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Structure and Analysis of Digital Campus Based on the Internet of Things

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Abstract: Application of Internet of Things products can improve the digital campus management level, improve efficiency and provide better service for the teachers and students' daily work. The Internet of things technology with the development of the Internet information technology and communication technology arises at the historic moment, after the screening and phased out, with RFID technology as the core of the Internet of things development becomes the new technical trend. This study provides the research of the digital campus system design and construction based on Internet of things technology with related concrete implementation ways and the analysis of the internet of things related research and statistics, combined with the demand of the digital campus building.

Key words: Internet of things, digital campus, RFID technology, sensing technology

INTRODUCTION

The rapid development of modern network communication technology and the rapid popularity of computer related hardware devices have promoted the pace of the information construction of colleges and universities, colleges and universities have been built into different sizes of digital campus. In reference documentation (Chen and Xu, 2012), many intelligent information methods have used to design that the university including information resources integration, internal electronic payment, the integration of financial systems and other kinds of information management system which brought a lot of convenience for the teachers and students study and daily life etc. (Dai, 2011; He, 2009). However, the current digital campus appeared in different degrees in the process of the construction of information system integration is difficult, user information collection and update is not convenient, student id card lost more tracking and difficult to recover. At the same time as the various types of institutions and Banks continue to launch a new credit card, each student often have more than one credit card, this brings the students' daily use a lot of inconvenience. In this study, the research of Internet of things technology based on the analysis, combined with the digital campus construction based on the technology of Internet of things needs, build a set of digital campus system based on Internet of things (Huang *et al.*, 2012; Li, 2011; Liu, 2013).

Definition of the internet of things: The Internet of things is an important part of the new generation of information

technology. The name of a word is "Internet", so it can be understood as "the Internet of things is the Internet of things". The two meanings can be drawn from the network name: first, the core and foundation of the Internet of things is still the Internet, is the extension and expansion on the basis of Internet; second, the extension and expansion of the client to any goods and goods between, for information exchange and communication. The intelligent perception, recognition technology and pervasive computing, ubiquitous network application of the Internet of things, is called the computer, the Internet information industry development of the world's third wave. The Internet of things is to expand the application of the Internet; the Internet of things is the network, as the Internet of things is the business and application. Therefore, application of innovation is the core of the development of the Internet of things; to the user experience innovation in 2 as the core is the soul of the development of the Internet of things (Lu, 2013).

About the definition of the Internet of things was first put forward in 1999, defines the Internet of things is: through the Radio Frequency Identification (RFID), infrared sensors, global positioning system, laser scanner, information sensing devices, such as gas sensors according to the contract agreement, connect any item with the Internet, information exchange and communication, in order to realize intelligent identification, location, tracking and monitoring and management of a network. In short, the Internet of things is connected to the Internet "content".

While in China, China Network Alliance will define the Internet of things is combined with current almost all technology and computer, Internet technology, between



Fig. 1: Frame of “the internet of things”

objects and objects: Environment and real-time information real time sharing and intelligent collection, transmission, processing, executive. Broadly speaking, the current relates to the application of information technology, can be incorporated into the category of things. The concept of the Internet of things is shown in Fig. 1.

Characteristics of the internet of things

Connectivity: Connectivity is the basis of the Internet of things. Network, wireless, cable or perceptual object, must embody the "connected" state and Internet connected together, so as to reflect the true sense of the Internet of things. The International Telecommunication Union believes, the Internet of things "connectivity" has four dimensions (1) Connectivity at any time, (2) Connectivity at any place, (3) Connectivity of arbitrary objects and (4) Connectivity of any person.

Associative: On the Internet, people use computer communication between person and person: The Internet of things through the exchange of technology and sensors, radio frequency identification technology, global positioning system. Internet remote communication between people and things done instant interaction between people and objects, objects and objects and thus realize the virtual world to real world connection transformation.

Intelligent: Intelligent is the use of computer technology, sensor technology and control technology to intelligent monitoring and intelligent control of each object in the system, from this point of view, the Internet of things is an important part of the intelligent, the development of the Internet of things will drive the intelligence process. It

makes the world objects not only for sensing mode can also be intelligent way association. The Internet of things is intelligent perception; it can sense the environment, to maximize the support people to gain a better insight into the use of various resources, in order to make the correct judgment.

HELPFUL HINTS

By searching for literature through CNKI, research literature on the Internet of things is 11931 and most of the articles are published in recent years. Magnetic tile, I also found by searching the Internet of things, the associated with the digital campus consists of 89 parts which are published in recent years.

Visible, the Internet of things applications in other fields widely, more researches in related fields, have become mature and produce the industrial chain. At present, some domestic universities have established majors about Internet of Things, supported by research on intelligent sensor network which is employed as the foundation for further development of the Internet of things technology, but the Internet of things technology in digital campus construction has not been widely studied, so is the basic design of exploring the research level or the Internet of things technology and relative applications in digital campus specific cases are less. This study will be the actual demand of Digital Campus Based on Internet of things, combined with the research on RFID technology and sensor technology, the digital campus based on Internet of things technology to design systematic construction.

ANALYSIS ON THE CONSTRUCTION OF DIGITAL CAMPUS NEEDS

Internet of things industry chain can be divided into: Recognition, perception, information processing and transmission of 4 links, each link of the key technology are wireless transmission network RFID, sensors, smart chip and telecom operators. In view of the domestic Internet industry foundation and the key link is relatively weak, standardization work relative lag, the national organization in 2012 started the Internet of things technology R and D and industrialization of special. By starting the national Internet of things application demonstration projects, it promotes the level of overall development of networking key technology R and D and industrialization. It promoted the standard system and the public service platform construction, improves the core technology breakthroughs and industrial chain and provides effective support for network application and

key parts of the demonstration. With the development of information technology, colleges and universities according to their own needs, have to use information technology to strengthen the management. Campus "one card" has become the common choice of the development of colleges and universities. Campus "one card" digital campus network and the application of information technology industry are developing rapidly. "One card" is the goal of the authentication mechanism, integrated data management and sharing. The main function of management is to realize the integrated logistics management system, attendance management system, computer management system, library management system and access control system. Combined with the use of digital campus, aiming at the existing problems in the management, implementation of the "one card" management by non-contact RFID tag card and high performance price ratio, according to the "typical application card" in the construction of digital campus, the more system based on Internet of things technology design.

CONSTRUCTION OF DIGITAL CAMPUS SYSTEM BASED ON INTERNET OF THINGS

According to the basic concept of digital campus, digital campus set a variety of functions, the user feel very convenient. In this study, automatic recognition of management, library management, consumption management, student information and other digital campus functions have been designed.

System architecture: According to the requirement, the realization of intelligent, digital campus network adopts three layers system as shown in Fig. 2, including the application of data service layer, network communication layer and user layer.

In Fig. 2, the application data layer includes a user information database; user information management server; consumption management database and all kinds of application server and its application of corresponding data backup server which are mainly used for information storage and management.

The intelligent digital campus system supplies the information for teachers and students to study and work in the management and treatment. And the basic user information, user account information, books information, multimedia classrooms, campus consumption information data can be checked.

The network communication layer includes the Internet of self built University campus wireless communication network and mobile communication

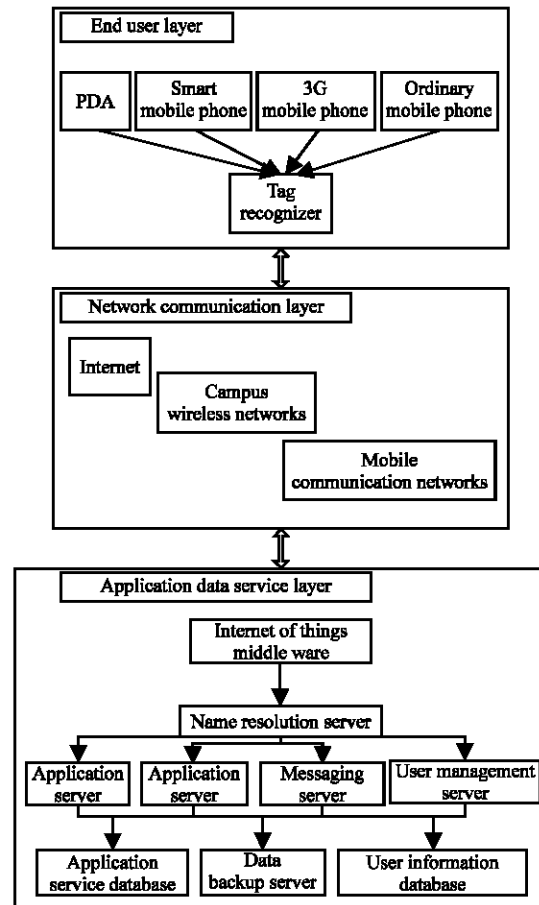


Fig. 2: Digital campus system architecture based on internet of things

network which are mainly for the exchange of intelligent digital campus information related to data and real-time communication. The terminal user layer includes a SIM card mobile phone, mobile phone, ordinary 3G Smartphone and PDA, tag recognizer which are for real-time data acquisition and storage of user information in the mobile phone SIM card. In this way, students can conveniently realize the efficient management and in all kinds of data and information sharing in the digital campus system and all kinds of information management systems can easily be achieved. The Table 1 shows the cost of the whole system.

System function module: The unified user identity recognition mechanism as the basis, system of intelligent digital campus network consists of four function modules of user identity management, meeting management, attendance management and vehicle management system based on campus.

Table 1: Investment budget table

Order No.	Project categories	Cost (10,000)
1	Design consulting fees	36
2	Data centers	684
3	Campus card	136
4	Intelligent building	988
5	Classroom configuration management	210
6	Vehicle management system	120
7	System of campus	560
8	Campus geographic information system	341
9	Multimedia classroom	480
10	Library	630
11	Campus network architecture	783
12	Power center	826
13	Consult	5794

The identity of the user management module is: Through the sensing technology and RFID technology to realize the library students an important venue staff import controls, in addition, but also with recording function which can import trips and time by recording the signal statistics.

The conference management module refers to: The technology for large conference organization and management through the Internet of things, especially the identification and statistics available to participants.

Student test management module refers to: To assist teachers in class to student attendance management, will test the students through the Internet of things technology transfer to the parents hand, provide the students live, study information for parents communication platform.

The vehicle management module is to achieve: The information acquisition and processing of fast, real-time, accurate use of RFID technology, as an upgrade and supplement to the traditional vehicle management method of digital campus, meet the requirements of vehicle management.

Design of RFID meeting no obstacle identification system: The organization and management of complex large conference, meeting an important issue in organization management is to identify and statistics available to participants. Conference of traditional management methods, will lead to the participants to wait for a long time, queuing sign phenomenon, especially the staff attendance is relatively concentrated, the more serious problems. The conference registration and recognition of widespread use of the manual study pen sign, manual checking documents and credit card. The following problems in these ways: Pen and study in easy cause large area congestion and take the signed, signed on behalf of such phenomena, cannot guarantee that the data correctly; manual checking documents efficiency is low, cannot guarantee the accuracy and is not easy to

statistics. The card needs to delegate to the designated place to produce documents and queuing cards, lack of human.

The design scheme of the far distance recognition RFID electronic tag technology as the core, supplemented by digital camera and infrared sensor technology to achieve its function. When the parameter will wear with electronic label card, composition after RFID induction device channel, radio frequency and infrared induction occurs. Radio frequency information for the document information, validity of judgment documents by the host; only through occurs infrared induction, system will start the camera to capture the facial images. If valid, the host will launch the participants, photos and original data and the management personnel check image. The whole process is efficient, convenient, accurate linkage.

Center algorithm: Contains reference nodes and ordinary nodes in a sensor network. The position of the reference node or coordinates is known as (X_i, Y_i) , the ordinary nodes by using the reference node receives the position or coordinates to estimate their position or coordinate:

$$(X_{est}, Y_{est}) = [(X_1+X_2+...+X_k)/k, (Y_1+Y_2+...+Y_k)/k] \tag{1}$$

Normal through the process, will be two into the radio frequency identification area and the two time cutting infrared which avoids the blind read, infrared cutting two times also can determine the participants is entering or leaving the role. Of course, primary objective infrared recognition is identity in radio frequency identification after warning.

Channel machine design of access control system in university library use, prone to mechanical failure in the actual use of the process, resulting in a certificate of personnel cannot be normal passage, undocumented persons followed drilling door phenomenon. The barrier free fast channel to achieve personnel access control is the more advanced management mode. Application of target is to establish a rapid channel based on RFID technology in the library management system, realize the personnel access automatic login system efficient management. This system has no physical barriers, facilitate quick access, can be achieved without credit card, issued a warning to undocumented workers. If required by the camera to capture the facial features and compare the reader photo library management system, to achieve scientific humanization management. The system consists of a sensing device, card reader and antenna and communication module.

The design of the infrared beam to detect the direction of motion and. After the passage are respectively embedded two antennas, known as the A antenna and B antenna:

- When carrying the induction card personnel near the A antenna, A antenna reads card but without any output
- When the induction card from the A antenna to the B antenna, the personnel is in accordance with the entry (Entrance) direction, this process, induction card after A antenna and B antenna when the card is read, read B antenna, reader in A channel output signal, representing 'into the letter no'
- If the next card and return A antenna from the B antenna, the personnel to the export direction, when the induction card returns the A antenna, reader in the channel output signal, representing the "signal", through the statistics of import signal, can help the administrator to check personnel in the closed

The teacher to student's attendance in class is very difficult. Usually the teacher need to occupy the classroom time attendance and pen and study statistics and often meet take another's place by counterfeiting etc., A communication needs of parents and school, appear S-F Communication, home school communication system provides an effective means for communication between schools and parents. But most of the system is still not perfect, need to undertake artificial intervention. The combination of 2.4 GHz active RFID technology, computer technology and wireless communication technology, the 2.4 GHz radio frequency identification system, Internet, communication technology, RFID cards for parents to provide the students live, study information communication platform.

Its main function is:

- Students' access to the campus, real-time text messages to inform the parents
- Students can record the path traced, student movement
- Automatic attendance system, automatic recording without credit card will

RFID card reader are respectively installed at the gate of the school, the stairs and the door of the classroom, the students realize the real-time location identification. All the reader are connected to form a bus network connected to the controller. The original data through the acquisition of students, attendance of students. Attendance for each class should be transmitted to teachers' mobile phone

conveniently checks. In the statistical work in the end, the educational administration management system management systems will automatically statistics of each student's attendance rate, so as to solve the difficult problem of teacher attendance.

Long distance vehicle recognition and license plate recognition system:

The traditional management mode of vehicle import is a pass, artificial verification remote release. The method is slow, prone to congestion situation. Artificial to credit card, automatic lift rod, in practice there will be forgotten card, magnetic card without electricity, resulting in the driver must negotiate with the administrator, thus released more slowly.

Three edge measurement principle. Three edge measurement principle is to determine the coordinates of the nodes according to the 3 known coordinates of the node to the distance of the unknown node. Known A, B and C coordinates of 3 nodes respectively (XA, ya), (XB, Yb) and (XC, YC), they are to the unknown node D distance were d a, DB and DC, coordinate assumption that nodes for D (x, y), can be obtained by calculation:

$$\begin{bmatrix} xb \\ yd \end{bmatrix} = \begin{bmatrix} 2(x_a - x_c) & 2(x_a - x_c) \\ 2(x_b - x_c) & 2(x_b - x_c) \end{bmatrix}^{-1} \times \begin{bmatrix} x_a^2 - x_c^2 - y_a^2 - y_c^2 - d_a^2 - d_c^2 \\ x_b^2 - x_c^2 + y_b^2 - y_c^2 - d_b^2 - d_c^2 \end{bmatrix} \tag{2}$$

Radio frequency identification (RFID) tag as a new technology for rapid, real-time, accurate information collection and processing, as the upgrade and supplement to the traditional vehicle management method, to meet the requirements of the vehicle management. Vehicle electronic label is arranged on the windshield of the vehicle or campus "one card", in vehicle channel or car park entrance to install RFID reader. In normal operation, when the vehicle passes through, the reader will a beep, indicating the success of automatic identification, the reader will read the information transmission to the entrance control processor, the realization of vehicle information collection and temporary vehicle fee and the control gate and other equipment to complete the channel control. The automatic recognition of the vehicle is shown in Figure 4.

Distanced location-Triangulation principle. Triangulation principle is to determine the node coordinates according to the relative angle of 3 known coordinates of nodes to the unknown nodes. Known A, B and C coordinates of 3 nodes respectively (xa, ya), (xb, yb) and (xc, yc), coordinate assumption that nodes for D (x, y). For node A, C and D, if the arc AC in ∠ ABC, then can only determine a circle, the relationship of A,B,C is shown in Fig. 3 and there exists the following equation:

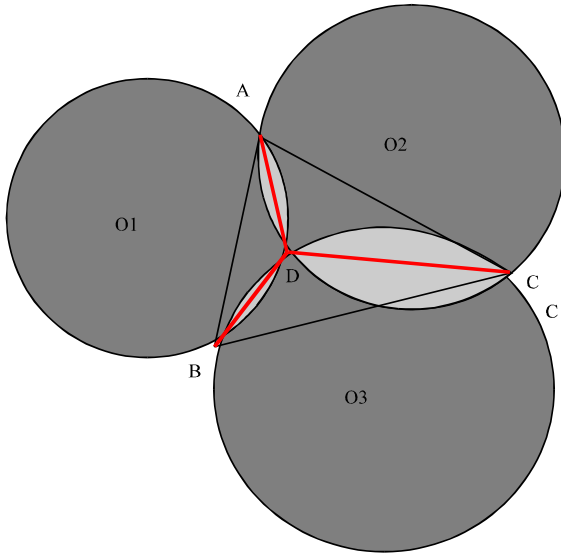


Fig. 3: Triangle diagram

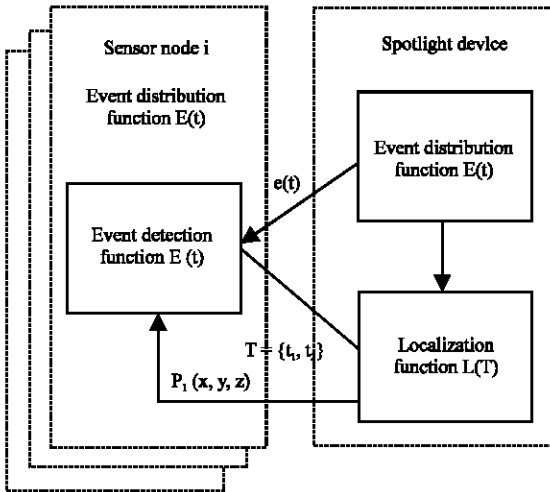


Fig. 4: Automatic recognition of the vehicle

$$\begin{aligned}
 \sqrt{(x_{o1} - x_a)^2 + (y_{o1} - y_a)^2} &= r_1 \\
 \sqrt{(x_{o1} - x_c)^2 + (y_{o1} - y_c)^2} &= r_1 \\
 (x_{o1} - x \cos \alpha)^2 + (y_{o1} - y_a)^2 &= 2r_1^2 - 2r_1^2 \cos \alpha
 \end{aligned}
 \tag{3}$$

Type: r_1 for the radius of the circle; $O_1(x_{O1}, y_{O1})$; as the central angle α angle $\angle AO_1C$.

THE DESIGN OF OTHER SYSTEMS

Canteen management: Canteen management is an important part of wisdom campus canteen management system, RFID technology is mainly divided into three parts based on:

- **RFID electronic label card:** Teachers and students have such a card, card contains user information
- **RFID reader:** In each canteens sale window placement of an RFID reader, read the information to the database query, read card amount and deduct the amount of consumption
- **Background database management system:** The user registration information storage in the database can facilitate the administrator of the canteen consumption business information

Bathroom water control management: RFID technology bathroom water control management based on water, can realize automation management, main function is to:

- **Real time display of information:** When the RFID card in reader induction zone, the reader on the display card balance, then can immediately enter the water charging state
- **Consumption:** Consumption patterns using real-time charging mode, the card is out of the water and the water use real-time fee deduction
- **Billing:** Billing according to the flow of use, namely external pulse flow, can charge according to calculation of the flow

Intelligent lighting: Intelligent lighting is the use of network technology, the campus wireless network so that the lamp can independently, each lamp can telemetry and telecontrol, classroom and road lamp accept control command, various state feedback lights, adjust the lighting brightness according to the light intensity and time. For example, the classroom lighting intelligent control, when the light is dark, lights automatically light; when the illumination is relatively strong, lights automatically turn, if found nobody in the classroom, the switch can be remote control lamp.

Laboratory management: The Internet of things is applied to the laboratory including equipment management, experiment management and smart socket:

- **Device management:** RFID storage experiment equipment basic attribute information, convenient access to information related to the reader and then use the network for unified management

CONCLUSION

The Internet of things technology which treats RFID technology as the core of the Internet of things development, becomes the new information research point

for the digital campus construction. This study provides concrete implementation ways of the research of the digital campus system design and construction which is based on Internet of things technology and related research, supplying the concept and a excellent example of the application of Internet of things.

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