RFID TECHNOLOGY FOR CLASS ATTENDANCE IN A VOCATIONAL COLLEGE

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Thematic Paper
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RFID TECHNOLOGY FOR CLASS ATTENDANCE IN A VOCATIONAL COLLEGE

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ABSTRACT

This thematic paper studied the subject using Radio Frequency Identification (RFID) technology for managing the student's class attendance in Vocational College, with the objective to find the efficiency from the RFID system usage to inspect the class attendance of Vocational College students, and to determine the satisfaction of RFID system users with inspection of student's class attendance with the programs "PhPMyAdmin" and "MySQL". After development, 10 teachers and 30 vocational college students answered questionnaires and the sample group, which was seven teachers who had teaching experience of more than 10 years, evaluated the system's efficiency.

The system efficiency results showed that this system can increase teaching time. It was suitable for practical use. If student numbers in a group are high, it will increase the efficiency and teaching time usage. For the satisfaction of users, it was found that the satisfaction in the dimension of data accuracy has a 4.43 mean. The satisfaction in dimension of system efficiency has a 4.38 mean. The satisfaction in dimension of system design has a 4.36 mean. The satisfaction in the overall dimension has a 3.60 mean. The satisfaction in all dimensions has a 4.33 mean, which can be considered as a good level.

KEY WORDS : RFID / RFID TECHNOLOGY / CLASS ATTENDANCE

70 pages

เทคโนโลยีอาร์เอฟไอดีสำหรับบริหารจัดการการเข้าชั้นเรียนในวิทยาลัยอาชีวศึกษา
RFID TECHNOLOGY FOR CLASS ATTENDANCE IN A VOCATIONAL COLLEGE

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บทคัดย่อ

สารนิพนธ์นี้ได้ศึกษาเรื่องการใช้เทคโนโลยีอาร์เอฟไอดีสำหรับบริหารจัดการการเข้าชั้นเรียนในวิทยาลัยอาชีวศึกษา โดยมีจุดประสงค์เพื่อหาประสิทธิภาพของการใช้ระบบอาร์เอฟไอดีในการตรวจสอบการเข้าชั้นเรียนของนักเรียนระดับอาชีวศึกษา และหาระดับความพึงพอใจของผู้ใช้ระบบอาร์เอฟไอดีในการตรวจสอบการเข้าชั้นเรียนของนักเรียนระดับอาชีวศึกษา โดยการพัฒนาระบบอาร์เอฟไอดีเพื่อใช้ในการตรวจสอบการเข้าชั้นเรียน ด้วยโปรแกรม phpMyAdmin และ MySQL เมื่อพัฒนาระบบแล้วให้กลุ่มตัวอย่างซึ่งเป็น ครูจำนวน 10 คน และนักเรียนระดับอาชีวศึกษา จำนวน 30 คน ทำแบบสอบถามความพึงพอใจ และ ให้กลุ่มตัวอย่างซึ่งเป็นครูที่มีประสบการณ์ในการสอนไม่น้อยกว่า 10 ปี จำนวน 7 คน ประเมินประสิทธิภาพของระบบ

ผลจากการศึกษาประสิทธิภาพของระบบ พบว่าระบบช่วยเพิ่มเวลาในการสอนแต่ละครั้งได้ มีความเหมาะสมที่จะนำมาใช้งานได้จริง และหากจำนวนนักเรียนที่สอนมีจำนวนมากจะยิ่งเพิ่มประสิทธิภาพและเวลาในการสอนได้ดียิ่งขึ้นสำหรับความพึงพอใจของผู้ใช้พบว่าความพึงพอใจด้านความถูกต้องของข้อมูล มีค่าเฉลี่ย 4.43 ความพึงพอใจด้านประสิทธิภาพของระบบ มีค่าเฉลี่ย 4.38 ความพึงพอใจด้านการออกแบบระบบ มีค่าเฉลี่ย 4.36 และความพึงพอใจในภาพรวมโดยทั่วไปของการใช้ระบบ มีค่าเฉลี่ย 3.60 ซึ่งความพึงพอใจในทุกด้านของผู้ใช้โดยเฉลี่ยมีค่า 4.33 ซึ่งถือว่าอยู่ในเกณฑ์ระดับ ดี

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CHAPTER I
INTRODUCTION

Policy in performance quantifying, stated by the Ministry of Education, has been changed for 5-10 years. Teachers are allowed to choose method of teaching and class assignment inavariety of ways. Nowadays, it is significant that vocational students are lacking of awareness of their class attending performance. Teachers have to have the accuracy and trustable evidence of the class attending records, as the tool to quantify the student performance in that class. With these days technologies, the solution to such concern seems to be achievable.

1.1Background and Statement of Problems

For this moment, there are two standard professional curriculums in the vocational school education. These are the curriculums of the vocational certificate and the higher vocational certificate. The educational system has to be implemented following the regulations and every announcement by the office of the vocational school committee, ministry of education.

The regulation of the ministry of education, concerning with the studying performance evaluation, following the vocational school certificate curriculum, B.D. 2545, 2547, Chapter 2 subject: Evaluation methods (สำนักงานคณะกรรมการการอาชีวศึกษา, กระทรวงศึกษาธิการ,2547).

For Article 11, Evaluation of study performance by subject,ithas to carry out continuously assessment on the real actual status all time in the semester, in dimensions of knowledge, capabilities, and attitude from the educational activities and the assigned tasks execution. This will cover the objectives and subject contents, by to use the suitable tools and other variety of methods. There has to assess to develop and assess to summarize the learning performance, by considering on each activity

assessment, and the assigned tasks with the ratio following the important priority of the activity, or assigned tasks. It is also to evaluate the student performance following the dual vocational training system, from their working in the private sector too, following the definition by teacher, who train and the teacher who inspect.

Under Article 12, it is required to use the numerical representing performance level in each subject, as following;

4.0	=	Excellent
3.5	=	Verygood
3.0	=	Good
2.5	=	Fairly Good
2.0	=	Fair
1.5	=	Fairly Poor
1.0	=	Pass
0	=	Fail

Under Article 13, the following characters are recommended.

W	=	Officially withdrawn : with penalty
W	=	Withdrawn : without approval
I	=	Incomplete
C	=	Class Attendance Incomplete
E	=	Examination Leave
A	=	Satisfactory Auditation
A	=	Unsatisfactory Auditation
P	=	Participation in Student Activities
N	=	Non-satisfaction for Participated Activities

Considering on the described regulations, it represents that the class attending or learning time of student is very important. If there is less than 80 percentages of the total learning period, those student's studying performance will not be allowed to be evaluated immediately. This will make consequence to let the student enroll that subject again as well.

Basically, to check the student attending time, there will be using the paper checking manually. This work is time consuming, and, sometimes, there may be

incorrect records. Therefore, there is a need for an educational system to bring in technology to help creating correct, fast, and accuracy information recording.

Radio frequency identification (RFID) is a rapidly growing technology that has the potential to make great economic impacts on many industries. Basically, RFID systems consist of small transponders, or tags, attached to physical objects. When wirelessly interrogated by RFID transceivers, or readers, tags respond with some identifying information that may be associated with arbitrary data records.While RFID is a relatively old technology, there is now more recent advancements in chip manufacturing technology are making RFID practical for new applications and settings, particularly consumer item level tagging. These advancements have the potential to revolutionize supply-chain management, inventory control, and logistics, and etc.

From the information described above, RFID technology should be a great choice to help in controlling the class attendance of students.Hence, the main purposes of this work include preliminary studies of the RFID system and its efficiency for class attendance management.

1.2 Objectives of Study

1. To design a managerial system for a class attendance.
2. To evaluate system efficiency and user satisfaction in implementing RFID technologies to manage the attendance of vocational students.

1.3 Scope of Study

1. Study key essential parameters of RFID devices
2. Determine the suitable RFID-assisted system for class attendance management
3. Evaluate the significance of using RFID technology to organize the class attendance in a vocational collegeby using users’satisfactionand system performance data.

1.4 Major Contributions

The system that allows an incorporation of RFID technologies to improve its organizingstrategy forthe attendance of vocational students.

CHAPTER II
LITERATURE REVIEW

Focused Technologies

2.1 Barcode

2.1.1 Barcode System

Barcode system is the indicator system, which has been brought to use mostly, comparing with other systems, due to it is popular to stick on the product body to know the identified code. This will effect to the business to know other information of those product quickly, such as sale amount, numbers of sold products, goods in inventory, etc.

Barcode contains information, which is important to business operation. There are important three components, which are:

a) Product identified number

This component is compound of black bars and the space between bars is white color, which are lined parallel in vertical. It is compound of number 13 digits, which is universal standard for referring. The code is separated to be 4 parts. The first part has number 3 digits, representing country code. The second part has number 5 digits, representing the organization identified code. The third part has number 4 digits, representing product code, and the last part, which has number 1 digits will be used for being code or the number to use for inspection by the organization, which has issued the barcode.

Figure 2.1 Barcode representing product identified code

b) Barcode Printer

Before choosing the printer, it has to consider both of the equipment which is present used and the printer to be bought for using in future, to be in accordance or not. Because it will be the investment to combine many equipment together and it has to be working with efficiency. The popular technologies are impact type, thermal type, laser type, and ink-jet type

c) Barcode Reader

This is the equipment to use for reading barcode. It could be separated into 2 groups, touching type, such as the pen type reader, card reader, and etc. and non-touch type, such as the Charge Coupled Device Scanner (CCD) reader, laser reader type, and etc. Besides, the barcode reader can be separated following the moving characteristic, by separated to movable and non-moveable

d) Computer and Software to use for processing

This is the equipment to be used when there has been already recorded the product identified code. It let management have the information for making decision haw to handle the product, such as to know it should be increase manufacture that product or not, due to there are few product numbers in the inventory.

2.1.2 Barcode Benefits

a) It makes the work process, which have to use the product information, fast, more correct. No matter what is manufacturer, distributer, buyer, and the logistics provider, can use the Barcode mutually.

b) Every level of the business partners, from starting to ending, can save cost, reduce time and possible problems from the mistake in recording.

c) It can extend the capability in other logistics dimensions, such as inventory management system, procurement system, transport system, etc.

d) It can use the new modern logistics management system software program, such as Cross-Docking, Just-in-Time (JIT), Vendor Managed Inventory (VMI), etc.

e) It can inspect the information backward (Traceability), to acknowledge that the product's raw materials, or source place of manufacturing. It can be traceable all in supply chain.

2.1.3 Barcode limitation

A particular barcode solution might have several limitations. These can be classified / categorized as follows.

a) Limitations of Platform-specific

There is a limitationspecific to the platform/environment of the issuing system. These can affect the maximum number of message characters, the message character set (some preliminary mapping may be needed), and the sets of involved intermediate character.

b) Limitations of Device-specific

There are also the limitationsinherent in the capabilities of the printer device (printer controller, HDD, DIMM, SD card, etc), e.g., proper support of required PDL commands.

c) Limitations of the related Solution-specific

There are the limitations specific to the particular solution implementing barcode printing too.

For example, if barcode fonts are employed, there will be the limitations generally inherent in the (font-based) approach and technology used, and the limitations particular to the specific fonts of this product.

2.2 Biometrics

2.2.1 Biometrics Definition

Biometrics is the automated methods to recognize a person, based on a physiological or behavioral characteristic. Biometric technologies are now becoming

the foundation of an extensive array of highly secure identification and personal verification solutions.

Examples of physiological characteristics are such as hand or finger images, facial characteristics, and iris recognition. Characteristic Behaviors are traits that are learned or acquired, such as Dynamic signature verification, speaker verification, and keystroke dynamics.

Biometrics is used in solutions to provide for increased homeland security, including applications for improving airport security, strengthening our national borders, in travel documents and visas, and preventing ID theft. Now, there is a wide range of interest in biometrics across federal, state, and local governments. Congressional offices are addressing the important role that biometrics will play in identifying and verifying the identity of individuals and protecting nation assets.

There are variety needs for biometrics beyond homeland security. Infrastructures of Enterprise-wide network security, security of electronic banking, investing and other financial transactions, retail sales, law enforcement, and health and social services are already benefiting from biometrics technologies. New applications can be found in such diverse environments as amusement parks, credit unions, banks, other financial organizations, enterprise and government networks, passport programs, driver licenses, colleges, physical access to multiple facilities (nightclubs), and the lunched programs in school.

Applications of biometric-based verification include workstation, network, and domain access, single sign-on, application logon, data protection, remote access to resources, transaction security, and web security. Biometrics can be utilized alone or integrated with other technologies such as smart cards, encryption keys, and digital signatures. Utilizing biometrics for personal verification is becoming convenient and considerably more accurate than current methods (such as the utilization of passwords or PINs). This is because biometrics links the event to a particular individual (a password or token may be used by someone other than the authorized user); is convenient (nothing to carry or remember); accurate (it provides for positive verification); can provide an audit trail; and the trend is more socially acceptable and inexpensive.

2.2.2 Biometrics Verification

The Biometric verification requires comparing a registered or enrolled biometric sample (biometric template or identifier) against a newly captured biometric sample (for example, a fingerprint captured during a login). During enrollment, as shown in Figure 2.2, a sample of the biometric trait is captured, processed by a computer, and stored forlater comparison.

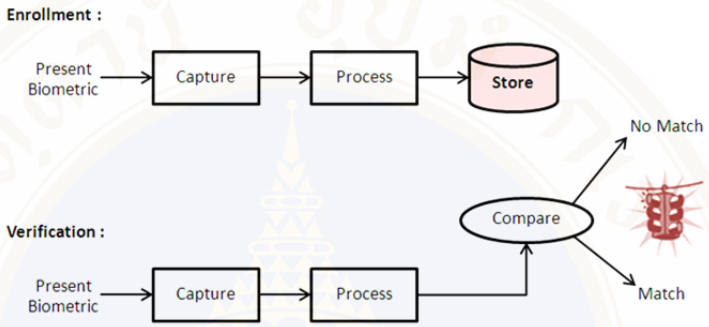


Figure 2.2 Capturing, processing and storing a biometric trait during enrollment.

This recognition can be used in identification mode, where the biometric system identifies a person from the entire enrolled population by searching a database for a match based solely on the biometric. Example, an entire database can be searched to verify a person has not applied for entitlement benefits under two different names. It is sometimes called one-to-many matching. A system can also be used in verification mode in which the biometric system verifies a person's claimed identity from their previously enrolled pattern.

It is also called one-to-one matching. In most computer access or network access environments, there would use the verification mode. User enters an account number user name, or inserts a token such as a smart card, but instead of entering a password, a simple touch with a finger or a glance at a camera is enough that the user to be authenticated.

2.2.3 Biometrics Types

There are many types of biometrics in use currently, and there will be many more types to come in the very near future (DNA, holograms, etc.). Nowadays,

some of the most common ones in use are fingerprints, face recognition, speaker recognition, iris recognition, hand and finger geometry, and signature verification.

a) Fingerprints

The Fingerprints are unique for each finger of every person, even identical twins. One of the most commercially available biometric technologies, fingerprint recognition devices for desktop and laptop access are now at a low cost, widely available from many different vendors. With these devices, users no longer need to type passwords, a touch provides instant access. Fingerprint systems can be used in identification mode. Several States make check fingerprints for new applicants to social services benefits to ensure recipients do not fraudulently obtain benefits under fake names.

b) Face Recognition

There can be done in a number of different ways the identification of a person by their facial image. Several approaching to modeling facial images in the visible spectrum are principal component analysis, local feature analysis, neural networks, elastic graph theory, and multi-resolution analysis

The challenges of the facial recognition in the visual spectrum include reducing the impact of variable lighting and detecting a mask or photograph. Some facial recognition systems may require a stationary or posed user in order to capture the image, though many systems use a real-time process in order to detect a person's head and locate the face automatically. Benefits of facial recognition are that it is nonintrusive, hands-free, continuous, and accepted by most users

c) Speaker Recognition

It has a history dating back some four decades, where the output of several analog filters was averaged over time for matching. Speaker recognition concept is to use the acoustic features of speech that have been found to differ between individuals. These acoustic patterns are to reflect both anatomy (size and shape of the throat and mouth) and learned behavioral patterns (voice pitch, speaking style). The incorporation of learned patterns into the voice templates (the latter called voiceprints)

has earned speaker recognition. It's classification as a behavioral biometric. Speaker recognition systems employ three styles of spoken inputs: text dependent, text-prompted, and text-independent. Most of the speaker verification applications use text-dependent input, which involves selection and enrollment of one or more of the voice passwords. Text-prompted input is used whenever there is concerning of imposters. Thevarious technologies used to process and store voiceprints including hidden Markov models, pattern-matching algorithms, matrix representation, neural networks, and decision trees. Some systems also use anti-speaker techniques, such as the cohort models, and world models. Ambient noise levels can impede both collections of the initial and subsequent voice samples. Performance degradation can result from the changes in the behavioral attributes of the voice and from enrollment using one telephone and verification on another telephone. Voice changes due to aging are also needed to be addressed by recognition systems. Many enterprises market speaker recognition engines, often as part of large voice processing, control, and switching systems. Capture of the biometric is seen as noninvasive. The technology needs little additional hardware by using existing microphones and voice-transmission technology, allowing recognition all over long distances via ordinary telephones (wire line orwireless)

d) Iris Recognition of the Eye

This recognition method uses the iris of the eye, which is the colored area that surrounds the pupil to be recognized. Iris patterns are thought to be unique. The iris patterns are obtained through the video-based image acquisition system. The Iris scanning devices have been used in personal authentication applications for several years. The Systems based on iris recognition have substantially decreased in price, and this trend is expected to be continued. The technology works well in both modes of verification and identification (in systems, performing one-to-many searches in a database). Current systems have special perform, it can be used even in the presence of eyeglasses and contact lenses. The technology is not intrusive for now. It does not require physical contact with a scanner. Iris recognition has been considered and demonstrated to work with individuals from different ethnic groups and nationalities.

e) Hand and Finger Geometry

These methods of personal verification are well established. Hand recognition has been available for over 30 years until now. To achieve personal verification, a system can measure physical characteristics of either the fingers or the hands. This measuring includes length, width, thickness, and surface area of the hand. One ofinteresting characteristics is that some systems require a small biometric sample (a few bytes). Hand geometry has gained acceptance in a range of applications for now. It can frequently be found in physical access control in commercial and residential applications, in time and attendance systems using, and in the general personal authentication applications

f) Signature Verification

This technique uses the dynamic analysis of a signature to verify a person. The technology is based on measuring speed, pressure, and angle used by the person when a signature is in producing. One focus for this technology has been e-business applications and other applications wherever signature is an accepted method of personal verification

2.2.4 Determine Accuracy

All of the biometric systems use human traits that are, to some degree, unique. Which system is best depends on the necessary level of security, the population who will use that system and the system's accuracy too. Most manufacturers use measurements like these to describe accuracy:

- False-accept rate (FAR): How many impostors the system accepts.
- False-reject rate (FRR): How many authorized users the system rejects.
- Failure-to-enroll rate (FTE): How many people's traits are of insufficient quality for the system to use?
- Failure-to-acquire rate (FTA): How many times a user must present the trait before the system correctly accepts or rejects them

2.3 RFID System

2.3.1 Radio Frequency Identification (RFID)

This is the technology to identify the object position, such as human, animal, things, etc. with radio frequency. There has to stick, install the FRID Tag on those objects. Besides, RFID will be the new replaced Technology on Barcode in future, due to it makes convenient and better efficiency working. But RFID price is now rather high. Then, there is still be using barcode with popularity. Nevertheless, to bring RFID system for using, management has to consider on the every limitation factors, when to use, such as the concerning regulations, laws about using the radio frequency and the transmitting power in each country, or electromagnetic field in the environment, which are different in using, etc.

2.3.2 RFID Components

a) RFID Tag, this tag is compounded of chip or memory unit, antenna, and battery.

b) RFID Reader, this is compounded of antenna, wave radio module, and control parts.

c) Controller, the duty is to be database connecting between Reader equipment and software to use in Tag reading.

Communication between reader tool and tag will occur when the object, which has been installed the RFID tag move into the area, which has the radio signal from the reader equipment, which will generate electromagnetic field. It makes the tag build the electrical energy transmitting information backward to the reader equipment, such as ID, manufacturing date, expired date, manufacturing source, etc. After that, the reader will transmit information to the Controller to bring the gotten information to use in the concerning works, such as stock-list making, transmitting information to manufacturing section, procurement section, inventory section, logistics section, etc.

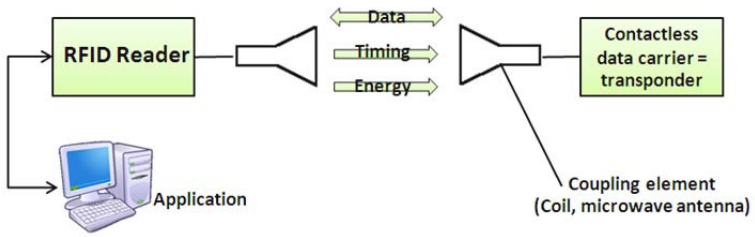


Figure 2.3 RFID components

2.3.3 RFID elements

There are 2 main parts of RFID elements

2.3.3.1 Tag or Transponder

Tag is usually known as a transponder used to transmit signal or the recorded data. Communication between tag and reader is using radio frequency gap through air. Tag's internal structures compound of a semiconductor chip and a coil, which duty is to be antenna for receiving and sending data. Both parts connect together.

Tags may be in many forms, up to application. The form might be like general credit card or small as pencil lead only 10 mm long, implanted under the animal skin. Or it might have big size for the tags attached with the machine, while transport execution. Tags may be brought to attach with products in any retail store, in order to protect thief. A big reader antenna can be installed at the entrance to detect thief. Tags will get the energy from RF signal to communicate with reader or use energy from the battery stowed in plate. This battery type is Lithium-ion having long life usage, and it is often used with this plate.General usage tags are 2 main types. Each type has different in dimensions of usage, price, structure, and principle of execution. There can be categorized as following;

a) Active Tag – this tag has internal mini battery got power supplied by electrical supply source to feed electrical energy to tag for normal working. This tag type has general functions. It can read and write data in the tag. To use battery, makes lifetime limited, up to the battery lifetime. It has to be discarded when the battery is empty, cannot be reused. Because there are sealed on tag body,

then there cannot make battery changed. Nevertheless, if it can design the tag circuit to consume very low current, it would have been last long as decade.

Figure 2.4 RFID Active Tag 2.4GHz

The internal memory of this active tag has varied sizes. The size can be as big as one Mega Bytes and have power of transmission covering 6 meters longer than passive type. Besides, it can work well even in the area with interfered signal. Although this tag type has many advantage items, it also has disadvantage items too, such as high price per unit, rather big size, and has limited working lifetime.

b) Passive Tag – no having internal battery, no essential to receive power from any electrical supply source. It will work by using the electrical power induced from electromagnetic from the reader (having internal mini electrical power generating circuit inside), which is called “Transceiver”. This makes passive tag having light weight and smaller size than active tag, cheaper and has last long life unlimited. The disadvantage is having data transmission with maximum distance 1.5 meters, which is a short distance for reading. It has small size memory, generally around 32 to 128 bits. The data reader properties have to be very sensitive and high power. Besides, the passive tag will always have problem, when applied in the area with high electromagnetic interference. But the advantage about lower price per unit

than the active tag and lifetime longer makes this type more popular. The manufactured IC of this passive tag will have size and shape from bar type to very small plate, which is rather invisible until very showy big size, up to the different applications.

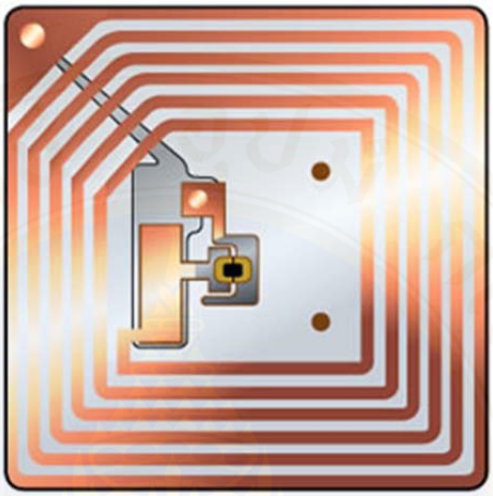


Figure 2.5 RFID passive Tag

2.3.3.2 Reader or Interrogator

The important duty of the reader or interrogator is to receive data sent from tag, inspect the data mistakes, and decode the received data signal, executed by microcontroller algorithm which is in the firmware in the microcontroller. The duty is to send and decode the received signal and communicate with computer to bring data through next process. Besides, the good reader has to have capability to protect duplicated data reading, such as in case of the tag was left in the area which the reader had created the induced electromagnetic field, or located within the receiving-sending distance. It might make the reader makes receiving-sending data from tag automatically with unlimited duplication.

Then the good reader which has this situation protection system is called “Hands Down Polling”. The data reader will order tag to stop data transmission, in case of occurring such of the above described situation. Or there may be many tags in the same area of electromagnetic field together or called “Batch Reading”. The reader should have ability to arrange priority of each tag reading.

2.3.4 The frequency range applied in the RFID system

RFID tag and reader use the radio frequency for communication. This frequency is call “Operating frequency”. The radio frequency is electromagnetic frequency, which is part of frequency spectrum of electromagnetic frequency. This is called “Radio Frequency Spectrum”. Due to the RFID system create and send electromagnetic frequency which is in the radio spectrum, then there has to be the system to allocate the radio frequency for any applications, such as radio, television, and mobile telephone. It is high essential to define frequency to apply in RFID system in order not to interfere other working system. The applied frequencies in RFID system have many frequencies within spectrum range of radio frequency. Mostly there are using in 4 principal frequency ranges. These are Low frequency (LF:30-300 KHz), High Frequency (HF: 3-30 MHz), Ultra High Frequency (UHF: 300 MHz), and Microwave frequency (1-300 GHz)

Thus, the RFID system will work within the 4 frequency ranges, which are LF, HF, UHF, and Microwave. These frequency ranges will affect to speed, reading distance, and accuracy in the system usage.

To design the RFID system, the important thing to consider is to choose the RFID system frequency range. Each range has different property and efficiency as following;

a) Low Frequency range (LF)

The LF is between 30-300 KHz. The RFID system using LF has the properties as following;

- Short distance reading – the LF RFID system has short distance (shorter than half of meter)
- Slow speed – it is well known if using high frequency the reading distance will be long and the data to be received and sent will be higher speed. Then using LF the speed of data reading is slow.
- Low absorption – the wave length is inversed to frequency. Therefore using LF in RFID system will make wave length longer. When use longer wave length, the signal in LF range will be absorbed difficult in atmosphere and it can travel through metal. This makes LF RFID range suited with application in water and metal.

- Due to RFID system using LF will have short reading distance and low absorption, it is popular applied in heavy usage, such as access control, animal and personal tracking, and vehicle immobilizer, etc.

b) High Frequency range (HF)

The High frequency has range 3-30 MHz. The RFID system will use frequency 13.56 MHz, which is the general usage frequency. The RFID system using in HF has properties as following;

- Reading distance is around 3 meters.
- Due to HF has short wave length, it cannot distributed through metal.
- Having higher speed in receiving-sending data than LF RFID system.

From all the properties, RFID system using in HF range is suited in application in Building access control, item-level tracking, and in Library, etc. Presently, the 13.56 MHz range is considered as standard with general using in HF RFID system.

c) Ultra High Frequency (UHF)

The Ultra High Frequency (UHF) has range between 300 MHz to 3 GHz. The RFID system will use 344 MHz and 860-960 MHz, which is considered as the frequency having high speed of data reading. The general properties of RFID system using UHF is as following;

- Due to having short wave length, it can be absorbed easily with liquid and metal, making the reading distance shorter.
- It can read and write data quickly. Then it has opportunity to make mistake easier.
- There are many numbers of equipment working in this frequency. This can easily be interfered by the frequency from other equipment.

Nevertheless, due to the RFID system, which is working in UHF range, has high speed of reading and long reading distance, it is suited for applied in automated toll collection, warehouse management, and goods list tracking, etc.

d) Microwave Frequency Range (MF)

The Microwave frequency range has range between 1 GHz to 300 GHz. The RFID system will use frequency 2.44 GHz and 5.80 GHz. These frequencies have very high speed in data reading. The RFID using in Microwave frequency range has properties as following;

- It has high speed of reading and it can receive and send data quickly.
- Readable Long Distance.
- It has low efficiency when being in the surrounding having water and metal, due to it has very short wave length. From the described properties, the RFID system using in Microwave range is suited for application in long distance vehicle controlling, vehicle indicating, express way automatic money collecting, and supply chain, etc. Therefore from pros and cons found in the RFID system using in any frequency range, practically, the RFID system has many practical frequencies. Each frequency has different in dimensions, such as reading distance, reading speed, and application in any surrounding, etc. This leads to different usage. Generally, the efficiency of the RFID system reading distance will rely on the factors as following;

♦ The energy sent from reader - Due to the RFID plate, passive type, needs energy from reader in executing, therefore if there is low energy sent from the reader, it will make the reading distance shorter.

♦ Usage frequency – the received energy is from antenna, when the working frequency changes, it will make antenna size changed too. This changes the receiving energy too.

♦ The RFID plate sensitivity – the maximum reading distance will rely on the energy requirement of RFID plate. It is up to the type of RFID plate and size of the antenna in RFID plate.

♦ Communication technique – the reading distance will rely on communication technique, whether it is inductive coupling or backscattering.

2.3.5 RFID Benefits

a) Average accuracy is 99.5 percentages, but Barcode reading has average accuracy at 80 percentages

b) It has resolution, and it can contain much information, which can classify the different of each product, even though these are the same product (Stock Keeping Unit: SKU)

c) It can read the product information from RFID Tag as the same time with plenty numbers of products

d) Speed of reading information of RFID is faster than of Barcode

e) It can transmit information to the reader equipment without to read with close, like Barcode's

f) It can make written information over the previous. then it can be brought to make reuse and reduce the cost of Tag manufacturing

g) The RFID Tag has priority of damage lower than barcode, due to there is no need to install it on the products outside

h) It can eliminate the problem of duplication reading, which may occur in Barcode system

i) High security system, difficult to change and duplicate

j) Humidity, vibrating, impacting Resisting

From allinformation discussed above, the RFID system can be used to make recording of checking in-out by collecting data as date/time and being able to represent in the required form. Some implementations of this technology can be found as follows.

Chanapol (2008) has studied on the application of RFID for tracking OPD card and found that

a) The efficiency on the curing history file inspection, stored in registration room, has speed faster than present 10 times, and the accurate on data reading is 100% for reading 28.85 files of curing history. It is considered as good efficiency and

b) The efficiency in the curing files flowing channel inspection, getting 100% accurate in data reading. This is good efficiency too.

Somkid (2008) said that the developed RFID system prototype can be used for inspecting the book list located on the bookshelf. It could know whether group

sorting is correct or not, and it could indicate the books list, which were not located on the bookshelf.

Wachiraporn (2009) has studied the development of automatic circulation system using RFID.In the Service of borrowing-returning books automatically, which needs not to wait for the officer, in case of there was not officer at there to serve, or the officer has gotten books returning but has not yet made given receipt (Sometimes, may be forget to make it, and it makes the list of not returning books, leading to create the fine money to pay), the service user can make borrowing-returning list and inspecting it with own self automatically. The developed work can issue any reports following the duty with correctly. The system can report the media, which has not gotten borrowing- returning with 1 month.

This technology can reduce 80% in the assets lost from stolen, or brought from library without intension. It can also reduce time of work executing 2.89 hours per day, and additionally creates satisfaction on the service users in the dimension of personal assets inspecting requisition.

From such advantages detailed above, the system with RFID technology might lead to improve theclass attendance management in a vocational college. Besides its suitable use, we chose the RFID passive tag with LF range since it can properly replace a student ID card.

CHAPTER III
METHODOLOGY

This chapter is to explain about the procedures of making RFID technology for the class attendance management in a vocational college. Detailed materials and methods in this study are as follows.

3.1 Population and sampling

3.2 Tools and materials

3.3 Design and development

3.4 Collection and analyze data

3.5 Information representation

3.6 The system efficiency evaluation

3.1 Population and Sampling

Population includes 17 teachers and 30 students at Thonburi Vocational Colleges.

3.2 Tools and materials

3.2.1 Tools

This work uses questionnaire for

- Requirement of system
- Evaluation system

3.2.2 Materials

3.2.2.1 Hardware

- Computer client

- CPU: Core i3 540 3.06Ghz (2C/4T)
- M/B: GIGABYTE H55M-S2V
- VGA: PALIT GTS 440 1GB DDR5
- HDD: WD5000AAKX 500GB SATA 3 / 16MB BLUE
- RAM: G.SKILL DDR3 2NQ/1333 (2GBX1)
- DVD: LG 22X SATA-Interface

Figure 3.1 Computer Client(source: bangkok.olxthailand.com)

- Computer server

- HP DL120 G6 X3450 HP SAS AP Svr
- Intel® Xeon® processor X3450 (2.67GHz, 95W, 8MB, 1333, HT, Turbo 1/1/4/4)
- 4GB (2x2GB) PC3-10600R-9 DDR3 RDIMM
- Embedded HP NC107i PCI Express Gigabit Server Adapter
- HP Smart Array P212/256MB Controller (Support Raid 0,1,5)
- Autosensing 400-Watt PFC Power Supply, CE Mark Compliant
- HP 9.5mm SATA DVD RW Kit
- HP 300GB 6G SAS 15K 3.5in Dp ENT HDD

Figure 3.2 Computer server(source: insightsystemsonline.com)

- RFID Reader

- Low cost solution for passive RFID tag reader
- Supports 125KHz RFID passive tag
- 9600 baud rate through RS232 standard
- Fully powered from 5V of USB connection

Figure 3.3 RFID LF 125 KHz Reader(source: technologythai.com)

- RFID Card

- Proximity Card (Blank - White - Credit Card Size)
- NXP S50 Chip
- R/W 1K Bytes

Figure 3.4 RFID Card (source:stronglink.en.ec21.com)

3.2.2.2 Software

- Computer client

- Windows XP

- Computer server

- CentOS 5.0
- PHP
- PhpMyAdmin

3.3 Design and development

3.3.1 Database Design

3.3.1.1 Context Diagram

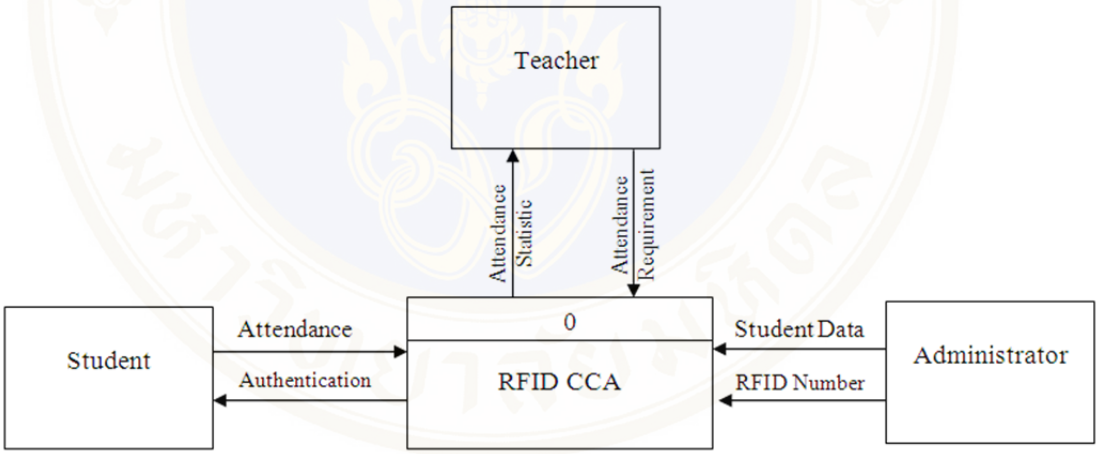


Figure 3.5 Context Diagram

This system is called RFID for Control Class Attendance (RFID CCA). This system will have functioned with the 3 external units, which are

- Administrator
- Teachers
- Students

Each unit has related functions with the system as follows.

a) Administrator has duty in sending the data from STD2011 program in Registration System, which is the standard system used in Office of Vocational Education Commission. The data will be composed of the fundamental data of students (76 fields of Students Data), in CSV file format.

Besides, the administrator is also having duty to save RFID numbers for each student.

b) Teachers can check out the statistics of student's class attendance following requirement. The system represents the statistical data in table.

c) Students have duty to make record their attendance by own self with RFID system. The system will inspect and inform the recorded data following the conditions, which the administrator and teacher had set.

3.3.1.2 Data Flow Diagram (DFD)

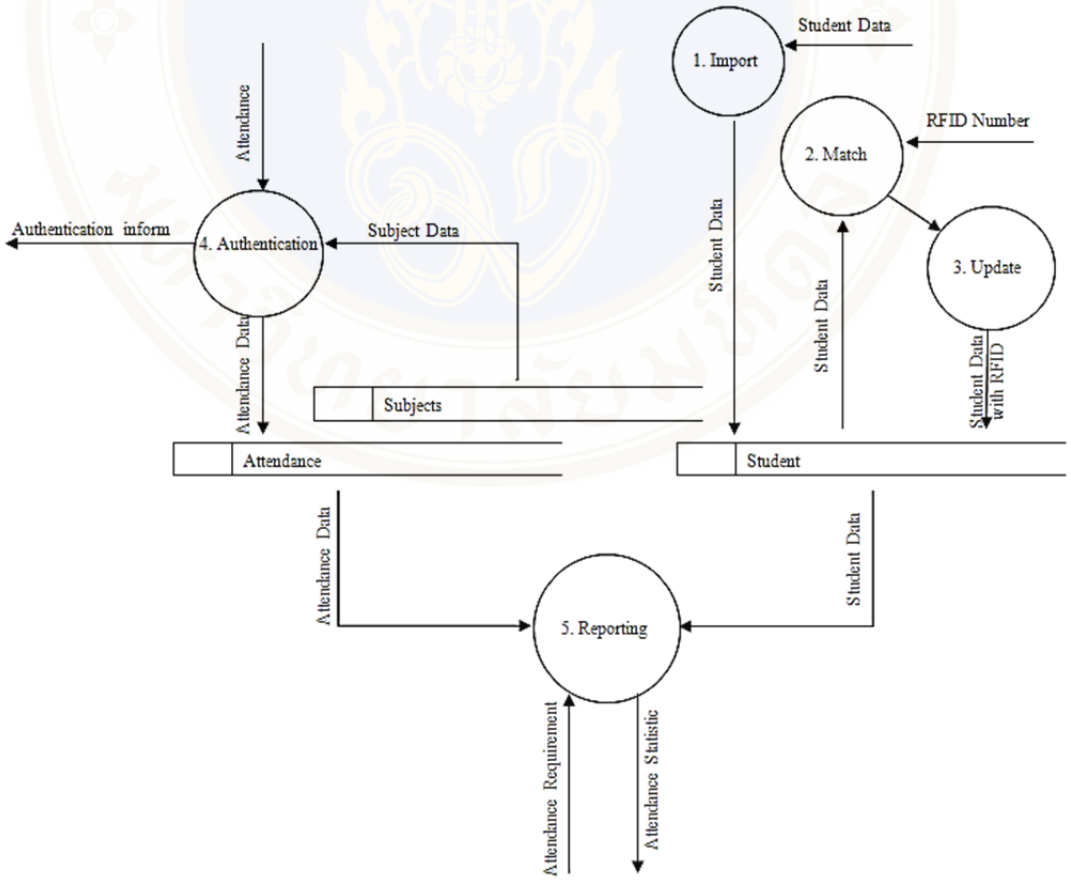


Figure 3.6 Data Flow Diagram

From Context Diagram, it can be explained with Data Flow diagram in Fig. 3.6 with the following processes.

a) Import: This is the process is to import data. The Administrator will bring in the personal data of students from Registration section, which is formed in CSV file. All of 76 fields will be transformed from CSV file to be at SQL data automatically.

b) Match: This is the process to record RFID data matching with the student data. The administrator will read students data from database and bring it to be identified RFID numbers matching with the student data.

c) Update: The process to modify data is executed after the process of writing RFID numbers to the student data. It will modify student data in the database by adding RFID numbers to be as part of the database.

d) Authentication: To inspect student's class attending. With this process, students will record the class attending data by own self using RFID card. The system will inspect this class attending recording before making record in the database. If there is any mistake in recording, such as attending out of time, attending different room, attending different subject, and etc. The system will inform the mistake issue to that student. If it is correct, the system will make record to the database.

e) Report: This is the process to report. It will support requisition from Teacher or others, by bringing out the data from student database and class attending database, and forming the report in which pattern required from users.

3.3.1.3 Entity-Relationship Diagram

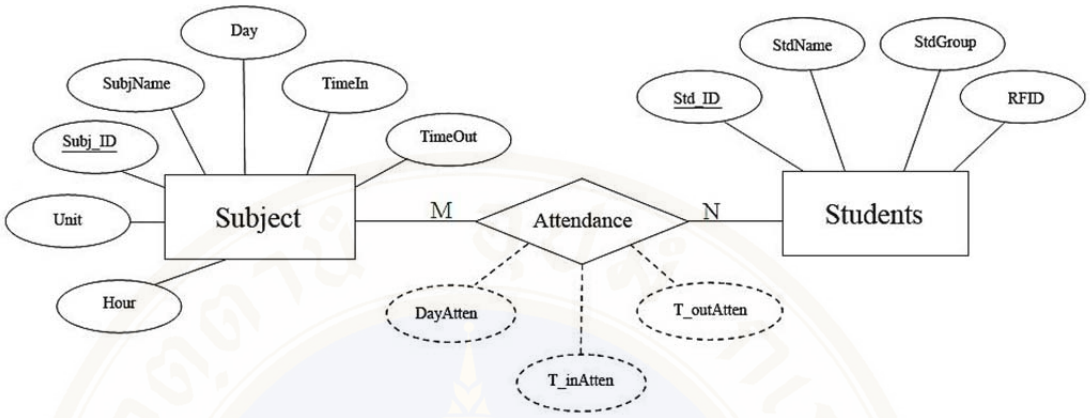


Figure 3.7 Entity-Relationship Diagram

From DFD diagram, RFID CCA consists of student data, subject data, and class attending data. It can be used for designing to be database system, as Entity-Relationship Diagram (ER-Diagram).

The data include:

a) Students

- Std_ID : Character10 digits
- StdName : Name-Surname of Student
- StdGroup : code of Student's group, there are character 8 digits
- RFID : RFID Number

There is using Std_ID as Primary Key

b) Subject

- Subj_ID : Subject code, using character 8 digits
- SubjName : Subject name
- Unit : Credit as integer
- Hour : The amount of hours per week
- Day : The learning day (Monday, Tuesday, Wednesday,…)
- TimeIn : Time attending class following the learning table

- TimeOut : Time of class finished, following the learning table

c) Attendance

- DayAtten : The Day name to attend class
- T_inAtten : Time, to attend class (day: month: year: hour: minute: second)
- T_outAtten : Time, going out from class (day: month: year: hour: minute: second)

The connection seen from the related functions is considered as ‘many to many’ relationship. That is each student can take many subjects, while each subject is also opened to many students.

3.3.2 Interface and Programming Design

The detailed procedure is described by the following steps.

3.3.2.1 Import Student Data From Department of Registration to Database

a. Import Form

Interface

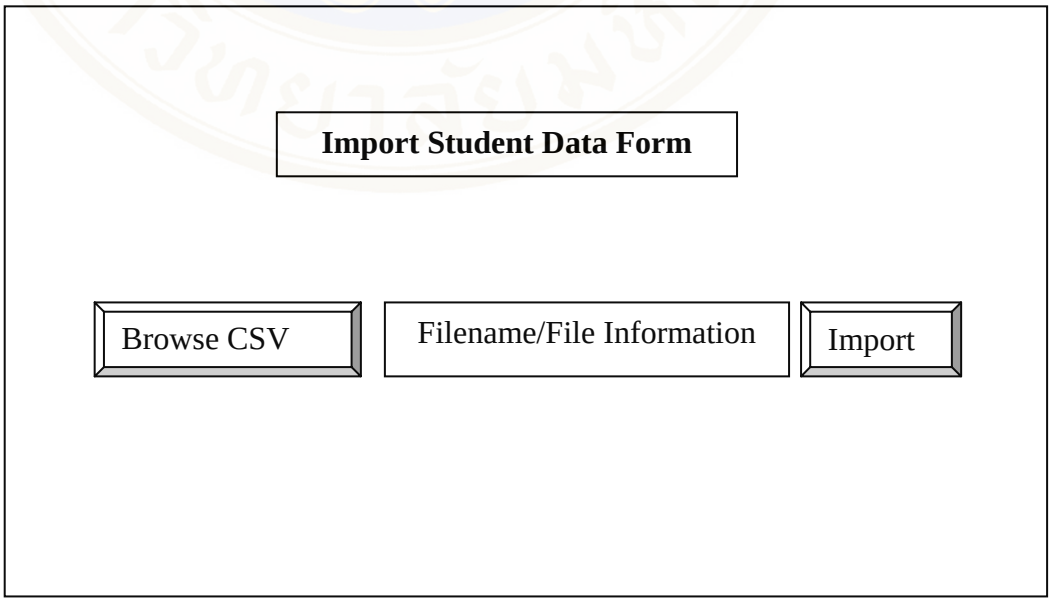


Figure 3.8 Import Form

b. Insert Student data Into Database

Interface

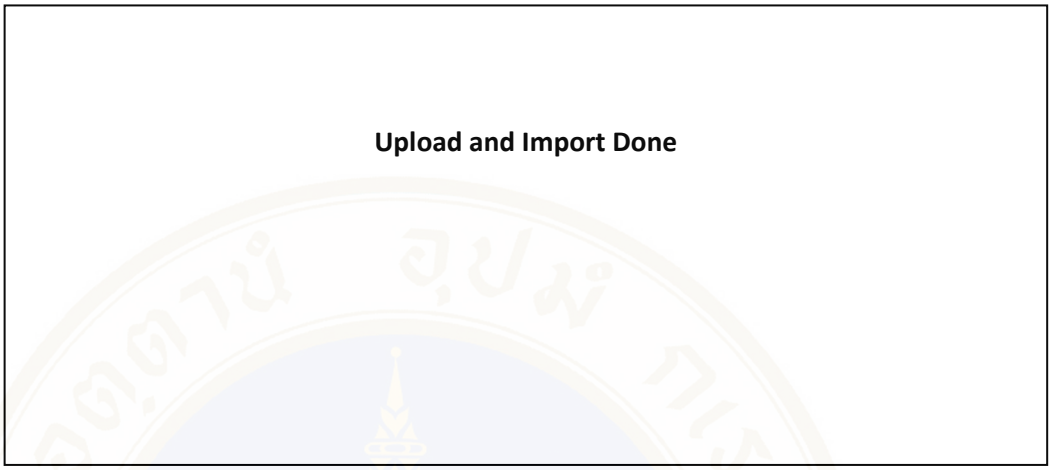


Figure 3.9 After insert student data into database

The step to import student data to the system database is the first step of execution in RFID CCA system (this is an administrator duty). It can be done as shown in Figure 3.8 by clicking button “browse CSV”, to find out the file CSV type (such as file, which name is “std_10166201.csv” through STD2011program from registration work) followed by clicking the button “import” to finish the process. The system will reply after there are finished uploading and importing, as shown in Figure 3.9.

3.3.2.2 Attendance

a. Attendance Checking Form

Interface

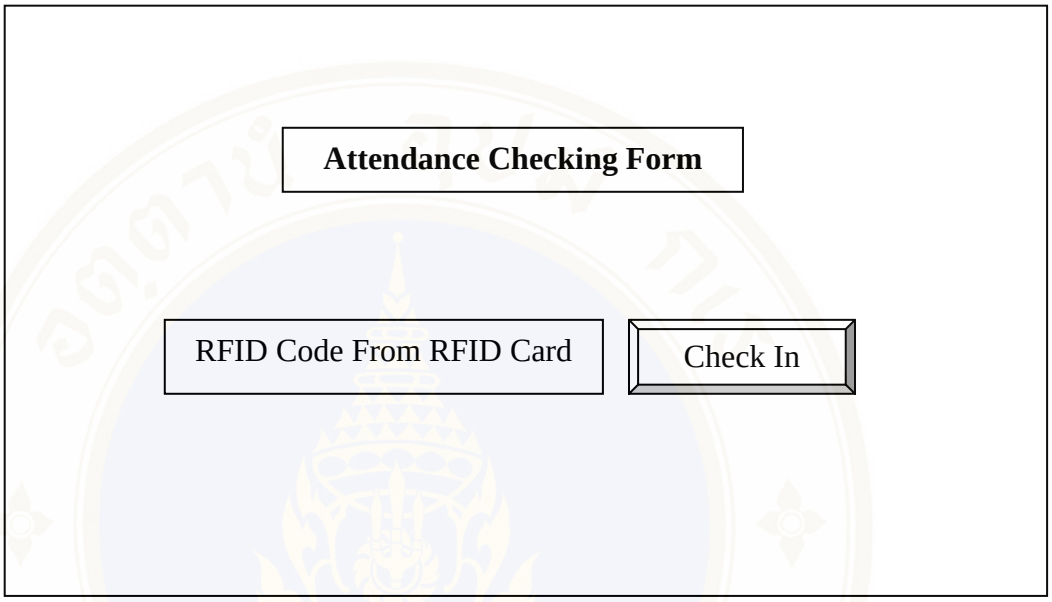


Figure 3.10 Attendance checking form

b. Attendance Checking Process

Interface

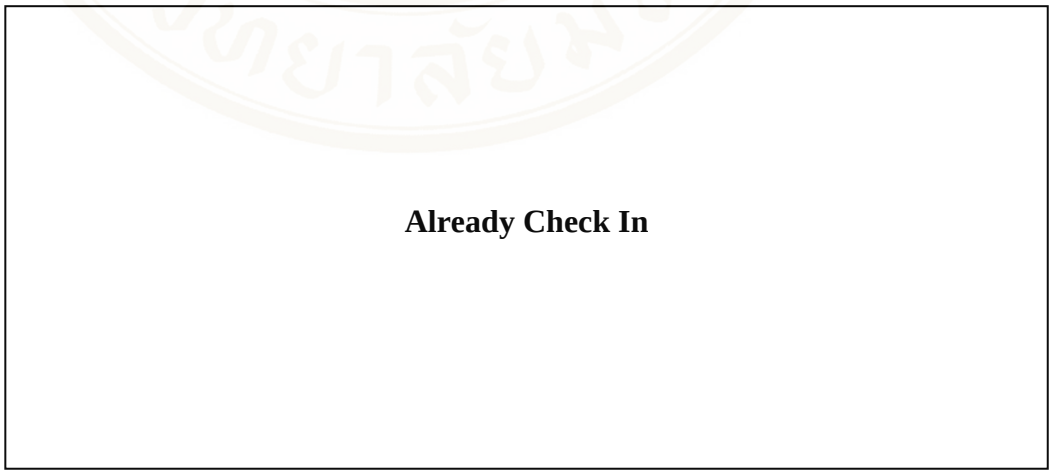


Figure 3.11 After attendance checking process

The step of attendance checking is the important step in the authentication of RFID CCA system, which is proceeded by students by bringing RFID card to touch

the RFID reader. When RFID number is displayed on monitor, the system will proceed ‘checking in’ automatically (no need to push button “Check in”) as shown in Figure 3.10. When the process is finished, the system will show the message “Already Check in” as shown Figure 3.11.

c. Attendance Report

Interface

Attendance Statistic Report

SubjectCode……..SubjectName…….

Unit……..HourNumber……StdentGrou……

StdID	STDname	P1	P2	P3	…	…	…	…	PN

Figure 3.12 Table attendance report

When the teacher would like to browse the class’s attending list, or the number of students attending the class, the teacher can call read all any time. The RFID CCA system will present the data as listed in Figure 3.12. The class attendance data can be accessible by the parents or authorized users.

3.4 Collection and analyze data

The data collected from the questionnaire for satisfaction and efficiency evaluation of using RFID CCA system from sampling group will be examined for their completeness before having numbered for data processing. To analyze the data, we proceeded using Microsoft Excel version 2010 with Descriptive Statistics method.

Since the data collected were somewhat scattered, a measure theory or scale is needed.

Likert Scale , by Rensis Likert (Uebersax, 2006), is an extensively used method for scaling responses in survey researcheither positive or negative response to

a statement. There will be 5 symmetric choose-able levels of choices starting from minimum, less, medium, much, and maximum.

The researcher will evaluate 3 principal dimensions, which are speed, correct, and satisfaction. The satisfaction of the officer who answer questionnaire is separated to be 5 levels, which they are as follows,

1 = Not at all satisfied
2 = Slightly satisfied
3 = Somewhat satisfied
4 = Very satisfied
5 = Extremely satisfied.

To calculate the level of satisfaction, the mean and standard deviation (S.D.) of each answer from each dimension are involved. In terms of standard deviation value, the lower represents the opinion alike of individuals. The final scale are given by

1.00 - 1.50 (strongly disagree)
1.51 - 2.50 (disagree)
2.51 - 3.50 (undecided)
3.51 - 4.50 (agree)
4.51 - 5.00 (strongly agree).

The individual's final score is obtained by summing the item score. The responses are then summarized by the respondent group by output.

3.5 The data representation

The collected data can be explained the characteristics of the qualitative statistic representation, separated following the type of variant or data, by categorized to be Categorical Data which may be nominal scale data or ordinal scale data for the qualitative group of statistic.

This is to summarize the importance of data, which will be able to represent in table form of Frequency Distribution. For example, Table 3.1 shows the frequency categorized by sex.

Table3.1 Frequency Distribution representation

Sex	Frequency	Percentage
Male	Xxx	xxx
Female	Xxx	xxx
Total	100	100

3.6 The system efficiency evaluation

For the system efficiency evaluation, seven assessors who are not the same persons from satisfaction questionnaire contributors were chosen. These participants are Thonburi Vocational College teachers, having teaching experience of more than 10 years, and have taught in a number of different subjects. The information contributed to the system efficiency were observed and recorded with and without using RFID CCA. The evaluation result use $\overline{X}$ and percentage to determine system efficiency.

CHAPTER IV
RESULTS AND DISCUSSION

In order to develop RFID system for controlling student class attendance, the researcher has proceeded the following steps as described in Chapter III. The Study Result can be separated into 4 parts as follows.

4.1 Database development

4.2 RFID CCA development

4.3 Trial User's Opinion studying result

4.4 The system efficiency evaluation result

4.1 Database development

We developed the online database using phpmyadmin tool. The database consists of tables of students, subjects, and attendance checks.

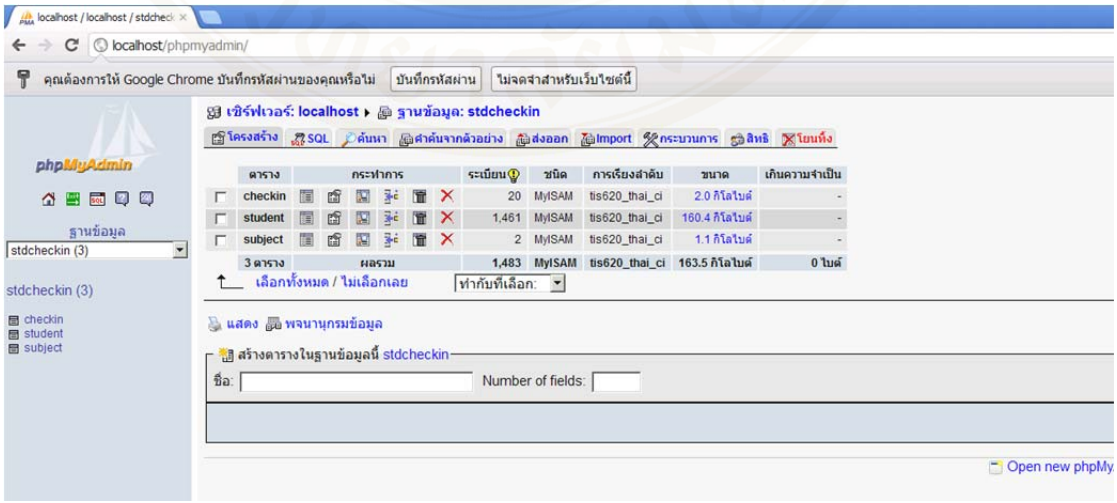


Figure 4.1 Developing the database on phpmyadmin

4.1.1 Student Table

Student table is the table that combines student data in 76 filed and put a RFID number for matching student data to RFID CCA system.

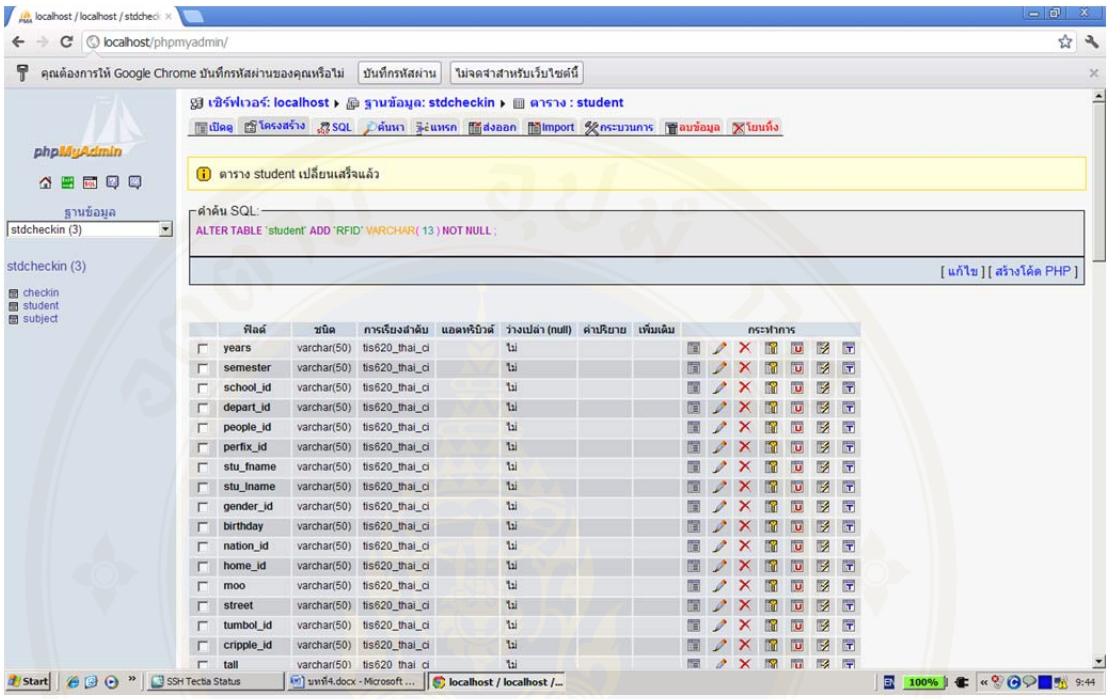


Figure 4.2 Creating student table

4.1.2 Subject Table

Subject table is the table that combines a subject data and time period to teach in the day.

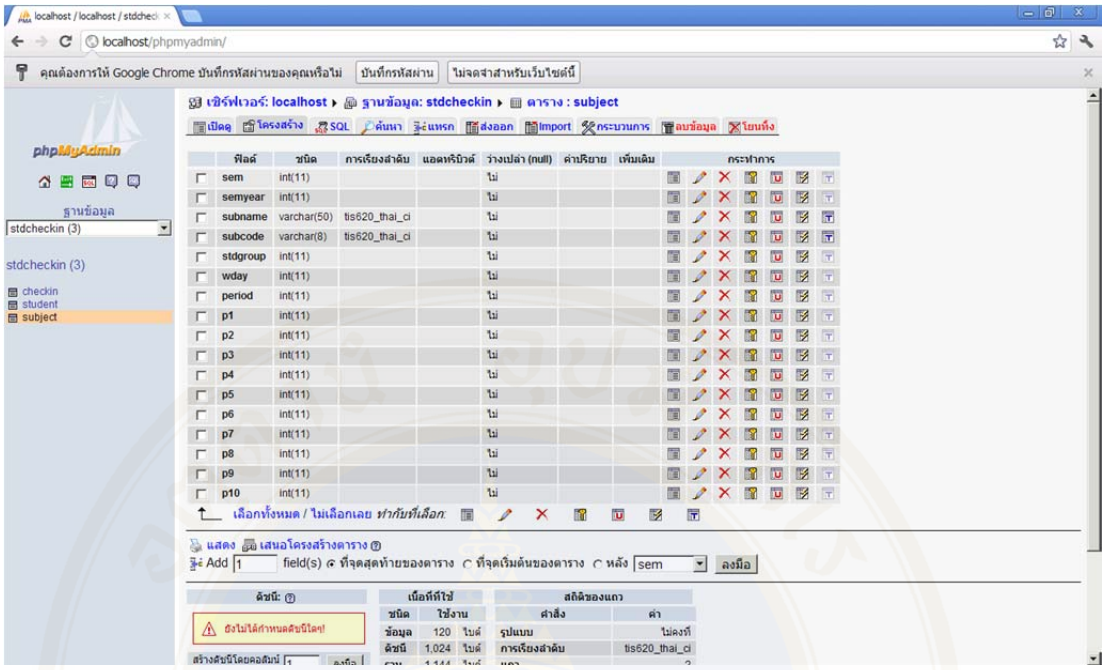


Figure 4.3 Creating subject table

4.1.3 Checkin Table

Checkin table is the table that combines the student attendance by RFID CCA system, this table joins a student data and subject data to statistically report student attendance in a class room.

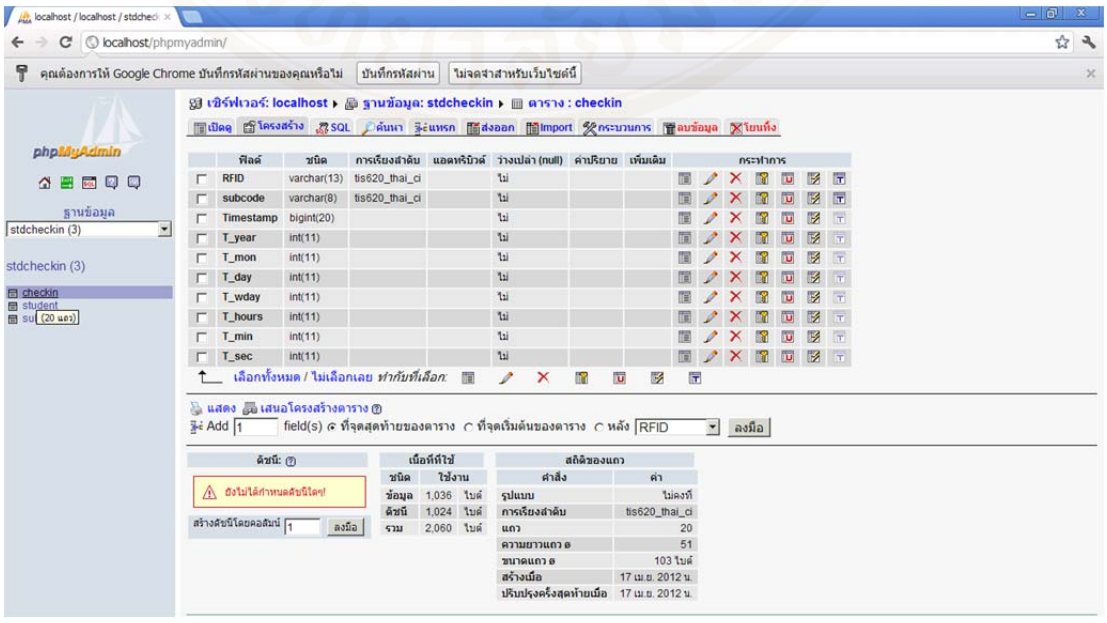


Figure 4.4 Creating check-in table

4.2 RFID CCA development

RFID CCA system can be used both in the Wired LAN network and Wireless LAN network. Both of these networks are medium to receive and transfer data, by using PHP language to develop system. The RFID CCA process has function steps as follows.

4.2.1 Import Data

Import data is a process to import student data in CSV type from registration department to MySQL database.

4.2.1.1 Select File

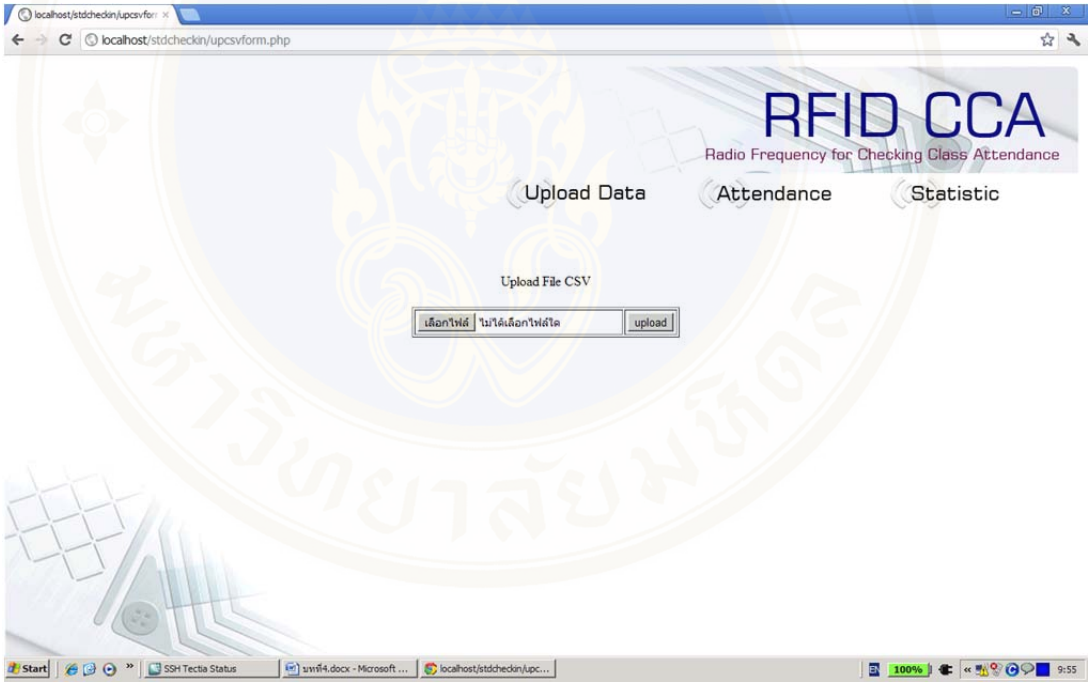


Figure 4.5 Uploading CSV file

This step is to bring student data, which is exported from STD2011 program, used with registration work, (This program is the standard program used in Office of Vocational Education Commission), and is in the form of CSV file. There are 76 fields in this data (see Fig. 4.5). It will be uploaded into the SQL database of RFID CCA system automatically (see Fig.4.6). To upload the student data will be done only once at the beginning of the semester.

4.2.1.2 Inform Upload Result

Figure 4.6 Uploaded student data

4.2.2 Matching Student data with RFID

This step is to record the data of RFID numbers incorporated by the student data. The RFID CCA will read data of student from database (see Fig.4.7) before insert RFID numbers (see Fig.4.8).

4.2.2.1 Select student group

Figure 4.7 Loading and select group of student

4.2.2.2 Insert RFID number to student data

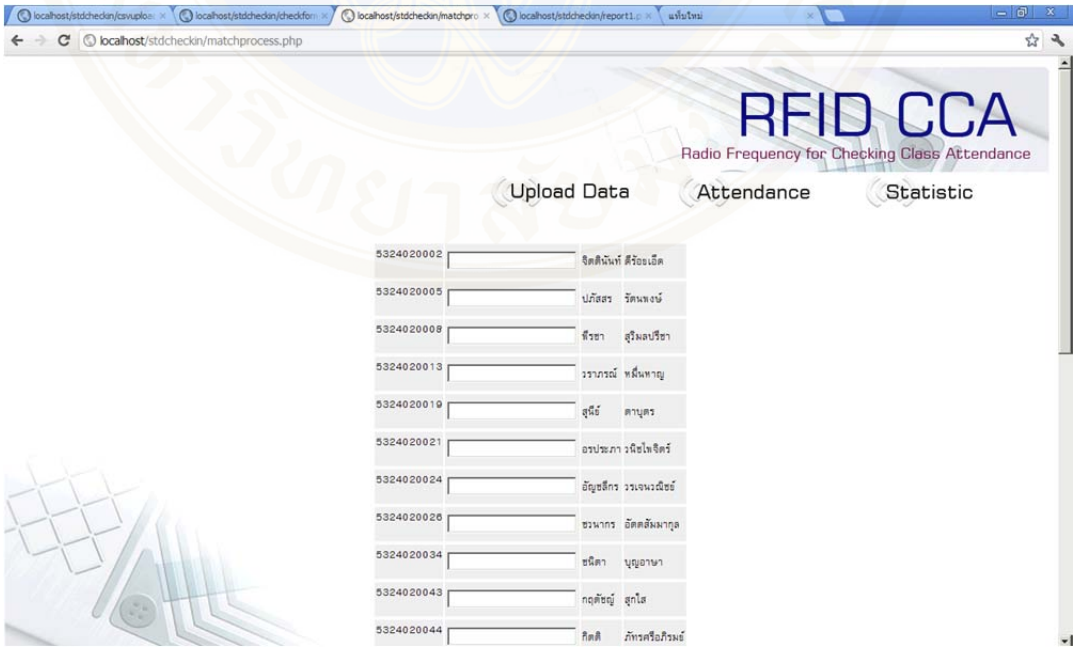


Figure 4.8 Matching RFID number to student data

4.2.3 Student Attendance

This step is to record entrance-exit data of student class. Students will record data of entrance-exit class by own self, by using RFID card touching RFID reader. The system will inspect each time the checking in, before making record in the database. The students will select the subject to learn (see Fig. 4.9) and record the class attendance by RFID card (see Fig.4.10).

4.2.3.1 RFID Check in for Student Attendance

Figure 4.9 Select subject for check-in

4.2.3.2 Inform Check in Result

Figure 4.10 Inform Check-in attendance

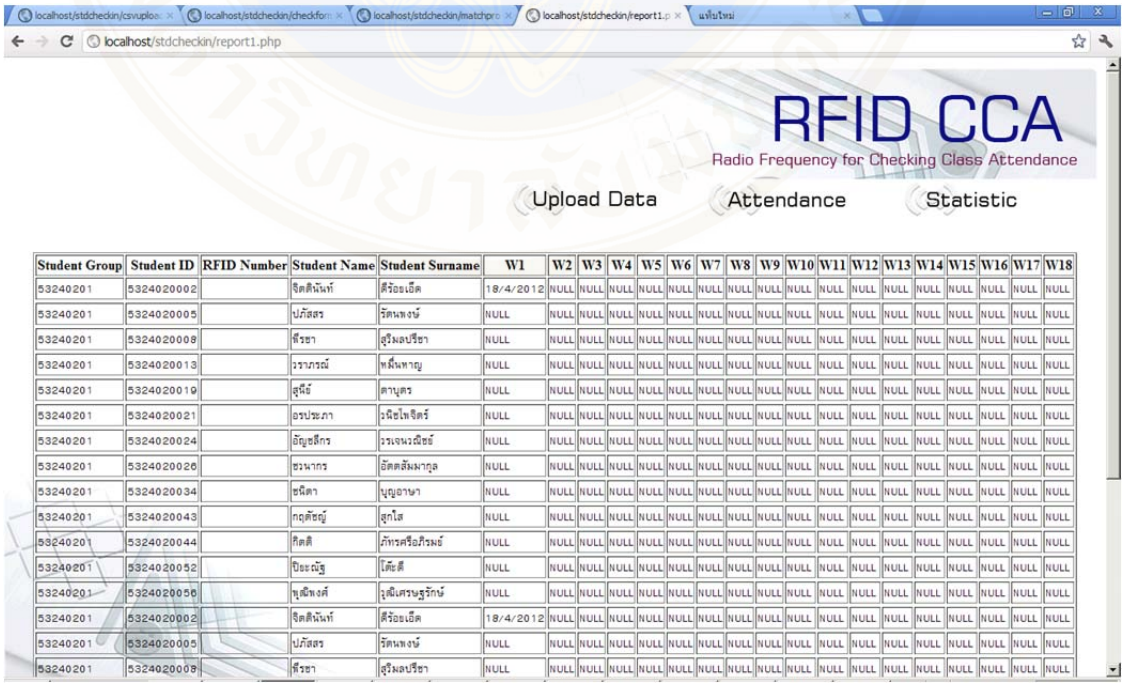
4.2.4 Reporting Data

This step is to show the report of class attendance of all students. It will be represented by subject and learning group (see Fig.4.11). The system will bring data from student data and class attending data to create of the table (see Fig. 4.12).

4.2.4.1 Select Report Requirement

Figure 4.11 User requirement

4.2.4.2 Report Student Attendance



Student Group	Student ID	RFID Number	Student Name	Student Surname	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14	W15	W16	W17	W18
53240201	5324020002		จิตตินันท์	ดีร้อยเอ็ด	18/4/2012	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
53240201	5324020005		ปภัสสร	รัตนพงษ์	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
53240201	5324020008		ทีรชา	สุริมลปรีชา	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
53240201	5324020013		วราภรณ์	หงษ์นหาญ	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
53240201	5324020019		สุนีย์	ตาบุตร	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
53240201	5324020021		อรปประภา	วนิชไพจิตร์	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
53240201	5324020024		อัญชลีกร	วรเจนวณิชย์	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
53240201	5324020026		ชนากร	อัศดสัมมากุล	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
53240201	5324020034		ชนิดา	บุญอาษา	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
53240201	5324020043		กฤตัชญ์	สุกโส	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
53240201	5324020044		กิตติ	ภัทรศรีอภิรมย์	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
53240201	5324020052		ปิยะณัฐ	โต๊ะดี	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
53240201	5324020056		พุฒิพงศ์	วุฒิเศรษฐรักษ์	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
53240201	5324020002		จิตตินันท์	ดีร้อยเอ็ด	18/4/2012	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
53240201	5324020005		ปภัสสร	รัตนพงษ์	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL
53240201	5324020008		ทีรชา	สุริมลปรีชา	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL

Figure 4.12 Report Student Attendance

4.3 Trial User's Opinion Studying Result

This is the result from questionnaires in response to users' satisfaction on the RFID CCA system. The users include 10 teachers and 30 students from Thonburi Vocational College where the details are listed as follows.

4.3.1 General information of questionnaire respondent

4.3.1.1 Questionnaire on Age

Table 4.1 Amount and percentage of the questionnaire respondent by age

Age	Amount (persons)	Percentage
Lower than 20 years	30	75
21 - 30 Years	3	7.5
31 - 40 Years	5	12.5
41 - 50 Years	2	5
Total	**40**	**100**

Figure 4.13 Chart representing percentage of questionnaire respondent by age

Table 4.1 and Figure 4.13represent the age ratio of 40 questionnaire respondents from lower than 20 years to 50 years. It was found that the highest percent is 75% for the age lower than 20 years while the lowest percent is 5% for the age between 41 and 50 years.

4.3.1.2 Sex

Table 4.2 Amount and percentage of questionnaire respondents by sex

Sex	Amount (persons)	Percentage
Female	18	45
Male	22	55
Total	**40**	**100**

Figure 4.14 Chart represents percentage of the questionnaire respondent by sex

Table 4.2 and Figure4.14 represent the sex ratio of 40 questionnaire respondents. It was found that the number of male respondents is higher than female's at 55%.

4.3.1.3 Questionnaire respondent's status

Table 4.3 Amount and percentage of questionnaire respondent separated by status

Status	Amount (persons)	Percentage
Teacher	10	25
Student	30	75
Total	**40**	**100**

Figure 4.15 Chart represents percentage of questionnaire respondent by status

Table 4.3 and Figure4.15 represent the status ratio of 40 questionnaire respondents. The numbers of teachers and students are10 (25%) and 30 (75%), respectively.

4.3.1.4 Questionnaire respondent's education level

Table 4.4 Amount and percentage of questionnaire respondent by educational level

Education level	Amount (persons)	Percentage
Vocational Certificate	20	50
Higher Vocational Certificate	10	25
Bachelor's Degree	6	15
Above bachelor	4	10
Total	**40**	**100**

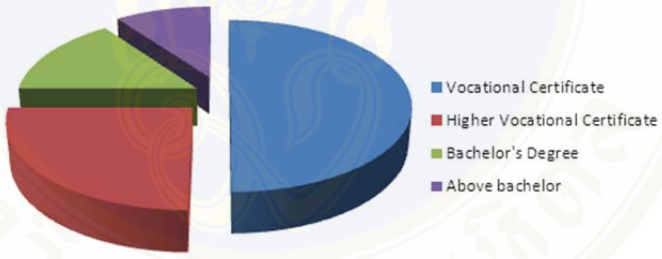


Figure 4.16 Chart represents percentage of questionnaire respondent by educational level

The chart inFigure4.16 was plotted by the level of education of 40 questionnaire respondents. The highest percent of 50 is obtained at the level of Vocational Certificate.

4.3.1.5 Experience of the questionnaire respondents

Table 4.5 Amount and percentage of the questionnaire respondent by teaching experience.

The years of teaching	Amount (persons)	Percentage
1 - 3 years	0	0
3 - 5 years	4	40
5 - 10 years	2	20
over 10 years	4	40
Total	**10**	**100**

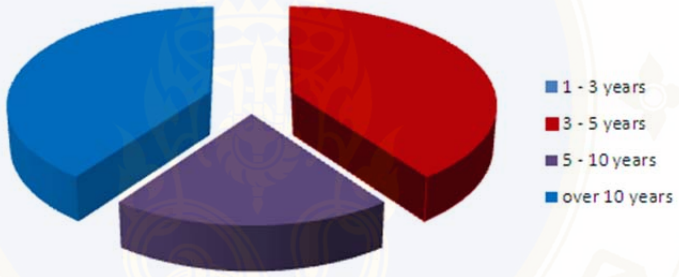


Figure 4.17 Chart represents the percentage of the questionnaire respondents by teaching experience.

Table 4.5 and Figure 4.17 represent 10 questionnaire respondents, who are teachers with different teaching years of experiences.

4.3.1.6 RFID system acknowledgement of the questionnaire respondents

Table 4.6 Amount and percentage of the questionnaire respondents who are familiar with RFID system

Familiarity	Amount (persons)	Percentage
Known and have usage experience	0	0
Known but no usage experience	2	5
Unknown	38	95
Total	**40**	**100**

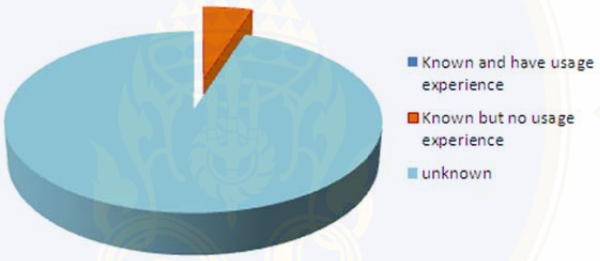


Figure 4.18 Chart represents the percentage of the questionnaire respondents familiar with RFID system

Table 4.6 and Figure 4.18 represent the ratio of questionnaire respondents who have different experiences of RFID system.

4.3.2 The satisfaction on the RFID CCA system

Users' satisfaction can be measured by statistical method with average ($\overline{X}$) and Standard Deviation value (S.D.) values in many dimensions as described in chapter III.

For satisfaction evaluation, it can be separated into 5 items as shown in table 4.7.

Table 4.7 Satisfaction of users on the RFID CCA system

User satisfaction evaluation, descriptions	$\bar{X}$	S.D.
RFID system efficiency	4.38	0.48
System designed	4.36	0.33
Data accuracy	4.43	0.59
General Overview of the RFID CCA usage	3.60	0.50
Average value	**4.33**	**0.48**

From table 4.7, it is found that the satisfaction evaluation of users on RFID CCA, by average, is in the agree level (3.51 - 4.50) with $\bar{X}$ = 4.33 and S.D. = 0.48. In details of evaluation, it is found that the users satisfaction in data accuracy is highest ($\bar{X}$ = 4.43, S.D. = 0.59). The second highest is in RFID system efficiency ($\bar{X}$ = 4.38, S.D. = 0.48). The lowest satisfaction evaluation is for General Overview of the RFID CCA usage ($\bar{X}$= 3.60, S.D. = 0.50)

From the evaluation descriptions in table 4.7, it can be explained in minor details in each description item of user satisfaction evaluation as follows.

4.3.2.1 The satisfaction in RFID system efficiency

It could be separated to be 3 items as shown in the following table.

Table 4.8 The satisfaction in RFID system efficiency

User satisfaction evaluation, descriptions	$\bar{X}$	S.D.
The system can be brought to made real practice	4.80	0.41
The system has useful in practice	4.65	0.58
The system can help reducing time of inspection the student class attending	3.70	0.46
Average value	**4.38**	**0.48**

From table 4.8, it is found that the satisfaction in RFID system efficiency, by average, having agree level ($\bar{X}$ = 4.38, S.D. = 0.48). When considering in details, it is found that the practical use of the RFID CCA system has the highest satisfaction

with strongly agree level ($\overline{X}$ = 4.80, S.D. = 0.41), while time reduction for class attendance check has the lowest satisfaction, with agree level ($\overline{X}$ = 3.70, S.D. = 0.46).

4.3.2.2 The satisfaction in the dimension of system design

For the satisfaction evaluation descriptions in system design, can be separated to be 4 items, following table 4.9

Table 4.9 The user satisfaction in the dimension of system design

User satisfaction evaluation, descriptions	**$\overline{X}$**	**S.D.**
The system has convenient in usage	4.88	0.33
The system is modernized	5.00	0.00
The system has nice designed interface window picture	3.80	0.56
The system has easy use of designed interface picture	3.78	0.42
Average value	**4.36**	**0.33**

From table 4.9, it is found that users have satisfaction in system design, by average, at agree level ($\overline{X}$ = 4.36, S.D. = 0.33). When considering in details, it is found that being modernized has the highest satisfaction with strongly agree level ($\overline{X}$ = 5.00, S.D. = 0.00), while an easy usage with picture interface has the lowest satisfaction with agree level ($\overline{X}$ = 3.78, S.D. = 0.42)

4.3.2.3 Satisfaction in the dimension of data accuracy

It can be separated to be 5 items as follows.

Table 4.10 User Satisfaction in the dimension of data accuracy

User satisfaction evaluation, descriptions	**$\bar{X}$**	**S.D.**
The system has accuracy of the represented result information	3.85	0.62
The system has precise of data processing	4.35	0.80
The system has reliability	4.85	0.36
The system can inform the information following the user requirement	4.28	0.75
The information can be brought to help decision on teaching evaluation	4.80	0.41
Average value	**4.43**	**0.59**

From table 4.10, it is found that the users have satisfaction in data accuracy by average at agree level ($\bar{X}$ = 4.43, S.D. = 0.59). When considering in details, it is found that the reliability has the highest satisfaction at strongly level ($\bar{X}$ = 4.85, S.D. = 0.36), while “The system has the data accuracy to represent” has the lowest satisfaction at agree level ($\bar{X}$ = 3.85, S.D. = 0.62)

4.3.2.4 The satisfaction in the dimension of general overview of RFID CCA usage

For the satisfaction in the general overview of RFID CCA usage, it can be seen in table 4.11.

Table 4.11 The satisfaction in the overview of RFID CCA usage

User satisfaction evaluation, descriptions	$\bar{X}$	S.D.
General overview of RFID CCA system	3.60	0.50
Average value	**3.60**	**0.50**

From table 4.11, it is found that the users has satisfaction in the in the general overview of RFID CCA usage with agree level ($\bar{X}$ = 3.60, S.D. = 0.50).

When comparing with other dimensions, we found that the users have minimum satisfaction. When analyzing by discussion and found that most of users have hesitation whether this system will be effective in practical use, due to high investment budget.

4.3.3 Additional Suggestions from questionnaire respondents

1) The RFID equipment should not be interfered with unwanted signals.
2) The network system has to be more reliable.
3) It needs to arrange training to users, in order to use the system with full efficiency.

4.4 The system efficiency evaluation result

This section shows the efficiency of the system evaluated by 7 teachers from Thonburi Vocational College, who have teaching experience more than 10 years with many subjects. It has details as follows.

The first teacher

- Teaching experience, more than 30 years
- Teach subject: Basic Chinese language1, to the higher vocational student 30 persons
- Before using RFID CCA, it used time for checking student's names around 5 minutes, but RFID CCA can help to be able to check within 2 minutes.

- Before using RFID CCA, for teaching 2 hours, it can teach around 5 issues. After using this system, it can teach with 5 issues the same, but students can have time more in practicing Chinese dialogue.
- For evaluating the students who lacked in attending the class more than 20%, it leads to affect the recalculated C (Class Attendance Incomplete), by counting times. If there are lacking more than 5 times, those student will be evaluated C (Class Attendance Incomplete) immediately.
- The RFID CCA system suitability for practical using level: medium
- If there is RFID CCA system development in order to be practical usage, it is hesitation to be used-able or not, because the teacher thought that the primitive student's name checking will create good relationship between teacher and students.

The second teacher

- Having teaching experience 21-30 years
- Teach subject: resident building design, to the 23 vocational students
- Before using RFID CCA, it used time for checking student's names around 5 minutes, but RFID CCA can help to be able to check within 1.5 minutes.
- About teaching issues, before using RFID CCA, for teaching 2 hours, it was up to the issue length. It was uncertainly. When to use this system, like the same, this system cannot tell that the number of issues will be increased or decreased.
- For evaluating the students, who lacked in attending the class more than 20%, it leads to affect the pre calculated C (Class Attendance Incomplete), by counting times. If there are lacking more than 4 times, those student will be evaluated C (Class Attendance Incomplete) immediately.
- The RFID CCA system suitability for practical using level: much
- If there is RFID CCA system development in order to be practical usage, the teacher will use it certainly because the teacher though this system will help increasing the behavior scores, and it will leads to increase studying achievement too.

The third teacher

- Having teaching experience 21-30 years
- Teach subject: Technical Drawing, to the 30 vocational students
- Before using RFID CCA, it used time for checking student's names around 7 minutes, but RFID CCA can help to be able to check within 3 minutes.
- Before using RFID CCA, for teaching 2 hours, there are not certain issues, up to the subject matter.
- For evaluating the students, who lacked in attending the class more than 20%, it leads to affect the pre calculated C (Class Attendance Incomplete), by counting times. Not much time usage in calculation.
- The RFID CCA system suitability for practical using level: much
- If there is RFID CCA system development in order to be practical usage, the teacher will use it certainly because this system will practice the students to have more responsible and have more alert in studying.

The forth teacher

- Having teaching experience 11-20 years
- Teach subject: Single Accounting system and Goods, to the 21 vocational students
- Before using RFID CCA, it used time for checking student's names around 5 minutes, but RFID CCA can help to be able to check within 2 minutes.
- Before using RFID CCA, for teaching 2 hours, there are not certain issues, and when execute this system, the students have time more in practice the account calculation.
- For evaluating the students, who lacked in attending the class more than 20%, it leads to affect the pre calculated C (Class Attendance Incomplete), by counting times. If there are lacking more than 4 times, those student will be evaluated C (Class Attendance Incomplete) immediately.
- The RFID CCA system suitability for practical using level: much

- If there is RFID CCA system development in order to be practical usage, the teacher had hesitation to use it or not, because the teacher thought that this system will make the teacher not to remember name-surname of students.

The fifth teacher

- Teaching experience, more than 30 years
- Teach subject: English language for enterprise1, to the 22 vocational students
- Before using RFID CCA, it used time for checking student's names around 7 minutes, but RFID CCA can help to be able to check within 2.5 minutes.
- Before using RFID CCA, for teaching 2 hours, there are teaching 3 issues, and when execute this system, there are the same teaching issues, but the students have time more to have questions on vocabulary.
- For evaluating the students, who lacked in attending the class more than 20%, it leads to affect the recalculated C (Class Attendance Incomplete), by counting times.
- The RFID CCA system suitability for practical using level: low
- If there is RFID CCA system development in order to be practical usage, the teacher will not use because the teacher thought that the existing system is still god and suitable.

The sixth teacher

- Teaching experience, 21- 30 years
- Teach subject: Fundamental Economics, to the 22 vocational students
- Before using RFID CCA, it used time for checking student's names around 5 minutes, but RFID CCA can help to be able to check within 2.5 minutes.
- About teaching issues, before using RFID CCA, for teaching 2 hours, it was up to the issue length.
- For evaluating the students who lacked in attending the class more than 20%, it leads to affect the pre calculated C (Class Attendance Incomplete), by

counting times. If there are lacking more than 4 times, those student will be evaluated C (Class Attendance Incomplete) immediately.

- The RFID CCA system suitability for practical using level: medium
- If there is RFID CCA system development in order to be practical usage, the teacher will not use because the teacher though that the existing system has not use time much, due to there are few students. This system will be good in practical when applying with the class with big student group.

The seventh teacher

- Having teaching experience 21-30 years
- Teach subject: Freedom English language studying, to the 15 vocational students
- Before using RFID CCA, it used time for checking student's names around 3 minutes, but RFID CCA can help to be able to check within 1.5 minutes.
- Before using RFID CCA, for teaching 2 hours, there are teaching 2issues, and when execute this system, there are the same teaching issues
- For evaluating the students, who lacked in attending the class more than 20%, it leads to affect the pre calculated C (Class Attendance Incomplete), by counting times. If there are lacking more than 5 times, those student will be evaluated C (Class Attendance Incomplete) immediately.
- The RFID CCA system suitability for practical using level: medium
- If there is RFID CCA system development in order to be practical usage, the teacher will use it certainly because this system will be useful for teaching practices.

RFID CCA system evaluation result, viewing in dimension of name checking time for student attending class, having unit in minute.

Table 4.12 RFID CCA system evaluation result

Assessor	Before using RFID CCA (Minute)	After using RFID CCA (Minute)	time gained (Minute)	time gained (entire semester) (Minute)
The first teacher	5	2	3	54
The second teacher	5	1.5	3.5	63
The third teacher	7	3	4	72
The forth teacher	5	2	3	54
The fifth teacher	7	2.5	4.5	81
The sixth teacher	5	2.5	2.5	45
The seventh teacher	3	1.5	1.5	27
Mean ($\bar{X}$)	**5.29**	**2.14**	**3.14**	**56.57**

From table 4.12, it can be seen that, in each time, there could get more teaching time by average 3.14 minutes with using RFID CCA. For the entire teaching semester, there could get more teaching time by average 56.57 minutes.

Summary the evaluation on efficiency in the dimension of practical usage, it could be seen that the assessors have given the level of efficiency evaluation in “much” level for 3 persons, “medium” 3 persons, and “low” with 1 persons. This is 3.29 by mean ($\bar{X}$) in agree level evaluation.

CHAPTER V
CONCLUSION AND FUTURE WORK

The objectives of this Independent Study are to design the management system for class attendance of vocational students and to evaluate the RFID CCA system efficiency. In summary, by analyzing from the questionnaires and the efficiency evaluation, it is found that users have high level of satisfaction in the RFID CCA system. Besides, the result from efficiency evaluation showed that the system has efficiency and is applicable in high levels due to itsthe usage benefits, accuracy, and reliability. When comparing with traditional method, it can reduce burden in checking student's class attendance and results in increased teaching time. It can alsocreate the report used to evaluate teaching andstudy efficiencies in any subject. This provides teachers a convenient and accuratetool to examine student's class attendance efficiently.

5.1 Research result summary

From the results of thisstudy, there are issues summarized as follows.

5.1.1 It was found that the developedRFID CCA system can helped increasing the efficiency in terms of teaching time, thusmaking this system suitable for a practical usage.

5.1.2 The reports created in according with the existing class attending process and management meet teacher requirements to use for teaching and study efficiency evaluation.

5.2 The found problems in prototype development

The problems found between developing the prototype were classified into 2 issuesas follows.

5.2.1 Technical problem

This problem can be separated to be 2 parts

a) The problem of main network equipment; to develop the RFID CCA system in this case, the researcher found that the system was unable toimport database from the simulated server to the practical server. The researcher solved the problem by implementing RFID CCA system through Ethernet system, in order to test the prototype system.

b) The WiFi network was found unreliable for the data network connection of laptop computer in the RFID CCA system.

5.2.2 Problem from users

The users can be classified into 2 groups, teachers and students;

a) Teachers werereluctant to adaptto checking the student class attendance with theRFID CCA system. But teachers accepted that this system can help this inspection by giving convenienceand reducing works.

b) Students were not familiar withthe class attendancecheckwith the self-checking system.

5.3 Suggestions

5.3.1 Suggestions for adjusting before practical usage

This research is to develop RFID technology to manage the vocational student’s class attendance. For a practical use, it needs to recondition the equipment to be suitable with the usage program, as follows.

a) Adding peripheral equipment such as camera attached to theRFID reader to collect data of student’s face once checking-in for reexamination.

b) Adjusting application in order to let teacher to manually input RFID number of student in case of no presence of RFID card.

c) The RFID number should be assigned to new students during the course registration process.

d) It should combine data of student’s class attendancewith the college entrance-exit existing inspecting system.

5.3.2 Suggestions for future works

a) To use RFID technology in library service of books borrowing and returning.

b) Application development to report the student class attendanceto their parents through emailand SMS automatically.

c) RFID technology development to use in controlling entrance-exit of vehicles in the academy.

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APPENDIX

User Satisfaction on the RFID system to control class attending Questionnaire

Explanation: This research questionnaire is part of the independent study, Enterprise Architecture curriculum, engineering master degree, Mahidol University. Please have your cooperation to give us the real information in order to be educational useful, and please be noted our thankful for your kind cooperation answering this questionnaire. This questionnaire is separated to be there sections.

Section1, general information of the questionnaire answerer
Section2, Satisfaction on the program (after trial using)
Section3, Additional Suggestions

Section1: General information of the questionnaire answerer

1. Age

☐1) lower than20 years ☐2) 21-30 years
☐3) 31-40 years ☐4) 41-50 years
☐5) 51-60 years ☐6) more than60 years

2. Sex

☐1) male ☐2) female

3. Status

☐1) teacher (if choosing this answer, please answer item 4 and 5)
☐2) student (if choosing this answer, please answer item 4 and 6)

4. Education level

☐1) Vocational certificate ☐2) Higher vocational certificate
☐3) Bachelor ☐4) Above bachelor

5. Teaching experience

☐1) 1 – 3 years ☐2) 3 - 5 years
☐4) 5 – 10 years ☐5) more than 10 years

6. Do you know RFID or not?

☐1) Yes, I know and having usage experience
☐2) Yes, I know but have no usage experience
☐3) No, I do not know

Section2: Satisfaction on the program (after trial usage)

Item	Descriptions	5 Extremely satisfied	4 Very satisfied	3 Somewhat satisfied	2 Slightly satisfied	1 Not at all satisfied
1	**RFID system efficiency**					
1.1	The system can be brought to made real practice					
1.2	The system has useful in practice					
1.3	The system can help reducing time of inspection the student class attending					
2	**System design**					
2.1	The system has convenient in usage					
2.2	The system is modernized					
2.3	The system has nice designed interface window picture					
2.4	The system has easy use of designed interface picture					
3	**Data accuracy**					
3.1	The system has accuracy of the represented result information					
3.2	The system has precise of data processing					
3.3	The system has reliability					
3.4	The system can inform the information following the user requirement					
3.5	The information can be brought to help decision on teaching evaluation					
4	**General overview of RFID CCA system**					

Section3: Additional Suggestions

Efficiency Evaluation Form

Using RFID system to inspect student class attending in Vocational College

This Efficiency Evaluation Form is part of The Thematic Paper, Enterprise Architecture Syllabus, Master of Engineering, MAHIDOL University. We may ask your cooperation to give us the true information, in order to be useful for education. We would like to further thank you to give us your cooperation answering this Efficiency Evaluation Form. This form is compounded of 3 sections

Section1: General information of the answerer

Section2: The Efficiency of RFID system to inspect class attending

Section3: Suggestions

Explanation

1. This system is named “RFID for Control Class Attendance (RFID CCA)”
2. In this evaluation, please answer the evaluation form after using the RFID system to inspect class attending for your 2 hours teaching with this system.

Section1: General information of the answerer

1. Name-Surname.....
2. sex ☐Male ☐Female
3. age ☐25 – 35 years ☐36 – 45 years
   ☐46 – 55 years ☐above 56 years
4. education
   ☐bachelor ☐master ☐doctorate
5. teaching experience
   ☐ 5 – 10 years ☐11 – 20 years
   ☐21 – 30 years ☐more than 30 years
6. Teaching
   Subject:.....

7. Student level ☐Vocational Student
   ☐ Higher Vocational Student
8. This teaching, there are ……. students

Section2: The Efficiency of RFID system to inspect class attending

1) Before using RFID CCA system, you use time for checking student's names for …… minutes (approximately)
2) You use time checking student's names with RFID CCA system for …… minutes (approximately)
3) Before using RFID CCA system in 2 hours teaching, how many issues you can teach (average)?

   .....
4) When using RFID CCA system in 2 hours teaching, how many issues you can teach?

   .....
5) Before each time studying performance evaluation, you have to calculate the percentage of student's class attend lacking to evaluate as C (Class Attendance Incomplete). How long you spend time to calculate?

   .....
6) You think RFID CCA system is suitable to be practical usage in what level?

   ☐ Maximum ☐Much ☐Medium ☐Less ☐Minimum

   Because.....
7) If there is RFID CCA system development to be able to be practical usage, will you use this system?

   ☐ Use ☐Not use ☐Un-certain

   Because.....

Section3: Suggestions

BIOGRAPHY

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