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AUTOMATED IRRIGATION SYSTEM USING A WIRELESS SENSOR NETWORK

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Abstract:
An automated irrigation system was developed to optimize water use for agricultural crops. The system has a distributed wireless network of soil-moisture and temperature sensors placed in the root zone of the plants. In addition, a gateway unit handles sensor information, triggers actuators, and transmits data to a web application. An algorithm was developed with threshold values of temperature and soil moisture that was programmed into a microcontroller-based gateway to control water quantity. The system was powered by photovoltaic panels and had a duplex communication link based on a cellular-Internet interface that allowed for data inspection and irrigation scheduling to be programmed through a web page. The automated system was tested in a sage crop field compared with traditional irrigation practices. Because of its energy autonomy and low cost, the system has the potential to be useful in water limited geographically isolated areas therefore ,the Innovative system has several Agriculture field Applications this paper focus on development and application of the system

Keywords: *temp sensor,humidity,GPRS.*

Introduction:
There are many systems to achieve water savings in various crops, from basic ones to more technologically advanced ones. For instance, in one system plant water status was monitored and irrigation scheduled based on canopy temperature distribution of the plant, which was acquired with thermal imaging. In addition, other systems have been developed to schedule irrigation of crops and optimize water use by means of a crop water stress index. This index was later calculated using measurements of infrared canopy temperatures, ambient air temperatures, and atmospheric vapor pressure deficit values to determine when to

irrigate broccoli using drip irrigation. Irrigation systems can also be automated through information on volumetric water content of soil, using dielectric moisture sensors to control actuators and save water, instead of a predetermined irrigation schedule at a particular time of the day and with a specific duration. An irrigation controller is used to open a solenoid valve and apply watering to bedding plants (impatiens, petunia, salvia, and vinca) when the volumetric water content of the substrate drops below a set point. The development of WSNs based on microcontrollers and communication technologies can improve the current methods of monitoring to support the response appropriately in real time for a wide range of applications, considering the requirements of the deployed area, such as terrestrial, underground, underwater, multimedia, and mobile.

Literature survey:

The main aim of this project is to design low cost Automated Irrigation System Using a Wireless Sensor Network and GPRS Module.

The purpose of this project is to provide cell phone based embedded system for irrigation to reduce the manual monitoring of the field and get the information in the form of GPRS. In this system we are trying to increase the flexibility of the farmers. Various commercial WSNs exist, ranging from limited and low-resolution devices with sensors and embedded processors to complete and expensive acquisition systems that support diverse sensors and include several communication features. Recent advances in microelectronics and wireless technologies created low-cost and low-power components, which are important issues especially for such systems such as WSN. Power management has been addressed in both hardware and software with new electronic designs and operation techniques. The selection of a microprocessor becomes important in power aware design. Modern CMOS and micro-electro-mechanical systems (MEMS) technologies allowed manufacturers to produce on average every three years a enhance generation of circuits by integrating sensors, signal conditioning, signal processing, digital output options, communications, and power supply units

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Transmitter section:

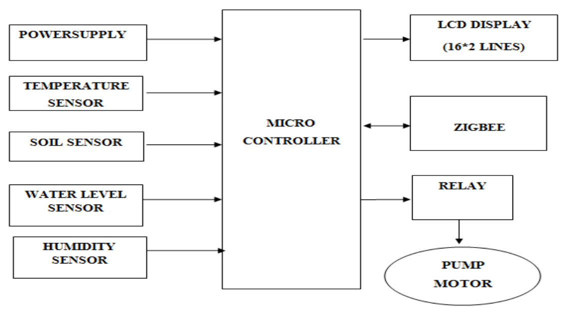


Fig:1:Block diagram

Photograph of Transmitter section

Receiver Section:

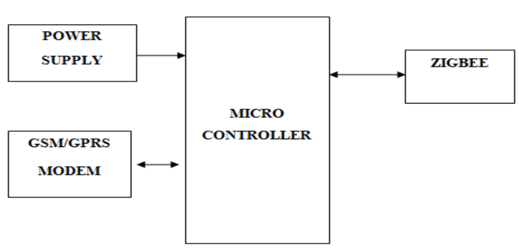
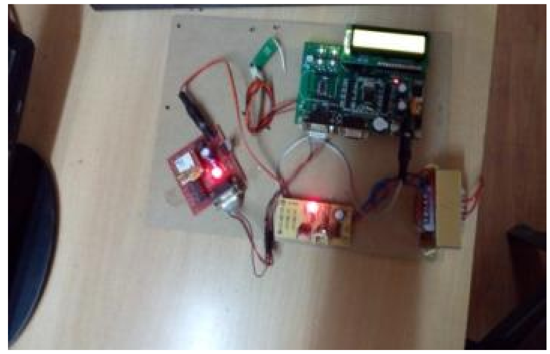


Fig:2:Block diagram



Photograph of Receiver section

In this project, the development of the automated irrigation system based on microcontrollers and wireless communication at experimental scale within rural areas is presented. The aim of the implementation was to demonstrate that the automatic irrigation can be used to reduce water use.A microcontroller for data acquisition, and transceiver; the sensor measurements are transmitted to a microcontroller based receiver. This gateway permits the automated activation of irrigation when the threshold values of soil moisture and temperature is reached. Communication between the sensor nodes and the data receiver is via the Zigbee.This receiver unit also has a duplex communication link based on a cellular Internet interface, using General Packet Radio Service (GPRS) protocol, which is a

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packet oriented mobile data service cellular global system for mobile communications (GSM).The Internet connection allows the data inspection in real time on a website, where the soil-moisture and temperature levels are graphically displayed through an application interface and stored in a database server. This access also enables direct programming of scheduled irrigation schemes and trigger values in the receiver according the crop growth and season management. Because of its energy autonomy and low cost, the system has potential use for organic crops, which are mainly located in geographically isolated areas where the energy grid is far away.

System Description:

Temperature sensor: A thermistor is a type of resistor whose resistance is dependent on temperature. Thermistors are widely used as inrush current limiter, temperature sensors (NTC type typically), self-resetting overcurrent protectors, and self-regulating heating elements. The TMP103 is a digital output temperature sensor in a four-ball wafer chip-scale package (WCSP). The TMP103 is capable of reading temperatures to a resolution of 1°C.

Fig:3: Temperature sensor

Humidity sensor:

Humidity sensor is a device that measures the relative humidity of in a given area. A humidity sensor can be used in both indoors and outdoors. Humidity sensors are available in both analog and digital forms. An analog humidity sensor gauges the humidity of the air relatively using a capacitor-based system. The sensor is made out of a film usually made of either glass or ceramics. The insulator material which absorbs the water is made out of a polymer which takes in and releases water based on the relative humidity of the given area. This changes the level of charge in the capacitor

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of the on board electrical circuit. A digital humidity sensor works via two micro sensors that are calibrated to the relative humidity of the given area. These are then converted into the digital format via an analog to digital conversion process which is done by a chip located in the same circuit. A machine made electrode based system made out of polymer is what makes up the capacitance for the sensor. This protects the sensor from user front panel (interface).

Fig: 4:Humidity sensor: SRHR-233C

Water level sensor:

The sensor used for measurement of fluid levels is called a level sensor. The sensing probe element consists of a special wire cable which is capable of accurately sensing the surface level of nearly any fluid, including water, saltwater, and oils. The sensor element is electrically insulated and isolated from the liquid into which it is inserted, and will not corrode over time. Unlike, other sensors, the measurement range is adjustable from a few centimeters to over several meters. A variety of sensors are available for point level detection of solids. These include vibrating, rotating paddle, mechanical (diaphragm), microwave (radar), capacitance, optical, pulsed-ultrasonic and ultrasonic level sensors.

Fig: 5:Capacitive water level sensor

Soil moisture sensor:

The two copper leads act as the sensor probes. They are immersed into the specimen soil whose moisture content is under test. The soil is examined under three conditions:

STEP1: Dry condition- The probes are placed in the soil under dry conditions and

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are inserted up to a fair depth of the soil. As there is no conduction path between the two copper leads the sensor circuit remains open. The voltage output of the emitter in this case ranges from 0 to 0.5V.

STEP2: Optimum condition- When water is added to the soil, it percolates through the successive layers of it and spreads across the layers of soil due to capillary force. This water increases the moisture content of the soil. This leads to an increase in its conductivity which forms a conductive path between the two sensor probes leading to a close path for the current flowing from the supply to the transistor through the sensor probes. The voltage output of the circuit taken at the emitter of the transistor in the optimum case ranges from 1.9 to 3.4V approximately.

STEP3: Excess water condition- With the increase in water content beyond the optimum level, the conductivity of the soil increases drastically and a steady conduction path is established between the two sensor leads and the voltage output from the sensor increases no further beyond a certain limit.

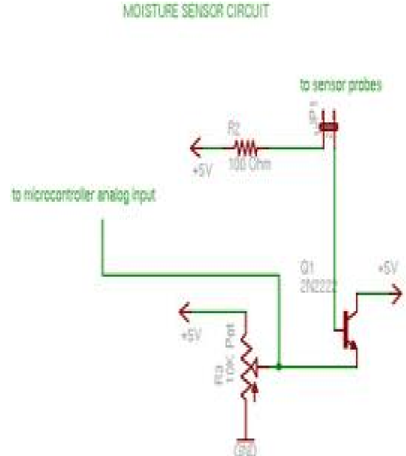

Fig:6:Moisture sensor maximum possible value for it is not more than 4.2V

GPRS:

GPRS (general packet radio service) is a packet-based data bearer service for wireless communication services that is delivered as a network overlay for GSM, CDMA and TDMA (ANSI-I36) networks. GPRS applies a packet radio principle to transfer user data packets in an efficient way between GSM mobile stations and external packet data networks. Packet switching is where data is split into packets that are transmitted separately and then reassembled at the receiving end. GPRS supports the world's leading packet-based Internet communication protocols, Internet protocol (IP) and X.25, a protocol that is used mainly in Europe. GPRS enables any existing IP or X.25 application to operate over a GSM

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cellular connection. Cellular networks with GPRS capabilities are wireless extensions of the Internet and X.25 networks.

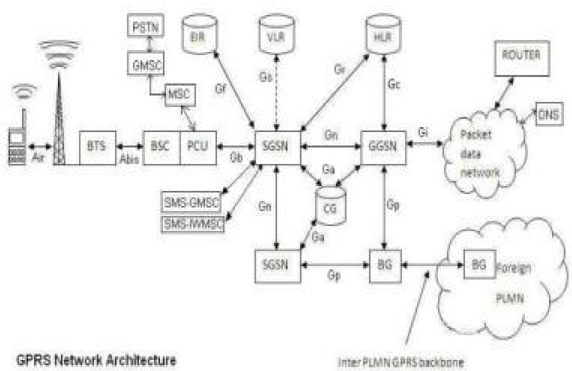

Fig:7: GPRS Architecture

ZIGBEE:

Zigbee modules feature a UART interface, which allows any microcontroller or microprocessor to immediately use the services of the Zigbee protocol. All a Zigbee hardware designer has to do in this case is ensure that the host's serial port logic levels are compatible with the XBee's 2.8- to 3.4-V logic levels. The logic level conversion can be performed using either a standard RS-232 IC or logic level translators such as the 74LVTH125 when the host is directly connected to the XBee UART. The below table gives the pin description of transceiver. The X- Bee RF Modules interface to a host device through a logic-level asynchronous Serial port. Through its serial port, the module can communicate with any logic and voltage Compatible UART; or through a level translator to any serial device. Data is presented to the X-Bee module through its DIN pin, and it must be in the asynchronous serial format, which consists of a start bit, 8 data bits, and a stop bit. Because the input data goes directly into the input of a UART within the X-Bee module, no bit inversions are necessary within the asynchronous serial data stream. All of the required timing and parity checking is automatically taken care of by the X-Bee's UART. [8] discussed about a method, Wireless sensor networks utilize large numbers of wireless sensor nodes to collect information from their sensing terrain. Wireless sensor nodes are battery-powered devices. Energy saving is always crucial to the lifetime of a wireless sensor network. Recently, many algorithms are proposed to tackle the energy saving problem in wireless sensor networks. There are strong needs to develop wireless sensor networks algorithms with optimization priorities biased to aspects besides energy saving. In this project, a delay-aware data collection network structure for wireless sensor networks is proposed based on Multi hop Cluster Network. The objective of the

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proposed network structure is to determine delays in the data collection processes. The path with minimized delay through which the data can be transmitted from source to destination is also determined. AODV protocol is used to route the data packets from the source to destination.

System interfacing & testing:

- Transmitter Section has been placed at Irrigation field & Receiver section is attached at monitor section at which all the sensor values are monitored on LCD.

At Transmitter section:

- ✓ Power supply of 5V has been supplied to initialize the transmitter section.
- ✓ TMP 103 sensor has been connected to measure the environmental temperature in Celsius.
- ✓ Soil sensor is used to detect the condition of soil whether it is wet (or) dry
- ✓ Water level sensor is used to measure the water level in the water tank which has been placed at irrigation field. Here the levels are Ground, Low, Mid, Full
- ✓ Humidity sensor measures Humidity of environment.
- ✓ Pump water has been placed to pump the water when soil is Dry & Water level is above the ground level.
- ✓ All the sensor values has been transmitted to Receiver section via Zigbee module. And the person will see the updates on LCD.

At Receiver Section:

- ✓ A separate power supply will be given to receiver section to initialize the operation.
- ✓ After getting initialized it shows getting Data from transmitter section (as we have placed Zigbee transreceiver at receiver) Sensor values will be updated on LCD.
- ✓ GPRS Modem has been placed to transfer the sensor values to IP address (Internet Of Things). Person from anywhere will observe the values on webpage.

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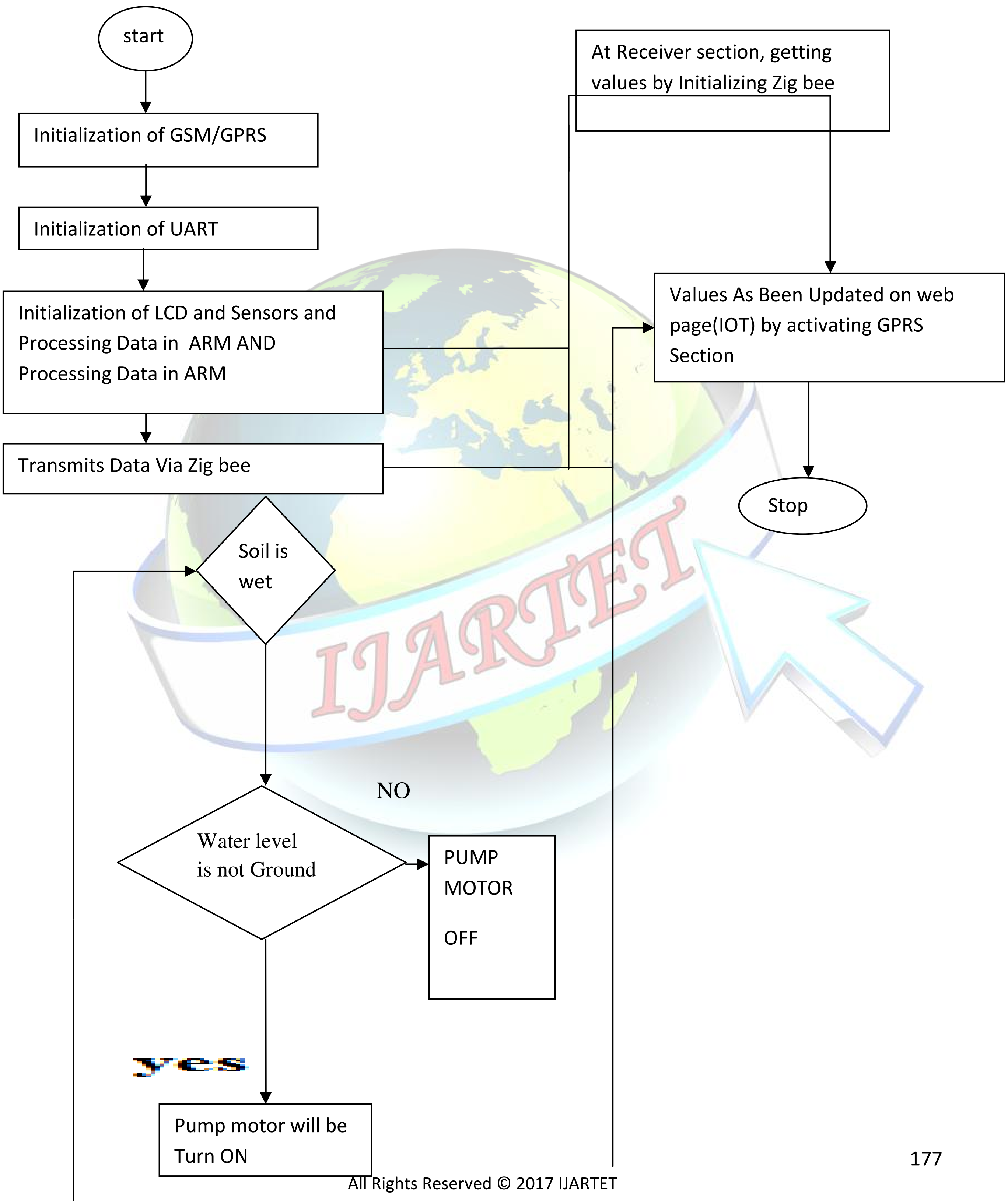
Software Flow Chart:



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CONCLUSION:

The automated irrigation system implemented was found to be feasible and cost effective for optimizing water resources for agricultural production. This irrigation system allows cultivation in places with water scarcity thereby improving sustainability. The automated irrigation system developed proves that the use of water can be diminished for a given amount of fresh biomass production. The use of solar power in this irrigation system is pertinent and significantly important for organic crops and other agricultural products that are geographically isolated, where the investment in electric power supply would be expensive.

FUTURE SCOPE:

Our project can be improvised by adding a Web scaper which can predict the weather and water the plants/crops accordingly. If rain is forecasted, less water is let out for the plants. Also, a GSM module can be included so that the user can control the system via smart phone. A water meter can be installed to estimate the amount of water used for irrigation and thus giving a cost estimation. A solenoid valve can be used for varying the volume of water flow. Furthermore, Wireless sensors can also be used.

Applications:

In Agriculture fields.

In Research Industries on soil.

In Biomedical Applications.

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