

# Application of Ecological Forest Chicken Intelligent Management System Based on Agricultural Internet of Things Technology

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## *Abstract:*

The climatic conditions, topographic features and soil properties around the forest farm are related to the forest microclimate. These characteristics have a certain impact on the quality of free range chickens in forest farms. This paper analyzes the development status and trend of Agricultural Internet of things at home and abroad in detail, and expounds that the application of Internet of things can greatly improve the breeding efficiency of chicken industry. Secondly, in order to ensure the feasibility of various functions of the system, various basic theories and key technologies are integrated, and a comprehensive practical test is carried out. Thirdly, in order to meet the needs of customers, this system uses the most popular "wireless sensor WiFi module server web browsing" structure. Finally, java socket communication is established, so as to realize the customer's fast and efficient remote control. After effective testing, the user module, environmental monitoring module, equipment control module and other functions can operate normally. The information in the henhouse can be fully displayed, and customers can control the equipment in the henhouse in real time.

*Keywords:* Agricultural Internet of Things, Ecological Forest Chicken, Breeding Efficiency, Java Socket.

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## I. INTRODUCTION

With the development of sensor technology, cloud computing, intelligent analysis, intelligent decision-making, big data and wireless communication technology, the application of Internet of things in breeding industry is becoming more and more mature. In the whole system, temperature and humidity, carbon dioxide concentration, light intensity, ammonia concentration and other environmental information are collected through a variety of sensors, and displayed on the display screen in real time and accurately [1-2]. Farmers can operate fans, wet curtains, conveyor belts and other equipment to ensure a comfortable growth environment for broilers,

and avoid the epidemic infection caused by people's frequent access [3]. In this way, the breeding industry can change from the original human centered, experience dependent and independent machine to the information-based and intelligent breeding mode, which makes it easier to expand the scale, reduce costs and control pollution, and finally make the breeding industry reach the information-based and intelligent modern agricultural standards.

Compared with beef and mutton, chicken has higher protein content, lower fat content, and contains a lot of unsaturated fatty acids [4-5]. It is also an important source of phosphorus, iron, copper and zinc. Eating chicken in an appropriate amount is very beneficial to the human body. China's existing large, medium, small and retail breeding scale, large and medium-sized farms have scientific breeding methods, they can reasonably control costs, effectively prevent epidemic diseases, timely deal with pollution, etc., have extremely strong market competitiveness, can create higher benefits [6]. However, due to less investment and traditional breeding concept, retail farming has the characteristics of intensive retail farming in some towns. Due to the unscientific breeding methods, farmers rely on experience and feeling, which will cause high cost, cross infection of epidemic diseases, waste of labor and serious pollution. If the retail investors in a township are concentrated to breed together, and the technology of Agricultural Internet of things is applied to it, it can bring a lot of benefits.

## **II. CORE TECHNOLOGY AND BASIC THEORY**

### **2.1 Definition of Internet of things**

The Internet of things (Internet of things) is to connect all kinds of things with the Internet according to certain protocols, and exchange information through various wireless communication technologies. Specifically, it is used in real-time information collection, identification technology, positioning function, remote command, preventive measures, remote control, reliability assurance, remote operation and maintenance, intelligent decision-making, data processing, report generation, real-time monitoring (centralized display of cockpit dashboard) and other management and service functions. It can achieve the integration of "supervision, management and control" of "fast, economical, reliable and green" for any goods.

The product of the combination of agricultural development and modern technology is agricultural Internet of things, which absorbs many advantages of Internet of things while maintaining its original characteristics [7-9]. Compared with the traditional agriculture, relying on experience, human perception and environmental conditions, the development of sensors provides intelligent perception for agriculture, getting rid of the shackles of heaven, earth and human, and makes the operation of various devices more automatic and intelligent under the command of remote computer. In actual production, farmers rely on intelligent decision-making system, just click, make a choice, or just listen to the "command", can be efficient and reliable breeding.

## 2.2 Specific Application of Agricultural Internet of Things

Modern agricultural Internet of Things has the following specific applications [10]: (1) Information collection. A variety of sensors are laid in the farm, which can collect environmental information at regular intervals, such as temperature and humidity, CO<sub>2</sub>, NH<sub>3</sub>, light intensity, etc., and then transmit it to the server platform through the wireless communication module. Finally, the obtained data are processed, and users can query in real time through mobile phones or computers. (2) Remote control. The electrical equipment in the chicken coop is no longer relatively independent, such as fans, conveyor belts, etc. If they are designed in the same system, they can form a whole and influence each other and complement each other. Users can carry out remote control through terminal devices such as mobile phones or computers. In addition, the environmental values needed for breeding can be programmed, and the system can control itself according to the obtained information. (3) Historical data query. The server stores the collected environmental information and the switch information of each electrical equipment in the database, and users can log in to the management system and inquire about these historical data, so as to get more perfect farming experience. (4) Alarm function. Before breeding, it is set according to the environmental values needed for breeding. However, some environmental values are more or less out of the set range in the chicken house. At this time, the alarm system will remind the user in time, and then the user will respond accordingly.

## 2.3 ZigBee Technology

ZigBee technology uses self-organizing network. Generally speaking, it is like a team of people, each with a ZigBee module in his hand, scattered in every corner of an area. As long as in this area, they can find each other, thus forming a Zigbee network. Moreover, the network is not immutable. With the change of network nodes, it will automatically refresh, find new communication objects, and ensure communication connectivity. This is the self-organizing network.

Because each ZigBee node can be used as a relay for other nodes, if the communication channel between two nodes is broken for any reason, the communication between two nodes will not be broken, because one node can transmit data to the third node, and the third node can be used as a relay for transmission. This function is very valuable in practical application.

## 2.4 Design of SQL Server database

SQL Server database, developed by Microsoft Corporation of America, is one of the most comprehensive database software at present, which provides considerable help for enterprises to manage data information. It has the following characteristics: (1) SQL Server has excellent performance and can be closely combined with WindowsNT. (2) It has advanced management technology and supports various graphical management tools, which can be operated locally and remotely. (3) The data can be processed quickly while the data can not be lost, and the rapidity and security can be guaranteed.

In terms of database operation, popular databases such as MySQL, Oracle, including SQL

Server, etc., all of which use SQL statements to write codes. These databases all use the same basic commands, such as update, create, insert, delete and so on, and their functions are the same in all databases.

### 2.5 JAVA language development

On the basis of many powerful functions provided by MyEclipse software, the intelligent breeding monitoring system is developed in JAVA language. The establishment of JDK environment is the foundation of JAVA language development, which is provided by Oracle Corporation. It is not only the basic environment of JAVA language development, but also the basic class library needed in the development process, which is commonly called API. JAVA is an object-oriented programming language, which is not as obscure as pointer and inheritance in process-oriented C language. JAVA language is concise and powerful.

The characteristics of JAVA: easy to operate, object-oriented, multi-clue, reliability, multifunction, portability, etc. It is widely used in computer software programming, mobile phone software programming, embedded programming, web page programming and other fields, and it is the most widely used programming language at present.

## **III. SYSTEM HARDWARE DESIGN**

### 3.1 Overall hardware structure design

The whole hardware design in the chicken house is mainly composed of signal acquisition and processing module, processor module and electrical equipment module. The signal acquisition and processing module is mainly composed of ZigBee wireless network and various types of sensors. The processor module of this system is mainly composed of CC2530 chip integrated with ZigBee protocol, ESP8266 wireless WIFI module and LCD display module. Electrical equipment is mainly composed of fans, conveyor belts, wet curtains, feeding machines and other equipment controlled by ZigBee terminal nodes. The following is the overall structure diagram of the system:

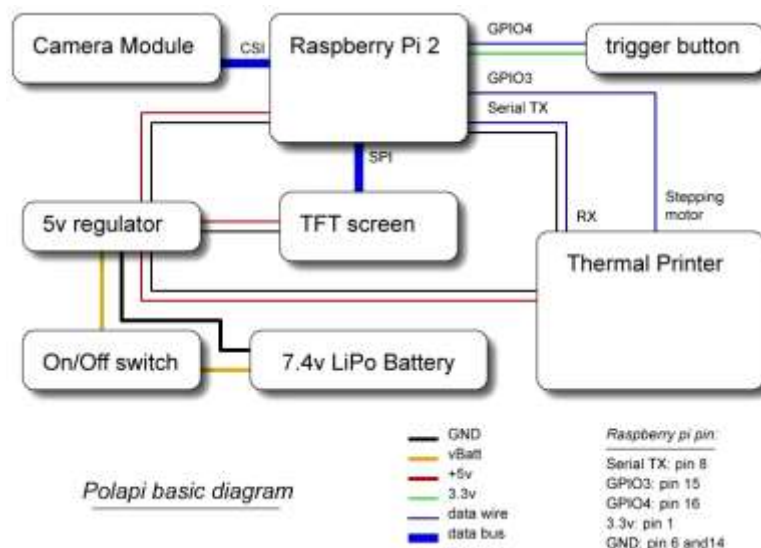


Fig 1: Hardware structure diagram of intelligent chicken control system

## 2.2 Introduction of system hardware equipment and circuit design

Considering the actual situation such as the scale of chicken farm, this system uses CC2530 chip as the control core. CC2530 is mainly used for ZigBee technology development in industry. Its greatest advantage is pertinence, and it integrates ZigBee protocol stack. Its main features are as follows:

- (1) High data processing efficiency, with 256KB flash memory, integrated with 51 MCU cores.
- (2) The material cost is low, and the conversion between functions consumes less.
- (3) Suitable for ZigBee development, integrated with RF transceiver, with high safety index.
- (4) The hardware is powerful and has CSMA/CA function.

The following figure is a block diagram of CC2530 chip structure.

The hardware circuit of intelligent breeding monitoring system is mainly divided into two parts: one is 3.3V and 5V circuits required by various chips, relays and display screens. And the other is a 220V motor circuit for controlling electrical equipment such as conveyor belts and fans. In order to ensure that the system can get stable power supply and reduce the cost as much as possible, the system has designed the conversion flow chart between various power supplies as shown in the following figure:

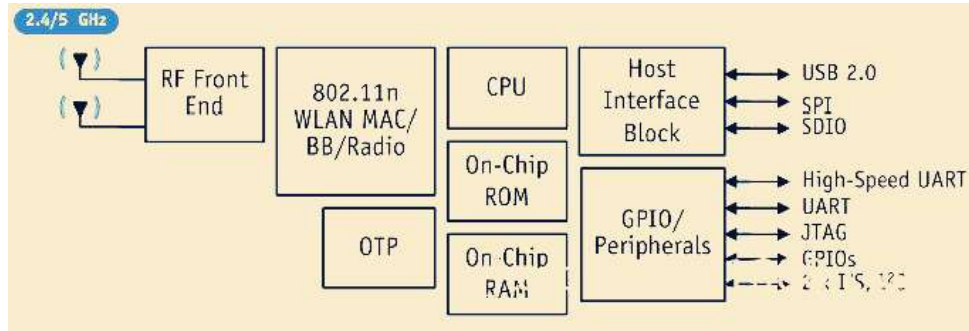


Fig 2: Chip structure diagram of CC2530

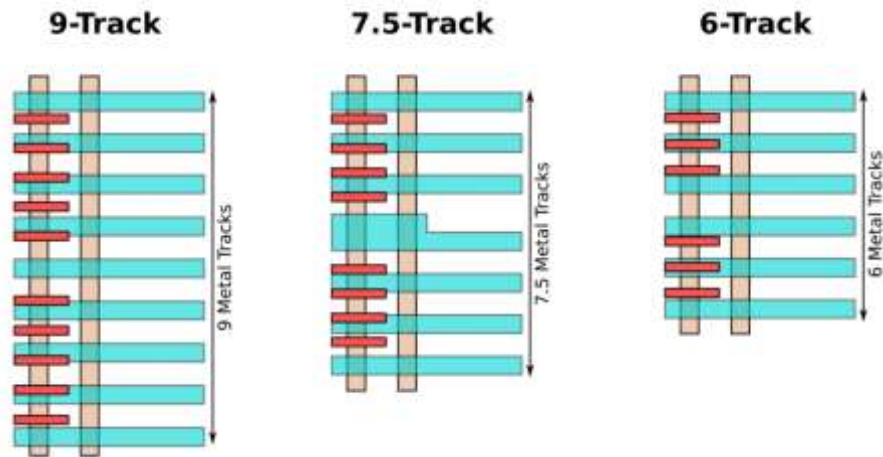


Fig 3: Flow chart of conversion between power supplies

As can be seen from the figure above, firstly, 220 V AC can supply power to the motor, then it can be converted into 12 V DC through switching power supply, and finally we can get the 3.3 V and 5 V voltage we need through various buck chips.

### III. SYSTEM SOFTWARE DESIGN

#### 3.1 Introduction of IAR

The chip of ZigBee module in this system is CC2530, which integrates 51 MCU core, so the software development needs IAR embedded workbench software. IAR embedded workbench software is developed by IAR company in Sweden, which mainly provides compilers for most microprocessors. The program of IAR embedded workbench software is developed with C / C + + language, which can realize the functions of program writing, program debugging and so on. IAR embedded workbench software is stable and easy to operate. It provides different development platforms for different MCU cores. The interface design is not complex and provides a variety of simulators. It is the preferred software for engineers engaged in 51 MCU development.

The following are some characteristics of IAR Embedded Workbench software: (1) high processing speed for FLASH; (2) Good compatibility with C/C++, with C/C++ debugger; (3) IAR can provide customers with multiple memory modes; (4) IAR provides relative path function and simplifies the development process; (5) Simple operation simulator reduces development time; (6) The compilation and debugging of the code is faster; (7) Provide different debugging tools for different lower computers; (8) High debugging efficiency and simplified code analysis process; (9) IAR provides a variety of development platforms for different hardware, with good compatibility.

### 3.2 Software design of upper computer

#### 1. User management module

Intelligent breeding monitoring platform is a multi-user Internet of things platform, users can enter the website and then register, login, modify, cancel and other functions. After inputting the correct user name and password, the user can browse the environmental information of the farm and the switch status of the electrical equipment through the web page, so as to make the corresponding operation. So the user management system is the stepping stone.

#### 2. Administrator module

The system is designed with public, that is, users of the system can log in to view and browse information. In order to prevent some users from stealing and modifying the system's private data, internal data and other information by illegal means, the administrator system is specially written to give all management authority. Including: users' addition and deletion, user data query, status of electrical equipment in each chicken house and other functions.

#### 3. Environmental information monitoring module

Intelligent aquaculture monitoring system mainly collects four kinds of main environmental information, such as temperature, humidity, CO<sub>2</sub> concentration, NH<sub>3</sub> concentration and light intensity. These environmental factors are the main factors affecting the growth of broilers, so the information should be collected in the henhouse in real time and uploaded to the server. Users can keep a suitable environment for the growth of broilers in the henhouse according to the data. In this way, users can sit in front of the computer to pay attention to the information in the chicken house, and do not need to enter the chicken house, which not only saves manpower, but also avoids bringing infectious diseases into the chicken house.

The specific process is as follows: set the time for the sensor to collect information every 10 minutes, upload it to the server according to the set communication protocol through the esp8266 wireless communication module, and the server inserts the received information into the corresponding data table in the database, and the user can query the information in the database in real time through the web page.

## IV. CONCLUSION

This paper mainly uses the current more advanced Internet of things technology to serve the breeding industry, the main purpose is to reduce the cost of the breeding industry and reduce pollution, reduce the incidence of disease, improve the meat quality of broilers. ZigBee technology can realize wireless detection and control of the whole chicken house. Users can remotely control the equipment in the chicken house according to the specific needs of broiler growth.

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