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Innovative Application of Robotics in Agriculture

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ABSTRACT: This paper presents a system with high speed of operation for an advanced agriculture process based on robotic platform. The robotic system is an electromechanical (conveys a sense that it has agency of its own) and artificial agent which is steered by DC motor which has four wheels. The measured sensor data is transferred through a Zigbee wireless protocol. Solar panel is used to charge DC battery. Temperature and soil sensors are used for analyzing the soil condition. Humidity sensors are also employed to analyze the moisture content in the atmosphere. Water is pumped or sprayed according to the measured quantities. Assembly language is used in programming the microcontrollers. The microcontroller is used to control and monitor the process ofsystem motion of vehicle with the help of DC motor.

I.INTRODUCTION

In the current generation most of the countries do not have sufficient skilled man powerspecifically in agricultural sector and it affects the growth of developing countries. So it's a time to automate the sector to overcome this problem. In India there are 70 percent people dependent on agriculture. So we need to study agriculture. Innovative idea of our project is to automate the process of watering the soil and to reduce the human effort. It also senses temperature, moisture content, humidity and light by using temperature sensor, moisture sensor, humidity sensor and LDR respectively. The process done by using DC motor. When the Robot reaches the end of the field we can change the direction with the help of using keys. The whole process is controlled by Microcontroller. The microcontroller acts as central processing unit of the system. When it receives the start command from the keyboard, then barrier motor starts, the machine starts moving in the appropriate direction. This project has presented the requirements and progress made towards achieving a future precision autonomous farming system. Since pumping and spraying is done by dc motor, this project increases the efficiency and accuracy. The project consists of two different mechanisms. The first mechanism contains making an assembly of vehicle and its motion, whereas second mechanism is sensing various parameters and taking control actions. The microcontroller is used to control and monitor the process of system motion of vehicle. It is controlled with help of DC motor and servo motor. Because of no man power requirement and high speed of operation, it has scope for further expansion. The aim of solving oftoday's irrigational problem is solved by this machine. The conventional method for seeding is the manual one.

II. LITERATURE SURVEY

In the current generation most of the countries do not have sufficient skilled man powerspecifically in agricultural sector and it affects the growth of developing countries. So it's a time to automate the sector to overcome this problem. In India there are 70 percent people dependent on agriculture. So we need to study agriculture. Innovative idea of our project is to automate the process of watering the soil and to reduce the human effort. It also senses temperature,

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III.AGRICULTURAL ROBOTIC MACHINE

3.1 Block Diagram

Fig 1 shows the block diagram of agricultural robotic machine. The major components are as shown below.

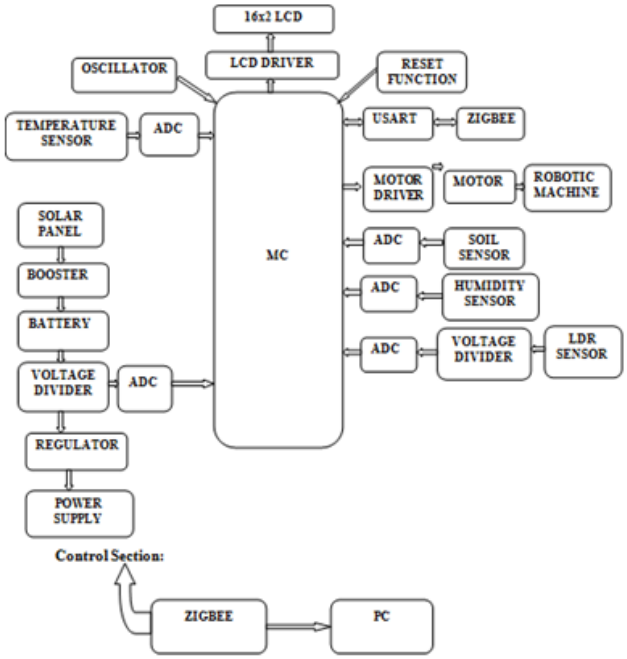

Fig -1: Block diagram

3.1.1 Microcontroller Atmega32

The high-performance, low-power Microchip 8-bit AVR RISC-based microcontroller combines 32KB ISP ash memory with read-while-write capabilities, 1KB EEPROM, 2KB SRAM, 54/69 general purpose I/O lines, 32 general purpose working registers, a JTAG interface for boundary-scan and on-chip debugging/programming, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a universal serial interface (USI) with start condition detector, an 8-channel 10-bit A/D converter, programmable watchdog timer with internal oscillator, SPI serial port, and five software selectable power saving modes. The device operates between 1.8-

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5.5 volts. By executing powerful instructions in a single clock cycle, the device achieves throughputs approaching 1 MIPS per MHz, balancing power consumption and processing speed.

3.1.2 LCD Display

A liquid-crystal display (LCD) is aat-panel display or other electronic visual display that uses the light-modulating properties of liquid crystals. Liquid crystals do not emit light directly. LCDs are available to display arbitrary images (as in a general-purpose computer display) or fixed images with low information content, which can be displayed or hidden, such as preset words, digits, and 7-segment displays as in a digital clock. They use the same basic technology, except that arbitrary images are made up of a large number of small pixels, while other displays have larger elements. LCDs are used in a wide range of applications including computer monitors, televisions, instrument panels, aircraft cockpit displays, and signage. They are common in consumer devices such as DVD players, gaming devices, clocks, watches, calculators, and telephones, and have replaced cathode ray tube (CRT) displays in nearly all applications. They are available in a wider range of screen sizes than CRT and plasma displays, and since they do not use phosphors, they do not super image burn-in. LCDs are, however, susceptible to image persistence. The LCD screen is more energy-efficient
and can be disposed of more safely than a CRT can. Its low electrical power consumption enables it to be used in battery-powered electronic equipment more efficiently than CRTs can be. It is an electronically modulated optical device made up of any number of segments controlling a layer of liquid crystals and arrayed in front of a light source (backlight) or reflector to produce images in colour or monochrome.

3.1.3 Motor Driver L293D

The L293 and L293D are quadruple high-current half-H drivers. The L293 is designed to provide bidirectional drive currents of up to 1 A at voltages from 4.5 V to 36 V. The L293D is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V. Both devices are designed to drive inductive loads such as relays, solenoids, dc and bipolar stepping motors, as well as other high-current/high-voltage loads in positive-supply applications. All inputs are TTL compatible. Each output is a complete totem-pole drive circuit, with a Darlington transistor sink and a pseudo-Darlington source. Drivers are enabled in pairs, with drivers 1 and 2 enabled by 1,2EN and drivers 3 and 4 enabled by 3,4EN. When an enable input is high, the associated drivers are enabled, and their outputs are active and in phase with their inputs. When the enable input is low, those drivers are disabled, and their outputs are off and in the high-impedance state. With the proper data inputs, each pair of drivers forms a full-H (or bridge) reversible drive suitable for solenoid or motor applications.

3.1.4 DB9-USB RS232

The DB9-USB connector modules can be used to upgrade an RS232 port to an active USB port without the need to redesign the PCB. The DB9-USB family consist of 6 modules. Two of these operate at RS232 voltage levels, while four of them operate at digital voltage levels (a choice of 5V or 3.3V). Each is available to replace either a male or a female DB9. DB9-USB modules can be used to upgrade a UART port of a device to an active USB port without the need for redesigning the devices PCB. These active connectors contain all the USB to UART (and vice-versa) conversion electronics and are designed to _t directly into the same PCB footprint as a PC compatible UART DB9 connector. The FTDI DB9-USB-RS232 modules are available in two types DB9-USB-RS232-M and DB9-USB-RS232-F. A DB9-USB-RS232-M can be used to replace a male DB9 connector that is wired in a PC compatible RS232 manner. This module operates at RS232 signal levels. A DB9-USB-RS232-F can be used to replace a female DB9 connector that is wired in a PC compatible RS232 manner. This module operates at RS232 signal levels. The purposes of these modules is to provide a simple method of adapting legacy serial devices with UART interfaces to modern USB ports by replacing the DB9 connector with this miniaturised module which closely resembles a DB9 connector. This is accomplished by incorporating the industry standard FTDI FT232R USB-Serial Bridge IC. The RS232 level DB9-USB modules include an RS232 level transceiver.

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3.1.5 Moisture Sensor

Soil moisture sensors measure the volumetric water 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 a proxy for the moisture content. The relation between the measured property and soil moisture must be calibrated and may vary depending on environmental factors such as soil type, temperature, 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 include tensiometers and gypsum blocks.

3.1.6 Humidity Sensor

A humidity sensor is an instrument used for measuring the moisture content in the atmosphere. Humidity measurement instruments usually rely on measurements of some other quantity such as temperature, pressure, mass or a mechanical or electrical change in a substance as moisture is absorbed. By calibration and calculation, these measured quantities can lead to a measurement of humidity. Modern electronic devices use temperature of condensation (the dew point), or changes in electrical capacitance or resistance to measure humidity differences.

3.1.7 Temperature Sensor

The LM35 is an integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the temperature (in degree Celsius).It can measure temperature more accurately than a thermistor. The sensor circuitry is sealed and not subject to oxidation. The LM35 generates a higher output voltage than thermocouples and may not require that the output voltage be amplified. The LM35 has an output voltage that is proportional to the Celsius temperature. The scale factor is .01V/degree Celsius.

The LM35 does not require any external calibration or trimming and maintains an accuracy of +/-0.4 degree Celsius at room temperature and +/-0.8 degree Celsius overall range of 0 degree Celsius to +100 degree Celsius. Another important characteristic of the LM35 is that it draws only 60 micro amps from its supply and possesses a low self-heating capability. The LM35 comes in many different packages such as TO-92 plastic transistor-like package, T0-46 metal can transistor-like package, 8-lead surface mount
SO-8 small outline package.

3.1.8 Light Dependent Resistor

A Light Dependent Resistor (LDR) or a photo resistor is a device whose resistivity is a function of the incident electromagnetic radiation. Hence, they are light sensitive devices. They are also called as photo conductors, photo conductive cells or simply photocells. They are made up of semiconductor materials having high resistance. There are many different symbols used to indicate a LDR, one of the most commonly used symbol. The arrow indicates light falling on it.

3.1.9 Oscillator

An electronic oscillator is an electronic circuit that produces a periodic, oscillating electronic signal, often a sine wave or a square wave. Oscillators convert direct current (DC) from a power supply to an alternating current (AC) signal. They are widely used in many electronic devices. Common examples of signals generated by oscillators include signals broadcast by radio and television transmitters, clock signals that regulate computers and quartz clocks, and the sounds produced by electronic beepers and video games. Oscillators are often characterized by the frequency of their output signal. A low-frequency oscillator (LFO) is an electronic oscillator that generates a frequency below 20 Hz. This term is typically used in the field of audio synthesizers, to distinguish it from an audio frequency oscillator. An audio oscillator produces frequencies in the audio range, about 16 Hz to 20 kHz. An RF oscillator produces signals in the radio frequency (RF) range of about 100 kHz to 100 GHz. Oscillators designed to produce a high-power AC output from a DC supply are usually called inverters. There are two main types of electronic oscillator: the linear or harmonic oscillator and the nonlinear or relaxation oscillator.

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3.1.10 Solar Panel

Solar panel refers to a panel designed to absorb the sun's rays as a source of energy for generating electricity or heating. A photovoltaic (PV) module is a packaged, connect assembly of typically 6*10 photovoltaic solar cells. Photovoltaic modules constitute the photovoltaic array of a photovoltaic system that generates and supplies solar electricity in commercial and residential applications. Each module is rated by its DC output power under standard test conditions (STC), and typically ranges from 100 to 365 watts. The efficiency of a module determines the area of a module given the same rated output an 8 percentage efficient 230 watt module will have twice the area of a 16 percentage efficient 230 watt module. There are a few commercially available solar modules that exceed 22 percentage efficiency and reportedly also exceeding 24 percentage. A single solar module can produce only a limited amount of power; most installations contain multiple modules. A photovoltaic system typically includes an array of photovoltaic modules, an inverter, a battery pack for storage, interconnection wiring, and optionally a solar tracking mechanism. The most common application of solar panels is solar water heating systems. The price of solar power has continued to fall so that in many countries it is cheaper than ordinary fossil fuel electricity from the grid (there is "grid parity").

3.1.11 Voltage Divider

In electronics, a voltage divider (also known as a potential divider) is a passive linear circuit that produces an output voltage (Vout) that is a fraction of its input voltage (Vin). Voltage division is the result of distributing the input voltage among the components of the divider. A simple example of a voltage divider is two resistors connected in series, with the input voltage applied across the resistor pair and the output voltage emerging from the connection between them. Resistor voltage dividers are commonly used to create reference voltages, or to reduce the magnitude of a voltage so it can be measured, and may also be used as signal attenuators at low frequencies. For direct current and relatively low frequencies, a voltage divider may be sufficiently accurate if made only of resistors; where frequency response over a wide range is required (such as in an oscilloscope probe), a voltage divider may have capacitive elements added to compensate load capacitance. In electric power transmission, a capacitive voltage divider is used for measurement of high voltage.

3.1.12 Zigbee

ZigBee is a low-cost, low-power, wireless mesh network standard targeted at the wide development of long battery life devices in wireless control and monitoring applications. Zigbee devices have low latency, which further reduces average current. ZigBee chips are typically integrated with radios and with microcontrollers that have between 60-256 KB of ash memory. ZigBee operates in the industrial, scientific and medical (ISM) radio bands: 2.4 GHz in most jurisdictions worldwide; 784 MHz in China, 868 MHz in
Europe and 915 MHz in the USA and Australia. Data rates vary from 20 kbit/s (868MHz band) to 250 kbit/s (2.4 GHz band). The ZigBee network layer natively supports both star and tree networks, and generic mesh networking. Every network must have one coordinator device, tasked with its creation, the control of its parameters and basic maintenance. Within star networks, the coordinator must be the central node. Both trees and meshes allow the use of ZigBee routers to extend communication at the network level. ZigBee builds on the physical layer and media access control defined in IEEE standard 802.15.4 for low-rate WPANs. The specification includes four additional key components: network layer, application layer, ZigBee device objects (ZDOs) and manufacturer-defined application objects which allow for customization and favour total integration. ZDOs are responsible for some tasks, including keeping track of device roles, managing requests to join a network, as well as device discovery and security. ZigBee is one of the global standards of communication protocol formulated by the significant task force under the IEEE 802.15 working group. The fourth in the series, WPAN Low Rate/ZigBee is the newest and provides specifications for devices that have low data rates, consume very low power and are thus characterized by long battery life. Other standards like Bluetooth and IrDA address high data rate applications such as voice, video and LAN communications.

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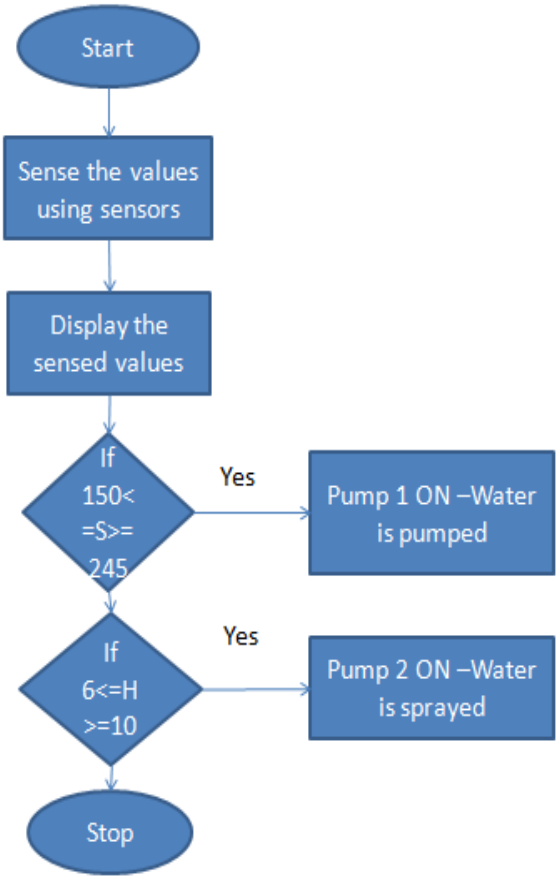
IV.WORKING OF AGRICULTURAL ROBOTIC MACHINE



This project presents a system with high speed of operation for an advanced agricultural process. Main function of this project is sensing various parameters such as temperature, humidity, moisture and light and these will be displayed on the LCD. Also control actions will be provided for it. Two pumps are present for control actions. These pumps are controlled by two motors. For the parameters, there is already a preset values. If the value of humidity and moisture goes below the preset value, the pumps may come into action. In the case of humidity, if the value is less than its preset value, one pump may start to spray water into atmosphere and if the value of moisture is less than its preset value, the other pump may pump water into soil. The motion of the vehicle is done by pressing keys on the PC. ZigBee is also used for wireless transformation.

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V. RESULT AND DISCUSSIONS

Fig -2: Working model

Agricultural Robotic Machine project was implemented and tested. Different typesof sensors are used for sensing agricultural parameters. Solar panel is used for charging the battery.

VI.CONCLUSION

This project has presented the requirements and progress made towards achieving a future precision autonomous farming system. The assembly is developed for watering automatically i.e. less power is required. So this project increases the efficiency and accuracy. The project consists of two different mechanisms. The first mechanism contains making an assembly of vehicle and its motion, whereas second mechanism is preparing sensing various parameters and taking control actions for it. The microcontroller is used to control and monitor the process of system motion of vehicle. It is controlled with help of DC motor. Because of no man power requirement and high speed of operation, it has scope for further expansion.

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