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Development of RFID and mobile application based attendance management system: a case study of secondary schools in Tanzania

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DEVELOPMENT OF RFID AND MOBILE APPLICATION BASED ATTENDANCE MANAGEMENT SYSTEM: A CASE STUDY OF SECONDARY SCHOOLS IN TANZANIA

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A Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree of Master's in Information and Communication Science and Engineering of the Nelson Mandela African Institution of Science and Technology

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ABSTRACT

In recent years, the development of different technologies has opened new possibilities for different activities to be accomplished easily in a smooth way. The rapid development in mobile phone technologies especially mobile phone based information system has contributed much in facilitating automation of activities in different sectors like Education, Agriculture, Health, etc. Mobile phone technology has continued to evolve in terms of computation power, speed, memory capacity and screen size. Many mobile applications for different activities especially on the Android platform as the free software are being developed.

Another technology which has shown tremendous development and application in the recent years is the Radio Frequency Identification. Radio Frequency Identification (RFID) is the wireless use of electromagnetic fields to transfer data, for the purposes of automatically identifying and tracking tags attached to objects(wikipedia). It has been around for many decades but now days it is becoming the more relied technology in the area of tracking objects due to its low cost and accuracy as compared to other auto-ID technologies like biometric systems and barcodes. The most interesting and widely used applications of RFID include those for supply chain management, security, and the tracking of important objects and personnel(Weinstein, 2005).

Based on the suitability, development and applicability of both RFID and mobile phone technologies, this research analyze and develop the low cost RFID and mobile application based attendance management system which is proposed to be used in ordinary level schools to efficiently manage student attendances. The system is proposed and designed in consideration of financial capacity and environmental challenges of educational institutions especially ordinary level schools in Tanzania.

Currently, the attendance management of both students and employees is being done manually using attendance registers. Employees' signs the attendance register book in the morning using attendance register books where for students, the responsible personnel call a roll call every day using attendance register books. Manual way of taking students and employees' attendance using attendance registers and class journals is inefficient, time consuming and error prone. This system aims to replace the manual paper based system.

DECLARATION

I, **Joseph Sospeter** do hereby declare to the Senate of Nelson Mandela African Institution of Science and Technology that this dissertation is my own original work and that it has neither been submitted nor being concurrently submitted for degree award in any other institution.

JOSEPH SOSPETER _____ 08/04/2016

Name and signature of candidate **Date**

The above declaration is confirmed

Shubi Kaijage _____ **05th April 2016**

Name and signature of supervisor **Date**

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CERTIFICATION

The undersigned certify that has read and found the dissertation acceptable by the Nelson Mandela African Institution of Science and Technology.

Shubi Kaijage **05th April 2016**

Name and signature of supervisor **Date**

ACKNOWLEDGEMENT

I Thank God the creator of heaven and earth for giving us strength, health and enable us to complete this work. If it had not been the Lord who was on our side, now may Israel say(David).

I wish to express my deep gratitude to my research supervisor Dr Shubi Kaijage for being available to support and provide assistance to complete the research in the best possible way. He has been a source of inspiration, motivation and courage for me all the time.

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I thank specifically my fellow class members for their moral and mental support in all of time of my presence here at NM-AIST.

Finally, my special thanks goes to my wife Grace Joseph, my first born Glory Joseph and the second born Joshua Joseph for their mental and spiritual support for all the time when I was away from them. This research work is dedicated to them.

DEDICATION

I dedicate this dissertation to my wife Grace Joseph, Our children Glory Joseph and Joshua Joseph. Also I extends my dedication to my late parents Sospeter Salawa (Father) and Mary Masalu (Mother), may their soul rest in peace.

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LIST OF ABBREVIATIONS

AMS	Attendance Management System
ARAT	Active Reader Active Tag.
ARPT	Active Reader Passive Tag.
BAP	Battery Assisted Passive tag.
DVM	Dalvik Virtual Machine.
EFA	Education for All.
ELF	Extremely Low Frequency.
EM	Electromagnetic.
EMF	Electromagnetic Fields
EPC	Electronic Product Code.
ERD	Entity Relationship Diagram
ETSI	European Telecommunications Standard Institute.
FCC	Federal Communications Commission
GPA	Grade Point Average
GPRS	General Packet Radio Service.
ICNIRP	International Commission on Non-Ionizing Radiation Protection
ID	Identity
IEEE	Institute of Electrical and Electronics Engineers.
IP	Internet Protocol
IR	Infra-red.

IRPA	International Radiation Protection Association
LAN	Local Area Network
LAN	Local Area Network.
MOE	Ministry of Education.
MPE	Maximum Permissible Exposure.
NIR	Non-Ionizing Radiation
OLS	Ordinary Least Squares.
OS	Operating System.
PRAT	Passive Reader Active Tag.
RF	Radio Frequency.
RFID	Radio Frequency Identification.
RMAMS	RFID and Mobile Application based Attendance Management System
SAR	Specific Absorption Rate.
SDLC	Software Development Life Cycle.
SMS	Short Message Service
TCP	Transmission Control Protocol
TCRA	Tanzania Communications Regulatory Authority.
UHF	Ultra High Frequency.
UV	Ultra-Violet.
VLF	Very Low Frequency.

CHAPTER ONE

INTRODUCTION

This chapter describes the general introduction of the study. It mainly focuses on the background information of the study, Research problem statement and justification, main and specific objectives of the study, research questions, significance of the study and dissertation organization.

1.1.BACKGROUND INFORMATION

Attendance management is one of the management core functions. It is the process of checking whether the personnel are at the required place on time. Attendance management is targeted to full utilization of the available organization human resources in order maximize production. Attendance management is aimed at developing a willingness on the part of all employees to attend work regularly, and to assist them in motivating their co-workers to attend work regularly(Benefits, 1987). In respect to education system, student attendance has a significant correlation with academics performance. Students who are absent from school receive fewer hours of instruction; they often leave education early and are more likely to become long term unemployed, homeless, caught in the poverty trap, dependent on welfare and involved in the justice system(Jones, 2006). For many years, the attendance management of both students and employees is being done manually using attendance registers. Employees' signs the attendance register book in the morning using attendance register books where for students, the responsible personnel call a roll call every day using attendance register books. Figure 1 show the sample of the traditional teacher's attendance register which is currently used in many of the secondary schools in Tanzania.

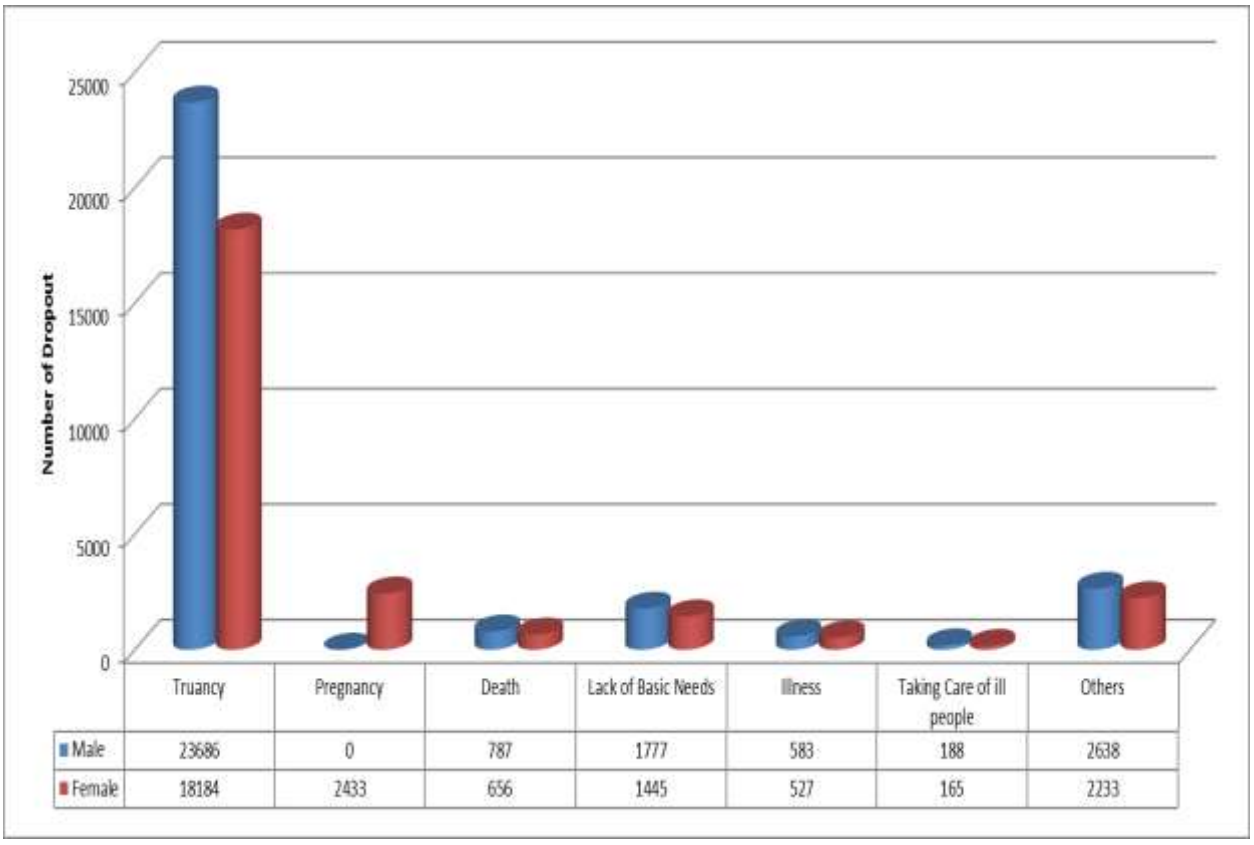
Figure 1: Sample of paper based student attendance management system.

Due to the inefficient, time consuming and error prone of the paper based attendance management system, there has been more efforts to automate the process of attendance management. But many of the efforts focus on employee attendances in different organizations and institutions. Today, innovations in information technology and electronic system are having wide-ranging effects across numerous domains of society, business transactions, and affordability of and access to information. Computers and other technologies allow for faster processing of data, easier retrieval of information. The development of technology has opened new opportunities in automation. Many of the activities which were not possible to automate due technical and cost limitations are now possible. This research focuses on the combined use of Radio frequency Identification and mobile application to manage student attendance at ordinary level schools. Radio Frequency Identification (RFID) is the wireless use of electromagnetic fields to transfer data, for the purposes of automatically identifying and tracking tags attached to objects(wikipedia). It has been around for many decades but now days it is becoming the more relied technology in the area of tracking objects due to its low cost and accuracy as compared to other auto-ID

technologies like biometric systems and barcodes. A mobile application is a computer program designed to run on Smartphone, tablet computers and other mobile devices(Wikipedia).

1.2.RESEARCH PROBLEM STATEMENT AND JUSTIFICATION

Truancy is the major problem in both primary and secondary schools in Tanzania. As per March 2014 records, Tanzania has a total of 16,609 primary schools and 4,573 secondary schools(Kawambwa, 2014). In 2013, for instance, 1,804,056 students were enrolled in secondary schools. This makes an average of 400 students per each secondary school. However, there is a significant drop out of students from school due to different reasons main being truancy. Figure 2 shows the Dropout of male and female students in Government and non-Government Primary Schools in the year 2012.



	Truancy	Pregnancy	Death	Lack of Basic Needs	Illness	Taking Care of ill people	Others
Male	23686	0	787	1777	583	188	2638
Female	18184	2433	656	1445	527	165	2233

Figure 2: Dropout in Government and non-Government Primary Schools by reason and sex, 2012 (Source: Ministry of Education statistics 2012)

Figure 3 below show Percentage Dropout in Government and Non-Government Secondary Schools by 2012.

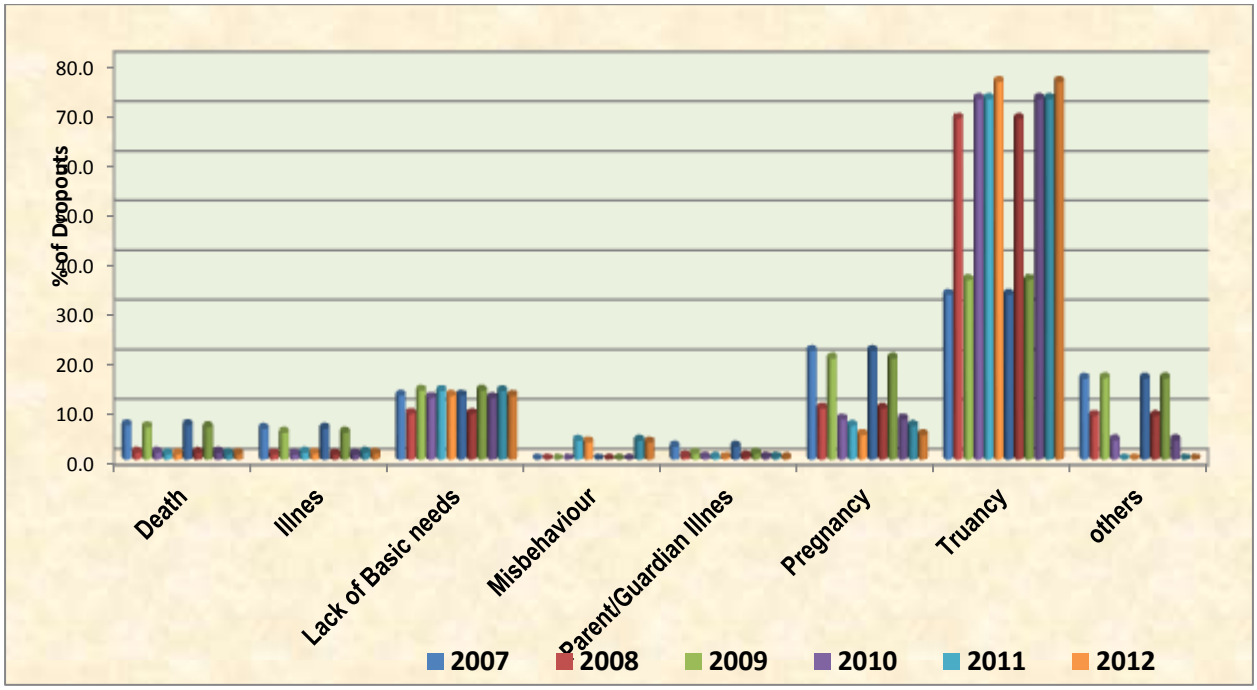


Figure 3: Percentage Dropout in Government and Non-Government Secondary Schools by 2012 (Source: Ministry of Education Statistics)

From figures 2 and 3, it can be easily observed that truancy is the major problem in both primary and secondary schools in our country. Many studies have indicated that the academic performance of a student is the function of his/her class attendance. A study by Durden and Ellis (1995) investigated the link between overall course grade and self-reported attendance levels in a sample of 346 principles of economics students over three semesters. Their results, based on Ordinary Least Square (OLS)controlling for ability and motivational factors (GPA (Grade Point Average), college-entrance exam scores, having had a course in calculus) indicated that attendance matters for academic performance(Aden, Yahye, & Dahir, 2013). A research on School Attendance and Student Achievement of Ohio Schools done by Dr. Douglas E. Roby suggests that, there is a statistically significant relationship between student attendance and student achievement in Ohio at the fourth, sixth, ninth, and twelfth grade levels. The correlation of student attendance and student achievement is moderate to strong, with the most significant relationship occurring at the ninth grade level, when comparing attendance and achievement rates(Roby, 2004). Also a report on absenteeism in the national's school by Robert Balfanz and Vaughan (2012) testifies that, students need to attend school

daily to succeed and that being in school leads to succeeding in school(Vaughan, 2012). Based on these findings, in order to boost student's academic performance, it is required to find the good means of managing student attendance and fighting against truancy and absenteeism in ordinary schools. The proposed attendance management system based on RFID and Mobile Application will ensure that the attendance of each student is recorded daily and any truancy case is being reported to the respective person in charge for further actions.

1.3.OBJECTIVES

1.3.1. Main Objective

To develop a Radio Frequency Identification (RFID) and Mobile application based Attendance Management System which can be easily adopted in ordinary level schools in Tanzania**.**

1.3.2. Specific Objectives

i. To review the suitability of RFID and other technological systems currently been used in student attendance management.
ii. To develop a Database and mobile application for student's class attendance records storage and manipulations.
iii. To integrate the RFID and mobile application to the backend database for easily recording, managing and communicating student attendance information.

1.4.RESEARCH QUESTIONS

i. How RFID technology can be used to achieve better student attendance management than the available systems for student attendance management?
ii. What are the features required for database and mobile application in recording and managing student attendances?
iii. How the RFID system and mobile application can with the backend database to record, retrieve and communicate attendance information?

1.5.Significance of the research

Student attendance has direct relationship with student academic performances. A study by Madan Mohan Laddunuri on the Status of School Education in Present Tanzania and

Emerging issues revealed that for the past five years, the status of education had not been stable which had led to unsatisfactory examination results in summative evaluation. The pass percentage of the students declined from 82.3 % to 50.74% since 2006 to 2010(Laddunuri, 2012). Another study by Tiberius P. Mlowosa, Natalia Kalimang'asi and Bundala Dodo Mathias revealed that poor academic performance is a problem and it has been growing. 51.7% of the respondents has agreed that truancy is a latent base for poor academic performance among secondary school students in Kigamboni ward.(Mlowosa, Kalimang'asi, & Mathias). Tanzania is among the countries which signed the commitment to implement Education for All (EFA) goals. The purpose of EFA is defined as meeting the basic learning needs by 2015 for every person (Child, youth and adults) to benefit from educational opportunities(MOE, 2010) and drop out has emerged as a major threat to achieving Education for All (EFA) goals. This research is of significance important in fighting against truancy and improving student's academic performance for ordinary schools in Tanzania. The study will contribute to the improvement of student attendance management system in ordinary level schools which is currently not efficient. Using the proposed combination of RFID and mobile application systems, attendance supervisors will be able to record and process student attendances easily.

1.6.DISSERTATION ORGANIZATION

The dissertation consists of six chapters. Chapter one covers general introduction, problem statement, research objectives, research questions and the significance of the study. Chapter two contains a paper titled "A Review on Development of RFID and Mobile Application Based Attendance Management System" which reviewed the related work conducted by other researchers. Chapter three contains a paper titled "Requirement analysis and design of RFID and mobile application based attendance management system, a case study of ordinary level schools" which clearly defines system requirement and design. Chapter four consists of a paper titled "Human health evaluation on Radio Frequency identification application for student's attendance management system "which clear show the compliance of RFID radiations with the ICNIRP standards. Chapter four contains a paper titled "Radio Frequency identification and mobile application integrated attendance management system". Chapter six being the last chapter presents the conclusion and recommendation of the study.

CHAPTER TWO

A REVIEW ON DEVELOPMENT OF RFID AND MOBILE APPLICATION BASED ATTENDANCE MANAGEMENT SYSTEM[1]

ABSTRACT

Mobile application development and RFID technologies are becoming popular in different applications. Mobile phone technology has continued to evolve in terms of computation power, speed, memory capacity and screen size. Many mobile applications for different activities especially on the Android platform as the free software are being developed. On the other hand, RFID technology is becoming the popular technology in tracking and detecting objects for the purpose of locating and ensuring security of movable equipments. This paper discusses different systems proposed for attendance management using different technologies. Based on this discussion a new approach for attendance management is proposed to be used specifically for ordinary level schools.

2.1.INTRODUCTION

Attendance management of students or employees is one of the functions performed by the School or Organization management. In respect to Education, students and teachers class attendance is the key factor for academic performance of students. Successful schools begin by make sure their students come to school regularly. The consequences of low class attendance for a student are serious and not just affect the student who miss school but also affect the community(Apandi, 2012). Academic performance of students in ordinary level schools in Tanzania is highly affected by persistent truancy of students. Figure 4 shows that, about 80% of students' dropout in schools are due to Truancy.

[1]Paper 1: Joseph Sospeter, and Shubi Kaijage **"**A review on Development of RFID and mobile application based attendance management system" International Journal of Computer Science and Information Security (IJCSIS) (**Accepted for publication**)

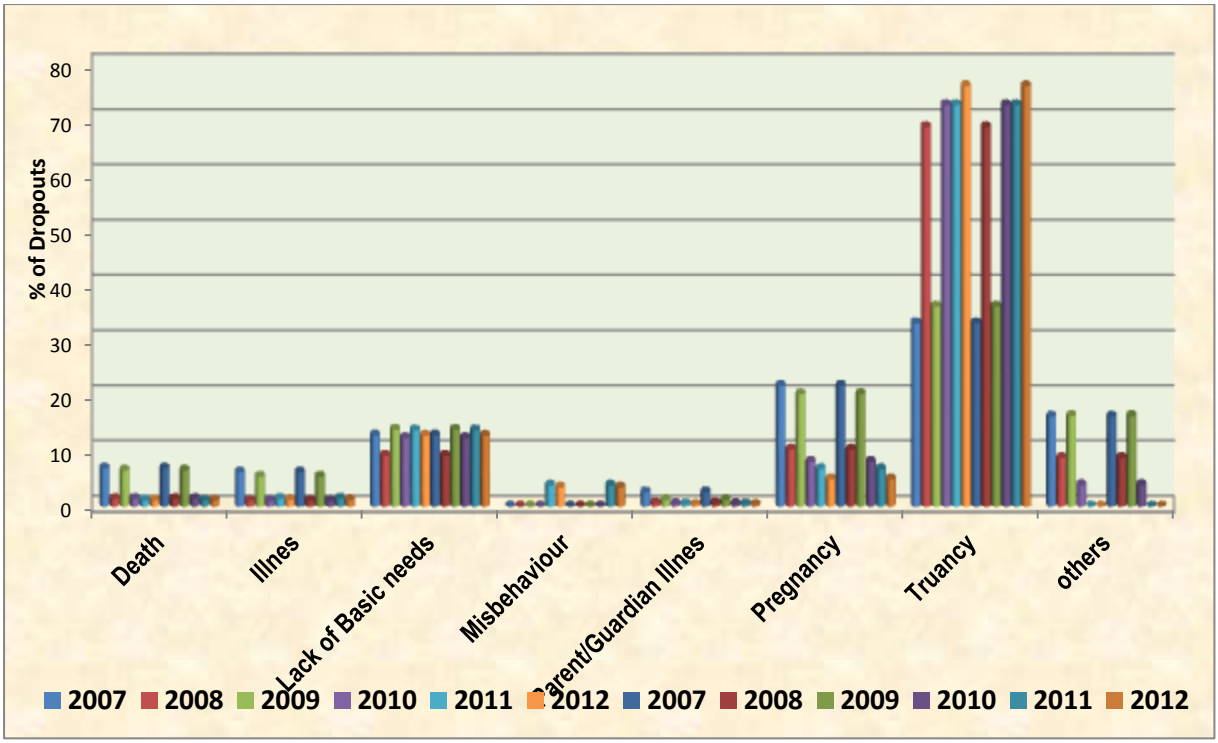


Figure 4: Percentage Dropout in Government and Non-Government Secondary Schools by 2012 in Tanzania (Kawambwa, 2012)

Currently, the attendance of both students and employees is being recorded manually using attendance registers. Manual way of taking students and employees' attendance using attendance registers suffers many problems in spite of being slow and error prone, it is prone to misplacement of registers which may lead to high search time and sometimes loss of attendance information. It is difficult to compile the attendance of each student monthly and yearly and therefore it is difficult to get clearly the number of days the student attendance to school monthly and yearly.

2.2.REVIEW OF DIFFERENT ATTENDANCE MANAGEMENT SYSTEMS.

Student is the largest union in the study environment so it is hard for managing student things especially in the respect of student class attendance, the original named style is hard to response to the really situation of student attendance(Yuru, 2013). Many researchers have tried to find the optimal solution on counteracting attendance recording challenges in

Education systems and companies. A fair review of different technologies proposed for attendance management is presented below.

2.2.1. Web Based Systems

Apandi S.H et al(Apandi, 2012) proposed the development of the web based attendance management system (AMS) in which the class teacher records students attendance to the server online. The server generates attendance related SMS and send to the student's parents or guardians. Figure 5 below shows the flow chart of the web based attendance management system proposed by Apandi S.H et al.

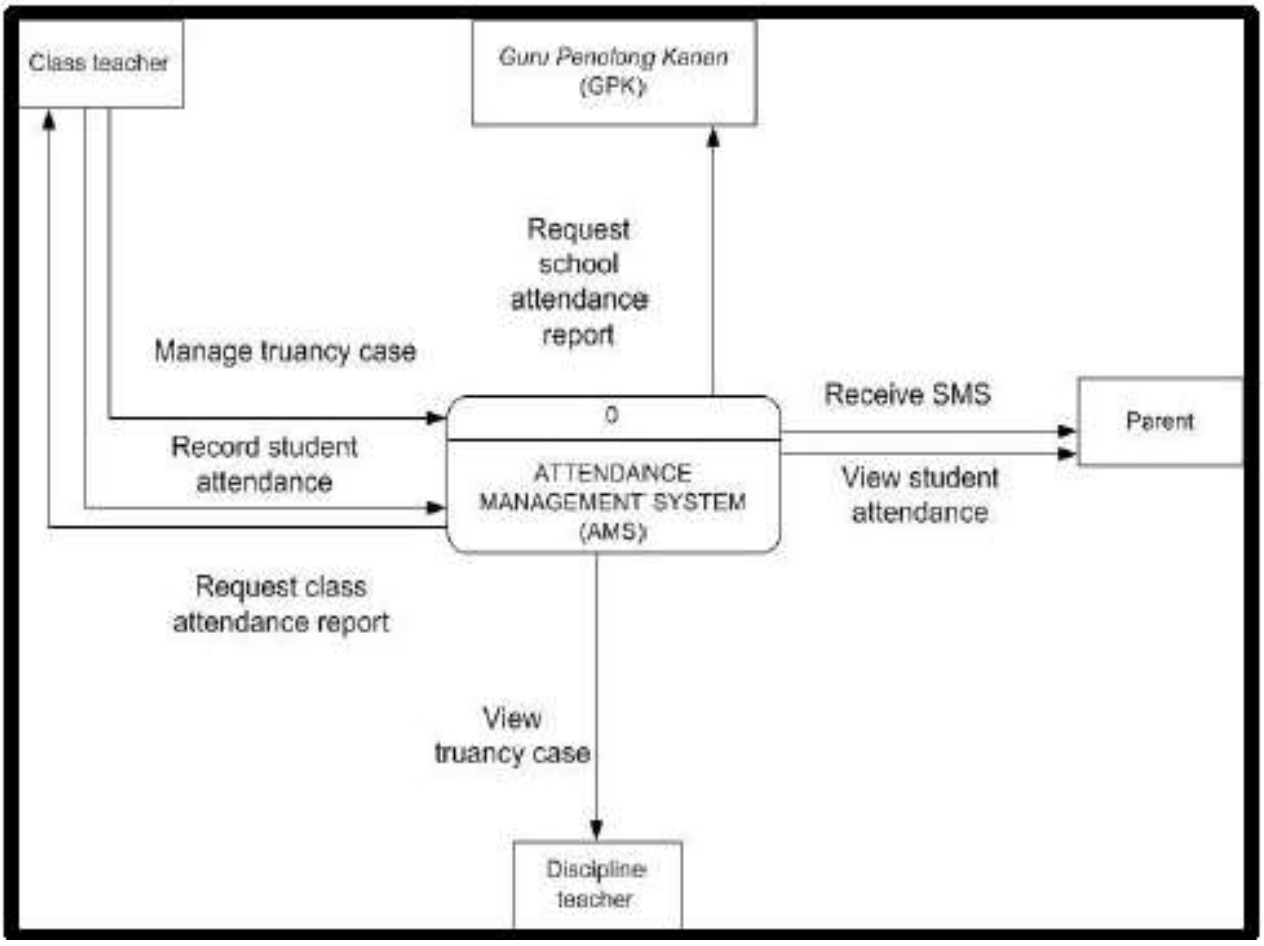


Figure 5: Flow chart for the web based attendance management system(Apandi, 2012)

The implementation of such a system requires internet connectivity in order for the teacher to upload class attendance. The system also is expected to be of high operation cost due frequent

SMS sending to the parents/Guardian and is likely to create a large SMS traffic on cellular networks. On top of that, the availability of reliable electricity may also complement the deployment of the system.

Another research conducted by Patel R et al (R. Patel, 2012) proposed the development of Online Students‘ Attendance Monitoring System in Classroom Using Radio Frequency Identification. In this system, RFID readers are to be installed per each classroom and then connected to the institutional Local Area Network (LAN). Student identity cards are embedded with RFID tags for identification. Figure 6 shows the topology of the online attendance management system proposed by Patel R et all.

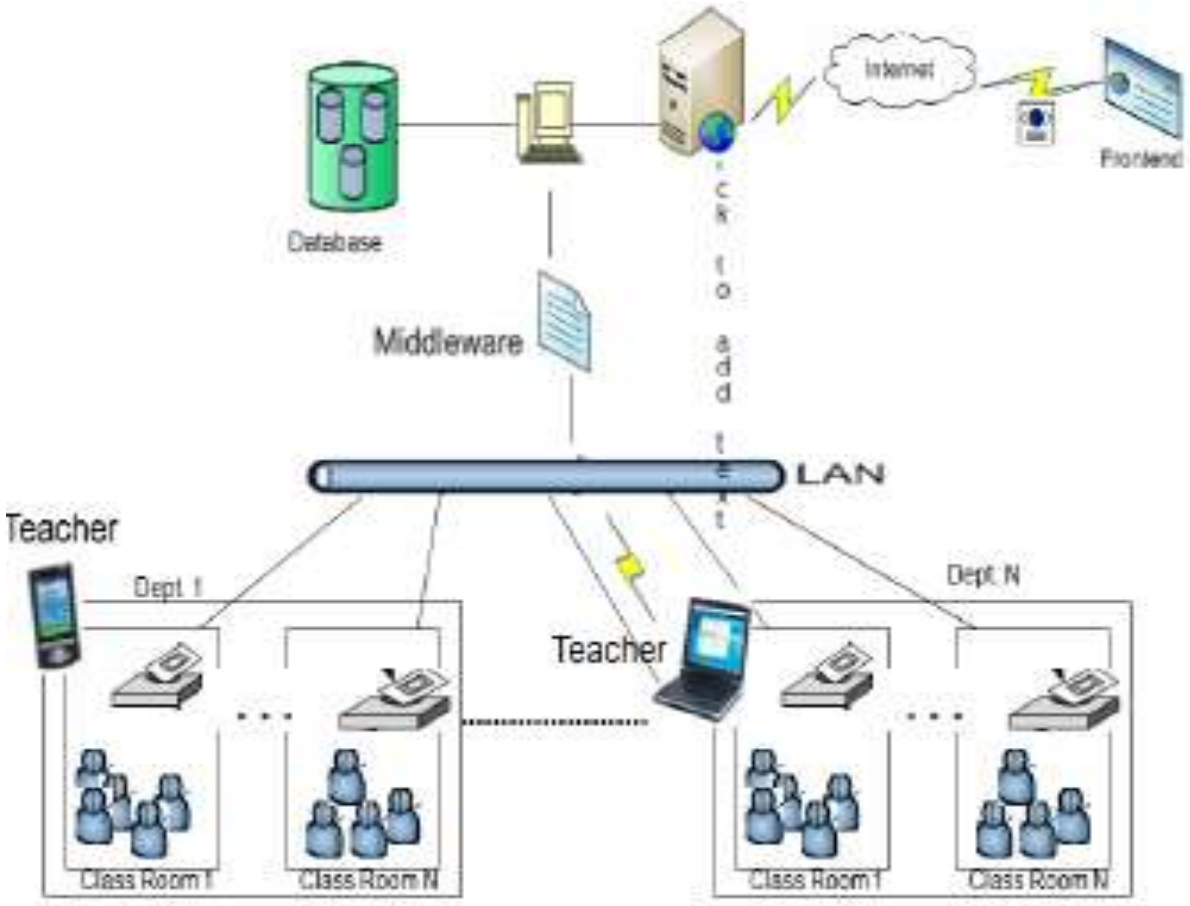


Figure 6: Web based attendance management system(R. Patel, 2012)

Mohamed A. A et al (Mohammed, 2013) also proposed a Web-Server based Student Attendance System using RFID Technology. In this system also the attendance is recorded using RFID technology and stored to the online database. Another system proposed by

Agrawal A (Agrawal, 2013) where an Online Attendance Management System Using RFID with Object Counter was developed.

As it was highlighted early, availability of reliable internet and electric supply turns to be the major limitation of all web based systems. For ordinary schools in Tanzania, it is not practical to implement web based system parse due to lack of reliable Electricity and internet connectivity. Web based system can suit best in economically stable organisations which are capable of employing an IT personel for mornotoring and administering the system.

2.2.2. RFID Based Systems

Chiagozie O.G et al (Chiagozie, 2012) proposed the development of Radio Frequency identification (RFID) based attendance system with automatic door unit in which the student attendance is captured using RFID technology. The student is required to show up the Tagged ID to the RFID reader, when the legitimacy of the student is verified, the system open the door and record the attendance.

Another related work was done by Unnati A. Patel in which a Student Management System based on RFID Technology was proposed (U. A. Patel, 2013). In this system, student attendance is captured using RFID technology and stored to the back end database connected to the RFID readers. Figure 7 below shows the component diagram of the RFID based attendance management system proposed by Unnati A.P et al.

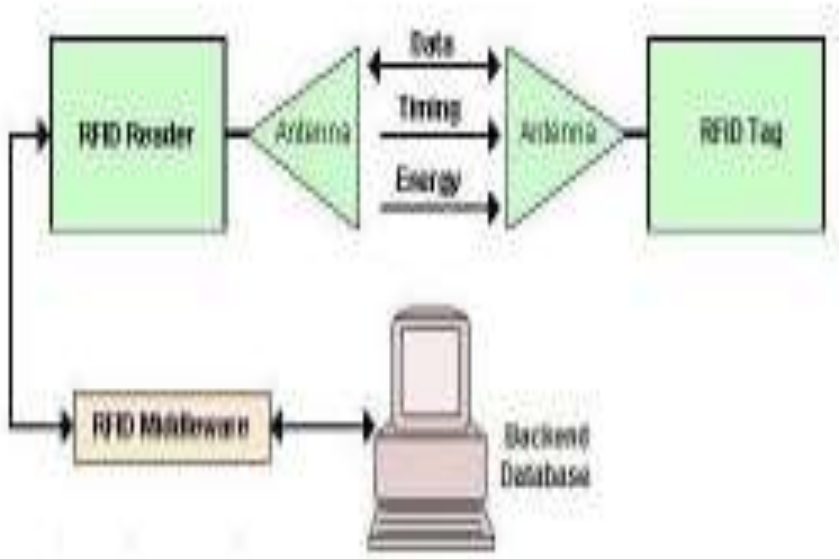


Figure 7: RFID based attendance management system(Patel, 2013)

Also, Nainan. S et al proposed an RFID Technology Based Attendance Management System(Nainan, 2013) . In this system also the student attendance is captured using RFID technology and stored in the back end database for further processing.

Another similar work was done by Arulogun O. T et al where the RFID-Based Students Attendance Management System(Arulogun O. T., 2013) was developed. In this system, in addition to recording student's attendance to the database using RFID system, the system has an added functionality of generating and sending an SMS to different stakeholders such as parents via SMS gateway or E-mail gateway. Figure 8 below shows the block diagram of the RFID based attendance management system proposed by Arulogun O.T et al.

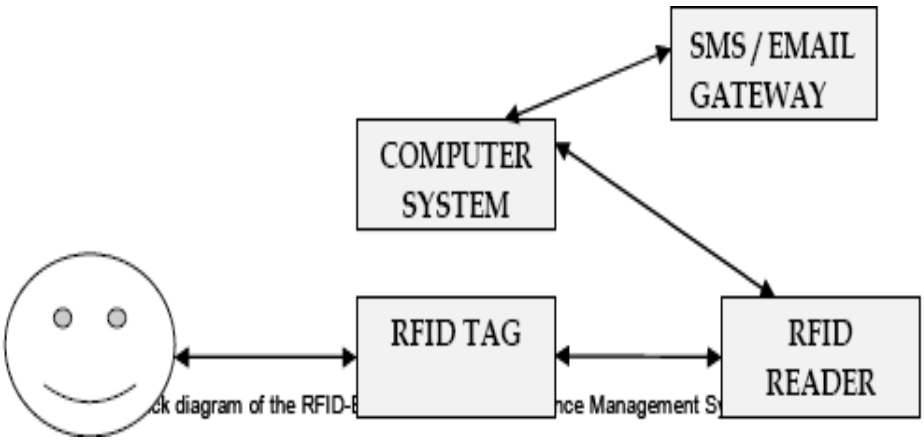


Figure 8: RFID based attendance management system(Arulogun O. T., 2013)

RFID technology has high capacity of recording many items within a short time than any auto-ID technologies. The RFID based attendance system is likely to be the best solution in recording student attendance. However in the area where there is no reliable electricity, it is not practical to rely on this system completely. Many of the ordinary level schools in Tanzania are not reached with national grid. Solar panels and generators are the major electric supplies in most of the schools. The other limitation of RFID system is based on the integrity of the attendance recorded as it allows a student to carry more than one tags.

Another related work was done by Aditi S.T et al where an Optimized Design of Student Attendance System Using RFID (S.Tiwari, 2014) was designed. In the system, RFID reader and tags are used to detect presence of the student with a valid tagged identity card. The detected attendance information is then transmitted by the aid of microcontroller and GPRS

to the far end database where it is recorded. Figure 9 below shows the circuit diagram of the optimized attendance system using RFID.

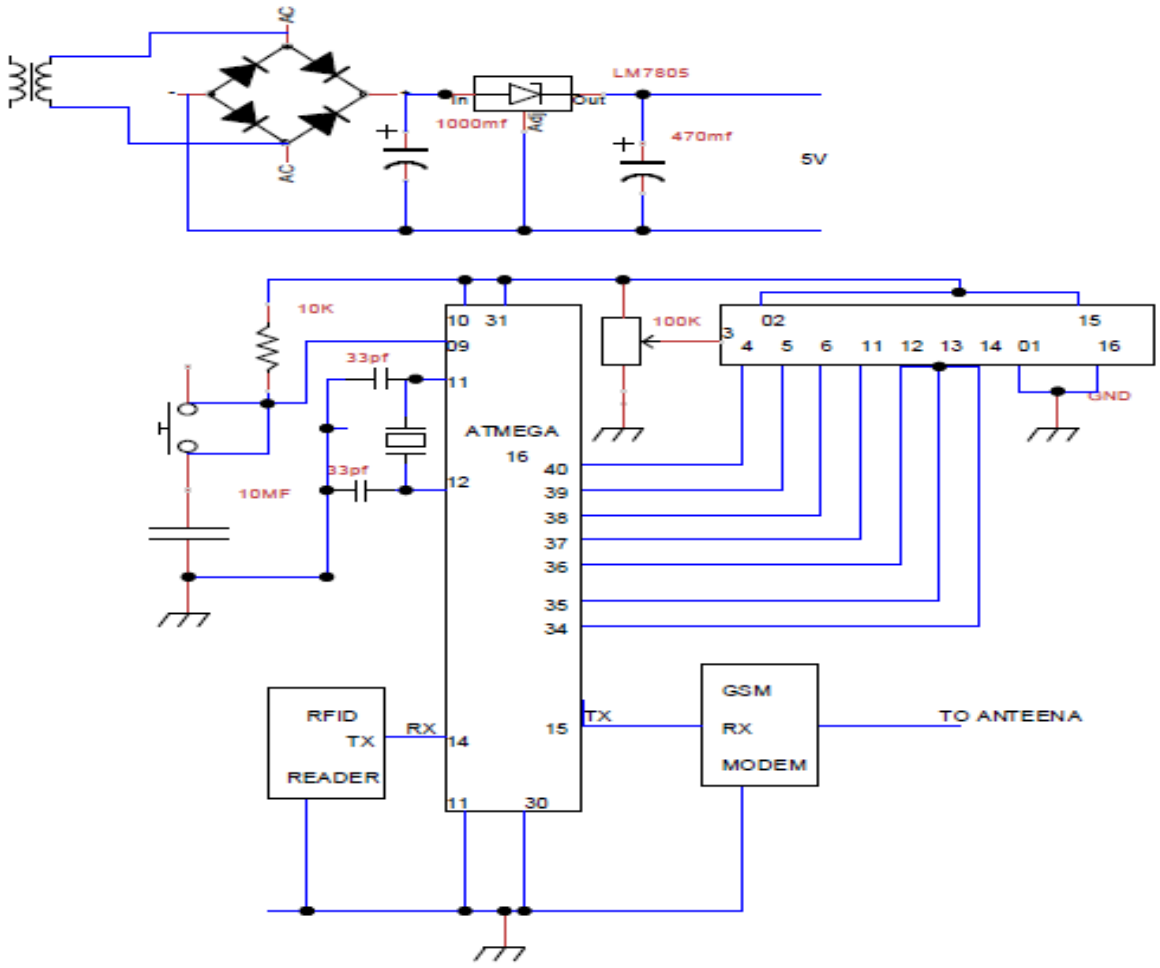


Figure 9: Circuit diagram of the optimized attendance system using RFID (S.Tiwari, 2014).

2.2.3. Biometric Based Systems

Biometric systems includes those of fingerprint recognition, face recognition, iris based, voice recognition(U. A. Patel, 2014) etc. Shoewu .O et al as shown in Figure 10 below, proposed the development of Attendance Management System using Biometrics (O. Shoewu, 2012). In this system, fingerprint recognition technology was used where the system takes attendance electronically by capturing the finger prints with the help of a finger print device and the records of the attendance are stored in a database (O. Shoewu, 2012)

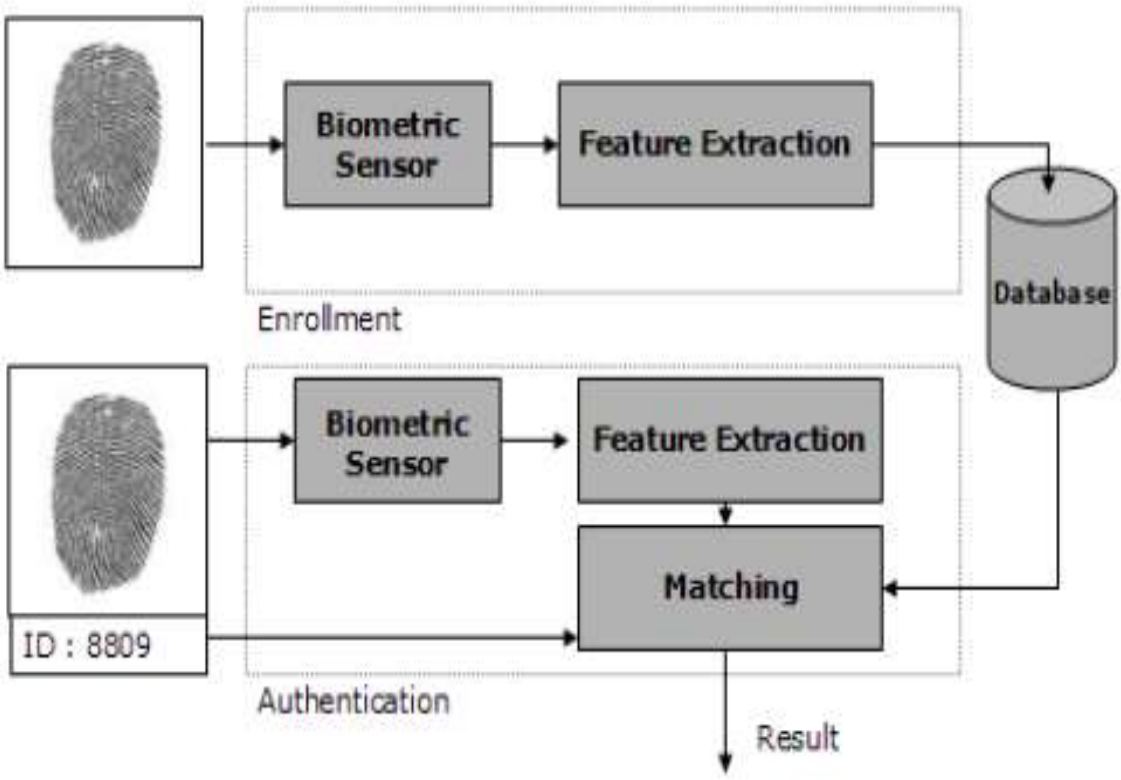


Figure 10: Biometric based attendance management system (Shoewu, 2012)

Another related work done by Akinduyite C.O et al in which Fingerprint-Based Attendance Management System was developed (C.O, 2013). Biometric systems are the best choose where the integrity and authenticity of the person information is required. They are mostly used in access control systems as it is almost impossible to produce fingerprint of another person during authentication. In respect to student attendance management, biometric are not suitable due to large execution time of average of 4.29 seconds(C.O, 2013). These systems may be not suitable for places with large number of participants like schools. Suppose you have a lecture class of 1000 students, using this system, it takes 4290 seconds which is equivalent to 72 minutes (one hour and 12 minutes). Each student will need to spend some minutes in a queue for attendance registration.

Other related system includes those of barcode technology that requires every employee or student to be issued a badge/card coded with barcode. In order to check into or out of the company or school, the badge/card is swapped on the time clock, and the data is captured by

the clock (C.O, 2013).Table 1 below show the comparison between different auto-ID technologies

Table 1: Comparison of different auto-ID Technologies (S.Tiwari, 2014)

System Parameters	*Barcode*	*Voice recording*	*Biometry*	*Smart card*	*RFID*
Data quantity	*1–100 k*	-	_	*16–64 k*	*16–64 k*
Data density	*Low*	*High*	*High*	*Very High*	*Very High*
Machine readability	*Good*	*Expensive*	*Expensive*	*Good*	*Good*
Readability by people	*Limited*	*Simple*	*Difficult*	*Impossible*	*Impossible*
Influence of dirt/damp	*Very high*	_	_	*Possible*	*No influence*
Influence of (opt.) covering	*Total failure*	_	*Possible*	_	*No influence*
Influence of direction and position	*Low*	_	_	*Uni-directional*	*No influence*
Degradation/wear	*Limited*	-	-	*Contacts*	*No influence*
Purchase cost/reading electronics	*Very low*	*Very high*	*Very high*	*Low*	*Medium*
Operating costs	*Low*	*None*	*None*	*Medium*	*None*
	Slight	*Possible (audio tape)*	*Impossible*	*Impossible*	*Impossible*
Reading speed (including handling of data carrier)	*Low ~4 s*	*Very low > 5s*	*Very low > 5–10 s*	*Low ~4 s*	*Very fast ~0.5s*
Maximum distance between data carrier and reader	*0–50 cm*	*0–50 cm*	*Direct contact*	*Direct contact*	*0–5-m, microwave*

2.3.PROPOSED ATTENDANCE MANAGEMENT SYSTEM

Most of the attendance management systems developed are developed with the aim of targeting high learning institutions and companies as many of them assume the full availability of internet connectivity, electricity and enough funds for deployment. Most of the Ordinary Schools especially in Africa are not connected with electricity national grid. The proposed system consists of RFID part and Mobile application part as can be seen from figure 11. The RFID part is intended for capturing student attendance and recording in the back end database. The mobile application part is intended for communicating student attendance information to parents/guardians. The mobile application part is also intended to be used as a backup for attendance recording in case there is no electricity or no enough funds to deploy the RFID part.

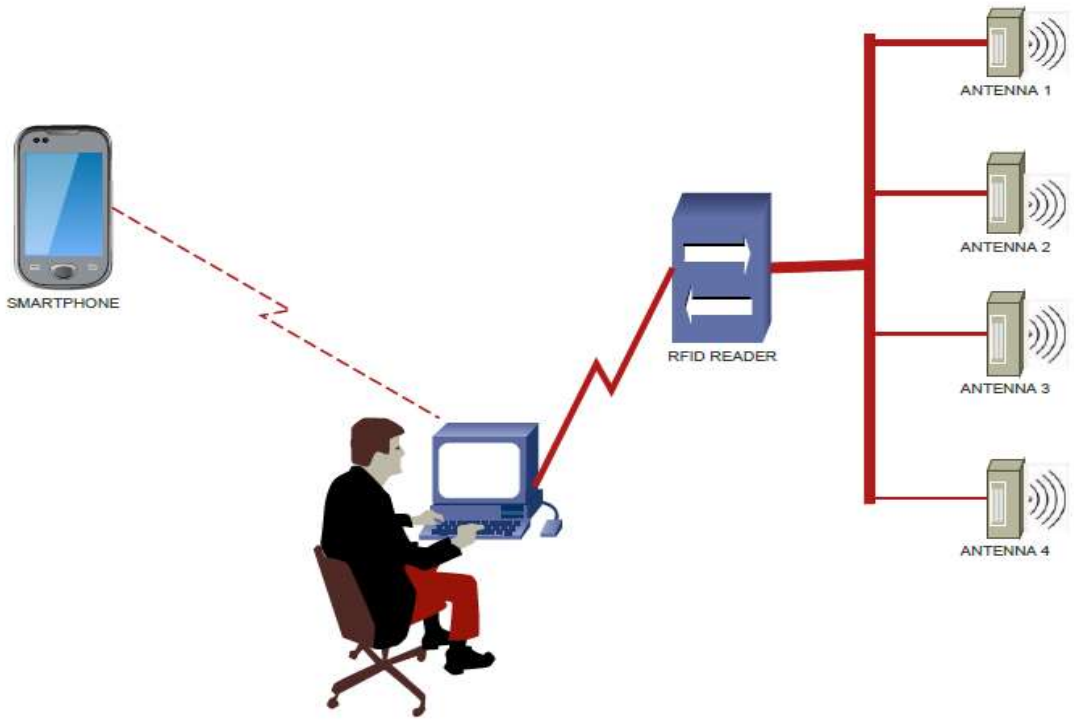


Figure 11: Topology of the proposed system.

2.4.CONCLUSION

We have presented a review of different technologies which are used for attendance recording and management. Currently in ordinary schools in Tanzania, student attendance is taken manually by class masters using attendance register. This process costs much of time and is error prone. Too much proxy attendance can be recorded in manual system. However, computerized system and RFID will be used to take auto attendance for all the students entered in the class and therefore eliminate the time loss of class teachers. On the other hand mobile application will communicate attendance information to parents/guardians and can be used for attendance recording in case there is no electricity or RFID part not installed or not working. Through improving the recording and communication of attendance information will help easy detection of truancy and takes appropriate measures to counteract.

CHAPTER THREE

REQUIREMENT ANALYSIS AND DESIGN OF RFID AND MOBILE APPLICATION BASED ATTENDANCE MANAGEMENT SYSTEM[2]

A Case study of Ordinary Level Schools

ABSTRACT

Mobile phone technology has continued to grow in terms of computation power, memory sizes and efficiency power utilization. The emergency of Smartphone has facilitated many applications for different activities to be developed. Smartphone are mobile phone with an advanced operating system and capable of running third-party applications (Wikipedia). Industry analysts estimate that there are more than 250,000 applications available through the various stores and marketplaces, some of which are available for multiple types of device(Wasserman, 2010).This paper presents requirement specifications and system design for RFID and mobile application based attendance management that can be useful in our ordinary schools and hence substitute the manual method of Attendance management which is tedious and error prone.

3.1.INTRODUCTION

Before implementation of any engineering project, it is a good practice to collect and analyze the requirement and produce a blue print design of the system. In software development, System requirements are the statements of what the system must do for its user in normal condition. They are categorized into functional and non-functional requirement. System requirement gathering and design are the early stages in software/system development life cycle (SDLC).

A mobile application is a computer program designed to run on Smartphone, tablet computers and other mobile devices(Wikipedia) This paper presents functional and non-functional system requirements as well as design for developing an RFID and Mobile application based attendance management. Requirement specification for an information system is important for several reasons: it serves as a means of communication between the user and system developer; as a result, the right system will be developed. It also represents in a systematic fashion the current state of the real world, its problems and future requirements. Additionally,

[2] Paper 2: Joseph Sospeter and Shubi Kaijage "Requirement analysis and design of RFID and mobile application based attendance management system "*Communications on Applied Electronics (CAE) – ISSN : 2394-4714 Foundation of Computer Science FCS, New York, USA Volume 2 – No.6, August.2015*

it enables the system developer to turn real world problems into other forms which are more manageable in terms of size, complexity, human understanding and computer process ability. Lastly, it serves as the basis for the design, implementation, testing and maintenance of the target system (Claus, 2014).

3.2.MOBILE PHONE OPERATING SYSTEMS

The most common operating systems used in smart mobile devices include the operating system Android (Google), iOS (Apple), Symbian (Nokia), BlackBerry OS (RIM), Samsung Bada, Microsoft Windows Phone, webOS (Hewlett-Packard) and Linux Maemo and MeeGo (Xanthopoulos & Xinogalos, 2013). From figure 12 below, Operating systems that monopolize the mobile market are Android (by Google) with a share of 69.6% of installations and iOS (by Apple) with 20.9%. The shares for the rest operating systems are much smaller: 3.5% for RIM; 2.9% for Microsoft; 1.2% for Symbian; and 1.9% for the rest (Egham, 2013). It shows that the market share for android platform is very large therefore the application developed based on this Operating system is likely to be used by many users in their mobile phones

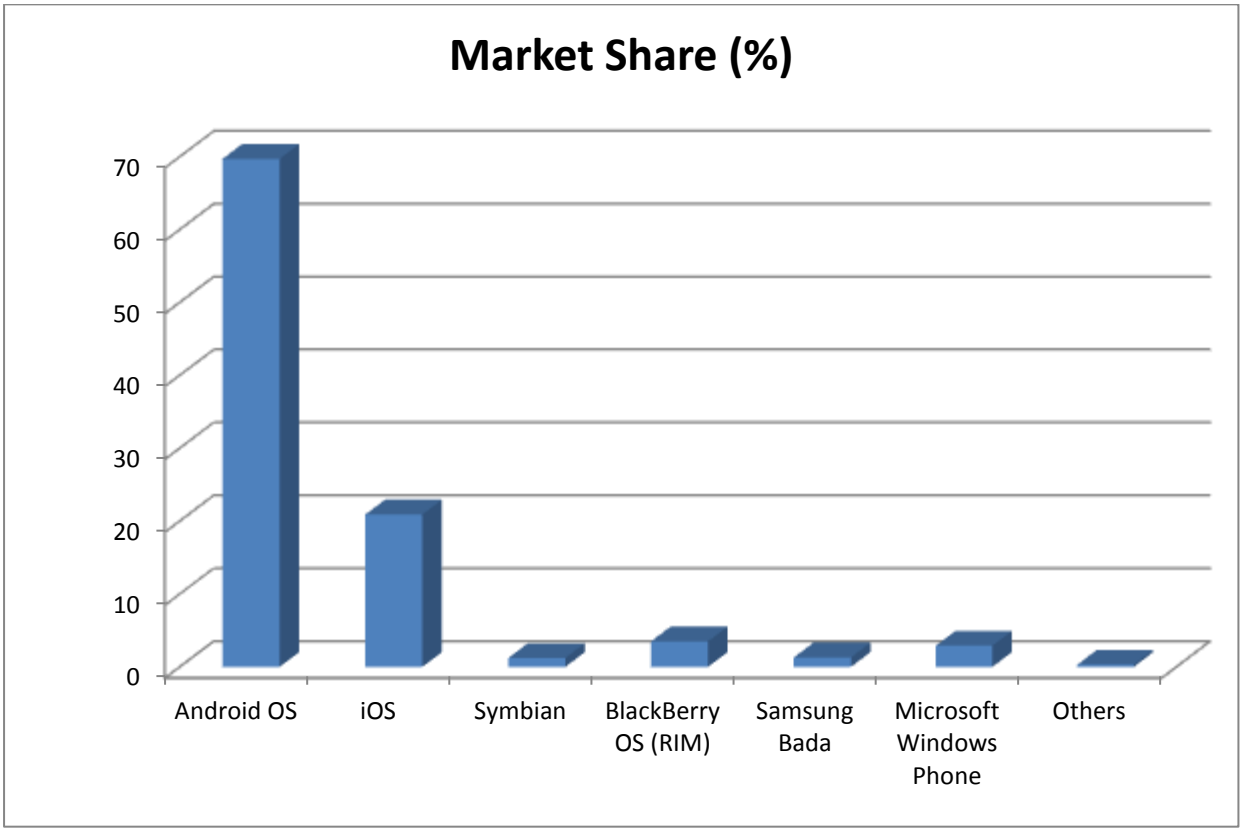


Figure 12: Operating Systems market share (Egham, 2013)

3.3.REQUIREMENT ANALYSIS AND SPECIFICATIONS

Requirements specify a set of features that the system must have. A **functional requirement** is a specification of a function that the system must support, whereas a **non-functional requirement** is a constraint on the operation of the system that is not related directly to a function of the system. The system abstraction in the figure 13 below shows the complete setting of the system with four RFID catchment areas represented by four antennas.

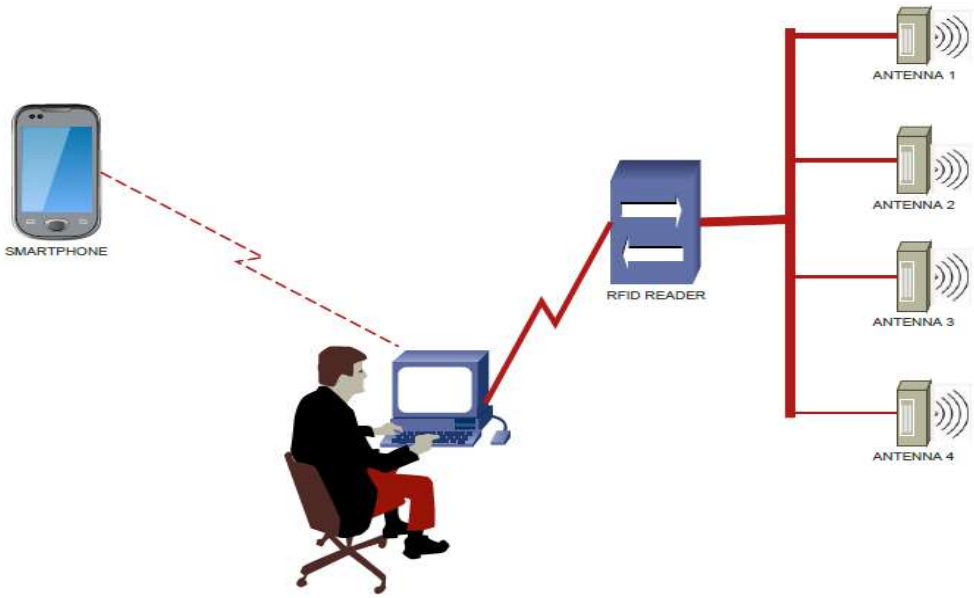


Figure 13: System setting of the proposed attendance management system.

3.3.1. Functional Requirements

The attendance management system to be developed is expected to facilitate the process of recording attendance through mobile phone and RFID, viewing attendance for different interval of time and be able to send the attendance information to the parents/Guardians through mobile phone. Tables 2 and 3 below show the functional requirements for the Attendance management system and Mobile application respectively.

Table 2: Attendance Management System Functional Requirements

ACTORS	REQUIREMENT	DESCRIPTION
RFID Reader	Record Attendance	RFID reader will be recording the attendance by detecting the Tags attached to student's uniform.
Mobile Application	Record Attendance Send Attendance info	Mobile application acts as a backup for recording attendance It will also be used to send attendance information to parents or Guardians
Class Teacher	Login View Attendance Edit Student Register Student	Class teacher will login into the system and upon successful, he/she will be able to view attendance information, Edit student details and Register new students.
Head Master	Login View Attendance Edit Student Register Student Delete Student	The Head Master will login into the system, view attendance, Edit students, Register Students and Delete Students.
Parent/Guardian	Receive Attendance info	Parents or Guardians will be receiving attendance information for their kids in case of truancy.

Table 3: Functional Requirements for Mobile Application

ACTOR	REQUIREMENT	DESCRIPTION
Class Teacher	• Take attendance • View attendance • Upload attendance • Login	• The class teacher/master is required to be able to take student attendance and upload to the back end database in case the RFID part is not working or not deployed. • The class teacher/master should be able to view

		student attendance for different interval of time.
Head Teacher/master	• Edit student • Register student • Delete student • View attendance • Login	• The head Master/Teacher monitors the registered students and their attendance. She/he is also responsible for registering or deleting student.

3.3.2. Non-functional Requirements

These are constraints on the operation of the system that are not related directly to a function of the system. Table 4 below shows the system non-functional requirement.

Table 4: System non-functional Requirements

S/N	REQUIREMENT	DESCRIPTION
1	**Operability**	◊The mobile application will be developed under Android platform. ◊The application will run on Smartphone with android OS 2.2 and above.
2	**Maintainability**	◊The application is specifically for android Smartphone
3	**Security**	◊The system shall provide access to only registered users. The authorized users will login to the application
4	**Performance**	◊The application will process attendance information as faster as possible from the moment of submission.

3.4.SYSTEM DESIGN

3.4.1. Use case Modeling.

Figures 14 and 15 below show the system use cases for both mobile application and the general attendance management system.

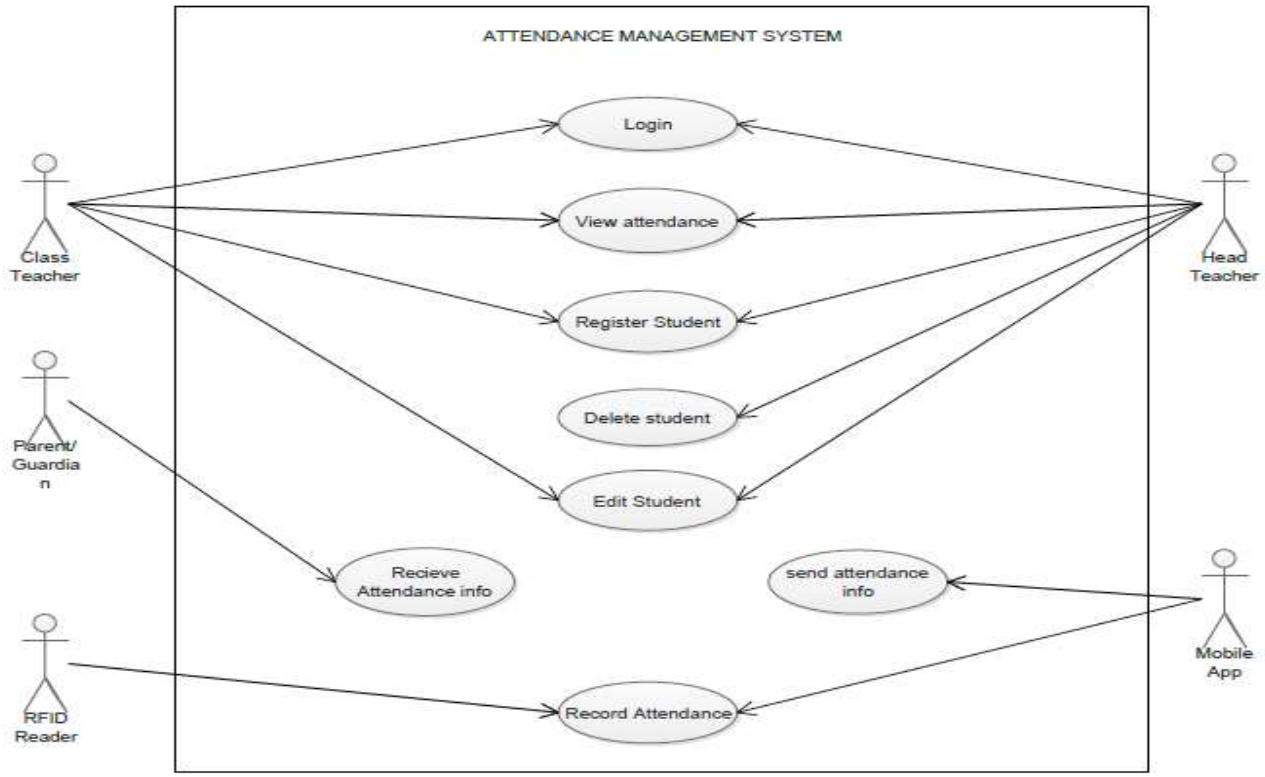


Figure 14: Attendance management system use case model.

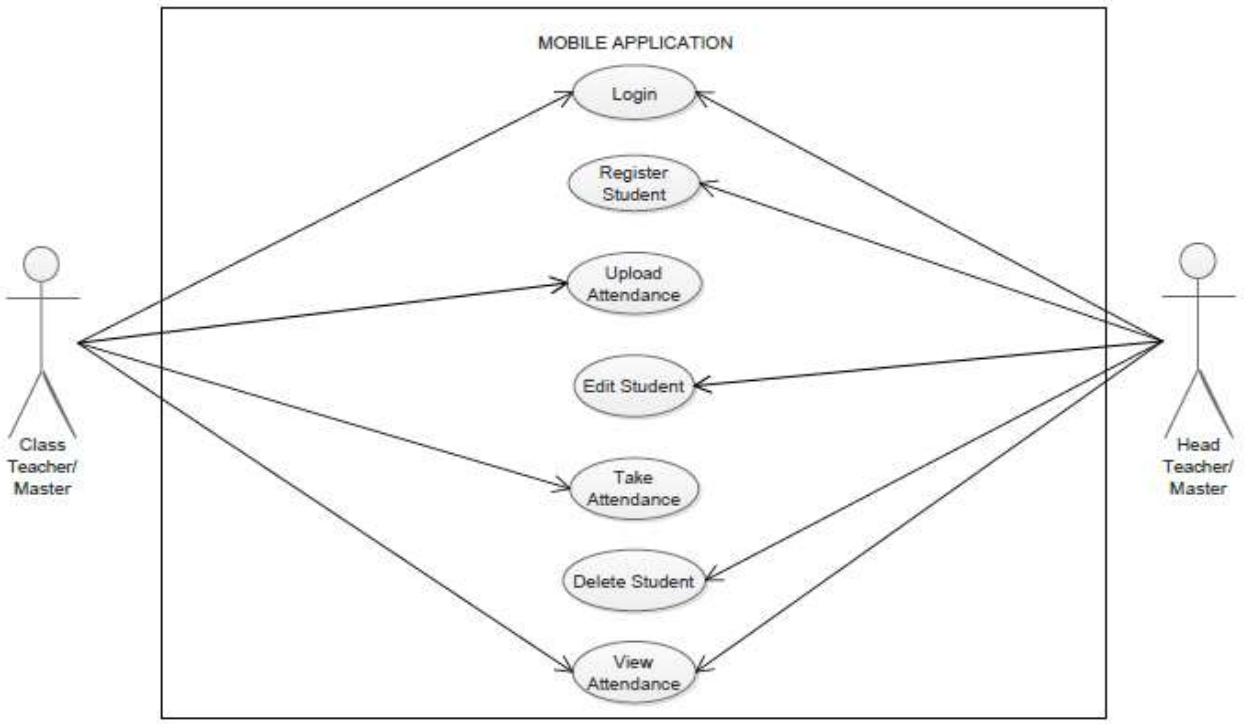


Figure 15: Mobile application use case model.

3.4.2. Detailed Use Cases

Tables 5 and 6 below show the list of use cases with associated actors for attendance management system and the Mobile Application.

Table 5: List of Actors and associated Use case.

PRIMARY ACTOR	USE CASE
1. RFID Reader	1.1 Record Attendance
2. Mobile Application	2.1 Record Attendance 2.2 Send Attendance Info
3. Class Teacher/Master	3.1 Login 3.2 View Attendance 3.3 Edit Student 3.4 Register Student
4. Head Teacher/Master	4.1 Login 4.2 View Attendance 4.3 Edit Student 4.4 Register Student 4.5 Delete Student

Table 6: Actors and associated use cases for Mobile Application.

ACTORS	USE CASE
1. Class Teacher/Master	1.1 Login 1.2 Take attendance 1.3 View attendance 1.4 Upload attendance
2. Head Teacher/Master	2.1 Login 2.2 Edit student 2.3 Register student 2.4 Delete student 2.4 View attendance

3.4.3. Entity Relationship Diagram

Entity relationship diagrams (ERD) are mostly used to build data model. Figure 16 shows the ER diagram describing conceptual model of Attendance management system**.**

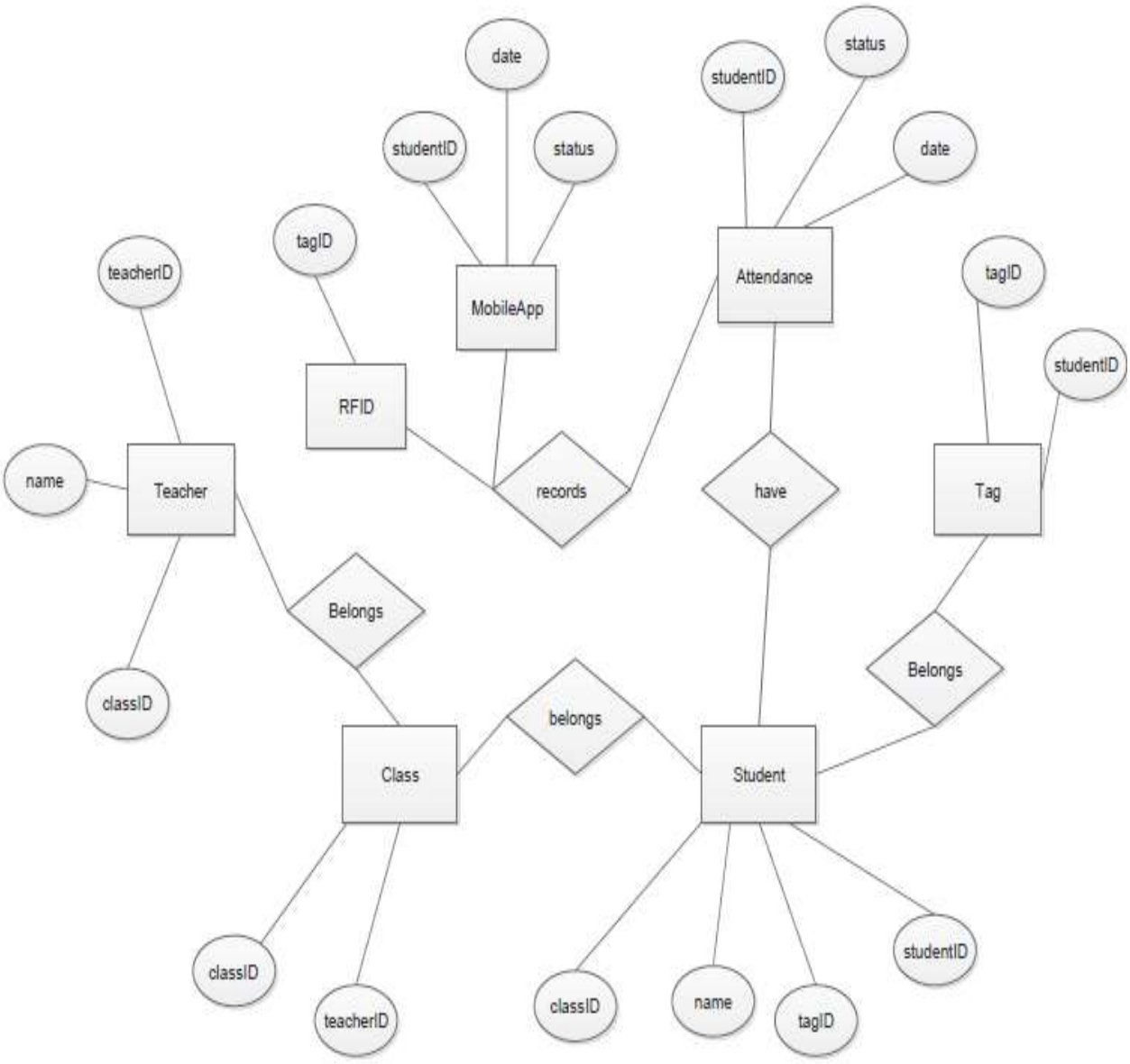


Figure 16: ERD of Attendance Management System.

3.5.SYSTEM CLASS DIAGRAM

Class diagram are used to show the abstraction of object with its attributes and characteristics. Figure 17 below shows the class diagram of the attendance management system.

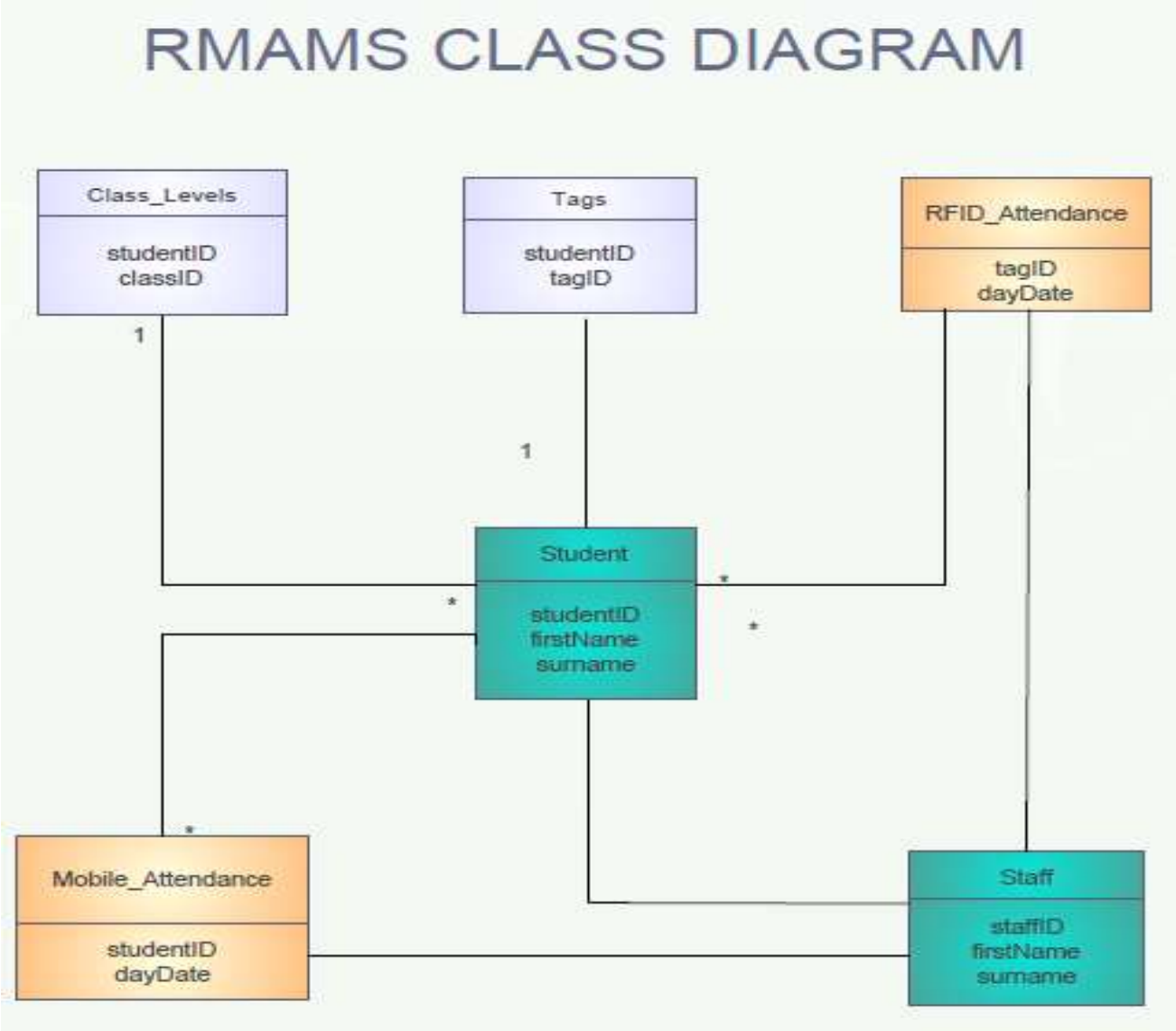


Figure 17: Class Diagram for Attendance Management System.

3.6.CONCLUSIONS

The attendance management system tool whose specifications have been presented in this paper provides simple but efficient means of recording and communicating students' attendance information. We also see how requirement gathering and design are very critical in any software development to make sure that the project solves the right problem in a right approach. So long as many studies have shown that, mistakes at development stage often leads to project failure, care is needed when establishing the requirements in order to avoid any subsequent catastrophes. Results presented are a foundation for the design and development of attendance management system which will also be improved through the feedback from the end users during testing and operation.

CHAPTER FOUR

HUMAN HEALTH EVALUATION OF RADIO FREQUENCY IDENTIFICATION APPLICATION FOR STUDENT'S ATTENDANCE MANAGEMENT SYSTEM[3]

ABSTRACT

One of the fundamental rules in the code of conduct and ethics for engineers states that "An engineer shall uphold paramount the safety, health and welfare of the public and the protection of the environment in the performance of his professional duties"(Registrar, 2013). As the use of RFID grows people very naturally ask the question, "Is it safe?"(Want, 2006). There is increased public concern over possible adverse health effects due to Electromagnetic Fields (EMF) radiated by Electronic equipments(Committee, 2012). This paper evaluates the human health safety to End user of RFID system basically for student Attendance Management in ordinary schools.

4.1.INTRODUCTION

Radio-frequency identification (RFID) is the wireless use of Electromagnetic fields to transfer data, for the purposes of automatically identifying and tracking tags attached to objects(Wikipedia). RFID devices are among of the Equipments approved by TCRA to be used in Tanzania(General, 2015). In recent years, radio frequency identification technology has moved from obscurity into mainstream applications that help speed the handling of manufactured goods and materials. RFID enables identification from a distance, and unlike earlier bar-code technology, it does so without requiring a line of sight (Want, 2006). Questions have been asked about health issues related to the use of RFID. In broad terms these have focused on three main areas, First, Is there a risk to users of readers, users of tags or those in the immediate area from

[3] Paper 3: Joseph Sospeter and Shubi Kaijage **"**Human health evaluation of Radio Frequency identification application for student's attendance management system" Journal of *Communications on Applied Electronics (CAE) – Foundation of Computer Science FCS, New York, USA* **(Accepted for publication).**

the radiation used to exchange data between the tag and the reader?.Second, is there risk associated with humans injecting implantable tags beneath the skin? Third, is there a risk to patient from using tags in a medical environment for patient identification or other applications?(Dallam Court, 2010). The evaluation of risks to public health associated with RFID system is of paramount importance for well-being of students and staffs and other people involved in the system. In 2002 the International Commission on Non-Ionizing Radiation Protection provided three advices to the European Commission on the risks to the public of a range of radiation sources (including RFID) (IEEE Standards Coordinating Committee 28, 1992). The ICNIRP advices identified three areas of potential interaction between electro-magnetic devices and biological systems First, the commission advised on the possible body heating effect, Secondly, the commission advised on membrane stimulation and lastly advised on Electroporation (Dallam Court, 2010). Since RFID uses Electromagnetic fields in its operation, it is necessary to assess the compliance of Electromagnetic fields emission based on the available standards from respected bodies.

4.2.ELECTROMAGNETIC FREQUENCY SPECTRUM

The Electromagnetic (EM) spectrum contains an array of electromagnetic waves increasing in frequency from Extremely Low Frequency and Very Low Frequency (ELF/VLF), through Radio Frequency (RF) and Microwaves, to Infrared (IR) light, Visible Light, Ultraviolet (UV) light, X-rays, and Gamma rays(Zamanian & Hardiman, 2005). Figure 18 show the frequency distribution in the frequency spectrum. From Figure 18, electromagnetic waves depending on their frequency and power carrying capacity are grouped into two groups. The two groups are ionizing radiations starting from ultra violet (UV) to gamma rays and non-ionizing radiations extending from visible light to very low frequency.

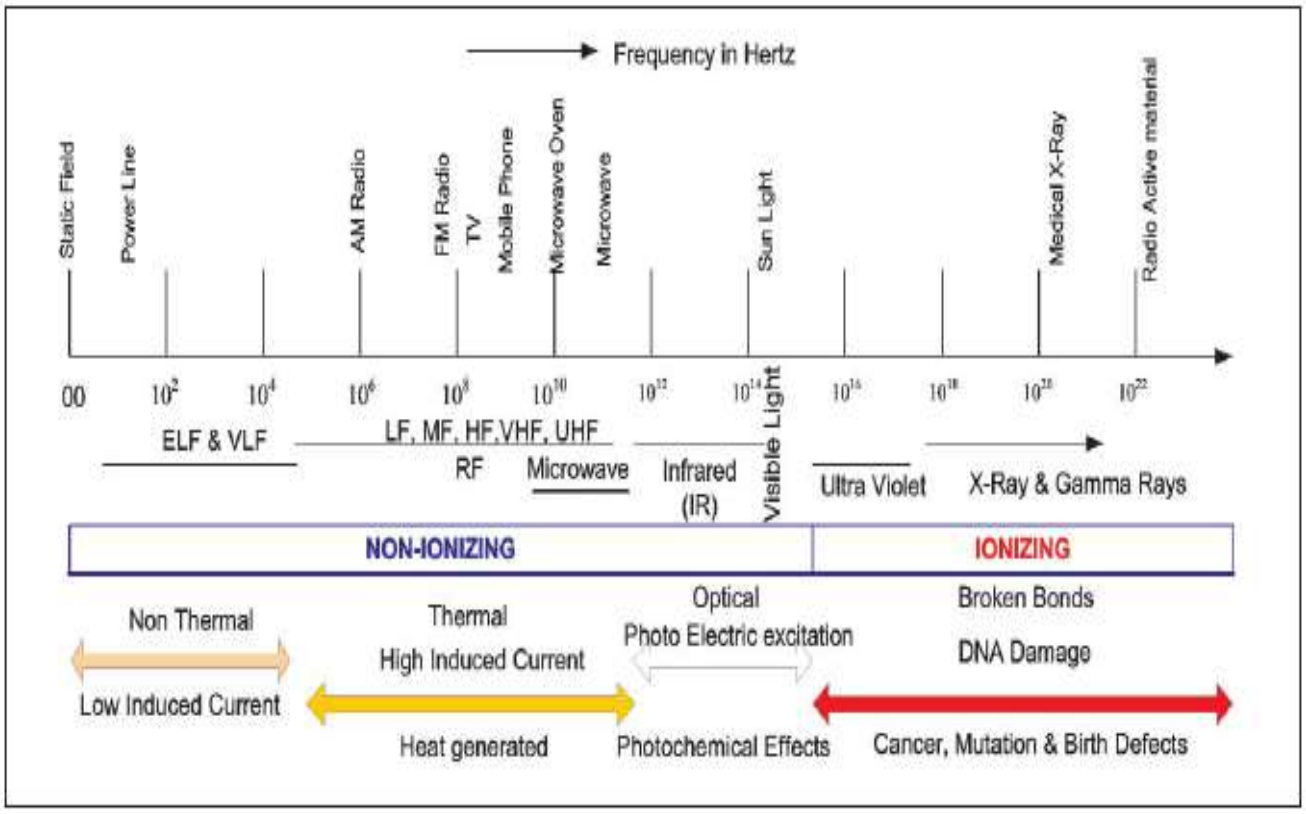


Figure 18: Electromagnetic Frequency Spectrum (Zamanian & Hardiman, 2005).

4.2.1. IONIZING RADIATION

These are high frequency radiations which contains sufficient electromagnetic energy to strip atoms and molecules from the tissue and alter chemical reactions in the body (converting molecules totally or partly into ions). X-Rays and Gamma rays are two forms of ionizing radiation.(Zamanian & Hardiman, 2005). These kind of radiations are used for special application such us cancer treatment and they extend in the upper range frequency.

4.2.2. NON-IRONIZING RADIATION

Non-ionizing Electromagnetic Radiation (EMR) are radiations on the low part of the frequency spectrum, with energy levels below that required to produce effects at the atomic level. Examples

of non-ionizing radiations are Static electromagnetic fields from direct current (0 Hz), Low-frequency waves from electric power (50-60 Hz), Extremely Low Frequency (ELF) and Very Low Frequency (VLF) fields (up to 30 kHz), Radio Frequencies (RF), including Low Frequency (LF), Medium Frequency (MF) High Frequency (HF), Very High Frequency (VHF), Ultra High Frequency (UHF) and Microwave (MW) and Millimeter wave (30 kHz to 300 GHz), Infrared (IR) light, Visible light and Ultraviolet (UV) light (above 300 GHz)(Zamanian & Hardiman, 2005). These frequency ranges are used it communication purpose. RFID systems mostly operate in the UHF and LF range.

4.3.ELECTROMAGNETIC RADIATION STANDARDS

In 1974, the International Radiation Protection Association (IRPA) formed a working group on non-ionizing radiation (NIR), which tasked to examine the problems arising in the field of protection against the various types of non-ionizing radiation (NIR),. The main objective of this group was to establish guidelines for limiting EMF exposure that will provide protection against known adverse health effects. Two group classes of guidance were developed. First group is Basic restrictions, Restrictions on exposure to time-varying electric, magnetic, and electromagnetic fields that are based directly on established health effects. Depending upon the frequency of the field, the physical quantities used to specify these restrictions are current density (**J**), specific energy absorption rate (SAR), and power density (S). For these restrictions, only power density in air, outside the body, can be readily measured in exposed individuals. Second group is Reference levels, these levels are provided for practical exposure assessment purposes to determine whether the basic restrictions are likely to be exceeded. Some reference levels are derived from relevant basic restrictions using measurement and/or computational techniques, and some address perception and adverse indirect effects of exposure to EMF. The derived quantities are electric field strength (**E**), magnetic field strength (**H**), magnetic flux density (**B**), power density (**S**), and currents flowing through the limbs (*IL*). In any particular exposure situation, measured or calculated values of any of these quantities can be compared with the appropriate reference level. Compliance with the reference level will ensure compliance with the relevant basic restriction. If the measured or calculated value exceeds the reference

level, it does not necessarily follow that the basic restriction will be exceeded. However, whenever a reference level is exceeded it is necessary to test compliance with the relevant basic restriction and to determine whether additional protective measures are necessary(Ng, 2003). Reference levels are categorized into Occupational Exposure and General Public Exposure. Tables 7 and 8 present Electromagnetic Radiation reference levels for occupational exposure and general public exposure respectively.

Table 7: Electromagnetic Radiation Reference Level for Occupational Exposure.

Frequency Range	E-Field strength (Minimum) (V/m)	E-Field strength (Maximum) (V/m)	H-Field Strength (Minimum) (A/m)	H-Field Strength (Maximum) (A/m)
1-10MHz	61	610	0.162	1.618
10-400MHz	61	61	0.162	0.162
400-2000MHz	60	134.16	0.159	0.356
2-300GHz	137	137	0.363	0.363

Table 8: Electromagnetic Radiation Reference Level for General Public Exposure.

Frequency Range	E-Field strength (Minimum) (V/m)	E-Field strength (Maximum) (V/m)	H-Field Strength (Minimum) (A/m)	H-Field Strength (Maximum) (A/m)
1-10MHz	27.5	87	0.0729	0.23
10-400MHz	28	28	0.0743	0.0743
400-2000MHz	27.5	61.49	0.0729	0.163
2-300GHz	61	61	0.162	0.162

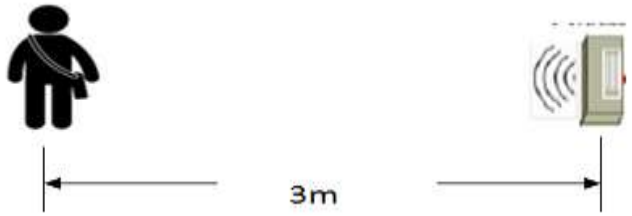
4.4.CALCULATED RFID ELECTROMAGNETIC RADIATIONS

FCC provides assistance in determining whether a given facility would be in compliance with guidelines for human exposure to RF radiation. The calculation methods discussed below should be helpful in evaluating a particular exposure situation(Cleveland, Sylvar, & Ulcek, 1997; Fields, 1997). The selected RFID Reader has the output power range of 20dBm to 33dBm and it supports the frequency range of 865MHz to 868MHz under ETSI standards and a range of 902MHz to 928MHz under FCC standards. The antenna selected has the power gain of 9.2dBi. It is expected that distance from the RFID antenna to the catchment area is about 3m (Expected minimum distance of a student for prolonged exposure to RFID electromagnetic radiations)

Using the RF free space propagation model equation {Matthew Sadiku, 2002}

$$P_r = \frac{P_t G_t A_e}{4\pi R^2}$$

Equation 1: Power at the receiving End.



Under free space condition, the power density is given by{Matthew Sadiku, 2002}

$$S = \frac{P_t G_t}{4\pi R^2}$$

Equation 2: Power Density

Converting the Power Density into decibel

$$S_{dB} = P_t^{dB} + G_t^{dB} - 10\log(4\pi) - 20\log R$$

Equation 3: Power Density in Decibel

From the Poynting's Theorem, the Power Density is the function of the average product of Electric fields and magnetic fields. It is given by

$$S_{ave} = \int_0^T \frac{E_o^2}{\eta} \sin^2(wt - Bx) a_x$$

Equation 4: Average power Density using Poynting's theorem {Matthew Sadiku, 2002}

This is equals to

$$S_{ave} = \frac{E_O^2}{2\eta} a_x$$

Intrinsic Impedance (η) is given by

$$\eta = \sqrt{\frac{j\omega\mu}{\sigma + j\omega\varepsilon}}$$

Equation 5: Intrinsic Impedance

For free space, $\eta = \sqrt{\frac{\mu_o}{\varepsilon_0}} = 377\Omega$. Also $H = \frac{E}{\eta}$

Using the formulas above, both Electric and Magnetic Field strengths can be obtained. Table 9 presents the calculated magnetic and electric fields.

Table 9: Calculated Electromagnetic Radiation Level from RFID Antenna at a Distance of 3m.

Power Density(dB)	Power Density(W)	E-Fields (V/m)	H-Fields(A/m)
-21.33	0.118481316	9.451714787	0.025071
-20.33	0.130942105	9.936314567	0.026356
-19.33	0.144713406	10.44576031	0.027708
-18.33	0.159933048	10.98132589	0.029128
-17.33	0.176753354	11.54435051	0.030622
-16.33	0.195342666	12.13624202	0.032192
-15.33	0.215887034	12.75848045	0.033842
-14.33	0.238592071	13.41262173	0.035577
-13.33	0.263685018	14.10030155	0.037401
-12.33	0.291417014	14.82323947	0.039319
-11.33	0.322065609	15.58324321	0.041335
-10.33	0.355937545	16.38221318	0.043454
-9.33	0.393371823	17.22214721	0.045682
-8.33	0.434743099	18.10514558	0.048024

Figures 19 and 20 present the graphs of both calculated Electric field strength and magnetic field strength respectively.

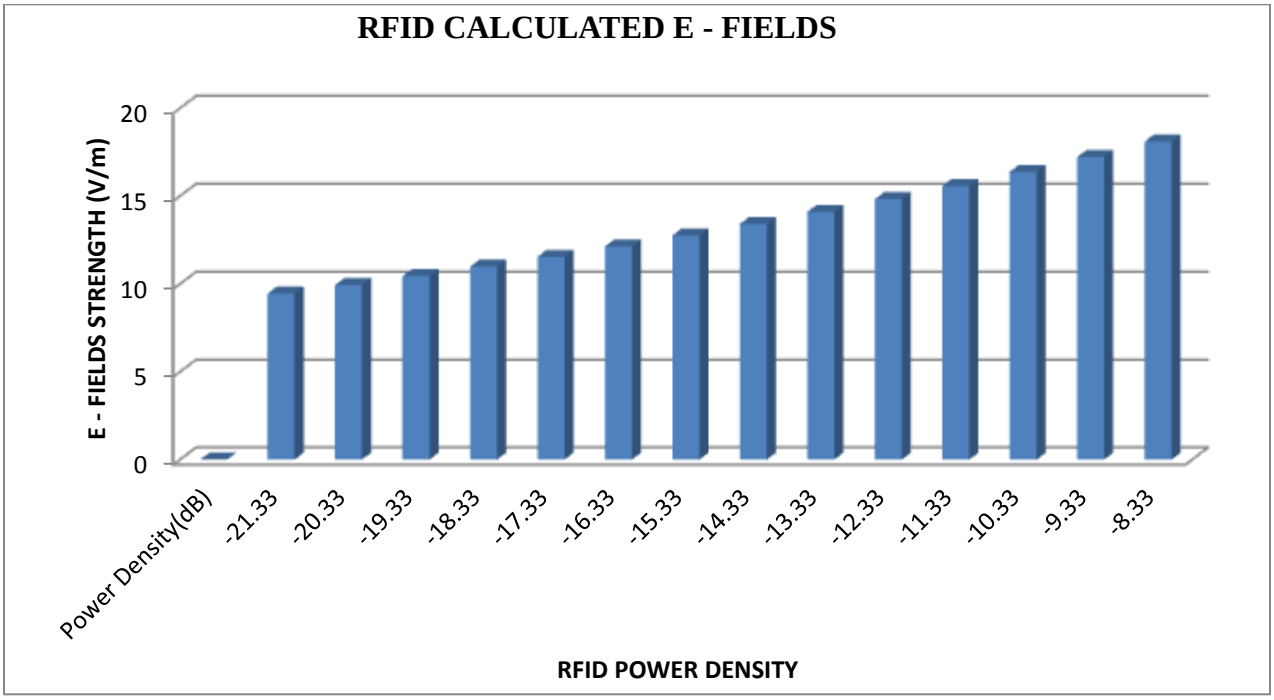


Figure 19: The Graph showing RFID calculated E-Fields Levels

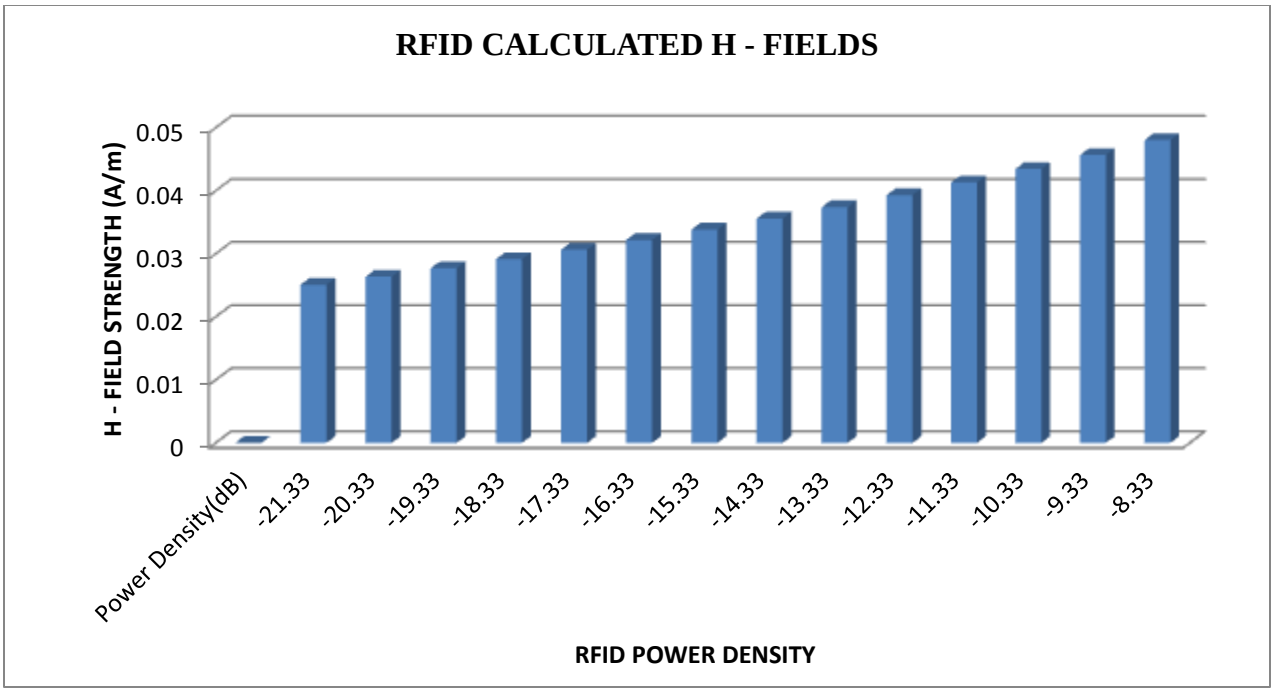


Figure 20: The Graph showing RFID calculated H-Fields Levels

4.5.COMPARISON BETWEEN CALCULATED RFID FIELDS AND ICNIRP STANDARDS

In any particular exposure situation, measured or calculated values of any of the stated quantities can be compared with the appropriate reference level(Zamanian & Hardiman, 2005). Compliance with the reference level will ensure compliance with the relevant basic restriction. Figures 21 and 22 below show the comparison of the calculated RFID electromagnetic radiation emission against the ICNIRP Standards.

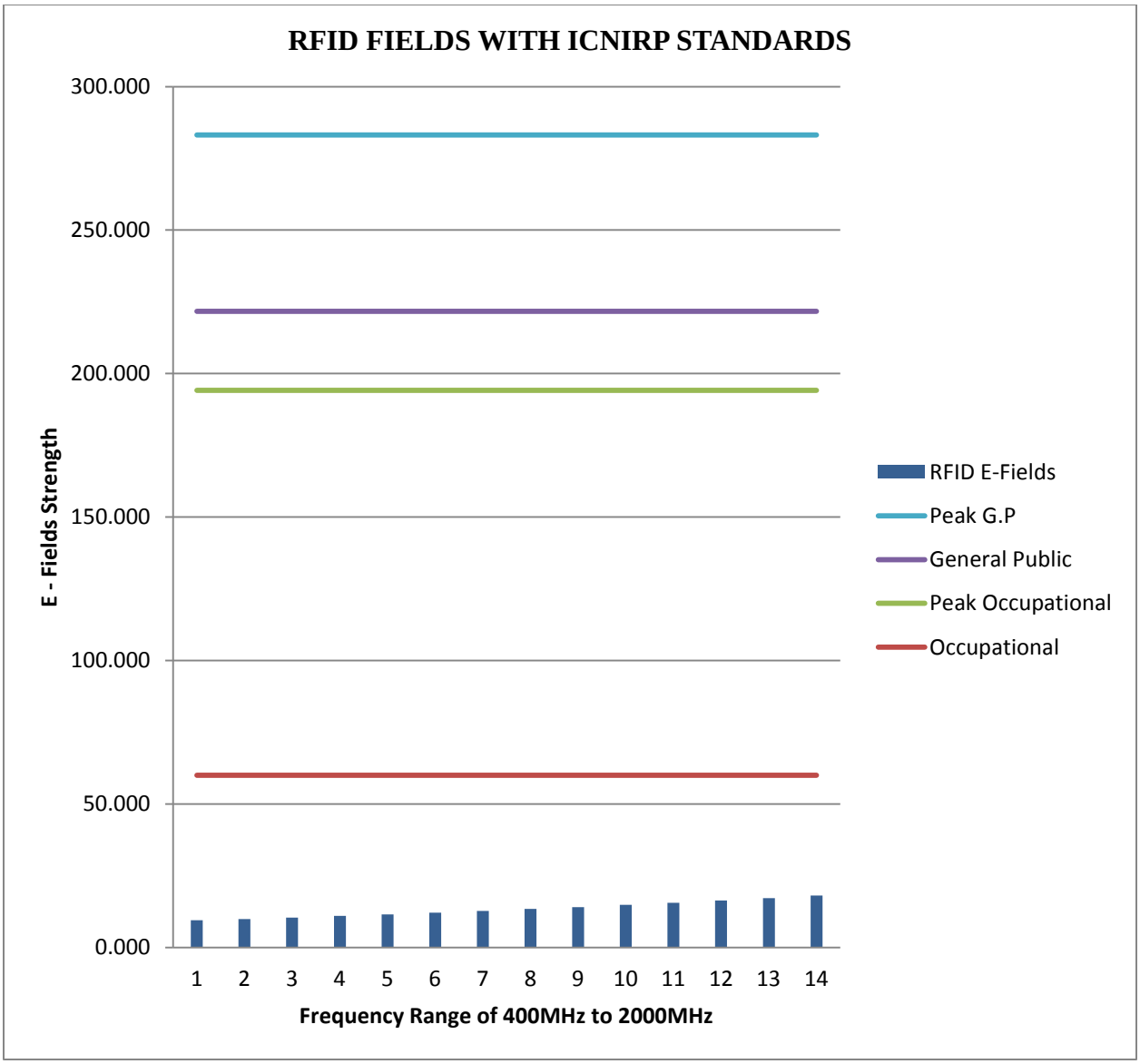


Figure 21: Comparison of the calculated RFID E-field strength against ICNIRP Standards.

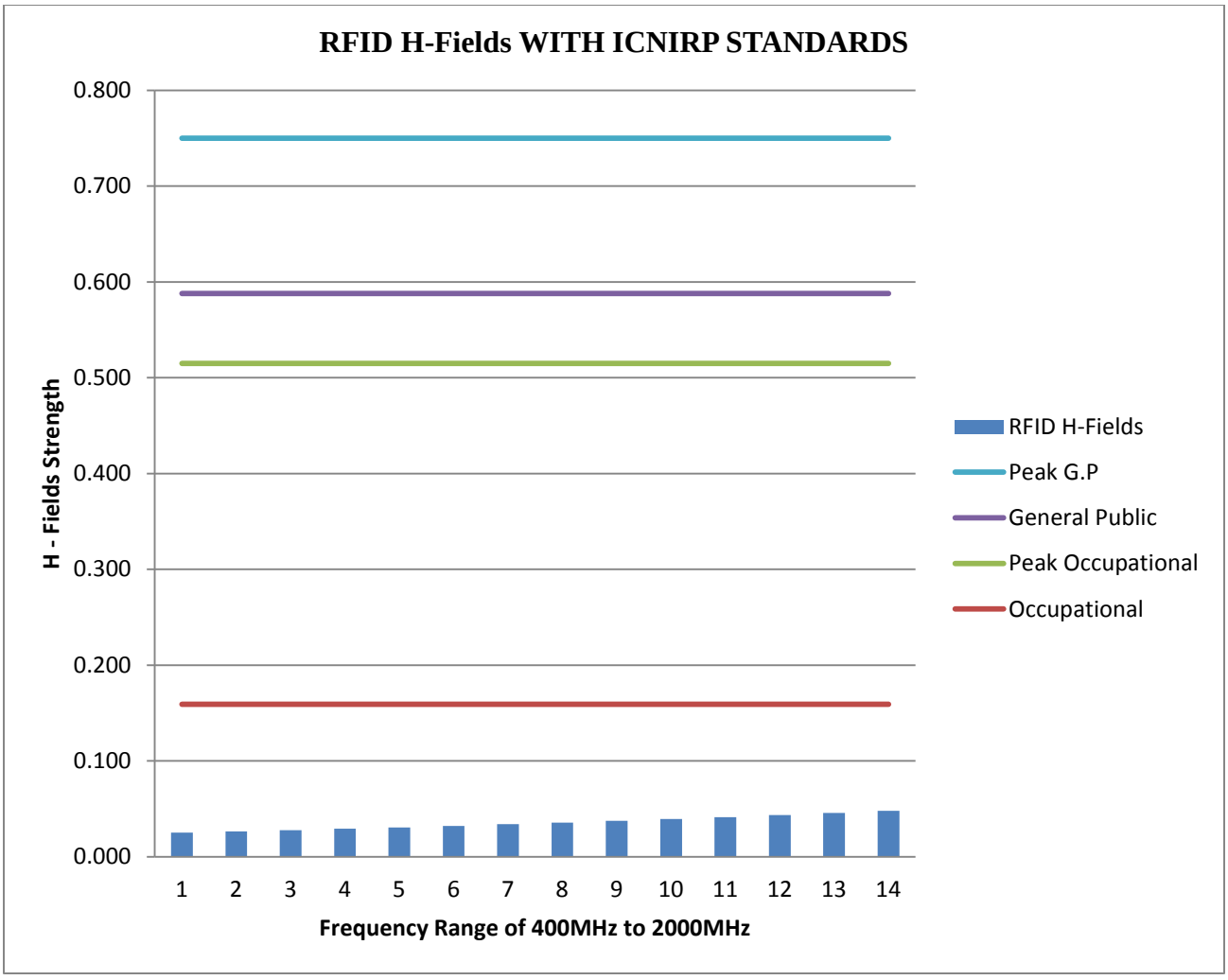


Figure 22: Comparison of Calculated RFID H-Fields strength with ICNIRP Standards.

4.6.CONCLUSION AND DISCUSSION

In any particular exposure situation, measured or calculated values of any of the stated quantities can be compared with the appropriate reference level. Compliance with the reference level will ensure compliance with the relevant Basic Restriction. The above figs 21 and 22 show the comparison between the calculated radio frequency Electromagnetic fields against the ICNIRP standards. From the figures, the calculated RFID fields strength are much lower than both Occupational Exposure reference level and General public exposure reference levels. From this evaluation, it can be clear observed that, RFID is safe to be used in managing student attendance.

CHAPTER FIVE

RADIO FREQUENCY IDENTIFICATION AND MOBILE APPLICATION INTEGRATED ATTENDANCE MANAGEMENT SYSTEM

ABSTRACT

Due to the fact that the current attendance management system for managing student attendance in ordinary level schools in Tanzania is inefficient and involves manual paper based technique in data recording and manipulation, this study proposes the hybrid of Radio frequency identification (RFID) and mobile application for improving student attendance management. This paper discusses the implementation of Radio frequency Identification and mobile application based attendance management system for efficient management of student attendances in ordinary level schools in Tanzania. In this system, RFID play part in detecting the presence of the respective student by detecting tags which are embedded on student's uniforms and hence recording the daily attendance of students. The mobile application part in this system is used as the backup in case the RFID part malfunctions or not fully deployed.

5.1.INTRODUCTION

The fast development of technology in the area of Radio frequency identification and mobile phone nowadays offers many possibilities. Industry and public interest in RFID technology took a major leap in 2003 when Wal-Mart mandated its largest 100 suppliers to commence using RFID tags on shipped items at the pallet level by 2005(Golding & Tennant, 2008). The mobile communication system technologies also have quickly become the world's most common ways of transmitting voice, data, and services in the developing world. The increase in memory capacity and processing capacity of mobile phones has facilitated the development of many mobile applications for different tasks. A mobile application is a computer program designed to run on Smartphone, tablet computers and other mobile devices(Wikipedia) to accomplish a certain task. Radio-frequency identification (RFID) is the wireless use of electromagnetic fields to transfer data, for the purposes of automatically identifying and tracking tags attached to objects. The tags contain electronically stored information (Wikipedia). RFID enables

identification from a distance, and unlike earlier bar-code technology, it does so without requiring a line of sight.(Want, 2006). RFID system consists of readers and tags. Due the capability of identifying objects attached with RFID tags, RFID system could be the best choice in managing student's attendance. Students is the largest union in the study environment(Yuru, Delong, & Liping, 2013) and therefore management of attendance is not an easy task. The combination of RFID and mobile application could be the best alternative for student attendance management in ordinary levels especially for low income countries. The system uses RFID tags which are to be attached to student's school uniforms at the shoulder as a label nearest to the RFID reader during detection, when the student passes the school gate or enters the class depending on how the system is deployed, the RFID reader reads the EPC (Electronic Product Code) and send to the database and hence the attendance being recorded. Before the EPC is send to the database, the system checks against the already recorded EPCs to avoid multiple reading. This system is intended to record student attendance once; however a more sophisticated system can be developed to record first and last EPC detection time. The mobile application is used when the RFID part is not working due electricity outage or any other circumstances. Using the mobile application, the attendance will be recorded and finally an attendance file will be generated whose records will be inserted into the database.

5.2.BACKGROUND

5.2.1. RADIO FREQUENCY IDENTIFICATION

Radio-frequency identification (RFID) is the wireless use of electromagnetic fields to transfer data, for the purposes of automatically identifying and tracking tags attached to objects. The tags contain electronically stored information (Wikipedia). RFID enables identification from a distance, and unlike earlier bar-code technology, it does so without requiring a line of sight.(Want, 2006). RFID system consists of readers and tags.

5.2.2. RFID READERS

An RFID reader, also known as an interrogator is a network connected device (fixed or mobile) with an antenna that sends power as well as data and commands to the tags. It provides the connection between the tag data and the enterprise system software that needs the information

(Impinj). RFID systems can be classified by the type of tag and reader. A **Passive Reader Active Tag** (**PRAT**) system has a passive reader which only receives radio signals from active tags (battery operated, transmit only). An **Active Reader Passive Tag** (**ARPT**) system has an active reader, which transmits interrogator signals and also receives authentication replies from passive tags. An **Active Reader Active Tag** (**ARAT**) system uses active tags awoken with an interrogator signal from the active reader. A variation of this system could also use a Battery-Assisted Passive (BAP) tag which acts like a passive tag but has a small battery to power the tag's return reporting signal. Fixed readers are set up to create a specific interrogation zone which can be tightly controlled. This allows a highly defined reading area for when tags go in and out of the interrogation zone. Mobile readers may be hand-held or mounted on carts or vehicles(Wikipedia). The reader can be connected to the computer through either RS232 connector or TCP/IP interface with an antenna cable of maximum 35m (More than one RFID Readers can be connected to a computer through a LAN switch for TCP/IP connection). Figure 23 shows the four port antenna RFID reader selected to be used in system testing.

Figure 23: Impinj YR806 RFID Reader

5.2.3. RFID TAGS

RFID tags, or simply "tags", are small transponders that respond to queries from a reader by wirelessly transmitting a serial number or similar identifier. A radio-frequency identification system uses tags, or labels attached to the objects to be identified. Two-way radio transmitter-receivers called interrogators or readers send a signal to the tag and read its response. RFID tags can be either passive, active or battery-assisted passive(Wikipedia). RFID tags are available of different types and shapes. Figures 24 and 25 show the samples of RFID tags.

Figure 24: Sample of Adhesive paper type RFID Tags

Figure 25: Sample of Card type RFID Tags

5.3.MOBILE PHONE OPERATING SYSTEMS

The most common operating systems used in smart mobile devices include Android (Google), iOS (Apple), Symbian (Nokia), BlackBerry OS (RIM), Samsung Bada, Microsoft Windows Phone, webOS (Hewlett-Packard) and Linux Maemo and MeeGo(Xanthopoulos & Xinogalos, 2013). From figure 26, Operating systems that monopolize the mobile market are Android (by Google) with a share of 69.6% of installations and iOS (by Apple) with 20.9%. The shares for the rest operating systems are much smaller: 3.5% for RIM; 2.9% for Microsoft; 1.2% for Symbian; and 1.9% for the rest(Egham, 2013).

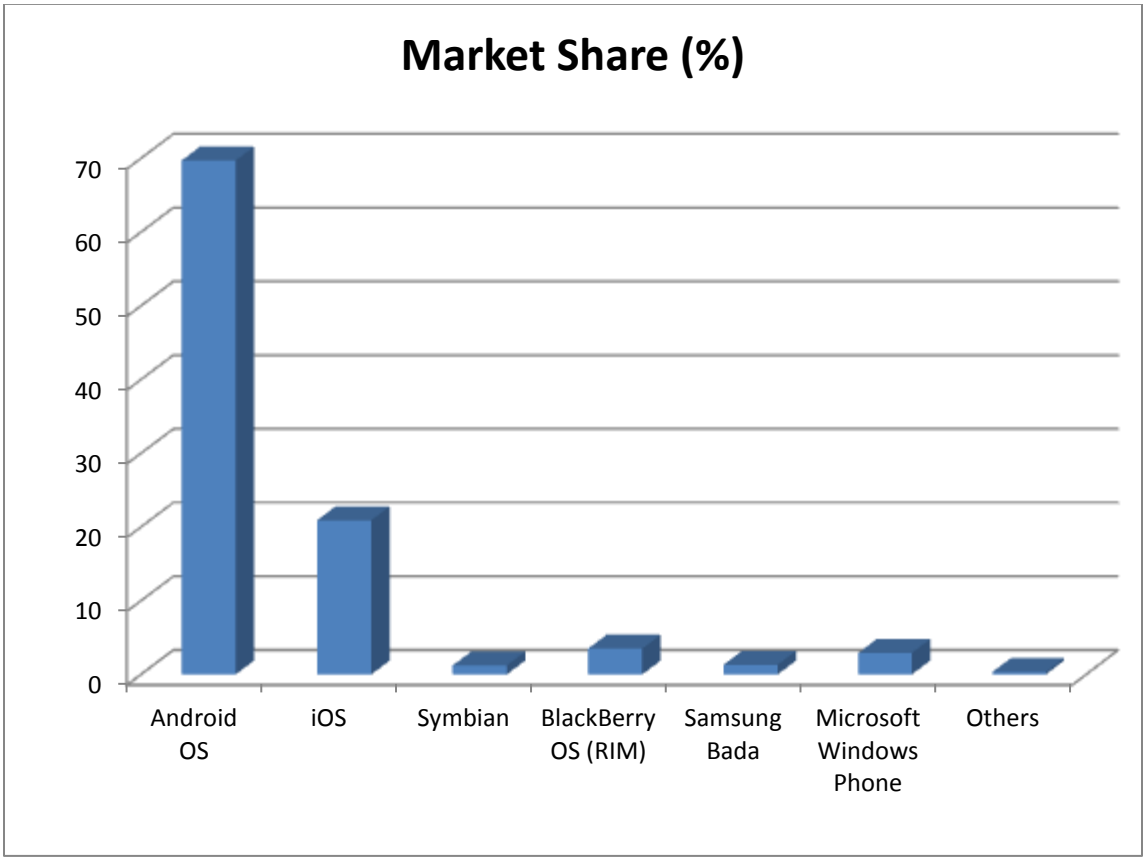


Figure 26: Operating Systems market share **(Egham, 2013)**

5.3.1. ANDROID OS

Android is more of a complete software stack for mobile devices than an operating system. It is a combination of tools and technologies that are carefully optimized for mobile needs. Android

relies on the well-proven Linux kernel in order to provide its operating system functions(Cinar, 2012). It is a stack of software that includes operating system, middleware and libraries and APIs written in C. It was developed by Google and Open Handset Alliance in July, 2005. Android is an open source and Google releases the source code under Apache license. This open source and free license allow the manufacturers and the enthusiastic developers to freely develop and modify their applications in Java-like language that utilizes Google-developed Java libraries(Rastogi & Gupta, 2013). From figure 27, Some of the features which help in the development of Android applications includes application framework, Dalvik Virtue Machine (DVM), SQlite Database management, Linux Kernel etc

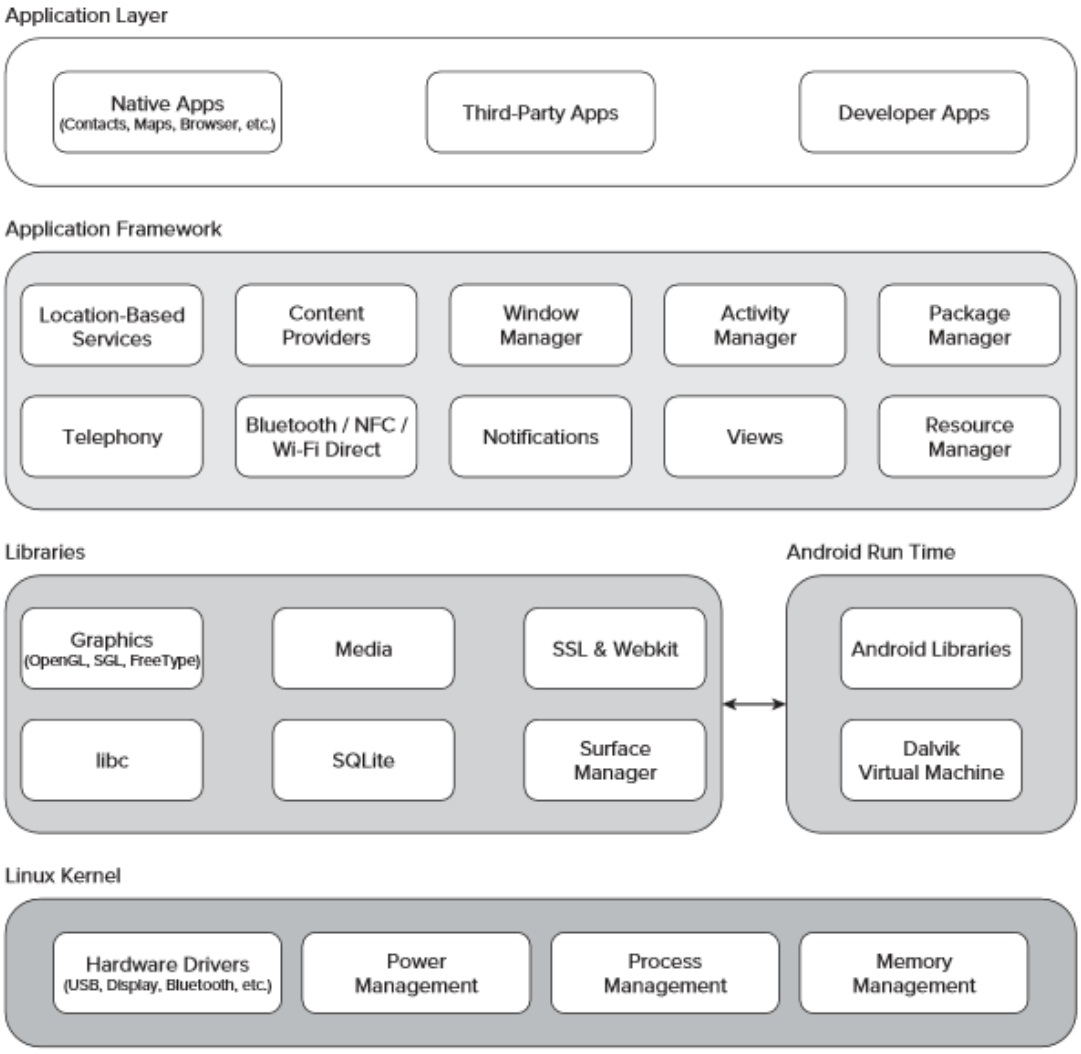


Figure 27: Android platform Architecture(Meier, 2012)

5.4.ATTENDANCE MANAGEMENT SYSTEM

Depending on the mode of recording student attendances, the designed system is divided into two parts, one constitutes an RFID part and the second constitutes a mobile application part.

5.4.1. MOBILE APPLICATION SECTION

This part explains the functionality of the mobile application for attendance management. Firstly, all staffs involved in attendance recording are to be registered in the system. The personal responsible for registration is the system administrator who may be any staff trained on the use of the mobile application. Students also have to be registered in the system in their respective class using their names and registration numbers. Deleting and registering new students is done by system administrator to maintain consistence. The application will be installed in the Smartphone which will be used for the same. The application can be installed in any Smartphone capable of running android applications. Figure 28 shows the mobile application (RMAMS) already installed in the Smartphone.

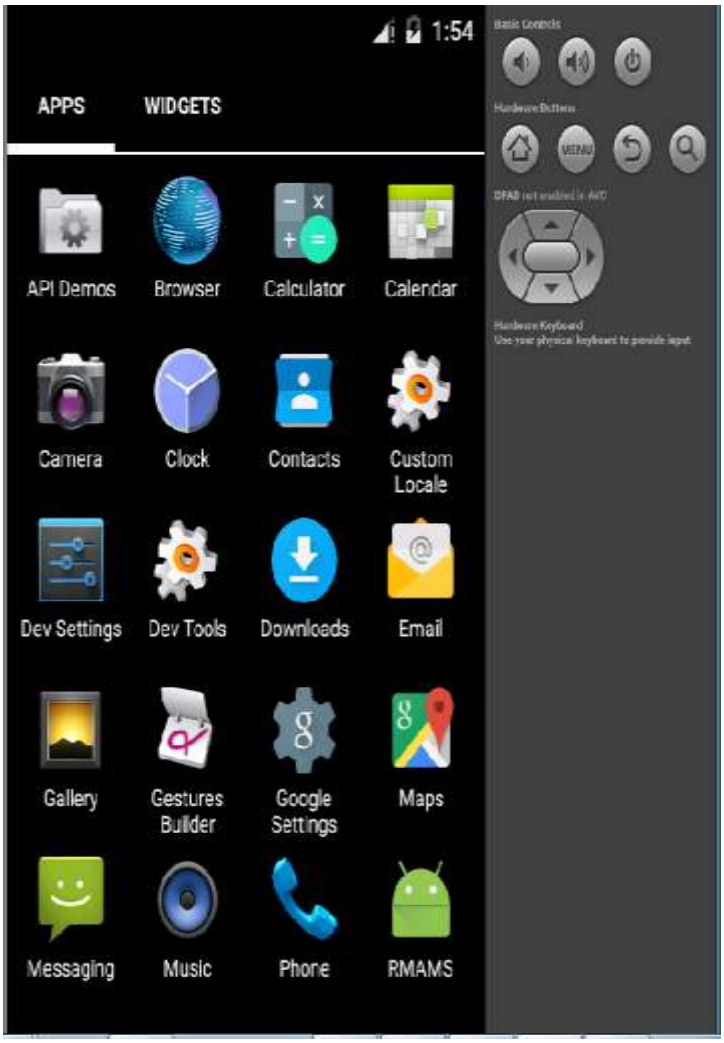


Figure 28: mobile application (RMAMS) Installed in the Smartphone.

Once the application is started, the user will have to provide login information to ensure integrity of the data recorded. Figure 29 below shows the login interface where the use is prompted for username and password.

Figure 29: Mobile application User Login interface.

After the successful login, the user will be directed to the list of tasks which can be performed by the application. Currently the system can facilitate the attendance recording and previewing the list of registered staffs. Figure 30 shows the interface for selecting activity to be performed.

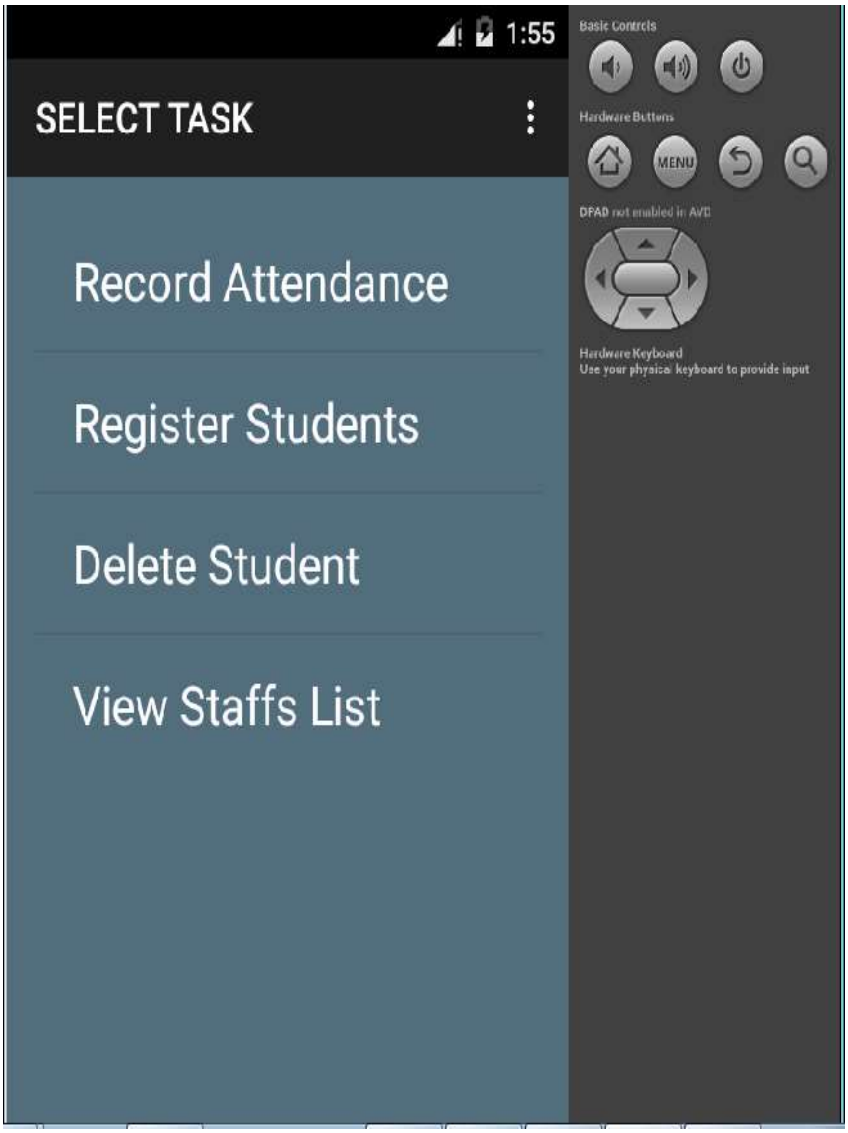


Figure 30: Mobile Application User activity interface.

For attendance recording, the user will need to select the “Record attendance” task. Once the task is selected, the user will be directed to selecting the class for which the attendance is to be recorded. Figure 31 shows the interface where the user will select the class for which attendance is to be recorded.

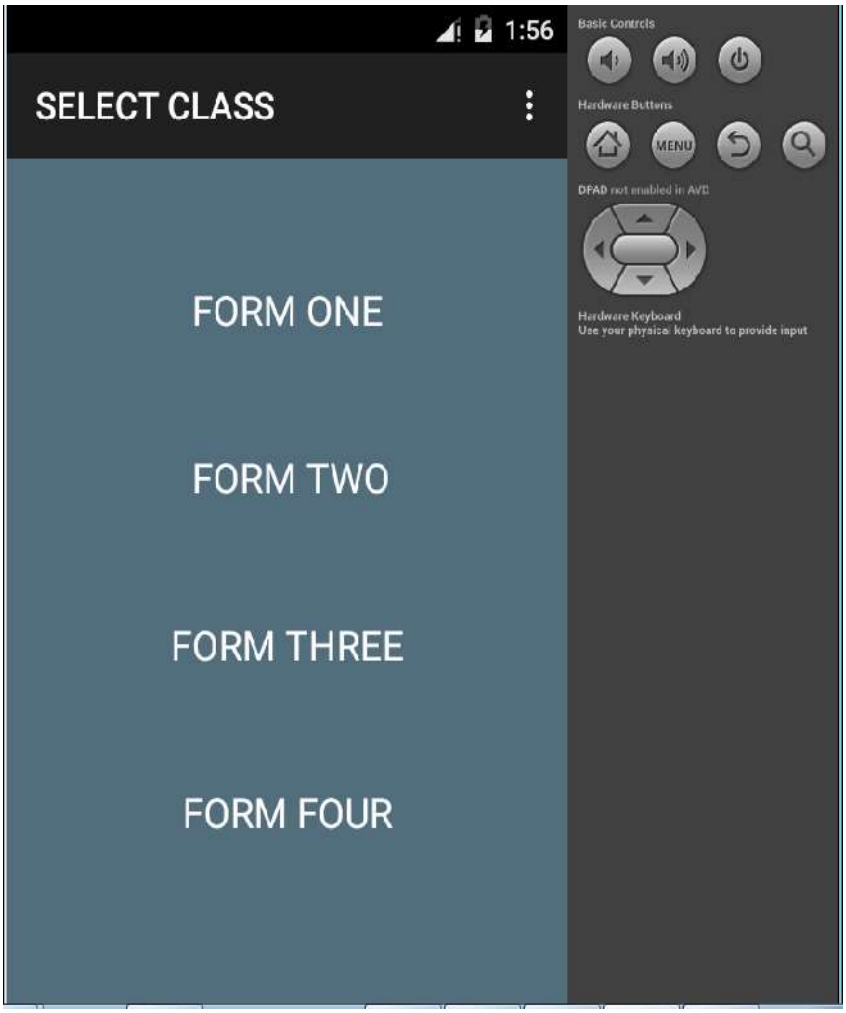


Figure 31: Mobile Application user interface for class selection.

Once the user has selected the class, he/she will be directed to the list of students in the respective class ready to start taking attendance. Figure 32 shows the interface with the list of students. The radio buttons are used to mark the presence or absence of the student. The radio button on the left when checked implies that the student is absent while the radio button on the Right when checked implies that the student is present. The interface also counts the number of students marked present while recording.

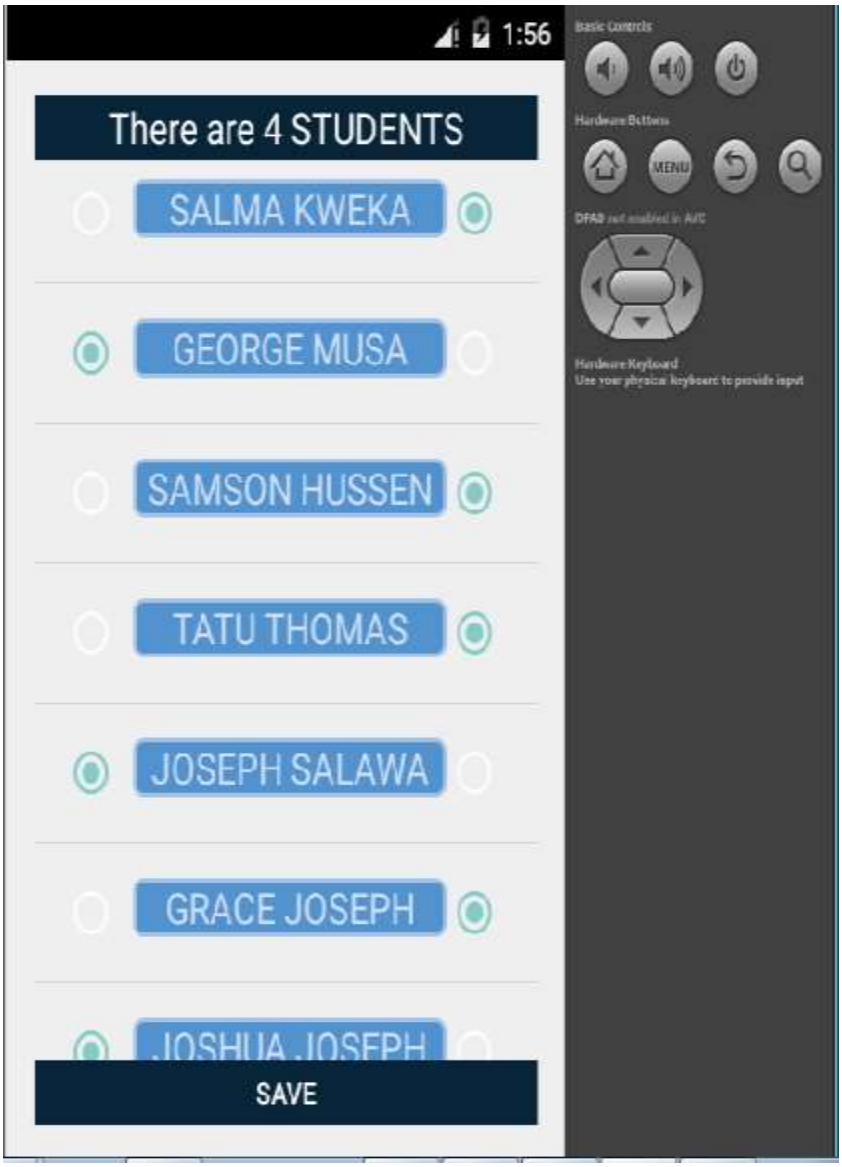


Figure 32: Mobile Application Student attendance list user interface.

After checking all the attendance, the user will click the save button to save the attendance. Once the save button is clicked, the application will generate an Excel file which contains the student identity (studentID) and the attendance count. The file will be temporarily saved in the mobile phone storage waiting to be uploaded to the database.

5.4.2. RFID SECTION

This part explains the functionality of the Radio Frequency Identification for attendance management. All students will be issue with RFID passive tags which will be embedded on the school uniform. RFID Antenna will be placed on the school gates or class doors as the catchment area. Once the student passes near the antenna, the EPC as tagID will be read and conveyed to the database and hence the student attendance being recorded.

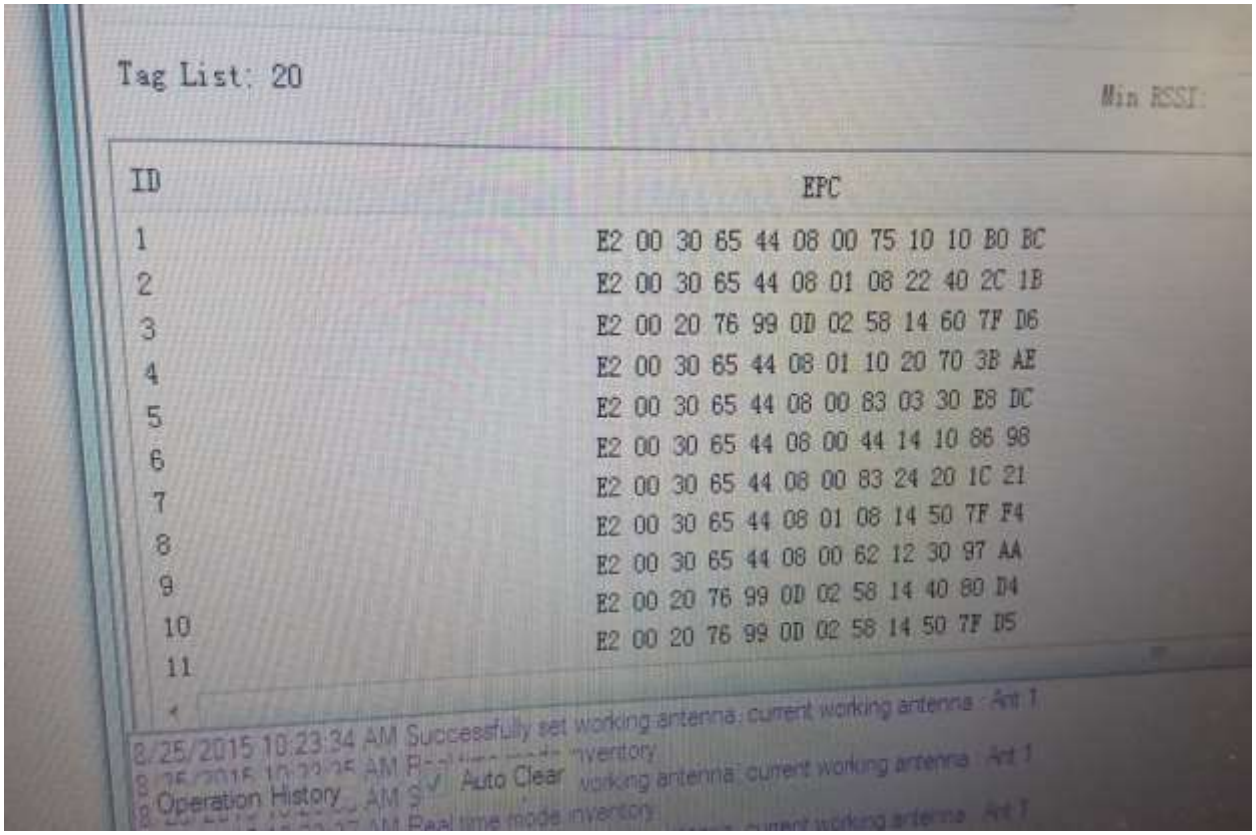


Figure 33: RFID system testing with 20 tags.

5.5.SYSTEM USER INTERFACE

This part explains the functionality of the computer system interface. All users have to be firstly registered in the system. The user will need to login to get access into the system. Figure 34 below show the login interface where the user will enter his/her username and password.

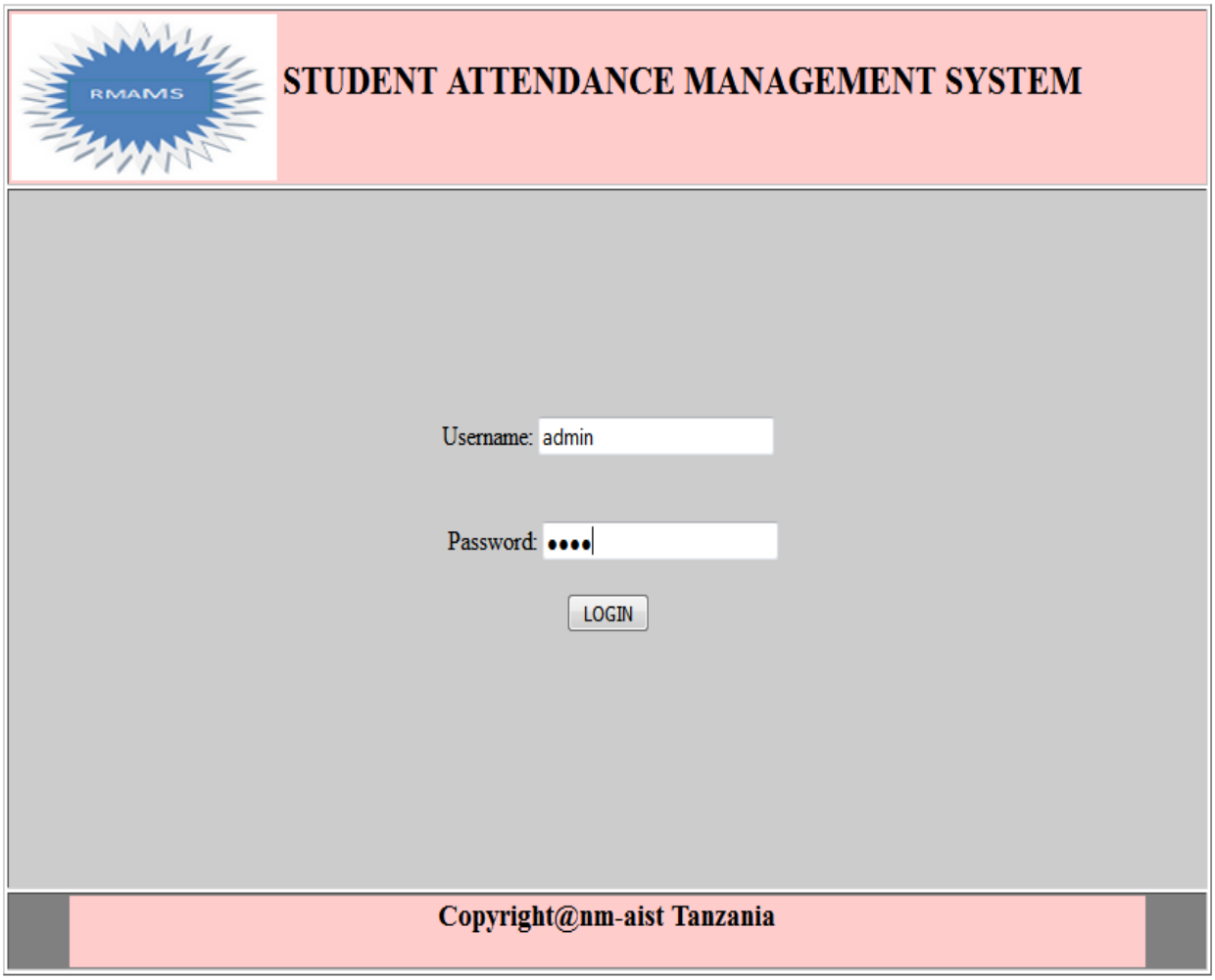


Figure 34: System user login interface.

After a successful login, the user will be directed to the interface where there he/she can choose functionality. At this interface, only the administrator will be able to register new student, to view monthly and daily attendance for each class. Other users are provided with little functionality including viewing attendance information and uploading mobile attendance. Figure 35 shows the major interface where the user can view attendances for all classes monthly and daily. The system will provide report for students who are absent from school for three consecutive days (all any agreed number of days). The report consists of parent mobile phone numbers and therefore can be contacted easily. However, this process can be automated using more sophisticated system with automated calls.

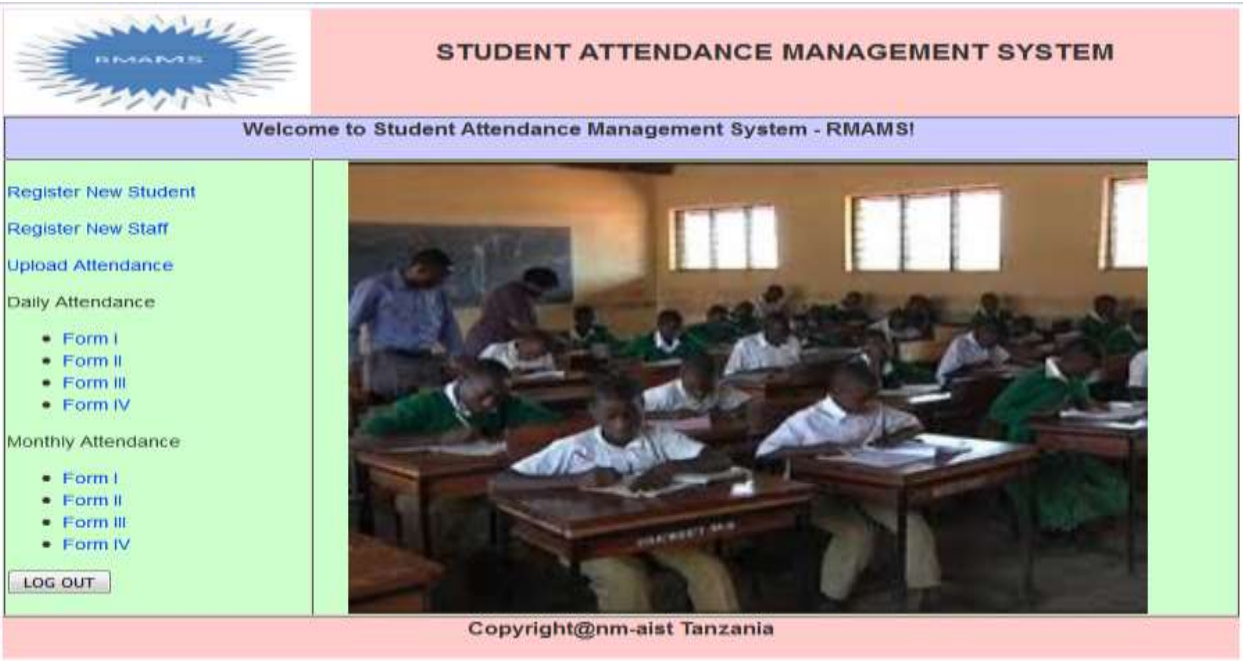


Figure 35: System main user interface.

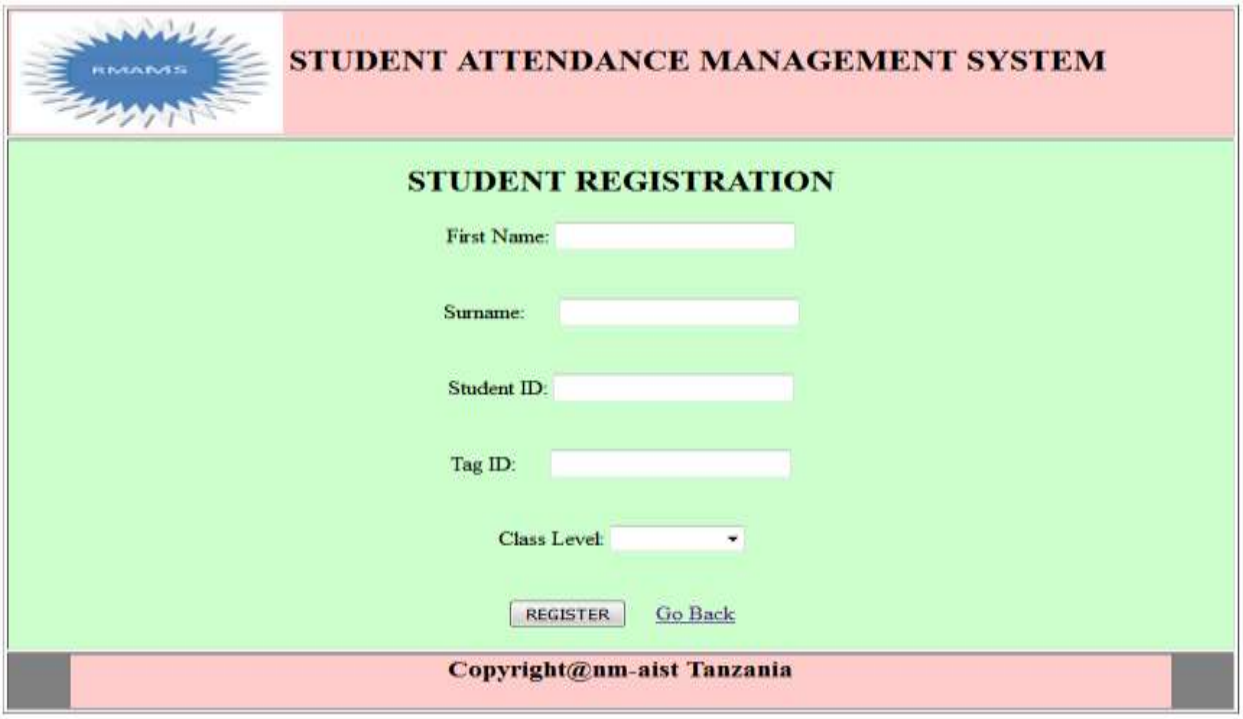


Figure 36: Student Registration Interface.

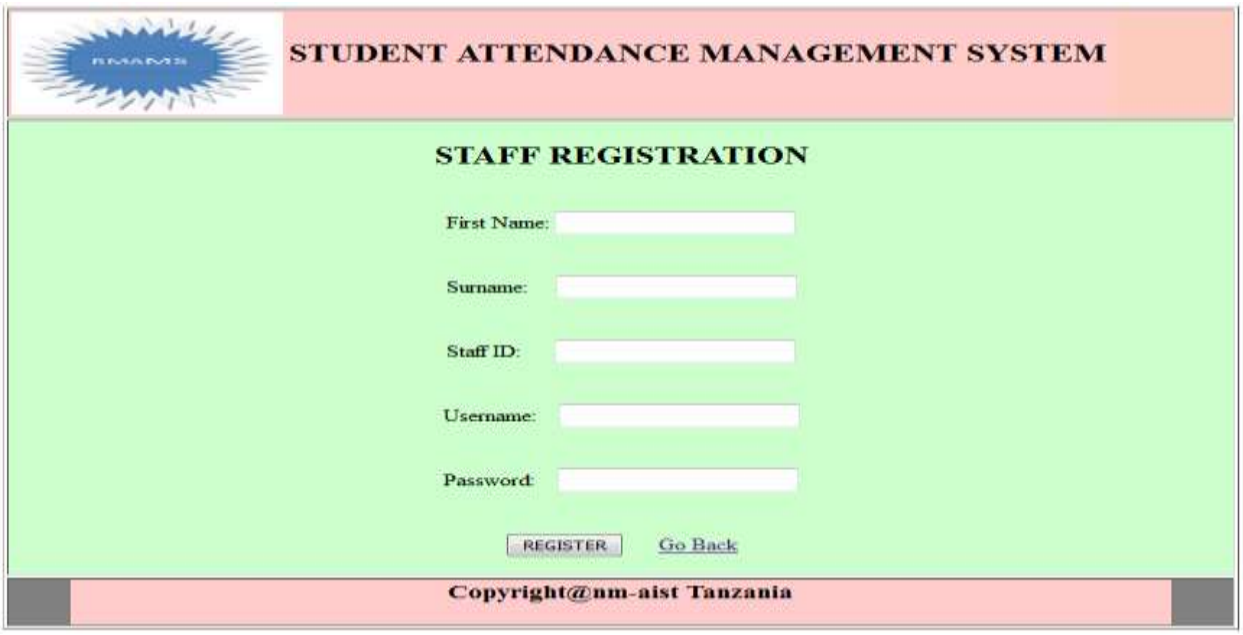


Figure 37: Staff Registration Interface.

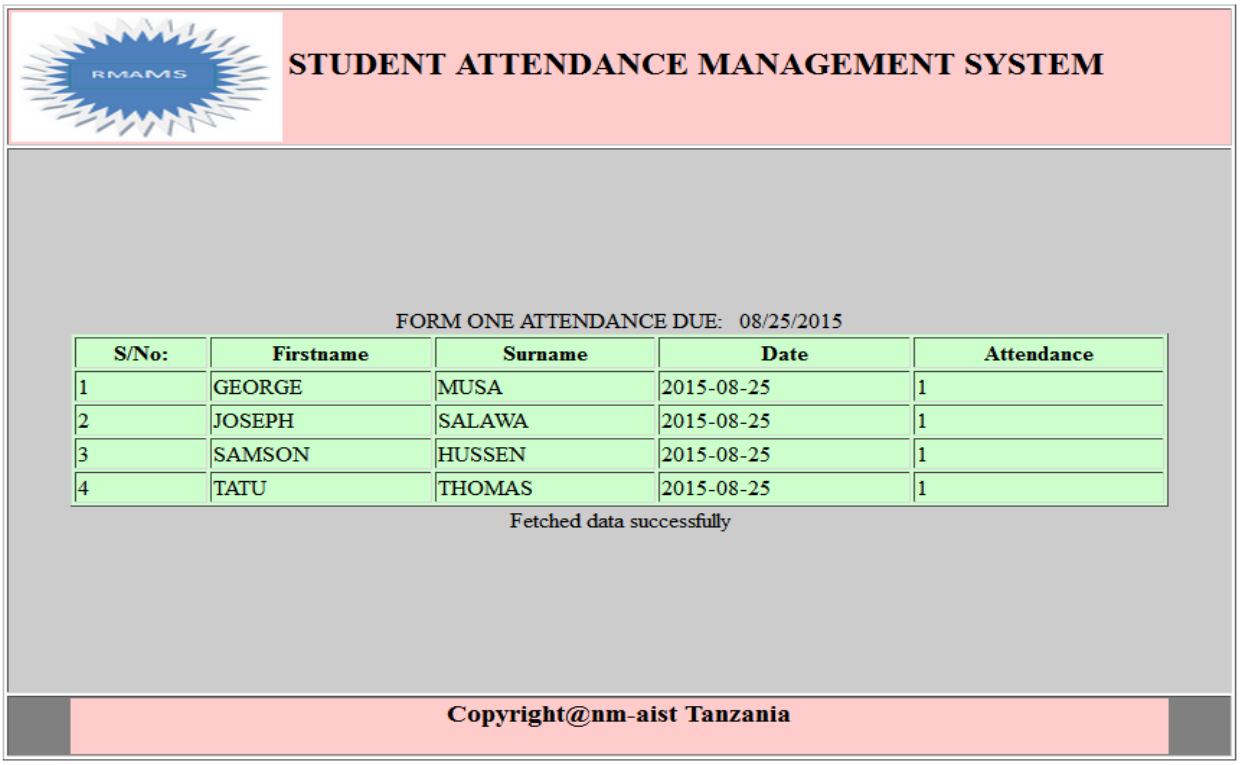


Figure 38: Sample of System Attendance view.

5.6.CONCLUSION

In this paper we have described the development and applicability of RFID and Mobile application integrated attendance management system. We have managed to show how the system can be used in attendance recording using both RFID and mobile application. However more attention is called on the area of data communication to enhance the direct communication between the attendance system and parents/Guardian or any responsible person.

CHAPTER SIX

GENERAL DISCUSSION, CONCLUSION AND RECOMMENDATIONS

6.1. GENERAL DISCUSSION

Several methods for student attendance management have been reviewed in this study. Each of the method has its own strength and weakness depending on the targeted area for deployment. Apart from the paper based system, most of the reviewed systems require internet connectivity to be able to record attendances. Paper based system which is currently most used in ordinary schools is inefficient, time consuming to staffs and error prone. Manual recording of attendance information and manual process of computing the total attendance of each student for each month are among the factors that lead to inefficient and inaccuracy of the paper based attendance management system. Most of the proposed electronic systems for recording attendance include barcode systems, biometric system, SMS based and RFID systems. The main limitations of most of the proposed system are cost of implementation, network requirements and full electric supply all the time.

In regard to this, the study came up with a solution that currently can match with the environment of ordinary level schools of Tanzania with a case of secondary schools. The study proposed the use of combination of RFID and mobile application. The proposed RFID reader consists of four antenna ports and therefore four different catchment points can be controlled by a single reader and hence reduce costs. Also passive RFID tags are proposed to be used because of their low costs. The RFID system is to be used to record attendance of student when there is electricity and enough budget to deploy the full system. For each particular day, the teacher on duty will cross check the list of absentees to see if there is anyone present but not recorded due to any factors for instance error caused by defective tag etc. Mobile application is deployed as the backup system for RFID system. Mobile application will be used in case of electricity outage or the RFID part has not been deployed. Mobile application records attendance and saves into a file which can then be imported into the database. The reasons of proposing the combination of RFID and Mobile application are based on considering both costs of implementation and the nature of ordinary level schools.

6.2. CONCLUSION

In order for an organization to become successful, it has to ensure that the employees come to work regularly. Failure to monitor employee attendance may result into failure of the organization to attain its goals. With respect to students, many studies have shown that a student who fails to attend classes regularly, he/she is likely to underperform in his/her studies. For any school to succeed academically first, is to ensure that students attends class regularly and teachers fulfill their duties. By that case, a smart attendance management system is required to manage student attendances. This study has shown the way, it is the duty of the school management and other responsible persons to pass through.

6.3. RECOMMENDATIONS

This study was conducted to improve efficiency in student attendance management, in other words, to replace the manual way of recording student attendance by an automated system. Since the developed system only records student attendance to the database, it is better to enhance the system to also record teacher's class attendance, send and receive messages to and from other stakeholders like parents/Guardians about the progress of their students. This study has shown the light on smart student attendance management, it is the duty of implementers to use the light for better success.

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APPENDICES

MOBILE APPLICATION SOURCE CODES

- MAIN ACTIVITY

```
public class MainActivity extends AppCompatActivity {
   @Override
   protected void onCreate(Bundle savedInstanceState) {
      super.onCreate(savedInstanceState);
      setContentView(R.layout.activity_main);
      TextView loginLink = (TextView) findViewById(R.id.code);
      loginLink.setOnClickListener(new View.OnClickListener() {
         @Override
         public void onClick(View v) {
            Intent i = new Intent(getApplicationContext(), login.class);
            startActivity(i); } });}
   @Override
   public boolean onCreateOptionsMenu(Menu menu) {
      getMenuInflater().inflate(R.menu.menu_main, menu);
      return true;}
   @Override
   public boolean onOptionsItemSelected(MenuItem item) {
      int id = item.getItemId();
      if (id == R.id.action_settings) {
         return true;}
      return super.onOptionsItemSelected(item);}}
```

- LOGIN

```
public class login extends AppCompatActivity {
   @Override
   protected void onCreate(Bundle savedInstanceState) {
      super.onCreate(savedInstanceState);
      setContentView(R.layout.activity_login);
      TextView staffRegister = (TextView) findViewById(R.id.link_to_register);
      Button btnLogin = (Button) findViewById(R.id.btnLogin);
      final TextView username = (TextView) findViewById(R.id.username);
      final TextView password = (TextView) findViewById(R.id.password);
      staffRegister.setOnClickListener(new View.OnClickListener() {
```

```
        public void onClick(View v) {
            Toast.makeText(getApplicationContext(), "Consult the System
    Administrator", Toast.LENGTH_SHORT).show();
            return;}});
        btnLogin.setOnClickListener(new View.OnClickListener() {
          @Override
          public void onClick(View v)
            String name = username.getText().toString().trim().toUpperCase();
            String pass = password.getText().toString().trim().toUpperCase();
            if (name.length() == 0) {
              Toast.makeText(getApplicationContext(), "Please enter Username.",
    Toast.LENGTH_SHORT).show();
              return;
            } else if (pass.length() == 0) {
              Toast.makeText(getApplicationContext(), "Please enter password.",
    Toast.LENGTH_SHORT).show();
              return;}
            String both=pass+" " +name;
            for (int i=0;i< namevalues.length; ++i)  {
              if(namevalues[i].equalsIgnoreCase(both)) {
                Toast.makeText(getApplicationContext(), "Welcome"
    +namevalues[i]+"", Toast.LENGTH_SHORT).show();
                Intent j = new Intent(getApplicationContext(), Tasks.class);
                startActivity(j);
                return;} }
            Toast.makeText(getApplicationContext(), "Wrong Cresidentials" ,
    Toast.LENGTH_SHORT).show(); }});}
      @Override
      public boolean onCreateOptionsMenu(Menu menu) {
        getMenuInflater().inflate(R.menu.menu_login, menu);
        return true;}
      @Override
      public boolean onOptionsItemSelected(MenuItem item) {
        int id = item.getItemId();
        if (id == R.id.action_settings) {
          return true;}
        return super.onOptionsItemSelected(item); }}
```

- TASK ADAPTER

```
public class TaskAdapter extends ArrayAdapter<ModelTasks> {
private final Context context;
private final ArrayList<ModelTasks> tasksArrayList;
public TaskAdapter(Context context, ArrayList<ModelTasks> tasksArrayList) {
   super(context, R.layout.activity_row, tasksArrayList);
   this.context = context;
   this.tasksArrayList = tasksArrayList; }
@Override
public View getView(int position, View convertView, ViewGroup parent) {
   LayoutInflater inflater = (LayoutInflater) context
         .getSystemService(Context.LAYOUT_INFLATER_SERVICE);
   View rowView = inflater.inflate(R.layout.activity_row, parent, false);
   TextView labelView = (TextView) rowView.findViewById(R.id.label);
   labelView.setText(tasksArrayList.get(position).getItem());
   return rowView; }}
```

- TASK LIST

```
public class Tasks extends AppCompatActivity {
   @Override
   protected void onCreate(Bundle savedInstanceState) {
      super.onCreate(savedInstanceState);
      setContentView(R.layout.activity_tasks);
      TaskAdapter adapter = new TaskAdapter(this, generateData());
      ListView listView = (ListView) findViewById(R.id.listView);
      listView.setAdapter(adapter);
      listView.setOnItemClickListener(new AdapterView.OnItemClickListener() {
         @Override
         public void onItemClick(AdapterView<?> parent, View view, int position,
long id) { if (position == 0) {
               Intent i = new Intent(getApplicationContext(), ClassList.class);
               startActivity(i);}
            if (position == 1) {
               Toast.makeText(getApplicationContext(), "Consult the System
Administrator", Toast.LENGTH_SHORT).show();
               return;}
            if (position == 2) {
               Toast.makeText(getApplicationContext(), "Consult the System
Administrator", Toast.LENGTH_SHORT).show();
```

```
            return; }
        if (position == 3) {
            Intent i = new Intent(getApplicationContext(), StaffList.class);
            startActivity(i); }} });}
    private ArrayList<ModelTasks> generateData(){
        ArrayList<ModelTasks> items = new ArrayList<ModelTasks>();
        setContentView(R.layout.activity_tasks);
        String[] values = new String[] { "Record Attendance","Register Students",
"Delete Student", "View Staffs List" };
        for (int i = 0; i < values.length; ++i) {
            items.add(new ModelTasks(values[i]));}
        return items;}
    @Override
    public boolean onCreateOptionsMenu(Menu menu) {
        getMenuInflater().inflate(R.menu.menu_tasks, menu);
        return true; }
    @Override
    public boolean onOptionsItemSelected(MenuItem item) {
        int id = item.getItemId();
        if (id == R.id.action_settings) {
            return true; }
        return super.onOptionsItemSelected(item);}}
```

- STUDENT ATTENDANCE BOOK

```
public class StudentAttendance extends Activity {
 private Button savebtn;
 static String TAG = "ExelLog";
 private ArrayList<RowObject> nameSource;
 private TextView counterDisplay;
 private ArrayList<MobileAttendance> mobileAttendances;
 @Override
 public void onCreate(Bundle savedInstanceState) {
    super.onCreate(savedInstanceState);
    setContentView(R.layout.activity_student_attendance);
    nameSource = new ArrayList<RowObject>();
    mobileAttendances=new ArrayList<MobileAttendance>();
    for (int i=0;i<namevalues.length; ++i) {
        nameSource.add(new RowObject(namevalues[i],false));
        mobileAttendances.add(new MobileAttendance(studentID[i],0));}
```

```
savebtn = (Button) findViewById(R.id.saveBtn);
counterDisplay = (TextView) findViewById(R.id.mTextView);
ListView mListView = (ListView) findViewById(R.id.listView);
mListView.setAdapter(new MyAdapter(getApplicationContext(), nameSource));
savebtn.setOnClickListener(new View.OnClickListener() {
   public void onClick(View v) {
      if (!isExternalStorageAvailable() || isExternalStorageReadOnly()) {
         Log.e(TAG, "Storage not available or read only");
         return; }
      Workbook wb = new HSSFWorkbook();
      Cell c = null;
      CellStyle cs = wb.createCellStyle();
      cs.setFillForegroundColor(HSSFColor.LIME.index);
      cs.setFillPattern(HSSFCellStyle.SOLID_FOREGROUND);
      Sheet sheet1 = null;
      sheet1 = wb.createSheet("Attendance");
      Row row = sheet1.createRow(0);
      c = row.createCell(0);
      c.setCellValue("studentID");
      c.setCellStyle(cs);
      c = row.createCell(1);
      c.setCellValue("Count");
      c.setCellStyle(cs);
      sheet1.setColumnWidth(0, (15 * 500));
      sheet1.setColumnWidth(1, (15 * 500));
      for (int i=0;i<namevalues.length;++i) {
         row=sheet1.createRow(i+1);
         c = row.createCell(0);
         c.setCellValue(mobileAttendances.get(i).getStudentID());
         c.setCellStyle(cs);
         c = row.createCell(1);
         c.setCellValue(mobileAttendances.get(i).getAttendance_count());
         c.setCellStyle(cs);}
      File f = new
File(Environment.getExternalStorageDirectory(),"Mobile_Attendance_F2.xls");
      FileOutputStream os = null;
      try {
         os = new FileOutputStream(f);
         wb.write(os);
         Toast.makeText(StudentAttendance.this, " SAVED IN" + f,
```

```
Toast.LENGTH_SHORT).show();
                finish();
            } catch (IOException e) {
                Log.w("FileUtils", "Error writing " + f, e);
            } catch (Exception e) {
                Log.w("FileUtils", "Failed to save file", e);
            } finally {
                try {
                    if (null != os)
                        os.close();
                } catch (Exception ex) { }}
            return   });}
    public static boolean isExternalStorageReadOnly() {
        String extStorageState = Environment.getExternalStorageState();
        if (Environment.MEDIA_MOUNTED_READ_ONLY.equals(extStorageState)) {
            return true;}
        return false }
    public static boolean isExternalStorageAvailable() {
        String extStorageState = Environment.getExternalStorageState();
        if (Environment.MEDIA_MOUNTED.equals(extStorageState)) {
            return true; }
        return false;}
    private class MyAdapter extends ArrayAdapter<RowObject> {
        class ViewHolder {
            RadioGroup rbGroup;
            RadioButton abs;
            RadioButton prs;
            TextView names;}
        private LayoutInflater mInflater;
        public MyAdapter(Context context, ArrayList<RowObject> nameSource) {
            super(context, R.layout.activity_row_list, nameSource);
            mInflater = LayoutInflater.from(context); }
        public View getView(final int position, View convertView, ViewGroup parent) {
            ViewHolder holder;
            if (convertView == null) {
                convertView = mInflater.inflate(R.layout.activity_row_list, null);
                TextView labelView = (TextView)
convertView.findViewById(R.id.namesList);
                labelView.setText(nameSource.get(position).getName());
                holder = new ViewHolder();
```

```
            holder.rbGroup = (RadioGroup)
convertView.findViewById(R.id.radioGroup);
            holder.abs = (RadioButton) convertView.findViewById(R.id.ABS);
            holder.prs = (RadioButton) convertView.findViewById(R.id.PST);
            holder.names=(TextView)convertView.findViewById(R.id.namesList);
            convertView.setTag(holder);  } else {
            holder = (ViewHolder) convertView.getTag();}
          holder.rbGroup.setOnCheckedChangeListener(new
RadioGroup.OnCheckedChangeListener() {
            public void onCheckedChanged(RadioGroup group, int checkedId) {
              switch (checkedId) {
                case R.id.PST:
                  nameSource.get(position).setStatus(true);
                  mobileAttendances.get(position).setAttendance_count(1);
                  break;
                case R.id.ABS:
                  nameSource.get(position).setStatus(false);
                  mobileAttendances.get(position).setAttendance_count(0);
                  break;}
              counterDisplay.setText("There are " + presentStudents() + "
STUDENTS");}});
          if (nameSource.get(position).isStatus()) {
            holder.prs.setChecked(true);
            holder.abs.setChecked(false);
          } else {
            holder.prs.setChecked(false);
            holder.abs.setChecked(true); }
          return convertView;  }
        private int presentStudents() {
          int count = 0;
          for (RowObject object : nameSource) {
            if (object.isStatus()) {count++;}}
          return count; }}
    @Override
    public boolean onCreateOptionsMenu(Menu menu) {
      getMenuInflater().inflate(R.menu.menu_student_attendance, menu);
      return true;}
    @Override
    public boolean onOptionsItemSelected(MenuItem item) {
            int id = item.getItemId();
```

```
if (id == R.id.action_settings) {
   return true;}
return super.onOptionsItemSelected(item);}}
```