International Journal of Engineering Inventions
e-ISSN: 2278-7461, p-ISSN: 2319-6491
Volume 11, Issue 3 [May.-June. 2022] PP: 798-805

Orchard Internet of Things Data Management and Decision-making System

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ABSTRACT:

For orchard environment intelligent detection requirements, designed the orchard iot data management and decision-making system, the system with STC15F2K60S2 mainly control chip, using the temperature sensor to detect ambient temperature, and using the optical resistance through the internal AD into light intensity level, can realize the light intensity, using soil humidity sensor to detect soil humidity, the collected data through the serial port to ethernet module and upper computer communication, so can be real-time view environmental temperature, soil humidity, light intensity, air temperature and humidity data.After analyzing the data, the data can be displayed in various chart formats, which is more intuitive. The system has the advantages of simple operation, convenient and intuitive, flexible configuration, low power consumption, effectively controlling the growth of crops, improving the yield and quality of crops, and the efficiency of managers is also improved.

Key words: orchard environment detection; database; intelligent monitoring; single-chip computer; agricultural Internet of Things

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Date of Submission: 12-06-2022 Date of Acceptance: 27-06-2022

I. INTRODUCTION

Due to the lack of fresh water resources in China, the use of accurate irrigation and reduce evaporation is an effective measure to cope with drought, and the drip irrigation effect is better when fruit trees grow. The Internet of Things system can be connected with sensors to collect soil humidity data to carry out reasonable irrigation. Traditional agriculture cannot master some important data, excessive fertilization of orchard, not only make the cost increased, for the land environment pollution also affected, serious will also make crop yield affected, so master crucial orchard real-time data, is to ensure the crop yield quality, the premise of orchard ecological environment, but also save resources to reduce the cost.

Orchard iot data management and decision-making system to improve the traditional orchard termination mode effect is obvious, using all kinds of sensors to receive induction some important real-time data, to understand the crop growth, and can effectively manage, also can find out the change law of agricultural environment, etc., encountered in planting problems can also be more intuitive access and troubleshooting, to avoid some unnecessary economic losses.

II. SYSTEM SUMMARY DESIGN

The purpose of this system is to more easily solve the problems existing in the orchard environment, such as: light, temperature, humidity, soil problems, fertilization problems, etc.

2.1 Basic system architecture

This design is the orchard Internet of Things data management and decision-making system design, mainly used to collect the soil humidity, environmental temperature, and light intensity in the orchard. With STC15F2K60S2 as the main control chip, DS18B20 for ambient temperature detection, using photosensitive resistance through the internal AD into light intensity level, realize the indication of light intensity, using soil humidity sensor YL-69 to detect soil humidity; the received information through our master chip from serial to Ethernet module to dual communication, ambient temperature, soil humidity and light intensity, statistical monitoring of real-time data of orchard.

The flow chart for the specific scheme of the system is shown in Fig 1:

2.2 System information transmission scheme

Due to some reasons, the system temporarily uses the network cable interface for data transmission. Follow the TCP / IP protocol, which is also a network protocol we learned in university textbooks. It divides the received data, and then transmits it through the network cable according to certain principles, and finally displays the received data in the upper computer.

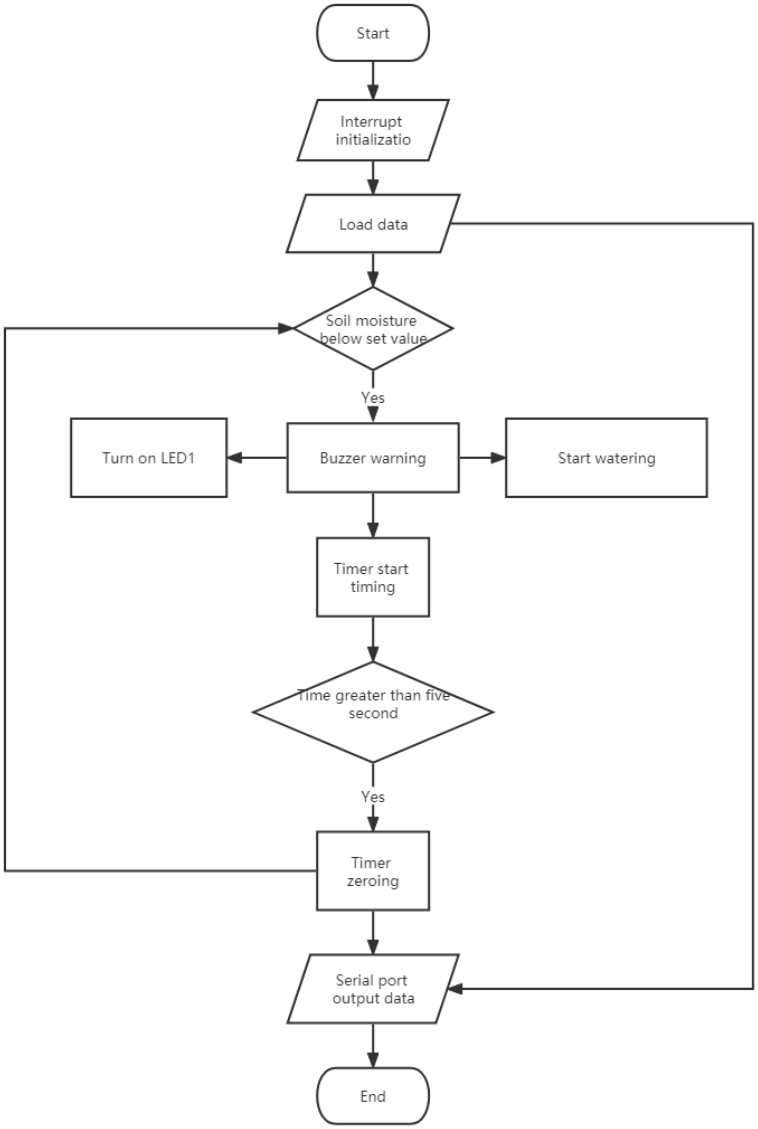

Fig. 1 Program block diagram

2.3 Design of the system database

System database is equivalent to a material storage warehouse, it will be our administrator in the beginning of the information saved, such as our different administrator user name and password, when they register will input save, also includes in the usual system upload data, will be recorded in the database, convenient we retrieve information in the background.

The Database Base Structure:

His basic structure is also roughly divided into the internal and external structure, one is the internal structure, which is the database we use, but the data we store does not adopt this model, but uses the external model.

Physical data layer:

It is equivalent to the data saved in the hardware facility, which belongs to the innermost database, and can store the raw data on the relevant physical devices.

Concept data layer:

He is mainly used to describe the logical relationship of some different objects, and the database is used in our system, so it is used to describe the logical relationship of our database.

User Data Layer:

This layer belongs to the outermost layer, and can directly communicate with users, and the main performance is different Set states of the logic between the operation language of the database is structured query language SQL, using SQL to add, delete, modify, search the databases is also a programming language, but managers do not need to consider these factors. Managers only need to carry out simple input and management operations on the database. Although different databases have different operations, they basically adopt roughly the same structure to query.

III. HARDWARE DESIGN

For orchard iot data management and decision-making system, the main function or need all kinds of hardware facilities can meet our data collection function, want to have a comprehensive understanding of the real-time orchard data, so our hardware must adopt a reasonable structure, but also to ensure the normal and stable operation of the hardware.

The lower computer mainly adopts the hardware system to collect data, and put different kinds of sensors reasonably, combined with the transmission mode of our system, to transmit the collected data to the upper computer.

This design is based on the orchard iot data management and decision system design, mainly used to collect the soil humidity, environmental temperature, and light intensity in the orchard. With STC15F2K60S2 as the main control, using DS18B20 to detect the ambient temperature, Use the photomistor and then convert to the light intensity level through the internal AD of the MCU to realize the indication of light intensity, using the soil humidity sensor YL-69 to detect the soil humidity of the collected data, showing some real-time data of temperature, soil humidity and light intensity on the host computer.

3.1 STC15F2K60S2 master control chip

First master chip is the bridge between the equipment, is also the core of the control equipment work, STCI5F2K60S2 the single chip computer we during school for its learning and understanding is particularly profound, and for its use also conducted a lot of learning and research, for some of its application and operation are familiar with, in order to more convenient design production, chose this as the main control chip of the system.

This design uses STCI5F2K60S2 as the master chip as the core part of orchard iot data management and decision system. Fig 2 is the circuit diagram of the SCM system.

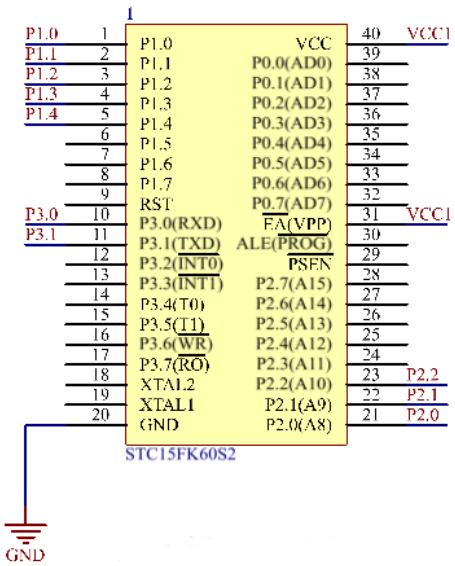

Fig. 2 Circuit diagram of the SCM system

3.2 DS18B20 temperature sensor

DS18B20 is a commonly used digital temperature sensor, it has small size, anti-interference ability, high accuracy and cheap price. The DS18B20 digital temperature sensor is also used because it is more convenient to connect. This sensor is selected to detect the ambient temperature in real time, transmit the collected data to the upper computer, and work with the LED lamp.

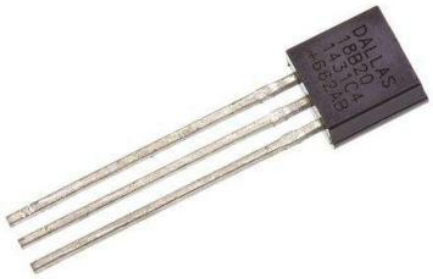

Fig. 3 The Temperature Sensor

3.3 YL- -69 humidity sensor

Orchard iot data and decision management system in the choice of temperature and humidity sensor first consideration is whether in the wet environment can continue to maintain normal work, and for a long time in the environment to ensure the accuracy and reliability of the data collected, so we are on choosing this device to choose the humidity sensor.

It can be automatically controlled by surrounding environmental factors. The soil moisture module circuit is shown in Fig 4.

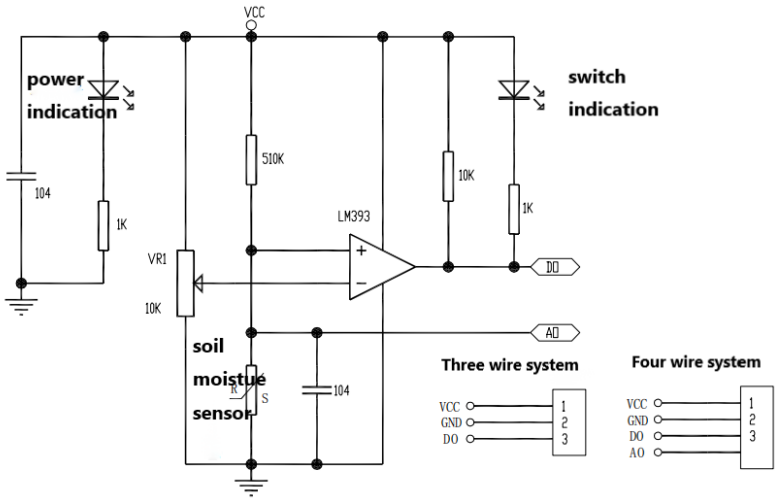

Fig. 4 moisture sensor soil

3.4 Lightmistor

The photomistor works based on the internal photoelectric effect. He is a kind of components using semiconductor materials, using the change of resistance value to measure light intensity, so that it can be very intuitive to see the degree of light intensity of crops, resistor is semiconductor photosensitive devices, the advantage is high sensitivity, fast reaction speed, the key is in the high ambient temperature and wet environment can be relatively stable work and provide data is particularly reliable. The photosensitive mister is used to change the characteristics of the resistance value due to the different light intensity to detect the light intensity. The data is processed by the microcontroller and communicated by the serial port to the upper machine. The upper machine monitors and statistics the net photosynthetic rate of plants and reasonable fertilization. Photosynthetic substandard LED3 lighting. The circuit diagram of the light intensity is shown in Fig 5.

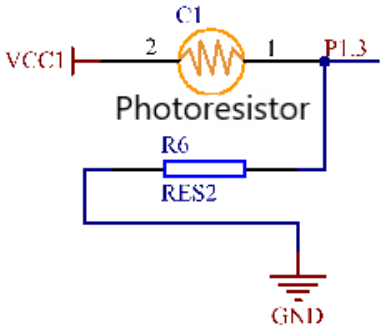

Fig. 5 Diagram of light intensity circuit

IV. SOFTWARE DESIGN

4.1 Programming Language C

Orchard Internet of Things data management more decision system uses the programming language for C #, it is a precise, simple, type security, object-oriented face of a mainstream language, mentioned C # but also to introduce. The net, which represents a collection, an environment, is a programmable structure, which can run well in our system, and is completely open source. It is also relatively skilled in learning and understanding of C # in universities. Therefore, our programming language in this system chooses C # as the system development language.

4.2 Development environment

The Visual Studio used by this system is a popular development environment today. It is more convenient to support multiple monitors, and the code is easier to read when using. The campus device learning also uses this development environment, which is easier to use when using. And our systematic database is also supported.

4.3 Introduction to serial port communication

The main function of the serial interface is to convert some received parallel data characters into continuous serial data flow to send out, and also to provide the data to the device, generally like the circuit that can complete the above functions, we call the serial interface circuit. For this kind of serial communication, we use one line to send the data and also use another line to receive the data. For the data of these two interfaces, as long as it can match, such a way is just more in line with the design of our orchard Internet of things data management system.

4.4 Software functions

4.4.1 Main controls

Timer and Serial Port are the main controls, and here I set the interval property of the timer to 100, so that it refreshes ten times per second to ensure that the data is accurate, and here I use the timer_Tick event to get the time, temperature, humidity, and light intensity.

Read of the SerialPort_DataReceived data

follow.Starting with NET Framework 2.0, C # provides the SerialPort class for implementing serial port control.Namespace: System.IO.Ports. Our installation frame here is.net framework 4.0 client profile 。We receive serial data using within serial port data received events. First read the information of the specified length from the buffer through the read method and return the length of the read information, use the Encoding method to code the system's current ANSI code page, then create a string array, then turn the information in the buffer into strings and then turn it to the string number, and finally execute the delegate method to intercept the required information.

4.4.2 Serial port connection

Series of slogan, here set a combo B ox click event, as long as we click the string with the mouse behind the slogan drop-down option box, the software will automatically update the device available port for users to choose, and then manually set the port rate, when both meet the requirements, click on the serial connection can get the data sent by the machine. And the data can be updated in real time according to the setting of the lower bit computer.

V. FUNCTIONAL DESIGN

5.1 Upper-computer function

5.1.1 User registration and login

In this design, the upper bit computer is used to enable the administrator to log in to the user, the following is the interface of the user registration, users can click on the registration, according to the guidance of the system, to complete the user registration, and after the registration will be input into the database. And in the login interface, enter the registered user name and password, you can successfully enter the program. The computer registration and login interface is shown in Fig 6.

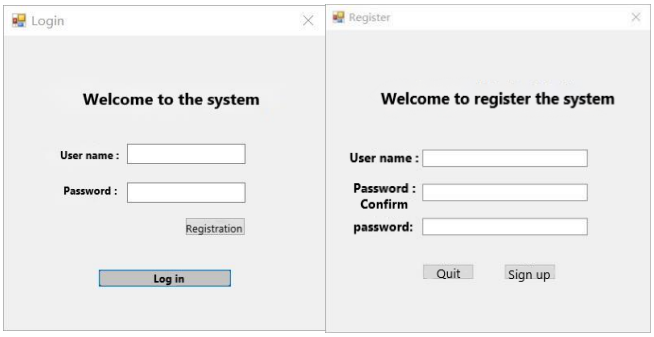

Fig. 6 Registration and login interface

5.1.2 Introduction of the window interface

After the user logs in successfully, he can view some relevant data in the orchard, including temperature, humidity, and light intensity data, and can also use external irrigation equipment to carry out an appropriate amount of water spraying when the soil moisture permits. If other problems occur, the user can disconnect the serial port and reconnect it to ensure the accuracy of the data. Convenient and efficient observation of real-time data, to make better decisions. The form interface is shown in Figure 7.

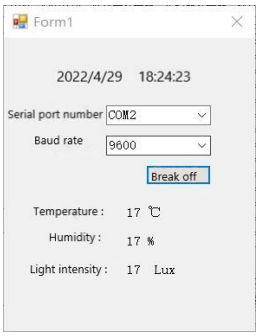

Fig. 7 Form Interface

This software is small and delicate, through the main interface can see the time, temperature, etc., this software is through the serial port communication technology, from the corresponding sensor to receive the corresponding data, through the designed communication protocol, the data will be accurately display on the main interface.

5.2 Flow chart of the upper computer program

Orchard managers after getting the system can first through the login interface for user registration, when the registration success will successfully put their user information into the database, after entering the system again input user name and password can identify the managers can detect orchard real-time dynamic situation, log in into the system after the system interface will show the surrounding environment of crops and detailed data, and will always update the uploaded data.

In the same management system, the identity information in the database can be added and deleted. When some administrator information is no longer needed, we can delete the information from the database. Operation flow is shown in Fig 8.

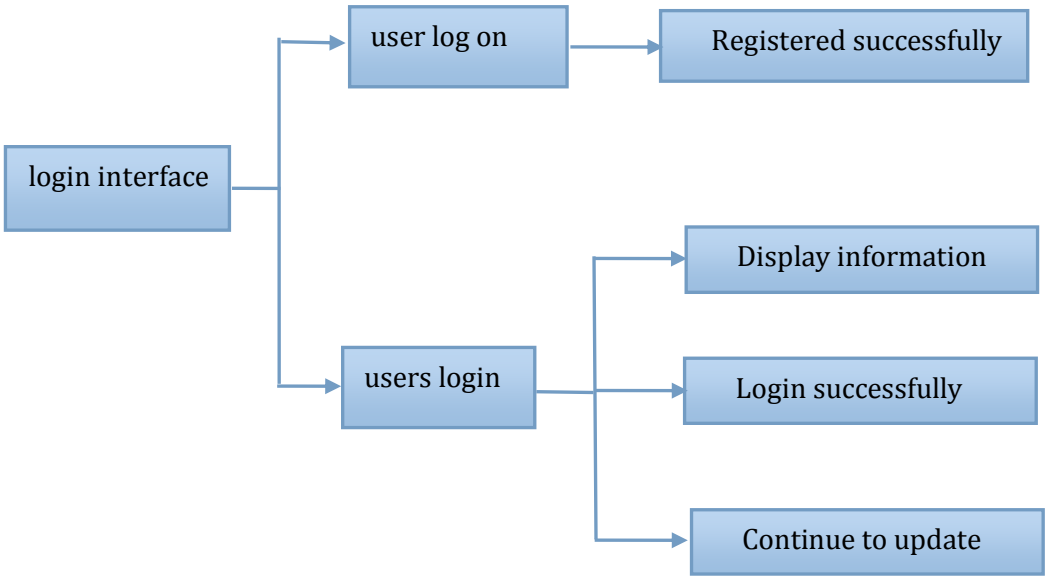

Fig. 8 Flow chart of the system

When the registration is successful, the user's information has been successfully input into the database, and the real-time data in the orchard can be displayed, and then the manager can monitor the orchard environment dynamics in real time.

VI. SYSTEM DEBUGGING

For this system, we first need to check whether our hardware works properly, Whether the sensitivity and the connected circuits are normal, Whether the data collected is accurate, and whether the update of the collected real-time data is normal? Then there is whether the device of our design is reasonable, Whether the induction intensity of some environmental factors is up to standard, can it adapt to the expected monitoring effect according to the orchard environment, there is a more important point is to check whether the circuit in some places is not designed or welded well, Open circuit or short circuit occurs, Causes some unnecessary hidden trouble occurrence.

When we detected the hardware facilities, then for the computer also want a series of tests, including whether login registration can be normally, may again after successful registration login will prompt not find information happens, and software is normal, because sometimes when the manager login will display warning information, and there is a problem with our database, when the manager want to retrieve the data, check the operation is normal, whether can successfully find some data information collected before, until our system can do normal operation.

VII. CONCLUSION

The system using all kinds of sensors and chips to do the orchard iot data management and according to the measurement system, the system implementation functions are: collect the orchard soil humidity, environmental temperature and light intensity monitoring orchard real-time data monitoring to the watering will automatically watering for orchard managers and crop yield and quality will bring great help.

ACKNOWLEDGEMENT: this work was supported by Science and Technology Project of Henan Provincial Science and Technology Department (Granted No: 212102310553, 222102210116), and the Ministry of Education industry and education cooperation and collaborative education project (Granted No:202101346001; 201902183002)； New Engineering Project of Henan Institute of Science and Technology 2020XGK08.

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