Natural Language Mobile Interface to Register Citizen Complaints

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***Abstract*—Municipal corporation (MC) of a city is a local governing body which takes care of the functioning of the city. Among many other things one of the chief responsibilities of an MC includes addressing the complaints that the residents of the city might have. Maintenance of a large city requires that the MC be aware of any shortcomings either through surveillance (sensors/cameras) or by allowing the citizens to report them. The second option is usually preferred because there is a sense of belonging. A mechanism to accept complaints from citizens 24 $\times$ 7 would be the expectation from both the citizens and the MC. The Mumbai MC allows its citizens to place their complaints through several channels. The chief modes of complaint registration is (a) a visit to the ward office - where a person in charge listens to the complaint and asks for some personal details and put it across into an electronic form for other departments within the MC to handle the complaint, (b) through a contact center over a telephone - where the complaint is registered by an call center agent by typing the complaint into the system and more recently (c) through a web portal. In this paper, we propose a natural English enabled mobile interface which can be used to lodge complaints[1]. The essential idea is to make use of the existing web portal infrastructure [6] and provide an easy, cheap and quick (complain as you see) mode of complaint registration around the clock. The proposed system enables and assists citizens to lodge compliant and seek redressal through their mobile phone in natural language.**

I. Introduction

There has been extensive research in the area of e-services for municipal use [9]. The idea is to understand the usability and utility of services that are provided by a MC using newer and better technologies. There have also been studies [1] which address the usability perspective of e-services for physically challenged citizen segment. While e-services have been in use in Europe for a while, they have been catching up in India in a big way in large cities, only recently. The MC of Mumbai [8] takes care of the upkeep of the city is one of the more tech savvy MC. There are several departments within the MC to handle different aspects of the city upkeep. It is important for the MC to know about the problems as and when they occur or come into existence in the city, so that the problem areas can be dealt with quickly and efficiently. For easier handling of city upkeep, the city is divided into wards. The city of Mumbai has about 24 wards. Any complaint relating to or originating from a ward is *only* handled by an officer associated with that ward. Complaint redressal gets significantly delayed if the complaint corresponding to one ward is routed to a different ward.

Efficient functioning of all the utilities and services in the area under MC depends on active citizen participation. Mumbai MC allows the citizens to voice their complaints using various interaction mechanisms. And a correctly routed complaint is handled promptly by the concerned departmental authority in that ward. Once a complaint is registered by the citizen, an appropriate departmental authority is notified about the complaint for action. The person complaining is notified of the status of the complaint. The chief modes of complaint registration mechanisms available to a person are (a) a visit to the local ward office, where a person in charge listens to the complaint and asks for some personal details and put it across into an electronic form which is stored in a central database (b) through a contact center over a telephone, where the complaint is registered by a call center agent by typing the complaint into the system and more recently (c) through a web portal interface [6] where the user fills in the necessary details by logging onto the portal. In all the cases the complaint is stored in a central database which is accessible to the concerned ward officer to handle. The ward officer can update the status of the complaint. The status of the complaint is available to the person who has placed the complaint through the portal to see 24×7. While all of these modes have been made available for the citizens to lodge their complaints, the participation by the citizens has been poor in the case of (a) and (b) because of the amount of time involved in lodging a complaint for different reasons. but these modes of complaints bare the web based complaint registration system have poor active citizen participation because of the difficulty in using the forum to lodge complaints. The web portal (Figure 1) has had a large number of users though the penetration of computers with Internet connectivity is not very high in India. On the contrary the mobile phone penetration is very high and is growing in India in general and significantly more in the city of Mumbai [7]. It makes sense to provide an *easy to use* mobile phone based interface to lodge complaints using their mobile devices. The most straightforward way to enable use of mobile devices to file complaint is to port the web interface into Wireless Markup Language (WML) so that it can be browsed by the WAP browser on the mobile phone. While this is not difficult, it is expensive in two ways (a) WAP enabled mobile phones are more expensive and (b) citizens need to pay the telecom

[1]In [2] we has shown a similar interface using the short messaging system (SMS)

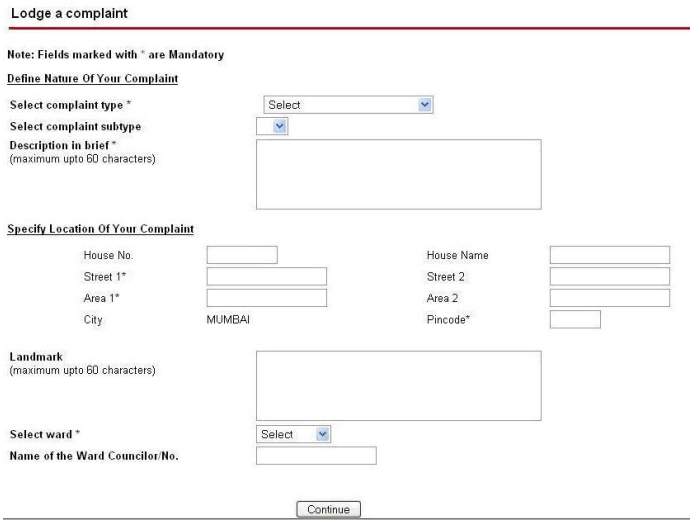

Fig. 1. Snapshot of the portal to register complaints.

operator for being on-line (accessing the complaint registration system through their phone). These are dampeners for an active citizen participation. *It is however important that active citizen participation is evoked only if the citizens are given an easy, cheap and yet effective mode of lodging their complaints.*

In this paper we propose a novel natural language interface (NLI) on a mobile phone to enable citizens to register complaints and seek redressal from MC. The advantage of this system is

(a) it requires no change in the already existing web portal to lodge complaints,
(b) doesn't require the citizen to remember any specific information to lodge their complaint and
(c) the mobile channel makes active citizen participation possible because of the higher penetration of mobile phones in India.

In Section II we describe the web based system and describe its short comings, Section III describes the proposed system, and we conclude in Section V.

II. Background

The web portal interface [6] to help people lodge complaints is a recent initiative of the Mumbai MC. The interface consists of essentially two types of information's (a) a set of drop down boxes where the user needs to choose from a select list of predefined options (see Figure 1 and (b) text box where the user is required to type in the complaint or the message (see Figure 1). The interface consists of six mandatory fields that need to be filled. The mandatory fields are

1) Department (drop down menu; example, Drainage, Road and Traffic etc),
2) Complaint type (drop down menu which is based on the department selected; typically there are 9-14 complaint types for each selected department),
3) Details (a text-box where the user needs to write the actual complaint),
4) Location (name of the region where the complaint is applicable)
5) Landmark (a description of location, for example, *near church*)
6) Ward (drop down menu, user need to choose from a list of 24 wards). Here the user needs to be aware of the ward name before lodging the complaint. Usually, people are unaware of the ward name and are only aware of the location names.

The optional inputs required by the system are (a) name of the person lodging the complaint, (b) address of the person lodging the complaint, etc. Once all the mandatory fields are filled up the system generates a complaint number and displays on the web page. This complaint number can be used to query the status of the complaint at a later date.

The web portal while allowing the user to lodge complaints has some serious constraints. The use is restricted to choose from among the list of pre defined drop down menus list. This poses a major problem in the sense that the user tries to fit his complaint into one of the predefined drop downs. This results in a wrong fit and the complaint being directed to the wrong department which in turn affects the time taken to resolve the problem[2]. The second major constraint is the need for the user to be aware of the ward number, additionally the user needs to have access to a networked computer. The mobile interface system proposed in this paper tries to overcome these issues to provide a easy to use interface.

The need for a networked computer is removed by facilitating lodging the complaint through a mobile phone; the need to select the *correct Complaint type* and *Department* is removed by enabling the user to pose a complaint in natural English; the need to know the ward number is removed by the system determining the ward number based on the location and landmark details entered by the user[3]. More recently, we have provided a provision for the user to send in the photograph captured using their mobile phone camera. This however require a higher end phone with camera facility plus an ability to download a small application on to the phone.

III. System Description

The proposed mobile natural language based interface system emulates the functionality of the web portal based complaint filing system. The architecture of the system is shown in Figure 4. The users use the mobile phone and do not need to access the web portal interface directly to file their complaint. The user downloads an application onto his mobile phone[4]. The user runs the application (see Figure 2) on his phone to get a welcome screen. The system allows the user to compose his complaint in 160 characters[5]. The complaint

[2]the incorrect choice is a result of too many *Complaint type* options in every *Department* option

[3]more recently we are using GPS when available on the phone to determine the ward number from the latitude and longitude information

[4]A one time effort. The current implementation is on Binary Runtime Environment for Wireless (BREW)

[5]typical limit imposed by Short Messaging Service (SMS)

Fig. 2. Welcome screen when the user launches the complaint lodging application on his mobile phone.

Fig. 3. User composes the complaint in natural English and presses the Next key.

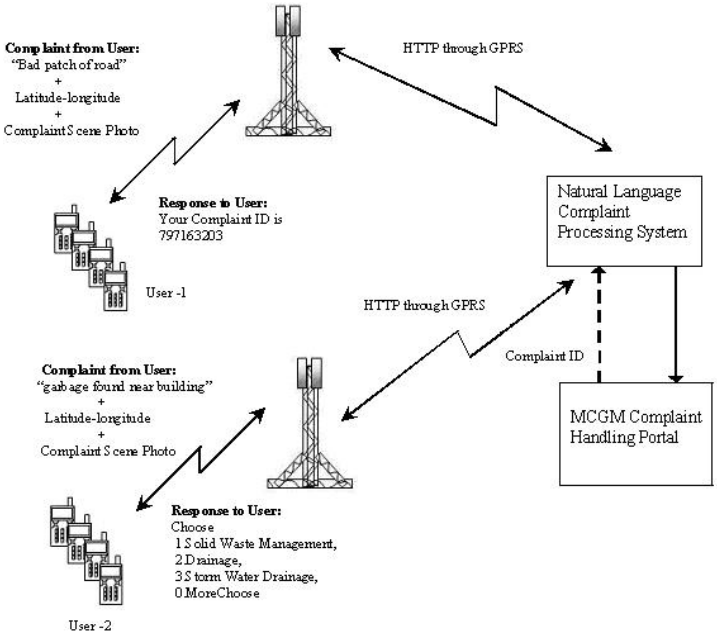

Fig. 4. Architecture of the proposed system.

in natural English is routed using the SMS channel to the system (Natural Language Complaint processing system block in Figure 4). The NL based complaint processing system then interpret the users complaint using natural language processing (NLP) techniques to determine the nature of the complaint (the *Department* and the *Complaint Type*) and other details (location, land mark, ward number) which are mandatorily required to lodge a complaint at [6]. Once these information has been inferred by the system, it sends the information to the MC complaint handling system in a compatible format (as a HTTP[6] request) to [6]. The response of the MC complaint handling portal is fetched[7] and is parsed to determine the complaint number. This complaint number is then received by the user on his mobile phone (see for example Figure 13). In the event the complaint is *incomplete* in the sense of not having all the information that is mandatorily required to generate a complaint number at the MC portal; the system gets into an interaction mode (see arrows marked 3 and 4 in Figure 5). In this mode, the system generates a set of dynamically generated queries to seek the required information from the user through menu choices (see for example Figure 11) or as a text input (see Figure 12). Once the system has *all* the required information, it send to the MC complaint handling portal [6].

The complete block diagram of the system is shown in Figure 5. The system makes use of the already available web portal interface [6] to complaint filing platform and assist citizens to file their complaint using their mobile phone. The system enables the user to send his complaint in natural[8] English (arrow 1; Figure 5). The input to the system is a free format English text. The system internally analyzes the complaint text using a set of natural language processing techniques to determine if the complaint has all the information required. If yes (arrow 6; Figure 5) it send the information in a form understandable by the MC complaint portal to [6]. The information received from the portal (complaint ID generated by [6]) is then sent back to the user (arrow 6, 7, 8; Figure 5), else (arrow 2; Figure 5; the complaint sent by the user is such that a complaint number can not be generated using the MC web portal interface system), the application intelligently generates queries and gathers the required information from the user interactively (arrow 3; Figure 5). The user responds to the system generated queries (arrow 4; Figure 5). This interaction can (path 3, 4, 5; Figure 5) happen more than once. All the information gathered, in addition to the free form complaint sent by the user is used to lodge the complaint with the web- based MC complaint registering portal and the generated complaint number is sent back to the user (path 6, 7, 8; Figure 5) for his reference and tracking of his complaint in the future.

A typical scenario is when a user complaint is complete in free English format (for example, *Garbage has not been lifted from under the flyover in Mulund*). The system analyzes the

[6]hypertext transport protocol
[7]a hypertext page

[8]free of format

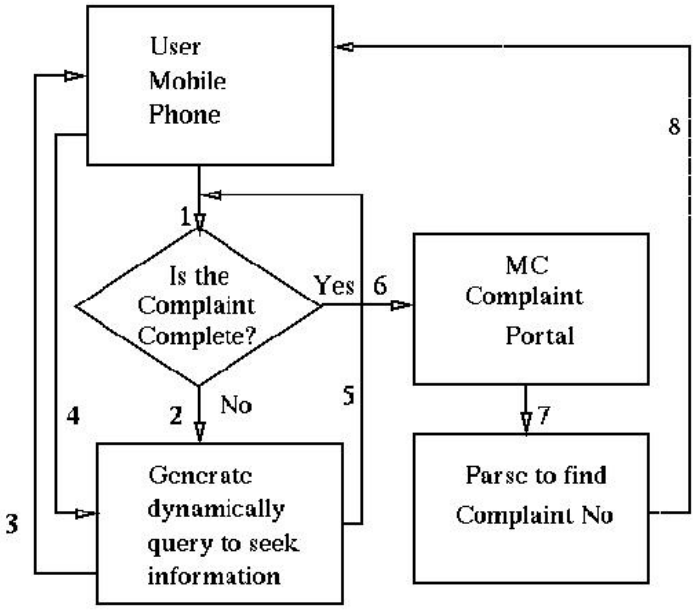

Fig. 5. Block diagram of the novel NL based system.

Scenario - 1: **Lodged Complaint Complete**
User: *Composes a free format complaint in English*
System: *(a) Files the complaint with the web-based complaint lodging system, (b) obtains a complaint number from web-based complaint system and (c) sends the complaint number to the user.*
Data Flow: *1 - 6 - 7 -8 (see Figure 5)*

Fig. 6. Lodged Complaint is complete.

Scenario - 2: **Lodged Complaint is Incomplete**
User: *Composes a free format complaint in English*
System: *(a) Identifies the "missing fields" in the user complaint, (b) Intelligently generates interactive queries requesting information from the user. For example, menu choices "Smelly Garbage", "Garbage not picked up"*
User: *Responds with a selection (by browsing on the phone using the mobile keypad)*
System: *(a) Assimilates all the information from all the responses and then files the complaint with the complaint portal [6], (b) obtains a complaint number from web-based complaint system and (c) sends the complaint number to the user.*
Data Flow: *1 - 2 - 3 - 4 - 5 - 3 - 4 - 5 ... - 6 - 7 - 8 (see Figure 5)*

Fig. 7. Lodged Complaint is incomplete.

Fig. 8. The application asks if the user wants to upload any image.

Fig. 9. This activates the camera of the phone; the user can click the picture of the scene of complaint and send it.

complaint for completeness. A complaint is deemed complete if all the required mandatory fields required to lodge the complaint are identifiable in the complaint composed by the user. This typically results in two extreme scenarios, namely, (a) the complaint is complete (Figure 6) and (b) the complaint is incomplete (Figure 7).

In Scenario 1 (Figure 6) there is no interaction with the user after the initial complaint has been sent by the user. The user is able to lodge his complaint in one go. While in Scenario 2 (Figure 7), the system interacts with the user to obtain the missing information to make the complaint complete before registering the complaint at the portal [6]. In the extreme case when no input is provided by the user - the system seeks all the 8 mandatory fields of information from the user in the form of menus and text boxes.

A. Functional System

The mobile interface allows the user to lodge a complaint in natural English. The system tries to decipher the mandatory details required to file a complaint using a set of natural language processing techniques. The natural language complaint

Fig. 10. The image of the scene is uploaded and the complaint checked for *completeness*

Fig. 11. In the event the complaint is *incomplete* the system gets interactive and provides the user to choose from a menu list. *Solid Waste* selected and sent by user.

Fig. 12. If required, the system interactively seeks *more* information from the user to register complaint with the [6] portal. In this case the landmark.

processing is based on a minimal parsing system (for details see [5]). The essential idea is to extract a key concept and a set of key words from the natural language complaint query using an ontology specifically crafted to this domain. The ontology is hand crafted by a team of linguistic and domain experts. More specifically, all the stop words[9] are initially removed from the query. The system then checks for any spelling mistakes in the complaint and corrects it[10]. Using an ontology[11] and domain specific knowledge the query is parsed to determine the nature of complaint and extracts the MC department in charge of the complaint. The location and the landmark details are picked up from the query with the help of Mumbai specific location knowledge base; further the landmark and the location details are used to determine the ward number details using a location - ward number knowledge base. Optionally, the application has the facility for the user to upload the scene of the complaint (see Figure 9) though the current architecture of the complaint handling system of MCGM [8] does not have the facility to upload image. We believe that this functionality will not only give authenticity to the complaint but it will also give a sense of *completeness* to the complaint filing system[12].

IV. Experimental Results

The system has been prototyped and has been tested by a select number of 25 users to check the functional experience of the system. The details collected in this experimental phase (especially the nature of SMS complaints) are being used to refine the natural language interface (for example, [3], [4]) of the system in terms of updating the knowledge base. In the experimental case a set of 200 complaints were filed by 25 users. About 80% of the queries were such that the user gave all the details in the first query. It has been noted that initial queries from the user needed interaction (step 2, 3, 4, 5; Figure 5) while the later ones[13] did not need any interaction (step 1, 6, 7, 8; Figure 5). This is understandable that the user leaned what the system needed and accordingly gave sufficient information to enable a non-interactive single query to file their complaint. An analysis of the performance of the system in terms of being able to determine the complaint type and the department was about 95%; the analysis was done by a person who was not part of the team involved in the building the system. One of the outcome of these experiments was that

[9]Stop words are words that by themselves do not give any extra information to the message

[10]a variant of dynamic programming algorithm and sound-ex has been used

[11]a special kind of dictionary where relationship between words are captured

[12]it is not uncommon to find even mid-range phones having a good camera

[13]repeat user

Fig. 13. A successfully registered complaint. Complete with a complaint ID which has been generated on [6] portal.

people tend to use words which are in their native language (example *ganta gadi* for *garbage truck*, *khara* for *garbage*). These have been incorporated in the ontology supporting the system.

V. Conclusions

We have proposed and built a novel mobile interface for users to lodge complaints about the city. The system is accessible to everyone who own a mobile phone and is available 24 $\times$ 7. The system uses the back-end infrastructure of the MC to lodge a complaint but gives the user the flexibility to file his complaint by sending a free format natural English complaint. The natural language processing based system is capable of analyzing the query and extracting the required information from the free format query to lodge a complaint. In the event of the complaint being *complete*, the system generates a complaint number (actually generated by the back-end system) and displays the complaint number to the user on his mobile phone. In the event the complain is *incomplete*, the system interactively seeks the required information from the user by asking for specific information (through menu choice). In this case the system uses all the information given by the user to lodge the complaint (the initial free format complaint and the subsequent responses to the system generated queries). The provision for sending the photographs of the scene along with the complaint adds to the authenticity of the complaint and in some sense makes the filing of the complaint complete. The minimal processing system [5] by design allows the system to be configured to other native languages and will require the design of screens in native language on the mobile phone.

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