Smart Complaint Management System

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***Abstract*—Customers are the essential factor in the organization. The business has to support the customers' preferences and demands for creating the customer loyalty, which make the customer still purchases with the particular company. The customer may feel dissatisfied with the service when he or she receives the delay of services and they do not know the channel for filing the complaint, and also the current complaint handling in the organizations still has the problems. Therefore, we, developers of this project implemented the Smart Complaint Management System (SCMS) consisting of the mobile application, chatbot and web application, for solving the customer's dissatisfaction issue. Furthermore, the SCMS has the service for classifying the complaint, then automatically direct to the responsible department, and the service for finding the similar complaint to avoid submitting the duplicate complaint. The test result shows that this system is able to reduce the time and procedures for complaint handling, increase the channel for filing the complaint, and increase the channel for progress reporting and tracking the status of the complaint.**

Keywords—customer complaint, complaint management, complaint handling, chatbot, classification

I. INTRODUCTION

Customer Relationship Management (CRM) is the business strategy for relationship management between the organizations and customers, so the organizations would learn the customer information from using CRM, which is designed to maximize the customer satisfaction [1]. The effectiveness of using CRM is the customer loyalty, and the organization would lead to higher revenue. According to the statistic of using CRM in the organizations, the customers are likely to spend 20-40% more the next time they make a purchase with the particular company and the revenue is increased by 41% per each individual sales representative [2]. Furthermore, the customer service is also one of the CRM, which has the responsibility to take care of a customer, listen to customer' s opinion, and receive the customer complaint. Therefore, the organization is able to improve the quality of products and services.

The customer complaint handling becomes the important factor of the organization, thus the organization should pay attention to the customer complaint and should solve problems as fast as possible. In contrast, the current complaint management system still has problems [3]. The problems of complaint procedure and complaint management are as follows:

Problems of complaint procedure

- Customers do not know the channel for complaint and how to file complaints from customers
- Customers spend a lot of time on complaint
- Customers do not have channel for tracking complaint

Problems of complaint management

- The redundancy of complaints from organizations
- The details of complaints are unclear and insufficient
- The organization do not have channel for asking further information about complaint and providing feedback
- Complaints are not related to the responsible department

SCMS is developed to handle these problems using the mobile application and chatbot for customers to submit the complaints and the web application for the organization to manipulate the complaints. Moreover, the back-end services provide the service for classifying the complaints to the proper department, and the service for finding the similar complaints to prevent the duplicate complaints.

The scope of SCMS would focus on maintenance complaints. For example, classroom maintenance, lab maintenance, and restroom maintenance. The system is the prototype for applying to Faculty of Information Communication and Technology, Mahidol University before expanding to the entire campus and other organizations.

Section II provides a background of the complaint management system and related research. Section III explains about the overall of design. Section IV provides the information about implementation method. Section V presents the evaluation result from the users. Section VI the summation of the research.

II. BACKGROUND

A. Complaint process

A complaint is a customer's expression of dissatisfaction with a product or a service. The complaint can be a written or oral communication to a responsible person [4]. Customer Complaint Management might affect the level of customer satisfaction, therefore many organizations usually have a process to handle complaints with the purpose of doing the maximize customer satisfaction.

Complaint management process [5] is a set of operations that used to handle complaints in organizations in order to resolve problems. The procedures for handling complaints are as follows:

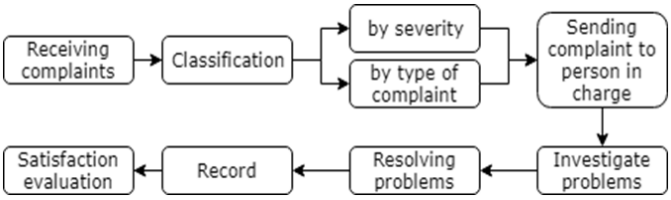

Fig. 1. Complaint Management Process

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B. Related Technology

1) Receiving Complaint via Chatbot

A chatbot is a computer program that used for communicating with a human through a messaging app, chat window or voice chat.

Nowadays, several businesses apply a chatbot to manage CRM and customer services. For example, a chatbot can be used for answering the problem from consumers, offering news or promotions, and giving suggestion or advice. From the statistic, 65% of consumers prefer using a messaging app when contacting a business [6] and over 50% of customers expect a business to be available 24/7 [7]. In addition, a chatbot is the best way to support needs of consumers.

There are two main types of a chatbot which are Rule-Based chatbot and AI (Artificial Intelligence) chatbot [8].

- Rule-Based chatbot: is designed to answer the questions based on predetermined rules. They are fairly fast to develop, easy to deploy, and low cost.
- AI chatbot: is an intelligent chatbot that uses deep learning processes with Natural Language Processing (NLP). NLP is used to help a chatbot to understand human language and human context.

2) Classifying Compliant via Machine Learning

Due to the fact that the organization has to deal with abundant complaints, the automatic classifying complaint is required for sending a complaint to a proper department. Thus, the benefits are saving time and labor.

Text classification is one of many techniques to automatically classify documents to predefined classes or categories based on the text in documents. Several algorithms can be applied such as Rule-Based and Decision Tree [9]. Several machine learning algorithms can be used to enable a system or a computer to learn and improve based on its received experiences and information. There are two types of machine learning algorithms which are the supervised learning and unsupervised learning. The supervised learning is a learning to predict the future events using the labeled training set. For instance, human provides the information and the correct result, so the computer will learn and use the algorithm to map between the information and result. As a result, the computer is able to predict the result for any given information. The example algorithms are Support Vector Machine, Naïve Bayes, and Gradient Boosting. In contrast, the unsupervised learning is learning without any predefined classes and labeled data set, therefore the computer will learn from the hidden structure of information. The example algorithms are K Nearest Neighbor and K-Mean [10].

C. Comparision with Existing Systems

The existing systems related to SCMS could be divided into four types, which are a paper form, call center, Electronic Complaint, and mobile app. Fig. 2 shows the comparison between the main features of SCMS and existing systems.

The strengths or advanced features of SCMS are tracking complaint status, automatic classifying complaint to a proper department, providing several channels to submit the complaint, and preventing duplicated complaints.

	Smart Complaint Management System	E-Complaint (Web, Mobile App)	Paper Form	Call Center
Tracking complaint status	✓	✓	✗	✓
Auto classify complaint	✓	✗	✗	✗
Complaint procedure	E-Form, Chatbot	E-Form	Hand written form	Voice
Prevent user to submit duplicate complaint	✓	✗	✗	✗
Data collection	Database	Database	Paper, File, Document	Voice record

Fig. 2. Comparision with Existing Systems

III. Analysis and Design

A. System Architecture Overview

Fig. 3. Overall of The System Architecture

The complainant uses the mobile app or chatbot to report the problem or complaints. After that, the complaint was sent to process in the cloud computing and store the data in the database. On the staff side, the web application retrieves all the classified complaint from the database, therefore, the responsible person could see all existing complaints via system dashboard. Besides, the responsible person could take notes about the correction method and update the complaint status, then send back to the complainant.

B. Interface Design

This section shows the interface design of both mobile application for complainants and web application for staff of the organization

1) Mobile Application

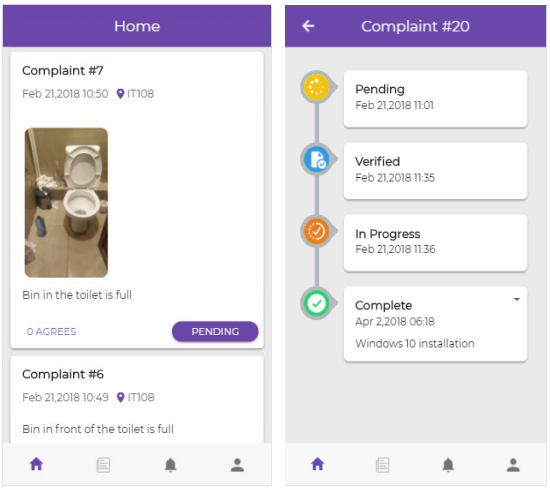

Fig. 4. Home Page (Left) and Complaint Status Page (Right)

After the users login to the application, users will be directed to the home page, Fig. 4 (Left). Users can see their complaints and their agreed complaints (i.e., complaints that are similar to their complaints). Each complaint contains the complaint identification number, date and time, location, pictures, and details. Also, users can see the complaint status (e.g., "pending") on the bottom right button. In the complaint status page, Fig. 4 (Right), users can check the progress of their complaint that updated by the responsible person.

To report the complaints, there are three channels for filing the complaint which are floor plans, barcode scanner, and chatbot.

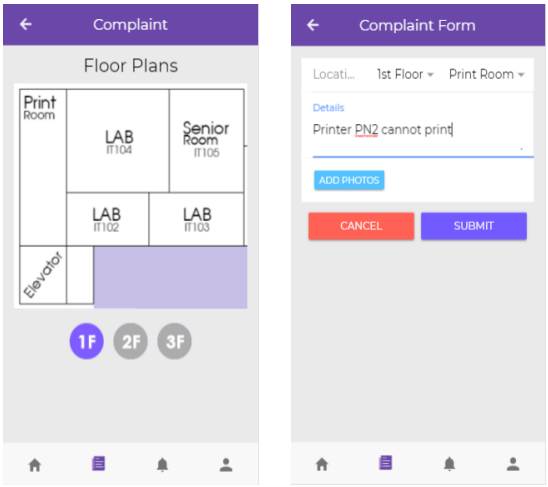

Fig. 5. Floor Plans Page

First, the floor plans page shows the position of each room in the Faculty of ICT. Floor plans help users to specify the location when users generate the new complaint. Therefore, users could select the place from floor plans, then the location name will be auto-filled in the complaint form.

After users provide the details, the application will automatically check the similar complaint, then show the top 10 most similar complaints to users. Users can click "Agree" button if the complaint is similar to the complaint that users are going to create to prevent submitting duplicated complaints.

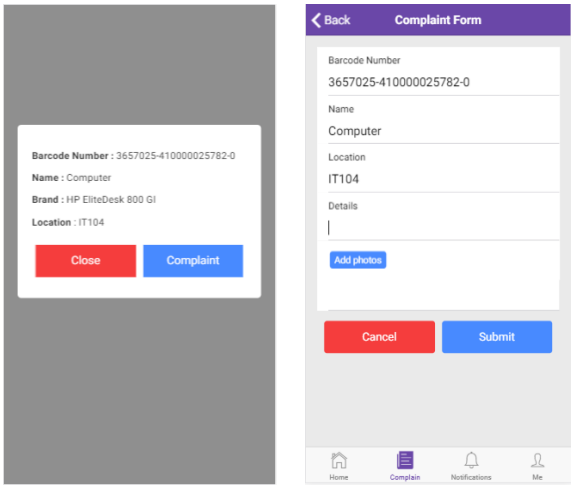

Fig. 6. Barcode Scanner Page

Second, the barcode scanner page enables users to use the mobile application to scan the barcode that attaches to the equipment for filing the complaint, then the information of that equipment is auto-filled in the complaint form.

Third, the chatbot messaging app is implemented on the Facebook Messenger platform. Users can report the problem and check the complaints' status via *SmartComplaintBot* Facebook account. To report, the bot will interact with the users to collection details of the problem, its location and any related photos. To check status, the bot will retrieve the data from the database and show the list of complaints from the user and the user can click "Check" button to see status.

Fig. 7. Report Complaint (Left) and Check Status (Right) via Chatbot

2) *Web Application*

Fig. 8. Dashboard Page for Houstkeeper Department

In the dashboard page, staff from each department will only see complaints related to their department. This Fig. 8 shows the dashboard from the housekeeper department.

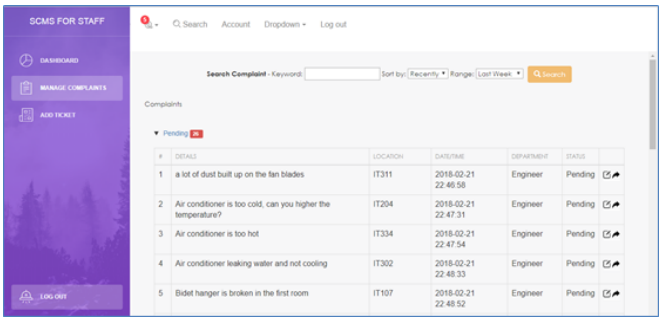

Fig. 9. Manage Complaint Page for Engineer Deprtment

On the manage complaint page, the staff can see the list of complaints in the system, which separated by the status of each complaint. There are two icons at the end of each records. The first icon is (✎) "Manage complaint". The staff can click this icon to go to the details page and add fixing update. This details page contains the information of the complaint including details, submitted date, the ID of the person who submitted, location, and list of fixing details. The second icon (➦) is "Forward complaint". Staff can click this icon to forward the complaint to another department.

IV. IMPLEMENTATION

A. Complaint Classification Service

SCMS was developed to increase the efficacy of the complaint management process, therefore, SCMS is able to automatically classify complaints and directly send them to the responsible department to resolve the problem.

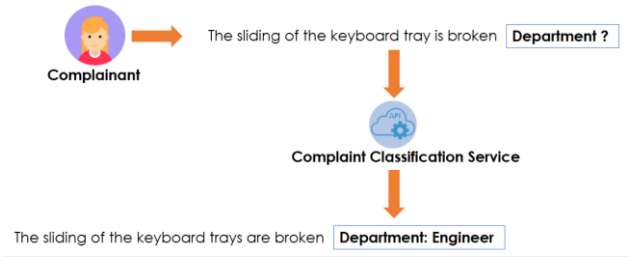

Fig. 10. Example of Complaint Classification Service

As shown in Fig. 10, after the complainant submits the complaint to the system, the complaint classification service, which runs on the cloud computing will predict the responsible department of that complaint. For instance, the complaint is "The sliding of the keyboard tray is broken", then the service will predict that the responsible department is the engineer. Fig 11 shows the procedures for building the complaint classification service.

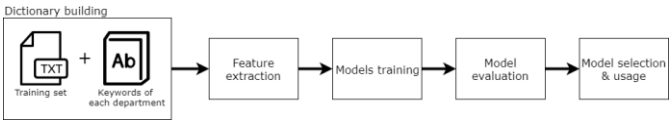

Fig. 11. Complaint Classification Service Procedure

1) Dictionary Building

Before building the dictionary, we have to prepare the data to use in this process. The first thing is defining the keywords of each department, which acquired from words that are frequently found in the existing complaints in the Faculty of ICT. The keywords from each department consists of 154 words, which are 54 words from IT department, 48 words from housekeeper department, and 52 words from engineer department.

The second thing is creating the training set, which is the list of labeled complaints. The training set consists of 323 complaints, which are 119 complaints from IT department, 77 complaints from housekeeper department, and 127 complaints from engineer department.

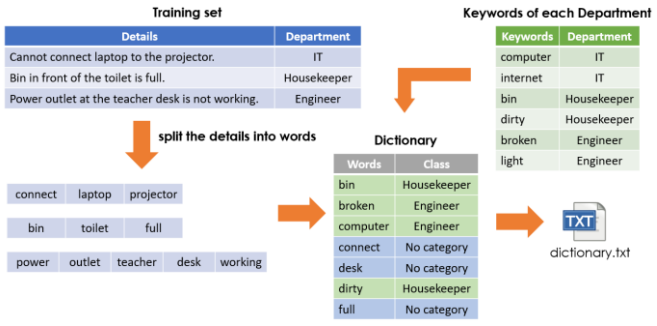

Fig. 12. Dictionary Building

After that, the dictionary table is created using the training set and the list of keywords of each department. The dictionary table consists of two columns which are words and class. We have to split the details in the training set into individual words, and remove the stop words, then combine with the keywords of each department. If any word in the training set does not belong to the keyword of each department table yet, it will be added to the dictionary table with 'No category' class. As a result, the total number of words in the dictionary is 507 words.

2) Feature Extraction

This step is to convert the data in the text format to the number format by using feature extraction technique. We have to extract the training set that we build before into the feature space. There are 511 columns, which the first 507 columns are the words in the dictionary, the later 3 columns are the sum of words in the class of IT, housekeeper and engineer, and the last column is the label department.

Fig. 13. Feature Extraction

Next step, we have to split the details in the training set into words and remove the stop words, then compare each word with the words in the dictionary in 507 columns. If the words from the details are matched, the number will be 1 otherwise, it will be 0.

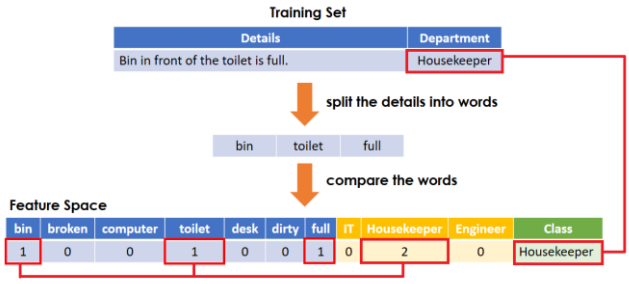

Fig. 14. Compare the words with the dictionary

Moreover, there are some words in the dictionary that categorized into the department. For example, the word "toilet" and "bin" are categorized into the class of housekeeper in contrast to the words "full" is not categorized into any class. Therefore, it will sum the number of words in each class into the later 3 columns. After that, bring the label department of the training set into the last column.

Finally, we generated 3 CSV files from the feature space that we build before for finding the most accurate feature space. The first feature space file is considering on the words in the dictionary only. The second file is focused on the sum of words in each department. The last file is the combination of the words in the dictionary and the sum of words in each department. The following are the examples of 3 feature space files.

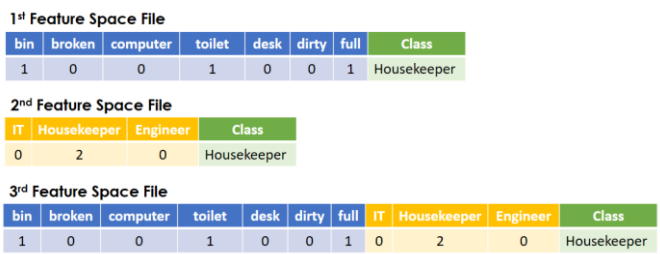

Fig. 15. CSV Files For Model Training

3) Model Training

After we generated 3 feature space files, we bring the files to classify in Weka for building the model.

Weka is an open source software which provides several machine learning algorithms for data analysis and predictive modeling. Moreover, Weka also provides the tool for data pre-processing, classification, clustering, regression, and visualization. The examples of machine learning algorithms are J48 Decision Tree, Sequential Minimal Optimization (SMO), and Naïve Bayes. J48 Decision Tree is an algorithm used to generate a decision tree for prediction of the target variable [11]. For the SMO, it is an algorithm for solving the Support Vector Machine (SVM) quadratic programming (QP) problem by decomposing it into QP sub-problems and solving the smallest possible optimization problem [12]. Naïve Bayes is an algorithm that uses the probability for finding the correct assumption using the prior knowledge [13].

In addition, we chose the supervised learning algorithms that suitable for our training set, which are the J48 Decision Tree, Sequential Minimal Optimization, and Naïve Bayes algorithms. Each supervised learning shows the characteristic of each machine learning type, J48 performs on decision tree, Sequential Minimal Optimization is similar to Space Vector Machine which is support on functional equation, Naïve Bayes do calculation on Bayes' rule which compute on the probability base.

4) Model Evaluation

The model evaluation divided into 3 sections based on our feature space files. In order to find the most accurate model, we recorded the weighted average score of Precision, Recall, and F-Measure, then we will select the feature space file and the model that gives the highest F-Measure to be the model in the complaint classification service because the F-Measure is the harmonic average of the precision and recall.

TABLE I. The First Experiment with Words in the Dictionary Using 3 Algorithms

1st Feature Space File			
Algorithm	***Precision***	***Recall***	***F-Measure***
J48 Decision Tree	0.640	0.638	0.627
SMO	0.775	0.762	0.762
Naïve Bayes	0.705	0.69	0.692

TABLE II. The Second Experiment with the Sum of Words in each Department Using 3 Algorithms

2nd Feature Space File			
Algorithm	***Precision***	***Recall***	***F-Measure***
J48 Decision Tree	0.668	0.616	0.613
SMO	0.695	0.628	0.626
Naïve Bayes	0.687	0.622	0.62

TABLE III. The Third Experiment with Words in the Dictionary and the Sum of Words in each Department Using 3 Algorithms

3rd Feature Space File			
Algorithm	***Precision***	***Recall***	***F-Measure***
J48 Decision Tree	0.736	0.728	0.73
SMO	0.803	0.796	0.796
Naïve Bayes	0.77	0.768	0.769

The result of 3 experiment shows that the 3rd feature space file with the Sequential Minimal Optimization algorithm gives the highest F-Measure about 0.796, which is the nearest to value 1. Therefore, we selected this feature space file with this algorithm to build the model for the complaint classification service in our SCMS.

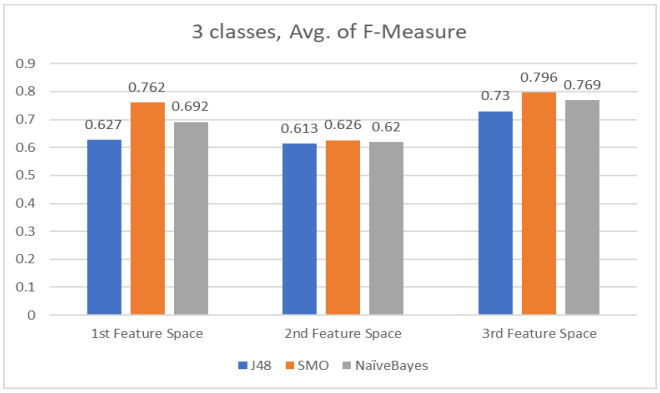

Fig. 16. The Result of 3 Experiments

5) Model Selection and Usage

The dictionary file and the model file generated by the Weka tool are used to implement the complaint classification service in the Java platform. For the model usage, when there is an incoming complaint, the service will split the detail into words (not including the stop words) and compare these words with the dictionary to extract the feature space. Finally, the service will use the model to predict the appropriate responsible department based on the extracted feature space.

B. *Finding Similar Complaint*

SCMS has a process that could avoid submitting the duplicate complaints by suggesting the similar complaints. Instead of always creating a new complaint, users can choose to "Agree" on any suggested (similar) complaint. Both complaints are considered to be similar if (i) they have the same location, (ii) their status are not completed yet, and (iii) they have some matched keywords in their details.

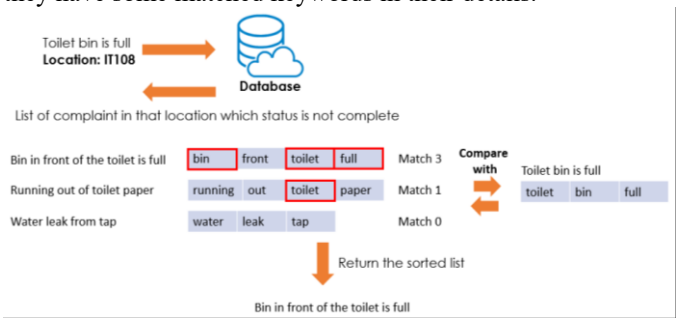

Fig. 17. Finding Similar Complaint

Fig. 17 shows the process of finding similar complaints. After the complainant selected the location, provided the details, and submitted the complaint, the system will retrieve a list of existing complaints from the database (using PHP). These complaints must have the same location as selected by the users and their status must be not completed. The system will split the details of each complaint into a list of words excluding stop words. Each existing complaint will be compared against the new complaint and the top ten most similar complaints sorted by the total number of the matched keywords of the complaints' details in descending order are selected.

C. *Data visualization - Keyword count (For Word Cloud)*

The dashboard page in the web app contains the word cloud map showing the keywords that mostly found in all complaints. The size of the word will be big and small depends on the amount of each keyword from all of the submitted complaints in the database.

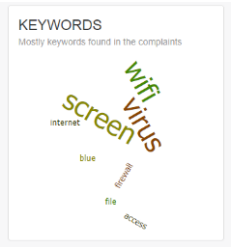

Fig. 18. World Cloud for IT Department

Initially, the set of keywords from each department was pre-defined and stored in the database. Then, the frequencies of each keyword found in all complaints were computed. Finally, the top 10 keywords that were most frequently found were used to make the world cloud.

V. EVALUATION

A. *User Satisfaction Test*

The objective of the observation is to gather the information from the people who are faced with the problems in the Faculty of ICT. Before testing, we provided the information and demonstrated the mobile application. Then enable the participants to use the application, and evaluate by using the Google form.

The total of 85 participants was selected to be the users of the mobile application. The participants were 20 students for each year (as total of 80 students), and 5 officers in the Faculty of ICT.

User evaluation	Satisfaction score					Average
	1	2	3	4	5	
User Satisfaction about Floor Plan	0	1	6	22	11	4.08
User Satisfaction about Barcode Scanner	0	2	3	18	17	4.25
User Satisfaction about Chatbot	0	3	7	17	13	4.00
User Satisfaction about Complaint Progress Tracking	0	0	4	20	16	4.30
User Satisfaction about Show the similar complaint	0	0	9	22	9	4.00
User Satisfaction about Classifying Complaint	0	1	3	22	14	4.23

Fig. 19. User Satisfaction Level of using mobile application and chatbot

Fig. 19 shows the satisfaction level of using our mobile application and chatbot, all of the main features had the average score more than 4 out of 5.

Moreover, the total of 10 participants were selected to be the users of the web application. They were 3 staff from IT department, 3 staff from Engineering department, 3 housekeepers department, and 1 administrator (the head of all departments). Staff in each department is able to see only the complaints in their department, and admin is able to see all the complaints in all departments.

The overall of user testing for the web application, out of maximum 5 score, the participants gave 4.43 score for the beauty, 4.37 score for how easy to use, and 4.47 score for how useful of web application. The page that the participants liked the most is the dashboard page, and they thought the web application was useful. Finally, most of participants would like to use web application when this web application available.

VI. CONCLUSION

SCMS was developed to enhance the current complaint management system by using the mobile application and web application. Therefore, SCMS was able to provide several channels for filing the complaint, which enables users to send the complaint easier, and also provides the channel for progress tracking by using the mobile application. Moreover, SCMS was capable of classifying the complaint and directly sending to the appropriate responsible department, therefore, the system could reduce the cost of hiring the staff and time of the operation. In addition, SCMS could decrease the duplicate complaints by suggesting the similar complaint to users. Furthermore, SCMS allows the staff to manage the complaint through the web application instead of done manually on the paper form. Finally, the system generates the data visualization for the summary of complaint data.

ACKNOWLEDGMENT

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