GPS based Complaint Redressal System

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***Abstract*— Citizens of any country face civic problems in their day to day lives. They resort to the one of the several ways provided by the government to file their complaints. With advancements in technology, the complaint registration systems have evolved in different ways to simplify the task of registering as well as addressing the complaints. This research paper presents the architecture of a GPS based Complaint Redressal System (GPSCRS). The complaint is registered via a mobile application. Global Positioning System (GPS) sensor present in smart mobile devices is used to determine the exact location of the complaint. The area of the complaint is automatically detected, and the complaint information is sent over the internet to a central server. The complaints are then plotted on a map in the web interface.**

Keywords—Global Positioning System; Internet; Application Programming Interfaces; Cameras

I. Introduction

Efficient governance is one of the biggest challenges for the government of every country. An important aspect of this governance is a robust complaint registration system through which citizens can express their grievances. In attempts to make this system accurate, efficient and easy to use, several new ways have been devised.

The current system in most countries provides some or all of these ways for citizens to register their complaints: (1) email, (2) helpline number, (3) short messaging service (SMS), and (4) online complaint registration portal. However, all of these methods require the complainant to describe the location of the complaint manually. This method is prone to human errors and thus misinterpretations, leading to inefficiency in addressing the complaints. The proposed GPS based Complaint Redressal System (GPSCRS) aims to solve this problem through a mobile application for registering complaints.

In the past few years, smart mobile devices have grown cheaper and have made their place from the lives of the rich to those of the common people. These devices have several capabilities, such as: (1) accessing the internet at high speed, (2) capturing high quality images, and (3) determining the location with the help of a GPS sensor. These features form the basis of the implementation of the GPSCRS mobile application.

The application fetches the location information through the GPS sensor present in the device. It automatically determines the administrative area from the location. Additional information regarding the complaint, such as photographs and problem details, can be provided. The complaint information is sent over the internet to a central sever.

The registered complaints can be viewed and plotted on a map through a web interface, allowing the authorities to determine the location of each complaint accurately. Each registered complaint is assigned a default priority initially. If a complaint is not addressed within a specific period, its priority automatically increases and it is assigned to a senior official. This allows for rapid action of complaints.

Section II gives a brief description of systems proposed in the past to improve the existing complaint registration systems. Section III describes the technologies used in GPSCRS. Section IV goes into the implementation details of the mobile application and web interface. Section V lists down the advantages of GPSCRS over existing systems. Section VI concludes the paper with a brief discussion on the future scope of the system.

II. Previous Research

Aditi Mhapsekar, Uma Nagarseka, Priyanka Kulkarni and Dhananjay R. Kalbande [1] have developed an architecture for Voice enabled Android application for vehicular complaint system using GPS and GSM-SMS technology. This application uses speech to text functionality to describe the complaint. It obtains the GPS coordinates, appends it at the end of the complaint information and sends the information as an SMS message to an SMS server over the GSM network. The server fetches this information and stores it in the database. The web interface then plots this information on a map.

Kim Nee Goh, Yin Ping Ng, Kamaruzaman Jusoff, Yoke Yie Chen and Yoon Yeh Tan have developed an architecture for GPS based road management system [2]. The proposed system obtains GPS coordinates on a cellphone supporting Assisted GPS. The complaint along with the GPS information is send via an SMS to an SMS server over the GSM network. The data in the SMS is retrieved and stored in a database. This information is then plotted on Google Maps.

Umar Farooq, Tanveer ul Haq, Muhammad Amar, Muhammad Usman Asad and Asim Iqbal have proposed a system based on GPS and GSM to improve public transportation management services in Punjab province of Pakistan [3]. Each bus is equipped with an In-BUS Module that sends information about its location and number of passengers to a base station using SMS. The base station uses the information received from all buses to respond to user requests for the location of a particular bus. The BUS Stop module on every bus stop receives information from the base station about the buses arriving at that stop, and displays this information on a dot matrix display.

III. TECHNOLOGIES USED

A. GPS

In the past few years, smart mobile devices have grown cheaper and have made their places from the lives of the rich to those of the common people. The GPS sensor present in these devices provides a huge scope for location based services. A GPS receiver uses signals transmitted by GPS satellites to calculate the exact location in terms of the latitude, longitude and altitude.

The GPSCRS Mobile Application uses GPS technology to obtain the location of the complaint.

B. PhoneGap

The presence of several mobile operating systems in the market makes application development more challenging. Developers aiming to reach out to the majority of users have to develop versions of their applications for several platforms. As each platform has its own set of technologies for developing applications, the development process becomes time consuming and expensive.

A solution to this problem has been devised in the form of hybrid applications. These applications are written using web technologies and run inside a native container on different platforms, thereby allowing the developers to write their applications once for all.

The GPSCRS mobile application has been developed using Phonegap [4], which is a framework for developing such hybrid mobile applications. It allows applications to be written using HTML5, CSS3, Javascript and jQuery, and automatically converts the applications for different platforms. It provides several application programming interfaces (APIs) for accessing different sensors in the device.

C. Google Maps API

Google Maps is a web mapping service application provided by Google Inc. It provides street maps and satellite imagery of all locations across the globe. The Google maps Application Programming Interface (API) [5] allows developers to embed the maps into their applications.

This API is used in GPSCRS for detecting the administrative area of the complaint and plotting all the registered complaints on the map.

IV. IMPLEMENTATION

A. Getting the location

The GPSCRS mobile application uses Phonegap's Geolocation API [6] to obtain the location information. The GPS sensor in the device takes some time after being invoked to determine the exact location. As a result, the location information obtained immediately after invoking the sensor is not accurate. In order to provide higher accuracy, the navigator.geocoder.watchPosition() function is used to periodically fetch the location. On every successful fetch, this function calls the onWatchSuccess() function that keeps track of the most accurate co-ordinates. The watchTimeout() function is scheduled to run one minute after the sensor is invoked. The periodic fetch is terminated when an accuracy less than 10 meters is obtained or when the watchTimeout() function is invoked, whichever occurs first. The co-ordinates corresponding to the minimum accuracy value are plotted on Google Maps using the marker object of type google.maps.Marker.

B. Getting the administrative area from the coordinates

A technique known as reverse geocoding [7] is used to determine the administrative area from the coordinates. Reverse geocoding is a process of converting a location on the map to a human readable address. Google Maps API supports reverse geocoding directly.

First a geocoderRequest object is created with a property latLng. This property is set to the latlng object of type google.maps.LatLng that holds the fetched latitude and longitude information. This object is then passed as a parameter to the geocode() function of the geocoder object of type google.maps.Geocoder. This function calls another function by passing the address information as a parameter to it. From the complete street information, the area is extracted. Finally, the area is displayed in a small information window above the marker on the map. This information window is displayed using the infowindow object of type Google.maps.InfoWindow.

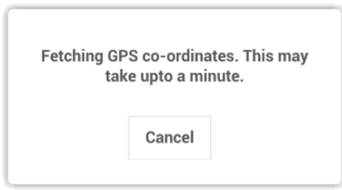

Fig 1. Fetching the GPS co-ordinates periodically for better accuracy

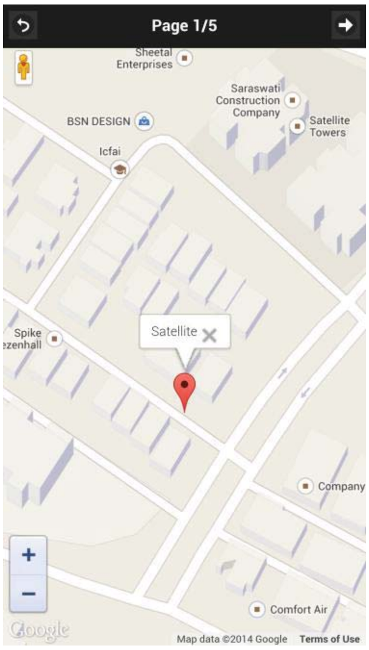

Fig 2. The fetched location plotted on the map with the name of the administrative area.

C. Capturing the image

Phonegap provides the Camera API [8] for capturing images. The navigator.camera.getPicture() function is used to capture the image using the device's camera application. The third parameter to the getPicture() function is an object with a destinationType property set to Camera.DestinationType.DATA_URL. This property specifies that the captured image should be saved in base64 encoded format. On a successful capture, the getPicture() function calls the onCaptureSuccess() function, passing the captured image data as a parameter. Finally this image data is saved and displayed on the screen.

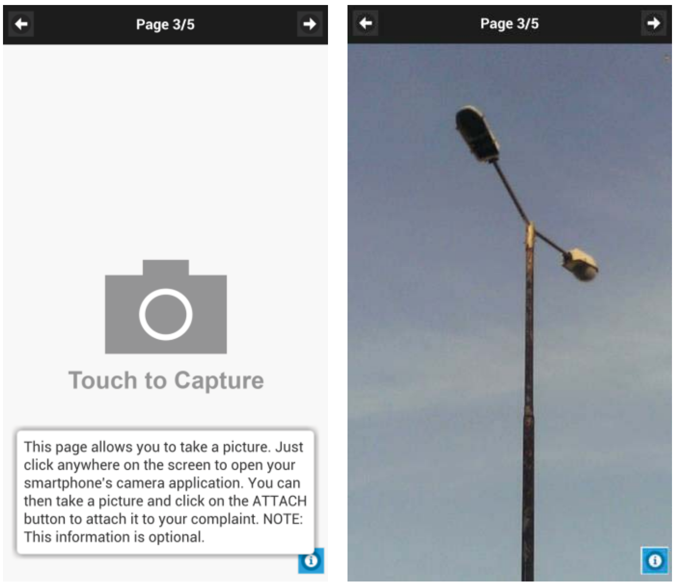

Fig 3. Page for capturing an image.

D. Fetching other details

The application provides a list of problem categories to choose from. The user can search for relevant categories by typing the keywords in the search bar, and the list is reduced accordingly. For implementing this, jQuery Mobile's listview element is used, with the data-filter attribute set to true. The list is created dynamically from an array of problem categories when the application starts.

Text fields are provided for entering user details and details regarding the problem.

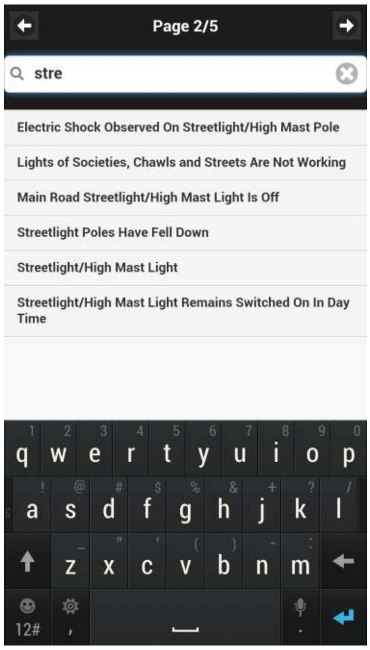

Fig 4. Page for selecting a problem category from the list.

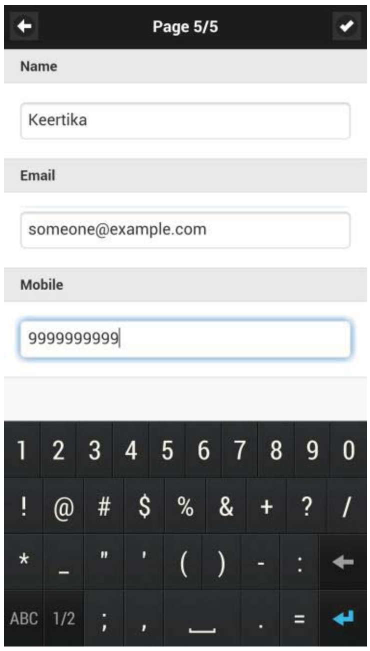

Fig 5. Page for entering the user details.

E. Sending the fetched data to the server

The data fetched through the application is sent to a central server through the internet. The submitData() function of the application performs this task. It uses an AJAX script to send the data, concatenated as a single string, to a specified URL using the post method. A PHP script on the server receives this information.

F. Storing the data in a database

The PHP script generates a unique identifier for each complaint. It establishes a connection to the MySQL database and stores the complaints with the generated identifier as the primary key. In addition to the information given by the complainant, a status field (representing the status of resolution of the complaint), a complaint_level field (denoting the priorty of the complaint), a datefld field (denoting the date of registration) and a timefld field (denoting the time of registration) are also stored in the database.

G. Managing the priority of complaints

Every complaint is initially assigned a low priority. If the complaint is not addressed within a specific period, its priority is automatically increased. For implementing this, a PHP script is scheduled to run once daily. This script processes every low priority complaint in the complaints table by calculating the number of days between the current date and date of registration of the complaint. If this value exceeds the maximum period for addressing the complaints, the value of the complaint_level field is changed to high.

H. Logging into the web interface

In practical situations, different officials are assigned different areas and authority levels for addressing the complaints. To support this, the GPSCRS web interface involves a login mechanism. An official logged into the system can view the complaints corresponding to his/her area and authority level only. Here the authority of the official corresponds to the priority of the complaints. This is achieved with the help of a users table that contains the username, password, authority and area of the officials. The login page sends a request to a PHP script with the entered username and password. This script runs a query against the users table with this information to check if the login is valid. On a successful login, the username is stored in a session variable.

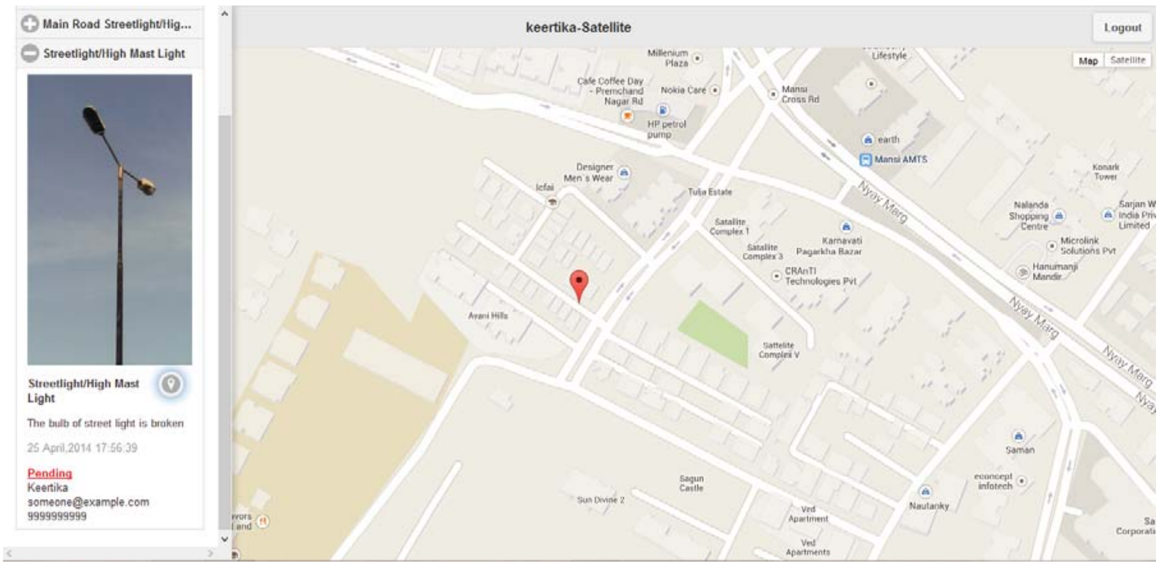

Fig 6. The web interface with a single problem plotted on the map.

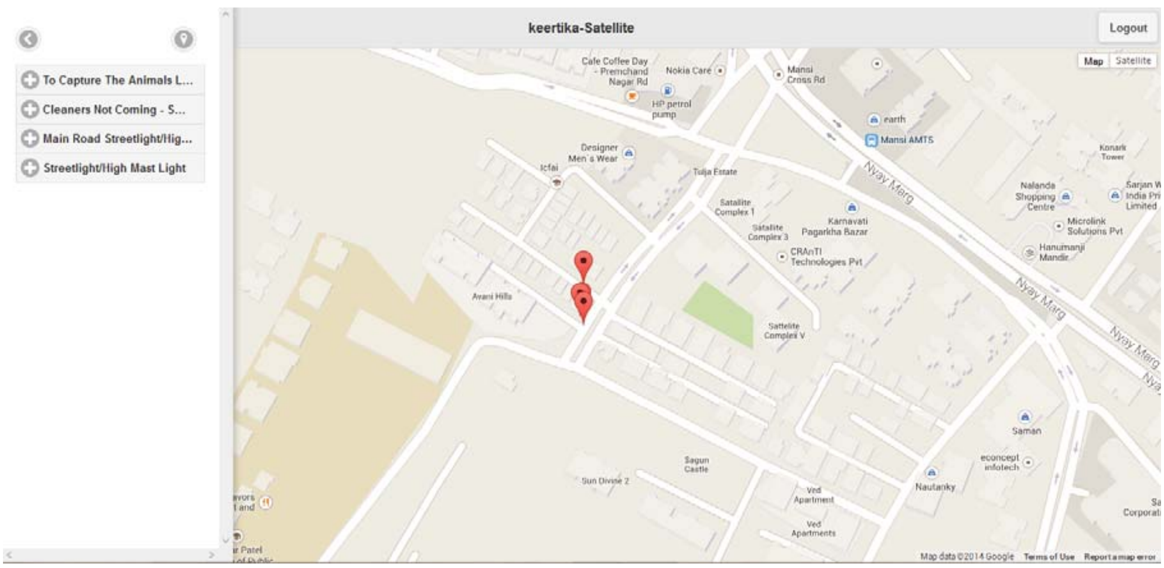

Fig 7. The web interface with all problems of an administrative area plotted on the map.

I. Displaying the complaints

The web interface displays the complaints corresponding to the area and authority of the user logged in. After a successful login, the fetchUserDetails() function sends a request to a PHP script with the username of the logged in user. The script runs a query against the users table with this username and returns the area and authority level of the user. The fetchComplaintsList() function then sends a request to another PHP script with this information. The script runs a query against the complaints table. The result is sent back to the web page and displayed on the screen. For each complaint a marker object of type google.maps.Marker is created with the GPS co-ordinates of that complaint and stored in an array.

A location button is displayed along with the details of each complaint. On clicking it, a function is called which fetches the corresponding marker object from the array and plots it on the map. Another button on top of the panel is used to plot all markers in the array on the map.

The web interface displays the status of each complaint and allows changing its value. The changes are reflected in the database automatically.

V. Advantages over Existing Systems

A. Higher Accuracy

The GPSCRS mobile application uses GPS technology to determine the location of the complaint. This allows easy and uniform interpretation of the location of all complaints. While specifying the location manually in the existing systems, the complainant will specify the name of the locality, street and landmarks. However there is no uniformity in the level of details provided. There is always a possibility of the authorities being unaware of the name of the street or landmark. Also it is difficult to specify the exact location on the street and accurate distance from a landmark. GPSCRS uses GPS to overcome these problems.

Michael G. Wing, Aaron Eklund and Loren D. Kellogg conducted a series of tests to measure the accuracy of consumer-grade GPS receivers [9]. The tests were conducted on six different GPS receivers and in three landscape settings. Their results showed positional errors varying from 1.4 m to 19.6 m in open sky conditions, 1.3 m to 6.8 m in young forest setting and 2.7 m to 11.4 m in closed canopy setting. These tests were conducted under conditions of poor satellite availability. In cities, the GPS receivers are expected to perform better. Even with the worst error value of 19.6 m, the GPS receivers are more accurate than the conventional methods of describing the location. An error of 19.6 m would mean that the location lies within a range of 39.2 m from the co-ordinates fetched by the receiver.

In order to achieve good accuracy, the GPSCRS mobile application fetches location co-ordinates repeatedly for one minute after invoking the GPS sensor or until the accuracy value falls below 10 meters, whichever occurs first. This provides the sensor with sufficient time to determine the location accurately. Here the accuracy is in terms of the error values with lower values corresponding to better accuracies.

B. Multi-platform

The GPSCRS mobile application has been developed as a hybrid application using Phonegap framework. As a result it is ready to be deployed across all major mobile operating systems with minimal modifications. This will allow the application and its updates to be delivered to the citizens quickly, irrespective of the platform being used.

Authors Sankar Srini and Sathish Venkatraman have described the advantages, disadvantages, challenges and implementation methods of hybrid mobile applications [10]. They have recommended the hybrid approach for developing applications that have a wide audience base and are targeted for diverse platforms. This approach is also helpful if the time to market is low and the total cost of ownership is significant.

C. Internet as a communication medium

The use of SMS as a medium for sending the complaint information to the server has several limitations. SMS allows the transmission of only text based messages with a limit of 160 characters per message. It requires the user to incur the cost of sending an SMS message in addition to the cost of accessing data services for using GPS. Also the system fails on devices that have a GPS sensor but no SMS functionality, such as tablets.

GPSCRS overcomes these limitations by using internet as a communication medium.

D. Analysis and prioritization of complaints

The GPSCRS web interface allows the authorities to view the details of each complaint along with its location on the map. It allows each complaint to be plotted individually for knowing its exact location. It also allows all complaints to be plotted together on the map. This will allow the authorities to allocate resources and manpower strategically on the basis of regions. It will help them identify regions that are more affected and act accordingly.

The login mechanism allows each complaint to be assigned to the officials of the corresponding area automatically. The increase in the priority of complaints after a specific period of time ensures that the complaints are addressed rapidly. The complaints that are not addressed within this time period are automatically assigned to senior officials.

The web interface can be extended to filter the complaints on the basis of their problem categories. This will allow prioritization of complaints on the basis of the severity of the problem.

Detailed reports and analysis charts can be generated using the information of all the complaints to aid in future planning.

VI. Conclusion and Future Scope

The system proposed in this paper incorporates GPS functionality into the existing complaint registration systems. The complaint is registered via a mobile application and sent over the internet to a central server. A web interface is used to view and plot the complaints on a map.

The system has been developed for civic complaints. It can be extended to include incident reporting to improve the efficiency of emergency services. The mobile application can be enhanced to display the location of the local administrative office, police station and other offices of the area in which the device is located.

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