CHAPTER 1

INTRODUCTION

1.1 Background of Study

Radio Frequency Identification (RFID) is classified as one of the automatic identification data collection (AIDC). Barcodes, card technologies, magnetic cards, smart cards and optical cards are other technologies that are classified in AIDC [1]. RFID is growing rapidly in today's world and are being implemented in industries such as race timing, passports, transportation payments, product tracking, transportation and logistics, inventory systems and many more [2]. As the name itself, RFID technology works by identifying people and objects by using radio frequency. It is basically divided into two types, passive RFID and active RFID. The difference is that active RFID requires battery while passive RFID doesn't. RFID main components are RFID reader (transceiver), RFID tags (transponder) and its data processing subsystem [3].

1.2 Problem Statement

As mentioned earlier, the current technique of student attendance system have many downside to it. That is why this final year project topic is chosen to overcome this problem. Some of the disadvantages of current student attendance system are:

- The system takes a long time to be completed. In some cases, students have not completed signing their attendance until class ends.
- Student that came to class forgot to sign their attendance or lecturer forgot to bring the attendance list to class.

- Attendance list are lost during class.
- Student cheated by signing attendance for their friends.

1.3 Objective and Scope of Study

The main objective of this project is to design a RFID Communication System as a Platform for Student Attendance System. This attendance system must be capable of detecting each student in a lecture hall during class efficiently. Therefore, student attendance can be recorded in a short space of time, making life easy for both students and lecturers. The scope of study will comprise first, **communication system**. This is to understand more on radio frequency, and the interference around. Secondly, **microelectronics** is involved in order to study on the circuit and configurations on the RFID readers, field generators and tags. Lastly, there will be some **programming** works. This is needed to build the database of the system. The project is also feasible since the hardware can be obtained from collaboration with external companies. The software development and the system testing can be done within the time frame allocated, as long as each task is done according to plan.

CHAPTER 2

LITERATURE REVIEW

2.1 RFID General Operation Principle

RFID communication involves a two way radio frequency communication process between transceiver (reader) and transponder (tags) via wireless air interface. The principles of RFID operation can be classified into two forms which are reactive/inductive coupling and coupling by propagation of electromagnetic waves [4].

2.1.1 Inductive Coupling and Load Modulation

In general, *Inductive Coupling* is the transfer of energy from one circuit to another through a shared magnetic field. An electrical current passing through the coil of a primary conductor creates a magnetic field that induces an electrical current in the coil of a secondary conductor exposed to the magnetic field. The coupling between the reader and tags is inductive for low and high frequencies (typically 13.56 Mhz) [5]. In inductive coupling, predominantly data in the communication of tags and readers is carried by magnetic field causing coupling to occurs (between primary and secondary coils) in an air-cored transformer. Electric current is induced in the tag's antenna, which is used to power the integrated circuit and obtain the ID. The data transfer operation between transponder and reader is operated using load modulation. According to *RFID Design Principle by Harvey Lehpamer* [6], in load modulation, the carrier signal is modulated by switching impedance from a matched condition to an unmatched condition to alter the reflection coefficient. Inductive coupling is usually applied in near field communication system.

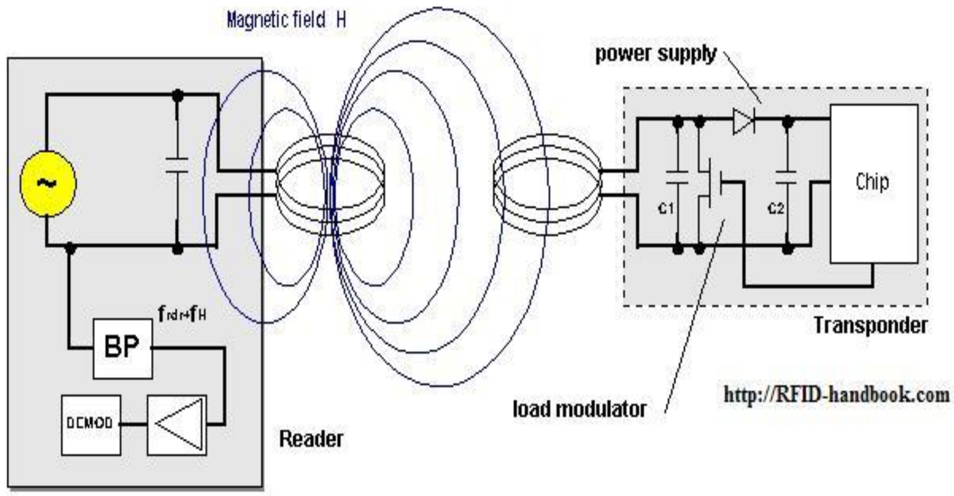


Figure 1 : Load Modulation Circuitry

2.1.2 Propagation Coupling and Backscatter Modulation

Propagation coupling involves ultra-high frequency (UHF). Using electromagnetic field to read and interrogate tags, these system field components dissociates from their source in the reader and propagate into free space[7]. Backscatter modulation is a form of communication method used by transponder to transmit data to transceiver. In other terms, backscattering is also defined as reflected power. This is because, the incident wave radiates by transceiver will be absorbed (part of it), then the rest will be reradiated as a backscatter wave[8]. Propagation modulation and backscatter is usually used in far field communication system.

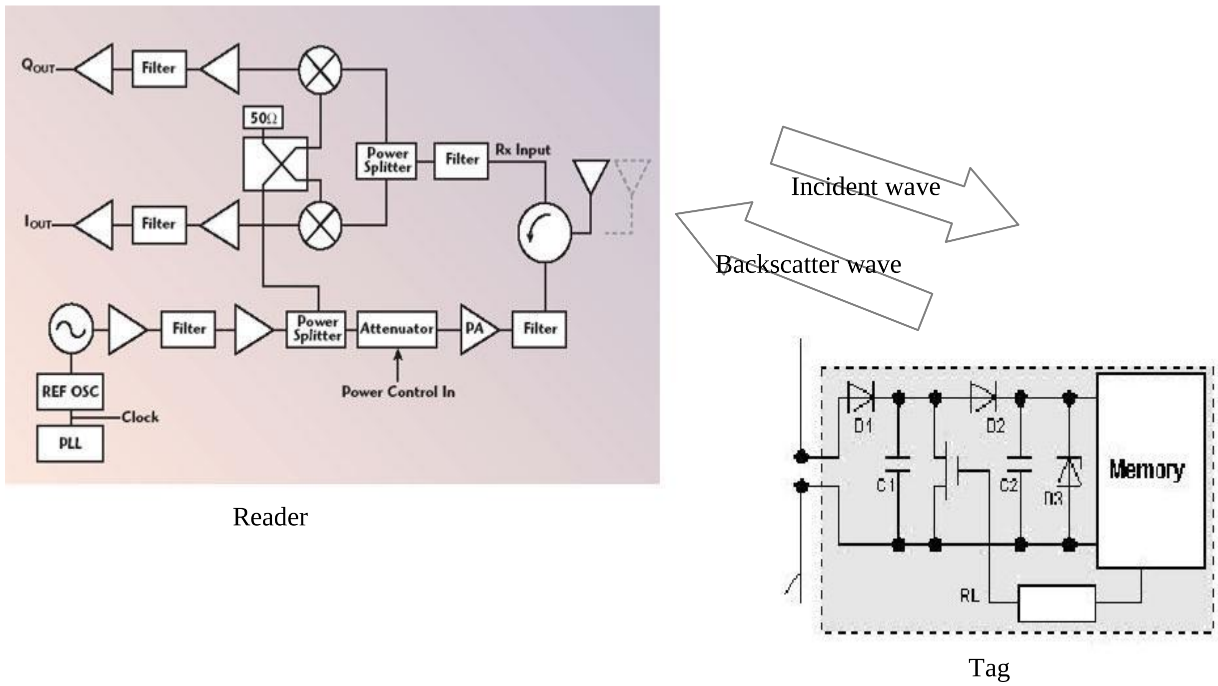


Figure 2 : Backscatter modulation circuitry

2.2 Passive and Active RFID

As discussed earlier, RFID technology is divided into two main categories which are active RFID and passive RFID. Whilst the real difference between both of them is that active RFID tags have an onboard battery which passive one doesn't have, there are many more differences in term of its capability and design.

2.2.1 Passive RFID

Passive tags rely only on the power emitted from the reader for both data processing and transmission. Passive tags may or may not contain an IC, memory block, or application specific IC [9]. Therefore, this kind of transponders must have an RF front end, an analog and digital circuit (depends on the data processing techniques). Because of its limited power supply, it has a limited transmission and limited range of broadcast, which is only a few meters. Similarly, passive tags can only contain a small amount of data, mostly ID's. Since the data processing abilities are limited with memory block of few kilobytes, passive tags are very hard to be programmed. The advantage of passive tag is that it is very cheap and has low maintenance. It is usually applied in environment which movement of the tagged assets is highly consistent, for example in medical, supply chain and inventory tracking. The block diagram below shows the common architecture of passive RFID. The functions of each component are:

1. RF antenna and matching: this component represent the front end of the tag which receives and transmits the radio frequency signal from and back to the RFID reader.
2. Analog circuit: rectifies the induced voltage from the reader's carrier signal in order to support the operation of other components like digital circuit and memory block. Can also have various functions, which depends on the tag's operation principle.
3. Digital part: this component acts like a state machine which usually consists of sequential network.
4. Memory block: this component of tag can comprise of electrically erasable programmable RO memory (EEPROM), static random access memory (SRAM) or ferroelectric random memory (FRAM)

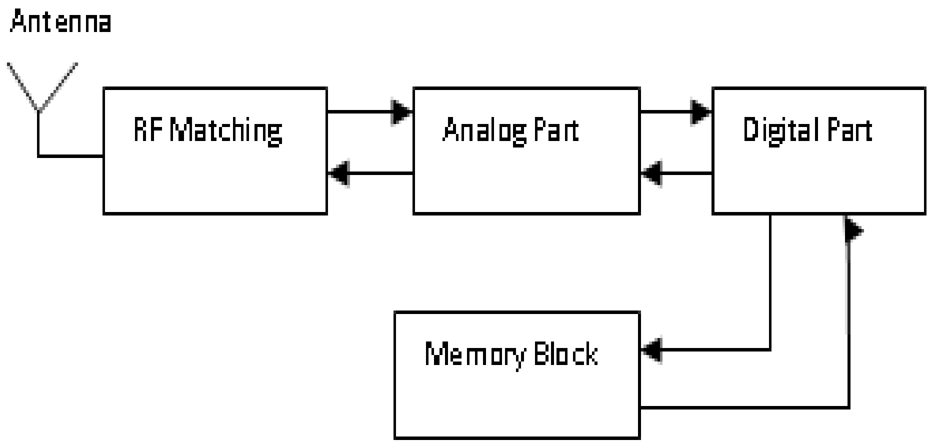


Figure 3: Block Diagram of Passive RFID Tag

2.2.1.1 Passive RFID Applications

In today's world, passive RFID has been used widely in industries. The applications of passive RFID are so wide and it is used more often that active RFID. Some of the applications for passive RFID are:

1. Passports
   - The first E-passport was issued by Malaysia in 1998. In addition to information also contained on the visual data page of the passport, Malaysian e-passports record the travel history (time, date, and place) of entries and exits from the country.
   - Standards for RFID passports are determined by the International Civil Aviation Organization (ICAO)
   - Fingerprints and biometrics data are also included in the passports in some countries.

2. Product tracking
   - As a replacement for barcode tags by Canadian Cattle Identification Agency to identify a bovine's herd of origin and this is used for tracing when a packing plant condemns a carcass.
   - Used in library book or bookstore tracking, jewellery tracking, pallet tracking, building access control, airline baggage tracking, and apparel and pharmaceutical items tracking. High-frequency tags are widely used in identification badges, replacing earlier magnetic stripe cards.

3. Inventory System
   - Provides an accurate knowledge of the current inventory. In an academic study performed at Wal-Mart, RFID reduced Out-of-Stocks by 30 percent for products selling between 0.1 and 15 units a day.
   - In 2004, Boeing integrated the use of RFID technology to help reduce maintenance and inventory costs and was able to save $29000 USD in labour alone after six months of integration.

2.2.2 Active RFID

Active tags have an onboard power supply, which is used to amplify signal from the reader and then transmitting data back to the reader. Because of this, it has longer reading range (up to 100 feet) and doesn’t need the RF carrier signal to energize the data processing section [10]. Active tags can hold more data and have the ability to store data from the reader. The data processing and protocols is controlled by microprocessors. For low power consumptions and longer life, sleep mode is introduced. The tag that doesn’t go through interrogation mode will stay in sleep mode, thus reserving power. Active tags came in bigger size than the passive one and are more expensive. The main advantage is that active tags can be programmed, thus can be used on various items repetitively. It is usually applied to tag variable movement assets, more sophisticated security and sensing. The functions of each component shown in figure below are as follow:

1. HF interface: this component consists of feeding and impedance matching network and modem circuit. It receives and transmits signal from and back to the reader.

2. Power supply: supply power for the operation of the transponder. Usually, a 3V battery is used for this purpose.

3. CPU: this is where operation is processed. It consists of microprocessor, internal register, encryption coprocessor and the microprocessor's internal RAM.

4. ROM: the operating system is implemented in this component. Consists of software drivers and applications that manipulate hardware for authentication, data processing and anti-collision procedures.

5. EEPROM: stored application data which can be changed depending on which type of services the RFID transponders and RFID readers are performing.

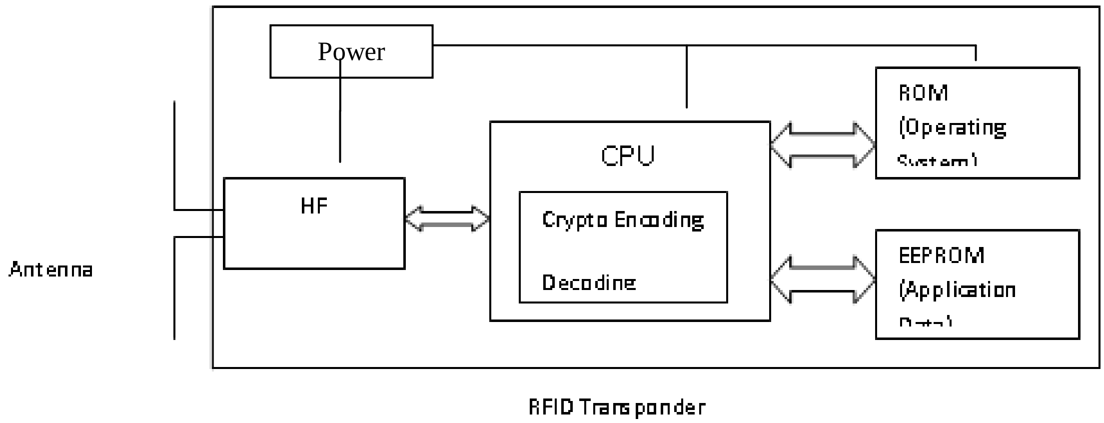


Figure 4: Block Diagram of Active RFID Tag

Sleep mode is introduced in order to optimize the energy usage for active RFID. According to Bjorn Nilsson in *Towards Energy Efficient Protocol for Active RFID* [11], in the optimal protocol there would be no energy loss for the tag to detect an RFID-reader and wake up from sleep-mode. The only energy that this optimized tag uses is when transmitting information to the RFID-reader and receiving a confirmation that the RFID-reader has successfully retrieved the tag information. After the received acknowledge message the tag enters deep sleep- mode. The tag stays in this mode for a predetermined time, specified in the acknowledge message from the RFID-reader. The flow chart below shows the typical state operation for a tag executing the optimal protocol. The power consumption in deep-sleep- and sleep-mode for all described protocols is much less than in the wake-modes where the tag is receiving and transmitting. Of great importance is then, of course, the duty cycle between wake- and sleep-mode.

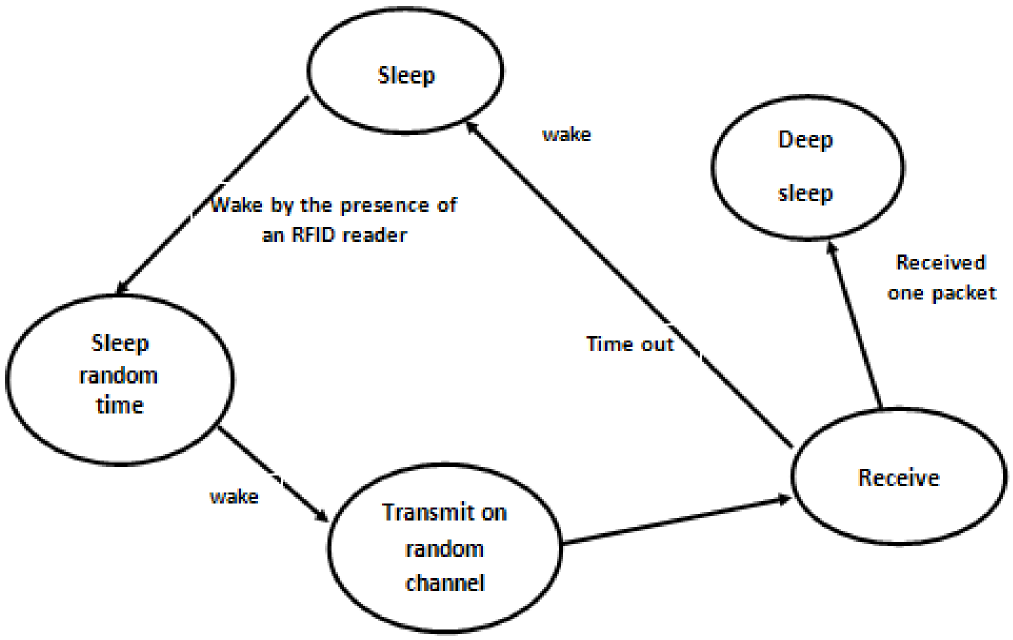


Figure 5: State diagram of a tag executing the optimal protocol

2.2.2.1 Active RFID Applications

Although active RFID are more costly than the passive one, it has its own unique applications in industries which passive RFID can't handle. Some of active RFID applications are:

1. Asset tracking and management
    - Mobile computers, with integrated RFID readers, can deliver a complete set of tools that eliminate paperwork, give positive proof of identification and prove attendance.

- Web based management tools allow organizations to monitor their assets and make management decisions from anywhere in the world, giving real time information of their valuable assets.

2. Headcount system
   - An emergency headcount system to track and identify missing individuals during emergencies in plants. Applied in PASB, Kerteh.
   - Improve old headcount system in many ways, thus reducing casualties and lost of lives.

3. Hospitals
   - Used to track patients, doctors and expensive equipment in hospitals in real time. RFID tags are attached to the ID bracelets of all patients, or just patients requiring special attention, so their location can be tracked continuously
   - Provide an electronic link for wirelessly communicating patient data. An instant assessment of critical equipment and personnel locations is also possible through RFID technology.
   - Facilitate triage processes by restricting access to authorized staff and "approved" patients during medical emergencies, epidemics, terrorist threats, and other times when demands could threaten the hospital's ability to effectively deliver services

4. Parking Lots
   - Creates independent, non-stop systems for security, parking, and access control. RFID technology provides businesses and communities with hands-free control to ensure only authorized vehicles have entry.
   - Each access are recorded in the RFID reader or host computer's database to maintain a history of access activities and administer billing of daily, weekly, or monthly fees

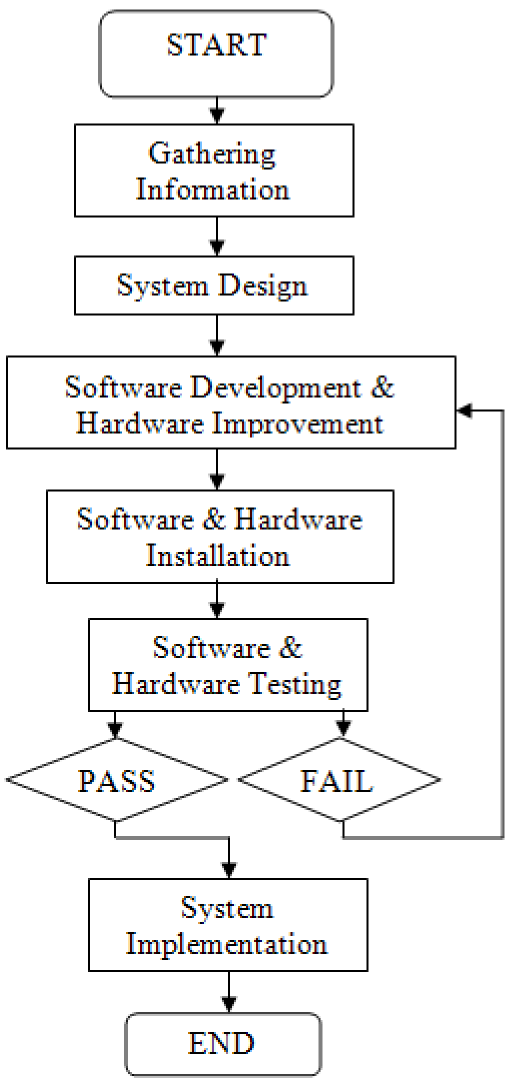
2.3 RFID Security and Privacy

Nowadays, RFID developments have been rapidly made throughout the world by corporate giants and companies. While there are merits to this technology, some section of people believe that the tracking ability of RFID would create an Orwellian world: A place where law enforcement officials and nosy retailers would gain knowledge and information of a person without their knowledge simply by installing RFID readers nearby. This is made possible since many times tags are manufactured by the same manufacturer and identifier, which will allow a third person to establish a connection between a tag and its owner easily [12]. Some of the threats that already been identified are spoofing of identity through impersonation, physical attacks through physical tag manipulations, data tempering through modification of tags data and eavesdropping through intercepting communication. All of this has cause great concern to the developer, thus some security measures and approaches to prevent this risks are being taken. The first one is tag killing command or permanent deactivation. This prevents eavesdropping by making read-out tags from unknown reader impossible. Secondly, a faraday cage or jamming approach is taken. This approach isolates RFID tags from any king of electromagnetic waves by using a metal or foil-lined container. There are many more approaches like the use of blocker tags, encryption, rewriting and re-encrytpion. All of this will ensure the security and privacy of the RFID users are well protected thus eliminating all possible threats.

CHAPTER 3

METHODOLOGY

3.1 Procedure Identification



- First of all, all beneficial information and data are collected from sources in order to help understand more on RFID and its implementation.
- Several designs for the student attendance system are made.
- System software is then developed to match application. Hardware weaknesses are identified and improvement will be made.
- Software and hardware are then installed on a lecture hall, based on the design created.
- Repetitive testing will be made on both hardware and software for each system designed. The most optimized system will then be selected to be implemented.
- The system that is working well is then implemented during lectures and classes, as a pilot project.

Figure 6 : Implementation Procedure

3.1.1 System Design

As discussed earlier, the main objective of this project is to produce an attendance system that is capable of recording student attendance efficiently during a lecture time. The system must be non-time consuming and able to detect the time of attendance of each student.

3.1.1.1 System Final Design

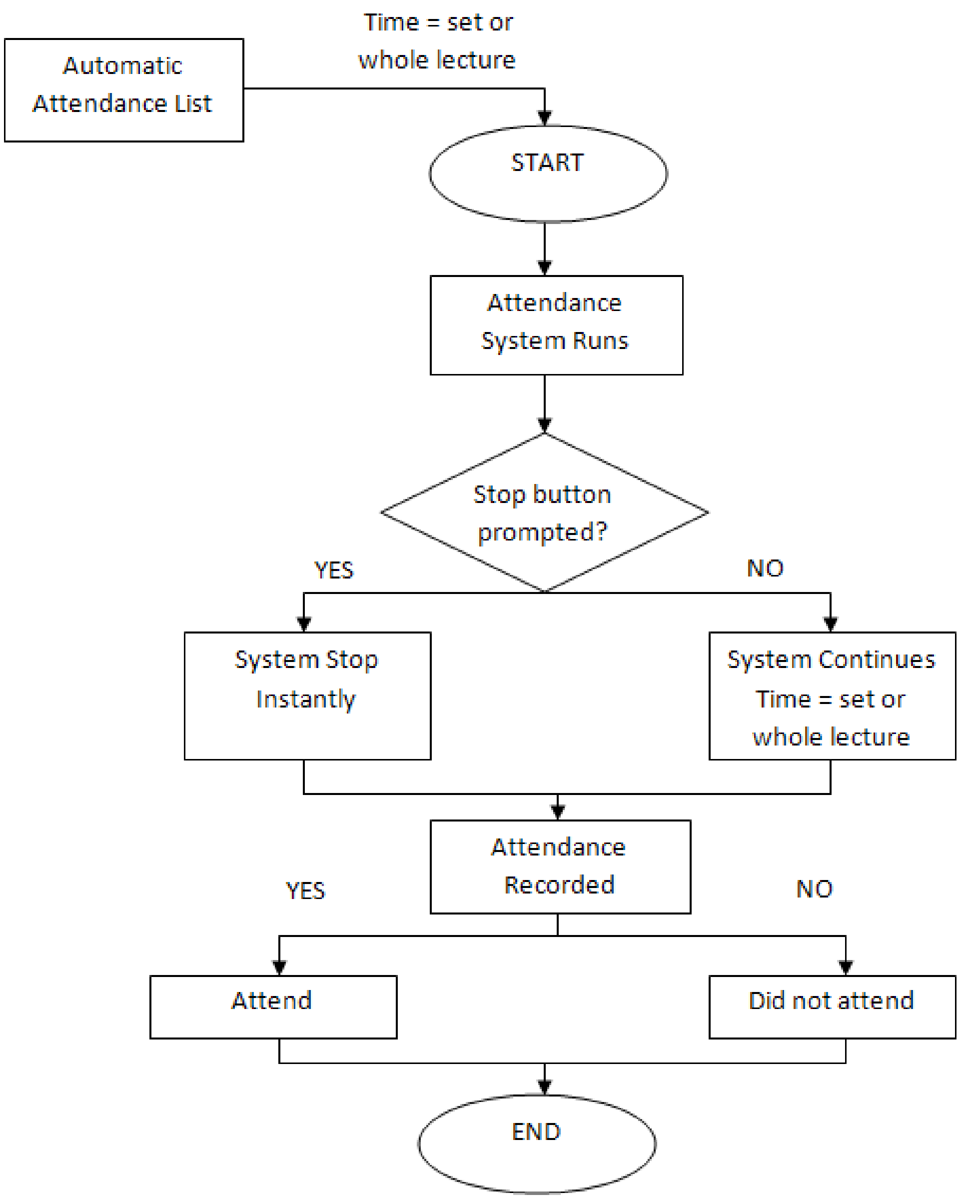


Figure 7: System Final Design

3.2 Tools and Equipment Required

3.2.1 Software Development

For the software development, there is three main software or program that is essential for the student attendance system. They are:

1. Programming Station
2. Student Attendance List Database
3. Attendance Check-In Program

3.2.1.1 Programming Station

The Programming Station software is an interface built by Activewave Inc. This interface allows user to easily configure the reader and tag. There are numerous options that can be configured in programming station. To enable the RFID reader to interact with this software on your computer, Microsoft .NET Framework must be installed beforehand. The basic commands for the reader are:

1. Reader – Reset
   - The Reset command allows user to reset reader. Same as power reset.

2. Reader – Enable
   - The Enable command allows user to enable reader. An enable reader will behave with all feature active.

3. Reader- Disable
   - The Disable command allows user to disable reader. A disable reader will not transmit or receive any RF packet.

4. Reader – Query

- The Query command allows user to request information from reader. Reader doesn’t have to be enabled to perform this command.

5. Reader – Configure

- The Configure command allows user to change configuration information for a specific reader such as reader ID, host ID and reader type.

For the tag commands:

1. Tag – Enable

- The Enable command allows user to enable a tag. An enabled tag will response to all Call commands from reader.

2. Tag – Disable

- The Disable command allows user to disable a tag. Disabled tags will not response to any Call commands from reader.

3. Tag – Configure

- The Configure command will allow user to configure tags in order to meet specific application requirements. The characteristics that can be adjusted are such as Tag ID, Reader ID and Tag Type.

4. Tag – Query

- The Query command allows user to get information about tags and how it is configured. Tag doesn’t have to be enabled to perform this command.

5. Tag – Call

- The Call command allows user to call a tag. Only tag that is enabled will respond to call command.

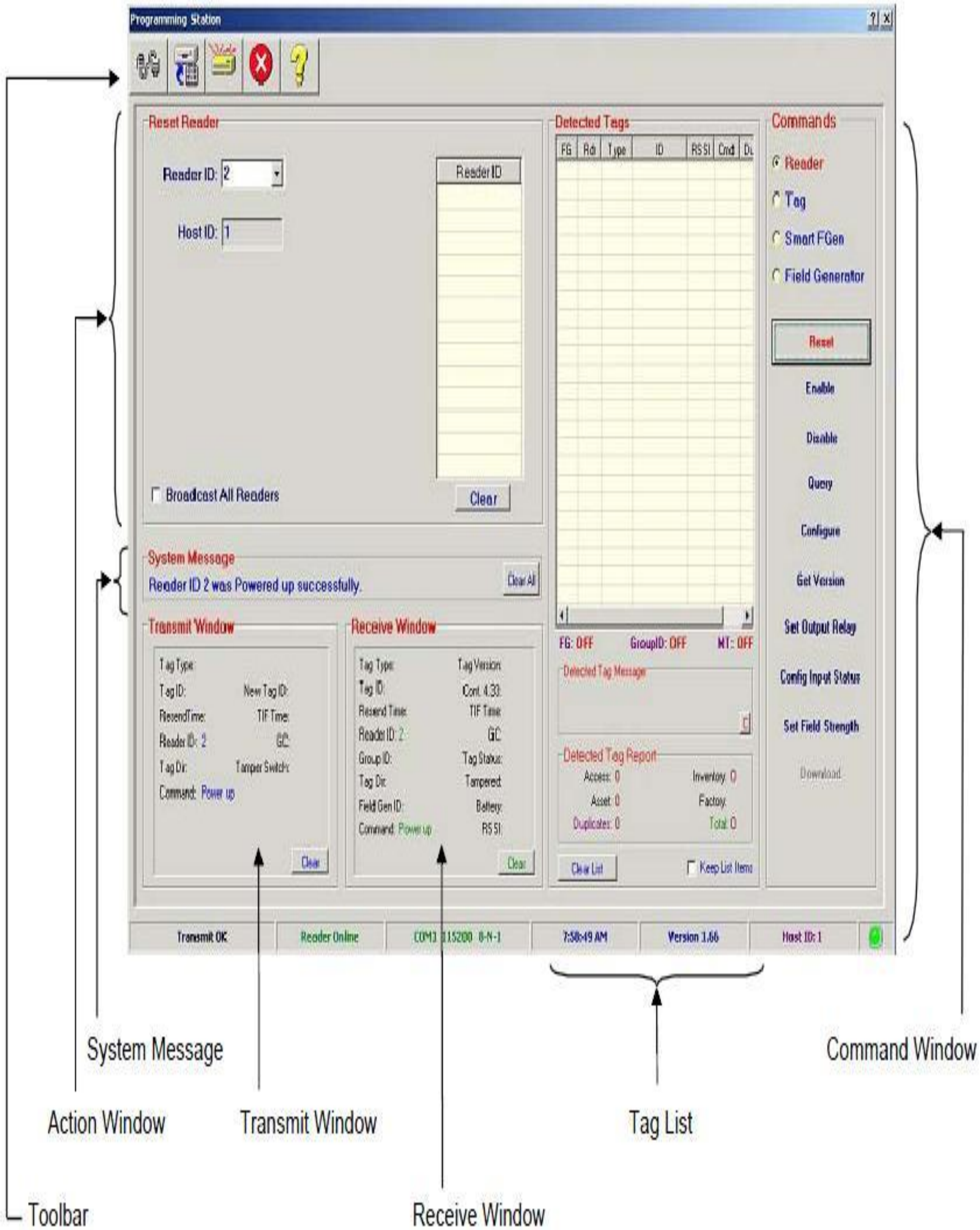


Figure 8: Programming Station Main Screen

3.2.1.2 Student Attendance List Database

The Student Attendance List Database is a database consisting the list of student in a course including each student name, matrix number and student's picture. This database is built using MySQL and XAMPP:

1. MySQL: runs as a server providing multi-user access to a number of databases.

2. XAMPP: an open source cross-platform web server from Apache for creating and manipulating databases in MySQL.

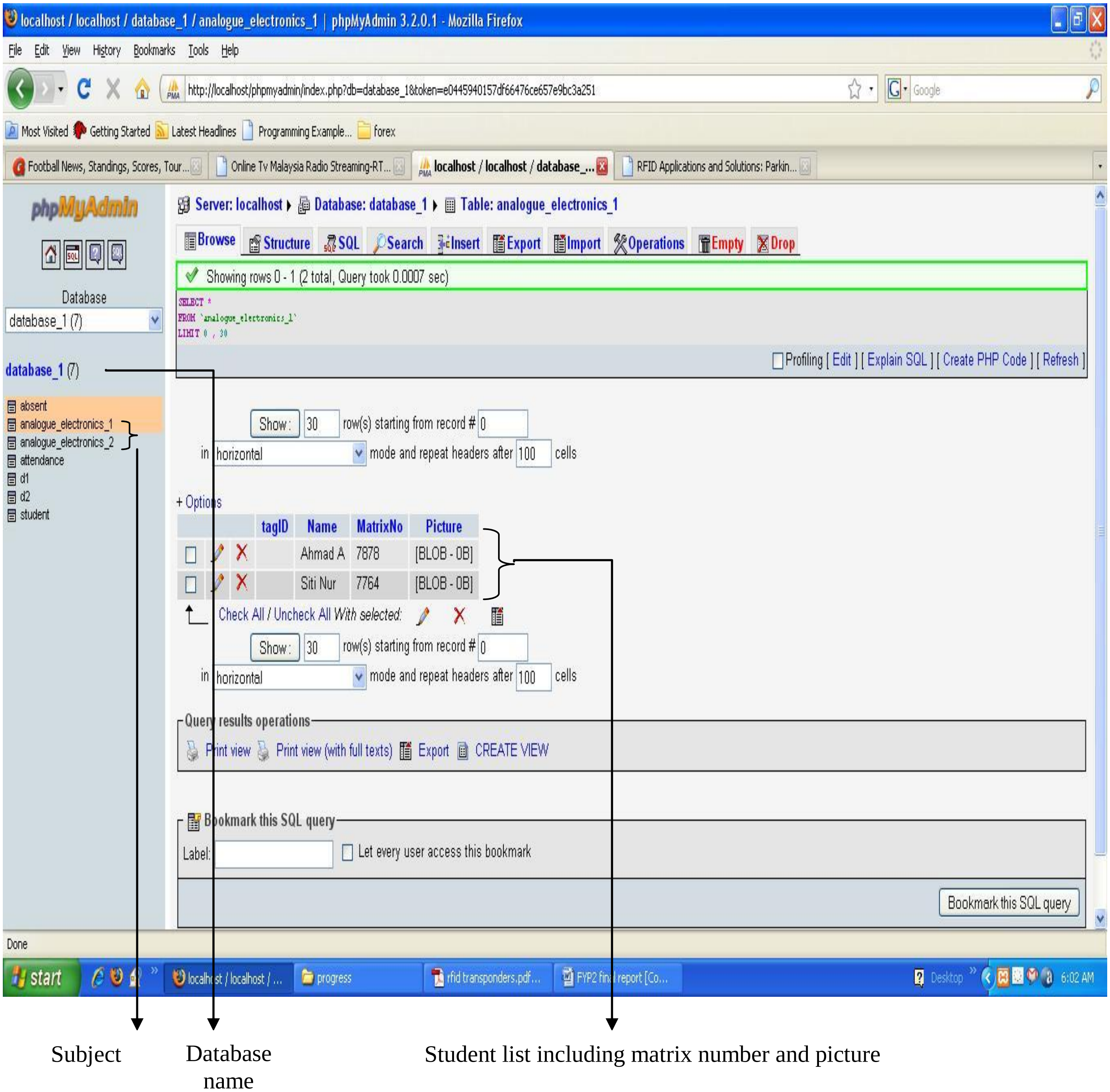


Figure 9: Student Attendance List Database

3.2.1.3 Attendance Check-In Program

The main function of this program is to record the attendance of every student in a particular lecture hall during lectures based on the student attendance list. The interface of this program is built using:

1. Visual Basic: The tool that is used to create any kind of application using any compatible programming language.
2. PHP: The tool that is used to display a form and retrieve information from it and interact with database.

This program built is designed and created to suits the following purpose:

1. Read the student list from the Student Attendance List database.
2. Establish connection and prompt reader to search for student tags.
3. Compare the student list with the tags identified.
4. Compile list of student attending and absent in a lecture.

3.2.2 Hardware Testing

Hardware testing is another crucial part in this project. The test that will be done includes:

1. Tag's battery condition: to make sure conditions of each tag during experiment/test as to optimize detection.

2. Reader and tag detection: tests need to be done for each tag detection with reader to make sure that every tag is working and communicate or responds to reader's call.

3. Reader's detection range: after making sure that every tag is working well, the range of detection is determined. This is done by varying the distance between tag and reader while recording the time taken for the tag to responds to reader's call.

3.3 Complete System (Software and Hardware) Establishment of Student Attendance System

The arrangement or establishment of the hardware and software will be done in the following order:

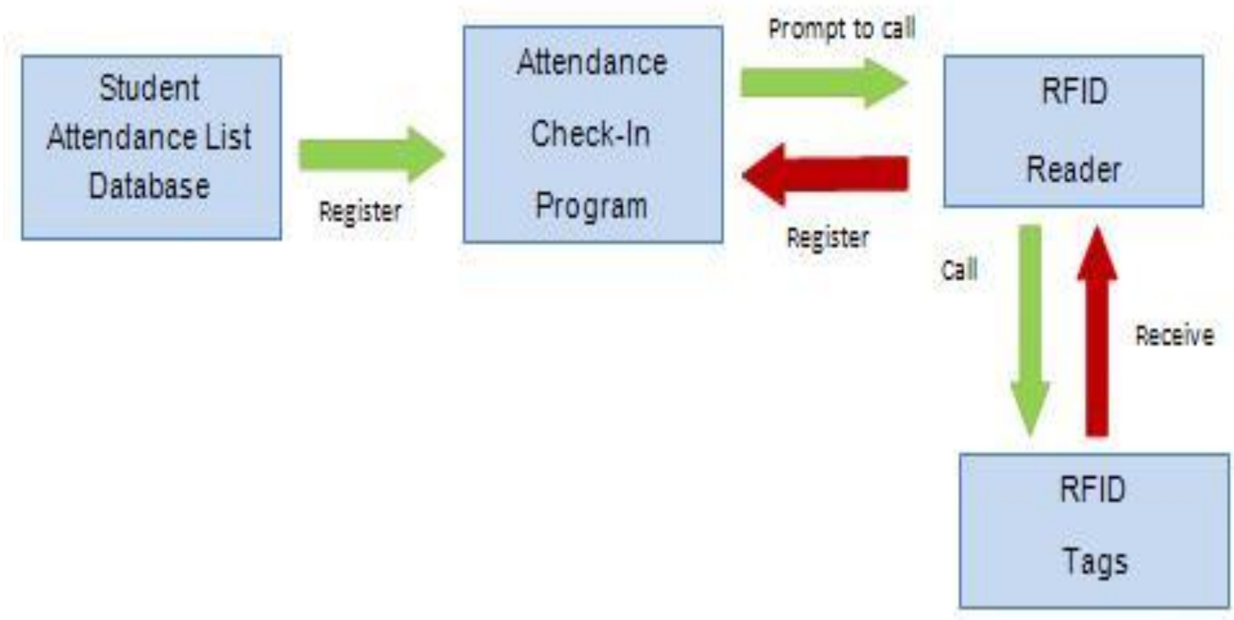


Figure 10: Software and Hardware Establishment

- The Student Attendance List Database will register the student list to the Attendance Check-In Program.
- RFID reader will be prompt by the Attendance Check-In Program to call for the tags present during a particular lecture.
- Once the RFID reader receives responds from the tags, the Attendance Check-In Program will register the tags and compare them to the student list.

3.4 Complete System (Software and Hardware) Testing

The complete system test is the final step in the methodology before the system is completed and proven to be working. This is done after designing the system, software development and hardware testing, which has been completed previously. The main objectives for this test are:

1. To know maximum coverage distance in environment.
2. To know possible interferences
3. System able to run perfectly and able to compile the correct result based on tag’s detection.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 System Final Design

The final design of the system is created in such a way that it meets the objectives of the system which is to give an automatic student attendance system which is controllable, efficient and making life easier for both lecturers and students. As stated in the previous report, it was a result from the combination of both system A and system B which is based on 5 factors:

1. Ease to lecturers
    - One of the main objective of this project is to provide an attendance system that will make lecturers job easier in taking student attendance list. Therefore, it is an important factor so that this objective is achieved.

2. Reliability of system
    - The system designed should provide reliability in terms of detecting each student that attends in a lecture hall during a particular lecture. This is crucial since without a reliable detection, this system won't function properly thus not meeting its objectives.

3. System controllability
    - Controllability of system defines the system easiness to be adjusted or manipulated in case of any changes occurred. For example, if the class is cancelled or the class started late, the system should be able to be adjusted accordingly.

4. Cost
    - The system designed should not exceed the budget limited for both FYP 1 and FYP 2 project which is RM 500.00.
5. Maintenance
    - System maintenance is chosen as a one of a factor because the system needs to be maintained every once in a while for its efficiency.

4.2 Software

As discussed in previous chapter, there are three main softwares or programs that is required in order for the system to work efficiently. The first program which is Programming Station is developed by Activewave Inc. and is already a proven program. The same goes to the second program, the Student Attendance List Database which is an open source program developed by Apache. Therefore, only the Attendance Check-In Program which is self-developed by the author will be discussed in this section.

4.2.1 Attendance Check-In Program

This program is very crucial for the attendance system since the built interface will communicate and react with both the reader and the attendance list database. Therefore, it is considered as the key program that will determine the successfulness of this project. The program interface is as shown by Figure 11. The functions of each numbered icon (refer to Figure 11) are as follows:

1. Choose Subject:
    - To choose the student attendance list from the Student Attendance List Database according to course or subject.

2. Connect:
    - To establish connection between the Attendance Check-In Program and the RFID reader.

3. On/Off:
    - Indication whether connection between the Attendance Check-In Program and the RFID reader is established or not.

4. Start:
    - To prompt the reader to start calling or looking for tags.

5. Stop:
    - To stop the reader from calling or looking for tags.

6. Registered:
    - This is where the student attendance list taken from the database is listed.

7. Present:
    - The student (tags) present during lecture is listed in this column (based on comparison of tags detected and tags registered in attendance list).

8. Printer:
    - To list and print out the list of student attending and absent during a lecture.

9. Elapsed time:
    - Indication of how long the program has been running.

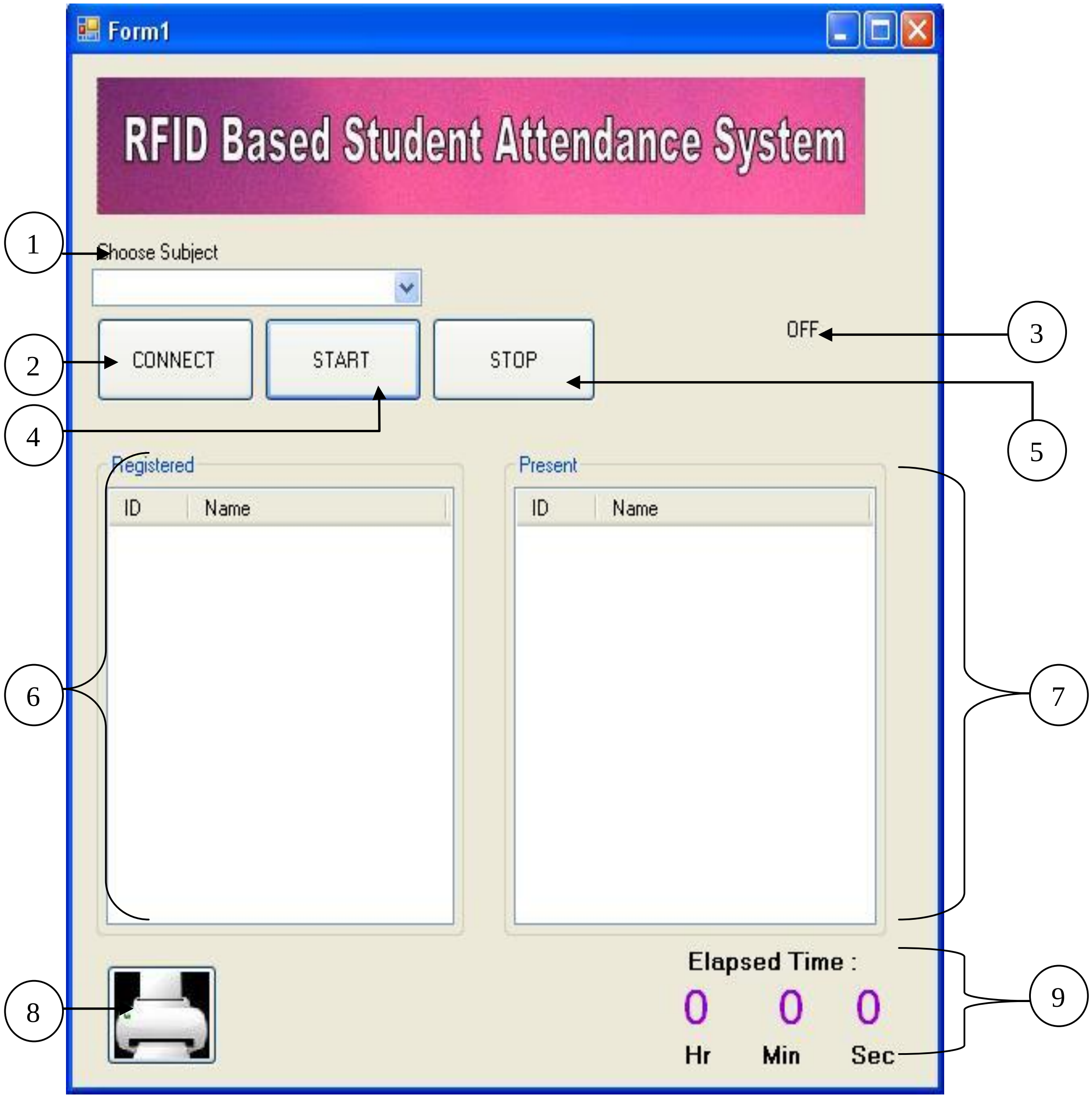


Figure 11: Attendance Check-In Program Interface

The interface built is then tested to fulfil its purpose as described in methodology part. From the test done, it is known that the system have worked successfully and the result is shown in Figure 12 and 13 respectively. Firstly, the interface must be able to read the student list from the database and prompt the reader to search for tags in a class. Each tag detected is then compared to the attendance list. The figure below shows the result of the test.

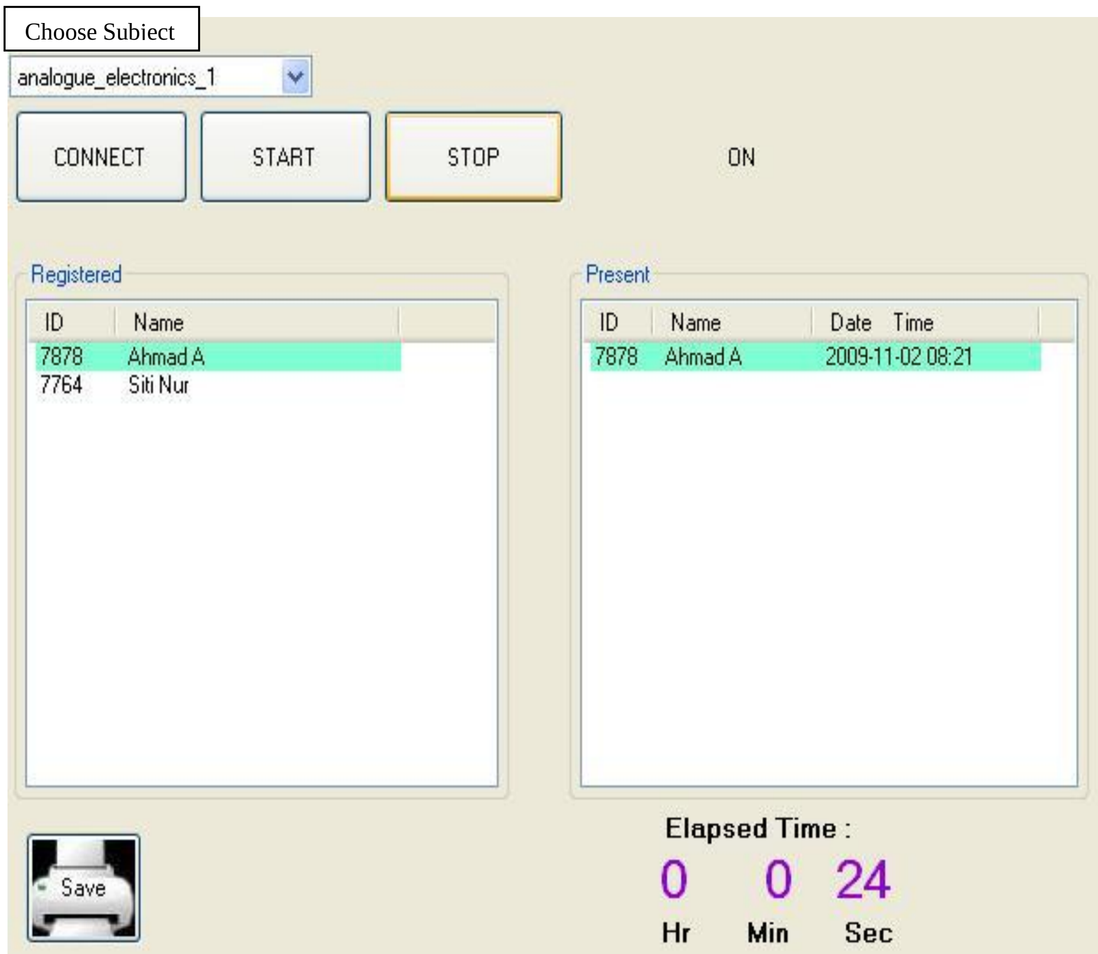
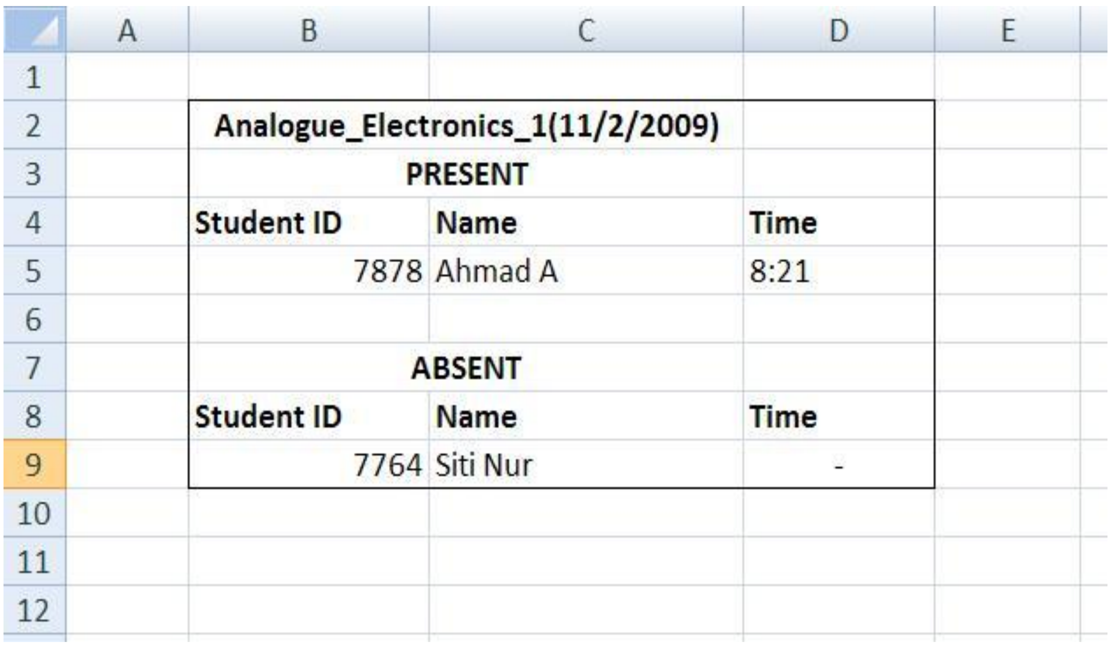


Figure 12: Detection of tag using the Attendance Check-In Program

After detecting the tag, the interface should compile the list of student attending and absent in a class. The result is compiled in a Microsoft Excel document and the directory will be in C:/subjectname_date. The result is shown in figure below.



Analogue_Electronics_1(11/2/2009)			
PRESENT			
Student ID	Name	Time	
7878	Ahmad A	8:21	
ABSENT			
Student ID	Name	Time	
7764	Siti Nur	-	

Figure 13: Compilation of Detection Result in Microsoft Excel

4.3 Hardware

This section will discuss on the hardware testing and the improvements needed. Hardware plays a major role since an optimize hardware will contribute to a very efficient system.

4.3.1 Hardware Testing

This main purpose of the test is to verify the maximum distance that the tag can responds to the reader's call. Firstly, the battery condition of the tag is verified. Although the battery is low, it is considered okay to be used for the test. Secondly, it has been verified that there is an establish connection or communication between the tag and the reader (refer to Figure 14). Both the first and second part is verified using the Query command in Programming Station.

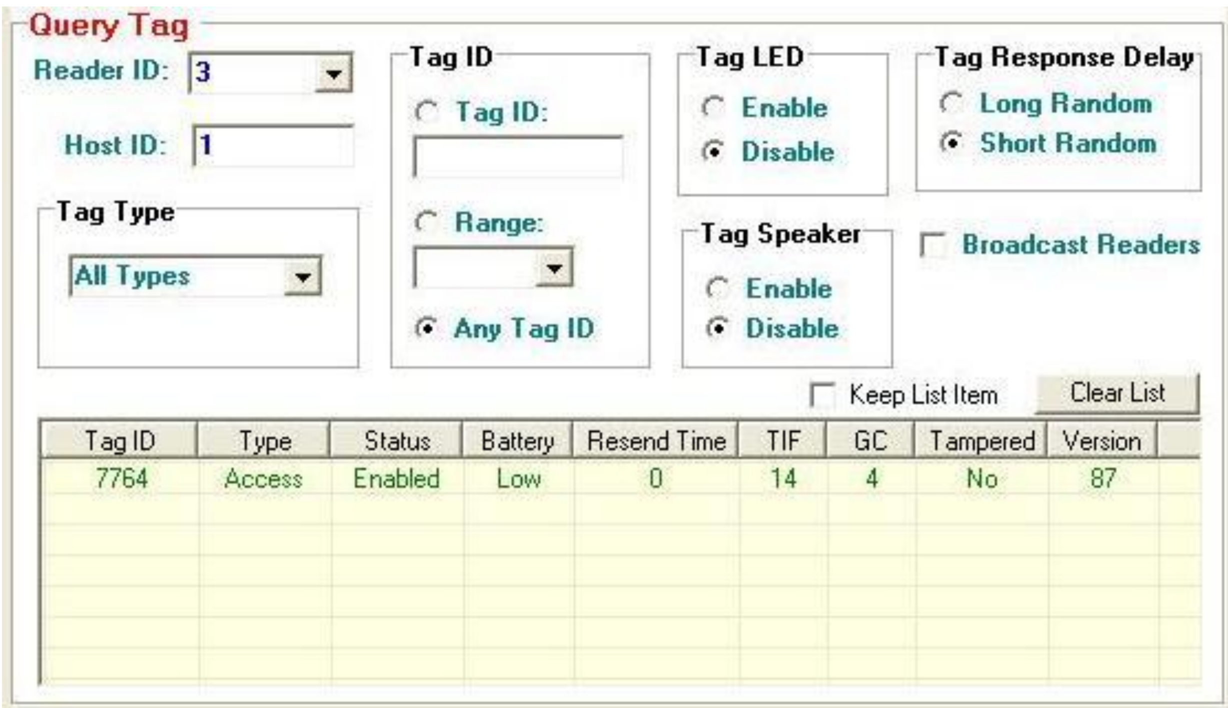


Figure 14: Query of tag for hardware testing

For the third part, the distance between the reader and the tag is varied, and the time taken for the tag to responds to reader’s call is taken. The test is being done in a room (confined space). The result of this experiment is as shown below in Table 1. From this is experiment, it can be concluded that the maximum distance that can be covered by the system is about 20 meters. Despite the result, more tests and experiments should be conducted in order to know the coverage distance of the reader and tag communications in various environments.

Table 1: Hardware testing result

Distance (meter)	Tag’s Detection (Yes/No)	Time Taken (sec)
2.0	Yes	5
4.0	Yes	5
6.0	Yes	6
8.0	Yes	6
10.0	Yes	8
12.0	Yes	10
14.0	Yes	14
16.0	Yes	16
18.0	Yes	20
20.0	Yes	30
22.0	No	-
24.0	No	-

4.3.2 Hardware Improvement

The most common problem with active tags is that the durability of the tag itself, since the battery life is unpredictable and sometimes the power can run out very fast. Therefore, more research needs to be done in order to improve the durability of the tags. There is also a need to optimize the whole system including readers and tags detection capability. To optimize the hardware, the steps below need to be taken:

1. Reader transmission and tag detection optimization
   - Design of lecture hall – study of the design of lecture hall in order to know the geographical position of the seats and the most suitable position to put the reader.
   - Interference caused by other source e.g, RF, EM – it is important to know recognize or identify the other possible source of radio frequency or electromagnetic as to reduce interference.

2. Tag's battery durability
   - Active tag circuitry – a study needs to be done on the circuitry of the tags in order to fully understand the function of each component and improvement can be taken to improve its durability.
   - Battery position in the tag – from the study of the tag circuitry, a closer look on the positioning of the battery can be done in order to improve its durability.
   - Rechargeable tag – the last option that can be done to improve the tag durability.

4.4 Complete System Testing

As discussed earlier, the objective of this testing is to test and make sure the attendance system created is working properly and meet the project's objective. It is also done to know maximum coverage distance of the system and the possible interferences.The test is done in a classroom (Block 22-00-07). First of all, the system is setup (refer to figure 10). The system is run and tag detection is recorded for various distances. Here, radio frequency is assumed to be covering distance in a circular radius [13]. In this test, the author used one RFID reader and two RFID tags.

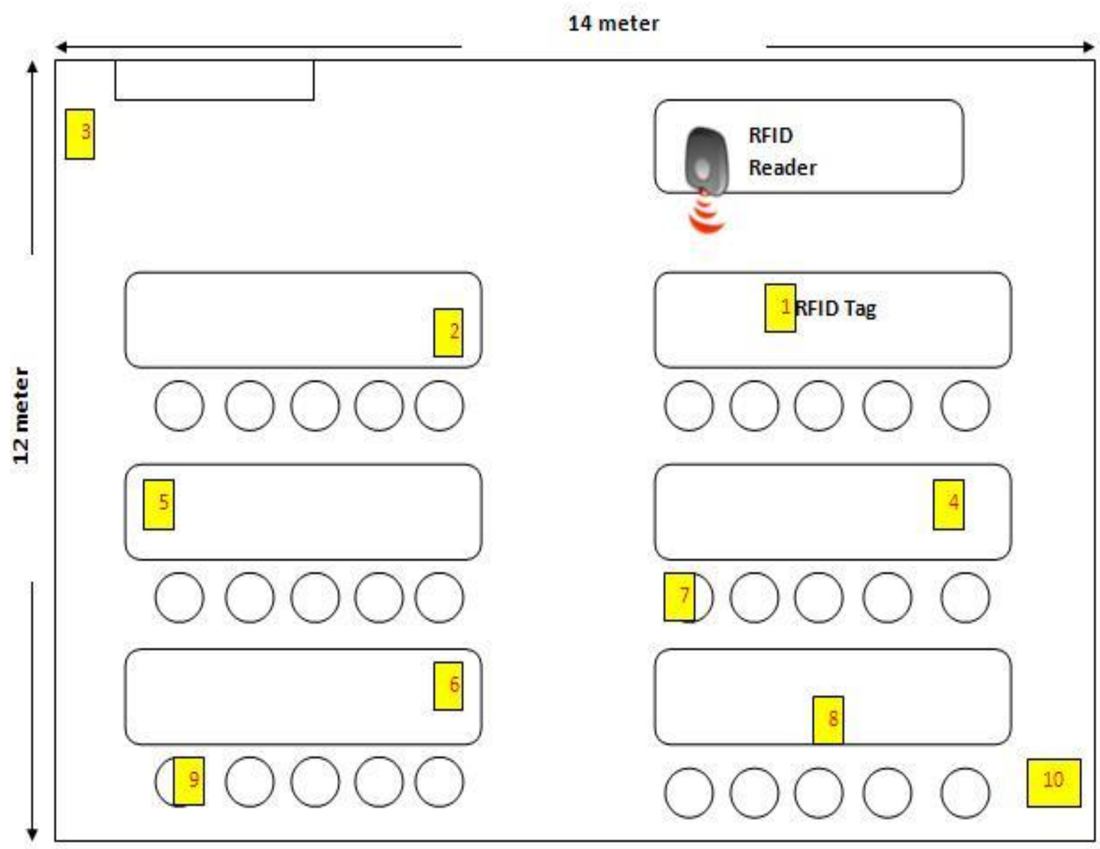


Figure 15: Location of Tags and Reader in Classroom

Figure 15 shows the location reader and various location of tag placed in a classroom. The tag is detected one by one (according to number) from the first location until the tenth location. The tags are also positioned differently which is on the table, on the chair and on the floor. The result of the testing is as follow:

Table 2: Result of Tag's Classroom Detection

Tag No.	Tag's Detection (Yes/No)	Time Taken (sec)
1	Yes	2 s
2	Yes	2 s
3	Yes	2 s
4	Yes	2 s
5	Yes	4 s
6	Yes	4 s
7	Yes	4 s
8	Yes	5 s
9	Yes	5 s
10	Yes	5 s

From the test done, it is shown that it took less than 5 second for tag to be detected in every location in the classroom. A confined space might contribute to this result, since it is known that RFID works efficiently in this condition. Therefore, it can be concluded that the system have been able to detect the tags efficiently in a classroom, thus meeting the project objectives.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

In a nutshell it can be concluded that this project main objective is to create an attendance system for the ease of both students and the university administration. The system created must be able to record the attendance of student in a particular lecture in a short time and most importantly it must be efficient. This is possible by using Radio Frequency Identification technology. RFID allows identification of specific tags through data exchanging with radio frequency being transmitted and received. Scanning can be done at a greater distance and with less effort than barcode scanning, offering great efficiencies [14]. RFID can deliver information in real time according to real life events [15].

The hardware of the system is borrowed from Consurv Technic Sdn. Bhd. The main interface, which is the Student Attendance Check-In Program is built using Visual Basic. The hardware and software are then combined to produce a complete system. Based on result of test that has been made on the attendance system, it can be concluded that the attendance system built are working perfectly, thus meeting the objectives of the project. However, the hardware part of the system still needs improvements mainly in the tag’s battery area. As a conclusion, this project has been successful in meeting its design objective and hopefully, it will become a platform for future attendance system of Universiti Teknologi Petronas.

5.2 Recommendation

This student attendance system project main objective is to be able to record the attendance of each student into classes automatically and in minimum time, making life easier for both student and lecturer. Although this project has been able to run accordingly to its objective, there are still some room of improvements need to be done.

The potential problem of student cheating by bringing tags for their friends is expected. Therefore, to overcome this problem, it is recommended that triangular method is applied by using multiple readers in order to detect students that carried more than one tags. Multiple readers will also improve the coverage detection of the system. However, the main problem of an active RFID technology still lies in the durability of the tag itself. More research and improvements on the power supply of the tag needs to be done in order to create durable tags that can endure harsh usage and have longer lifetime.

REFERENCES

[1] Paolo Magrassi (2001). "A World Of Smart Objects: The Role Of Auto Identification Technologies". http://www.gartner.com., 2006

[2] http://en.wikipedia.org/wiki/RFID

[3] Steven Shepard (2005). RFID: Radio Frequency Identification.

[4] Monahan, Torin (2006). Sureveillance & Security. Technological Politics ans Power in EverydayLife. New York: Routledge

[5] Delia Arnaud-Cormos, Thierry Letertre, Antoine Diet, Alain Azoulay.Laboratoire des Signaux etSystème / Département de Recherche en Électromagnétisme, France.

[6] Harvey Lehpamer (2008). RFID design Principle. Norwood: Artech House Inc.

[7] Michael Buettner, David Wetherall (2008). an Empirical Study of UHF RFID Performance.California

[8] Nowshad Amin, Ng Wen Jye, Masuri Othman (2007). A BPSK Backscatter Modulator Design for RFID Passive Tags. Selangor

[9] Stevan Preradovic, Nemai C. Karmakar, Isaac Balbin (2008). RFID Transponder. MelbourneAustralia

[10] Yanna Hao, Zhiliang Hong (2007). Development of a Low-cost Active RFID Platform. ShanghaiChina

[11] Bjorn Nilsson, Lars Bengtsson, Urban Bilstrup, Per-Arne Wiberg and Bertil Svensson (2006).Towards an Energy Efficient Protocol for Active RFID. Sweden

[12] Lu Yan, Yan Zhang, Laurence T. Yang, Huansheng Ning (2008). The Internet of Things. NewYork: Auerbach Publications

[13] Peter Bernardin, Meng Yee, Thomas Ellis (1998). Cell Radius Inaccuracy: A New Measure of Coverage Reliability, Texas

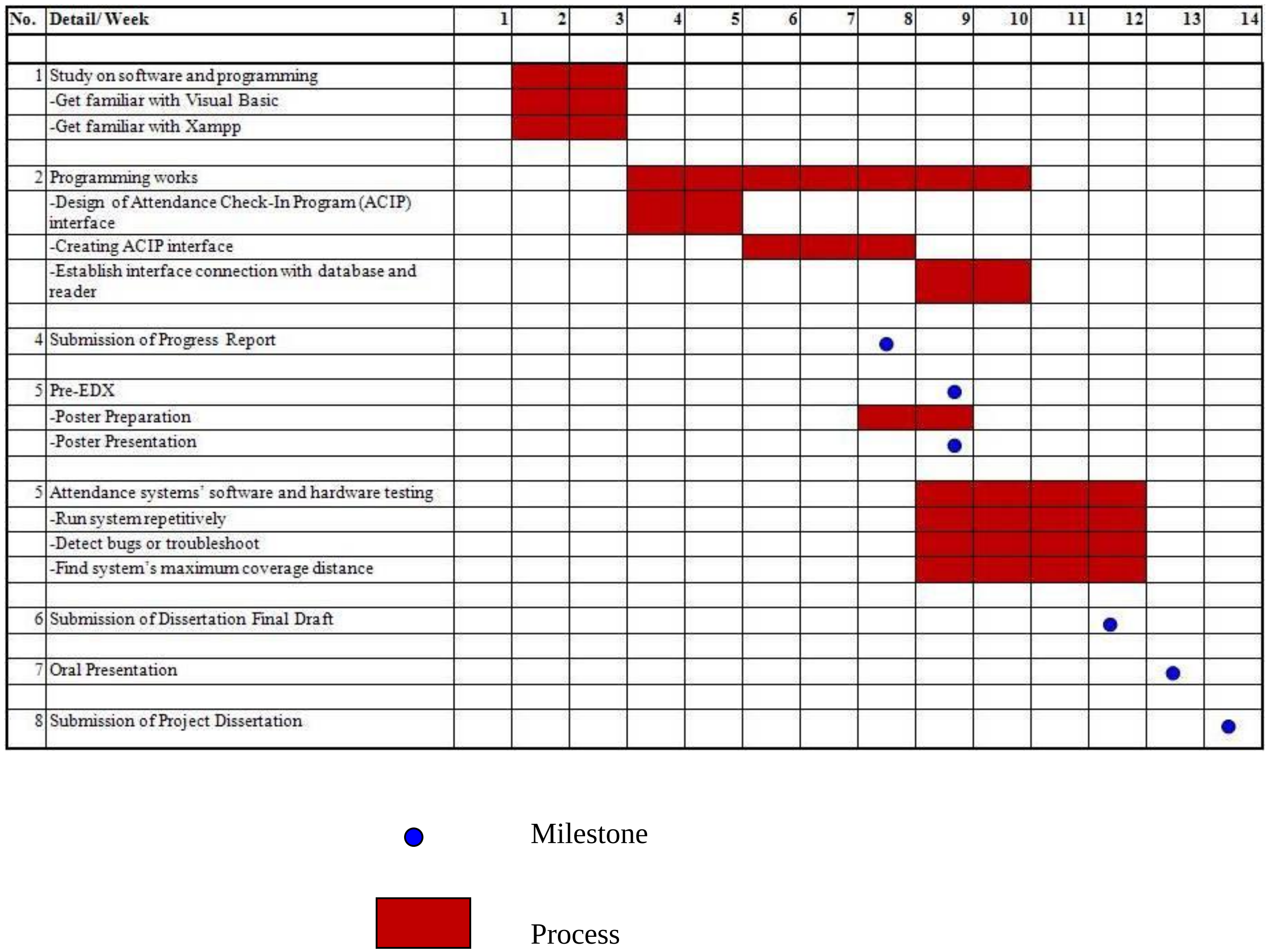
[14] Patrick J. Sweeney (2005). RFID for Dummies. John Wiley & Sons

[15] http://www.rfidjournal.com/article/articleview/4311/1/82/

APPENDICES

APPENDIX A

PROJECT GANNT CHART


No.
Detail/ Week
1
2
3
4
5
6
7
8
9
10
11
12
13
14
1 Study on software and programming
-Get familiar with Visual Basic
-Get familiar with Xampp
2 Programming works
-Design of Attendance Check-In Program (ACIP) interface
-Creating ACIP interface
-Establish interface connection with database and reader
4 Submission of Progress Report
5 Pre-EDX
-Poster Preparation
-Poster Presentation
5 Attendance systems' software and hardware testing
-Run system repetitively
-Detect bugs or troubleshoot
-Find system's maximum coverage distance
6 Submission of Dissertation Final Draft
7 Oral Presentation
8 Submission of Project Dissertation
Milestone
Process

APPENDIX B

FREQUENCY RANGES FOR RFID SYSTEMS

	Frequency ranges for RFID-Systems	
frequency range	comment	allowed fieldstrength / transmission power
< 135 kHz	low frequency, inductive coupling	72 dBµA/m max
3.155 ... 3.400 MHz	EAS	13.5 dBµA/m
6.765 .. 6.795 MHz	medium frequency (ISM), inductive coupling	42 dBµA/m
7.400 .. 8.800 MHz	medium frequency, used for EAS (electronic article surveilance) only	9 dBµA/m
13.553 .. 13.567 MHz	medium frequency (13.56 MHz, ISM), inductive coupling, wide spread usage for contactless smartcards (ISO 14443, MIFARE, LEGIC, ...), smartlabels (ISO 15693, Tag-It, I-Code, ...) and item management (ISO 18000-3).	60(!) dBµA/m
26.957 .. 27.283 MHz	medium frequency (ISM), inductive coupling, special applications only	42 dBµA/m
433 MHz	UHF (ISM), backscatter coupling, rarely used for RFID	10 .. 100 mW
865 .. 868 MHz	UHF (RFID only), Listen before talk	100 mW ERP Europe only
865.6 .. 867.6 MHz	UHF (RFID only), Listen before talk	2W ERP (=3.8W EIRP) Europe only
865.6 .. 868 MHz	UHF (SRD), backscatter coupling, new frequency, systems under developement	500 mW ERP, Europe only
902 .. 928 MHz	UHF (SRD), backscatter coupling, several systems	4 W EIRP - spread spectrum, USA/Canada only
2.400 .. 2.483 GHz	SHF (ISM), backscatter coupling, several systems,	4 W - spread spectrum, USA/Canada only
2.446 .. 2.454 GHz	SHF (RFID and AVI (automatic vehicle identification))	0.5 W EIRP outdoor 4 W EIRP, indoor
5.725 .. 5.875 GHz	SHF (ISM), backscatter coupling, rarely used for RFID	4 W USA/Canada, 500 mW Europe

APPENDIX C

ACTIVEWAVE’S STANDARD READER SPECIFICATION

Functionality	Reads and writes RFID tags	
Multi-Tag Read Capability	Yes	
Transmit Frequency to Tag	433 MHz	
Receive Frequency from Tag	916 MHz, 927 MHz, or 868 MHz	
Range	30m (100 feet) to tag	
	85m (280 feet) from tag	
Host Communications	RS232	9600 - 115200 Baud
	Ethernet	10/100 Mbps
	WLAN (optional)	2.4 GHz, 5.2 GHz
Power	12Vdc, 1.5A	
Dimensions	without antennas	150 mm x 85 mm x 27 mm (5.9 in x 3.3 in x 1.1 in)
	with antennas	150 mm x 85 mm x 167 mm (5.9 in x 3.3 in x 6.6 in)
Weight	680 grams (1.5 lbs)	
Case Material	Impact resistant polystyrene with UL94-HB flammability rating	
Temperature	Operating	-35C to +50C (-31F to +122F)
	Storage	-40C to +85C (-40F to +185F)
Indicators	RF LED	On while receiving packet from tag.
	HOST LED	On while sending validated tag packet to Host.
	ACCESS LED	On while transmitting packet to tag.
	POWER LED	On when Reader is powered.
Connectors	Power	12Vdc, 1.5A
	Ethernet	RJ-45 female to Host
	MotionDetector	RJ-11 male
	Host Comm.	Same RJ-11 male to Host (DB9 female to Host optional)
	Input	Two contact sense inputs
	Output	Two isolated dry contact relay outputs

APPENDIX D

ACTIVEWAVE’S CARD TAG SPECIFICATION

User Memory	0 - 256 Kbits	
Multi-Tag Read Capability	Yes	
Transmit Frequency	916 MHz, 927 MHz, or 868 MHz	
Receive Frequency	433 MHz	
Read range	Receive	85m (280 feet) *max with extended range antenna
	Transmit	152m (500 feet) *max with extended range antenna
Power	3V Lithium-ion watch battery	
Battery Life	1 - 3 years depending on use (tag has low battery detection)	
Dimensions	85.0 mm x 54.3 mm x 5.6 mm (3.3 in x 2.1 in x 0.2 in)	
Weight	23 grams (0.8 oz)	
Case Material	ABS (Acrylonitrile Butadiene Styrene)	
Temperature	Operating	-35C to +50C (-31F to +122F)
	Storage	-40C to +85C (-40F to +185F)
Options	Memory	0 - 128Kbit memory sizes available in 2^x increments