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Advanced Automated Agriculture

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ABSTRACT

Farming is the widest financial area and theatres vital part in the general financial growth of a country. Business progressions in the field of farming will govern to upsurge the capability of specific agricultural events. In this paper, we have proposed a new procedure for smart agriculture via connecting a smart detecting scheme besides smart irrigation scheme through wireless communication technology. The respective scheme emphases on the size of bodily constraints such as soil moisture content, automated irrigation, intrusion detection, real time data processing that plays a dynamic role in agricultural events. Grounded on the important bodily and biochemical constraints of the soil measured, the essential amount of water is sprinkled on the harvests with a smart irrigator, which is connected to a Raspberry Pi kit. The complete demonstration and control policies of a smart irrigator and smart agricultural system are established in this paper.

Keywords: Raspberry Pi, Smart farming, Smart agriculture System, Smart Identifying Scheme.

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I. INTRODUCTION

Farming is the support of Indian economy. In India, about 70% of the people make their living from farming. The new improvement in information technology has made it possible for the agriculturalists to obtain a massive quantity of site-specific information for the farms. The key actions involved are information gathering, processing, and flexible amount of application of inputs. We can decrease a lot of physical efforts in the field of farming by means of automation. The main issue faced in numerous farming areas is that absence of automation in farming activities. In India farming activities are conducted by physical labor, using suitable gears such as plough, sickle. Our advanced automated agriculture system educethe physical effort and automates the farming events or activities by using various sensors such as soil moisture, humidity, temperature as well as IR sensor as well as real time data can be processed to make suggestions for farmers which will help in increasing the productivity

II. METHODOLOGY

A. Raspberry Pi

Raspberry Pi [7] is a small computer board working on the Linux operating system which connects to a computer monitor, keyboard, and mouse. Raspberry Pi can be applied to a electronic structure and programming network work, it can also served as a personal computer and Apache Webserver, MySQL could be installed in the board. A GPIO [10] pin can be used as either a digital input or a digital output, and both operate at 3.3V. Unlike the Arduino, the Raspberry Pi which does not have any analog inputs. For that you must use an external analog-to-digital converter (ADC) or connect the Pi to an interface board must be used. [2]

B. Arduino

Arduino is an open-source microcontroller compatible with developed platforms. The controller appears not to be expensive and uses low electrical power, 5.5 volts. C and C++ were employed for this development. Arduino can connect to a computer via the Universal Serial Bus (USB) and perform with compatible connected accessories in both analog signal and digital signal.

The Arduino is a microcontroller platform, mounted on a board that plugs easily into most computers. It allows the user to program the onboard Atmega chip to do various things with programming language, in programs called sketches. [2]

C. Humidity Sensor module

Environmental conditions directly affect animal livelihood contributing to some chronic epidemics such as Bird Flu and Hand Foot and Mouth Disease. Therefore, DHT22 is use as a censor for measuring temperature (for both Fahrenheit and Celsius value) and humidity. The measurement unit will be demonstrated in a digital signal form.

Python programming is applied for the development of Raspberry Pi. Python would read the Arduino signal value via UART and then collect the obtained signal to the database for processing. If the value surpassed threshold, the over signal would be sent to GPIO pins to aware the analog signal. In case of high quality data, a "High" signal would be sent to GPIO pin 17 and the ventilator would erase the internal air (Fan out on). In case of high temperature, a "High" signal would be sent to GPIO pin 27 and the ventilator would work automatically (Fan in on). In the event of luminescence change, the data would be sent to GPIO pin 22 and electric lamps would be opened. Conveniently, working of accessories could be customized by the user as mentioned in Fig. 4 expressing the flowchart of the Python programming in Raspberry Pi.

Another important thing is that this Smart Phone works with the Android OS. Developed applications are on the Android operating system using the Java language and interacted with the Raspberry Pi through the wireless network. This will take the value from the Arduino to read displays such as temperature, humidity, light, toxic gases, etc. It's able to control fans and lights, and can be tracked via the internet at any time. [2]

Hardware connection

The Raspberry Pi and Arduino were connected via UART. The connection was a serial communication as Full Duplex since there was two-ways that data could be transmitted via pin TX and RX.

A direct connection between the Raspberry Pi and Arduino was prohibited, because of its electrical potential differences, which is 3.3 volts for the Raspberry Pi and 5 volts for the Arduino. Bi-directional Logic Level Converter should be used to separate them. [2]

System Overview

The system can notify using a real-time alarming system to smart phones reporting such as the current and daily highest/lowest temperature, humidity, and weather quality of the farm surroundings. Users can also control the filter fan switches and customize the notification system to the smart phone. [2]

III. SYSTEM DESIGN

In this work, cheap soil moisture sensors, temperature and humidity sensors, are used. They uninterruptedly track and monitor the farm and send it to the cloud server for real time data processing. The sensor information is stored in database. The web application is developed in a particular way to analyse the information received and get the threshold values of temperature, humidity and moisture. The server does the decision making to automate the irrigation. The motor is automatically switched ON if the soil moisture sensor's value is less than the threshold value and the motor will be switched OFF if the value tops the threshold. Likewise, his technique can be used in green houses where in addition light intensity control can also be controlled and automated.

The system is developed and tested and various conditions. The soil moisture is tested in all climatic conditions and results are interpreted successfully. The LDR is tested in all light conditions. Different readings were taken under different condition. The temperature reading was taken at different weather conditions. The wireless transmission was achieved using Zigbee [1]

In sensor data collection and irrigation control was put forward on vegetable crop using smartphone and wireless sensor networks for smart farming. The environmental data can be collected and the irrigation system can be controlled using smartphone.[1]

A novel cloud-computing-based smart farming system was proposed for early detection of borer insects in tomatoes. This problem is solved using Cloud computing and IOT. In a real-time monitoring of GPS-tracking was suggested for multifunctional vehicle path control and data acquisition based onZig-Bee multi-hop mesh network. It summarizes portion that isrelated to path planning for a multifunctional vehicle. The vehicle-tracking system uses the global positioning system (GPS) and Zig- Bee wireless network based on to make the system communicate.

The architecture of the system is shown in below figure

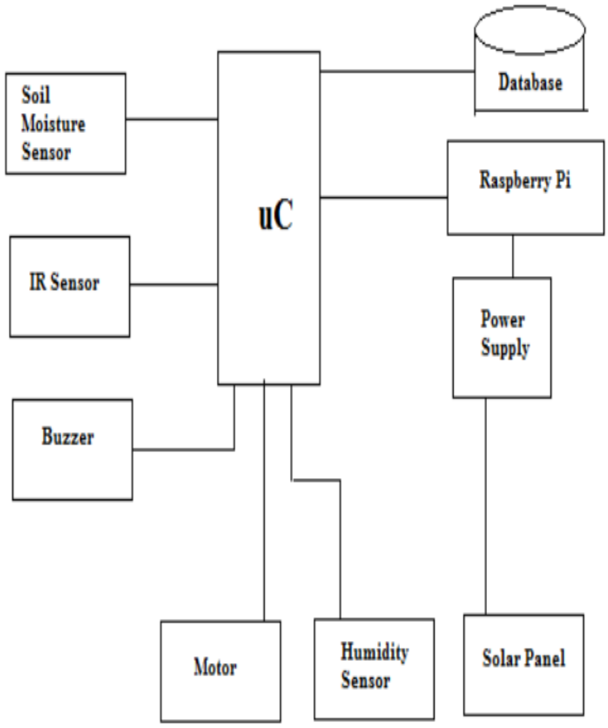

Fig. 1. Raspberry Pi architecture

A. Sensors Data acquisition

The sensors which are to be used are previously deliberated. Let's know about information acquisition from sensors. The sensor is interfaced with Raspberry Pi microcontroller and programmed. After it is programmed we have to place it inside a box and it should be kept in the field. The two probes of soil moisture sensor are inserted in the soil. The current is passed by the probes in the soil. When there is less resistance the sensor passes more current and when there is more resistance, it passes less current. The exact moisture of the soil is detected by resistance value. Fig. 2. Shows soil moisture sensor. [1]

1. Light sensor (LDR)

Light intensity of the environment is detected by light sensor. Light is the main source for crops which is accountable for photosynthesis. The voltage divider circuit is designed to measure resistance due to light intensity variations. Light Dependent Resistor (LDR) is used in which the resistivity decreases with increase in light intensity and vice versa. The voltage level increases with increase in light intensity. The analog reading is taken from the board. It can be used in green houses where artificial lighting is done using any of the incandescent lamps, fluorescent lamps instead of sunlight.[1]

2. PIR (Passive infrared sensor)

PIR stands for Passive InfraRed. This motion sensor is made up of fresnel lens, an infrared detector, and supporting detection circuitry. The lens on the sensor emphases any infrared radiation existing around it to the infrared detector. Living forms produce infrared heat, and as a result, this heat is detected by the motion sensor. The sensor produces a 5V signal for a period of one minute as soon as it senses the occurrence of a person. It offers a tentative range of detection of about 6-7 meters and is highly sensitive. When the PIR motion sensor senses a person, it produces a 5V signal to the Raspberry Pi through its GPIO and we define what the Raspberry Pi should do as it senses an intruder through the python coding.

B. Transmission of Data (Wireless)

The data acquired from sensors are transmitted to the web server using wireless transmission. NRF24L01 module is used for wireless transmission between the field and the web server. NRF24l01 uses 2.4GHz transceiver from Nordic semiconductor. The data rate of this module is 256Kbps/1 Mbps/2Mbps.The voltage required is 1.9-3.6V. NRF24L01 is cheaper than other wireless transmission modules like Zigbee (IEEE 802.14). The transmitter and receiver modules are connected with arduino boards. The transmitter is place in the field and the receiver is placed in the system end.The transmitter and receiver is given a id while configuring it. All the transmitters in the field should know the receiver's id which is the destination address. The receiver will receive data from various transmitters kept in the field. The receiver at the system end is connected to the web server via Ethernet. The Ethernet is a IEEE 802.11 standard in computer networks technology for Local Area networks. The Ethernet is used here because of its low cost while interfacing with arduino micro-controller and fast connection establishment. When the data from the transmitter receives the receiver, it sends request to the web server. The Ethernet cable is connected to the arduino micro-controller using Ethernet shield for arduino. The arduino Ethernet will be assigned an IP Address which should be in the range our network. The arduino is given with the address of the web server to send request. The web server designed using PHP script to insert values in the appropriate table. The web server processes the request and stores the received data in its database. [1]

C. Data Processing and Decision making

The data received from the field are wirelessly transmitted using NRF24L01 and then saved in web server mysql database using Ethernet connection at receiver end. Periodically the data are received and stored in database. The data processing is the task of checking the various sensors data received from the field with the already fixed threshold values. The threshold values vary according to the crops planted. This is because different crops need different amounts of water. For example, in a paddy field to produce 1 kg of rice 5000 liters of water and for wheat it is liters. Similarly, the temperature and humidity vary for different crops. The sensor values also vary according to the climatic conditions. The soil moisture will be different in summer and winter seasons. The temperature and humidity also vary in summer, winter and rainy season. The threshold values is fixed after considering all these environmental and climatic conditions.

The motor will be switched on automatically if the soil moisture value falls below the threshold and vice versa. The farmer can even switch on the motor from mobile using mobile application. Automation of Irrigation System

The irrigation system is automated once the control received from the web application or mobile application. The relays are used to pass control from web application to the electrical switches using Arduino micro-controller. A relay is an electrically operated switch. The circuits with low power signal can be controlled using relay. There different types of relays which includes reed relay, solid state relays, protective relay etc. The relay used here is Solid State Relay (SSR).If n external voltage is applied across the ends the relay switches on or off the circuit.

The ultrasonic sensor is used to monitor water level in tanks. The ultrasonic sensors are used to measure distance of the distant object. The depth of the water level in the tank is calculated to check whether the water is sufficient or not. The ultrasonic sensor work based on the piezoelectric method. It has trigger pin and echo pin. The trigger pin act as transmitter and the echo pin is a reflector. The trigger pin sends ultrasonic waves once it started functioning. The ultrasonic waves hit the water and reflected towards the echo pin. The duration (in seconds) to receive the echo is calculated. [1]

IV. CONCLUSIONS

The IOT is innovative for modern day farming, which changes a traditional farm to an "Advanced Automated Agriculture". Also the system could work on applications of smart phones serving the farmers to regulate and monitor real time environmental contexts like various weather condition and soil conditions as well. The intelligent system can decrease labor cost, time, other costs and it is very helpful for farmers.

In the coming future, Raspberry Pi Model B should be changed into Raspberry Pi 2 because of its more effectiveness and server working reduction. All collected farming information should be sent from the server and stored in a new system. Moreover, a livestock feeding system should be also developed to make this a more complete system.

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