

# Research on Electronic Label System based on Internet of Things Technology

Wenbo Zeng

School of Electronics and Information Engineering, Heyuan Polytechnic, Heyuan 517000, China

Zengwenbo09319@163.com

**Abstract.** This article designs an electronic tags system solution based on Internet of Things technology. In order to clearly explain the scheme, this paper first introduces the system structure of the IoT electronic tags, then introduces the key hardware modules and terminal control software design to realize the electronic tag system, and does a lot of system experiments. The thinness of the electronic tags is only 1.1mm. The data still exists after the system is powered off. The 433MHz communication mode can be used between the first-level main control and the system gateway of the electronic tags. It can also be flexible according to different applications, such as using ZIGBEE, WIFI or other wireless communication methods. The system has good compatibility, low power consumption design, low cost, and easy system upgrade and expansion. Compared with other electronic tags system schemes, the proposed electronic tags system based on Internet of Things technology has obvious advantages. The IoT electronic tag system has the value of continued research and better market prospects.

**Keywords:** Electronic tags system; Internet of Things; Electronic paper display.

## 1. Introduction

In recent years, the development of Internet of Things technology has become more and more rapid [1], and the Internet of Things technology has become increasingly mature. Based on market demand, IoT technology is widely used in various fields of society [2-3]. The market demand for electronic tags is strong and has a large market space [4]. Traditional electronic tags are based on radio frequency identification (RFID) technology, an electronic tag used to store and identify item information [5-6]. At present, electronic tags have been developed to take the electronic screen as the mainstream [7-8]. The traditional electronic tags are thick, the system cannot be displayed normally after power failure, the system compatibility is poor, the cost is high, and the system upgrade is difficult to expand [9-10]. Article [7] proposed a ZigBee-based electronic tags system design, which can better solve the problem of poor compatibility and difficult system upgrade and expansion, but the system uses liquid crystal display JM12864LCD module thickness 3mm, After the system is powered off, the data cannot be displayed normally, and the solution only takes care of the data only to the PC server. In the era of mainstream development of the mobile terminal, the function of the mobile APP is lacking. Article [8] He Yulie et al. proposed a wireless electronic label design based on electronic ink screen. This solution solves the problem that the electronic tags system can display normally after power failure. Unfortunately, the program does not take care of the functions of the PC server. Moreover, with the development of semiconductor technology, thinner electronic paper displays have been available. Based on the analysis of the above problems, this paper discusses an electronic tags system based on the Internet of Things technology. The scheme uses a thickness of only 1.1mm. After the electronic tags is powered off, it can still be displayed normally. Fully test the system's first-level master, the second-level master. On the gateway side, the information exchange between the handheld mobile device and the PC server is good, the system compatibility is good, the power consumption is low, and the upgrade and expansion are easy. Based on the IoT technology architecture, the structure of the electronic tag system based on the Internet of Things is proposed [11-12]. Furthermore, the workflow of traditional electronic tags is compared with the workflow and practice of electronic tags using IoT technology, and the advantages and development prospects of electronic tag systems based on IoT technology are pointed out.

## 2. The Electronic Tags System Architecture based on Internet of Things Technology

The design of the electronic tags system based on the Internet of Things technology includes: ultra-thin liquid crystal display, IoT electronic tags node level master, IoT electronic tags second-level master, intelligent mobile terminal, PC server. The electronic tags system based on the Internet of Things technology adopts the second-level micro-control method. The first-level control uses the low-cost 8051 core MCU to collect and update the electronic tags data. The second-level main control adopts the popular use of the IoT company for the Internet of Things. Application development of a chip development board specifically for low power consumption in the field of microcontroller systems. The secondary master control is responsible for the conversion of the Internet of Things electronic tag communication protocol, which is essentially the first-level main control node of the Unicom electronic tag, the PC server, and the network coordinator device of the handheld smart mobile terminal. The electronic tag s level and the electronic tag secondary master communicate with each other through the CC1101 wireless communication module. The PC server is connected to the network coordinator device as the secondary master through the USART interface, and the handheld smart mobile terminal is connected to the network coordinator through the WIFI wireless module. The overall design block diagram of the electronic label system based on the Internet of Things technology is shown in Figure 1.

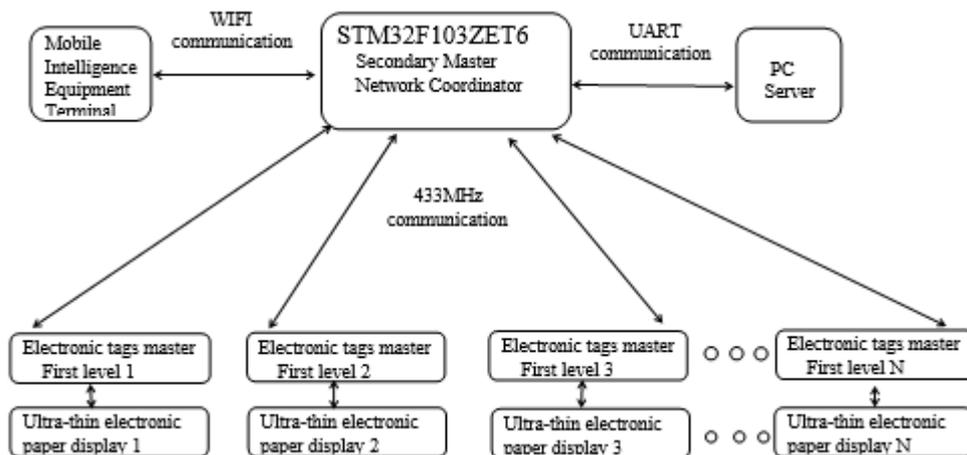


Fig. 1 Structure diagram of electronic tags system based on internet of things technology

## 3. The Design of Key Hardware of Electronic Tags System.

### 3.1 Low Power STM32F103ZET6 Development Board.

The low-power STM32F103ZET6 is responsible for system communication protocol conversion as a secondary master chip. The essence is to communicate with the first-level node, the PC server, and the network coordinator gateway device of the handheld mobile terminal. The design of the electronic tag system based on the Internet of Things technology adopts a two-level control mode. The first-level main control adopts a stable and low-cost 8051 single-chip microcomputer to collect and update electronic tag data, and the second-level main control adopts micro-control. The low-power STM32F103ZET6 chip development board from STMicroelectronics in the field of system systems. The primary and secondary masters communicate via the CC1101 wireless communication module operating in the 433MHz band. The STM32F103ZET6 is a core low-power signal microprocessor based on the ARMx7 architecture Cortex family. The development board has abundant onboard resources, and the CPU chip is 144-pin patch package. 1M bytes expanded SRAM: IS62WV51216, SPI, 8M bytes FLASH: W25Q128, 1 capacity 256 bytes EEPROM: 24C02, 3 SPI interfaces, 5 UART serial ports.

### 3.2 433MHz Wireless Communication Module and Ultra-thin Liquid Crystal Display Module.

The electronic tag first-level node control end and the second-level main control coordination end transmits information by the 433MHz communication, and the CC1101 module is used for data transmission and reception. The CC1101 is a transceiver module that integrates modulation methods such as FSK/ASK/MSK/OOK. The communication module provides extended hardware support for packet processing, bursting, null data buffering, idle channel evaluation, link quality indication, and wireless wake-up. It can be used in 315/433/868/915MHz ISM/SRD and other frequency band systems. In this topic, the 433MHz frequency band is selected for communication.

The electronic tags system display module of this project adopts ultra-thin electronic paper display. This type of display has a small appearance, excellent refreshing effect, and has the effect of not losing power data. Communication via the SPI interface, application of the embedded microcontroller (COG package) and on-chip storage of waveforms. The thickness is only about 1mm.

## 4. Software Design of Control Terminal for Electronic Tags System based on Internet of Things Technology.

In order to achieve effective intelligent control, the electronic tag system based on the Internet of Things technology adopts a two-level control method.

In the system program design, the electronic tags level master control program is developed with low-cost 8051 single-chip microcomputer. The electronic tags first-level master control and the second-level master control gateway end STM32F103ZET6 master controller communicate by 433MHz wireless, and the Communication parameters should be correct set firstly. The user communicates with the secondary master through the TCP protocol using the handheld smart terminal or connects to the secondary master gateway through the PC server by UART port. In the program, when the intelligent terminal sends data to the second-level master through the UART protocol through the TCP protocol or the PC server, the second-level master transmits the data to the target electronic tag level master through the 433MHz CC1101 transceiver module. After the target level master recognizes the corresponding information, it will send the data to the ultra-thin LCD through the corresponding protocol (SPI or I2C), and the item label information will be updated on the ultra-thin LCD.

The STM32F103ZET6 main controller is equivalent to a “transfer station” of the electronic label system. The flow chart of the electronic tags system control gateway program is shown in Fig.2.

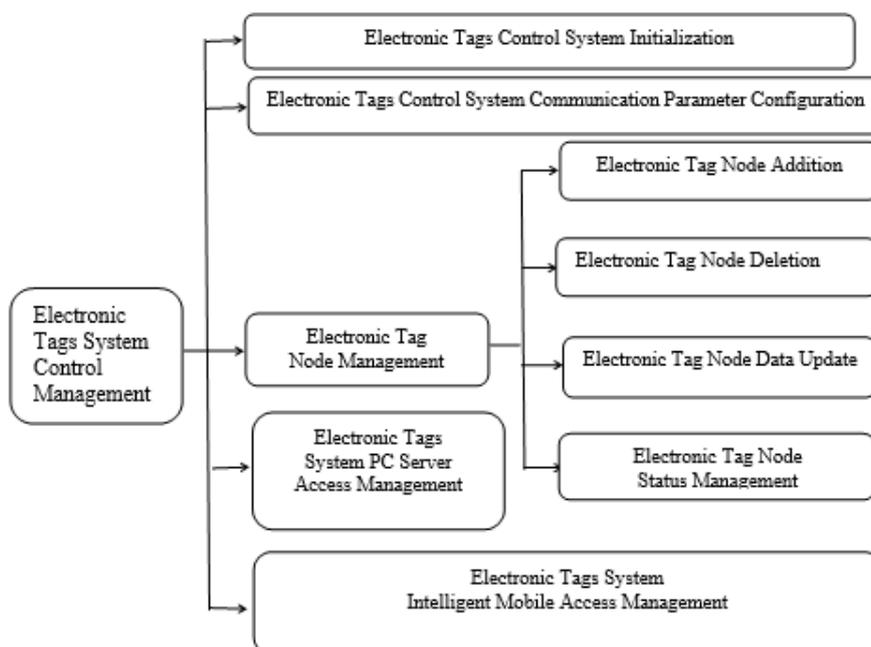


Fig.2. The Electronic tags system control gateway terminal block diagram

## 5. Analysis and Comparison of the Electronic Tags System.

In this paper, an electronic tags system scheme is designed based on the Internet of Things technology. The electronic tags thinness based on the Internet of Things technology is only 1.1mm. The data exists after the system is powered off, the system compatibility is good, and the low power consumption design is adopted. The cost is low and the system upgrade is easy to expand. Table. 1 is a comparative analysis table of the scheme and other schemes. It can be seen that compared with other electronic label system schemes; the proposed electronic tags system scheme based on the Internet of Things technology has obvious advantages.

Table 1. Four Scheme comparing

Function Scheme	Electronic Tags Thinness	The Characteristic After the System is Powered Off	System Compatibility	System Cost	System Upgrade Extension
Traditional Electronic Tags System	Thick	Cannot Display Properly	Difference	High	Difficult
Li Yao, etc. [7]	LCD Display JM12864LCD Module Thickness 3mm	Cannot Display Properly	Better	Lower	Only on The PC Server, and The Mobile APP Function Is Missing.
He Yulie, etc. [8]	Electronic ink Screen, Thickness 1.2mm	Display Properly	Better	Lower	Only on The Mobile APP Side, the PC Server Function is Missing
This Article	Ultra-thin Electronic Paper Display Technology, Thickness Is Only 1.1mm	Display Properly	Fine	Lower	IoT Technology, System ,Easy to Upgrade and Maintenance

## 6. Conclusion

This chapter designs an electronic tags system solution based on Internet of Things technology. In order to clearly explain the scheme, this paper first introduces the system structure of the IoT electronic tag, then introduces the key hardware modules and terminal control software design to realize the electronic tag system solution, and does a lot of system experiments. The thinness of the electronic tags is only 1.1mm. The data still exists after the system is powered off. The 433MHz communication mode can be used between the first-level main control and the system gateway of the electronic tags. It can also be flexible according to different applications, such as using ZIGBEE, WIFI or other wireless communication methods. The system has good compatibility, low power consumption design, low cost, and easy system upgrade and expansion. Compared with other electronic tags system schemes, the proposed electronic tags system based on Internet of Things technology has obvious advantages. The IoT electronic tag system has the value of continued research and better market prospects.

## Acknowledgements

This work was financially supported by Higher Vocational Education Brand Professional Construction Project of Guangdong Province (No. (2016) 114) and Heyuan Vocational and Technical College-level Scientific Research Project (No. (2016KJ07)).

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