

Smartphone Based Citizen Complaint System for Urban Maintenance Using GIS

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Abstract— Today different countries have civic bodies that are the local governing bodies which help to maintain cities. Pointing to the complaints of the citizens in urban areas is a prime factor that can ensure trust of different citizens. This Smartphone application will help the common people under the jurisdiction of Municipal Corporation to register their grievances day to day complaints in their ward through a mobile application. This application provides an interface to register one's complained and follow it up. It will provide a common man to deliver his complaints and problems to municipal authority as well as let the municipal authorities to address the problem in a short period of time. It provides a camera module which helps clicking up a picture of any problem that people are facing and upload its image along with the complaint. The location of complaint is tracked by Global Positioning System (GPS) unit. Reverse-geocoding is used to find the address from GPS provided co-ordinates. Application display list of complaints registered which are get from server. Once the complaint is submitted it can also be share onto the social media, complaint shared in the form of complaint register location which is latitude and longitude along with description

Index Terms— Non-Emergency, Urban areas, Geographical Information system (GIS), Local Government, Smart city

1 INTRODUCTION

Direct and common Communication between the local governing body and the citizen of that city is a very efficient in solving the issue related to the citizen, in India unfortunately there is no such way i.e. for getting a problem solved in our place we have to go through the hassles of registering the complaint to respective departments which in turn forward to the concern officers and then the problem get solved which takes a lot of time. To overcome this issue previously NIC (National Informatics Centre) has launched a project named Prajavani through which public can post the petitions or complaints on the website and get them solved in a specific amount of time and can also know the current status of the complaint or petition that he has previously lodged. Few years back phones were merely used for calling or texting. But now days, it has changed. now more focus is given on the availability, and the use of the internet and thus use of various apps which are available in the mobile stores. Now we are used to manage our daily work on fast, and with satisfaction. So we are using various apps in our life for fulfilment of our daily work.

The simplest method to make cities smarter is to make a platform where citizens are allowed to participate in the decision concerning the society as citizens can be more accurate then sensors and cameras and they are cost less as well as participation will not be remunerated [1]. In India the current system of complaining is very tedious and complex, citizen who wants to lodge a complaint need to go the respective department and file a complaint by standing in line, many a term people don't even know Which department the complaint is to be filed thus

making the process very complex and inefficient so sometime people don't even file the complaint to save them from this Process. Apart from this after filing a complaint there is no proper way to check the current status of the complaint and what action have been taken on the complaint ,making the system more complex.

World is going through the urban development phase. Experts predict that the population will be double by 2050 meaning 70 percent of the total population will be living in major town or city. With the ever increasing population it is necessary for local government body to improve their services because the city as only as smart as the services provided by it, as the services directly impact the quality of the citizens life. So the urban apps are one of the requirements for smarter cities [2]. So the propose system would be in which people can take pictures of the neighborhoods issues and submit the picture along with details to local government body, the complaint would be lodged along with the address of the issue with the local government which in turn can forward the problem to the appropriate department and the department will look after the issue. The citizens will be made available with the current status of the complaint and what action is being taken against it and how quick the problem can be solved [3].

The main purpose of this project is to help the public by providing them a system that can be used for betterment of the city and can make the city clean and problem free as well as the citizen life easier.

2 RELATED WORK

In this section, we briefly examine the existing system and current system for complaint systems. The non-emergency management mainly deals with registering the complaint and resolving the issue in time, so data collection, selection and assessment are the main phases in this system. Proposed non-emergency system if for the urban areas in Aurangabad city with coordinates 19.88°N 75.32°E [11]. the Literature is divided into two parts 1] the current system in city and others im-

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plemented 2] Available different system for non-emergency complaints.

2.1 Existing System

(a)The current Complaint system in Aurangabad city has two ways of lodging a complaint firstly u can go directly to the concern department and file a complaint or secondly u can use the online system. The Second method is a web based System in which u can register the complaint with detailed information such as type and subtype of complaints .after successful registration of the complaint the operator then forwards the complaints to concerned departments heads which in turn forward to the ward officer concerned with that area. Currently the Aurangabad district is divided into three parts and has different officers for this three different parts so according to the complaints location the head of the respective department forwards the complaints to the appropriate officer in charge of the area[4][5]

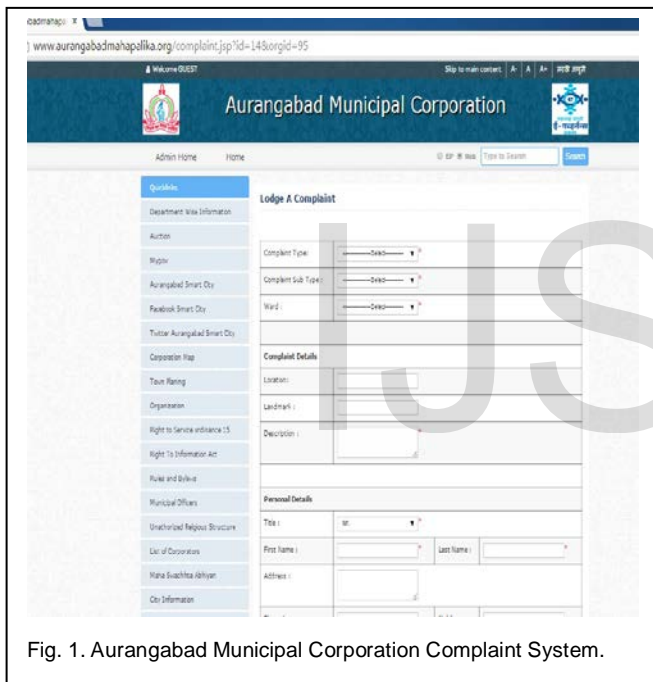


Fig. 1. Aurangabad Municipal Corporation Complaint System.

(b)Prajavani is an e-governance initiative by the District Administration and NIC (National Informatics Centre) in Ranga Reddy (AP, India). The initiative is giving RTI (Right to information) act practical shape, but is also creates job the educated and unemployed youth of Ranga Reddy. Prajavani is new grievance system which is more helpful to people who are living in remote areas of the district , the complainer will also know which officer is assigned for resolving his issues. It gives citizens an opportunity to interact with the government without coming to any government office. The Prajavani system not only helps the citizens but also the Collector, it gives him an effective tool to check the performance of various departments. The NIC provided the necessary technical know-how for the project. The Project has been started in beta stage at Ranga Reddy district and is running successfully in Nalgonda & Adilabad [6].

2.2 Different Systems For Non-Emergency Complaint Systems

(a)City of Boston

The city of Boston has implemented the constituent relationship management [CRM] system by which the constituents can easily request services from city agencies like the department of public work .they have created an application for smart phones called citizen connects that allows the constituents to take the pictures of issues street light outages, potholes and other public issues and send them directly to the government. The system uses the location of the user to register the complaint [1][6].

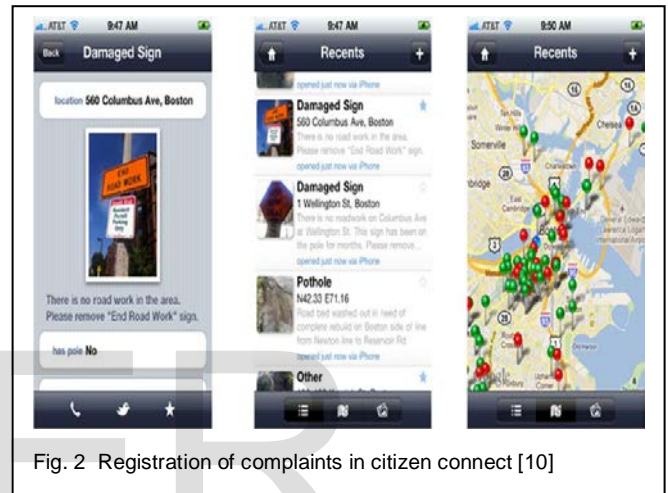


Fig. 2 Registration of complaints in citizen connect [10]

(b) Pothole tracking system

It is a mobile application that is for detecting and reporting the surface conditions of roads. It is basically a system to keep track of the civil infrastructure of roads. The pothole tracking system uses the mobile of the participating citizen, it gives him the option to take the pictures of the potholes and by using the GPRS of the mobile submitting the image in the system, and processing the data to assess road surface conditions. Using a simple geo-tagging technique available in the smart phones today, it show that we are able to identify potholes and other road surface anomalies from images submitted by the citizens and uploaded by the same application on the server.



Fig. 3 Pothole tracking system.

(c)City sourced Smartphone 311 App

The application developed by the company City sourced is a similar app with some changes the Smartphone 311 app realizes that Smartphone and GIS could be used to crowd source these reports in a way that was both easier for residents and more efficient for governments. To report the problem the a citizen simply takes a picture of it using the Smartphone's camera and submit it directly to the government with categorizing then problem using the drop down menus, the users does not need to add address as the Smartphone geo-tags the image with location the app automatically returns the location on the map. All the reports are delivered in Esri format that can be easily integrated with existing GIS implementations; City sourced has developed the application using REST API (application programming interface) Data is returned is in XML or JSON. The cities that use the City sourced services are given a customized app for the city [3].

with municipal corporation and as soon the user have registered his issues the complaint will be forwarded to the concern department and from there to the concern officer.

System Architecture:

In the initialization of the application the user would be allowed to take the picture of the issue and since most of the Smartphone now have the option of geo-tagging the image we can access the current location of the user, if geo-tagging isn't available we can still find the location by using the latitude and longitude value of the position and geo-code the address from it in more easily readable form for the user, after the location of the user is detected the next step is to choose the type of issue he has from the list of various issue or he can type in his issue if the problem isn't categorized in any of the given problems. Then after filling all the additional information required the user can submit the request to the system, after that he can view the current status of the problem using the problem id generated or by using the complaint in your area tab [13].



Fig. 4 A complaint registered in city sourced [3].

3 METHODOLOGY

The proposed web complaint system will consist of registering the complaints and see the numbers of complaints registered i.e. through mobile. For mobile we are focusing on all operating system for its more reach as we want everyone to use the application and for the web based system HTML 5 and java script is being used along with C# and SQL Server. The basic reason for using this technologies is because they provide great and easy methods for doing the programming in them and is generally used a lot in the market so no problem of integrating it into a bigger system in future, along with these technologies we are going to use some of AJAX for the purpose of displaying the dynamic content on the map which is going to help the user for the purpose of registering the complaints. All the data that will be generated will be saved in the SQL databases [14]. The Application will includes most of the general complaints or issue that public face in their day to day life namely potholes repairs, street light disorder, graffiti removal, abandoned vehicles, water shortage and many more along with the option of uncategorized complaints to register

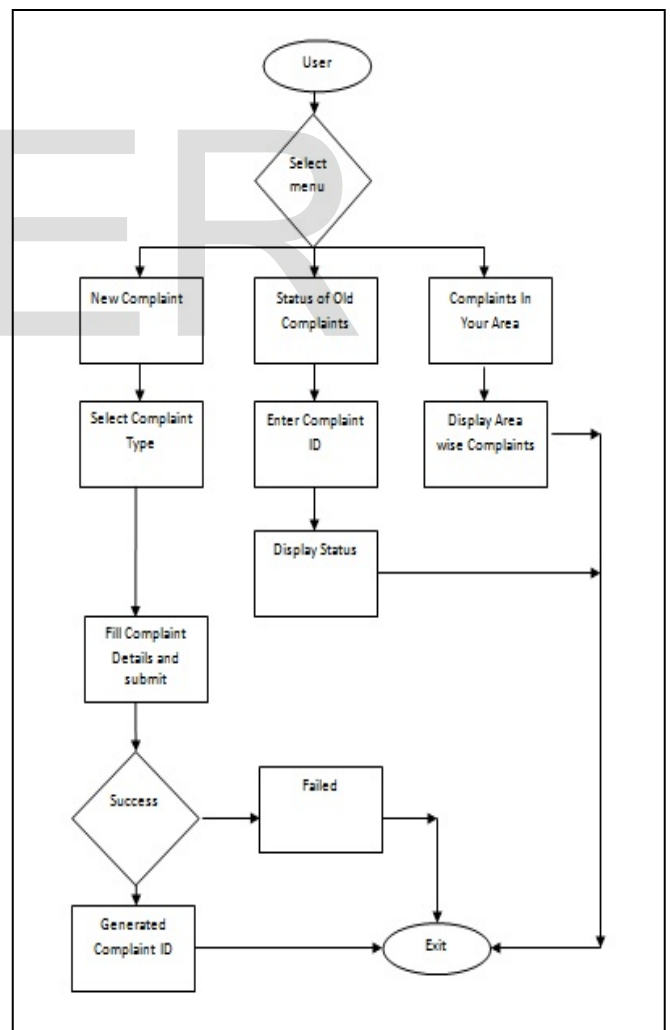
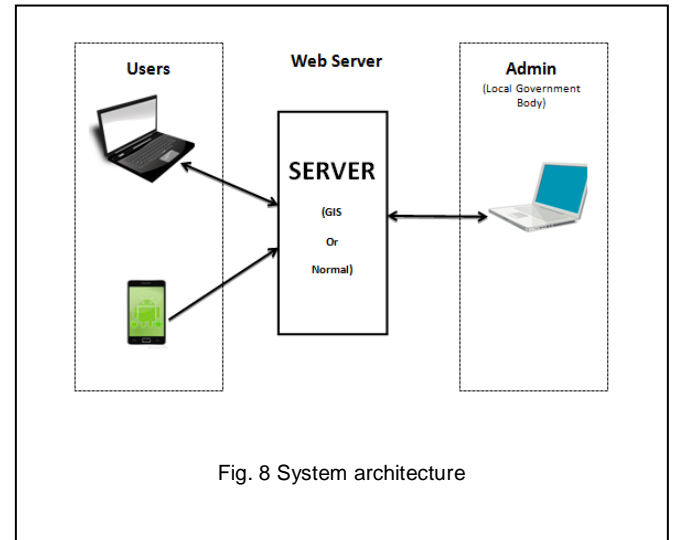
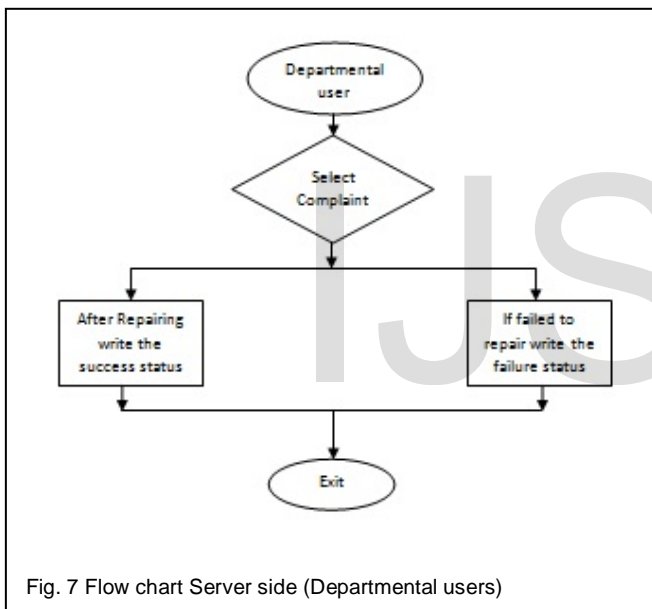
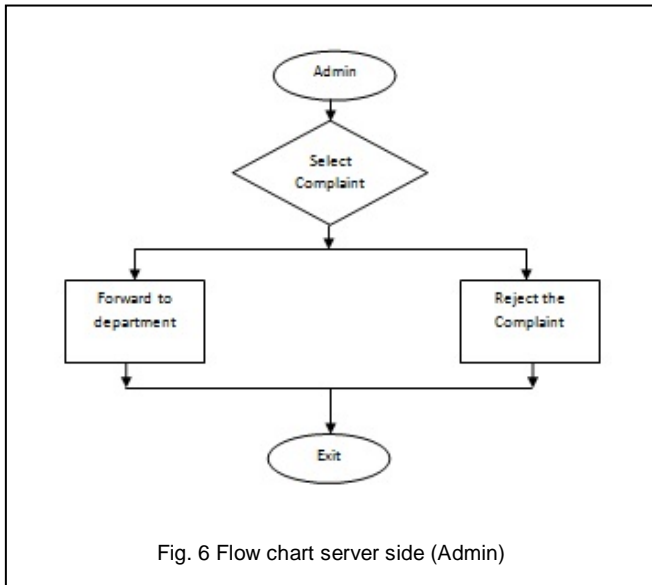


Fig. 5. Flow chart Client side



For the web application the system architecture would be same as for mobile application but the only way for accessing the location of the problem would be through the geo-location metadata stored inside the image, the rest procedure would be the same. The system architecture for the mobile application would be as follows.

3.1 Technologies used

In this paper we used following technologies for the development of emergency reporting client-server application with all the technologies works in their original form. It is important to remember that some technologies are present only in the client (Phonegap, JQueryMobile, AngularJS), some only in the server (C#, SQL) and some are found on both (JSON).

3.1.1 Phonegap

The idea for the client was similar to the Java motto, "write once, run anywhere", pursuing to overcome the handicaps of different programming languages and very heterogeneous systems for today's mobile devices [7].

PhoneGap is a software evolution structure by Adobe System, which is utilized to develop Smartphone applications. To utilize apps using PhoneGap, the developer does not require having knowledge of mobile programming language like for android we need knowledge of Java Programming, for IOS app development objective C++ knowledge is necessary, but only web-development and design languages like, CSS, HTML and JavaScript. PhoneGap utilizes and developed apps for all popular mobile OS platforms such as iOS, BlackBerry, Android and Windows Mobile OS etc [8].

With the help of apache cordova (Adobe software, previous phonegap) in visual studio 2015 Enterprise we develop cross-platform application for emergency reporting.

3.1.2 JQueryMobile

JavascriptQueryMobile [9] is JavaScript libraries for developing mobile application and it is also a user interface structure based on JavaScript Query that works across all popular phones, desktop platforms. Based on services and universal entrance in mind, it follows responsive web outline and HTML5 markup-design configuration makes to learn easy using JQueryMobile.

3.1.3 AngularJS

AngularJS is a very powerful JavaScript Framework. It is used in SPA (Single Page Application) projects. It extends HTML

DOM with additional attributes and makes it more responsive to user actions. AngularJS is completely free, open source, and used by thousands of developers around the world. It is licensed under the Apache license version 2.0 [10].

3.1.4 Onsen UI

Onsen UI is a front-end UI framework built on Topcoat and optimized for AngularJS, which were developed by Google and Adobe respectively. This means that Onsen UI requires basic knowledge of AngularJS[11]. Onsen UI is a front-end development framework for PhoneGap/Cordova hybrid apps. It is used for the creation of easy to use mobile applications.

3.1.5 Google Reverse geocoding API

In our paper we used the Google reverse geocoding API(Application programming interface) services. Geocoding is the process of converting addresses (like "Post Office Rd, Gulmandi, Shahgunj, Aurangabad, Maharashtra 431001, India ") into geographic coordinates (like latitude 19.8882361 and longitude 75.3302264), which you can use to place markers on a map, or position the map.

Reverse geocoding is the process of converting Longitude and latitude into a human-readable address. The Google Maps Geocoding API's reverse geocoding service also lets you find the address for a given place ID.

The Google Maps Geocoding API provides a direct way to access these services via an HTTP request. [12]
Algorithm for the reverse geocoding

Start:

```
// variable Declaration
//import Plugins for geo-location and Google maps
Function initMap(){
Var map =new.google.maps()
Vargeocoder = new.google.maps.geocoder
Varinfowindow = new.google.map.infowindow
// initializing all variable required for Google maps
Navigator.geolocation.getCurrentposition( function(position){
Lat= position.cords.latitude
Long= position.cords.longitude
}
//the current location of the user is accessed by using the gps
Geocoder.geocode({location:latlang}),fuction(results,status)
If (status=== google.mapps.geocoder.status.ok)
Address =results[1].formatted_address;
Else
Alert("no results found");
// geo coder method takes the location in latlang coordinates
and returns the address in postal address form
```

End

Reason for choosing this algorithm

We used the analysis of programmable web for the analysis of top seven free and paid mapping api

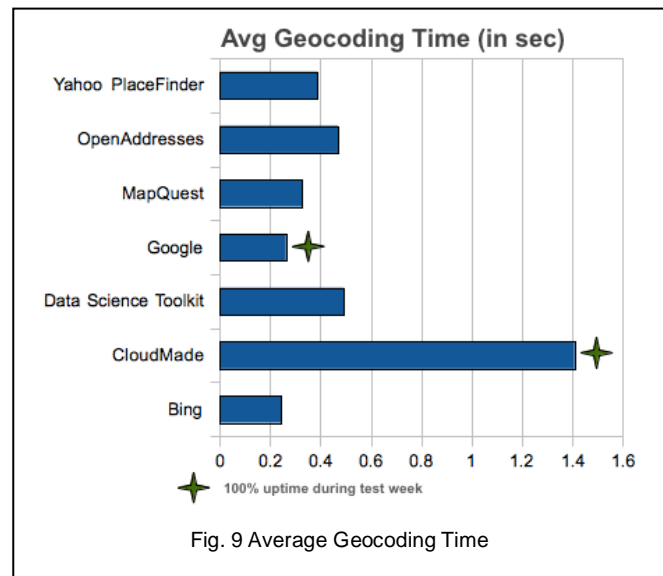


Fig. 9 Average Geocoding Time

For geocoder timing, programmable web checked each API every ten minutes for a week. The address we used was the same for all geocoders. Most had only a single instance of downtime in our week of testing. Google Geocoding API and Cloudmade Geocoding API were the only two with 100% uptime. In terms of speed, the fastest two were Bing Maps Geocode and Google Geocoding[14]. Cloudmade Geocodings API was the slowest in tests. Thus Google Geocoding and reverse Geocoding was the obvious choice. the service requires no API key, it does limit geocodes to 2,500 per day and require that the resulting application show data with a Google Map. The REST API returns data as JSON or XML.[14]

3.1.6 Apache cordova plugins for camera

As of version 3.0, Cordova implements device-level APIs as plugins. This plugins can be used to access the native feature of the mobile in which the application is installed, they can access all the features like camera, geolocation, accelerometer etc. we have used the camera plugins in our paper for accessing the camera of the mobile for taking the picture which are used for capturing the images[13]

Algorithm for taking image:

Start:

```
// variable declaration
// import plugins for camera
Navigator.camera.getpicture(onsuccess,onfail)
//onsuccess is the method fired after successful execution of
method or else onfail is fired.
Quality: 50,
Sourcetype: camera.picturesourcetype.CAMERA,
Destination type: camera.destinationtype.DataURL
//quality of the image of the image taken
// to choose from existing files r take a new photo with the
phone camera
```

```
//convert the image to base 64 encoded format
Function :onsuccess(imageData)
// after successful capture of image assigned the image to use
in app
Image.src =" data: image/jpeg; base 64" +imageData;
Function :on fail()
// after unsuccessful give the error message to user
Alert("failed because"+ message)
End
```

Reasons for choosing this Algorithm

The other algorithm for doing the same job is

```
Start:
navigator.camera.getPicture(onSuccess, onFail, { quality: 50,
  destinationType: Camera.DestinationType.FILE_URI });
function onSuccess(imageURI) {
  var image = document.getElementById('myImage');
  image.src = imageURI;
}

function onFail(message) {
  alert('Failed because: ' + message);
}
End
```

The basic difference between the two algorithms is the way they generate the result the second algorithm give the image in the form of a local address of the image inside the mobile device and the algorithm we chose gave the image in the form base 64 string format.

Thus the base 64 string can be easily transferred from mobile to the web service and can be easily stored in the database where as the in second algorithm the image needs to be converted in bytes for transferring the image from mobile to web service and vice versa thus increasing the overhead of conversion on the mobile device which will degrade the application performance

4 EXPERIMENTAL WORK

(a)Client side Graphical user Development

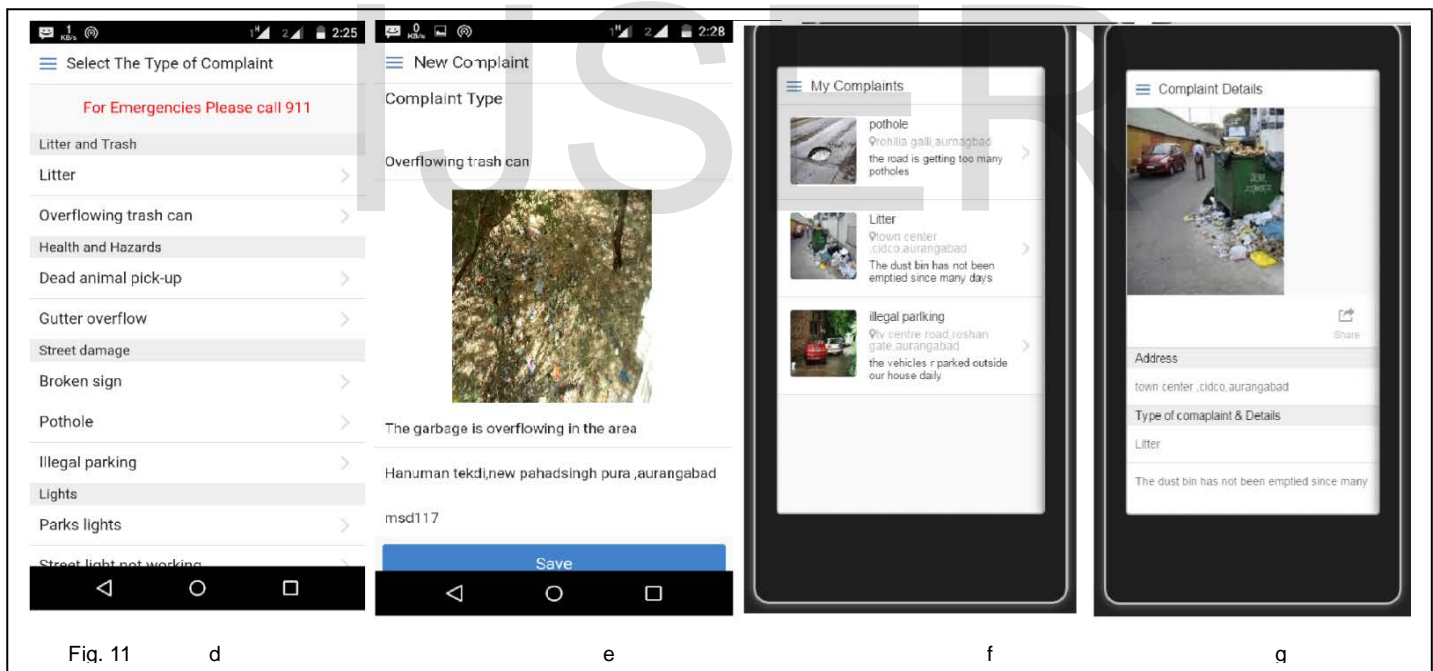
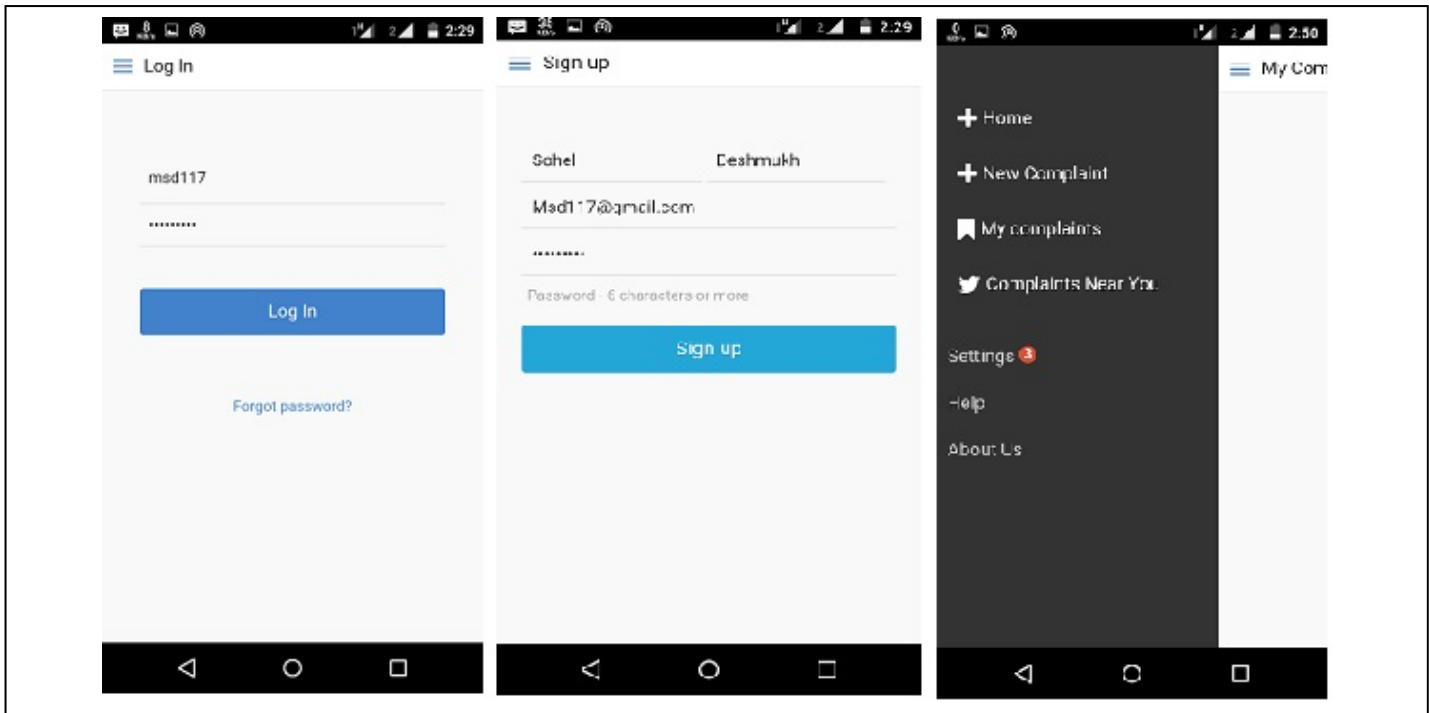
We have design the GUI for the citizen of the smart city or advanced city in which the user can use this application to submit here grievances to the municipal corporation of the city. Here in picture show fig (a) is the image of the user login into the application, the user would need a username and correct password to login, if suppose the user does not have the login for accessing the application.

fig(b) shows the process of creating the account the user has to fill the primary details and register himself with the application. After successfully login into the application the user would be taken to the home page fig(c) the home page contains all the links as well as the instructions for using the application in well detailed format, the links to every option of

application including new complaints, my complaints, complaints near you which shows all the complaints as well as the login and sign up options.

Fig (d) shows the type of complaints that can be registered with the applications which include potholes, litter, illegal parking, etc; there is also an option of others for a complaint that does not fit in any of the category , fig (e) shows the next step in registering the complaint after selecting the type of complaint in the first step the user can fill the details of the complaint here, he can submit the details description of the complaint , take the image of the complaint as it is said a picture a better then thousand words so image can be more descriptive if user fails to explain the problems in the description, the address of the complaint would be directly taken by the application by using the reverse geocoding algorithm of Google then the user can submit the complaint and he will be informed with the alert message of successful or unsuccessful submission of the complaint.

Fig(f) shows the number of complaints submitted by user in the list form it contains all the complaints that have been successfully submitted through the application. Fig(e) shows the details of the submitted complaint, after clicking any of the complaint from the list shown in fig(f) the user is shown the complaint details which the contains the current status of complaint which can be any of submitted, approved, forwarded to department or resolved depending upon the situation the complaint



(b) Server side Graphical user development

To support the application and for the administrator and departmental users we have created the server side GUI. All the processing of the mobile application is done on server side by using web services we have used dot net framework for creating the web services. The server side GUI contains the homepage where everybody can see the complaints that are being generated by the people in the city where all users can

view the all the complaints that are being generated and can also view the current status of those complaints.

The fig (h) show the login section which is for the administrator and departmental users from where they can access the complaints which is shown in fig(i) the administrator's role is to Approve the complaints and also forward it to the respective department. Then the departmental users will view the complaints and will work on it and later on once the complaints is fixed will end the complaint

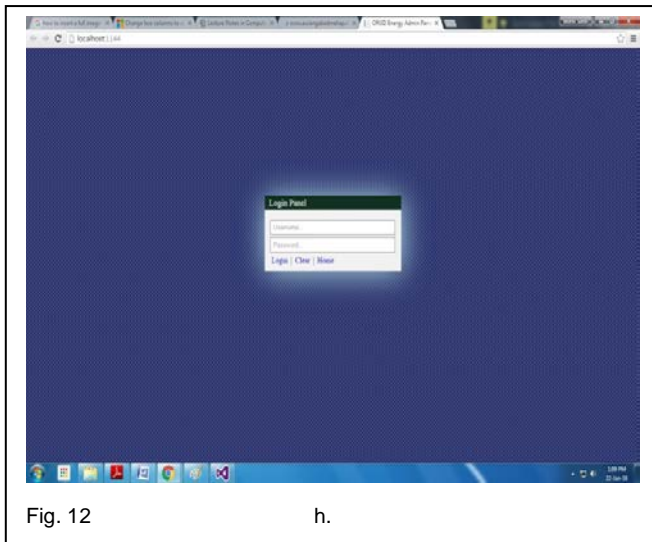


Fig. 12 h.

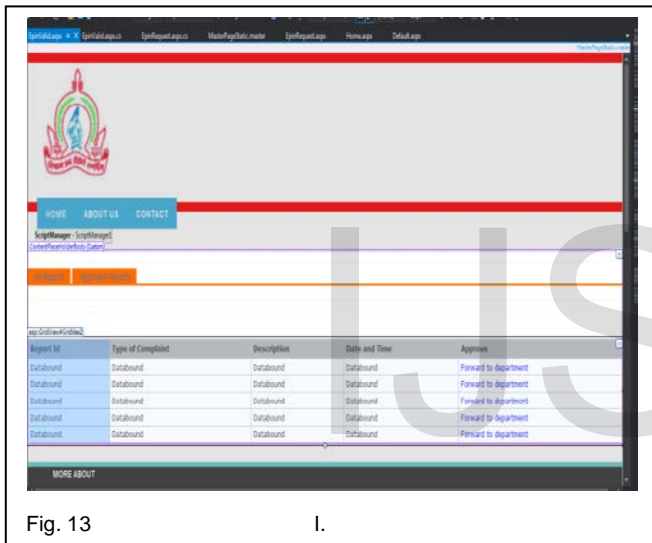


Fig. 13 l.

5 CONCLUSIONS

The implementation of a complaint system in a city has a potential to make a city operations more responsive and efficient, that will assist citizens with better utilization of services provided by Municipal Corporation within a particular area but such gains are entirely dependent on citizen participation.

The direct communication between the municipal corporation and the citizen to help in registered problems that citizen facing in urban areas and by continuously track them will

result in a clean, peaceful and good environment.

The significance of such application system would help in good governance It not only gives the local community confidence in its council, but improves the faith that elected members and officers have in their own local government and its decision-making processes. It also leads to better decisions, helps local government meet its legislative responsibilities and importantly provides an ethical basis for governance.

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