EMERGENCY SOCIAL MEDIA SEARCH

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ABSTRACT

Providing real time information from people involved in an emergency is vital in emergency management. Nowadays, large number of emergency information management resources and also a number of social media search tools that deliver user generated content are available online. However, there is an increasing demand for additional informational resources and tools which query and present user-submitted information about emergencies and disasters.

The primary objective of our research is to unite the areas of emergency information management and user generated social content. The main motivation behind our research is the fact that the real time information coming in from the general public should be utilized in emergency management. We have made this possible by developing an Emergency Social Media Search (eSMS) tool that allows users to search for the social media updates based on emergency categories and optimize the search results based on keywords and geographic location.

ACKNOWLEDGEMENTS

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1. INTRODUCTION

Social media has taken the internet by storm. It is one of the most important platforms to share information among friends and has taken communication to a new level. According to Antony Mayfield, Social media can be defined as "*a new kind of online media which share characteristics such as participation, openness, conversation, community and connectedness*". These might include social networks, blogs, wikis, podcasts, forums, content communities and micro blogging [1]. It is a form of online media that facilitates conversation between users and differs from traditional media in allowing the users to participate in the creation of the content. A comparative study on social media trends conducted in 2008 highlighted the importance of growing trends in social media sites as the fastest growing category on the web, doubling their traffic every consecutive year [2]. This study which includes 17,000 respondents from 29 countries using internet at least every other day has stated that:

- 73% of active online users have read a blog

- 45% have started their own blog

- 57% have joined a social network

- 55% have uploaded photos

- 83% have watched video clips

Social media have been used innovatively to connect with people during real time disasters such as Japan earthquake and tsunami, flash floods in Australia, and US wildfires with medical and health services [3]. It allows the victims and the relief

organizations to communicate with each other even when the traditional media is unavailable [4]. Social media improve the ability of the people to get them prepared, respond for and recover from the natural calamities [5].

Social networks such as Facebook and Twitter present an online interactive platform for the users to post "instant updates" that will be available to be viewed by the people in the purview of the authors' network. Most internet users access search engines such as Google and Yahoo to look for content using keywords. Based on the keywords, the search engines display results from various sources on the web which might also include social media sites and generic web content. However, the user might be interested in keyword searches related to social media sites. This streamlining process is further made possible by dedicated social media search tools which provide a platform that searches the socially-created content from one or multiple sources and aggregate the search results into a single stream of information.

According to [6] Social sites can be defined as web based services that allow individuals to:

- Construct a public or semi-public profile within a bounded system.

- Articulate a list of other users with whom they share a connection, and

- View and traverse their list of connections and those made by others within the system. The nature of these connections may vary from site to site.

Today social networking is increasingly popular and can be attributed to various functions such as emotional support and wellbeing, job information, peoples' profiles both personal and professional and many more [7]. Other than the above functions,

increasing awareness about situations related to disasters and emergencies is one of the significant aspects of social networking which is largely being ignored.

A large number of disaster and emergency information agencies such as Federal Emergency Management Agency are present which gives firsthand information regarding impending disasters and emergencies. They operate both regionally and nationally and interoperate with each other while dealing with crisis. For example United States Environmental Protection Agency (EPA), states that its core purpose and mission is to "Lead the national effort to prevent, prepare for, and respond to environmental emergencies and closely work with state and local response agencies, and industry to prevent accidents and maintain and provide superior response capabilities" [8].

Emergency information management plays a vital role in ensuring that the people have adequate information to prepare for disasters in order to prevent loss of life and property. Broadly, an emergency management process consists of different elements such as mitigation, preparedness, response, and recovery [9].

Emergency social media search tools are believed to be built on the foundations of conversations in a virtual environment. Consequently, its being largely opined that social media platforms can be used by emergency management agencies in situations such as asking for a public feedback regarding an emergency simulation program [10].

As an extension to the various parameters taken into consideration, integration of location based application into the tool through a Google map interface will further enhance peoples' awareness in their geographic area of crisis. Public at large are

becoming more involved by integrating into the large response network rather than being mere bystanders or victims [11].

Social media search tools use keywords and fetch results from one or more sources of social media and aggregate the results into a single stream. Some social media tools such as WhosTalkin and SocialMention are available on the web.

WhosTalkin allows users to search for conversations surrounding the topics that they care about most, whether it is a favorite sport, favorite food, celebrity, or your company's brand name [12]. SocialMention allows a user to easily track and measure what people are saying about a company, a new product, or any topic across the web's social media landscape in real-time [13].

Though these social media tools address a wide range of aspects, a dedicated social search engine related to emergencies and disasters is not available. Additionally geographic and location based information is the need of the hour. In our tool we have initially considered incorporating the twitter social media platform as the source of user generated content. These messages are commonly referred to as the "tweets". The tool fetches the tweet updates based on the key word search and selected geographic location. Also it helps the users to retrieve the updates within a certain radius of the selected geographic location. These updates are topographically depicted on the Google maps based on the latitudinal and longitudinal information of the source of tweets. Another remarkable feature incorporated into this tool is "a report incident feature" which allows the user to record an incident in geographic vicinity that they have witnessed. This further pops up in the search query results if another

user searches for information in the particular geographic location where the incident was reported.

In this chapter we have given an introduction and importance of social media and its influence in the society. This sets a good precedent about the various factors which go into making of this tool. The implementation, design and the need to design this tool have been discussed. In the upcoming chapters we will discuss background and related information, the basic system design, and the different technologies used to design this tool. In this process we have given several examples on using the tool interface and the way results are retrieved. All the different features which make this tool unique and useful will be discussed. We conclude the paper with remarks and observations on the current work and recommendations for future work.

2. BACKGROUND AND RELATED WORK

2.1. The Advent of Social Media

Since we have defined "social media" we will delve into the brief history of how social media has found its way into the 21st century.

Human history has seen a continuous need for evolving ways to communicate with each other [14]. The use of telegraph in 1792 to send and receive messages, usage of radio and telephone in the 1800's for social interaction are some of the earliest trends in social communication [15, 16]. These forms of communication were gradually advanced to the use of digital media through the use of electronic mail commonly referred to as the "email" in the 1960's. To send and receive emails both the sender and the recipient needed to be on the computers. But later the emergence of servers has simplified the process by storing and transmitting the messages later [17].

Social networking sites such as Six Degrees, Black Avenue and Move on blogs such as Blogger and Epinions have emerged in the 1990's. In 2000's a flurry of social media sites such as YouTube, Facebook, Friendster, MySpace, Twitter etc. have evolved. This greatly improved and increased the interaction between persons and organizations that have common interest in places, movies, music and education based on social networking [18].

2.2. Twitter: The Micro-blogging Site

Micro-blogging refers to a miniature version of blogging where short messages are used to communicate between users on a network. The most popular micro-blogging site is "Twitter" in which users can exchange messages up to 140 characters in length.

The shared messages are popularly referred to as "tweets" and forwarding these messages are referred to as "retweets" according to the Twitter jargon. People on the network can usually be the "followers" who constantly get updates from them. Several other features such as search functions when a keyword or query is used or any other trending topic based on geo-location information have also been incorporated.

Though twitter was initially seen as a medium to exchange personal messages and updates, it became seemingly popular in engaging social issues and opinions such as the recent revolutionary protests in Egypt [19]. Celebrity tweets were amongst the highly followed tweets regarding the recent anticorruption protests in India. In one way it can be said that this platform has catapulted the social issue to the national level. A limited amount of research on how twitter is used during emergencies and disasters is available on the web. Studies on the Flooding of the Red river valley by Starbird et al 2010, Southern California wildfires by Sutton et al 2008 are some of the few studies which reported the use of Twitter during emergency crisis [20]. Additionally they have also shown how people rely on first hand official information given by the participating governmental institutions. Twitter communication during emergency is one of the main aspects which needs to be further researched based on real time situations. Based on literature review Mark Latonero from University of California and Irina Shklovski from IT university of Cophenhagen [21] have categorized the usage of twitter communication during emergency crisis into four broad types:

- Users posting self-generated messages about the emergency crisis to their twitter network.

- Users re-tweeting messages from other users, official and unofficial sources.

- Emergency management professionals sending official and unofficial messages to the public and affected communities.

2.3. Emergency and Disaster Management Preparedness

Evaluation of crisis management situations have shown that humans lack communication and frequently fail to coordinate and respond to various situations [22]. Therefore it is very important to understand and evaluate how to deal with disasters and emergencies. This process can be referred to as "emergency and disaster management preparedness".

In 1979, the Federal Emergency Management Agency (FEMA) was established by an executive order and merged many of the disaster related responsibility agencies into a single agency. According to FEMA, "Disaster can strike anyone, in any community and at any time. It can take many forms, building over time, or hitting suddenly without warning". FEMA's mission is to reduce the loss of life and property and protect communities nationwide from all hazards, including natural disasters, acts of terrorism, and other man-made disasters. FEMA leads and supports the nation in a risk-based, comprehensive emergency management system of preparedness, protection, response, recovery and mitigation [23]. FEMA operates under some core competencies such as:

- Service to disaster victims: This includes assistance to eligible individuals and communities.

- Integrated preparedness: This includes working in tandem with voluntary agencies, federal, state, tribal and local governments.

- Operational planning: This includes developing planning capabilities and incident specific plans to help disaster victims.

- Hazard Mitigation: This includes reducing or eliminating the impact of disasters on a long term basis.

- Emergency communications: This includes devising and implementing effective communication methods during and after disasters.

Several other organizations which are operational at the local, state and national level operate more or less with similar guidelines and missions. The ultimate goal of these organizations is to better prepare the public for impending disasters and aftereffects. Another such organization is the Disaster Information Management Research Center (DIMRC) which develops and provides access to health information resources and technology for disaster preparedness, response, and recovery [24].

Table 2.1 depicts the general classification of the different types of disasters according to the Center for Research on the Epidemiology of Disasters [25].

2.4. Related Work

Various social media search tools are present on the web. These tools help to generate and conduct research for marketing strategies. They also allow us to see company ratings, products and services. These social media search engines filter out unnecessary results compared to the conventional search engines [26].

Table 2.1. General Classification of Disasters [25]

Disaster - Sub Group	Definition	Disaster - Main Type
Geophysical	Events originating from solid earth	Earthquake, Volcano, Mass Movement (dry)
Meteorological	Events caused by short-lived/small to meso scale atmospheric processes (in the spectrum from minutes to days)	Storm
Hydrological	Events caused by deviations in the normal water cycle and/or overflow of bodies of water caused by wind set-up	Flood, Mass Movement (wet)
Climatological	Events caused by long-lived/meso to macro scale processes (in the spectrum from intra-seasonal to multi-decadal climate variability)	Extreme Temperature, Drought, Wildfire
Biological	Disaster caused by the exposure of living organisms to germs and toxic substances	Epidemic, Insect infestation, Animal Stampede

Social media search engine such as 'SocialMention' and 'Whos Talkin?' searches blogs, microblogs, bookmarks, comments, images etc. for the specific search term.

Similarly, 'Snitch.name' gives user the option to choose the social media web sites where they want the search query to get the results from. 'Snitch.name' further classifies websites into Social ex: Facebook, professional ex: LinkedIn, academic ex: Google scholar and blogs ex: Word press.

Google social search helps to searches for content within our own social circle and also has an advanced search tool options. In addition to the above mentioned ones, a slew of search tools are present on the web which cater to the users based on their search criteria.

3. DESIGN PHYLOSOPHY OF eSMS TOOL

3.1. Technologies Used

The design and implementation of eSMS tool is mainly based on PHP server side scripting language in combination with Hypertext Markup Language (HTML), Cascading Style Sheets (CSS), and JavaScript. MySQL is used as backend database.

Web developers often use PHP to create database driven dynamic web applications. The fact that PHP is open source and is compatible with most of the operating systems available today makes it one of the most sought after scripting languages.

HTML stands for Hyper Text Markup Language. In a hypertext document the various components are represented through this language on the World Wide Web. As this language defines the structural content of the document and the way it has to be displayed on the web, it is known as a markup language. This consists of a set of embedded codes in a plain text document. These codes which define the various structural components are commonly referred to as "tags". Tags often come in pairs, enclosing the text they affect between them, called as an element [27].

Different elements on the web pages can be formatted using a style sheet language known as Cascading Style Sheets (CSS). Though HTML enables us to control the different elements on the web page such as headings, images, links, tables and paragraphs, CSS further helps to format these elements in much more detail. CSS also assists in providing a uniform look across several web pages by defining the elements once rather than individually manipulating them in every web page [28].

JavaScript is a scripting language i.e. lightweight programming language, developed and released by NetScape and Sun Microsystems in 1995. JavaScript is referred to as an interpreted language because of its ease to be embedded in HTML pages to be interpreted and run by client browsers. JavaScript is compatible with all major browsers. It can react to an event i.e. a JavaScript can be set to execute when something happens, like when a page has finished loading or when a user clicks on an HTML element. JavaScript provides interactivity within the web pages and can read/write HTML elements and also can be used to validate data before it is submitted to a server [29, 30].

Due to its broad range of features and uses we chose PHP in conjunction with other languages as our platform in developing eSMS tool.

3.1.1. PHP – Hypertext Preprocessor.

PHP is open source software which was first developed by Rasmus Lerdorf in 1995. It originally stands for Personal Home Page but later changed to Hypertext Preprocessor. It is a server side scripting language used to create dynamic web applications. There are several advantages of using PHP as a scripting language. It is primarily open source software, fast and uses minimal system resources. It is easy to understand and serves as a cross platform for various operating systems like LINUX, UNIX and Windows. In addition to the above uses it provides support for various database servers including MySQL, Oracle, PostgreSQL. It can either be embedded in HTML or can serve as a standalone binary. It does not need any special browsers or plugins to see the PHP perform as it is a server side technology. Another important

feature of PHP is the levels of security it offers to prevent malicious attacks. PHP uses an Apache module, written in C, and is extremely fast and loads very quickly. PHP uses a modular system of extensions and enhances its connective abilities by interfacing with a libraries ranging from graphics, encryption and XML. PHP can also be extended by writing our own extensions and creating our own executables and loading them using PHP [31].

PHP is commonly used with MySQL database, as they work well hand in hand and MySQL can be easily accessed from PHP. The programming interface between them is logically paired. An added benefit is that PHP and MySql run on various computer types and operating systems, including Mac OS X, Windows-based PCs, and Linux [32].

3.1.2. MySQL and Structured Query Language.

MySQL is one of the most commonly used Relational Database Management System (RDBMS). SQL stands for "Structured Query Language". The primary function of any RDBMS is to store and retrieve data that the users request for. MySQL database management system stores data in a tabular format and makes it accessible as well as manageable using the Structured Query Language.

SQL is designed for updating, deleting, and requesting information from databases. SQL queries can contain statements, clauses, expressions, predicates needed to get the desired result [32]. The eSMS tool uses MySQL database to store and access the user reported emergency incidents data.

3.2. Conceptual Framework

The conceptual framework of information processing in the proposed system is shown in Figure 3.1.
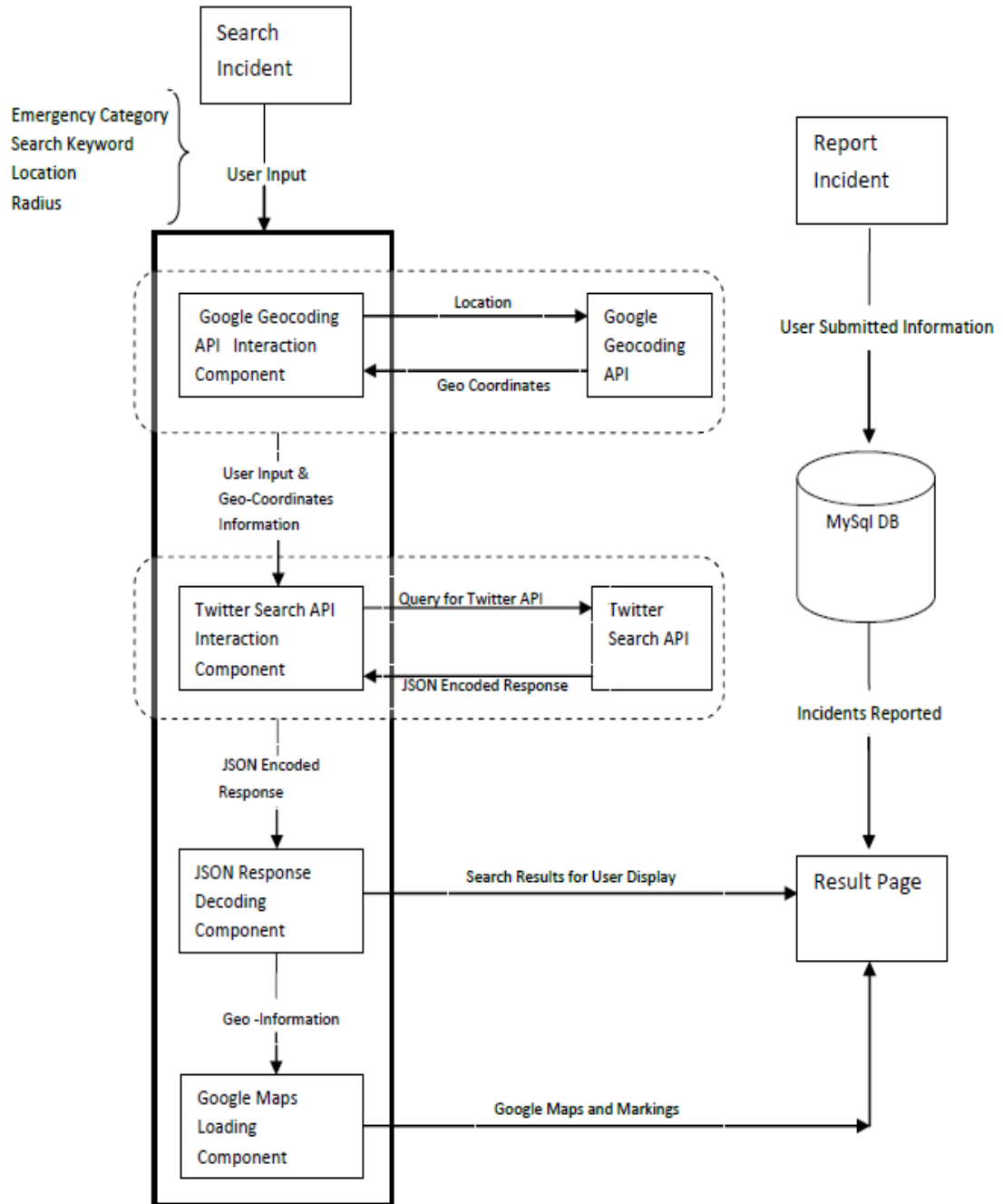

Figure 3.1. Overview of the System

Figure 3.2 depicts the homepage of the Emergency Social Media Search tool and how it appears when the user accesses the tool through the World Wide Web. The web interface consists of various fields where the user can input information and retrieve results.

Figure 3.2. Web User Interface of eSMS Tool

There are two major features that the system offers:

- **Search Feature:** This searches the queried information against the real-time twitter feeds and also the local database of reported incidents. Fetches the results that match the query, from both Twitter and local database and displays it to the user.

- **Report Feature:** This feature helps the user to report an incident in an area. This information is stored in the local database.

3.2.1. Search Feature.

In the Search Feature, the execution proceeds in 5 steps: Querying, generating geo-coordinates, Twitter feed retrieval, decoding retrieved response and displaying results. We discuss each step in detail here.

3.2.1.1. Querying.

The first and foremost step is to accept the users' input through a web user interface. The user input includes the following parameters.

- **Emergency Category:** This category field is a multilevel dropdown menu that lists the possible types of emergencies/disasters. Possible emergency categories were listed, based on the classification of disasters charted out by the International Disaster Database. The user can select an emergency/disaster from this list of available types. Shown in Figure 3.3.
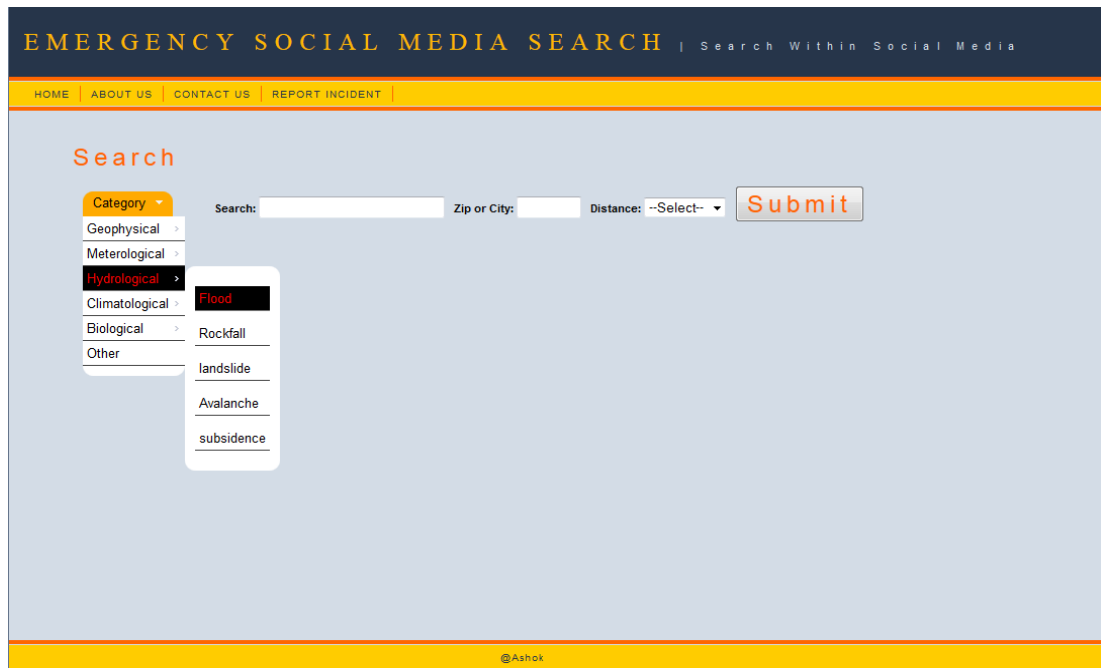

Figure 3.3. Selecting the Emergency Category

In Figure 3.3, example of emergency category is depicted. Hydrological type of emergency category is selected and further flood is selected as an emergency situation. Other sub-classifications of the primary category are also viewable.

Once the user selects the categories and subcategories of the emergency types, the selection hierarchy is displayed on the left hand upper corner as shown in Figure 3.4. We have highlighted the selection hierarchy with a red rectangle.
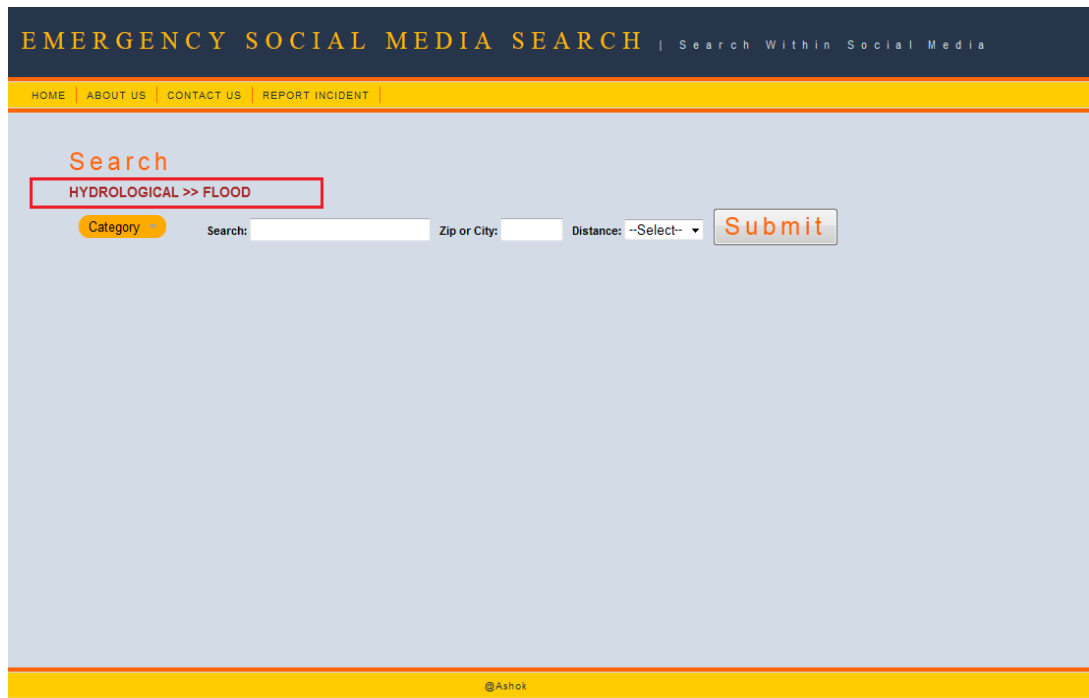

Figure 3.4. Example of Tracking Emergency Selection

The selection hierarchy feature shown in Figure 3.4 helps the users to keep track of their choice/selection.

- **Search Keyword:** The users can enter any relevant search keyword(s) related to the emergency category which they are interested in.

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- **Location:** The search is further narrowed down using either the zip code or city entered by the user. With this the user is providing the system with a location of interest.

- **Radius:** The user can select a value for radius, from the distance drop down menu. This distance parameter can further help the user to obtain the tweets within a particular radius around the selected location.

Figure 3.5 displays an example of how the emergency category, search keyword, location (city/zip-code) and the radius can be submitted into the tool.

Figure 3.5. Submitting the Input Parameters

Once user submits the input parameters, they need to be converted into a valid format. The formatting is required for calling Twitter Search API, which acts as an interconnect between the eSMS tool and Twitter. The emergency category and search keyword(s) are concatenated together into a single string called as **search term**. This

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search term is arranged in such a way that it can be passed as a single input entity to the Twitter Search API. Also the location information is converted into geo-coordinate (latitude/longitude) values as Twitter Search API cannot understand the user entered location information as is.

In the next section we discuss how the user submitted location information can be converted into geo-coordinate values, using the Google API.

3.2.1.2. Geo-Coordinate Generation.

Based on the input parameters received from the user, the location information is channelized to the Google Maps Geocoding API. This is further transformed by the Google Maps Geocoding API into geo-coordinate (latitude/longitude) values.

3.2.1.2.1. Geocoding API.

It is the process of converting human readable addresses into geographic coordinates (example: latitude -34.397 and longitude 150.644), which you can use to place markers on the map.

The Geocoding API can be accessed directly over HTTP by sending a request to http://maps.googleapis.com/maps/api/geocode/output?parameters, where the 'output' can be either 'JSON' (JavaScript Object Notation) or 'XML' (Extended Markup Language) format, and the 'parameters' could be the 'address' that you want to geocode [33].

3.2.1.2.2. Reverse Geocoding API.

The process of doing the converse of Geocoding i.e. converting the geographical coordinate (latitude/longitude) values into a human readable address is known as Reverse Geocoding.

The Reverse Geocoding API can be accessed directly over HTTP by sending a URL request to http://maps.googleapis.com/maps/api/geocode/output?parameters, where the 'parameters' could be the 'latitude, longitude' values, for which you need the address [33].

3.2.1.2.3. Geo-Coordinate Generation in Current System.

In Geo-Coordinate Generation process, the Geocoding API is called by sending an HTTP request to http://maps.googleapis.com/maps/api/geocode/xml?$address, where '$address' is the location information received from the user. The API returns an XML response for this request, which is wrapped inside the root element and its sub-elements. Each sub-element contains a single set of geocoded address information and geometry information. This XML response is then parsed with the XML parser function within PHP to obtain the latitude and longitude coordinate values for a location parameter keyed-in by the user.

In the next section we discuss how this geo-coordinate information along with search term is passed to the Twitter Search API and the retrieval process of the tweets that meet the specific criteria.

3.2.1.3. Twitter Feed Retrieval.

Before considering the Twitter feed retrieval we need to have a basic understanding of how the Twitter API operates. Therefore, we provide a brief introduction of the Twitter API.

3.2.1.3.1. Twitter API.

One of the most popular micro-blogging sites on the web today is Twitter. Many applications and tools based on Twitter are being designed because of the ease and

accessibility of data. Twitter API helps to retrieve real time posts compared to most of the other social networks which lack this feature. These features have made Twitter social media an acceptable and appealing platform for researchers.

Third party services can retrieve data from twitter through an Application Programming Interface commonly referred to as API. The Twitter API consists of two parts [34]:

- Representational State Transfer (REST) API, which retrieves a variety of data such as messages and social graph relations [34].

- Streaming API, which lets the users to create steady connections and have access to a variety of subsets of messages posted on Twitter in real-time [34].

3.2.1.3.2. Twitter Search API.

The Twitter Search API is one of the services provided by REST API, which is the specialized API designed for running the searches against the real-time directory of latest Tweets and fetching the tweets that meet specific criteria [35]. Web developers can automate Twitter searches using Twitter Search API. It is particularly useful when a developer needs to display latest tweets with specific content and varying by small time periods [35]. This Search API can be accessed directly over HTTP by sending an URL request through browser. An example of such a request is shown below:

http://search.twitter.com/search.json?q=ndsu&lang=en&geocode=46.922343,-96.840133,10mi

In this URL, "search.twitter.com" is the domain, where Twitter Search API resides. The word 'search' after the first backslash also specifies the service that is requested.

Following the word 'search' is the .json extension. This means that the results for the search will be returned in the JSON encoded format. The other possible return types are Atom (.atom) and RSS (.rss).

The parameters in this query are 'q' (which is short for *query*), 'lang' (short for language), and 'geocode' (short for geo-coordinates). In our current system 'q' takes the encoded search term; 'lang' restricts the tweet results to specific language and 'geocode' returns tweets generated by users located within a given radius of the given latitude/longitude. Table 3.1 show Twitter Search API Query Parameters, adapted from https://dev.twitter.com/docs/using-search [35].

Table 3.1. Twitter Search API Query Parameters [35]

Parameters	Description
Q	A UTF-8, URL-encoded search query of 1,000 characters maximum, including operators. Queries may additionally be limited by complexity.
Lang	Restricts tweets to the given language, given by ISO 639-1 code.
Geocode	Returns tweets by users located within a given radius of the given latitude/longitude. The parameter value is specified by `"latitude,longitude,radius"`, where radius units must be specified as either `"mi"` (miles) or `"km"` (kilometers). A maximum of 1,000 distinct "sub-regions" will be considered when using the radius modifier. **Example Values**: `37.781157,-122.398720,1mi`

3.2.1.3.3. Feed Retrieval Process in Current System.

A call is made to Twitter Search API by sending a URL request over HTTP in order to retrieve the relevant tweets from Twitter. These tweets contain specific keywords and have been generated by users of a particular geographic area. Such URL is constructed using the 'search term', 'geo-coordinate values', and the radius parameter input from the eSMS user. For example:

http://search.twitter.com/search.json?q=$searchterm&lang=en&geocode=46.922343,-96.840133,10mi

Where the key-value pairs:

1. 'q=search term' tells the API to search in the real time index of recent tweets, for the ones that contain the specific words or the combination of words that are in the 'search term'.

2. 'lang=en' will restrict the API to fetch the tweets that are in English language only.

3. 'Geocode=46.922343,-96.840133,10mi' tells the API to return the tweets that are generated by the users located within 10 miles radius from a given latitude(46.922343) and longitude(-96.840133) coordinates on the map.

4. The extension '.json', indicates that the response received from the API will be in JavaScript Object Notation (JSON) format.

When combined together, these key-value pairs form a URL request that is sent to Twitter Search API, which in turn returns a JSON object that encapsulates a set of real-time tweets that are written in English, having specific key words, and are generated by the users in a particular geographic area.

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3.2.1.4. Decoding Retrieved Response.

The response from the Twitter Search API is in JSON encoded format. For better understanding of the response format, a brief introduction to the JavaScript Object Notation is given below.

3.2.1.4.1. JavaScript Object Notation (JSON).

JSON stands for JavaScript Object Notation. It is a lightweight data-interchange format and is widely used because of the following advantages [36]:

- Easily readable and writable by humans.

- Easy for machines to parse and generate.

- Though in text format, it is language independent.

- Uses conventions that are familiar to programmers of the C-family of languages.

The above features make an ideal data interchange language.

JSON is built in two structures:

- A collection of name/value pairs, which realized in various languages as an object, structure, record, hash table, dictionary or associative array [36].

- An ordered list of values, which is realized in most languages as an array, vector, or sequence [36].

The data structures listed above are universal and are supported by most programming languages in one form or another. Hence, any data format that can be interchanged with programming languages can be based upon these data structures [36].

According to http://www.json.org/ the JSON encoded structure can take one of the following forms:

An **object** is an unordered set of name/value pairs. An object begins with { (left brace) and ends with } (right brace). Each name is followed by : (colon) and the name/value pairs are separated by , (comma) [36]. Shown in Figure 3.6.
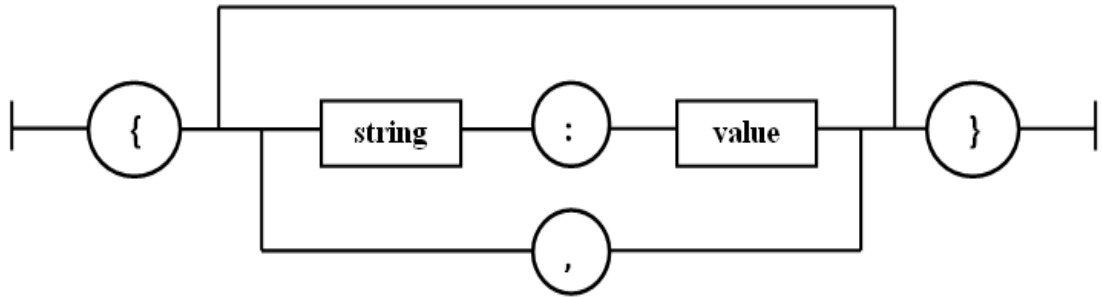

Figure 3.6. JSON Object Structure

An **array** is an ordered collection of values. An array begins with [(left bracket) and ends with] (right bracket). Values are separated by , (comma) [36]. Shown in Figure 3.7.
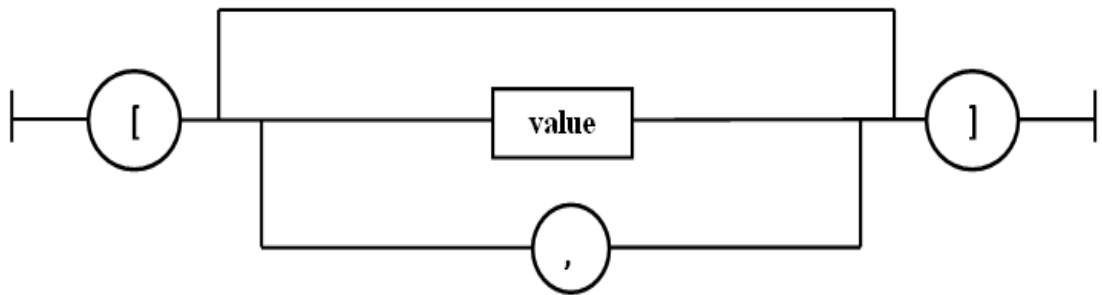

Figure 3.7. JSON Array Structure

A **string** is a sequence of zero or more Unicode characters, wrapped in double quotes, using backslash escapes. A character is represented as a single character string. A string is very much like a C or Java string [36].

A **number** is very much like a C or Java number, except that the octal and hexadecimal formats are not used [36].

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A **value** can be a string in double quotes, or a number, or true or false or null, or an object or an array. These structures can be nested [36]. Shown in Figure 3.8.
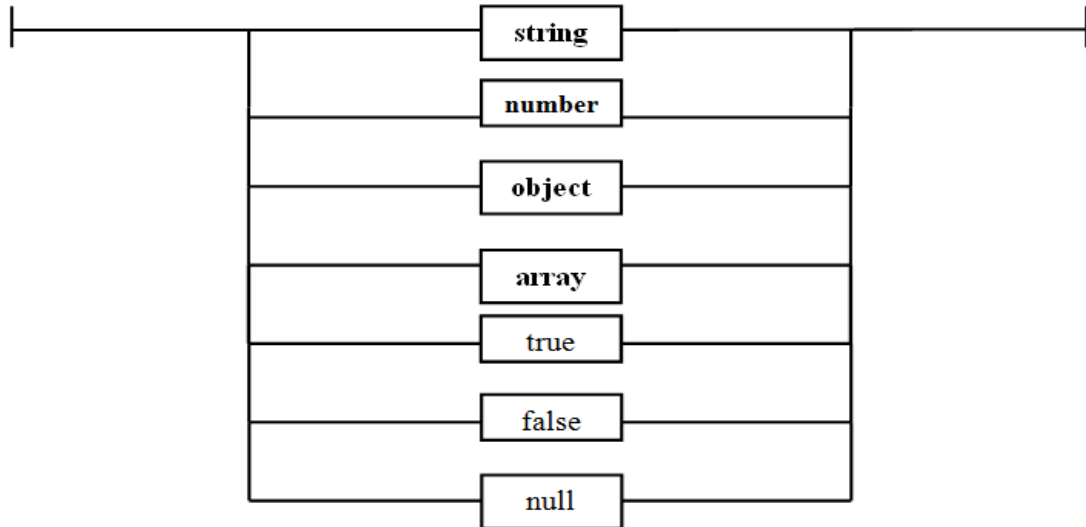

Figure 3.8. JSON Value Structure

3.2.1.4.2. Decoding Twitter Feeds in Current System.

The JSON encoded data is human-readable and can be easily decoded using JSON functions within PHP. A partial JSON object is shown in figure 3.9.

```
{
"created_at":"Sat, 05 Jan 2013 18:00:07 +0000",
"from_user_id":25597770,
"from_user_name":"Red River at Fargo",
"geo":{"coordinates":[46.872001,-96.767541],"type":"Point"},
"location":"Fargo, ND",
"id":287619501086871552,
"iso_language_code":"en",
"metadata":{"result_type":"recent"},
"profile_image_url":"http:\/\/a0.twimg.com\/profile_images\/105172402\/Red_River.jpg",
"text":"Red River @ Fargo is 13.92'. -4.08' flood stage. -26.9' record crest."
}
```

Figure 3.9. JSON Object Snippet That Represents Single Twitter Feed

The response from Twitter Search API is parsed into multi-dimensional string array using PHP Json_decode() function. Each element in the array stores a single Twitter

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feed data (which is shown in Figure 9), i.e. each element has a set of information pertaining to the owner of a particular tweet in the form of key-value pairs. Each element of the array is iterated over the key-value pairs, and the values that the eSMS user is interested in are sent out for display, while the geographical coordinates information in the tweets are sent to the Google Maps Loading Component of the eSMS system.

3.2.1.4.3. Google Maps Loading Component.

The eSMS tool uses the Google Maps feature to topographically depict the location information present in the tweet results, for the end user search. Google Maps JavaScript API provides a free service to embed Google Maps in the web pages and also provides a number of utilities for customizing and adding content to the map through a variety of services. This API is designed using JavaScript and responds to the user events such as mouse or keyboard events. Thus the maps embedded in the web pages can listen to the user events like mouse click, double click, mouse up, mouse down, mouse over, mouse out. Also it provides an option to point a particular place on the map with an image, provided the latitude and longitude coordinates of that point [37].

We discuss how these location-related results are displayed on the map by eSMS in the next section.

3.2.1.5. Displaying Results.

In this section, we explain how the results will be displayed by the eSMS system. The results that are being displayed are basically coming from two places. One is the Search feature of eSMS that we have explained above and the second is from the

local database that contains reported incidents data. More information regarding the report incident feature will be discussed in the next section.

An example of the result page display is shown below in Figure 3.10. Results are obtained as two different outputs. One half of the result page shows the tweets retrieved from Twitter and the other half shows a map. In this example the tweets for the Red River Flood are shown on the left hand side while the location based information through the Google maps interface is shown on the right. Specific locations of the tweets on the map are indicated by a green flag icon. It has to be mentioned here that Twitter might not have location information for all the tweets generated through the search. In such a situation the flag icons are shown only for the available location information.
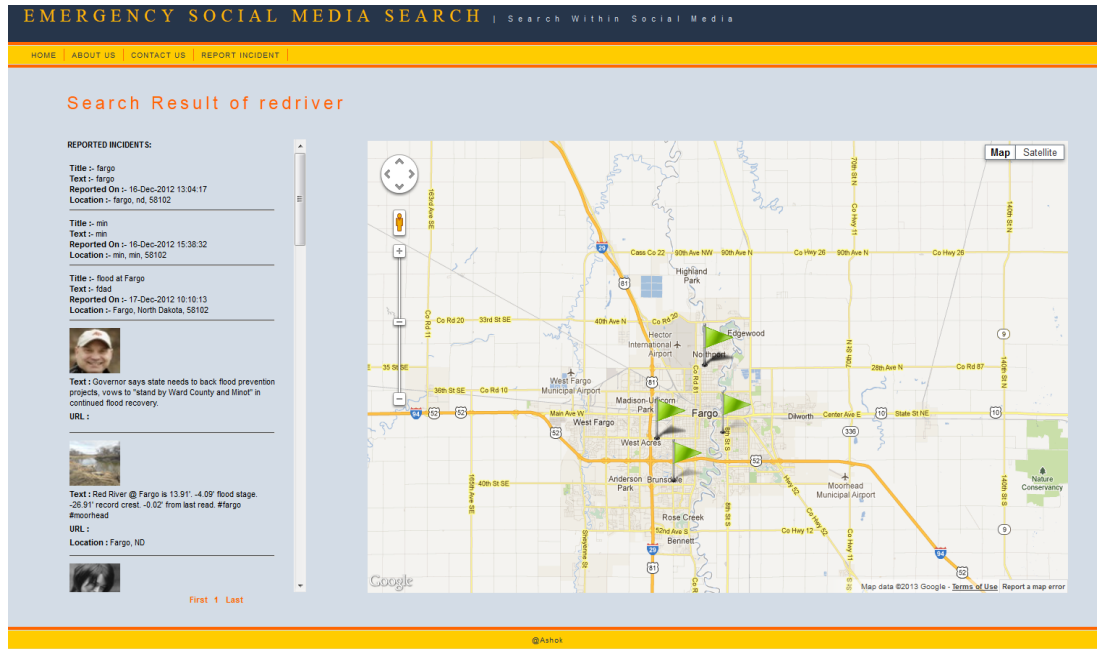

Figure 3.10. Example of Display of Results

A number of close locations in a particular geographic area can be confusing to the user, since it might be difficult to correlate the tweet and the specific location. The

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feature shown in the Figure 3.11 enables us to locate the specific tweet by clicking on the flag to generate a pop up box displaying the information.
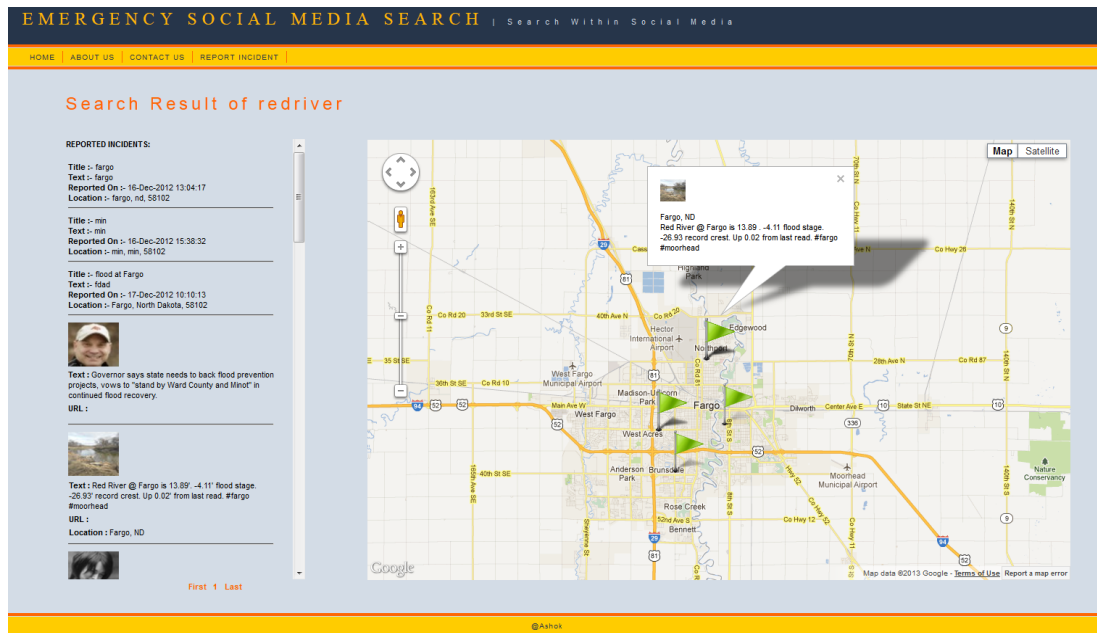

Figure 3.11. An Example of Tweet Tracking on the Google Map

3.2.2. Report Feature.

Report incident is an important feature of eSMS, which enables the user to submit emergency related information. Once an incident is reported it is stored in the local database and can be retrieved when another user searches for information.

While developing this tool we initially had browsed through a lot of examples wherein the reported information was found to be extremely useful to the end user.

The reported incidents are shown as special information by separating them in results section. Report feature was designed keeping both people as well as Emergency Administrative offices in mind. Emergency Administrative offices dealing with emergencies in a particular location can find vital information on eSMS that can better equip them to deal with the situation when incidents are reported by

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people of that area/location. Figure 3.12 shows a screenshot of the Report Incident page.

Figure 3.12. Report Incident Feature

3.2.2.1. Reporting Incidents on eSMS Tool.

In this section we provide an illustrated example of how user can report incidents to eSMS tool.

There are six fields that the user needs to fill to report an incident. The fields Title, Description, Zip Code, City, State and Date are pretty much self explanatory. The Date field can be filled using an interactive date and time picker calendar that pops up when the calendar icon is clicked as shown in Figure 3.13. This calendar allows user to easily input the date and time of the incident being reported. If the user do not select specific date and time, by default it access the date and time of the users' local computer.

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Figure 3.13. Date Field of Report Incident Feature

Figure 3.14 show a screen capture of an incident being reported to the eSMS tool

Figure 3.14. Incident Being Reported to eSMS Tool

As soon as the SAVE button is pressed, the information keyed in by the user is sent to a MySQL database.

Figure 3.15 shows that the results displayed by eSMS also include the reported incidents that match the user entered query. The reported incidents have been highlighted within a red rectangle in the figure.
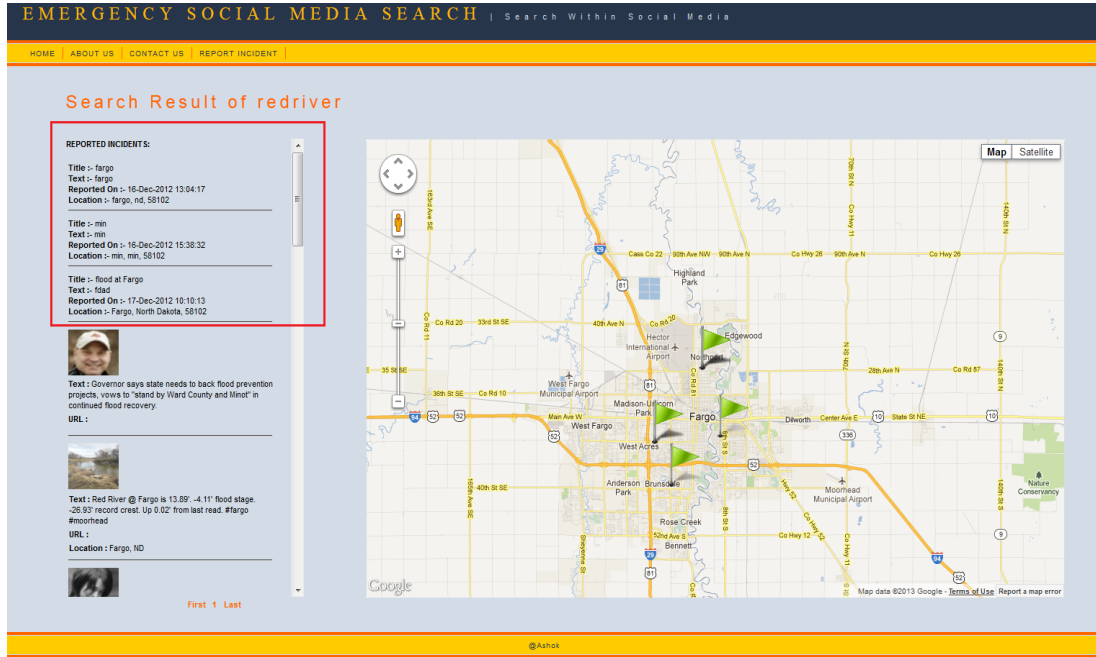

Figure 3.15. Reported Incident Being Displayed by eSMS

In the next chapter we conclude the paper with remarks and observations on the current work and recommendations for future work.

4. CONCLUSION AND FUTURE WORK

Social media is the buzz word in the current context of web world. Several social media tools have been developed which cater to the needs of the users. These tools are mostly designed to retrieve results from various web based sources based on the user submitted information.

We have designed and developed a tool which is specifically intended for retrieval of first hand results related to emergencies and disasters. Further, we have provided many additional features such as location, maps, incident report etc. The web user interface is extremely user friendly and can be easily understood and operable by a layman. Though many social media sites such as Facebook, MySpace, YouTube etc are available, we have initially selected Twitter due to its ease and accessibility in integrating it into our tool as a source of information. The Application Programming Interconnect of twitter helps to retrieve real time index of recent feeds compared to other social media API's. PHP has been selected as the primary language platform as it is compatible with a range of operating systems and can be conveniently embedded into HTML web pages and clubbed with other script languages such as Java script. The results obtained from twitter are in the JSON format which can be easily decoded using JSON functions within PHP. Another important feature that we incorporated into this tool is the report incident feature which will help people report an incident in a particular location and will in turn show up in the results.

Since there will be a larger demand for information related to disasters and emergencies, lot of enhancements can be made to the existing tool. Apart from twitter, a number of other social networking sites can be integrated into the tool to

press for a larger informational database. This is surely going to be a challenge since integration of many social media sites is a herculean task. Nevertheless, this is going to provide varied choices for the user. Drop down menu can be provided to select from the various social media sites. Ranking the results based on the trusted sources of information and by tracking the "current most trending" words related to the emergency in a particular geographic location. Additionally the types of emergencies and disasters can be further classified at a micro level. Validate the user reported emergency information to check the format before storing it in the eSMS local database tables. The performance of the application can be improved by implementing the multi-threading feature.

Based on the above observations, we predict that this tool will be useful especially in the context of emergencies and disasters where first hand information is needed. Further developments of the current tool, as discussed in future work, can greatly enhance its acceptability and reach among the users.

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