ONLINE CLOUD BASE SERVICE PROVIDER 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 Cloud Base Service Provider (CSP) consisting of the mobile application, chatbot and web application, for solving the customer's dissatisfaction issue. Furthermore, the CSP 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 not clear 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

CSP is developed to handle the 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 CSP 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.   LITERATURE REVIEW

A. Complaint process

The complaint is a customer's expression of dissatisfaction with a product or service whether it be writing or speaking to the responsible person within the organization.[4] Customer Complaint Management might affect the level of customer satisfaction, therefore each organization will 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:
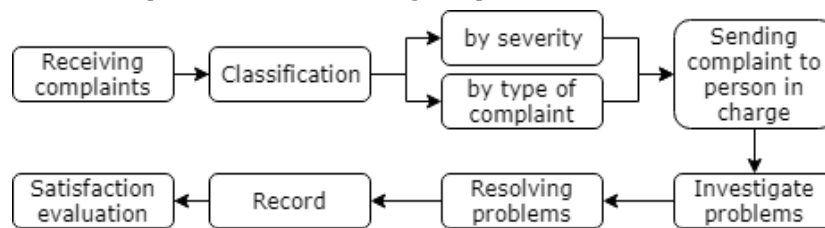

Fig 1: Complaint Management Process

B. Related Technology

1) Receiving Complaint via Chatbot

A chatbot is a computer program that used for communicate with a human through the messaging application, chat window or voice chat.

Nowadays, several businesses apply a chatbot to manage CRM and the customer service. For example, use a chatbot for answer the problem of consumers, offer news or promotions, and give counsel. From the statistic, 65% of consumers prefer using a messaging app when contacting business [6] and over 50% of customers expect a business to be open 24 hours [7]. In addition, a chatbot is the best way to support the need 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 relatively fast development, easy to deploy, and low cost.
- AI chatbot: is the intelligent chatbot that use the deep learning processes which called Natural Language Processing (NLP). NLP 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 several complaints, the automatically classify complaint is required to use for sending the complaint to the proper department. Thus, the benefits are saving time and labor.

Text classification is the automatic classifying of documents to predefined classes or categories based on the text in documents. There are several algorithms that are in text classification such as Rule-Based, and Decision tree [9].

Machine learning is one of the artificial intelligence (AI), which enables the system or computer to automatically learn and improve based on the experiences and the information that received. Normally, there are two types of machine learning algorithms, which are the supervised learning and unsupervised learning. The supervised learning is learning to predict the future events using the labeled examples from the human input. 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, then the computer is able to predict the result for that information. The example algorithms are Support Vector Machine, Naïve Bayes, and Gradient Boosting. In contrast, the unsupervised learning is learning without providing the result from human, therefore the computer will learn from the hidden structure of information. The example algorithms are K Nearest Neighbor and K-Mean [10].

B. Comparison with Existing Systems

The existing system that related to CSP could be divided into four formats, which are a paper form, a call center, E-Complaint, and a mobile application. The following is the comparison of the main features of CSP and current existing systems.

	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

CSP has the strength points such as complaint status tracking, automatically classify complaint to the proper department, provide several channels to submit the complaint, and able to prevent duplicate complaint.

III.   PROPOSED METHODOLOGY

A. System Architecture Overview
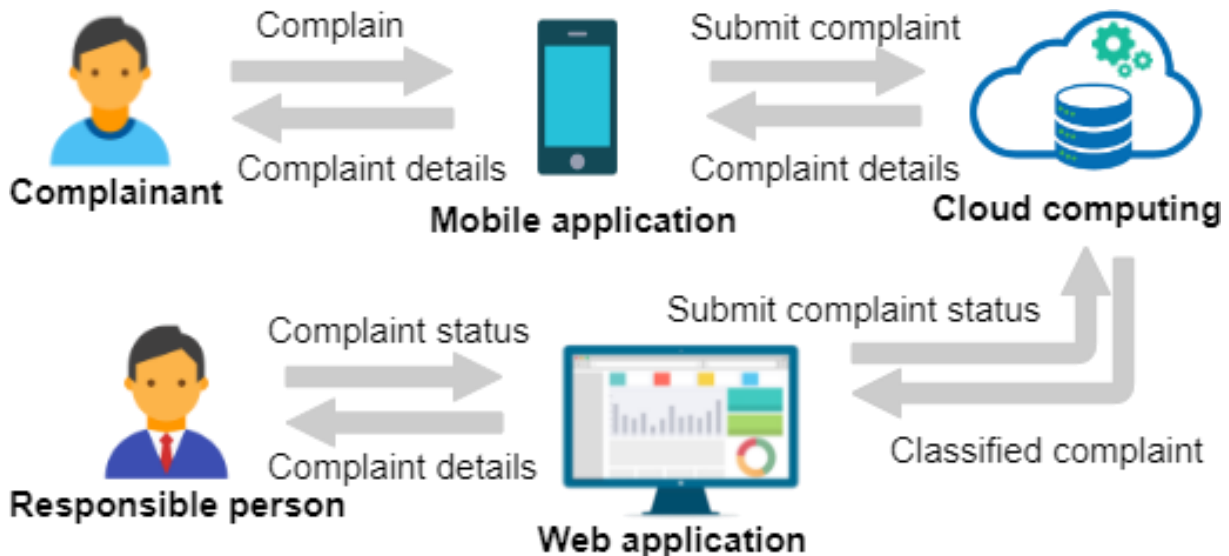
Fig 3: Overall of The System Architecture

The complainant uses the mobile application or chatbot to report the problem. After that, the complaint was sent to process in cloud computing and collect in the database. On the staff side, the web application retrieves all the classified complaint from the database; therefore, the responsible person could see the data visualization and existing complaints. 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**

1) Mobile Application

Fig 4: Home Page and Complaint Status Page

After the users login to the application, users will lead to the home page, then users could see their complaint and their agreed complaint. In addition, the complaint shows the complaint identification number, date and time, location, pictures, and details. Also, users could see the complaint status on the bottom right button.

In the complaint status page, users could check the progress of their complaint that updated by the responsible person.

There are three channels for filing the complaint which are floor plans, barcode scanner, and chatbot.
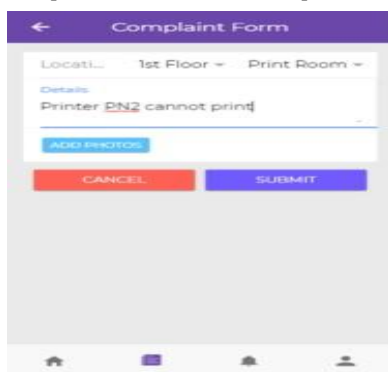
Fig 5: Floor Plans Page

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 to users. Therefore, users could click "Agree" button if the complaint is similar to the complaint that users are going to create to prevent the duplicate complaint.
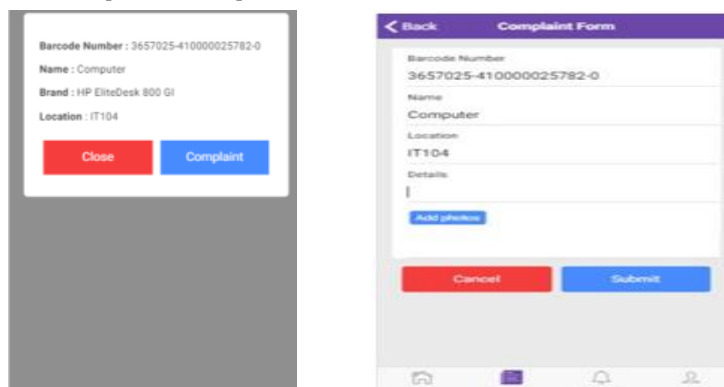
Fig 6: Barcode Scanner Page

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.
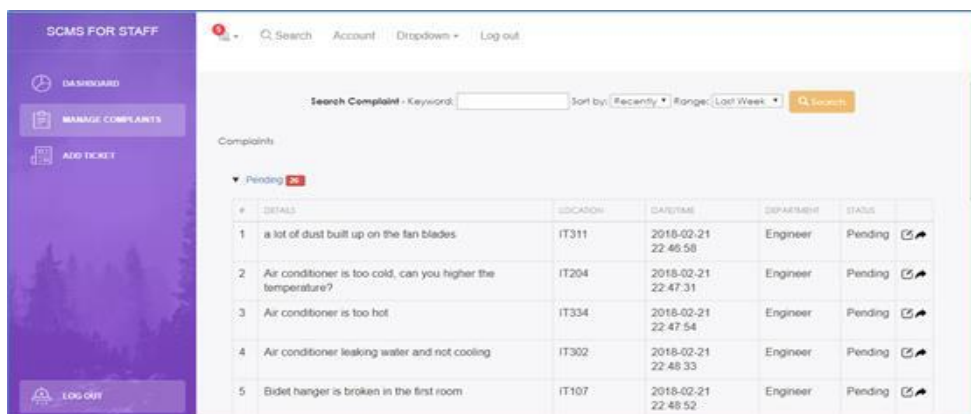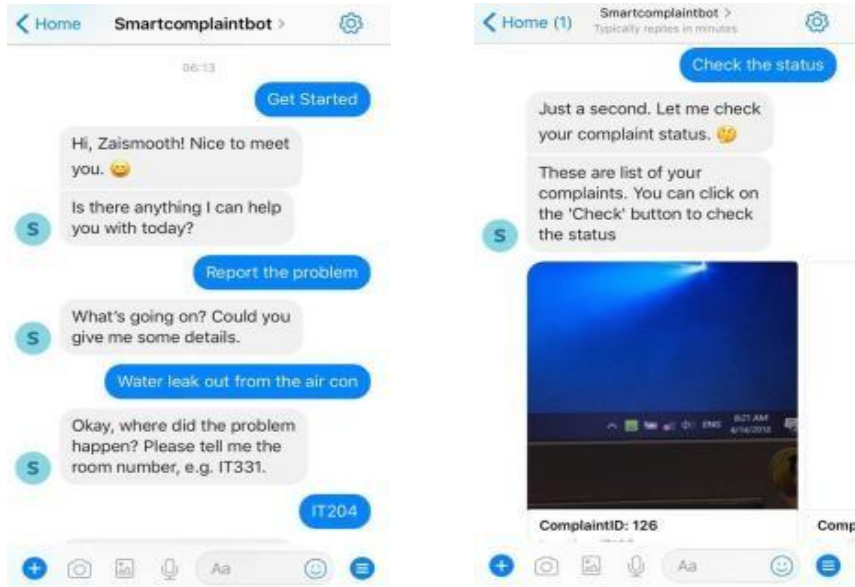

Fig 7: Chatbot

The chatbot is on the Facebook Messenger platform. Users could report the problem and check the status of the complaint via Smart ComplaintBot.

2) Web Application

Fig 8: Dashboard Page

In dashboard page, staff from each department will only see complaints related to their department. This example shows IT department and Housekeeper department. Each department will see the information from that department.

Fig 9: Manage Complaint

On this page, the staff can see the list of complaints in the system, which separated by the status of each complaint. There are two icons on the right side of the table. The first icon is "Manage complaint". The staff can click this icon to go to the details page and add fixing update. The second icon is "Forward complaint". Staff can click this icon to forward the complaint to another department.

After staff clicks the "Manage complaint" button, the page will lead the staff to the complaint details page. This page shows the details of the complaint including details, submitted date, the ID of the person who submitted, location, and fixing update table.
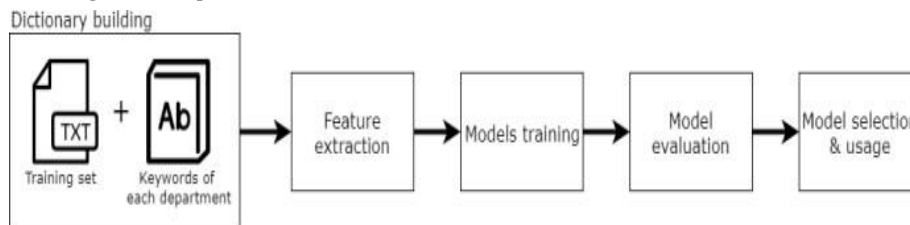
C. Complaint Classification Service

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

Fig 10: Example of Complaint Classification Service

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 sliding of the keyboard tray is broken, then the service will predict that the responsible department is the engineer. The following figure, Fig 14, is the procedures for building the complaint classification service.

Fig 11: Complaint Classification Service Procedure

1. Dictionary Building

Before building the dictionary, we prepared the data for use in this process. The first thing was 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 of each department are consisting of 154 words, which are 54 words of IT department, 48 words of housekeeper department, and 52 words of engineer department.

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

After that, the dictionary table is created using the training set and the keywords of each department table. The dictionary table consists of two columns which are words and class. We had to split the details in the training set into 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 the result, the total number of words in the dictionary is 507 words.
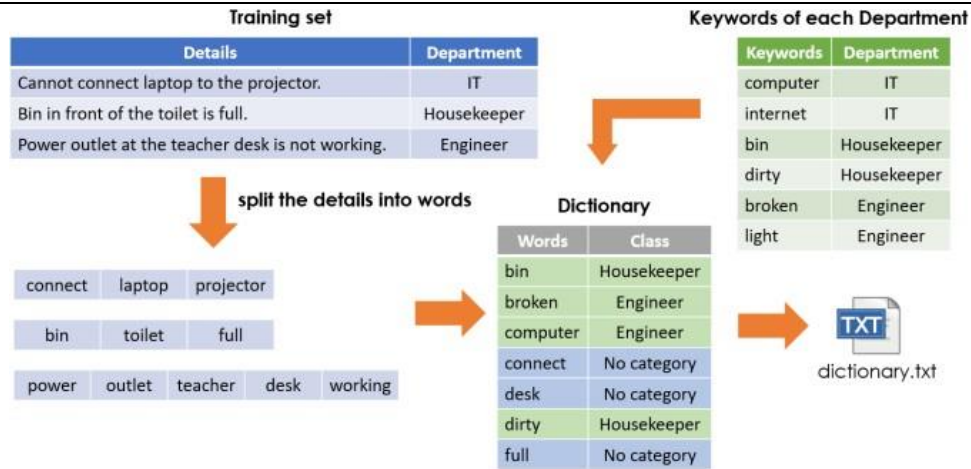
Fig 12: Dictionary Building

2. Feature Extraction

This step is to convert the data in text format to the data in number format. Therefore, we had 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 had 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 1: The 1st Experiment With The 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 2: The 2nd 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 3: The 3rd Experiment With The 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 nearest to the best value at 1. Therefore, we selected this feature space file with this algorithm to build the model for complaint classification service.


Fig 16: The Result of 3 Experiments

5. Model Selection and Usage

For the model usage, when there is an incoming complaint, it will split the detail into words not include the stop word, and use these words compare with the dictionary to extract the feature space. After that bring the feature space and the model file to use in the Weka classifier to predict the responsible department.

D. Finding Similar Complaint

CSP has the process that could decrease the duplicate complaint by suggesting the similar complaints to users. Therefore, users are able to click "Agree" instead of creating the new complaint.
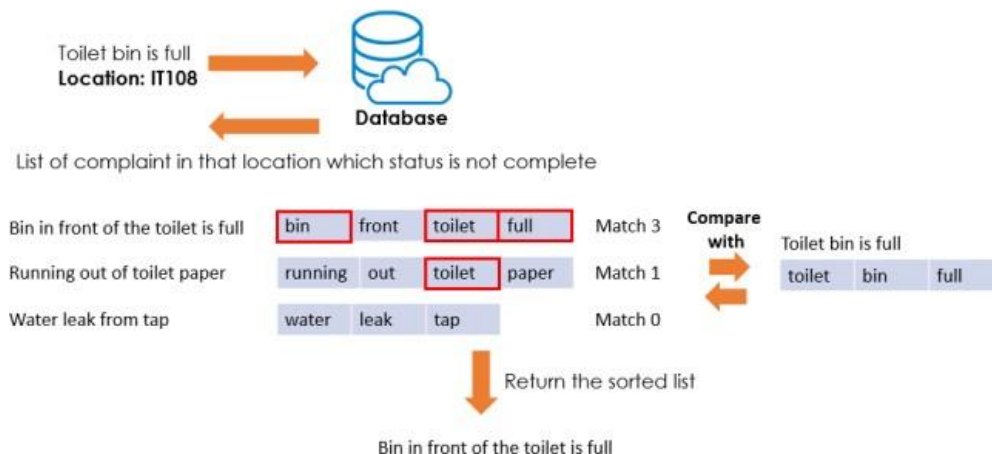
Fig 17: Finding Similar Complaint

Fig. 21 shows the process of finding the similar complaint. After the complainant selected the location and provided the details in the Complaint Form Page, the PHP file will retrieve POST data, then retrieve the list of

the existing complaint based on the location that the complainant selected and the complaint status is not complete from the database, then split the details into words not include the stop word. After that compare each of existing complaint with the new complaint details and count the matched words. Finally, remove the unmatched complaint and return the sorted list of the similar complaint.

E. Data visualization - Keyword count (For Word Cloud)

CSP website dashboard page got the word cloud map. World cloud map shows 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

Initially, we already have the set of the keywords in the database. We considered each keyword, then find that keyword from all complaints, to count how many times that keyword got used. After that, we will have the collection of keywords and the number of keywords used. We sort it by the highest number and use that data to make the word cloud.

F. 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.

There are 85 participants were selected to be the users of the mobile application. The participants are 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

This table shows the satisfaction level of using our mobile application and chatbot, all of the main features has the average score more than 4 out of 5.

Moreover, there are 10 participants were selected to be the users of the web application. There are 3 staff from IT department, 3 staff from Engineering department, 3 housekeepers, 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 every department.

The overall of user testing for the web application, out of maximum 5 score, the participants give 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 like the most is the Dashboard page, and they think the web application is useful. Finally, most of participants would like to use web application if this web application exists.

IV. RESULT

In this project, we implemented Online Cloud Base Service Provider System. Online system which is run on internet with compatible with all devices. User can search any category wise complaint or services at home just filter by type and product category other hand all users come on single platform. Public user can get complaint status and notification at home on smart phone or computer online. Customer user can submit their complaints online according to online availability and admin user can get complaint from customers and assign to employee for resolve. In this system multiple employee user can access their account and update complaint details.

V. CONCLUSION

The CSP was developed to enhance the current complaint management system by using the mobile application and web application. Therefore, the CSP is able to provide several channels for filing the complaint, which enables users to send the complaint easier, and also provide the channel for progress reporting by using the mobile application. Moreover, the CSP is capable of classifying the complaint and directly send to the responsible department, therefore, the system could reduce the cost of hiring the staff and time of the operation. In addition, the CSP could decrease the duplicate complaint by suggesting the similar complaint to users. Furthermore, the CSP allow 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.

VI. FUTURE SCOPE

The scope of an Online cloud base service provider is to build and maintain positive relationships with customers, identify opportunities for business growth, and resolve customer complaints. To keep expectations realistic, make a list of questions for yourself and the vendors of your shortlist platforms. Provide dashboards and reporting tools for service providers to analyze the performance of their offerings and for administrators to track system usage.

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