

Design and Implementation Smart Information Service Customer Touching Application to Support Customer Relationship Management

Muhammad Afnan Habibi

Electrical Engineering Department
Faculty of Engineering
State University of Malang
Malang, Indonesia
afnan.habibi.ft@um.ac.id

Ahmad Mursyidun Nidhom, Febrianto Alqodri and Azmi Fachriza Firdaus

Informatics Engineering Department
Faculty of Engineering
State University of Malang
Malang, Indonesia
nidhom.ft@um.ac.id; febri.alqodri@gmail.com; and fachrizaazmi@gmail.com

Abstract

Information broadcast is one of the main shafts in the business service process so that the wheels of business can run properly. This is relevant to service efforts based on the Customer Relationship Management (CRM) component. There are many mechanisms that can be used to broadcast information, one of which is using an SMS Gateway. In the results of the implementation of the CRM approach through the SMS Gateway, an information broadcasting system was developed. This study aims to improve the performance of sending SMS in a conventional way. The system can work efficiently because it has artificial intelligence integrated in it (by C4.5 algorithm), such as smart data sending, smart operator classification, data transmission cost efficiency, and auto resend information under certain conditions. By implementing the ISO/IEC 25010:2011 standard, the proposed system is capable to run 100% without errors with a usability test result rate of 93%. Based on the results of the delivery trial, 92.4% of SMS were received and 7.6% were not received. The results were satisfying the customers as the system has high successful rate of sent messages for them.

Keywords

Smart Information Service, CRM, Information Broadcast, SMS Gateway.

1. Introduction

In the industrial environment, customer relationship management (CRM) is one of the customer management methodologies (Goodey 2015). This is true not only in the broad industrial field, but also in specialized areas like education. This strategy can be directly related to touch the customer side or not. CRM will further increase the value of an industry because it can easily manage data related to the customers it serves. Seeing the importance of CRM in today's competitive environment, CRM is a very important measure of a company's performance to be implemented (Chi 2021).

One important aspect in implementing CRM is the role and service provided to customers through an application that "touches" them directly. One example of an application that can touch directly in CRM is the use of mobile apps that are used to trade stocks (Kim et al. 2020), where users can easily get information and services from brokers related to stock prices, analysis, news, etc. Where the service aims to make it easier for customers to make stock purchase options and provide feedback if there are obstacles in the operational process, this is called the Customer Touching Application. Over time, Customer Touching Applications that process a lot of data certainly need a mechanism that

is more efficient in their performance, one alternative is the use of artificial intelligence embedded in the application (Aguirre et al. 2020; Mazzia et al. 2020).

The pandemic that has occurred in 2020 has had many impacts on many sectors (Rai, Tripathi, and Gulati 2020), one of which is in the world of education. The Department of Electrical Engineering, Universitas Negeri Malang as one of the higher education institutions in Indonesia, implements an online activity process in service to students (Maqableh and Alia 2021). These services include lectures, practicum, and administrative services. The quality assurance team at the department level also always provides feedback regarding the processes/activities carried out by the department manager to improve service to the students in that condition. Department managers adopt CRM in the service process to students (as customers) through online networks. The Customer Touching Application used uses a Short Message Service (SMS) approach which serve to provide information to students regarding important information. SMS is considered to be more optimal in providing information, because the position of users who sometimes cannot be reached by internet signals is actually reached by the provider's SMS signal. The use of SMS is still appropriate (not outdated) in the era of social media, this can be seen from the banking process which also adapts SMS as a One Time Password (OTP) service to ensure the validity of recipient data (Puthussery 2019).

1.1 Objectives

To optimize the SMS delivery mechanism, we need a local server that functions as a gateway for sending SMS. The server will trigger the SMS provider to send SMS to the destination phone number. After sending, the server automatically gets information from the SMS provider regarding the SMS delivery report. This is very useful for users (SMS Gateway Administrator) to get this information as a report material to the department manager and the head of quality assurance. To ensure that SMS is sent, it is necessary to create an automatic mechanism in the process of sending data, this can be anticipated using an artificial intelligence feature that is able to select SMS that need to be retransmitted according to certain criteria.

2. Literature Review

The methodology for developing a Smart Information Service Customer Touching Application with an SMS Gateway approach to support CRM uses the waterfall software development method. The selection of this method is due to the sequential, systematic, and very simple to implement of the development method (Prasetya, Suharjo, and Pratama 2021). The working steps used in this study are described below.

This requirements step aims to obtain the information/initiation of the required requirements after the development process is complete. Based on the needs analysis data obtained from the Head of Quality Assurance in the Electrical Engineering Department, Universitas Negeri Malang, several requirements are needed, including, (1) the application can send SMS to one person; (2) application can send SMS by broadcast/blasting; (3) the application can automatically provide reports regarding the status of SMS delivery; (4) the application can resend information if there is an SMS that failed to be sent to students.

3. Methods

The high-level design process is needed to further simplify the implementation process that will be carried out later. The design is based on an analysis of hardware availability, software development, and integration between systems using the Application Programming Interface (API) (Zhao and Peng 2019). API will facilitate the development of an application that will be large-scale. The general design of this system integration of local server with SMS provider to send SMS shown in the Fig. 1.

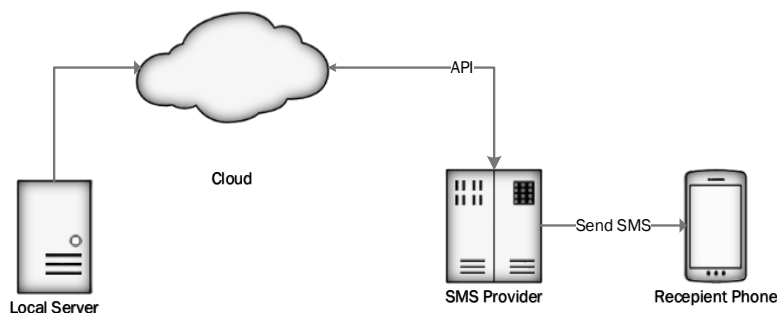


Figure 1. System Integration of Local Server

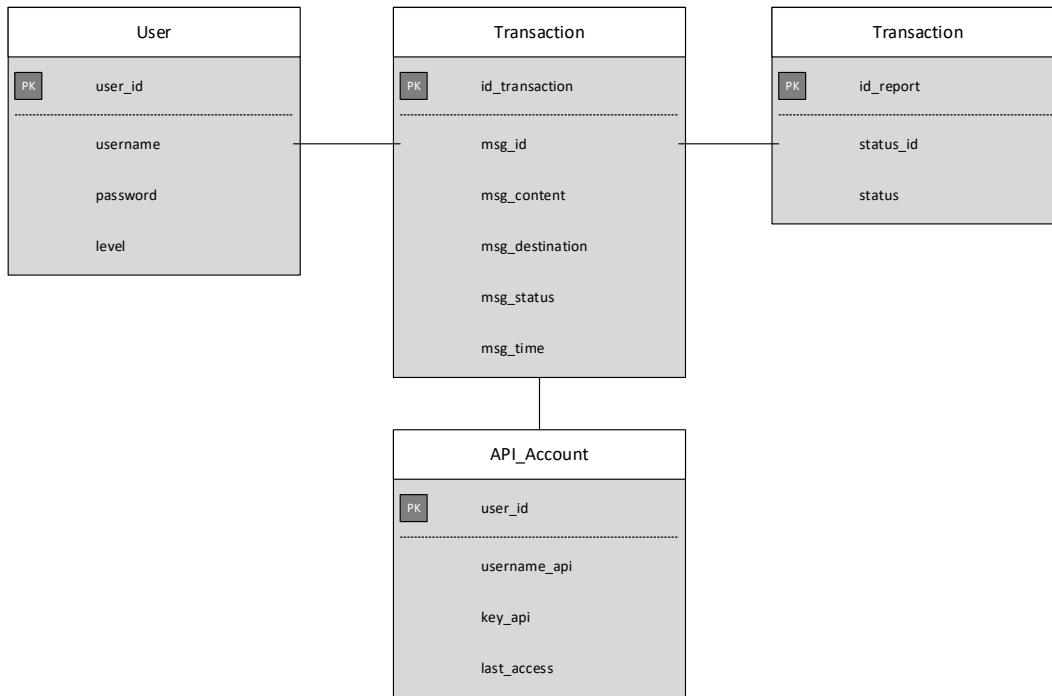


Figure 2. ERD Design of Software

Based on the Fig. 1, it can be seen that the local server will send students as SMS recipients through their cellphone numbers, the command will be triggered by the SMS Gateway administrator to the local server to send SMS, the command will be sent to the SMS provider to forward the message that has been sent by the administrator via PI mechanism. After the process at the provider is carried out, the provider will send delivery information/reports to the local server for later SMS delivery reports that can be viewed by the SMS Gateway administrator.

Based on Fig. 2 above, there are 4 main tables that are related to each other. User table has functions as the master data containing the user's name and telephone number for later entry into the transaction table (for the process of sending SMS). The data has been entered in the transaction table will be sent to the SMS provider through the API network that has been connected through a certain account (stored in the account table). The process of sending SMS, which has the possibility of being sent or failed, will be compiled and included in the report table to make it easier to evaluate/view the SMS delivery report.

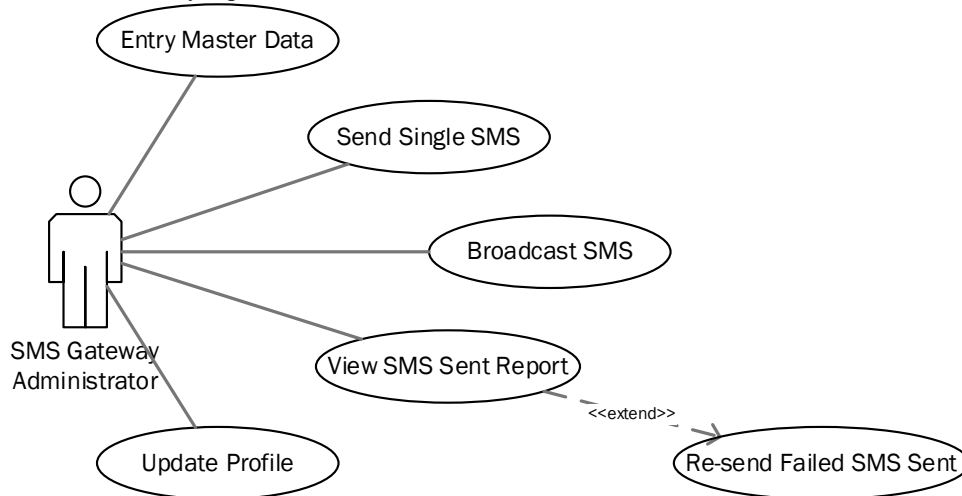


Figure 3. UML Use Case Diagram

The UML design from Fig. 3 shows five main access rights that can be done by the SMS gateway administrator as the SMS server manager. There are access rights that are data mastering (use case master data), transactional access rights

(send single & broadcast SMS), access rights that are reporting (view SMS report), and personal data (update profile). The distribution of access rights is intended to ensure that the process of data entry, delivery, monitoring, and evaluation can run optimally on the SMS Gateway.

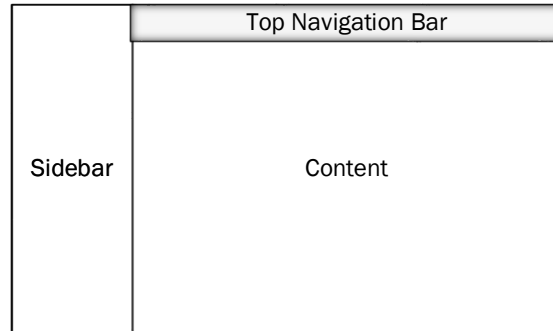


Figure 4. User Interface Design

In addition to the general design of the large system, the software development process is also designed in the form of software design. The software design approach is in the form of Entity Relational Diagram (ERD) for database design (Cohen and Gil 2021), Unified Manipulation Language (UML) for workflow design (Gueidi, Gharsellaoui, and Ahmed 2021), and User Interface for interface design (Y. X. Liu and Li 2020). The general design of the table used (simple ERD) in the development of this software is shown in Fig. 2. The UML design in the form of access rights is called the UML Use Case Diagram. Use Case Diagram of this development is shown in Fig. 3. User interface design is shown in Fig. 4.

The coding process is a process that implements a design that has been developed in the previous stage in the form of making a program written through a particular programming language. The programming language used is PHP with additional language plugins such as CSS, Java Script, JSON (Agocs 2018), and shell scripts (linux operating system) that are integrated with the server. This process also integrates an approach method used in an artificial intelligence decision tree, namely the C4.5 algorithm. The use of this algorithm is because this algorithm has a higher level of effectiveness and efficiency than other decision trees such as ID3 and CART (Ghiasi, Zendeboudi, and Mohsenipour 2020). The use of artificial intelligence will make a selection based on predetermined conditions, such as retransmitting if there is a failed delivery status.

4. Data Collection

Testing is the stage for test the results of the implementation of the program code that has been carried out. The main purpose of this testing is to ensure that the results of the implementation of the program code that have been made can function as the main requirements have been described. There are two testing mechanisms that can be carried out on a program, namely white box and black box. In this study, the test was carried out using only black box testing, this means that the tests carried out are only oriented to the input and output responses displayed by the program.

Testing in terms of programs, is carried out independently by the developer and the head of quality assurance using the ISO/IEC 25010:2011 standard on aspects of functional suitability and usability. at the end, a trial was conducted regarding the success rate of sending SMS to the test subjects. The functional suitability and usability criteria of the ISO/IEC 25010:2011 standard are shown in Table 1.

Table 1. Functional and Usability Aspect of ISO 25010

Aspect	Sub-Aspect
Functional suitability	Functional completeness
	Functional correctness
	Functional appropriateness
Usability	Appropriateness
	Recognizability
	Learnability
	Operability
	User error protection
	User interface aesthetics
	Accessibility

As shown in Table 1., there are two aspects of the assessment that will be used by the developer and the Head of Quality Assurance to test the program that has been developed. The functional suitability aspect is used to test the functionality of a program, while usability is used to test the ease of use. Each of these aspects is assessed based on the Gutmann scale which will later be taken according to the percentage of conformity through the completeness matrix (Linnosmaa and Alanen 2019). The final percentage result will be used as a trial basis to users (SMS sending to recipients). This maintenance process aims to make improvements if there are errors or adjustments when the application is run. The improvements made can be in the form of resetting the server or re-coding the programs that have been developed. The ultimate goal of this process is to ensure the application can run optimally.

5. Results and Discussion

5.1 Numerical Results

After the development process, a trial was conducted to test the success of the development process carried out. The process of testing the functional and usability aspects using the Gutmann scale, where the questionnaire only focuses on the functionality of the software being developed. This functional test focuses on the program code to run a command, this is because if the program has been validated and can run well, the assumption is that there are no errors that occur from the process flow or program logic. Usability testing is done more to the user's acceptance to use this software. The results of the functional suitability and usability trials are shown in the application development process as shown in Table 2.

Table 2. Result of Testing

Aspect	Sub-Aspect	Percentage Result	Testing Aspect	Success Rate
Functional suitability	Functional completeness	100 %	10	10
	Functional correctness	100 %	23	23
	Functional appropriateness	100 %	25	25
Usability	Appropriateness	92%	25	23
	Recognizability	94%	19	18
	Learnability	92%	26	24
	Operability	93%	14	13
	User error protection	92%	26	24
	User interface aesthetics	97%	27	26
	Accessibility	89%	18	16
Average		96.5 %		

Based on Table 2, the average result from the SMS Gateway application development process is 96.5 %, so this application is included in the category of no need for revision (H. Liu, Kulturel-Konak, and Konak 2021). If examined further, the functional suitability aspect has an average of 100%, this means that the entire set of code developed runs accordingly. In the usability aspect, the resulting average is 93%, where the best percentage is in the user interface aesthetics sub-aspect and the lowest is accessibility. The user interface aesthetics aspect gets a high percentage because it was developed using the latest user interface pattern, while accessibility gets the lowest percentage because there is little difficulty in accessing when using a local server in the API integration process with the SMS provider.

5.2 Graphical Results

Design and implementation of smart information service developed for customer touching application using SMS technology embedded on local server. This technology aims to support customer relationship management between the quality assurance team and students majoring in electrical engineering, State University of Malang. Several features resulting from this development process are applications that are able to (1) send SMS to one person; (2) send SMS by broadcast/blasting; (3) show the SMS delivery report; (4) automatic delivery if there are SMS that fail to be sent. Login page display of SMS Gateway application as shown in Fig. 5.



Figure 5. Display of Login Page

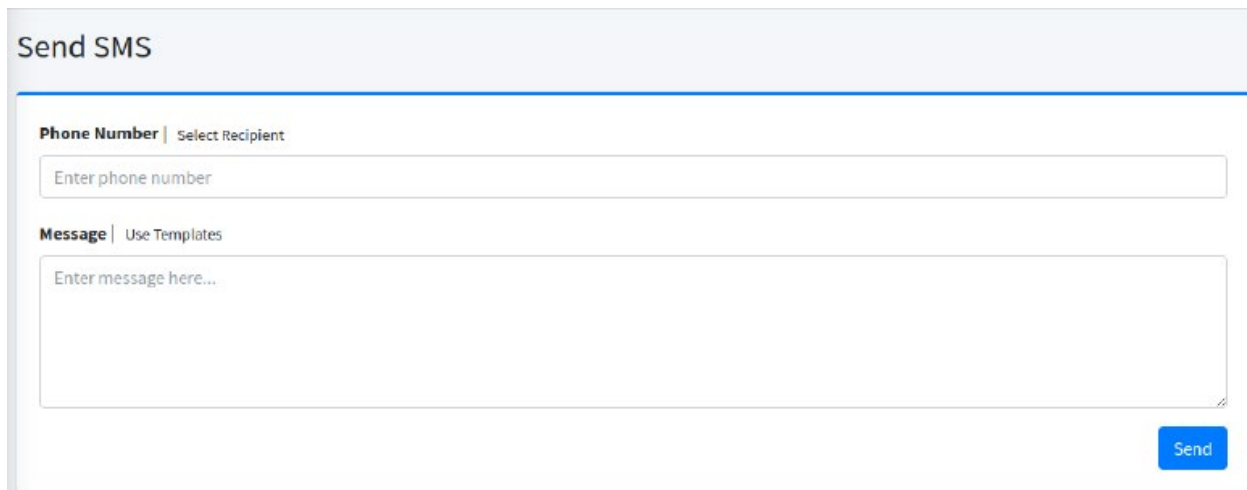


Figure 6. Display of Personal Send SMS Feature

To send SMS personally to students, administrators can use the Send SMS feature which will later be asked to fill in the destination cellphone number and the contents of the message to be sent. Because the user approach mechanism uses SMS, the maximum character of the message sent is only 160 characters. The process of sending a personal message takes about 30 seconds to reach the recipient's cellphone. In the pattern of sending SMS by broadcast/blasting, there is a slight difference in the selection of SMS recipients, that is, we can choose a group/data collection of HP numbers to which we will send the SMS. An example of a delivery display with a personal pattern is shown in Fig. 6. An example display for broadcast delivery is shown in Fig. 7.

After the delivery process is done, the server will automatically generate a report that can be seen by the SMS administrator and the head of quality assurance. The report relates to the number of SMS sent and the distribution of operator types of telephone numbers. Reports on the number of SMS are accumulated every month with the aim of knowing the level of server activity which will later be used as an evaluation tool for the use of SMS gateways, while the distribution of operator types is used to determine steps related to SMS providers in adjusting services provided to local servers. An example of an SMS delivery report display is shown in Fig. 8.

The screenshot displays the 'SMS Blasting' interface. At the top, there is a 'Dashboard' header with navigation icons. Below the header, the title 'SMS Blasting' is prominently displayed. The main area contains a form for selecting recipients, with radio buttons for 'Dosen', 'S1 TI', 'All Mahasiswa', 'S1 PTI', and 'S1 PTE'. Below the recipient selection, there is a 'Message' section with a 'Use Templates' link and a text input field labeled 'Enter message here...'. A blue 'Send' button is located at the bottom right of the form.

Figure 7. Display of Broadcast Send SMS Feature

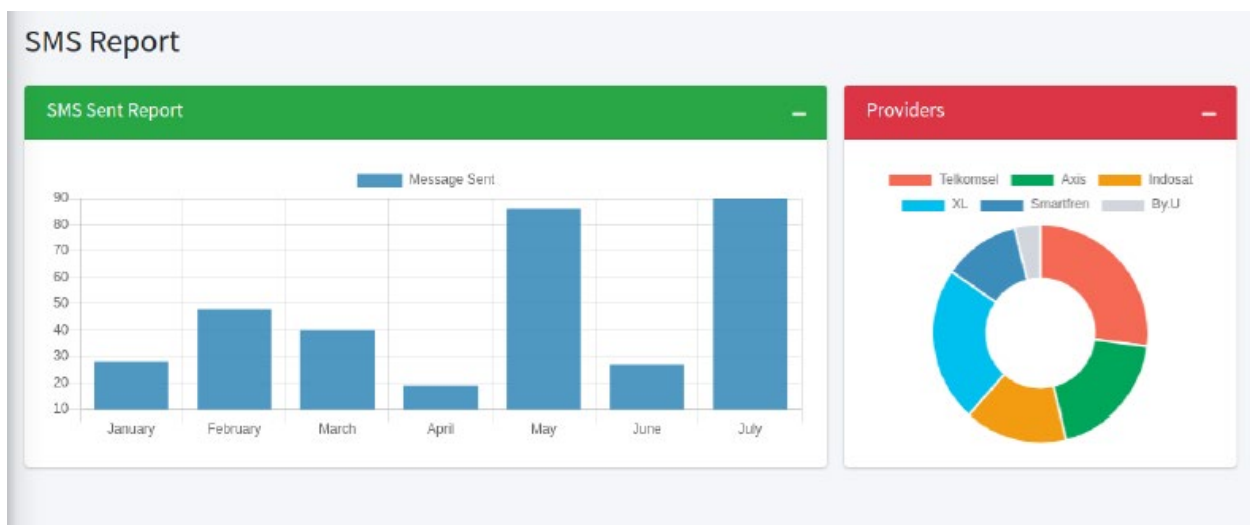


Figure 8. Display of Report Broadcast Send SMS Feature

5.3 Proposed Improvements

The renewal of the SMS gateway in this study is that there is an automatic delivery if there is an SMS on that day that has been sent but failed. This can be interpreted by an SMS delivery that can be entered into the SMS delivery service (SMS provider) to be sent to its destination. However, it could be that the destination cannot receive the SMS due to its location, the active period of the mobile number has expired, etc. This is to ensure that the destination receives the SMS that has been sent by the server. The re-send can be triggered manually from the SMS Gateway administrator or automatically using a shell script from Linux which is always automatically executed every afternoon (using a Cron Job). The selection of re-send is automatically carried out every afternoon with the aim that the SMS sent that day can be received by the user on the same day. This is because there may be information that really must be received by the recipient on the same day, so the same-day re-sending mechanism is applied. Mechanisms like this are what make

SMS gateways to approach users called smart applications, which have automation based selection (by artificial intelligence concept).

5.4 Validation

After being tested independently, the application is tested for the success rate of sending to SMS recipients. This is done to determine the extent to which users get services from this SMS Gateway. Based on trials on 225 students, the success rate of receiving SMS was 92.4%. There are several students who do not receive SMS, this can be due to several factors, namely (1) the location of residence that does not get optimal signal from the provider; (2) the number entered by the student has expired; and (3) there are network constraints; (4) etc. An example of the results of receiving SMS by students is shown in Fig. 9.

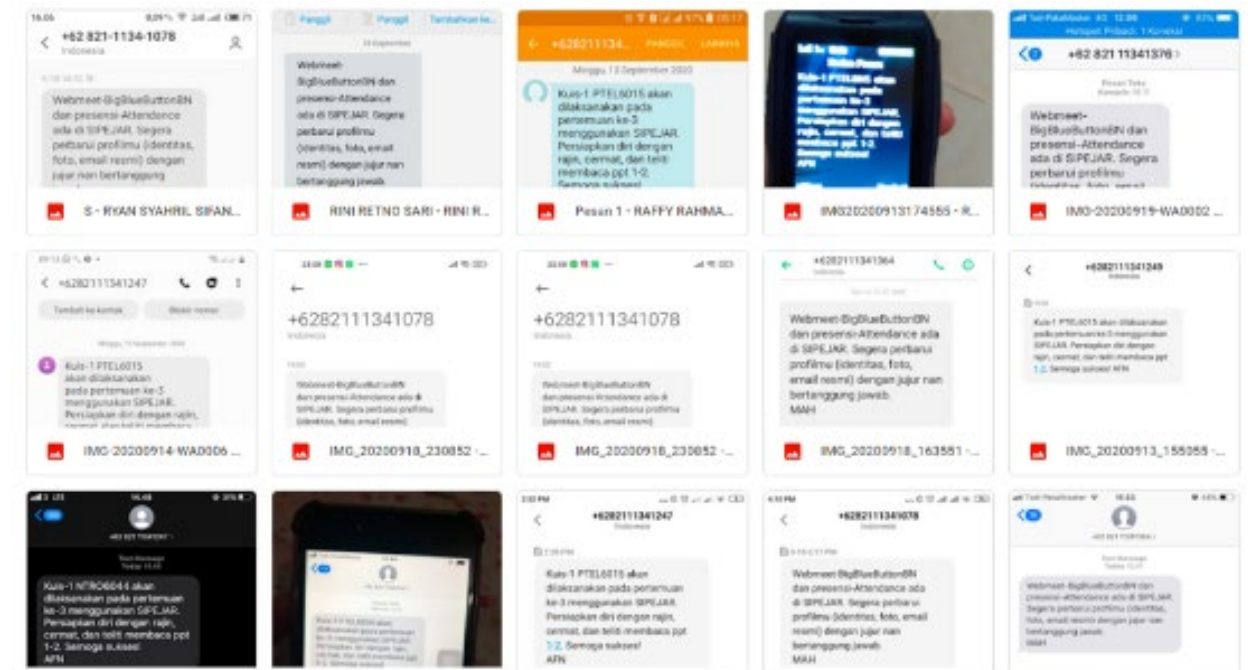


Figure 9. The Uploaded Picture of the Received Messages

6. Conclusion

Based on the results of the development of smart information service customer touching application using SMS Gateway to support Customer Relationship Management, it is concluded that:

1. SMS Gateway application has been developed which has four features; (1) the application can send SMS to one person; (2) application can send SMS by broadcast/blasting; (3) the application can automatically provide reports regarding the status of SMS delivery; (4) the application can resend information if there is an SMS that failed to be sent to students.
2. The test results of functional suitability is 100% and usability 93% based on ISO/IEC 25010:2011 standard, so it has an average percentage of 96.5 % which means that the application is feasible to use without any revision.
3. The results of the trial of sending data directly to 225 students, obtained a success rate of 92.4%. The 7,6 % data is obtained due to several factors, namely (1) the location of residence that does not get optimal signal from the provider; (2) the number entered by the student has expired; and (3) there are network constraints.

Acknowledgment

This research was conducted with excellent teamwork. Both the team of lecturers and Electrical Engineering Department students of Universitas Negeri Malang which provided best insight and intuition. More than that, this research is financially supported by PNPB FT funding sources in 2021.

References

- Agocs, Adam. "Construct Knowledge Graphs." *2018 International Conference on Computer, Information and Telecommunication Systems (CITS)*, 1–5. 2018.
- Aguirre, Anthony, Gaia Dempsey, Harry Surden, and Peter Bart Reiner. "AI Loyalty: A New Paradigm for Aligning Stakeholder Interests." *SSRN Electronic Journal* 1 (3): 128–37. 2020.
- Chi, Nguyen Thi Khanh. "Innovation Capability: The Impact of e-CRM and COVID-19 Risk Perception." *Technology in Society* 67 (September): 101725. 2021.
- Cohen, Jonathan, and Jorge Gil. "An Entity-Relationship Model of the Flow of Waste and Resources in City-Regions: Improving Knowledge Management for the Circular Economy." *Resources, Conservation & Recycling Advances* 12 (September): 200058. 2021.
- Ghiasi, Mohammad M., Sohrab Zendeheboudi, and Ali Asghar Mohsenipour. "Decision Tree-Based Diagnosis of Coronary Artery Disease: CART Model." *Computer Methods and Programs in Biomedicine* 192: 105400. 2020.
- Goodey, Paul. *Salesforce CRM – The Definitive Admin Handbook - Third Edition: EBSCOhost*. <http://web.a.ebscohost.com/ehost/command/detail?vid=7&sid=ce59ff5f-404b-4d6d-912b-440ac2ed8e77%40sdc-v-sessmgr02&bdata=JnNpdGU9ZWhvc3QtG12ZSszY29wZT1zaXRl#AN=946200&db=nlebk>. 2015.
- Gueidi, Afef, Hamza Gharsellaoui, and Samir Ben Ahmed. "Towards Unified Modeling for NoSQL Solution Based on Mapping Approach." *Procedia Computer Science* 192: 3637–46. 2021.
- Kim, Dongyeon, Kyuhong Park, Dong Joo Lee, and Yongkil Ahn. "Predicting Mobile Trading System Discontinuance: The Role of Attention." *Electronic Commerce Research and Applications* 44 (March): 101008. 2020.
- Linnosmaa, Joonas, and Jarmo Alanen. "Demonstration of a Conformity Assessment Data Model." *IEEE International Conference on Industrial Informatics (INDIN)* 2019-July: 369–73. 2019.
- Liu, Haibin, Sadan Kulturel-Konak, and Abdullah Konak. "A Measurement Model of Entrepreneurship Education Effectiveness Based on Methodological Triangulation." *Studies in Educational Evaluation* 70 (March 2020): 100987. 2021.
- Liu, Ying Xin, and Xi Yuan Li. "Design and Implementation of a Business Platform System Based on Java." *Procedia Computer Science* 166: 150–53. 2020.
- Maqableh, Mahmoud, and Mohammad Alia. "Evaluation Online Learning of Undergraduate Students under Lockdown amidst COVID-19 Pandemic: The Online Learning Experience and Students' Satisfaction." *Children and Youth Services Review* 128 (January): 106160. 2021.
- Mazzia, Vittorio, Aleem Khaliq, Francesco Salvetti, and Marcello Chiaberge. "Real-Time Apple Detection System Using Embedded Systems with Hardware Accelerators: An Edge AI Application." *IEEE Access* 8: 9102–14. 2020.
- Prasetya, Kresna Dwi, Suharjito, and Devriady Pratama. "Effectiveness Analysis of Distributed Scrum Model Compared to Waterfall Approach in Third-Party Application Development." *Procedia Computer Science* 179 (2019): 103–11. 2021.
- Puthussery, Antony. "Online Transaction Against Attacks." *2019 Third International Conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) (I-SMAC)*, 221–25. 2019.
- Rai, Jitender, R. C. Tripathi, and Nipun Gulati. "A Comprehensive Survey of IT Sectors Affected by Covid-19." *Proceedings of the 2020 9th International Conference on System Modeling and Advancement in Research Trends, SMART 2020*, 52–54. 2020.
- Zhao, Hang, and Shuangyun Peng. "Design and Implementation of the Lost-and-Found System Based on Amap API." *Proceedings of the IEEE International Conference on Software Engineering and Service Sciences, ICSESS* 2018-Novem: 199–202. 2019.

Biographies

Muhammad Afnan Habibi, S.T., M.T., M.Eng. He acquired a B.Eng. in Electrical Engineering from Universitas Brawijaya, Indonesia in 2015. Following this in 2017, he got an M.Eng. in Electrical Engineering from dual degree program at the two universities, Universitas Brawijaya (UB), Indonesia and University of Miyazaki (UoM), Japan. He was a laboratory assistant of Basic Electrical and Measurement Laboratory for two years before finished his first degree. Then he joined UB's Power System Engineering and Energy Management Research Group (PSEEMRG) as a research assistance. Since 2018, he has been employed as a lecture in Electrical Engineering Department at Universitas Negeri Malang (UM), Indonesia and belongs to the Intelligent Power Electronics and Smart Grid (IPESG) Research Group. He is presently the head of Quality Assurance Unit at the department as well as has been producing or co-

authoring over 25 proceedings and 3 journals. His research interests include electric motor drives, high frequency power electronics, and wireless power transfer. He can be contacted at email: afnan.habibi.ft@um.ac.id.

Ahmad Mursyidun Nidhom, S.Pd M.Pd. He obtained a bachelor's degree in Informatics Engineering from Universitas Negeri Malang (UM) in 2011. Then in 2013, he got a master's degree in education at the same University. He has been a Multimedia and Augmented Reality laboratory system assistant. Then he joined as a young researcher in informatics education. He has been a member of the Application Development Expertise Group in learning until now. Currently, he has produced six books, 15 copyrights, and more than 150 scientific works that have been published. He is also a member of the International for the Engineers and the Computer Scientist (IAENG), 174192, Hung to Road, Hongkong. He actively researches international cooperation and manages international journals. It also has a network of research collaborations in Southeast Asia. He can be contacted at e-mail: nidhom.ft@um.ac.id.

Febrianto Alqodri, S.Pd. He acquired B.Ed. in Informatics Engineering Education, Universitas Negeri Malang (UM), Indonesia in 2017 with research on data mining for education in Indonesian Vocational Education. He currently works as a computer network and programming laboratory staff at the State Universitas Negeri Malang (UM). Currently, he has owned 5 copyrights, 2 books on programming, 21 scientific articles, and 2 journals. He is currently developing cloud computing for IoT which has integrated user behavior analysis on public networks. Topics of interest are computer networks, programming, artificial intelligence, data mining, IoT, and cloud computing. He can be contacted via email: febri.alqodri@um.ac.id.

Azmi Fachriza Firdaus, S.Pd. He acquired B.Ed. in Informatics Engineering Education, Universitas Negeri Malang (UM), Indonesia in 2020 with research on decision support systems currently used in Electrical Engineering, State University of Malang. He was a Computer Programming laboratory assistant for one year before completing his degree. Then after completing his degree, he was hired as a Software Engineer located in Surabaya. He is currently working on several Indonesian state-owned enterprises projects in the fields of agriculture, oil and gas, digitizing product distribution, and supply chain operations. His interests include machine learning, algorithms, and artificial intelligence. He can be reached at email: fachrizazmi@gmail.com.