Wireless Sensor Network Based Agricultural Monitoring System

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Abstract : wireless sensor based Agriculture field monitoring designed with various futures and the device will be single system with multiple applications, The design which helps to collect, manage and visualize and upload the water level, temperature, moisture content, pH level information in the monitoring land, Where the different sensors are connected to the Arduino , the sensor values are stored in Raspberry pi using Zigbee , then we can know the exact situation of the monitoring land via internet , This is mainly designed to help formers for monitoring the various changes in the agriculture field.

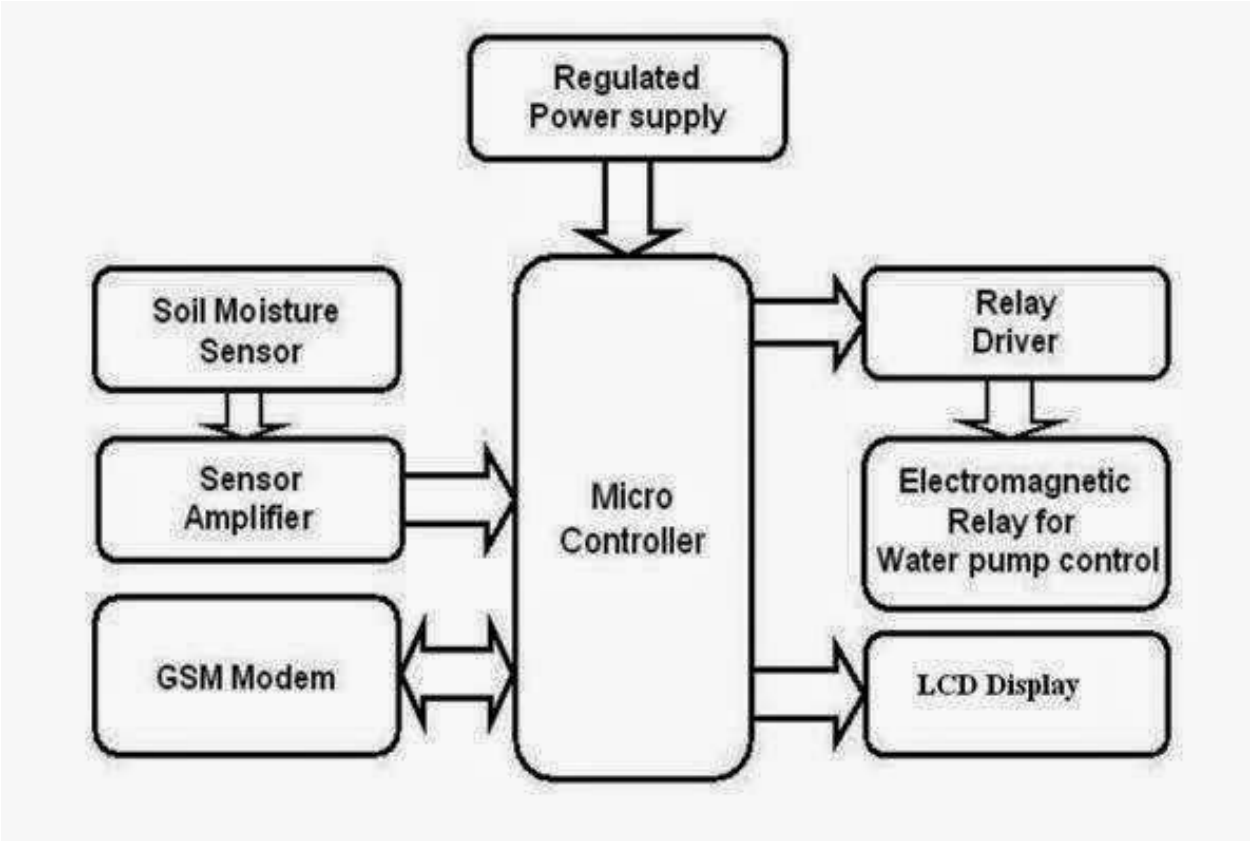
Index Terms – Zigbee, Raspberry PI, Arduino, Sensors, Agriculture.

I INTRODUCTION

Wireless sensor network (WSN) refers to a group of spatially dispersed and dedicated sensors for monitoring and recording the physical conditions of the environment and organizing the collected data at a central location. WSNs measure environmental conditions like temperature, humidity, wind, and so on. The WSN is built of "nodes" – from a few to several hundreds or even thousands, where each node is connected to one (or sometimes several) sensors. Each such sensor network node has typically several parts: a radio transceiver with an internal antenna or connection to an external antenna, a microcontroller, an electronic circuit for interfacing with the sensors and an energy source, usually a battery or an embedded form of energy harvesting. A sensor node might vary in size from that of a shoebox down to the size of a grain of dust, although functioning "motes" of genuine microscopic dimensions have yet to be created. The cost of sensor nodes is similarly variable, ranging from a few to hundreds of dollars, depending on the complexity of the individual sensor nodes. Size and cost constraints on sensor nodes result in corresponding constraints on resources such as energy, memory, computational speed and communications bandwidth. The topology of the WSNs can vary from a simple star network to an advanced multi-hop wireless mesh network. The propagation technique between the hops of the network can be routing or flooding in this paper we are going to discuss about soil moisture, temperature level, ph level and water level using wireless sensor networks.

II EXISTING SYSTEM

In this system the optimized data are collected from the wireless sensor nodes and then the data are analyzed for an expert irrigation scheduling using fuzzy logic in order to optimize water usage. The fuzzy logic approach is used and implemented using Arduino UNO board. This system is also used to check whether the plant is affected by any disease from its leaf image using image processing techniques and tested using MATLAB. The system mainly consists of Zigbee, GSM, sensors, controller and motor. The data from different sensors are aggregated to repeatedly monitor the soil moisture level, temperature level and humidity level in the farmland and the plant health status. Once the information is received by the sensor node, it is transmitted to the wireless node through a wireless protocol. This system uses Zigbee wireless module for data transmission from the end devices to the web server node. With the information from the web server node the farmer can monitor and control the irrigation automatically using android application. Mostly GSM is used to transmit the data to the user and the water level is being controlled through SMS



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CCTV cameras also are used to monitor the field where the soil condition is checked periodically and the water level is being maintained. In this case CCTV cameras are placed at different locations and the field is monitored on a computer and the water level is being supplied manually by the user. Manually Monitoring the agriculture application it is not possible all the time ,Then we using the GSM technology, it will take more time to get the exact situation and CCTV camera monitoring is possible but we cannot sense the temperature, water level and position of the valves**.** These are the major problem we faced in agriculture monitoring system.

III PROPOSED SYSTEM

` The proposed idea is to focus on the application which will help the farmers to take care of their yield in a more efficient way. The WSN based agriculture monitoring system includes more techniques in monitoring the field. The system is designed using Raspberry Pi and Arduino. In the proposed system the monitoring is done through sensors such as soil moisture sensor, temperature sensor, pH sensor and water level sensor. Here the data is transmitted from Arduino via Zigbee. In this system the data is being processed by Raspberry Pi which is the currently emerging technology. The Wireless Sensor Networks is regarded as the third wave of information technology after Internet and mobile communication network, which is characterized by more thorough sense and measure, more comprehensive interoperability and intelligence. The soil moisture sensor senses the moisture level in the soil, the humidity sensor senses the humidity level in the atmosphere, the temperature sensor gives the surrounding temperature and the water level sensor gives the level of water flowing.

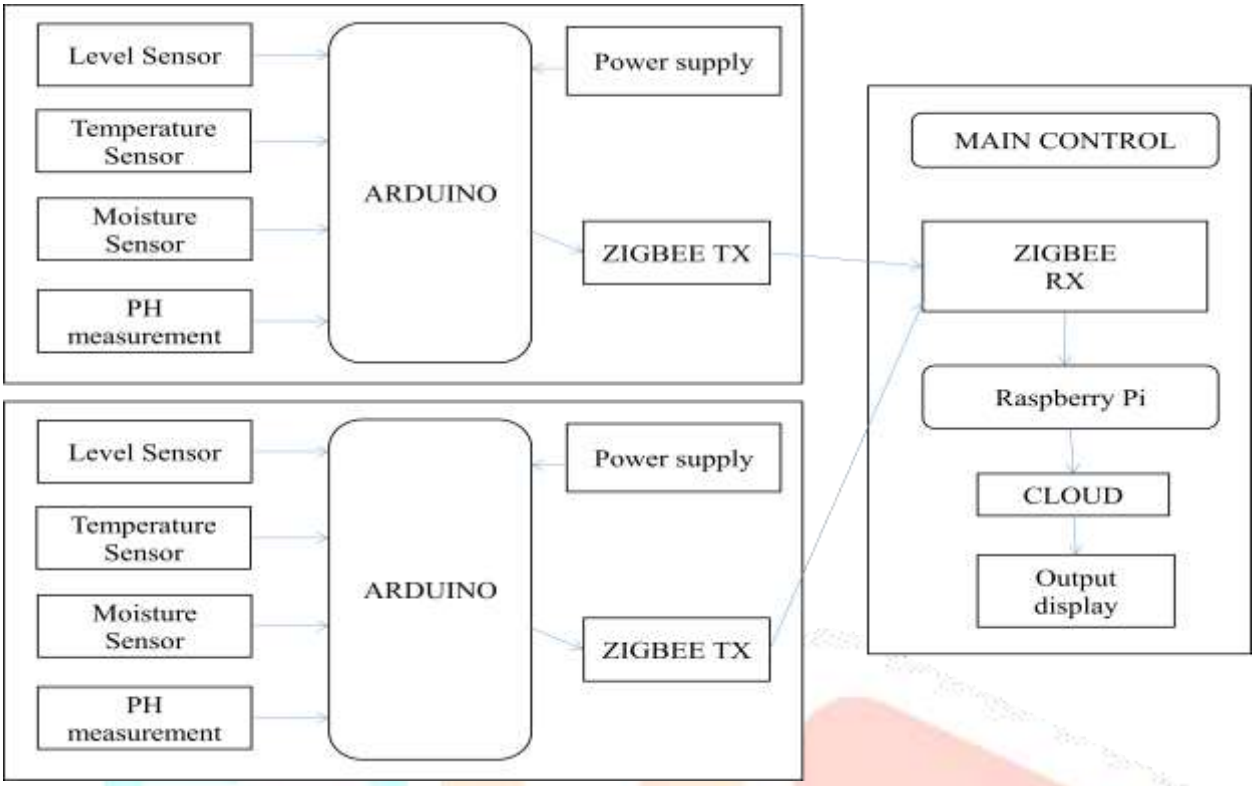

Fig. Block diagram of proposed system

The data are processed and the optimum water level will be supplied to the field by automatically switching on the power supply to the water pump. These data will be transmitted to the user over a web page through IoT using a separate IP address for the given Raspberry Pi module which is programmed to send the data given by the sensor to the user through a web page showing the live condition of the field.

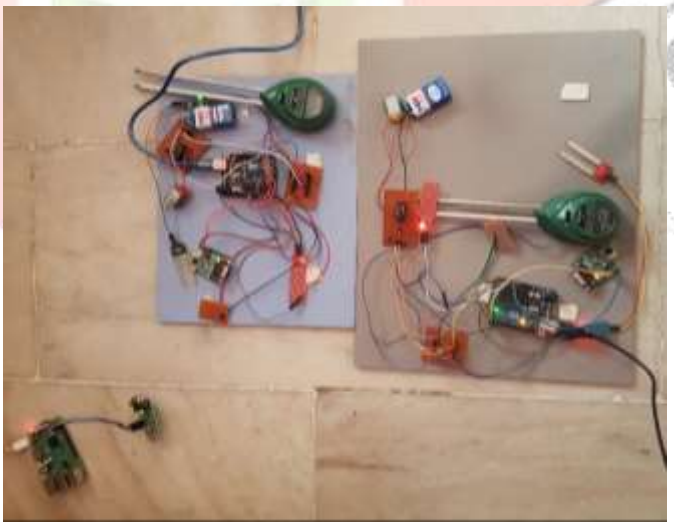

Fig. Circuit setup

Fig. Web Page

IV HARDWARE

4.1 Raspberry PI-3

Raspberry PI is a credit card sized minicomputer. Raspberry PI is a series of small single board computers. There are several generations in Raspberry PI. Raspberry PI3 model B has an on-board Wi-Fi/Bluetooth support. We use Raspberry PI3 model B in our smart plug device.The Raspberry PI has several advantages and speed of the processor than many other micro controllers. This Raspberry PI3 model B has some advantages. Raspberry PI runs Debian based GNU/Linux operating system. Raspberry PI3 model-B has a Broadcom BCM2837 Processor which we can also use for 64-bit processors. Raspberry PI3 model B have a Central Processing Unit (CPU) core is Quad core ARM Cortex-A53. The speed of the processor is 1.2 GHz, which is purely 50% faster than its previous model Raspberry PI2.

The Random Access Memory is 1GB. For network connection reliability, there is an Ethernet port where RJ-45 cable can be inserted.One of a specialty in Raspberry PI3 model B is, it has a Wireless LAN (Wi-Fi) which has an Internet Protocol address 802.11 which is majorly used for Local Area Network. Also it has a Bluetooth connectivity version 4.1. Raspberry PI3 models B have a ceramic antenna which is used by Wi-Fi and Bluetooth 4.1. It also has four USB ports mounted and a 15-pin MIPI port for camera usages.

Fig. Raspberry PI3

4.2 Arduino UNO

Arduino is a single board microcontroller which is mainly used for building various kinds of digital devices. It can also be used to control and interface with various electronic components such as sensors, actuators and many more. It has its own Static RAM and stores data at flash memory and also at EEPROM (Electrically Erasable Programmable Read Only Memory). The Central Processing Unit consists of 32-bit ARM Cortex-M3. This is more advanced than older version of arduino. In our implementation, we use sensors like temperature sensor (LM-35), soil moisture sensor, PH level sensor and water level sensor. Basically sensors do not give digital outputs, and Arduino has its own analog to digital conversion pins within it. Arduino is very easy to program. It uses programming languages like C and C++. It is very easy to interact between sensors and arduino.

Fig. Arduino UNO

4.3 Temperature sensor

Thermistors are thermally sensitive resistors whose prime function is to exhibit a large, predictable and precise change in electrical resistance when subjected to a corresponding change in body temperature. A temperature sensor is basically a device which is designed for the purpose of measurement of hotness or coldness of an object. LM-35 is an IC, temperature sensor which tends output as temperature. This temperature sensor is more accurate than thermistor. This sensor doesn't get heated easily. It has three terminals, input as +5V, output terminal and ground.

4.4 Soil Moister sensor

This soil moisture sensor measures the water content in soil. It senses the moisture content by various factors in properties of the soil like, electrical resistance, dielectric constant or interaction with neutrons. It measures the moisture by various environmental factors such as soil type, temperature, or electrical conductivity. It is mainly used in agriculture and gardening purposes. It accurately estimates volumetric water content.By measuring the flow of electricity between two electrodes in the soil resistivity, we can determine the soil moisture content.The water present in the soil can be determined easily by the voltage produced, because the water will act as an electrolyte and produces electricity. It is very similar to galvanic cell.

Fig. Soil Moister sensor

4.5 Water Level sensor

The water level sensor detects the level of water and other fluids. It can be implemented in any environment like tanks, reservoirs without any moving parts. This sensor has a sensing probe element which senses the surface level of nearly any fluid which includes water, salt water, and oils. The main advantage of the sensor is it do not get corrode easily. And it can be interfaced with arduino easily. The water level sensor can be easily calibrated to nearly any range and any fluid in the field with the use of two buttons. One

button records the minimum fluid level (0V level), and the other button records the maximum fluid level (3V level). After being calibrated, the sensor will return a value of 0 to 3 volts linear with the liquid level.

Fig. Level sensor

4.6 PH sensor

The PH sensor is a device which is used to measure the PH level of the solution. It has three states like acidic, basic and neutral. This sensor can able to give output signal corresponding to the hydrogen ion concentration that is measured by PH electrode. We can observe the PH value at any time.PH is measured from 0 to 14. Where all those 14PH levels indicate 14 different colours. The 0 to 6 are acidic and 7 is neutral (water is neutral). And 8 to 14 are alkaline (non acidic) or base.This device has input range as 5 Volt and output range as 414.12 micro Volt. The response time is higher as lesser than 2 minutes. Temperature range of the ph sensor is around 0-60 ℃.

4.7. Zigbee

ZigBee is the most popular industry wireless mesh networking standard for connecting sensors, instrumentation and control systems. ZigBee, a specification for communication in a wireless personal area network (WPAN), has been called the "Internet of things." Theoretically, your ZigBee-enabled coffee maker can communicate with your ZigBee-enabledtoaster. ZigBee is an open, global, packet-based protocol designed to provide an easy-to-use architecture for secure, reliable, low powerwireless networks. ZigBee and IEEE 802.15.4 are low data rate wireless networking standards that can eliminate the costly and damage pronewiring in industrial control applications.

Fig. Zigbee

V SOFTWARE USED

5.1 Sublime text

Sublime Text is a proprietary cross-platform source code editor with a Python application programming interface (API). It natively supports many programming languages and markup languages, and functions can be added by users with plugins, typically community-built and maintained under free-software licenses.

The following is a list of features of Sublime Text:

- "Goto Anything," quick navigation to files, symbols, or lines
- "Command palette" uses adaptive matching for quick keyboard invocation of arbitrary commands
- Simultaneous editing: simultaneously make the same interactive changes to multiple selected areas
- Python-based plugin API

- Project-specific preferences
- Extensive customizability via JSON settings files, including project-specific and platform-specific
- Cross platform (Windows, macOS, and Linux)
- Compatible with many language grammars from TextMate

VI CONCLUSION

We have developed a functional prototype of an agriculture monitoring system. The final product is a device that can be placed in an agriculture land in different places reading the water level, soil moisture, pH of the soil and the temperature of the surrounding and the read data is sent to the main control and this data can be read by the user through a web page and the water pump can be controlled using the switch given on the same web page.

VII FUTURE WORKS

In future many advanced sensors can be added or combined sensors for different parameters can be implemented and an alarm or notification can be sent to a user when the readings is not in the optimum condition. The water pump can be made automatic so as to switch on and off depending on the sensor readings without the need of user's effort.

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