Electronic Cartero Machine (ECM): An RFID-Based One-Way SMS-Sending Kiosk

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Abstract: The study's goal was to see whether a one - way text messaging machine using RFID will be effective to the students, teachers, and parents/guardians. The study has taken advantage of the school's usage of RFID to record the attendance. The same RFIDs are to be used to register into the Electronic Cartero Machine (ECM). The researchers built a system where students can message their parents/guardians their concerns by tapping the students registered RFID using the Raspberry Pi as a controller to show the GUI (Graphical User Interface) of the system. The main program is custom made using Java SE (Standard Edition) and Swing. There are 20 respondents to the survey, consisting of the students, teachers, parents/guardians, and administrative staffs to evaluate the appearance, maintainability, ease in usage and accuracy. The survey uses general acceptability indicators to describe the mean of the outcome. From the results of the survey, the appearance mean is 4.25 which suggests that the design of the ECM, especially the GUI is clear and identifiable, the maintainability mean is 4.7 which indicates that it can easily be maintained. Ease in usage is 4.9 which means that it can send the text messages to the proper recipients. The overall mean is 4.5675. It scored "Excellent" on the general acceptability indicators. Furthermore, the researchers discovered that the ECM is similar with the regular cellular phones in terms of sending time. Also, the number of characters being sent affects the sending time of the ECM.

Key Words: SMS; RFID; GUI; no cellular phone policy; communication

1. INTRODUCTION

RFID stands for Radio Frequency Identification which is an auto recognition technology that allows RFID reader to read data from RFID tags (labels) via wireless communication or better to say via radio signals from a distance (Scanlan, 2015).

The principle of using RFID to track things is used by many schools today to keep track of the students' attendance, students' time of arrival and departure from school that then texted to the students' parents.

The Lyceum of the Philippines University creates a Laguna Student Electronic Attendance and Logging System. This study was developed to create an electronic attendance and logging system using Radio Frequency Identification (RFID) and Short Messaging Service (SMS) with a web-based management system portal that allows user to access real time data to ensure campus security and smart information management.

Currently, with the widespread use of technology, the Department of Education (DepEd) in the Philippines has issued Department Order (DO) No. 83, s. 2003 - Reiteration to DECS Orders Nos. 70, s. 1999 and 26, s. 2000 - Prohibiting Students of Elementary and Secondary Schools from Using Cellular Phones and Pagers During Class Hours.

With order being implemented, students are not allowed to bring cell phones, an example of a school implementing such policy is the school of the researcher.

In this line, the researcher is making a proactive approach that can help improve communication between students and parents in case a message is needed to convey in any given situation. Using this system, just tap their RFID, screen will be activated, type your message, press send and will automatically send the text message to any GSM network of parent's registered number, then will prompt the message has been sent and will logout automatically to serve the next student.

1.1 Statement of the Problem

The study aims to provide a more efficient system of communication between the students of Tarlac Montessori School and their attending guardians.

The study also aims to answer the following questions:
1. How can the Electronic Cartero Machine be described in terms of:
    1. Appearance;
    2. Maintenance;
    3. Ease in usage ;

4.   Accuracy?
2. Is there a significant difference between the ECM and the regular cellular phone in terms of sending time?
3. Is there a significant relationship between the sending time of the ECM and the number of characters sent?
4.   What are the implications of the ElectronicCartero machine to the society?

1.2 Significance of the Study

The purpose of this study is to strengthen the communication between the attending guardians and students during the students' time in school. With this study, the school would have an alternative communication system which can be utilized when a student needed to message their parents because of an emergency or because they needed something.

This study will significantly benefit the attending guardians students, and the school administrations.

1.3 Scope

The researchers' proposed system will be using the idea or concept of the current system of the RFID of Tarlac Montessori School (which notifies parents/guardians if their child has entered or left the school campus) and enhance it by adding an SMS so that the student will be able to send a message to the parents/guardians regarding specific topics using their own RFIDs. The system can be used by all schools that have acquired or will acquire for an RFID system.

2. METHODOLOGY

2.1 Experimental Design

The researchers developed an RFID-Raspberry Pi-GSM System to test the one-way text processing system that will be needed in the study. Figure 1 shows the System Block Diagram. The main program is custom made using Java SE (Standard Edition) and Swing [GUI (Graphical User Interface) Development Language for Java] or simply Java program. For an RFID and GSM system to link to Java program, the programmers use AT (Attention), expect and bash (Bourne Again Shell) programming languages. As shown in the Figure 1, the student's ID is used to tap the ID to RFID reader. The RFID reader will forward the information to the data base on Raspberry Pi. The RFID information embedded will served as login authentication to enter the system. The ID should be registered to the system, otherwise a message will prompt that the student is not a registered user and cannot use the system until the student completed the registration process.

System Administrator is responsible to process the addition of user/s in the system. Once the system recognized that the student is a valid user, a GUI (Graphical User Interface) will appear to the LCD monitor processed using Raspberry Pi running on Raspbian OS (Operating System). Java JRE (Java Runtime Environment) is also installed in the Raspbian to run the Java program. The student can send the SMS message to his/her parent's cell phone numbers regardless of their carrier's network. The system is capable to identify and process SMS in any network. The GSM System is used to process any SMS to and from the Raspberry Pi. The sender or student can see two previous successful message sent by the parent or guardian found in Inbox as shown in Figure 4.
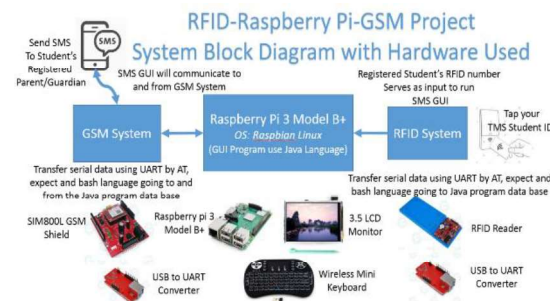

Figure 2. RFID-Raspberry Pi-GSM Project System Block Diagram
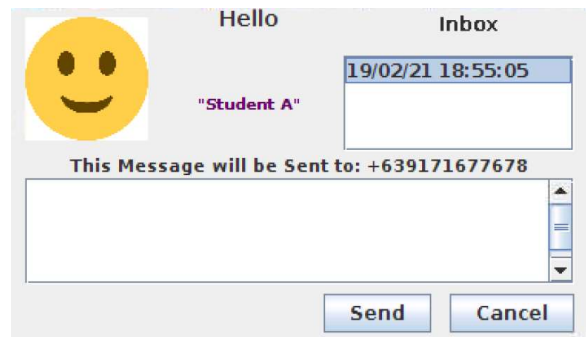

Figure 3. Main GUI Design

Figure 4. SMS GUI Design

Please click the 'Scan' button and Badge your ID to Activate this Form [Scan]

*RFID Number: [   ] [Scan]

*Student Full Name: [   ]

Student Photo Location: [   ] [Browse]

*Guardian Full Name: [   ]

*Guardian Mobile Number: [   ]

[Register] [Cancel]
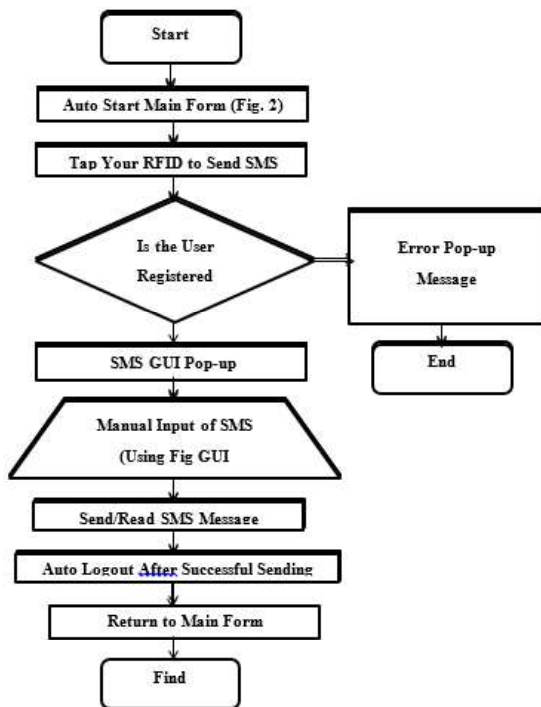
Figure 5 shows the Registration GUI Design

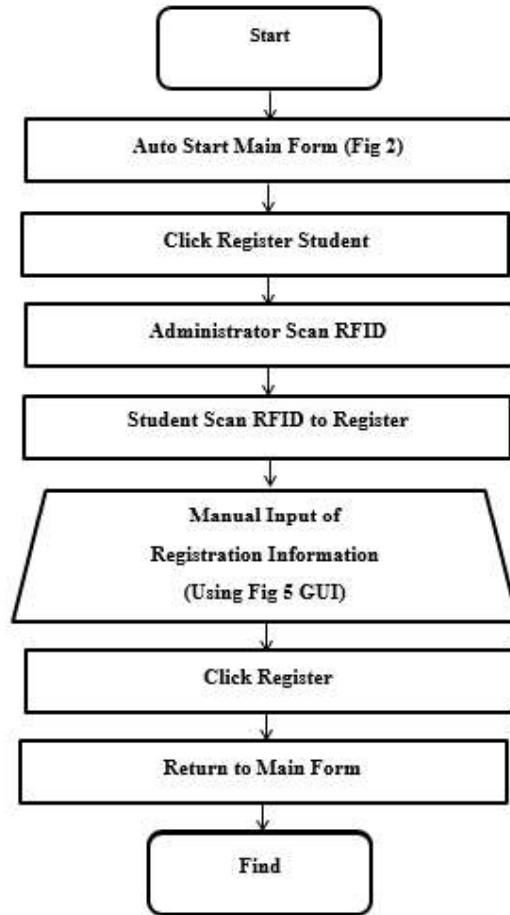Figure 6. The Flowchart if Sending SMS

Figure 7. The Flowchart of Registration

The system was be tested by random students, teachers, parents/guardian, and administrative staffs using the effectiveness, reliability, and maintainability criteria.

To assure the quality of the RFID-Raspberry Pi-GSM System, the researchers asked the help of the school's System Engineer and Programmer to check and evaluate on the system functionality and make sure that it will be able to send the one-way text message to the parents of the students at any cases and everything is considered. This will fault proof and be able to correct the bug/s in case it will be found out. Aside from technical checking, the researchers also asked the Systems Engineers to evaluate the system in terms of effectiveness, reliability, and maintainability.

2.2 Experimental Procedures

A. Assembly and Preparation of Raspberry Pi System and Peripherals
B. Testing the hardware and system function
C. Program Design and Programming
D. Testing, Evaluation, and Prototyping
E. Respondents' Testing and Evaluation

2.3 Data Gathering Instruments

After the respondents tested the device, the researchers gave them a questionnaire that will rate the device based on the three criteria: effectiveness, reliability, and maintainability. The data that the researchers gathered were used in helping to address the problems that is sought to be answered by the study.

2.4 Statistical Treatment

Statistical Tools were used to measure the appearance, maintainability, ease in usage and accuracy was mean on the one-way text messaging system or RFID-Raspberry Pi-GSM System. The Two Sample T-Test assuming equal variance and the Pearson Product Moment Coefficient of Correlation were used to determine the significant difference and relationships in the study.

Pearson's r
$r = \frac{n\sum xy - (\sum x)(\sum y)}{\sqrt{n\sum x^2 - (\sum x)^2}\sqrt{n\sum y^2 - (\sum y)^2}}$

T-Test
$t = \frac{\bar{1} - \bar{2} - d_0}{s_p\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$

2.5 Indicators

Table 1
General Acceptability Indicator

Integral Value	Interval	Description
1	1.00 – 1.80	Poor
2	1.81 – 2.60	Fair
3	2.61 – 3.40	Good
4	3.41 – 4.20	Very Good
5	4.21 - 5.00	Excellent

Table 1 shows the integral value with the corresponding description of the general acceptability indicator.

3. RESULTS & DISCUSSIONS

These are the findings from the tests conducted in this study and the interpretation of these findings.

Table 2
Average scores of the One-way text messaging system using RFID

Respondents	Mean score per indicator:			
	Appearance	Maintainability	Ease in Usage	Accuracy
High School Teachers	4	5	4.5	5
Grade School Teachers	4.5	4.5	5	5
Pre School Teachers	5	5	5	5
High School Parents	5	4.5	5	5
Grade school parents	3.5	4.5	4.5	4.5
Preschool Parents	3	5	4	5
IT Specialists	4.5	5	5	5
Office Staffs	4.5	4.5	5	4.5
Yayas	4	4.5	5	5
Students	4.5	4.5	5	5
General Average	**4.25**	**4.7**	**4.8**	**4.9**

Table 2 shows the average score the One-way text messaging system using RFID acquired in terms of appearance, maintainability, ease in usage and accuracy in the survey that was conducted to the following people; two (2) High school teachers, two (2) Grade school teachers, two (2) Preschool teachers, two (2) High school parents, two (2) Grade school parents, two (2) Preschool parents, two (2) IT specialists, two (2) Office staff, two (2) yayas, and two (2) students. Table 2 also shows the general average the One-way text messaging system acquired in terms of the five (5) aspects mentioned.

Table 3
General Description for the One-way text messaging system using RFID

General Acceptability Indicators	Mean Score per indicator	Description per indicator	General Mean	General Description
Appearance	4.25	Excellent		
Maintainability	4.7	Excellent		
Ease in Usage	4.8	Excellent	4.5675	Excellent
Accuracy	4.9	Excellent		

As the table shows, the mean scores the One-way text messaging system using RFID acquired in terms of appearance is 4.25 which translates to excellent in the description indicator. This suggest that the design of the One-way text messaging system, especially the GUI is clear and can be identified easily.

In terms of Maintainability, the One-way text messaging system using RFID garnered a mean of 4.7 which is considered as excellent. This indicates that it can easily be maintained by the people in charge of it and that it is not too costly to operate.

The One-way text-messaging system using RFID, in terms of Ease in Usage, garnered a mean score of 4.8 which is equivalent STET. This means that the One-way text messaging system is easy to understand and operate or that it is user-friendly in general.

With a 4.9 mean score, the One-way text messaging system using RFID is very good in terms of accuracy. This means that the One-way text messaging system is capable of and is good in sending the text messages to the proper recipients. Also, this means that the system can record the correct data (phone number. of students) for each RFID.

Overall, the general mean the One-way text messaging system using RFID acquired is 4.5675 which is considered to be very good. This means that the one-way text-messaging system is acceptable and has received a high score in terms of appearance, maintainability, ease in usage and accuracy.

Table 4
Difference on the Sending Time of the ECM and Cellular Phone

Variables	Means	α Level	df	Critical Value	t-Stat	Decision
ECM	7.09					
Cellular Phones	7.51	0.05	8	2.3060	0.4879	Do not Reject Ho

Table 4 shows the difference on the sending time of the ECM and of regular phones. It can be seen that at alpha level 0.05, degree of freedom of 8, the critical value is 2.3060; comparing this to the computed t-statistic of 0.4879, the null hypothesis is not rejected. Thus, there is no significant difference on the sending time of the ECM and of regular phones. It can also be inferred that the ECM and the regular cellular phones have the same sending time. Thus, in terms of time in sending, the two resources are just the same.

Table 5
Relationship Between the Number of Characters and Sending Time of the ECM

Variables	Means	α Level	df	Critical Value	r-Stat	Decision
Characters	30					
Sending Time	8.19	0.05	7	0.666	0.7822	Significant

Table 5 shows the relationship between the number of characters sent and the time required to send these by the ECM. It can be seen that at 0.05 level of significance and critical value 0.666 the computed r-stat, 0.7822 will reject the null hypothesis. Thus, there is a significant relationship between the sending time of the ECM and the number of characters sent. This infers that the number of characters being sent by the ECM will affect the sending time of the ECM.

4. CONCLUSION

One of the alternative solution to send SMS inside the school campus from a TMS student to parent if needed is the proposed one-way text messaging.

The prototype is working as expected and can send a SMS to parent/guardian in case of emergency.

This system can be used by the TMS and be able to strengthen the policy of not bringing cell phone inside the campus. Students will have anytime readily mode of emergency communication through one-way text messaging system with their parent or guardian. This can be installed in several units around school strategically and serves as very good additional options to the TMS students.

Using RFID will enable students feel secured. Every student's RFID has unique card number and allow their RFID card to send SMS using the one-way text messaging system provided if they are registered to the system. The data base of registered students will control the access to be able to send SMS to student's registered number of parent/guardian. Also, There is no significant difference between the ECM and the regular cellular phone in terms of sending time. And there is a significant relationship between the sending time of the ECM and the number of characters sent.

5. RECOMMENDATIONS

The prototype made is intended to make the one-way text messaging system work like how to make

the RFID system function and be connected to raspberry pi, how the GSM system sends SMS without fail, and how these two systems collaborated using Java program. Here are the recommendations of the researchers to improve and optimize the system:

1. Upgrade the monitor to 7 inches for better reading and usage experience.
2. Change the RFID reader or module and GSM module to basic board function to lessen the cost of the system,
3. Find the same keyboard size that is easy to use.
4. Explore on using a smaller version of Raspberry Pi which is the Raspberry Pi Zero W model.
5. Design a container or box same size as the 7 inches monitor and RFID reader.
6. Install power bank module that can supply all power requirements of raspberry pi, RFID system, and GSM system.
7. Improve the cooling system to avoid excessive heat accumulating on the container.
8. Optimize the window (GUI) settings that can fit a 7inche screen.
9. Another thorough programming debugging to check possible bugs that will affect the sending of SMS and reading RFID performance.
10. Explore of using GSM modem instead of GSM module. This will enable two or more units share the same number. This is also a cost-effective approach.

6. ACKNOWLEDGEMENTS

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