

Campus Intelligent Safety Supervision System Based on RFID

<https://doi.org/10.3991/ijoe.v13i11.7663>

Ning Chen, Qingqing Yue^(✉)

School of Computer Science, Xi'an Polytechnic University, Xi'an, China
492966047@qq.com

Abstract—In this paper, for the problem of the security of students in primary and secondary schools, we propose a campus intelligent safety supervision system based on RFID technology. Through the use of RFID technology for non-contact automatic recognition features, the system achieves the goal of supervising the school gate, classroom, danger zone entrance and other places in the primary and secondary schools. Then the information of the acquisition is classified, compared, displayed, alarm, etc. The information is automatically acquired and transmitted in real time, which makes the supervision and management of the school more intelligent. Compared with the existing campus management system, the system can be more accurate access to information in real-time, improve the convenience and effectiveness of safety management, and realize the intelligent supervision and management of the students in primary and secondary schools.

Keywords—RFID, smart. Safety, supervision system

1 Introduction

At present, the application of contact smart card in the campus management is quite mature. In general, people offer for operation with card, but if there are more people to waiting in line, the process will waste a lot of time, and information identification is relatively slow[1]. Students usually need to get the attendance information by name. If there are more students in the class, the attendance takes up a lot of class times between teachers and students. In addition, the teaching attendance of teacher is basically carried out by inspection of school administrators, which result in the waste of manpower. Contact smart card can not timely obtain the distribution of students on campus, and also not avoid some incidents, such as fighting, skipping class. etc. Therefore, a smart campus safety supervision system based on RFID technology is proposed to supervise the all situation[2, 3].

With the rapid development of hardware and software technology and the strong support of national policies, Harry K. H. Chow etc. studied the application of RFID in logistics management and transportation[4, 5], which not only facilitates the management of goods, but also saves a lot of manpower. Luo chunbin and Yi Bin analyzed the applications and advantages of RFID in traffic and anti-counterfeiting[6]. In

addition, the RFID technology has been used in medical[7, 8], manufacturing[9], warehouse material management, waste treatment and other fields[10-12], and also largely used in campus management, such as book management in the library[13], laboratory equipment management, attendance management[14], digital campus etc. The process of RFID technology identify the target do not need to mechanical or optical contact, artificial interference and intervention between the system and unrecognized target. Furthermore, the entire identification process can work at any time any place[15]. But there are some problems in the RFID application system. First of all, according to the environment of the RFID application, the tag need to meet the needs of the application system. Therefore, the design of tag style must satisfy the requirement of easy access to information and easy to carry. Secondly, in the same time period there is the problem of multiple tag information collision. Moreover, communication security in the process of information transmission is also worth paying attention.

Putting forward applying RFID technology to the campus safety supervision and management will put the tag information encapsulated in the school badge or school uniform, which is not only to facilitate access to information, but also to represent the student identity. In order to prevent the information collision of a large number of students in and out during the same time, the paper puts forward the method of placing multiple readers, which has obtained the invention patent. At the same time, the on-campus information is analyzed timely to obtain the dynamic information of the students' activities for preventing the occurrence of cluster and fighting in the campus.

2 Overview of system

2.1 Requirement analysis of system

The system aims to protect the safety of students, and promptly know about the dynamic information of students. We need to prevent the occurrence of unsafe accidents on the way school, and get in touch with parents of students timely. Therefore, it is necessary to accurately identify each student and record the time of the students in and out of the primary places, such as school gate, teaching building, classroom, activity area, etc. Knowing about the situation of students and teacher in class, it is not only the double supervision of the students' school security, but also helps to strengthen the education level of the school. Database must be exist, which is used to store the basic information of the students, teachers, administrators and real-time access to tag information. The database information is more important for data processing. The communication of the system needs to be reliable for safeguarding information security to prevent the information leak.

2.2 System structure based on RFID

In general, RFID systems consists of electronic tags, readers and antennas[16]. Each tag is composed of IC chip and antenna, when the tag get into the identification

range of readers, if the system is passive RFID system, tags gain energy at first, and then send stored in the chip of coded information to reader. After receiving information through the antenna and decoding, the reader obtain the tag ID number or data content, and transmit the information to the information management system to data processing and analysis. As shown in Fig. 1, which is module composition of RFID system.

Application system: the visualization of the information in the database make the information more intuitive, and the operation is simple, convenient and fast.

Reader and electronic tag: the tag is used to write each individual data information. when the tag into the reader cope the tag information is recorded to the reader, and then stored in the database, which complete the collection of individual data information.

Smart campus safety supervision system based on RFID, as shown in Fig. 2, includes a number of readers and electronic tags. A number of readers are set at the school gate and the classroom door, dangerous area, etc. The electronic tag is carried by each student in the student's school uniform, school bag or school badge. The reader completes the transfer of data through a communication gateway and a central switch connected to an application system.

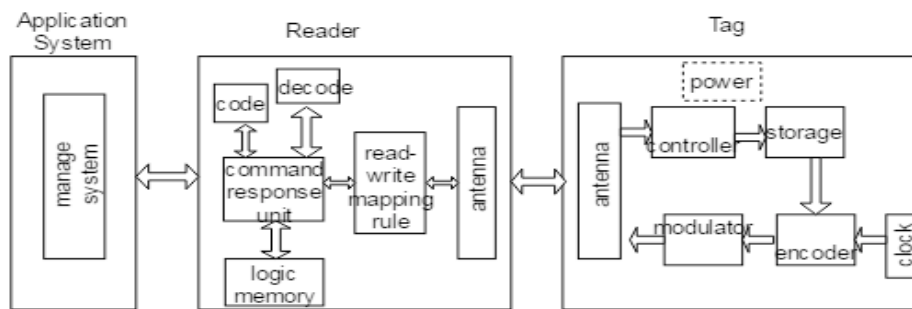


Fig. 1. module composition of RFID system

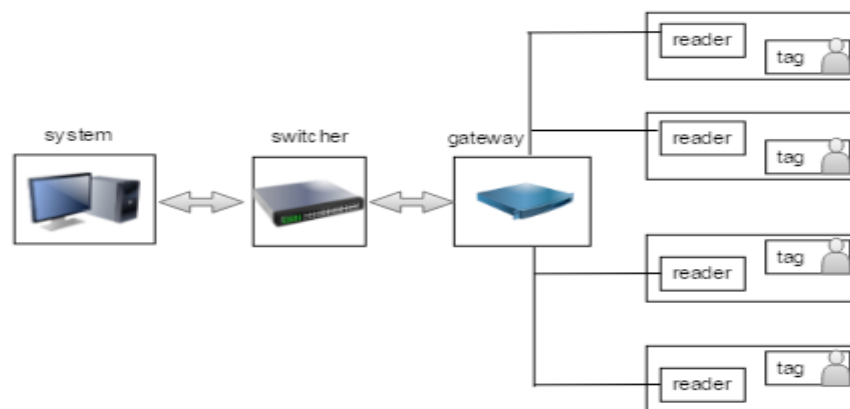


Fig. 2. system structure

Students with tags get into the reading scope of reader that is placed on primary position. Different position of reader obtain the students information, and then the network layer transmit the information to the application system that receives the transmission of information. The information was stored in the database. Then the application system deal with information stored in the database for system interface intuitive display, warning, alarm, and so on.

3 Key technology

3.1 Hardware option

Since the identify distance is not more than 5m, the transmission distance is not too large, and the tag information in this system needs to be read and written every day, so a large amount of data needs to be stored. Through the analysis and research of the whole, compared with the active electronic tag the passive electronic tag is relatively low in power consumption, less power, small volume, easy to use and lower price. UHF tags have large data volume, fast transmission speed and long distance of signal transmission. There is a need for special encapsulation of the tags' appearance, so the smaller the tag, the easier the encapsulation. After analysis and comparison, the RFID technology in this system was studied with the UHF passive RFID system of 860MHz - 960MHz.

3.2 Anti-collision technology

There is a problem of tag information anti-collision in the attendance of the main position of schools. Due to a large number of students appear in a certain time period, it not only leads to the information collision in the tag communication process, but also makes the information cannot be accurately obtained for the inter-occlusion with the tags. Therefore, the method of placing multiple readers is proposed, and at the time of each judgment, the tag information can be obtained once at least. According to different type of school gate, different number of readers are installed in different locations to obtain information timely and accurately. This method has been patented. (patent number:201720099847. 9)

4 System design and implementation

4.1 System process

This system is mainly aimed at the supervision and management of students' safety, followed by the management of students' learning and life in the school. Therefore, it is necessary to timely and accurately obtain the specific information of the students to the school for keeping in close contact with the parents and preventing all kinds of unsafe accidents that occur on the way to the school. The second is to obtain

the specific information of students entering the classroom, which can be used for the second confirmation of whether students have arrived at the school, and can also record the students' information on duty to preventing students from skipping classes. In the end, students are prevented from entering certain unsafe areas, such as balconies and the entrance to the roof. At the same time, there is also a need to impose regulations on areas where students congregate to fight. As shown in Fig 3, which is system design flow chart.

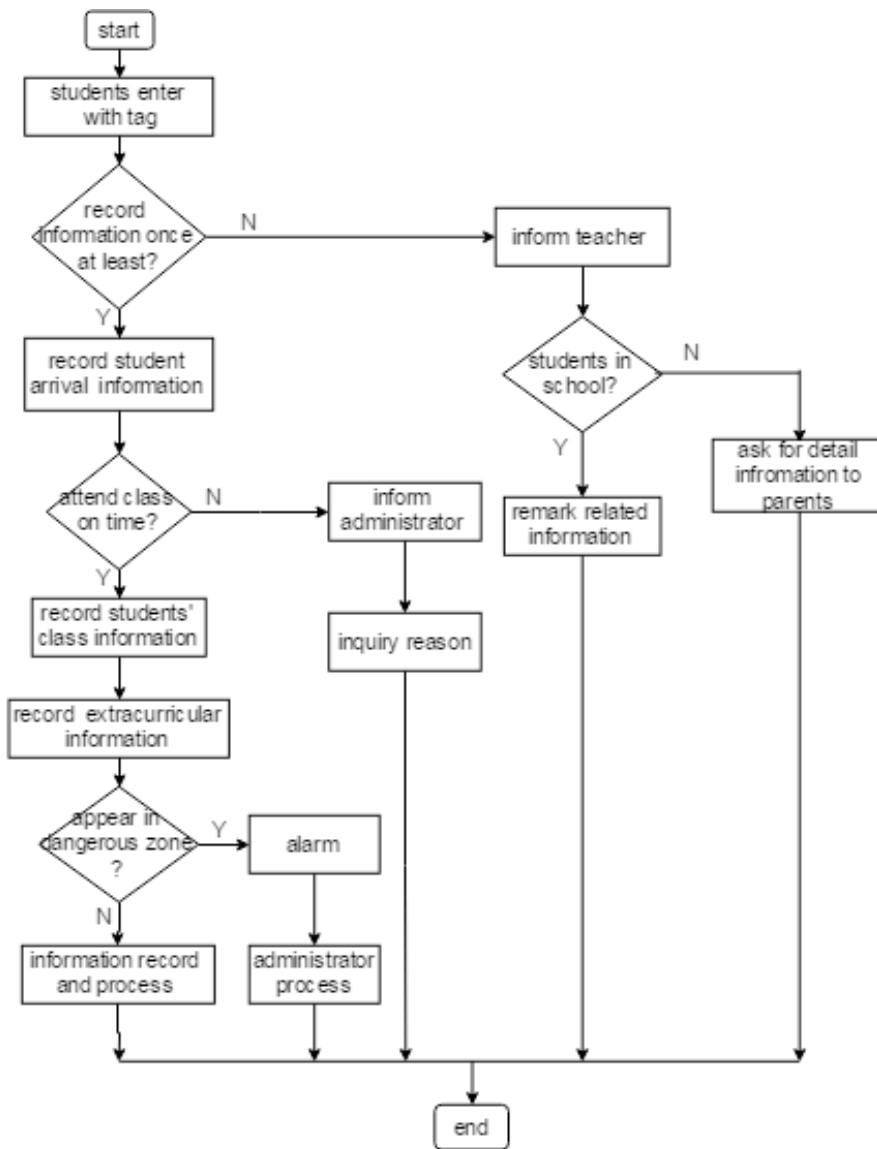


Fig. 3. system design flow chart

Among them, in order to prevent the information leakage caused by too much students at the school gate. In this system, we adopt the method of placing more than one reader, as long as one reader record information to the students at least. the reader location associated with the school gate types. In order to prevent the appearance of instead of attendance, the strength of the signal received by the reader can be compared at the same time. We can also track the students' daily status according to the chronological order.

4.2 Main function of system

The functions of this system are mainly divided into several major modules, namely, the school gate information acquisition module, the student information on duty module, the dangerous area information module, and other modules. Other modules can be used as extension modules for students' learning and life management modules on campus. Information can be obtained, recorded, displayed and reminded in each module, As shown in Fig4.

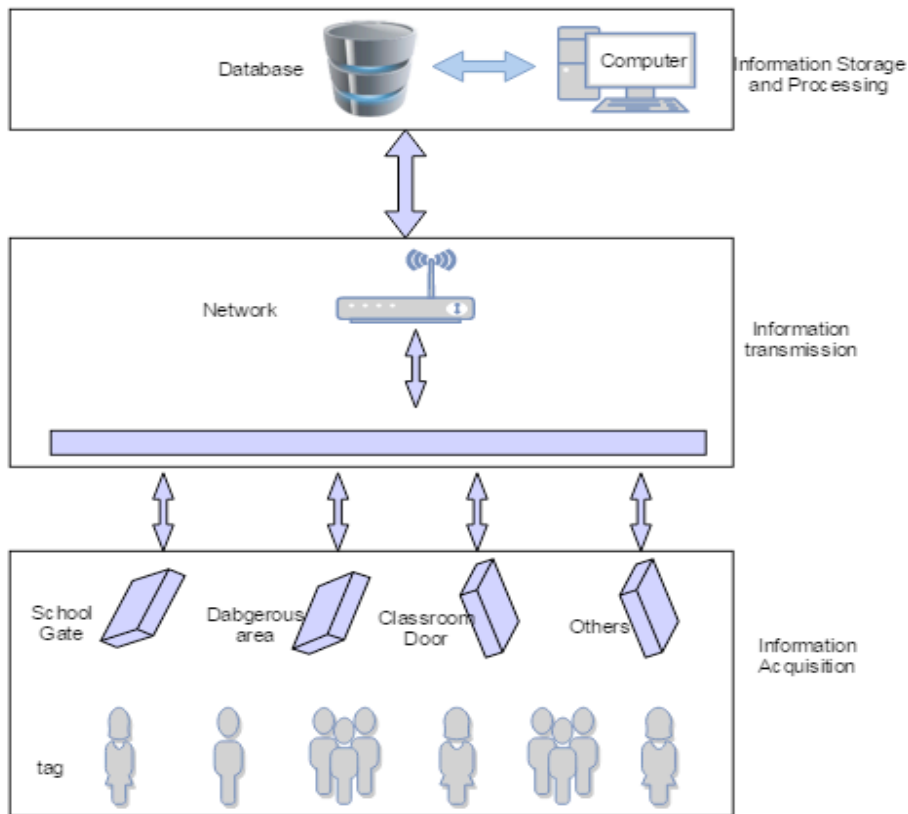


Fig. 4. system module

School gate attendance module. The main function of this module is to get information when student arrive at school timely. In order to prevent the all sorts of accidents appearing on the way school, and promptly get in touch with parents of students, it is very important to accurately obtain attendance information at school gate. In this module, the information is classified to different group according to its special number. Therefore, the student information of each class is obtained in time.

Student information on duty module. The function is to record the time of students enter the classroom and out of the classroom as students' attendance. The teacher do not need to carry out the attendance of the students one by one to avoid student skipping classes and a waste of time.

Dangerous area information module. To monitor the dangerous area of the school and get the information in the area in time. Once someone enter these dangerous areas, the system sends an alarm signal, and the location of the alarm is determined based on the reader number. The administrator sends some to check the area in time.

Basic information module. The record of basic information such as students, teachers, school administrators and other basic information is realized. The basic information of personnel can be updated in time to ensure the accuracy and real-time of basic information, which achieve the intelligent management of information.

Information processing module. To process all of the stored information, including all kinds of attendance information query, modify, delete, add. What's more, the information is classified by time, class or classroom number, which helps to understand students' dynamic information and behavior analysis.

4.3 System front-end design

System homepage:mainly used to display the basic information of the school, recent school dynamic activities information, the detail information of school various departments etc. It is convenient for parents and external personnel to fully understand the school situation, and for students to obtain the latest school situation and attendance status at the same time.

User login: user login is divided into three categories: students, teachers and administrators. Different users can operate with different permissions. Because the administrator has the highest authority, they can carry out all operations in the system.

Reader information:the readers that place different locations have different numbers and detailed information about the reader, which mainly dispose the reader information and display the link status of reader.

System main menu page:it mainly completes three functions, one is the management of basic information, such as students, parents, teachers and managers, to ensure the accuracy of information. The second is the display, classification, comparison and other operation of the readers in different places to find the problems of students and make corresponding decisions. The third is the reflection of students' learning and living conditions.

4.4 System architecture

The system architecture has B/S and C/S two type. B/S is called browser/server mode. C/S is called customer/server mode. Because this system only need to input in the corresponding browser URL, and enter the school web to query information, the client that only need to install a web browser can operate anywhere at any time without having to install any special software. Therefore, the system use B/S mode. B/S processing mode is more convenient, low maintenance cost and workload, which is more suitable for the management system.

4.5 Database design

The database used in the system is the MySQL database. According to the demand of the system, the main database table are school attendance table, hazardous area information table, student information table, the classroom attendance information table, student score table and so on.

The main entities included in this system are teachers, students, system administrators, classrooms and courses. System administrators not only manage all of the teachers' and students' information and attributes, the distribution of the classroom and the course arrangement, but also conduct the system maintenance and management, message notification and release. Teacher is responsible for the management of students, the check of students attendance, extracurricular activities and learning, the subject achievement etc, and timely understand and master student's study and life in school. It is important that teacher adopt different way of teaching and management to different students in the light of students' performance. Students can query the classroom and course arrangement and distribution, the class attendance information, and access to personal and performance information, etc. In addition, if there are some wrong information students can timely response to teachers and management personnel to ensure the veracity of the information. The entity relationship diagram, as shown in Fig5.

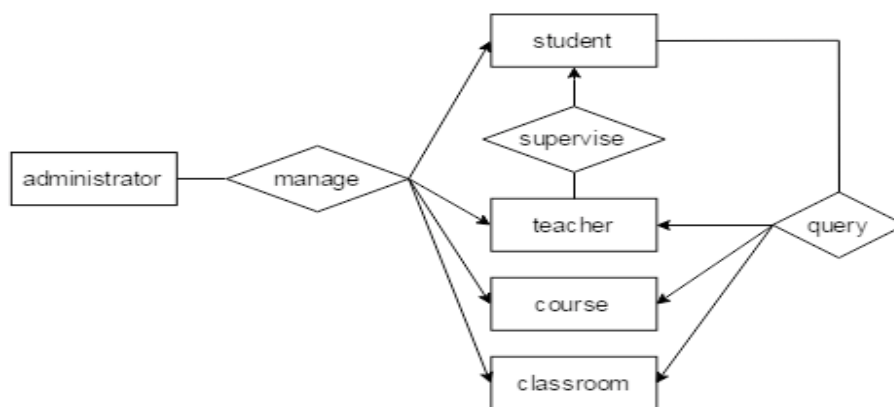


Fig. 5. entity relationship

5 Conclusion

In order to strengthen the safety management of primary and middle school students and the intelligent safety supervision and management level of primary schools, this paper proposes an intelligent security supervision and management system based on RFID. The system used in non-contact radio frequency identification technology to realize the student information. The reader place at the entrance of the school , the danger zone, teaching building, the door of the classroom and other important location to timely and accurate access to information. The management personnel can deal with the existing problems in time by checking, classifying and comparing the received information.

The entire intelligent management system can achieve the following goals:

1. For Solving the problems caused by the accidents on the way to the school, parents and school administrators cannot timely know the problems. Student on his way to school is vulnerable to temptation or close to danger, for schools to ensure the timely know each student to school situation, if the students did not arrive person need to contact parents and understand the specific situation in case of an accident happen while parents and schools do not know at all.
2. To Avoid the occurrence of unsafe incidents after students are absent from class. Attendance is an important means to monitor students' skipping classes.
3. It prevent students from entering the unsafe areas of the campus, students fighting in groups.

The use of the system can greatly reduce the investment of manpower and material resources in the campus management. Information collection become more convenient and timely. The campus safety regulation is still more comprehensive. Moreover, this system further improve the safety supervision level of primary and middle school students.

6 References

- [1] Liu Bin, Han JiangHong, Hu SongHua, Zhang L. (2013). Structure and Analysis of Digital Campus Based on the Internet of Things. *Information Technology* , 12(24):8622-8628. <https://doi.org/10.3923/itj.2013.8622.8628>
- [2] J. V Gorabal and D. H. Manjaiah. (2013). RFID Concepts, Applications and Issues. *International. Journal of Engineering . Resources and. Technology* , 2 (12):3319–3321.
- [3] S. A Weis. (2010). RFID (Radio Frequency Identification): Principles and Applications, in *Emerging Technologies*, Harvard, 1–23.
- [4] Harry K. H. Chow, K. L. Choy, W. B. Lee. (2007). A RFID based knowledge management system-an intelligent approach for managing logistics processes. *IEEE*, 1(20):23-27.
- [5] ZHANG Jianqi, LI Changzheng, BAO Fumin. (2012). WCF Applications in RFID-Based Factory Logistics Management System. *Instrumentation, Measurement. Circuits and Systems Advances in Intelligent and Soft Computing*, 127:913-921. https://doi.org/10.1007/978-3-642-27334-6_108

- [6] Luo Chunbin, Yi Bin. (2009). Development and application of RFID technology. *Communication Technology*, 42(12):112-113.
- [7] Hau-Ling Chan, Tsan-Ming Choi, Chi-Leung Hui, etc. (2015). Quick Response Healthcare Apparel Supply Chains:Value of RFID and Coordination. *IEEE Transaction on System, Man, and Cybernetics:Systems*. 45(6):887-900.
- [8] M. Landin and J. Perez. (2015). Class attendance and academic achievement of pharmacy students in a European University. *Curr. Pharm. Teach. Learn.* , 7(1): 78–83. <https://doi.org/10.1016/j.cptl.2014.09.013>
- [9] Yahaya, C. K. H. C. K. , et al. (2011). A framework on halal product recognition system through smart phone authentication, in *Lecture Notes in Electrical Engineering*. 49-56.
- [10] I. Exposito, J. A. Gay-Fernandez, I. Cuinas. (2013). A Complete Traceability System for a Wine Supply Chain Using Radio-Frequency Identification and Wireless Sensor Networks. *IEEE Antennas and Propagation Magazine*, 55(2):255-267. <https://doi.org/10.1109/MAP.2013.6529365>
- [11] Raymond E. Floyd. (2015). RFID in Animal-Tracking Applications. *IEEE Potentials*, 34(5):32-33. <https://doi.org/10.1109/MPOT.2015.2410308>
- [12] Inigo Cuinas, Robert Newman, Mira Trebar, etc. (2014). Rfid-based traceability along the food-production chain. *IEEE Antennas and Propagation Magazine*, 56(2):196-207. <https://doi.org/10.1109/MAP.2014.6837090>
- [13] Coyle, K. (2005). Management of RFID in Libraries[J]. *The Journal of Academic Librarianship*, 31(5):486-489. <https://doi.org/10.1016/j.acalib.2005.06.001>
- [14] R. B. Kuriakose, H. J. Vermaak. (2015). Developing a Java based RFID application to automate student attendance monitoring. *IEEE Conference Publications*, 48-53.
- [15] J Landt. (2005). The history of RFID. *IEEE Journals and Magazines*, 24(4):8-11. <https://doi.org/10.1109/MP.2005.1549751>
- [16] R Want. (2006). An introduction to RFID technology[J]. *Pervasive Computing*, IEEE, 48(3):382-387. <https://doi.org/10.1109/MPRV.2006.2>

7 Authors

Chen Ning was born in 1970, associate professor, postgraduate supervisor. He received a doctor in computer science and technology from Xi'an JiaoTong University, and he has been teaching in the computer science institute of Xi'an Polytechnic University. Once he won the first prize of electronic industrial science and technology by ShanXi province electronic industry department. His current research interests focus on the information processing and computer network.

YUE Qingqing was born in 1992, a postgraduate student in Xi'an Polytechnic University. She research interests are in information processing. intelligent management. (e-mail:492966047@qq.com)

Article submitted 04 September 2017. Published as resubmitted by the authors 14 October 2017.