The Implementation of Finite State Automata in Government SMS Services (MySMS)

Nik Sakinah Nik Ab Aziz, Nor Fazlida Mohd Sani, Rozaini Othman, Haslila Othman
Faculty of Computer Science and Information Technology, Universiti Putra Malaysia (UPM), 434000 Serdang, Selangor, Malaysia.

INTRODUCTION

Government agencies use multiple ways to deliver services to its clients and public such as through emails, application systems, websites, social networks and face to face. This is depending on the services type and availability. In years, the evolution of mobile Short Message System (SMS) application is become one of the high demand technology which introduced fast service delivery and cost saving. So due to this, the Government of Malaysia uses this technology to offer various personalized SMS services.

In the earlier stage of implementation, the government agencies have their own ways in providing SMS services and no specific standards to follow. Most of them have their own SMS numbers/ codes and the charges are varies. So, the public needs to use different contact numbers to request mobile services from different agencies.

Government SMS Gateway (MySMS) is the initiative introduced in 2008 by Malaysian government through Malaysian Administrative Modernisation and Planning Unit (MAMPU) to deliver government info and services via mobile with ease and simplicity. The system is centralized; using only one number that people can use to get different information from multiple agencies. Services are accessible through SMS 15888 which can be divided into two types, Information on Demand (IOD) and Document on Demand (DOD). IOD is a service type that offer relevant SMS information based on user’s SMS request. DOD is a function that enables documents requested by SMS to be pushed to user’s email. In addition, the service cycle is completed with a Payment Exchange for those who wish to make payment to government agencies.

According to MAMPU, there are about 160 government organisations participate in this initiatives with more than 1400 services being offered. Among the high impact services are the announcement of SPM examination result (Ministry of Education), status review of identity card application (National registration Department) and status review of the national service programme (PLKN). As of 20th November 2012, 299917 have registered for MySMS services.

There are certain limitations need to be addressed especially the risks of the system of becoming unstable. This is the statement of the problem. MySMS requires the system efficient mechanism to handle huge number of requests and involving 160 agencies (service providers). We need to check the traffic within the network. Sometimes there are risks traffic bottleneck and the system might crash if there are so many requests at a time. This is because in existing system, they have many possibilities that need to be checked whether the sending request is success or fails.

II. Related Work:
A. Mobile SMS:
Frode Eika Sadness (2005) writes about Evaluating Mobile Text Entry Strategies with Finite State Automata. She proposed a methodology for representing text input strategies for miniature and mobile device. It is based on representing text input strategies as graphs. The methodology incorporates...
with Keystrokes Per Characters checking for errors recoverability and correctness. Model that have been used is DateStamp approach which from methodology six text entry strategies.

Siti Dianah and Ali Selamat (2008) proposed model checking approach to handle validation and verification of mobile SMS application to ensure system correctness. They used agent that have ability to sense, communicate and achieve the task at given time once the knowledge are delivered. The design algorithm have the ability to verify the validity of the SMS message that based on syntax formality, data type checking and time consume.

B. SMS and e-Government:

Chete, Oyemade, Abere, Chiemake and Ima (2012) developed the model and suggests that SMS-based e-government services can be classified into six level which are: Listen, Notification, Pull-based Information, Communication, Transaction and integration. They also report about studied carry out by Susanto and Goodwin (2010) which identified fifteen factor influencing citizen adoptions of SMS based e-Government service in twenty countries. From the study they found out there are three reasons why utilizing SMS. It is because SMS users are much higher, the SMS infrastructure is more extensive and the SMS price compared to the Internet is much lower. Additionally, SMS based on e-government has proven benefits. Providing public services through the SMS channel significantly reduces time and cost; introduces a cheaper, easier and faster information-accessing channel; improves transparency, accountability, communication and the relationship between government and citizens; makes the services and procedures easier for the citizen to use; improves the political image of the district, engages more people and increase citizens participations. There are 4 types of SMS delivery as presented in Chete et al. (2012)

- **Pull SMS:**
  
  Users can request services by SMS from a wireless handset then the requested service is sent back to the handset via SMS. This approach has been demonstrated in the services such as users requesting ring tones or games by SMS.

- **Push: Event based SMS:**
  
  An SMS message is sent to the user activated by event-based application; for example a confirmation SMS may be sent to citizens whenever their personal data in the government’s database is altered.

- **Push: Scheduled SMS:**
  
  An SMS message is sent to a user activated by a time schedule-based application; for example a tax notification-SMS may be sent to particular citizens when nearing the due date (quarterly, half yearly or annually).

- **Push: Personal Profile:**
  
  An SMS message is sent to the user activated by applications based on profile and preferences of the user; for example an SMS about childcare benefit information may be sent to parents who satisfy the conditions for receiving childcare benefits.

Fayu Wang and Hua Zhang (2010) study the characteristics and the practical needs of current government in China about information system services using SMS platform. The research briefly introduced the system structure of the short message platform, the primary functions of the mobile government information service platform and the key technology of it design and realization.

**MATERIALS AND METHODS**

A. **MySMS Architecture:**

Fig. 1 is the detail architecture of the Government MySMS system. In the architecture, it describe how the data will be transfered from the sender phone to telco then to the government gateway. Then, the gateway will escalate/ forward the sms request to the respective government agency, by refering to the service keyword. The response will then be initiated and send back to the requester.

![Fig. 1: Government MySMS Architecture.](image-url)
intermediate part (Telco companies and Government SMS gateway) and server site (government agencies). The requester (mobile phone user) will send SMS request for information/document. Then, the responder (any participating government agency) will respond/send result to the requester. All the data transmission need to go through all these phases and follow certain format.

![Fig. 2: Simplified MySMS Framework.](image)

**RESULTS AND DISCUSSION**

A. **MySMS Nondeterministic Finite Automata (NFA) Model:**
Finite automata has been applied in MySMS. After some revision, we found out that NFA can be used for this system. NFA has a lot of advantages that may help this system be a better system. An NFA can make a state transition spontaneously, without consuming an input symbol ($\varepsilon$). This may reduce some of the traffic in the network. NFA also has the ability to be in various states at once. Compared to DFA which need $2^n$ states to recognize all words over $\{0,1\}$, NFA only needs $i + 1$ states. An NFA diagram is created based on system flow.

In this NFA (Fig. 3), it describes how the system works by reading the input from the user and the replies from government agencies MySMS system.

![Fig. 3: MySMS NFA Model.](image)

Table below (Table 1) gives description of each state. Initial state means the starting point for our diagram, while check input is the input that received from the user. If it is correct, it will go to the next node. If the input is accepted it will end at final state (double line circle) while if the input is rejected it will end at die node.

<table>
<thead>
<tr>
<th>State</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>qRequest</td>
<td>Initial State</td>
</tr>
<tr>
<td>qPart1</td>
<td>Check input (Keyword Part 1)</td>
</tr>
<tr>
<td>qPart2</td>
<td>Check input (Keyword Part 2)</td>
</tr>
<tr>
<td>qPart3</td>
<td>Check input (Keyword Part 3)</td>
</tr>
<tr>
<td>qCheck1, qCheck2, qCheck3</td>
<td>Process Requested Info</td>
</tr>
<tr>
<td>qResult, qDocs</td>
<td>Respond the requester with result (Final State)</td>
</tr>
<tr>
<td>qNotify</td>
<td>Notify the requester</td>
</tr>
<tr>
<td>qError</td>
<td>If the checking process found that the input is wrong, go to this state (End State)</td>
</tr>
</tbody>
</table>

Table below (Table 2) shows how the diagram will be tested. There will be four types of request that can be used to test the diagram. This diagram later on will be deploying using JFLAP and test the input using real data.

B. **Testing using simulation tool (JFLAP):**
We have used JFLAP, a package of graphical tools for Formal Languages and Automata Theory to test or simulate the proposed model. The testing is done by using five type of inputs. All inserted data give different result and need to achieve final state. Five sample input have been used to test the diagram. Result after the testing using JFLAP as in Fig.4.

The result shows the testing were successful. All inputs end at the accepting states (qResult and qDocs) or dead state (qError). These were depending on combination type of inputs (as in Table 3).
Table 2: Type of Request and Example.

<table>
<thead>
<tr>
<th>Type of request</th>
<th>Examples of Request and Response</th>
</tr>
</thead>
</table>
| 1. KW1+ref_no.=result | **Eg.1:**
| Request: REG MySMS ROZAINI OTHMAN <send to 15888>  
Response/Result: Your registration has been approved.  
**Eg.2:**  
Request: UPSR AR1234 <send to 15888>  
Response/Result: BM1-A,BM2-A,B1-A,M-A,S-A=5A  |
| 2. KW1+KW2.=result | **Eg.1:**  
Request: LHDN ADDRESS <send to 15888>  
Response: LHDN KL, Lvl 9, Menara PGRM, Cheras, KL.  |
| 3. KW1+KW2+ref_no.=result | **Eg.1:**  
Request: POLICE SUMMON WLS2272 <send to 15888>  
Response/Result: You have 1 summon RM300 12/11/2012 Kajang PLUS KM80. Payment should be made before 31/12/2012.  |
| 4. KW1+KW2+ email_addr.=result | **Eg.1:**  
Request: LHDN BRIM haslila@gmail.com <send to 15888>  
Response/Notification: Your document has been sent to your email.  
Result: <document can be viewed and downloaded from email>  |

Fig. 4: JFLAP Test/Simulation.

Table 3: JFLAP test result.

C. MySMS Simulation - How the system work?:

This section shows the screenshots and gives overview of the system (user perspective). For the purpose of this paper, we have developed a prototype or simulation system to better understand the concept been proposed. The system was developed based on the model and using C# programming language. The screenshots with the samples of input and output of the system are as Fig. 5 and Fig. 6.

This system consists of two main classes that are Service Class and Register Class. When the user send request to use the system, it will check either the phone number is registered or not. If not, it will call Register class. In this class, user will send registration request and get the result of the request. Then, user can continue to use the services. Few tests have been doing using this simple simulation. Result of this simulation test is as in Table 4.

Result from Table 4 describe that the simulation is working fine that it is accepted all correct input that related to the right agencies. And it will end the request by sending failed message if the input or data request not exist.

For example, when user sends LHDN ADDRESS KL, the respond is “ERROR: Please insert <REG> <MySMS> <Name> <IC> and send to 15888 to register” because user not yet register the phone number to use the service. So user needs to register before they can use the system.

If the user already registered, the system will send the response (result of UPSR), after processing the requested SMS. This means it meets the final state.
The algorithm for this system is as follows:

```plaintext
Service Class()
{
    if phone number == null
    {
        Register Class()
    }
    Else
    {
        Check service //to send data to the specific agency
        Send request (r)
        Return result (x)
    }
}
Register Class()
{
    Send registration request (r)
    Return result (x)
}
```

Table 4: Simulation Result.

<table>
<thead>
<tr>
<th>Input</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>LHDN ADDRESS KL</td>
<td>&quot;ERROR: Please insert &lt;REG&gt; &lt;MySMS&gt; &lt;Name&gt; &lt;IC&gt; and send to 15888 to register&quot;</td>
</tr>
<tr>
<td>REG MySMS sakinah 1010101010101010</td>
<td>&quot;SUCCESS: Thank you for your registration. You now can use the services.&quot;</td>
</tr>
<tr>
<td>UPSR GS13810</td>
<td>&quot;Thank you for using MySMS. Your UPSR result is 5A's. Congratulation.&quot;</td>
</tr>
<tr>
<td>POLICE SUMMON ABC1234</td>
<td>&quot;Thank you for using MySMS. You have no summons.&quot;</td>
</tr>
<tr>
<td>LHDN BRIM <a href="mailto:sakinah112@gmail.com">sakinah112@gmail.com</a></td>
<td>&quot;Thank you for using MySMS. Your requested document has been sent to your email.&quot;</td>
</tr>
</tbody>
</table>

D. The Reliability of MySMS:

To test either all related data is accepted and success, we use decidable and un-decidability method. Below is the algorithm use to test the design:

\[
A_{NFA} = \{ \langle N, w \rangle : N \text{ is an NFA that accepts input } w \} \]

The following TM decides \(A_{NFA}\):

\[
N := \text{On input } \langle N, w \rangle, \text{ where } N \text{ is an NFA and } w \text{ is a string}
\]

1. Convert \(N\) to a DFA \(D\)
2. Run the TM \(M\) for \(A_{DFA}\) on input \(\langle D, w \rangle\)
3. If \(M\) accepts, accept. Otherwise, reject.

As results shown that NFA has been chosen as the model because we can minimize the number of nodes as compared to DFA. For example, NFA
allows many transitions in a node. From our tested model and simulation, we gather a lot of data that support our hypothesis. NFA model can be used to overcome traffic problem in this system. This is because the NFA model allows all the transactions inclusive no input and can differentiate various types of services.

Transmission of request from initial node to accepting/final node is depends on the type of service (route). The input that is not complied with the format will be rejected and ends at die node. After a few tests and revisions, the proposed model is correct and can be implemented. As a result, this will improve the performance of the system (faster to reply the request).

V. Conclusion and Future Work:

In this paper we proposed NFA model for MySMS. It has been shown how the model tested and verified using JFLAP. MySMS prototype/simulator been developed and could be used to improve MySMS traffic performance especially when handling big number of requests at one time.

In future, it is recommended that a research should be done for further enhancement of MySMS. Since most of the mobiles users currently are using smartphones, we can assess the possibility to minimize the dependency to telco_(remove some states) by using latest messaging or data exchange technology (native application). This will shorten the process, path and reduce cost. In addition, Context Free Grammar (CFG) or Push Down Automata (PDA) can also be applied to model and test this system.

REFERENCES


