

## **E-Complaint System for Internal Customer in Royal Malaysian Police Force Using Formal Language Method**

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**Abstract:** The effectiveness to respond to customers' feedback also depends on an effective workflow. By having an effective method and workflow, the management can response immediately, hence improves the quality of services and facilities offered. The aim of this paper is to analyze the development of a complaint management system that uses formal language theory methodology. The E-Complaint System is been developed to use by the internal staff in the Royal Malaysian Police Force (PDRM). Before starting to develop the system, we try to model the system's flow using two type of method, i.e. the Deterministic Finite Automaton (DFA) and Non-deterministic Finite Automaton (NFA). The selected method to be used is the DFA, because it has a clear direction of each step. Among the function in the systems are Complaint Form, Review Complaint Status, Manage Complaint Process and the Email Form.

**Key words:** Complaint Management System, Deterministic Finite Automata (DFA), Non-deterministic Finite Automata (NFA).

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### **INTRODUCTION**

Purpose of formal language theory is to bring an order to a complex system order. It can be characterized by predefined rules, like formal notations in mathematical, logic and computer science. A finite automaton is a string processor that assists in defining certain formal languages by accepting or rejecting a sequence of symbols. Finite-state based notions and tools enable the introduction of efficient algorithms to generate and select test cases automatically. The elements of the approach will be illuminated and validated by realistic examples (Razali et.al, 2011; Shlayan and Kachroo, 2012).

Customers have the right to complaint or give comments on the services and facilities provided (Belli, 2003). Normally the customers will make their complaints directly. Unfortunately, in most of cases customers face difficulties to channel their complaints and comments to the right party. Hence, resulting them in complaining in the media such as television and newspapers. This actually gives a negative impact to the Police reputation. Besides that, the customers also have difficulties in knowing the status of their complaints.

#### **Related Works:**

Pyon et al. (2010) believed that customer complaints through call centres are adequate to support the analysis for service improvement in financial service industry. Hence, they proposed a web-based decision support system for business process management employing customer complaints, namely Voice of the Customer (VOC). The system is handling data for service improvement and involves VOC conversion for data enrichment and includes analysis of summarization, exception and comparison.

Najar et al. (2010) tried to improve relation between citizens and government by presenting a new model based on Service Oriented Architecture (SOA). With utilizing the presented model in government body on one hand governments will have the ability to minimize citizens' dissatisfaction and on the other hand it can encourage citizens to participate in controlling government body such as governments' staffs and organizations. Results of this study are becoming a good reference to find out users' needs from e-complaint and the importance of complaint in the body of government.

Jan et al. (2010) hypothesized that credibility and congruence in attitude orientation positively enhance complaint utility perceptions and strongly bias complaint dialogue evaluations. The research is highlights that expected relevant results for online complaint managers and marketers alike are the inclusion of post-complaint communication into corporate image and relationship management as well as using credibility perceptions as a benchmark for online customer satisfaction and potential positive electronic word-of-mouth.

Coussement and Van den Poel (2008) introduced a methodology to improve complaint handling strategies through an automatic email classification system that distinguishes complaints from non-complaints. Hence, complaint handling becomes less time consuming and more successful. The classification system combines traditional text information with new information about the linguistic style of an email. The empirical results

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show that adding linguistic style information into a classification model with conventional text-classification variables results in a significant increase in predictive performance.

Kopparapu (2008) proposed a natural English enabled mobile interface which can be used to lodge complaints. The essential idea is to make use of the existing web portal infrastructure and provide an easy, cheap and quick mode of complaint registration around the clock. The system enables and assists citizens to lodge complaint and seek redressal through their mobile phone in natural language.

This study was undertaken to improve the current complaint management to benefit the department. The objective of this study is to propose implementation of e-Complaint system, an online system to channel complaints and comments to the management. For a start we have identified a new complaint management process which includes a work flow process and a method.

### MATERIALS AND METHODS

The main purpose of this research works is to propose a system with which has been modeled and tested carefully before been developed. The E-Complaint System is developed for the usage of the internal customer in the Royal Malaysian Police Force (PDRM). Before starting to develop the system, we try to model the system's flow using two type of method, i.e. the Deterministic Finite Automaton (DFA) and Non-deterministic Finite Automaton (NFA). Among the Function in the systems are Complaint Form, Review Complaint Status, Manage Complaint Process, Email Form and etc. The objective is to provide a platform for the staff to make complaint about the infrastructure, IT peripheral, office equipment, human resources related, regarding the administration, procurement, finance and etc.

In this research work, there are two type of finite automata model has been selected in the development of the system that is the DFA and NFA. Brief definition of these two different models is presented in Table 1.

**Table 1:** Differences of DFA and NFA.

DFA	NFA
Also known as deterministic finite state machine is a finite state machine that accepts/rejects finite strings of symbols and only produces a unique computation (or run) of the automaton for each input string.	Also known as Nondeterministic finite state machine is a finite state machine where from each state and a given input symbol the automaton may jump into several possible next states.
There is a fixed number of states and can only be in one state at a time	There is fixed number of states but can be in multiple states at one time
Consist of 5-tuple, $(Q, \Sigma, \delta, q_0, F)$	Represented formally by a 5-tuple, $(Q, \Sigma, \delta, q_0, F)$
	Can be converted to DFA by eliminating $\epsilon$ -transition
<u>Advantages</u> Limited memory bandwidth requirement. Require only a single state traversal for each input character processed, independent of the number of Regular Expression in the data-set.	<u>Advantages</u> Limited memory space requirement, which is dependent only on the number of characters present in the set of Regular Expression.
$\Sigma = \{a, b\}$ 	

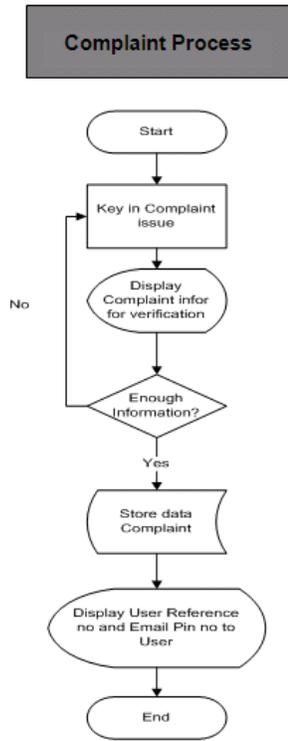
In order to come out with the detail model of DFA and NFA, the processes involves in the system need to been identified. In this task, flowchart is used as the representation to show the flow of the processes. The following flowcharts are divided into 2 parts: a) User Action, which contain Complaint Process as shown in Fig. 1, and Review Complaint Process as shown in Fig. 2; b) Management Action as shown in Fig. 3.

#### A. User Action - Complaint Process:

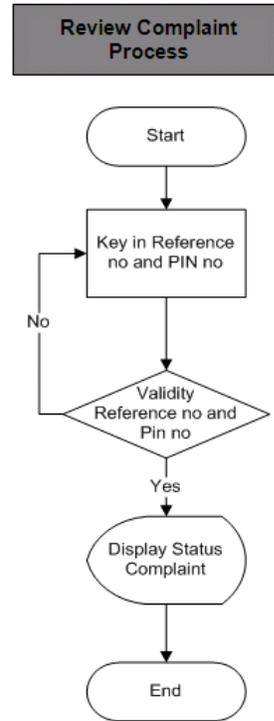
- On this process user can insert their complaint by using a form.
- Each complaint must be true and enough with the information
- If the complaint information is not complete, the management will mark it as not valid or not true, and the complaint will not be processed.
- After receiving the complaint, the system will generate a Reference Number and a PIN Number. The User will receive the Reference Number via the system while the PIN Number via their Email. The process will provide an additional security to the system.
- Each complaint will be processed within 21 days.

**B. User Action - Review Complaint Process:**

- On this process user can review their complaint by using the Reference Number and the PIN Number.
- The User must provide that Reference Number and PIN Number into the form, then the complaint's status will be shown.



**Fig. 1:** User Complaint Form Process.



**Fig. 2:** User Review Complaint Process.

**C. Management Action – Management Complaint Process:**

- On this process, the management as the owner of the system will process all the complaint receives from the user.
- The management enter the system by using the Username and Password that are provided to them by the System's Admin.
- Each management are categorized into several accesses in the system. The user type are as shown below;
  - Admin – User that receives the complaint, update the user management and assign the action for each complaint.
  - Investigation – User that investigate the complaint and decide whether the complaint is valid or not
  - Proposed – User that proposes the action to solve the complaint.
  - Corrective – User that do the correction action.
  - Endorsement - User that will endorse the complaint action.
- After the completion of each action for the complaint, the Admin will send the report to the User thru email and an also the system.

**RESULTS AND DISCUSSION**

The methodology used before starting to develop the system is using the DFA and NFA model, from the flowchart we have come out with 8 DFAs process model and 1 NFA process model. We test the model using the JFLAP simulator and the input result for each model are shown in the following figures. The number of, type, and definition of states, together with the transition and its transition details also has been discussed as presented as follows:



Fig. 3: Management Complaint Process flowchart.

A. DFA for User Complaint Process

State	Type of State	State Define	Transition State	Transition Details
q0	Initial state	Complaint form	1	Submit complaint information
q1	Normal state	Display complaint information for confirmation	2	Confirm complaint submission
q2	Accepting State	Receive confirmation page	3	Review complaint information

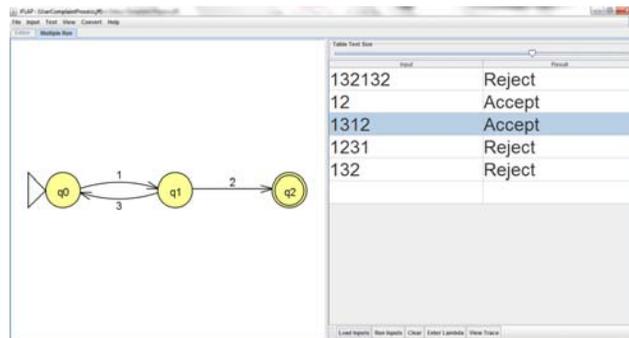
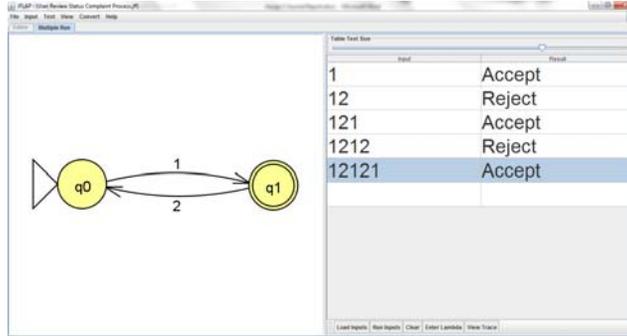


Fig. 4: DFA Diagram with input result – User Complaint Process.

**B. DFA for User Review Status Complaint Process**

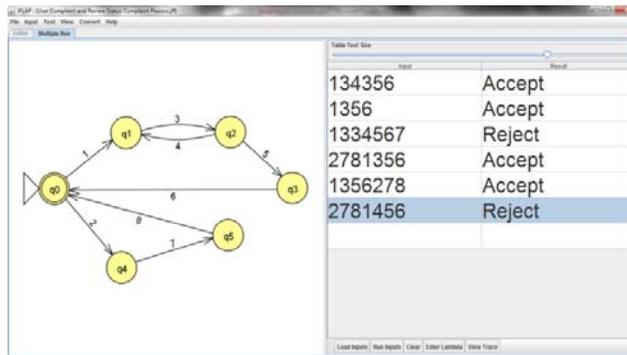
State	Type of State	State Define	Transition State	Transition Details
q0	Initial_state	Login Review Status Complaint form	1	Submit_Reference&PinNo
q1	Accepting State	Display Complaint information Status	2	Review_Another_Complaint_status



**Fig. 5:** DFA Diagram with input result – User Review Status Complaint Process.

**C. DFA for User Compliant and Review Status Complaint Process(Combined)**

State	Type of State	State Define	Transition State	Transition Details
q0	Initial state / Accepting State	Menu Page	1	Make Complaint
q1	Normal state	Complaint Form	2	Review Existing Complaint
q2	Normal state	Review Form	3	Submit Complaint Information
q3	Normal state	Display complaint information for confirmation	4	Update Complaint Information
q4	Normal state	Receive confirmation page	5	Confirm_Complaint_Submission
q5	Normal state	Display Complaint information Status	6	Go to menu page
			7	Submit Reference&PinNo
			8	Go to menu page



**Fig. 6:** DFA Diagram with input result – User Complaint and Review Status Complaint Process (combined).

**D. DFA for Complaint Manager Process**

y	Type of State	State Define	Transition State	Transition Details
q0	Initial_state / Accepting_state	View Complaint	1	Select Action_Distribution
q1	Normal_state	Action_distribution_Form	2	Update_Action_Distribution
q2	Normal state	Email form	3	Select Email Action
			4	Send_Email_to_Complainant

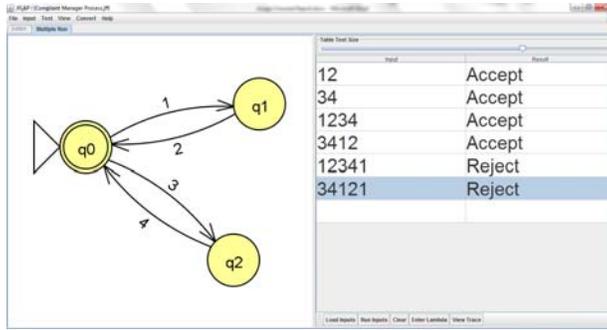


Fig. 7: DFA Diagram with input result - Complaint Manager Process.

E. DFA for Manage Complaint Process

State	Type of State	State Define	Transition State	Transition Details
q0	Initial state / Accepting State	View Complaint	1	View Complaint List
q1	Normal state	Complaint Form	2	Select Action
			3	Update Complaint

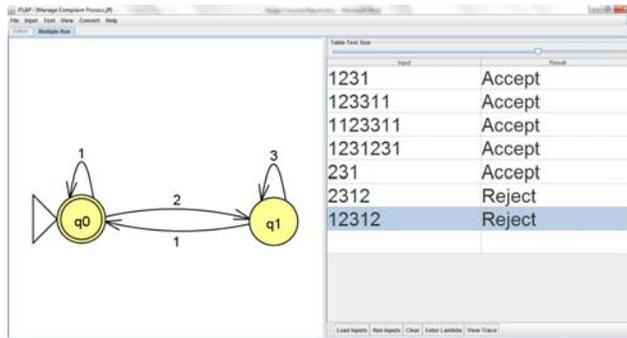


Fig. 8: DFA Diagram with input result – Manage Complaint Process.

F. DFA for Investigation Action

State	Type of State	State Define	Transition State	Transition Details
q0	Initial state / Accepting state	View Complaint List	1	Select Investigation Action
q1	Normal state	Investigation Form	2	Update Investigation Action

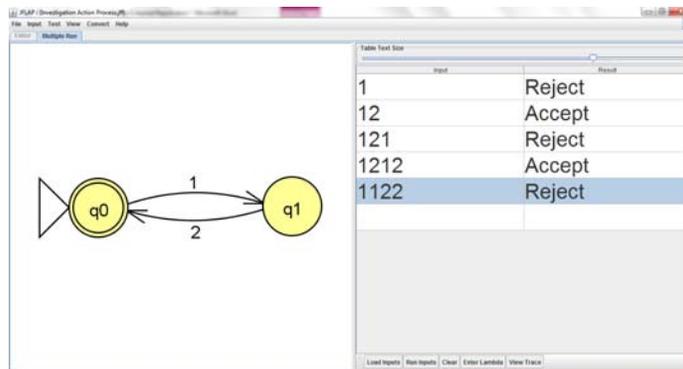


Fig. 9: DFA Diagram with input result – Investigation Action.

G. DFA for Investigating, Proposed Corrective and Correction Action (for Same Department)

State	Type of State	State Define	Transition State	Transition Details
q0	Initial state / Accepting state	View Complaint List	1	Select Investigation action
q1	Normal state	Corrective Action Form	2	Update Investigation action
q2	Normal state	Proposed Corrective action form	3	Update Proposed Corrective action
q3	Normal state	Corrective action form	4	Update Corrective action

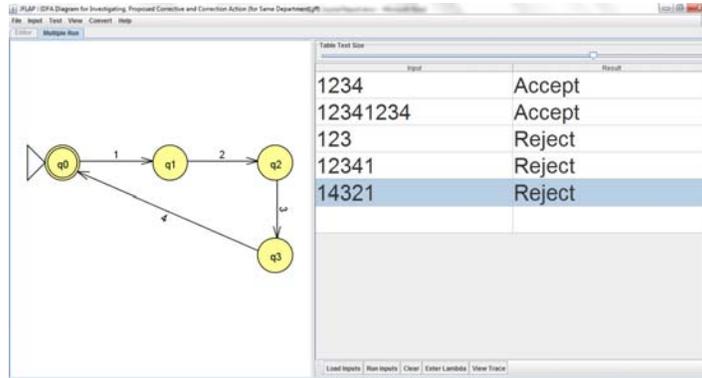


Fig. 10: DFA Diagram with input result – Investigation, Proposed Corrective and Correction Action (for Same Department).

H. DFA for Endorsement Action

State	Type of State	State Define	Transition State	Transition Details
q0	Initial_state / Accepting_state	View Complaint List	1	Select Endorsment Action
q1	Normal state	Endorsment Action Form	2	Update Endorsment Action

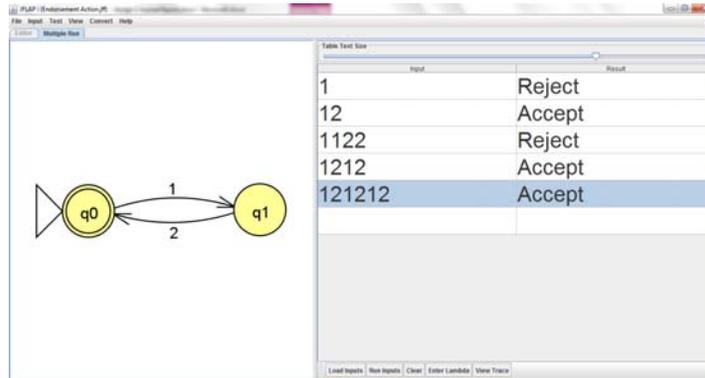


Fig. 11: DFA Diagram with input result – Endorsement Action.

I. NFA for Action Complaint Process

State	Type of State	State Define	Transition State	Transition Details
q0	Initial_state / Accepting State	View Complaint action	1	Investigation action
q1	Normal state	Investigation form	2	Update Investigation action
q2	Normal state	Proposed Corrective action form	3	Proposed action
q3	Normal state	Corrective action form	4	Update Proposed Corrective action
q4	Normal state	Endorsment action form	5	Corrective action
			6	Update Corrective action
			7	Endorsement of corrective action
			8	Not Verified
			9	Verified

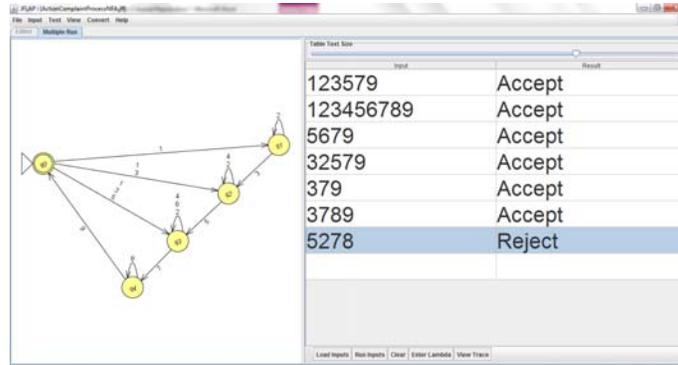


Fig. 12: NFA Diagram with input result –Action Complaint Process.

Based on the model and tested transition approved for selected states, the next step is to develop the E-Complaint System. The system has been developed using the PHP language and MySQL as the database. Some outputs of the system interfaces are presented with Fig.13 shows the Complaint Form Page, Fig. 14 shows the Review Complaint Status Page, Fig. 15 shows the Login Page for Administrator, and Fig. 16 is the Main Page for Complaint Confirmation Officer handles the complaint from the internal customer.

The screenshot shows the 'eComplaint System' interface for the Royal Malaysian Police. It features a navigation menu on the left with options: MANAGEMENT, COMPLAINT, and COMPLAINT STATUS. The main content area includes a header with the police logo and the text 'eComplaint System Royal Malaysian Police'. Below this is a message: 'ALL YOUR COOPERATION VERY MUCH APPRECIATED'. The form contains several input fields: Name, Department, Telephone (marked with a red asterisk), Staff No, E-Mail (marked with a red asterisk), Type (a dropdown menu currently showing 'PLEASE SELECT'), and Description of complaint (a text area marked with a red asterisk). A 'Send' button is located at the bottom right of the form. A footer note states: '\* Compulsory fields are indicated - required for respond inquiry'. The footer also includes the text 'eComplaint v 1.0 Royal Malaysian Police All Right Reserved©2012'.

Fig. 13: Complaint Form Page.

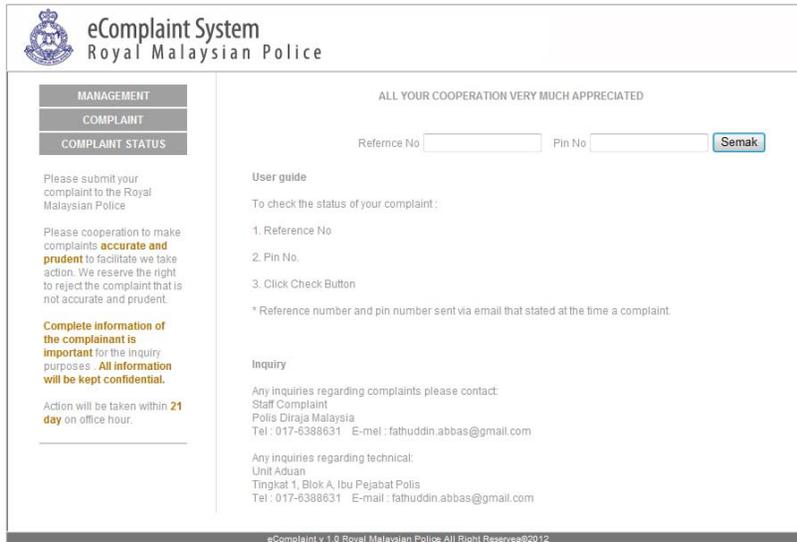


Fig. 14: Review Complaint Status Page.



Fig. 15: Login Page for Administrator.

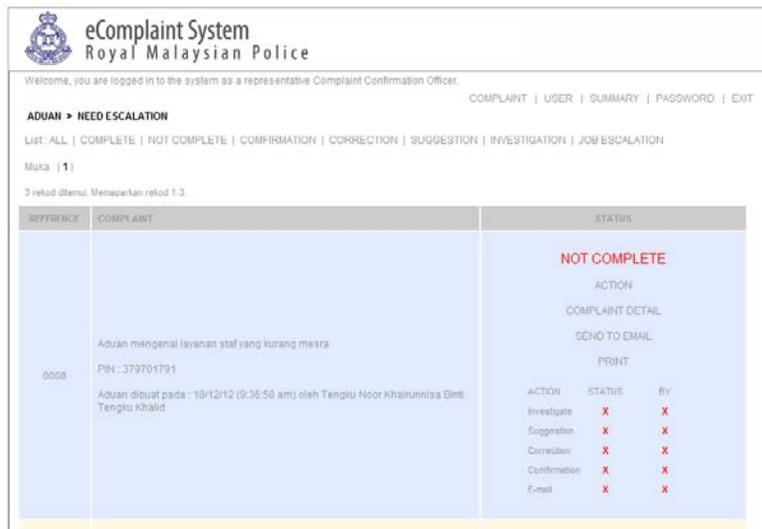


Fig. 16: Main Page for Complaint Confirmation Officer handles the Complaint from the internal customer.

**Conclusion:**

The e-Complaint System is the platform the user can make a complaint regarding their office infrastructure, IT peripheral, office equipment, human resources related, regarding the administration, procurement, finance and etc. Using the Formal Method (automata) the process of managing the complaint can be effectively monitored and processes. For developing the system, the selected model to be used is the DFA model. This is because DFA can be implemented easier since their next state is clearly stated and usually determined by a

function, the system to be developed is not a complicated system, NFA is harder to be implemented and required more memory, but if it implemented using NFA model it can save the process time of a complex system.

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