Automated Supply of Water Remotely and Theft/Security Control using Raspberry Board, Grove Sensors and Camera

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ABSTRACT
Agriculture is the field which becomes more challenging field to face the shortage of man power who knows to do agriculture and natural threats. To overcome the challenges, this paper concentrates on how activities involved in agriculture like supplying of water and sprinkling of fertilizers to the plants remotely according to the exact level. All data will be collected from the various sensors placed all over the farm and based on the values collected from the sensors, water and fertilizers are supplied to the plants automatically Equal distribution of water and fertilizers can be monitored with the help of camera. This will be monitored using camera attached to each sensor. This paper will briefly explain about the supplying of water automatically from the remote side without any specific or additional software requirements precisely.

Keywords
Precision farming, automation of water using raspberry board, WSN, Grove sensors

1. INTRODUCTION
Form ancient age India is dependent on Agriculture. Due to the climatic challenges and westernization, agriculture is facing big threats like natural calamities, scarcity of people who knows to do agriculture, and to use the natural resources wisely. To overcome the threats, WSN can be used. Wireless sensor networks (WSNs) consist of several sensors which can be connected in the same network via WI-FI. Sensors are always used for retrieving the real time data from the field and communicated to the sensors via any one of the communicating channels available. The sensors would in turn actuate the automation based on the information stored in the server.

The plant monitoring system has the following modules

- Sensing the agricultural parameters.
- Measuring the water level assumptions for each crops and distributing water based on the humidity level.
- Measuring the fertilizer level needed for each crop.
- Gathering the data for crops for analytics
- Monitoring the corps remotely using cameras.

This paper concentrates on the implementation of the automation of supplying of water according to the exactly required level by connecting the sensors to the raspberry board via the Grove Pi+ board. All the real-time values from all the sensors (soil moisture and humidity / temperature sensor)are collected and stored in the server through the WI-FI networkand the actuator, the relay sensor for automating the supplying of water to the plants which needs the exact level and the report has been generated for all the irrigation timing. All the retrieved values from the real world environment contributes to the hardware part and in the other side,at the software part, web application is used as the GUI for the users. GUI is designed in such a way that it can be accessible easily everywhere without any additional installation software required.

2. RELATED WORK
[1] In this paper, Tuan Dinh Le and Dat Ho Tan discussed about deploying the wireless sensor network for the precision agriculture for monitoring and controlling the agricultural and the environmental parameters. The collected data will be stored and transmitted wirelessly to the farmers. The software side real times environment and the agricultural information are collected and given to the farmers to manage the field. [2] In this paper, DeeptiBansal discussed only about the alert messages which are transferred to the central data center via the communication device called SMS. The data collected at the central location is used only for analytics. The data acquired about the environmental factors of the field is transmitted to the farmer enabling him to control the actuators in the field. Zigbee based low power devices are employed to enable cost saving, and the valves and sprinklers are employed to save the water usage for irrigation. The technology used is simple and easy to implement and the parameters recorded helps a great way to farmer to enable a "Smart farms" theory work for him. The microcontroller is the heart of the idea which controls all the devices and activates it and runs them in synchronization. [7] In this paper, Anurag D and Siuli Roy discussed how the sensors placed at different locations of the field will perform the actions, how all the data will be aggregated and perform the automated task for managing the plants. But it fails to represent the actual data. Since it uses RFID, all the data collected are not fully reliable. It also describes about the routing algorithms which is used to communicate within the deployed sensors. It also deals with the Smart Fields monitored by wireless Nano-sensors and the plans for the Smart field system and the 'SoilNet-A Zigbee based soil moisture network. The RF devices can be considered as a active RFID nodes. Each node transmits its own identity and the location in the form of beacons. The RF nodes will perform three roles(ie., as a RFID gateway, RFID actuators, RFID routers). The agricultural parameters like soil pH, soil moisture,electrical conductivity, soil temperature are collected through RFID and sent to the data center. [9] In this

paper, Andres F.Murillo discussed about the aggregation of data in the data center just for monitoring and not automated.

3. IMPLEMENTATION

The Raspberry pi camera board is used as the device for collecting the information from the sensors and controlling them. The versions of the board are different and they served for various purposes. The board with the Ethernet facility is one kind and the board without the Ethernet facility is the other one.The microSD card which is loaded with the Linux based Raspian OS is used for booting the Raspberry device. The Raspian OS is the tiny OS which has in-built support for Java, Python and C. The power can be supplied to the Raspberry Pi A+ board through the separate power cable or through the USB cable from the laptop. Once powered on through the power cable, the Raspberry board will start booting the Raspian OS through the SD card. The Raspberry board is provided with the HDMI connectors. Through this, Raspberry board is directly connected to the big projector to configure the necessary changes in the Raspian OS.

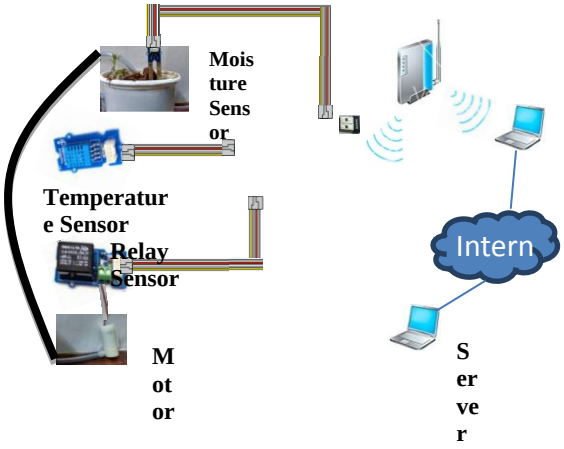


Fig 1: Process Flow Diagram

The WI-FI network is configured in such a way that laptop, Raspberry board are connected in the same network to retrieve all the values from the respective sensors.The values from the various sensors (soil moisture, temperature/ humidity and relay) are transferred to the communication channel (WI-FI). The communication channel in turn will communicate to the device(Raspberry board) to store the values in the server or to take the appropriate steps accordingly and to generate the reports.

The first module concentrates on the automation of the supplying of the water based on the moisture and humidity / temperature sensor. The soil moisture sensor is connected to Raspberry board through the Grove Pi+ board. To avoid the complexity of hardware connections, Grove Pi+ board is used for the connectivity of the sensors to Raspberry board. The soil moisture sensor is connected to the analog port of the Grove Pi+ board whereas the humidity/temperature sensor is connected to any of the digital ports of the Grove Pi+ board. Grove Pi+ softwares are used to configure the sensors primarily and Python language is used for the retrieving the values from the sensors. The values are transmitted to the Raspberry board through the WI-FI network. Relay sensor is used to control the automation of water to the plants. Relay sensor is connected to the digital port of the Grove Pi+. The Vin of the Relay sensor is connected to the battery and Vout of the relay sensor is connected to the positive end of the motor. The other end of the battery is connected to the negative charge of the motor.

Once both the sensors (soil moisture, humidity/temperature) are connected to the respective ports, relay sensor is connected to Grove Pi+ and connected with the motor as discussed earlier, the sensors start to retrieve the values and transfer to the data center or to the server. Predetermined values and threshold has been set for the values retrieved. The retrieved values will be compared with the predetermined threshold values. According to the results based on the comparison, the server will either actuate the relay to open the valve of the motor to pump the water or it will produce the report mentioning that water is sufficient. The connection setup is shown in the Fig.2

Fig 2: Connection setup in hardware side

From the Fig.2, A indicates the temperature/humidity sensor, B indicates the relay sensor and C indicates the soil moisture sensor.

In the software part, GUI is designed in such a way that, no additional software is required to perform the automation of supplying of water. The network communication (transmission control Protocol) is used to communicate by the client to the board. The client will place the request directly in the GUI. Once the request is placed, the request will transfer to the board(Raspberry board), collect necessary details and displays the output in the GUI. Two timings are stored priorly to pump the water on the regular basis. Everyday on the respective timing, it automatically checks the moisture and the humidity/temperature sensor values and accordingly it will automatically actuate the motor to supply the water. The report will be generated for both the cases whether water has been supplied or not supplied. The timing of 120 seconds are set for the automation of the supply of water and the timing can be configurable at any time according to the needs. The soil needs some time to absorb the water into the soil and moisture level cannot be predicted exactly when the water is flowing. So to limit the flow of water, timing is set previously when the water is automatically flowing from the motor.

4. RESULTS

The software part includes the socket programming to retrieve the values form the sensor and transmitted to the sensor.

A. Home

When the local host is connected with the network, the GUI will be displayed as follows. In the Home tab, all the current values from soil moisture, temperature level and humidity level from the humidity/ temperature sensor and the recent

irrigation status will be displayed. The fig 2 shows the home page of the GUI.

B. Configuration

In the configuration tab, each and every values under the irrigation, Temperature and the soil moisture level can be configured and can be saved. Because to give sophisticated room for the farmers to change the values according to the climate existing. Fig 3 shows the configuration page of the GUI.

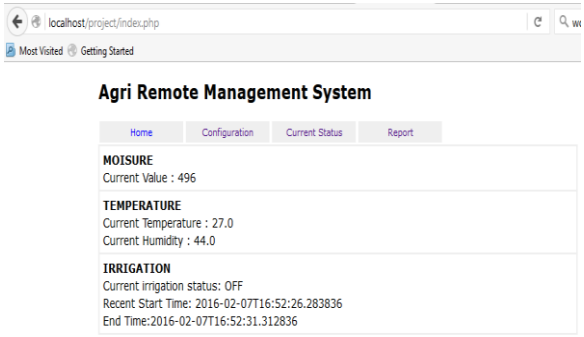


Fig 3: Home page of the GUI

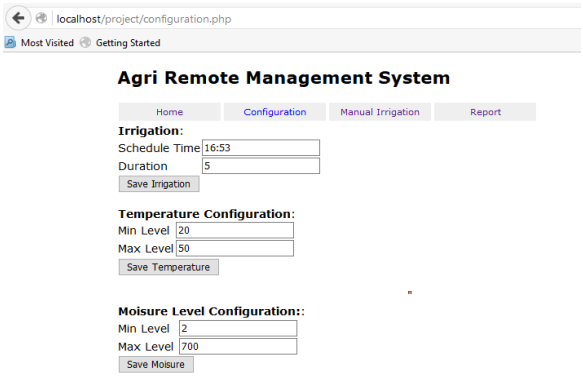


Fig 4: Configuration page of the GUI

C. Manual Irrigation

Manual Irrigation is used in the rare cases when there is need to pump the water because of the sudden temperature change. The duration will be entered in the format of the seconds, so that the water is pumped only according to the specific seconds mentioned. With camera we can monitor equal distribution of water for all crops Fig 5.

D. Report

The reports will be generated with the time when the pumping starts and the time when the pumping ends and the status of each pumping.

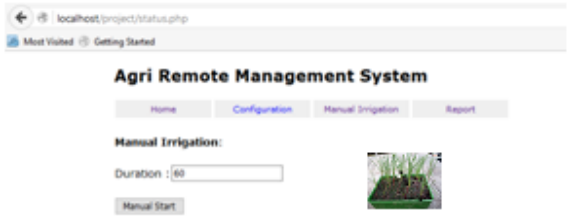
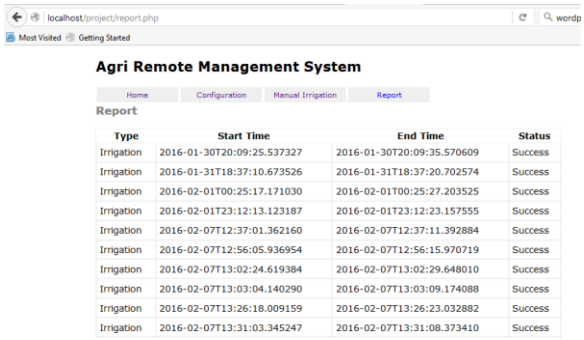


Fig 5: Manual Irrigation page of the GUI



Type	Start Time	End Time	Status
Irrigation	2016-01-30T20:09:25.537327	2016-01-30T20:09:35.570609	Success
Irrigation	2016-01-31T18:37:10.673526	2016-01-31T18:37:20.702574	Success
Irrigation	2016-02-01T00:25:17.171030	2016-02-01T00:25:27.203525	Success
Irrigation	2016-02-01T23:12:13.123187	2016-02-01T23:12:23.157555	Success
Irrigation	2016-02-07T12:37:01.362160	2016-02-07T12:37:11.392884	Success
Irrigation	2016-02-07T12:56:05.936954	2016-02-07T12:56:15.970719	Success
Irrigation	2016-02-07T13:02:24.619384	2016-02-07T13:02:29.648010	Success
Irrigation	2016-02-07T13:03:04.140290	2016-02-07T13:03:09.174088	Success
Irrigation	2016-02-07T13:26:18.009159	2016-02-07T13:26:23.032882	Success
Irrigation	2016-02-07T13:31:03.345247	2016-02-07T13:31:08.373410	Success

Fig 6: Report page of the GUI

The following Fig 7 shows the graph of the duration of the irrigation depends on the values of the moisture and the temperature level. Timings is placed on the x-axis. With the gap of two hours, moisture and the temperature values are retrieved and the irrigation is done based on both the values.

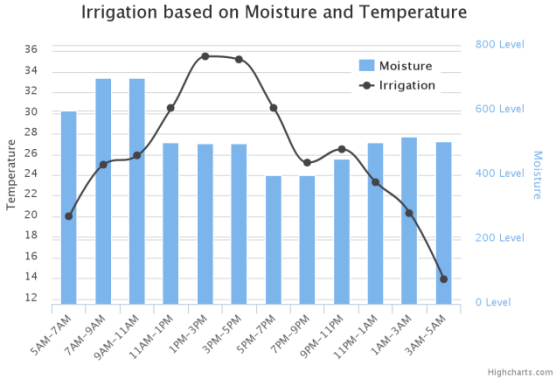


Fig 7: Irrigation duration based on moisture and temperature level

5. CONCLUSION

This paper describes the design, implementation and the usage of the sensors in the geographical field to retrieve the values form the real time environment to the server through the sensors and actuate the relay sensor to open or close the valve according to the predetermined values stored in the server. This system will enable the farmers to get the report on the daily basis of the pumping and also the configured values easily and monitoring crop without any additional software needed.

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