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Sensor Based Autonomous Field Monitoring Agriculture Robot Providing Data Acquisition & Wireless Transmission

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ABSTRACT: Agricultural Robots or Agribot is a robot deployed for agricultural purposes. .The main intention of these robots in agriculture is at the harvesting stage. Robots are designed to replace human labour, it mostly reduces the human operators and produce effective results. In most cases, a lot of factors have to be considered (e.g., the size and color of the fruit to be picked) before the commencement of a task. Current methods for off-road navigation using vehicle and terrain models to predict future vehicle response are limited by the accuracy of the models they use and can suffer if the world is unknown or if conditions change and the models become inaccurate .In this paper, an adaptive approach is presented that closes the loop around the vehicle predictions. This approach is applied to an autonomous vehicle known as field robots used in agriculture. Temperature & moisture sensors are used for analyzing the soil condition. The measured sensor data is transferred through a wireless long range communication channel in order to store in the remote terminal. The design criteria of this project involve the localization of robot position by using GPS module. It enables the robot position which can be tracked globally by transferring the data valued of Latitude and Longitude values. The location of Robot & tested soil sample location can be represented by using Google maps.

The data acquisition is accomplished using Zigbee wireless protocol. The acquired data will be displayed on the host system using Google maps. For independent functioning of mobile robot, application program is written in Embedded 'C' language.

KEYWORDS: Robot, Soil Moisture Sensor, Temperature Sensor, Micro Controller, Motor, Zigbee

I. INTRODUCTION

Now-a-days technology is growing day by day, so in order to reduce methods of agriculture a new system of "Agricultural Robo" was developed using controllers. This system consists of three steps, which includes Controller, Temperature Sensor and the Zigbee. This type of system is very useful for the mankind to save the time in Agricultural environments. The idea of applying robotics technology in agriculture is very new. In agriculture, the opportunities for robot-enhanced productivity are immense – and the robots are appearing on farms in various guises and in increasing numbers. We can expect the robots performing agricultural operations autonomously such as spraying and mechanical weed control, fruit picking, watching the farms day & night for an effective report, allowing farmers to reduce the environmental impact, increase precision and efficiency, and manage individual plants in novel ways.

The applications of instrumental robotics are spreading every day to cover further domains, as the opportunity of replacing human operators provides effective solutions with return on investment. This is especially important when the duties, that need to be performed, are potentially harmful for the safety or the health of the workers, or when more conservative issues are granted by robotics. Heavy chemicals or drugs dispensers, manure or fertilizers spreaders, etc. are activities more and more concerned by the deployment of unmanned options. Although, large sized wheels are required in muddy soils, robots small sized wheels perform well. Robot scouts are employed to get detailed information about the crop such as the presence of diseases, weeds, insect infestations and other stress conditions. The lightweight of the robots is a major advantage, since they do not compact the soil as larger machinery does. Robo will wander on fields to take care for plants.

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II. RELATED WORK

In [1] authors designed a robot prototype and built for a new aided fruit-harvesting strategy in highly unstructured environments, involving human-machine task distribution. The operator drives the robotic harvester and performs the detection of fruits by means of a laser range-finder, the computer performs the precise location of the fruits, computes adequate picking sequences and controls the motion of all the mechanical components (picking arm and gripper-cutter). Throughout this work, the specific design of every module of the robotized fruit harvester is presented. The harvester has been built and laboratory tests with artificial trees were conducted to check range-finder's localization accuracy and dependence on external conditions, harvesting arm's velocity, positioning accuracy and repeatability; and gripper-cutter performance. In [2] authors represents about the broad spectrum of the current trend of Indian agriculture. The main aim is to create the awareness cum current need about agricultural automation and the scope of opportunities available with Indian agricultural field. This in turn ushers our industrials' to turn cum focus their vision into agricultural automation related product development as like our automotive sector. As part of government also to fully extend their support by giving subsidies, tax rebate and support in collaborative works to the agricultural automation product manufactures. This creates our future generation from food crisis cum starvation, countries economy growth, higher productivity, Reduces unemployment related problems. In [5] the authors used suitable data acquisition system incorporated in the robotic system. A servo motor based robotic arm is designed for collecting soil sample and test various soil parameters. A closed loop feedback algorithm based on Digital PID controller has been developed for precise position and speed control of mobile robot. The wireless control of mobile robot and monitored data acquisition is accomplished using zigbee wireless protocol. In [6] the author implemented a dynamic and smart wireless mesh sensor network for aquaculture and water quality management applications. This system utilizes the Waspmote embedded systems platform developed by Libelium, mesh networking transceivers from Digi International and smart sensors from UNISM to implement a novel smart Wireless Mesh Sensor network –Aquamesh with multiple gateways of different technologies (Zigbee, GPRS and WIFI). The system is designed to continuously monitor aqua-environmental parameters and then initiate an alert or early warning to system user when certain thresholds are exceeded. The data generated from this system is stored locally on the gateway or sent to a remote web server. Data on the local database or remote web server can be accessed with smart mobile phones or personal computers.

III. PROPOSED METHODOLOGY

In Agriculture Industry, plants are prone to diseases caused by pathogens and environmental conditions. This leads loss of field growth and revenue loss. To overcome all these problems, an agriculture robot or agribot is designed to continuous monitoring of soil conditions autonomously.

LPC2148 ARM Controller: We use ARM controller to control all the peripherals in agricultural robo. LPC2148 is used as MCU in this design. Because of the advanced 32 bit architecture, it can detect changes as low as 3 millivolts, faster compared to PIC's and other 80series micro controllers. Inbuilt ADC was an added benefit of LPC2148. Hence we used this as our micro controller unit.

Fig- ARM7 LPC2148 Development Board

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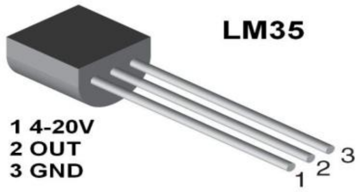
A Microchip microcontroller LPC2148 is used to collect, process the data and then stores it in a serial buffers. The LPC2148 is a 32k instructions program buffers, 512 kb bytes of RAM, three timers, and a 32-bit A/D converter microcontroller. It has RISC architecture and can use oscillators, thus it is ideal to be used as an embedded system.

Soil moisture Sensor: The Soil Moisture Sensor is used to measure the volumetric water content of soil. This makes it ideal for performing experiments in courses such as soil science, agricultural science, environmental science, horticulture, botany, and biology. Use the Soil Moisture Sensor to: Measure the loss of moisture over time due to evaporation and plant uptake. Evaluate optimum soil moisture contents for various species of plants. Monitor soil moisture content to control irrigation in greenhouses. Enhance your Bottle Biology experiments. The Soil Moisture Sensor uses capacitance to measure dielectric permittivity of the surrounding medium. In soil, dielectric permittivity is a function of the water content. The sensor creates a voltage proportional to the dielectric permittivity, and therefore the water content of the soil. The sensor averages the water content over the entire length of the sensor. There is a 2 cm zone of influence with respect to the flat surface of the sensor, but it has little or no sensitivity at the extreme edges. The figure above shows the electromagnetic field lines along a cross-section of the sensor, illustrating the 2 cm zone of influence.

Temperature Sensor: LM35 temperature sensor is arranged to detect if the temperature of agricultural land is higher. The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The output of sensor converted to digital that easy connecting with microcontroller.



GPS: A GPS receiver calculates its position by precisely timing the signals sent by GPS satellites high above the Earth. Each satellite continually transmits messages that include:

- the time the message was transmitted
- satellite position at time of message transmission

The receiver uses the messages it receives to determine the transit time of each message and computes the distance to each satellite. These distances along with the satellites locations are used with the possible aid of trilateration, to compute the position of the receiver. This position is then displayed, with a moving map display or latitude and longitude. Many GPS units show derived information such as direction and speed, calculated from position changes.

L293D Motor: We discuss about L293D motor driver working for motors. The L293 and L293D are quadruple high-current half-H drivers. The h-bridges are mainly used to change the polarities. .If we give logic bits 1, 0 then current flow is Vcc to motor positive after that motor positive to negative and then flows to ground. Then motor rotates in one direction. We change the logic bits as 0, 1 then current flow is Vcc to motor negative after that motor negative to positive and then flows to ground. Then motor rotate in opposite direction. If we give logic bits 1, 1 then Vcc and ground are short. So motor does not rotate. If we give logic bits 0, 0 then motor does not start, because two pins are given to zero. The L293and L293D is characterized for operation from 0°C to 70°C.

ZIGBEE WIRELESS MODULE: This technology allows for devices to communicate with one another with very low power consumption, allowing the devices to run on simple batteries for several years. Zigbee is targeting various forms of automation, as the low data rate communication is ideal for sensors, monitors, and the like. Home automation is one of the key market areas for zigbee. ZigBee is a low-power wireless technology, rewriting the wireless sensor equation. It is a secure network technology that rides on top of the recently ratified IEEE 802.15.4 radio standard. It is designed to interact with the remote controlled devices, which are put under a single standardized control interface that can interconnect into a network .Once associated with a network, a ZigBee node can wake up and communicate with other ZigBee devices and return to sleep.

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The designed system comprises of Temperature sensor, Moisture sensor and LPC2148 microcontroller. Initialize LCD sensor, Moisture sensor and LPC2148 microcontroller. Here temperature sensor and moisture sensor acts as an inputs for agriculture robot.

If the temperature is high the temperature sensor detects the value and reads through ADC and transmits the data to PC with the help of Zigbee. The moisture sensor detects if the moisture content in the soil is low then the robot moves to unit distance and gets location through GPS and transmits the location to PC through Zigbee transmitter. LCD displays the temperature and moisture levels. If the moisture level is below when compared to the limits, it sends a signal to the microcontroller and immediately a relay, which acts as a switch will be ON and the water gets sprinkled at that particular location. It indicates that the deficiency of moisture can be reduced by sprinkling the water at that particular location. All the peripherals are controlled by ARM LPC2148 Micro controller.

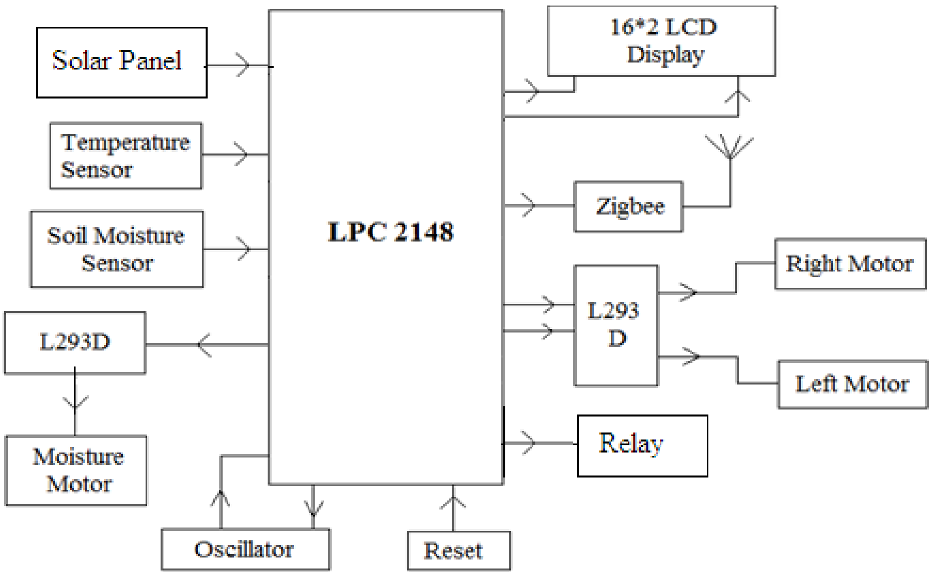

Fig – Transmitter Block Diagram

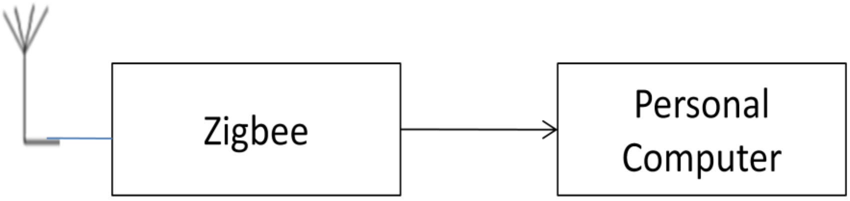

Fig – Receiver Block Diagram

Two probes are connected in the front panel of the robot. Those two probes penetrate into the soil. Robot moves to a certain distance and checks the temperature and soil moisture levels and sends the data by using Zigbee transmitter. The received temperature and moisture values along with latitude and longitude position values of robot will be displayed on the LCD display. The location of soil samples, where the robot has tested will be represented by using Google maps.

The robot should continuously monitor the field. It requires power supply or battery back-up. Power supply for the mobile robot is a complex one. It requires more battery back-up, as it is continuously working. To overcome this

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problem, a solar panel is integrated to the circuit. With the help of Solar energy, the robot can continuously working without fail.

IV. FLOW CHART

Firstly LCD, ADC and serial port are initialized. After initializing LCD, ADC and other required peripherals configuration, the Robot moves to a certain distance and checks the temperature and soil moisture levels and sends the data. The data is converted to digital form and fed to microcontroller. The microcontroller converts the digital data to ASCII code and displays it on LCD.

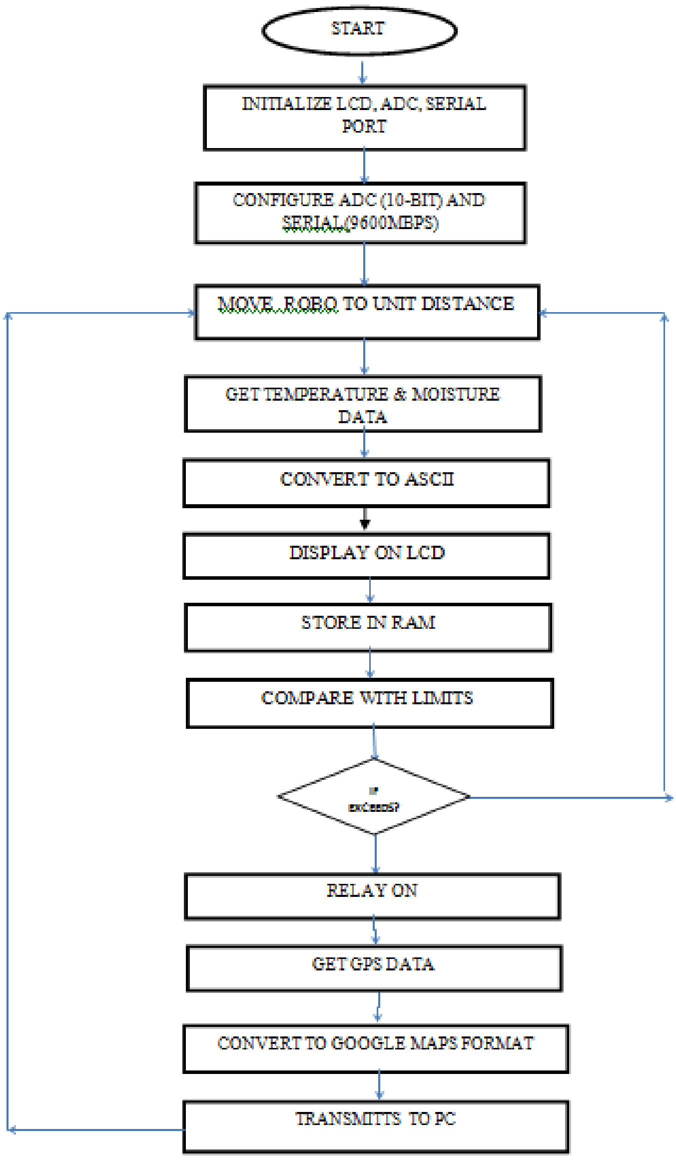

Fig – Flow Chart

The data thus obtained is stored in RAM. Then the data is compared with the limits, gets the GPS data, converts the data stored in the RAM to Google Map format and transmits to the PC Server. If the data does not exceed the

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limits then it again moves to the unit distance and starts checking the temperature and moisture levels and like this the process is continued in a cyclic pattern.

V. RESULTS

By using this AGRICULTURE ROBOT, we can easily monitor the soil conditions continuously and autonomously. The moisture and temperature readings analyzed by the agriculture robot were displayed on the 16X2 LCD display which was integrated to the LPC2148 microcontroller.

If the temperature and moisture levels are out of limits, then the GPS transmits the location/position of robot to the host system by using Zigbee wireless module through LPC2148. The latitude and longitude values of the Agriculture robot were displayed on the host system by using serial transmission.

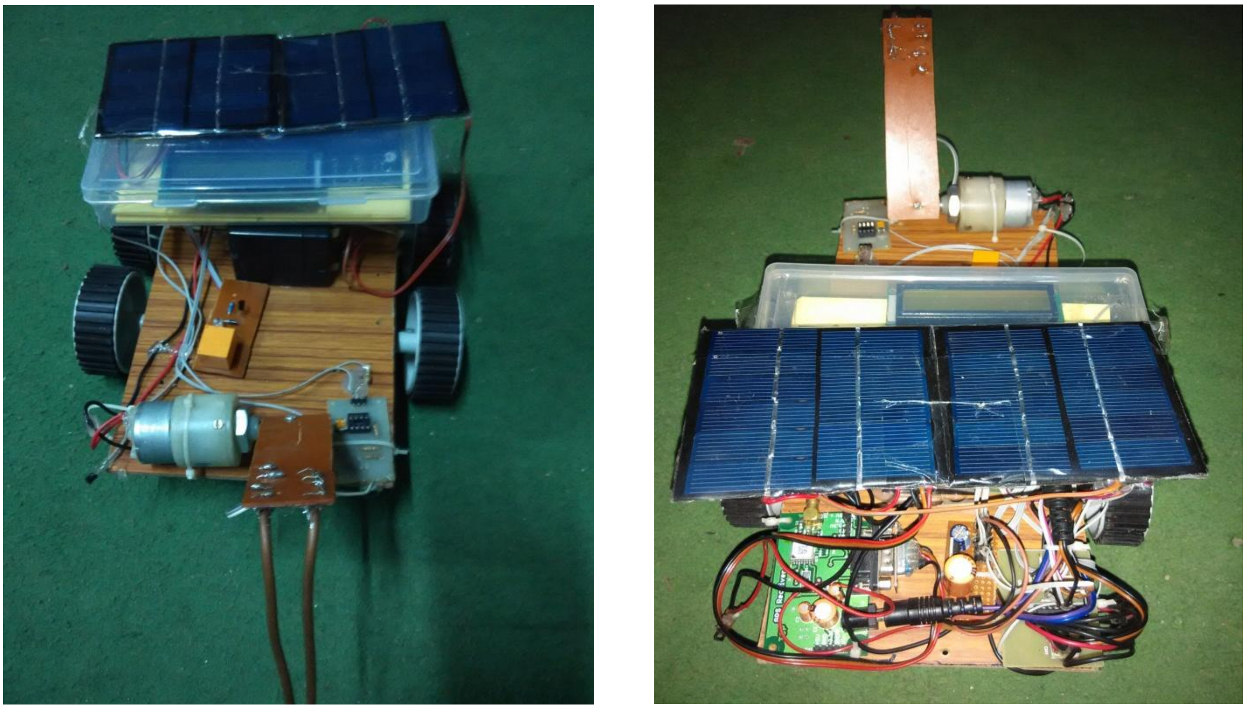

Fig – Agriculture Robot

The moisture level is out of limits, then the relay gets ON indicates that the motor gets ON for sprinkling the water at that particular position. Based on the Latitude and Longitude values, the robot position was represented in the Google maps.

VI. CONCLUSION AND FUTURE WORK

In this paper, we designed and implemented an Agricultural Robo which is designed to continuously monitor various temperature readings and coverts them into required form of data and stores them in memory. It avoids the human intervention, provides efficient location reading using GPS avoids the ambiguity and reduce the maintenance cost. It displays the corresponding information on LCD for user notification. In future it may be further developed by using 3-D technology which makes the work of the agriculturists easier to locate the moisture present at a particular point of instance and can be used to control the levels of moisture according to the user's requirement. It can be further developed by making flying robot which can be landed whenever needed; it increases the speed and effectiveness. The

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size of the flying robot will be reduced. By integrating camera for this agribot will give the pictorial representation by using GSM module. By using GSM module, the range of communication will be increased.

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BIOGRAPHY

Hemalatha Tankala pursuing M.Tech in LIMAT in the stream of Embedded Systems, was born on 2nd December,1991. She received graduation with a Bachelor Degree in Electronics and Communication Engineering from Vijaya Institute of Technology for Women, Enikepadu in 2013. Since her keen interest in Embedded systems and strong support from LIMAT, the author is involved in the development of monitoring and automation applications for industries and agriculture.

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