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Development of effective method for agriculture monitoring using WSN and IOT

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Abstract—

In our daily activities, controlling and monitoring plays a vital role and it helps the end user to decide what to and what not to do for making the attempt successful. In this paper, sensors are the key elements which collect the data from surrounding and upload it to the web server. End user will monitor it from a simple customized web page with a login. ARM processor with Laptop/PC is used for logging the data into the server. Sensors used in this paper for prototype were Soil Temperature Sensor, Soil Moisture Sensor, and a Soil Conductivity Sensor interfaced with ARM processor at antilog port. Python API is used in the laptop for sending the data captured by the laptop's serial port into the web server.

Keywords— Python API; ARM Processor; Web Data; Internet of Things

I. INTRODUCTION

Now-a-days, controlling and monitoring plays a main role in our day to day life. Everything we can control using advanced technologies and we can also monitoring the things we need. Now we can control and monitor anywhere using Internet of things. If you have Internet in your PC/Mobile you can direct upload the data you need and control it from internet itself. When we talking about the Internet of things.

The **Internet of Things** (**IoT**) is the network of physical objects or "things" embedded with electronics, software, sensors and connectivity to enable it to achieve greater value and service by exchanging data with the manufacturer, operator and/or other connected devices. Each thing is uniquely identifiable through its embedded computing system but is able to interoperate within the existing Internet infrastructure.

Thing Speak is an open source Internet of Things application and API to store and retrieve data from things using HTTP over the internet or via a local area network. With think speak, you can create sensor logging applications, and social network of things with status updates.

In addition storing and retrieving numeric and alphanumeric data, the Thing Speak API allows for numeric data processing such as time scaling, averaging, median, summing, and rounding. Each Thing Speak channel supports data entries of up to 8 data fields, latitude, longitude, elevation, and status.

The channel feeds support JSON, XML, and CSV formats for integration into applications.

The Thing Speak application also features time zone management, read/write API key management and JavaScript-based from High slide software

In this proposed solution, mainly three sensors are the key elements which collect the data from surrounding and upload it to webserver .
End user will monitor it from a simple customized web page with a login. And those three sensors are Soil Moisture sensor and Soil

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Conductivity sensor interfaced with ARM processor at analog port. Python API is used in the laptop for sending the data captured by the laptop's serial port into the web server.

II. SYSTEM ARCHITECTURE

The system architecture of this proposed system is divided into two different blocks.

ARM7 END: Hardware implementation for this proposed system is shown below with the simple blocks. Power Supply block is designed and developed to generate power source for the ARM processor and its relevant components. Reset Circuit is designed and developed to reset the program whenever necessary and interfaced to the ARM processor for greater stable response. Clock Circuit is designed and developed to generate oscillationsand interfaced to the ARM processor for needy response. LCD Display can also interface to the ARM processor for displaying the status of the system for better understanding. A simple block diagram shown below:

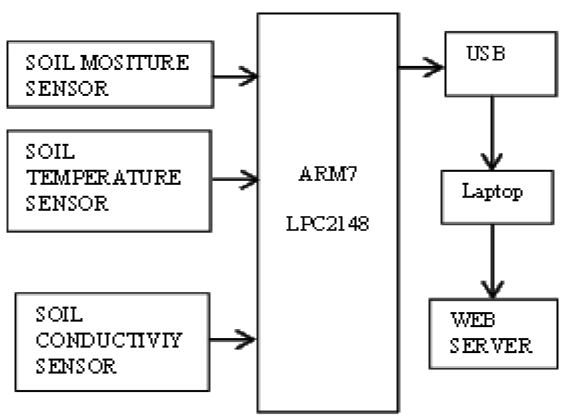

Figure – 1: Block Diagram

SERVER END: A WEB SERVER is designed and developed for collecting the data from surroundings through Sensors and upload it in to web server. Manual UI is designed for understanding of process with the help of HTML and PYTHON. Using the concept of Internet of Things we are uploading the each individual sensor values to the web server, there I can monitor the sensor values.

III. IMPLEMENTATION

HARDWARE:

In hardware implementation, ARM processor plays a key role in monitoring and controlling the security system. Low-power consumption ARM processor (LPC2148) operating at 3.3V, 50uA is designed and mounted on a PCB along with Reset Circuit and a Clock Circuit. LPC2148, a 32-bit microcontroller with advanced RISC architecture and having 48 GPIO lines with a program memory of 32KB and a data memory of 512Bytes.

And we have 2 UART ports i.e. UART0 and UART1. In this project XBEE connected to the UART0 port of ARM7 (LPC 2148). And 3 Analog to Digital channels, though I connected three Analog sensors to ADC channels of ARM7, so that it converts Analog Values to Digital Values. Those values i have uploaded into ThingSpeak.

Each Sensors and its behaviour explained in below. And ARM7 (LPC 2148) internal architecture overview has shown below as well ARM7 (LPC 2148) with LCD has shown below.

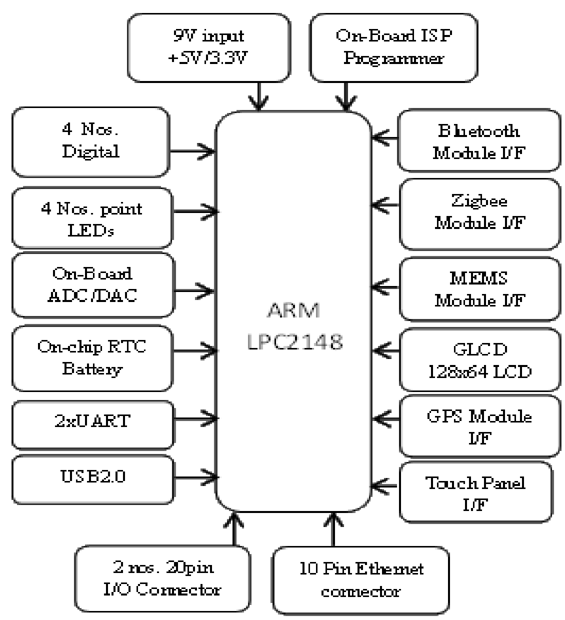

Figure – 2: ARM Overview [LPC2148]

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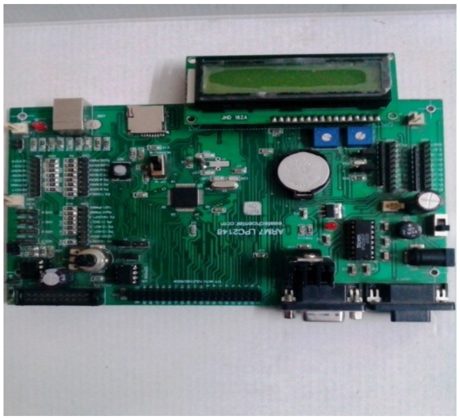

Figure – 3: LPC2148 Development Board

*Soil Moisture Sensor:*Soil moisture sensors measure the direct gravimetric content in soil. Since the direct gravimetric measurement of free soil moisture requires removing, drying, and weighting of a sample, soil moisture sensors measure the volumetric water content indirectly by using some other property of the soil, such as electrical resistance, dielectric constant, or interaction with neutrons, as as proxy for the moisture content. The relation between the measured property and soil moisture must be calibrated and many vary depending on environmental factors such as soil type, temperature type or electric conductivity. Reflected microwave radiation is affected by the soil moisture and is used for remote sensing in hydrology and agriculture. Portable probe instruments can be used by farmers or gardeners.

Soil moisture sensors typically refer to sensors that estimate volumetric water content. Another class of sensors measure another property of moisture in soils called water potential, these sensors are usually referred to as soil water potential sensors and includetension meters and gypsum blocks.

Here soil moisture sensor (LM 393) has interfaces at ARM7 (LPC 2148). Soil moisture sensor shown below:

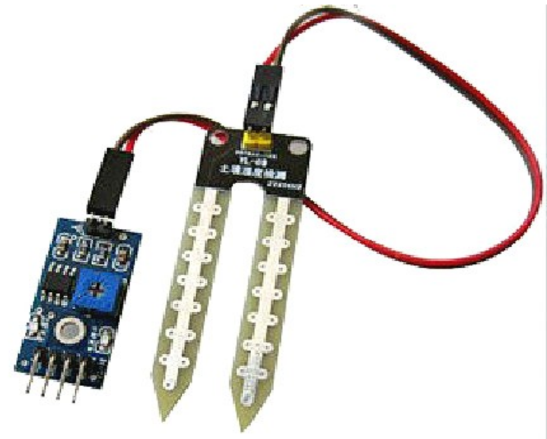

Figure – 4: Soil Moisture SensorLM393 interfaced to LPC 2148

Pin description of soil moisture sensor (LM 393) is shown below:

Pin	Definition
Vcc	5V
GND	GND
D0	Digital output interface(0 and 1)
A0	Analog output interface

Figure – 5: Soil moisture sensor PIN description

Temperature Sensor: The Temperature sensor (LM 35) has interfaced at ARM7. LM35 series are precision integrated-circuit temperature. The LM35 requires no external calibration since it is internally calibrated. The LM35 does not require any external calibration or trimming to provide typical accuracies of ±1⁄4°C at room temperature and ±3⁄4°C Over a full -55 to +150°C temperature range.

The LM35's low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 µA from its supply, it has very

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low self-heating, less than 0.1°C in still air. The characteristics of LM35 sensor shown below:

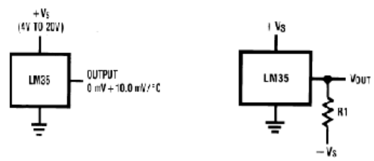

Figure – 6: LM35 characteristics

For each degree of centigrade temperature it outputs 10 mille volts.

In this project I've connected LM35 at P0.27 pin of ARM7 (LPC 2148). The output of LM35 would be in the form of Analog, to convert analog to digital I've used ADC. The output of LM35 given to the ADC and the output of ADC is in the form of digital. This output has given to the ARM7 and to the webserver through PC/Laptop.

The connection between ARM7 and LM35 shown below:

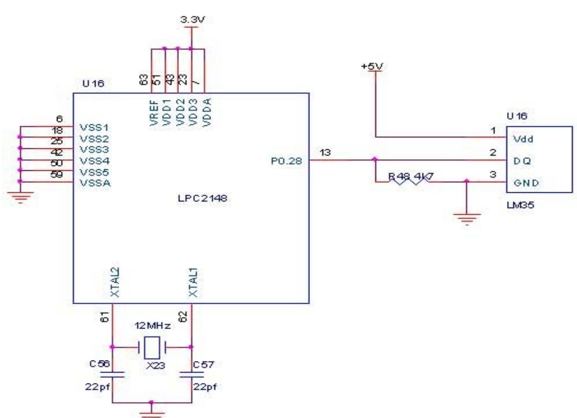

Figure – 7: LM35 interfaced to LPC 2148

*Soil ConductiveSensor:*Conductive level sensors are ideal for the point level detection of a wide range of conductive liquids such as water, and is especially well suited for highly corrosive liquids such as caustic soda, hydrochloric acid, nitric acid, ferric chloride, and similar liquids. For those conductive liquids that are corrosive, the sensor's electrodes need to be constructed from titanium, Hastelloy B or C, or 316 stainless steel and insulated with spacers, separators or holders of ceramic, polyethylene and Teflon-based materials. Depending on their design, multiple electrodes of differing lengths can be used with one holder. Since corrosive liquids become more aggressive as temperature and pressure increase, these extreme conditions need to be considered when specifying these sensors.

Conductive level sensors use a low-voltage, current-limited power source applied across separate electrodes. The power supply is matched to the conductivity of the liquid, with higher voltage versions designed to operate in less conductive (higher resistance) mediums. The power source frequently incorporates some aspect of control, such as high-low or alternating pump control. A conductive liquid contacting both the longest probe (common) and a shorter probe (return) completes a conductive circuit. Conductive sensors are extremely safe because they use low voltages and currents. Since the current and voltage used is inherently small, for personal safety reasons, the technique is also capable of being made "Intrinsically Safe" to meet international standards for hazardous locations. Conductive probes have the additional benefit of being solid-state devices and are very simple to install and use. In some liquids and applications, maintenance can be an issue. The probe must continue to be conductive. If buildup insulates the probe from the medium, it will stop working properly. A simple inspection of the probe will require an ohmmeter connected across the suspect probe and the ground reference.

Typically, in most water and wastewater wells, the well itself with its ladders, pumps and other metal installations, provides a ground return. However, in chemical tanks, and other non-grounded wells, the installer must supply a ground return, typically an earth rod.

Soil conductive sensors detect the level of liquids and other fluids ad fluidized solids, including slurries, granular materials, and powders that exhibit an upper free surface. Substances that flow become essentially horizontal in their containers because of gravity whereas most bulk

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solids pile at an angle of repose to a peak. The substances to be measured can bein side a container or can be in its natural form.

The level measurement can be either continuous or point values. Continuous level sensors measure level within a specified range and determine the exact amount of substance in a certain place, while point-level sensors only indicate whether the substance is above or below the sensing point. Generally the latter detect levels that are excessively high or low.

Soil conductive sensor has shown below:

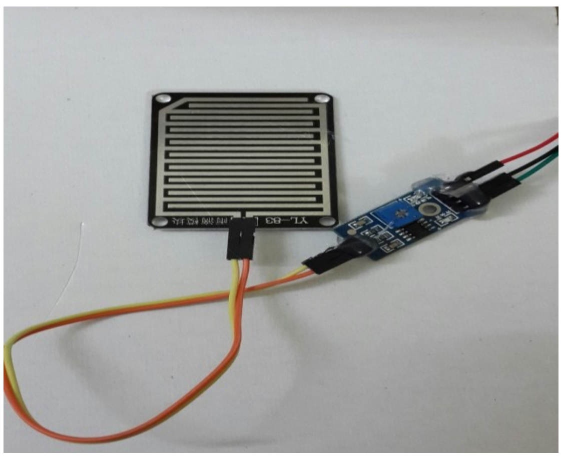

Figure – 8: Soil conductive sensor

All Sensors connected to ARM7 (LPC 2149) as per the following schematic diagram:

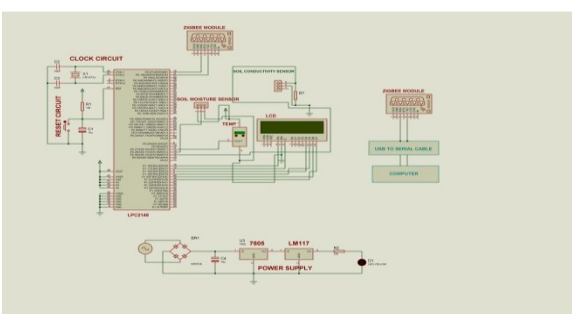

Figure – 9: Schematic Diagram

Soil moisture sensor (LM 393) connected at P0.28 of ARM7 (LPC 2148), LM35 sensor has connected at P0.29 of ARM7 (LPC 2148) and Soil conductive sensor connected at P0.30 of ARM7. All three Analog sensors are connected to Analog channel of ARM7. Reset Circuit and Clock Circuits were interfaced at RST, XTAL1, and XTAL2 of LPC2148.

SOFTWARE:

Here, to program ARM processor Keilu Vision 4 was used as a cross-compiler and Flash Magic was used as a programmer. ThingSpeak is an open source Internet of Things application and API to store and retrieve data from things using HTTP over the internet or via a local area network.

ALGORITHM & FLOWCHART

ALGORITHM:

Step – 1: Initialize ARM, LCD and UART.

Step – 2: Wait until you see WELCOME on LCD.

Step – 3: You see three sensors default values.

Step – 4: Wait until sensors values have been changed.

Step – 5: UART port must be Open while sending the sensor values from processor to Thing Speak.

Step – 5: Now login to ThingSpeak and Create channel and fields.

Step – 6: Now open the Python Program and run main.py, when sensors values changed then you can see the graph of sensors.

Step – 7: you can see sensors values in ThingSpeak until power supply on.

FLOWCHART:

The flowchart of this paper is shown below:

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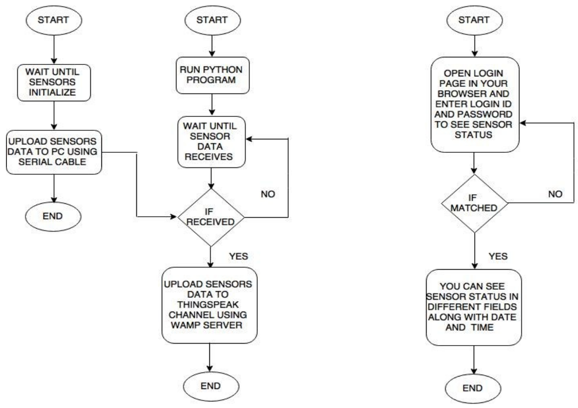

Figure – 10 : Schematic Diagram

IV. RESULTS

Figure – 11: Server Login

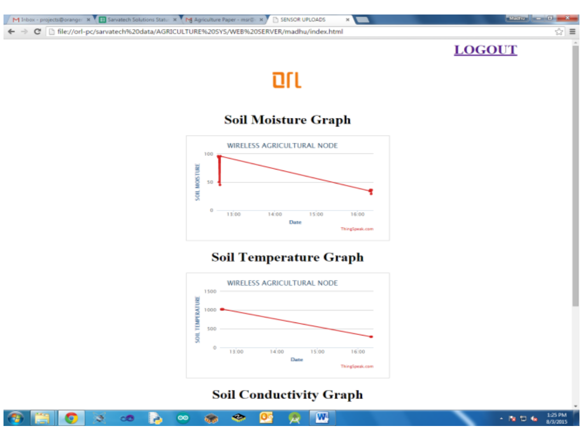

Figure – 12: Sensor Upload 1

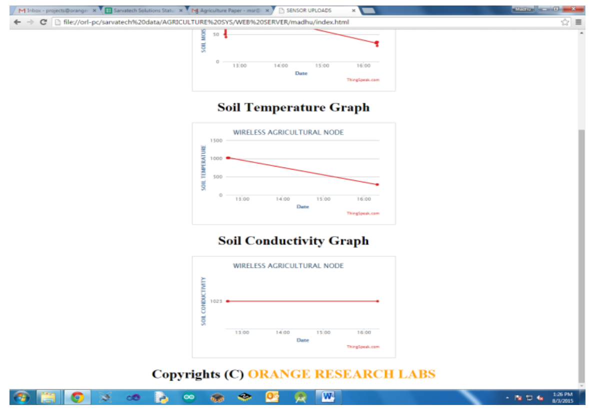

Figure – 13: Sensor Upload 2

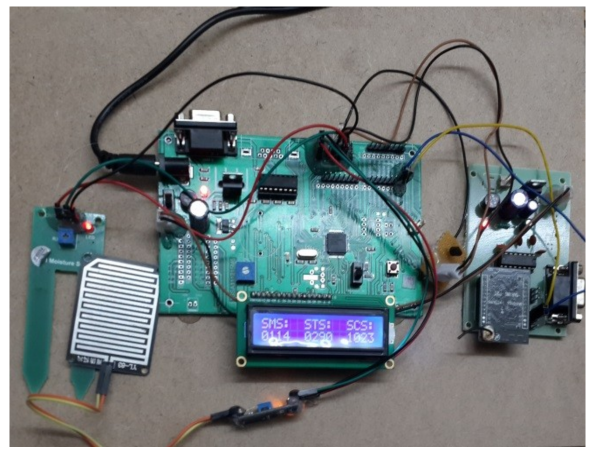

Figure – 14: Final Prototype 1

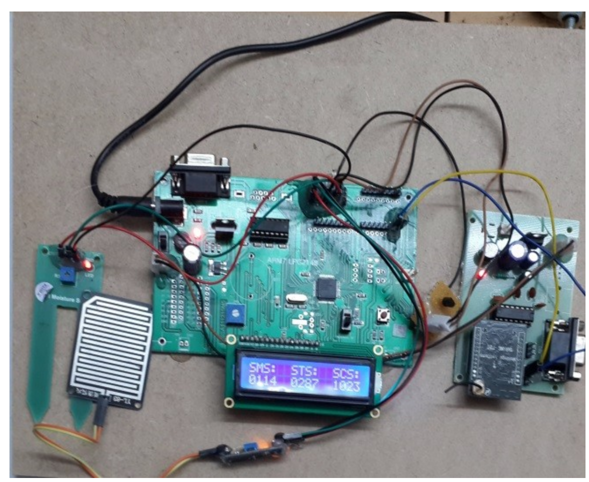

Figure – 15: Final Prototype

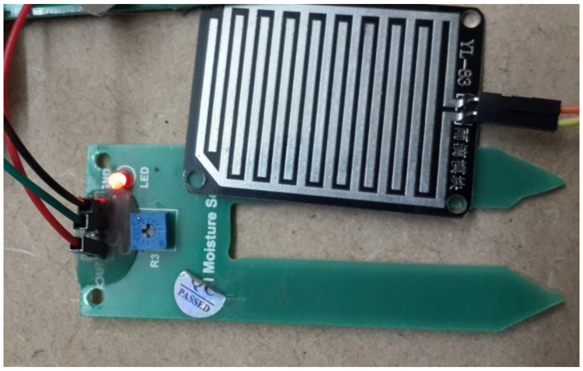

Figure – 16: Soil Moisture Sensor and Conductivity

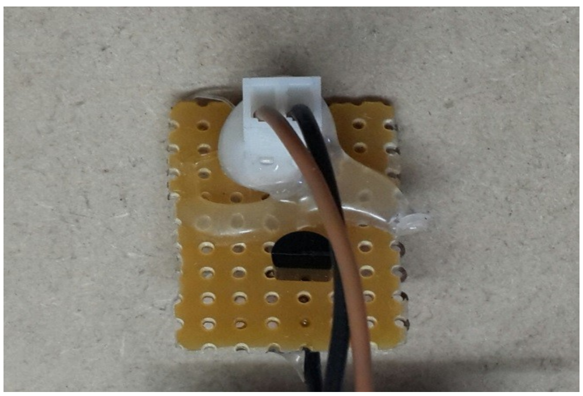

Figure – 17: Temperature Sensor

Figure – 18: Sensors Data

V. CONCLUSION

Here, an Internet of Thing Controlled Sensor Node is designed and proposed for an alternative for Wireless Sensor Node. A simple, IOTSN is designed with the help of XBEE transceivers and Laptop with the internet connectivity.

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[9]https://en.wikipedia.org/wiki/ThingSpeak

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