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Design of greenhouse environment monitoring system based on wireless sensor network

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ABSTRACT

In the greenhouse environmental monitoring system, the wired sensor networks have some issues, for example, complicated wiring, inflexible sensor location, cable soften and corrosion and so on. To solve the above problems, we use ZigBee technology to build a wireless sensor network for monitoring temperature, humidity, light intensity, carbon dioxide concentration. And each node is low-power design. Based on the Modbus protocol, we built RS-485 bus to achieve the communication between a number of greenhouse sensor networks and upper computer (PC). The system has advantages such as flexible sensors placement, low power consumption, easy installation maintenance and expansion, low cost, strong practicability.

Keywords: *Wireless sensor network, Zigbee, Greenhouse environment.*

1. INTRODUCTION

The greenhouse is a kind of place which can change plant growth environment, create the best conditions for plant growth, and avoid influence on plant growth due to outside changing seasons and severe weather [1, 2]. The most important factor that affects the growth and yield of plants is an environment of crops. Hence, it is very important to build a suitable environment for crops. The development direction of modem agriculture is digital, accurate and bright [3]. Although, at present, most of the agricultural information monitoring and controlling system in our country take on the wired way for data passing on and control which has the problem of thorny wiring, high installation cost and high preservation cost [4]. For that reason, the research of greenhouse environment monitoring and controlling system based on wireless sensor network has considerable practical importance.

(A) Problem statement

In the existing system, operation can be done only in the manual mode.

So it is difficult to perform in automatic operations where it doesn't require humans. Fewer operations can be performed [5]. It is not user-friendly. In the greenhouse environmental monitoring, the wired sensor networks have some problems, for example, complex wiring, inflexible sensor location, cable aging and corrosion and so on.

(B) Approach to the solution

This paper brings out a solution by using ZigBee technology to build a wireless sensor network for monitoring temperature, humidity, light intensity, carbon dioxide concentration [6]. And each node is low-power design. So in the proposed system, the operation can be done in both manual and automatic mode. So that by using these two modes, vast operations can be performed. Has intelligence to avoid flooding of the field.

2. EXISTING SYSTEM

The environment of crops is the most important factor that affects the growth and yield of plants. In most of the greenhouse environment monitoring, wired sensor networks are being used [7]. The following methods are currently being followed in the greenhouse.

(A) Wired sensor networks

In available greenhouse monitoring, the wired sensor networks are being used which have some issues, for example, complicated wiring, inflexible sensor location, cable soften and corrosion and so on. It is not user-friendly due to its complexity. Fewer operations can be performed.

(B) The manual mode of operation

At times when human beings are not accessible, it is difficult to perform any operation. Operations can be done only through one mode and hence only limited operations can be performed.

3. PROPOSED SYSTEM

(A) Wireless sensor networks

By replacing wireless sensor networks with wired sensor networks many problems like cable aging, complex wiring,

inflexible sensor location and corrosion and so on can be avoided [8]. It can be easy to make and maintain when compared with the other.

(B) DUAL MODE OF OPERATION

In the proposed system operation can be done in both manual mode and automatic mode. So that by using these two modes, vast operations can be performed.

System structure

The greenhouse environment monitoring and controlling consists of monitoring center, coordinator, control execution structure and the terminal node. Each function terminal node transmits environment information by ZigBee wireless transmission technology to the coordinator, then the coordinator via a serial port in the form of cable transmission to the monitoring center [9,10].

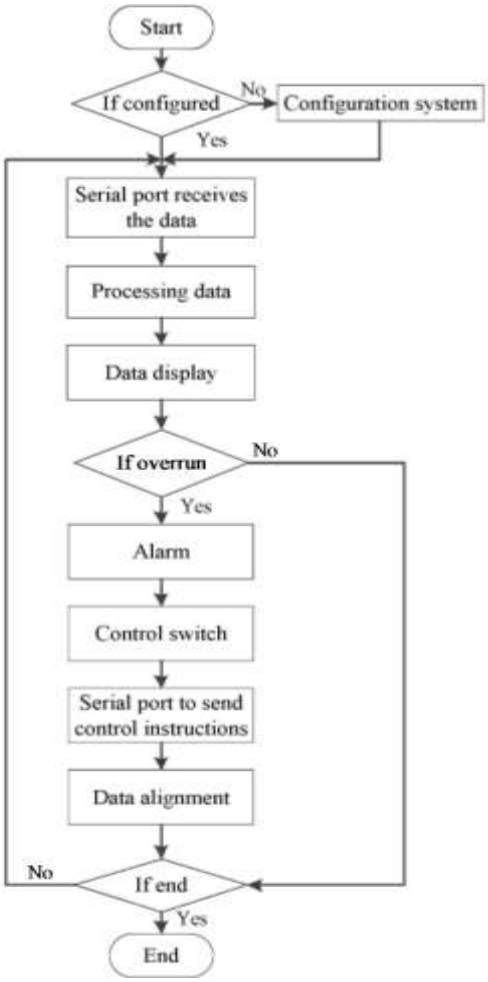

Fig. 1: Lab view software flow chart

4. COMPONENTS REQUIRED

a) Arduino UNO:

The Arduino UNO is a microcontroller board with the implementation of ATmega328 .Fourteen digital I /O pins , 6 analog inputs, 16MHz porcelain resonator, USB connection, a power jack, an ICSP header and a reset button has been used here. It is provided with everything needed to support the microcontroller [11, 12]. Just link it to computer with a USB cable or power it with an AC-to- DC adapter or battery to get go ahead.

b) Light-dependent resistor:

A Light Dependent Resistor is a manoeuvre which has a resistance which alter agreeing to the quota of light falling on its surface [13]. A characteristic light dependent resistor is visualized above together with (on the right hand side) its circuit diagram symbol. Unlike LDR's have wide-ranging specifications, though the LDR's we trade in the shop are equally standard and have a resistance in total dusk of 1 MOhm, and a resistance of a couple of KOhm in bright light.

c) Temperature sensor:

The temperature sensor is an integrated circuit sensor that can be used to measure temperature with an electrical output relational to the temperature.

d) Rain detector:

This rain detector will offer you a heads-up the immediate it starts to rain, keenly giving you time to handy windows and bring in properties. The battery-powered circuit lures nearly no current when the sensor is gasping and the current consumption is low when the buzzer is activated so a couple of AA cells will former a long time [14, 15]. In turn, a molded power supply with a simple voltage controller to drop the voltage to 3 volts could be used. The circuit is basically a handy flasher circuit that operates well on only 3 volts using ordinary silicon transistors. When the circuit is started, the buzzer is pulsated near once per second for a very little time, giving it a dripping water sound which looks suitable. Water is simple need in every one's life. Equivalent and proper usage of water is very important. Here is an easy process which will give the alarm when there is rain, so that we can make some actions and save the rainwater. The rain detector is suitable for outdoor use. The sensing part of the probe is an etched area which contains of three carbon electrodes parted by a waterproof resin. The sensing area is smooth to allow water droplets to run off more easily. A slower, longer beep may be had by increasing the 1 uF capacitor. The 10 k resistor may be improved for a longer beep time without reducing the beep rate but at some point the circuit will terminate to function properly, reliant on the gain of the transistors [16].

e) ZigBee:

ZigBee is a wireless technology established as an open global standard to report the single needs of low-cost, low-power, wireless sensor networks. The standard incomes full advantage of the IEEE 802.15.4 physical radio specification and operates in unrestricted bands worldwide at the subsequent frequencies: 2.400–2.484 GHz, 902-928 MHz and 868.0–868.6 M.

The ZigBee module actions as both transmitter and receiver. The Rx and Tx pins of ZIGBEE are connected to Tx and Rx of microcontroller correspondingly. The data are from the microcontroller is successively transmitted to ZigBee module via UART port [17, 18]. Then ZigBee transmits the data to another ZigBee.

5. BLOCK DIAGRAM

This paper grants a monitoring and control system for greenhouse over wireless network. The system will display the various environmental conditions such as humidity, LDR, temperature, presence of rain, etc. If any state crosses certain limits, a message will be shown to control section [19, 20]. The microcontroller will automatically turn on the motor if the soil moisture is less than a particular value. A rain sensor will sense the rain detect or not. All information stored in pc through ZigBee. LCD display the current status.

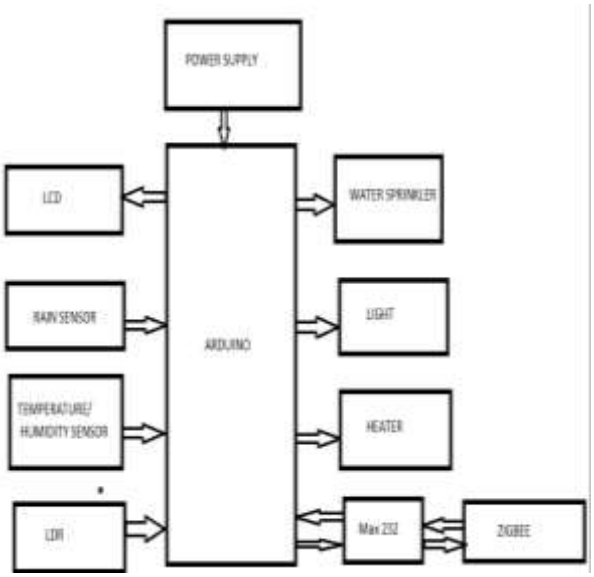

Fig. 2: Transmitter section

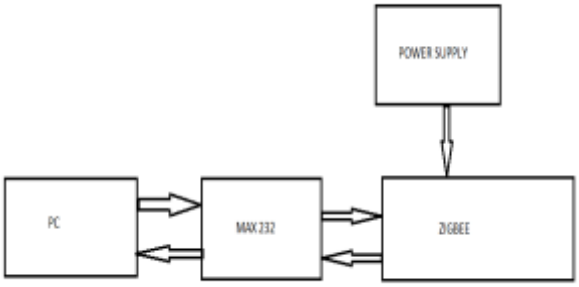

Fig. 3: Receiver section

6. OUTCOME

If wireless sensor network is swapped by wired sensor network, issues arising out of wired networks can be avoided in modern greenhouse monitoring and controlling system.

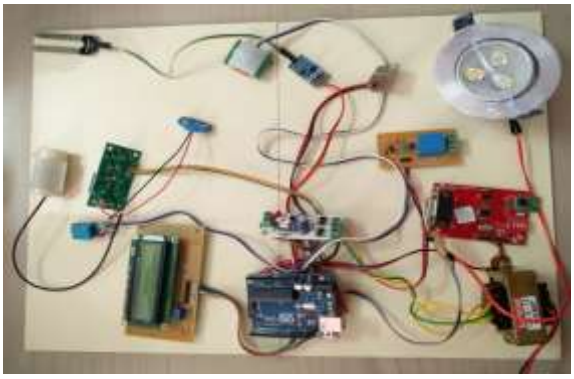

Fig. 4: Transmitter part of greenhouse monitoring and controlling system

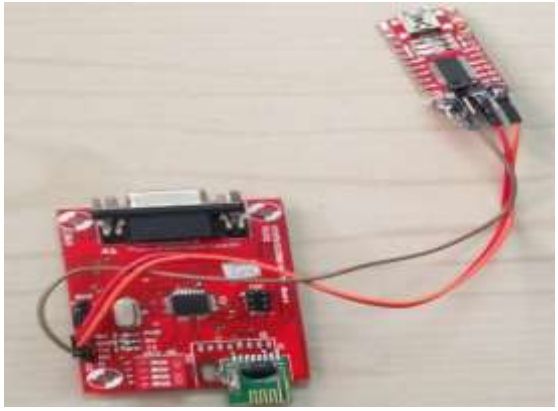

Fig. 5: Receiver part of greenhouse monitoring and controlling system

7. CONCLUSION

The above-proposed system disables the issues of complex wiring, inflexible sensor location, and cable soften and corrosion and so on. The process can be done in both manual mode and automatic manner. So that by using these two modes, massive operations can be performed. Has intelligence to avoid flooding of the field. The system has advantages such as strong practicability, easy installation maintenance, and expansion, low cost.

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