sufficient and need not be watered.

The output pin of the Arduino board is connected wirelessly to the smart phone via the HC-05 Bluetooth chip. There is an application called S2 Terminal on the smart phone that displays the readings obtained from the HC-05. As soon as the communicate button on the Serial Terminal is pressed, the user will be able to see 1s or 0s appearing on the screen at regular intervals, depending on the time period specified in the code. These values indicate if the motor has to be switched ON or not. the farmer has to respond by sending a y (yes) or n (no) response respectively. This response then fed back to the Arduino board via the HC-05. the code loaded in the Arduino board then checks the response received from the smart phone. if the response is y, it sends a HIGH(1) to an output pin that is connected to the power controller of the motor. on the other hand, if the input response is n (no) it sends a LOW (0) to the output pin wired to the power controller. The power controller turns ON/OFF the motor based on the reading to water the plants.

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Sr. No	Crop	Moisture level (in %) for every 150 g of soil sample
1	Sun ower	9.5%
2	Wheat	12%
3	Soybean	13%
4	Milo	13%
5	Rice	13.6%
6	Corn	15.5%
7	Maize	18-24%

Table 1: Moisture Content for various crops

The moisture content data required for optimum productivity for various crops for every 150g of soil sample level that have been obtained by experimental observation are shown in Table 1. The threshold values must also be included in the code that is loaded into the Arduino board. The owchart corresponding to the code loaded in the Arduino Uno board for comparison of the sensed and threshold values and initiates switching decisions is illustrated in Fig.

B. *Mathematical Module:*
System Specification:

S = fS, s, X, Y, T, f_{main}; DD; NDD; f_{friend}; memory shared; CPU_{count}g S(system):- Is our proposed system which includes following tuple.
s(initial state at time T) :-GUI of search engine. The GUI provides space to enter a query/input for user.
X(input to system) :- Input Query. The user has to rst enter the query. The query may be ambiguous or not. The query also represents what user wants to search.
Y(output of system) :- List of URLs with Snippets. User has to enter a query into search engine then search engine generates a result which contains relevant and irrelevant URLs and their snippets.
T(No. of steps to be performed) :- 6. These are the total number of steps required to process a query and generates results.
f_{main}(main algorithm) :- It contains Process P. Process P contains Input ,Output and subordinates functions. It shows how the query will be processed into di erent modules and how the results are generated.
DD (deterministic data):- It contains Database data. Sensor data will be stored on server for further uses.
NDD (non-deterministic data):- No. of input queries. In our system, user can enter numbers of queries so that we cannot judge how many queries user enters into single session. Hence, Number of Input queries are our NDD.
f_{friend} :- WC And IE. In our system, WC and IE are the friend functions of the main functions. Since we will be using both the functions, both are included in riend function. WC is Web Crawler which is bot and IE is Information Extraction which is used for extracting information on browser.
Memory shared: - Database. Database will store information like list of re-ceivers, registration details and numbers of receivers. Since it is the only mem-ory shared in our system, we have included it in the memory shared.
CPU_{count}: - 2. In our system, we require 1 CPU for server and minimum 1 CPU for client. Hence, CPUcount is 2.

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Subordinate Functions:

Identify the processes as P.

S= fI; O; P; ::::::::g

P = fSDE; FMg

Where,

SDE is Sensor Data Extractor FM is Farm Manager.

P is processes

SDE= fSD, MAX, CSg

Where,

SD= Data from various sensors MAX = f1, 2, 3,.....,n

CS is Control Signals for FM.

DM = fCS, CA, Info

Where,

CS is Control Signals.

CA is control actions depending upon values of CS.

C. *Algorithms:*

Step 1: SDE.

Step 1.1 : Collect multiple sensor data.

Step 1.2 : Send Sensor data to FM.

Step 2: FMStep 2.1 : Process incoming data from SDE.

Step 2.2 : Log data into database.

Step 2.3 : Perform required operation on the basis of sensor data.

Step 3: Farm Sensors.

Step 3.1 : Detect value of Moisture.

Step 3.2 : Send data to FM.

Step 4: FM will increase or decrease water ow based on incoming sensor dat

Step 5: Stop

V. SIMULATION RESULTS

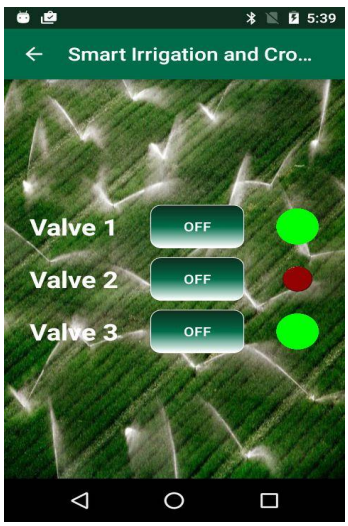

Fig.2. valve

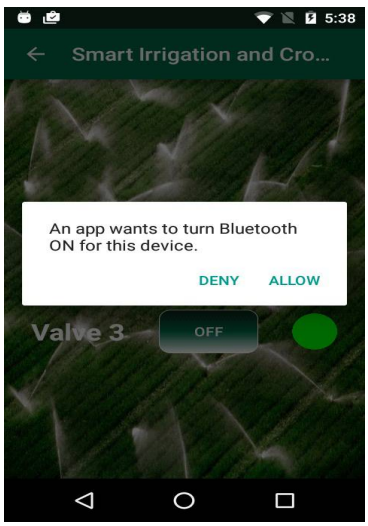

Fig. 3. Bluetooth Option.

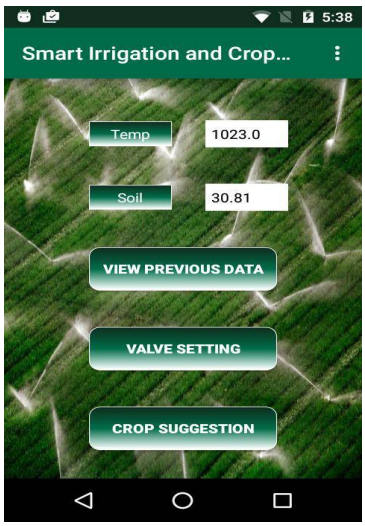

Fig. 4. Data encryption performance base on data size

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For the system performance evaluation, calculate the matrices for accuracy. The system is implemented on Android with INTEL 2.8 GHz i3 processor and 4 GB RAM. First window of result is for valve selection to on and off. This window fig2, is after Login and Registration part.

Another is fig.3 indicate that the Bluetooth Option window that turn on the Bluetooth setting. It has 2 options on and off.

Here is the output window fig.4, that shows the result by detecting temperature and soil of current date and time. We have other options also like view previous data, valve setting and crop suggestion.

VI. CONCLUSION AND FUTURE WORK

We conclude that Cultivation Management System based on cloud is very effective system for the user which cultivates the plants on farm field or in Green house. By this farmer can examine their farm field information and detail from anywhere in between this range. The monitor tool gives soil moisture details, water level, temperature information, etc. If such environmental factors are monitored and proper actions such as to on/off water motor, etc. is taken there as output, it can be help to increase in productivity by using such automated irrigation system consist of Moisture sensors, temperature sensor, Aurdino processor which sends information on android application via Bluetooth device HC-05.

FUTURE WORK

Proposed system can be extending in future by adding feature for remotely monitoring sensors that can detect crop growth and livestock feed levels. In future adding of feature that remotely manage and control their smart connected other irrigation equipments in proposed system.

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