Design and Implementation of DAS for soil Monitoring and Controlling System

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Abstract—As the world is getting innovatively and technically progressed, we find new technology coming more into our personal and commercial lives. Present day Soil monitoring systems make use of PC based servers. We need to interface the appliances to these PCs for the purpose of monitoring and controlling the governed parameters. And for this purpose we need to always keep the system's server on. This consumes more energy and hence system's production cost increases which is not desirable. The remedy to this problem is use of "Embedded Web server" in place of "PC based server".

We can design this embedded web server by using Raspberry Pi and implementing Ethernet networking standards on it. This server can communicate with devices under control without using computer. Its communication takes place with the Ethernet standards which is embedded in the Pi. As a result of this server it is possible to monitor and control devices at remote places. For this all it needs is an IP address of the Pi and a local web browser. This project develops such a simple electronic model which is scalable.

Keywords—Raspberry Pi, Wi Fi, Relay, PH sensor, Gas sensor, Temperature Sensor.

I. INTRODUCTION

In agricultural application of data acquisition system, Soil pH is a key parameter for crop productivity therefore its spatial variation should be adequately addressed to improve agriculture management system. Soil pH affects the soil's physical, chemical and biological properties and processes and thus plant growth, and durability. When we try to analyse soil parameters, we noticed that pH parameter is very important factor to classify soil. Soil pH is defined as the negative logarithm (base 10) of the H+ concentration (moles per liter) in the soil. As the acidity of the H+ in the soil increase the soil pH value decrease.

Soil monitoring becomes very important when farmers need advice for crop and farming. For this demand, the development of a microcontroller based embedded system is design for monitoring. Such a system should monitor and provide data for remote examine. The collected data by monitoring system can easily be exported to a PC via a serial port to make subsequent data analysis or graphic and digital storage thus automatic data collection is possible without giving up PC resources.

Additionally, temperature and gas sensors are used to measure temperature, oxygen and carbon dioxide levels in the soil for fermentation.

Internet of Things (IoT) is the network of physical things embedded with electronic circuits, sensors, software and network connection which enables these things to exchange data from one another. IoT is the fusion of the digital and physical world. In a world of IoT, millions of things or devices will be interconnected and uniquely identified on the Internet. The Internet of Things allows objects to be sensed and controlled remotely across existing network infrastructure, creating opportunities for more direct integration between the physical world and computer-based systems, and resulting in improved efficiency, accuracy and economic benefit. In near future, IoT is expected to provide many more services like advanced connectivity of physical objects over a wide network and also many applications.

Fig.1.Das for soil monitoring

ILEXISTING SYSTEM

In the previous research, Soil monitoring is the process of collection of soil and testing in laboratory or at field by analytical methods. Soil monitoring system is used to sustain the quality of soil which can be used to evaluate whether soil quality is being degraded, improved or maintained. Different methods are available for soil monitoring such as

Direct Inspection: This is least expensive methods which rely on digging up soil samples in the field and then inspecting, feeling, or weighing and drying them.

Feel and appearance method: Take walnut-sized soil samples from various locations and depths in the field, and then by feel and appearance method, consider soil quality with practice and diligence. A soil probe, auger, or core sampler is far superior to
Hand push probe method: In this method we use a hand-push probe (sometimes called a Paul Brown Probe or Brown Moisture Probe) to determine the depth of wetted soil and also to retrieve soil samples. To determine the depth of wetted soil, push the probe vigorously into the soil by putting your weight on the handle without turning. The probe will stop abruptly when it reaches dry soil. (Rocks and gravel will also stop the probe, but these are easily detected by a metallic click.) Check the mark on the probe shaft to determine the depth of the wetted soil.

To obtain a soil sample, twist the probe after pushing it into the ground. The probe will be full of soil when you pull it up. Then use either the “feel and appearance” method or gravimetric weight method to estimate soil moisture.

Gravimetric Weight method: This method involves weighing soil samples, drying them in an oven, weighing them again, and using the difference in weight to calculate the amount of water in the soil. While too time consuming to be used for day-to-day management decisions, this highly accurate and low-cost method is often used to calibrate other tools.

Meters and sensors method: In this method, more sophisticated devices such as meters and sensors measure some physical property that is correlated with soil moisture. Some portable sensing tools are pushed directly into the soil or into an access tube implanted in the soil. Other systems rely on buried sensors that are either hard-wired to a fixed meter or else have long attached wires (electrodes) that are left above-ground and hooked to a portable hand-held meter.

III. PROPOSED SYSTEM

The design and implementation of soil monitoring & controlling system is the model with the ability to perform data acquisition on Ph, temperature and gas sensors attached. Here the sensors send the digital values to the Raspberry Pi. In Raspberry Pi Board we will be setting some threshold values by coding using Python Language/Linux. If the sensors value goes up above the threshold value then it will controlled through Relay circuit. Relay will be connected with the Raspberry Pi which will do the work of controlling. As the sensors value goes up the Raspberry Pi sees which sensors value has gone high and accordingly it will give the instruction to the Relay circuit which will perform ON/OFF action depending upon requirement so as to control the parameters which are under measurement. This data will also be monitored by the user through the PC by using local browser raspberry pi’s particular IP address. Camera Sensor attached to Raspberry Pi will detect any suspicious moments near plant and send those pictures on concerned person’s mobile phone automatically. Here Raspberry Pi will be connected to the Wi-Fi which will send this data over the Internet by which the user will be able to see the data and can keep a watch on proper functioning of his system.

**BLOCK DIAGRAM**

A. Temperature Sensor: The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. It is low cost and small size sensor which can be used for soil temperature measurement. Its temperature range is -55°C to +150°C.

![Figure 2: Block Diagram of Proposed Data acquisition System using RBP](image)

B. PH Soil Sensor: pH soil sensor is used to detect the decimal logarithm of the reciprocal of the hydrogen ion activity, H+ in a field area. In soils or growing media, pH strongly affects the nutrients and the presence of micro-organisms as well as plants in the soil. Soil moisture sensor measures the water content in soil. It uses the property of the electrical resistance of the soil. The relationship among the measured property and soil moisture is calibrated and it may vary depending on environmental factors such as temperature, soil type, or electric conductivity. Here, It is used to sense the moisture in field and transfer it to microcontroller in order to take controlling action of switching water pump ON/OFF.
C. Gas Sensor: The CO2 Gas Sensor (MQ-2) is highly sensitive to Methane, Butane, LPG and Smoke. This sensor is connected to analog input pin A1 and other pins of sensor. We manually supply the heat to heat up the sensor.

D. Raspberry Pi

The Raspberry Pi is a small pocket size computer used to do small computing and networking operations. It is the main element in the field of internet of things. It provides access to the internet and hence the connection of automation system with remote location controlling device becomes possible. Raspberry Pi is available in various versions. Selected Raspberry Pi module uses Broadcom BCM2836 ARMv7 Quad Core Processor which controls Single Board Computer running at 900MHz. It has 1GB RAM so you can now run greater and all the more capable applications. Identical board format and impression as the Model B+, so all cases and 3rd party add on boards intended for the Model B+ will be completely compatible. HAT compatible. It has 40 pin stretched out GPIO to upgrade your "real world" projects. Full HDMI port, 4 USB ports, Ethernet port, 3.5mm audio jack, video Camera interface (CSI), the Display interface (DSI), and Micro SD card slot. It has 10/100 Ethernet Port to rapidly interface the Raspberry Pi to the Internet.

VI. HARDWARE

In first case, the user will be able to monitor the soil environmental parameters such as temperature, soil PH and gas. In this process the sensor will be sensing the temperature, soil PH and gas values. This value will be transmitted to the RBP. RBP will transmit this value over the webpage through wireless connection. User from his/her machine will be able to monitor easily. For transmitting over wireless network we are making use of the webiopi service provided by the Google. The Raspberry Pi assigns different IP address at every time because we have used DHCP protocol. We are making use of SSH protocol with port no's: 22. The user will be provided with the username and password for authentication purpose. Hence user can make use of the IP address generated by Raspberry Pi so as to monitor the soil and environment parameters.

In second case, temperature, soil PH and gas will be controlled so as to maintain the soil and environmental condition. The sensors will transmit the sensed value to the RPI. RPI will compare those digital values with the set threshold value. If the value goes high/low; the RPI will take the decision about which action to be performed. This action will be transmitted to the relay circuit. Relay circuit performs the action such as ON/OFF (e.g. In case of temperature, if the temperature value of environment goes high with respect to room temperature then FAN will be switched ON and when the temperature goes low the FAN will be switched OFF. Here the controlling action will be performed directly by the relay circuit so it will provide advantageous to the system as no human source will be required or forced for controlling.
V. SYSTEM SOFTWARE
In this project, Flow of software is as follows. They are

Fig.11 To get Remote Desktop connection

Fig.12 Entering into Pi

Fig.13 Raspberry Pi

Fig.14 To get connected with Web through Pi

Fig.15 Programming through things

Fig.16 Programming window
V. EXPERIMENTAL RESULTS

The soil & environmental monitoring data sensors automatically monitor the temperature, Soil Ph and other gas concentrations. It can realize the remote access of sensor monitoring data and download of the environmental monitoring data to the client according to requests.

1. When temperature is below room temperature, Soil pH is less than threshold value (i.e. below 7) then soil is acidic and more oxygen get sensed, soil is aerobic.

![Fig.17. Output display on internet](image1)

2. When temperature is above room temperature, Soil pH is greater than threshold value (i.e. above 7) then soil is alkaline and less oxygen get sensed, soil is anaerobic.

![Fig.18. Output display on internet](image2)

VI. CONCLUSION

"Embedded Web Server" is new technology which can be used for monitoring and controlling parameters. This technology facilitates the monitoring and controlling of parameters remotely with the help of raspberry pi and IOT. This system is inexpensive, scalable, and highly efficient and it also provides fast response. As it uses a low powered raspberry pi board and different low powered sensors, it helps to atomize the industry in less cost and less energy which decreases over all cost of the atomization.

VII. REFERENCES

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