

# CLOUD GIS FOR CRIME MAPPING

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**Abstract:** In developing countries, the lack of infrastructure like GPS (Global positioning system) and GIS (Geographic Information system) have hindered the growth of the police department. This paper proposes a simple, useful and cost effective solution for crime mapping. Google cloud resources like satellite data, application and GIS software have been used to develop this application. The developer requires only a simple computer connected to the internet. The source of crime data is the RSS (Really Simple Syndication) feeds from various news websites.

**Keywords:** Cloud GIS, Crime Mapping, Google Fusion Table

## I. INTRODUCTION

Cloud computing is a style of computing where IT related capabilities (software, infrastructure, platform) are provided as a service through the internet. The important features of the cloud are its low cost, flexibility, fast deployment and scalability. Now day's people can leverage the cloud facilities like getting storage, access to application software and also processing power online at no cost. One of the best examples of cloud is the Google documents where you can create, manage and store your documents, spreadsheets and presentations online without any charges.

Geographic information system (GIS) is used to digitally represent and analyze the geographic features present on the earth's surface and the events that take place on it. In the light of the fact that seventy percent of the data we use in our daily life has a geographical reference as its denominator, it becomes imperative to underline the importance of a system which can represent the given data geographically. It helps to bring information collected from diverse sources onto a common platform and subsequently generate meaningful information by integrating non-spatial data with the spatial maps, using geography as the common feature so that it can be used for making effective decisions for various problems. The collective spatial and non-spatial information can be very useful for natural resource management, infrastructure development and various projects as information when

presented in a map format allow a better perception, visualization of spatial patterns and their relationship with the neighboring areas. A sophisticated GIS can give answers to the queries related to the location, conditions, trends, patterns, routing and modeling.

Today with the advancements in the web GIS realm, people can access high resolution satellite imagery and vector data using Wikimapia, Google earth and other mapping websites. Customized maps and applications can also be created using various API's and websites like Google maps and ESRI online, free of cost. A fusion of cloud and GIS can be done to create effective applications which have advantages of both.

## II. RELATED WORK

Various applied research studies in the domain of archaeology, health, tourism, environment and even vehicle routing have utilized satellite imagery and spatial vector data available on Google earth and Google maps to find solutions to their problems, below is a description of such studies. [1] has developed a web-based SOLAP (Spatial online analytical processing) tool, which relies on the integration of a standard Geobrowser (Google Earth) with Mondarin which is an OLAP engine to extract useful information from large repositories of data. Archaeological studies like [2] and [3] have also used the satellite images from Google Earth to mine useful information. [4] and [5] have used Google earth for the development of recommendation system for tourist attractions and for critical analysis. Health related studies like mapping of strategic health authorities [6] and creation of a dengue surveillance system [7] have also used Google earth and maps. [8] had used these resources for creating a web spatial decision support system for vehicle routing while [9] used them to map the deep-water horizon oil spill. All these studies show that valuable information and applications have been created using this online satellite imagery, maps and spatial analysis tools which are free of cost.

In most developing countries, the police are not equipped with infrastructure like GPS and GIS for mapping of crime. This infrastructure is costly, its

setup is time consuming and requires trained advantages of viewing data in the form of a map are massive as compared to grasping tabular data of crime incidents. A crime map gives a comprehensive view of the controlled area and it is easy to identify spatial patterns and incident clusters which can be used as a decision support system to control the crime. According to [10] crime mappers can unlock the spatial patterns and strive for a better theoretical understanding of the role of geography and opportunity, as well as enabling practical crime prevention solutions that are tailored to specific places. [11] and [12] also emphasizes the use of geo-spatial information and communication technology tools for spatial and 3D analysis in crime related studies.

Input data for such a system is collected through a GPS and satellite imagery. A GPS enabled device is used to collect crime location points and the satellite imagery can be used as a base layer or create base vector layers representing roads, settlements, utility network, rivers, canals etc. Input data for this study is collected from the RSS (Really Simple Syndicate) feeds from various news websites. RSS is a syndication method for delivering content to users. [13] has customized the RSS aggregator software to collect content based on both time and location so that the RSS protocol can work for location based services. There are various websites which provide GeorSS feeds which can be mapped easily as they contain the

manpower to operate and manage it. But, the geographic co-ordinates but most of the news websites in developing countries do not provide it.

### III. OBJECTIVE

The main objective of this applied research is to develop a cost effective decision support system which will help the police department to map and analyze crime. This system combines the spatial and non-spatial data to derive meaningful information. Google's cloud and GIS technology has been used for this study. The crime information (non-spatial data) source is the RSS feeds from various newspapers and news channels websites. The spatial data is in the form of the satellite imagery on Google maps, no GPS is required for this study.

### IV. METHODOLOGY

The Methodology of the study is as follows:

- 1) Crime related news is collected using RSS feeds. The news is collected daily in Google docs spreadsheet using the ImportFeed() function. A spreadsheet is assigned to each RSS feed as shown in Figure 1. The crime related news is extracted manually from the collection of news and formatted in a desired format with attributes like location, type of crime, details, link to the news web page etc in a final spreadsheet.

	A	B	C
1	Indiatimes	<a href="http://timesofindia.indiatimes.com/rssfeeds/3947051.cms">http://timesofindia.indiatimes.com/rssfeeds/3947051.cms</a>	
2	Title		Title
3	Devotees throng temples on Mahashivratri	<a href="http://timesofindia.indiatimes.com/city/ludhiana/Devotees-throng-temples-on-Mahashivratri/articleshow/11971381.cms">http://timesofindia.indiatimes.com/city/ludhiana/Devotees-throng-temples-on-Mahashivratri/articleshow/11971381.cms</a>	Devotees throng temples on Mahashivratri
4	Making vintage run smooth is Amandeep's first love	<a href="http://timesofindia.indiatimes.com/city/ludhiana/Making-vintage-run-smooth-is-Amandeeps-first-love/articleshow/11971369.cms">http://timesofindia.indiatimes.com/city/ludhiana/Making-vintage-run-smooth-is-Amandeeps-first-love/articleshow/11971369.cms</a>	Making vintage run smooth is Amandeep's first love
5	3 videographers electrocuted	<a href="http://timesofindia.indiatimes.com/city/ludhiana/3-videographers-electrocuted/articleshow/11971369.cms">http://timesofindia.indiatimes.com/city/ludhiana/3-videographers-electrocuted/articleshow/11971369.cms</a>	3 videographers electrocuted
6	A book to promote child literature in Punjabi	<a href="http://timesofindia.indiatimes.com/city/ludhiana/A-book-to-promote-child-literature-in-Punjabi/articleshow/11971333.cms">http://timesofindia.indiatimes.com/city/ludhiana/A-book-to-promote-child-literature-in-Punjabi/articleshow/11971333.cms</a>	A book to promote child literature in Punjabi
7	Farmhouse party on Anayata's birthday	<a href="http://timesofindia.indiatimes.com/city/ludhiana/Farmhouse-party-on-Anayatas-birthday/articleshow/11971309.cms">http://timesofindia.indiatimes.com/city/ludhiana/Farmhouse-party-on-Anayatas-birthday/articleshow/11971309.cms</a>	Farmhouse party on Anayata's birthday
8	Parents, kids bond over bat and ball	<a href="http://timesofindia.indiatimes.com/city/ludhiana/Parents-kids-bond-over-bat-and-ball/articleshow/11971269.cms">http://timesofindia.indiatimes.com/city/ludhiana/Parents-kids-bond-over-bat-and-ball/articleshow/11971269.cms</a>	Parents, kids bond over bat and ball
9	Artistic skills on display in flower arrangement contest	<a href="http://timesofindia.indiatimes.com/city/ludhiana/Artistic-skills-on-display-in-flower-arrangement-contest/articleshow/11971230.cms">http://timesofindia.indiatimes.com/city/ludhiana/Artistic-skills-on-display-in-flower-arrangement-contest/articleshow/11971230.cms</a>	Artistic skills on display in flower arrangement contest
10	An emotional tribute to ghazal maestro Jagjit Singh	<a href="http://timesofindia.indiatimes.com/city/ludhiana/An-emotional-tribute-to-ghazal-maestro-Jagjit-Singh/articleshow/11971147.cms">http://timesofindia.indiatimes.com/city/ludhiana/An-emotional-tribute-to-ghazal-maestro-Jagjit-Singh/articleshow/11971147.cms</a>	An emotional tribute to ghazal maestro Jagjit Singh
11	Kidnapped minor girl found near a temple	<a href="http://timesofindia.indiatimes.com/city/ludhiana/Kidnapped-minor-girl-found-near-a-temple/articleshow/11971128.cms">http://timesofindia.indiatimes.com/city/ludhiana/Kidnapped-minor-girl-found-near-a-temple/articleshow/11971128.cms</a>	Kidnapped minor girl found near a temple
12	Gorgeous and young sashay down the ramp	<a href="http://timesofindia.indiatimes.com/city/ludhiana/Gorgeous-and-young-sashay-down-the-ramp/articleshow/11971116.cms">http://timesofindia.indiatimes.com/city/ludhiana/Gorgeous-and-young-sashay-down-the-ramp/articleshow/11971116.cms</a>	Gorgeous and young sashay down the ramp
13	Mahashivratri: Ludhianwis pour out devotion in shridings	<a href="http://timesofindia.indiatimes.com/city/ludhiana/Mahashivratri-Ludhianwis-pour-out-devotion-in-shridings/articleshow/1196631.cms">http://timesofindia.indiatimes.com/city/ludhiana/Mahashivratri-Ludhianwis-pour-out-devotion-in-shridings/articleshow/1196631.cms</a>	Mahashivratri: Ludhianwis pour out devotion in shridings
14	Punjab bodybuilders' team in nationals	<a href="http://timesofindia.indiatimes.com/city/ludhiana/Punjab-bodybuilders-team-in-nationals/articleshow/11956811.cms">http://timesofindia.indiatimes.com/city/ludhiana/Punjab-bodybuilders-team-in-nationals/articleshow/11956811.cms</a>	Punjab bodybuilders' team in nationals
15	Mobile enthusiasts come together for MoMo	<a href="http://timesofindia.indiatimes.com/city/ludhiana/Mobile-enthusiasts-come-together-for-MoMo/articleshow/11956795.cms">http://timesofindia.indiatimes.com/city/ludhiana/Mobile-enthusiasts-come-together-for-MoMo/articleshow/11956795.cms</a>	Mobile enthusiasts come together for MoMo
16	Amamath's Punjabi beats enthrall all	<a href="http://timesofindia.indiatimes.com/city/ludhiana/Amamaths-Punjabi-beats-enthrall-all/articleshow/11956786.cms">http://timesofindia.indiatimes.com/city/ludhiana/Amamaths-Punjabi-beats-enthrall-all/articleshow/11956786.cms</a>	Amamath's Punjabi beats enthrall all
17	64-yr-old killed in road accident	<a href="http://timesofindia.indiatimes.com/city/ludhiana/64-yr-old-killed-in-road-accident/articleshow/11956779.cms">http://timesofindia.indiatimes.com/city/ludhiana/64-yr-old-killed-in-road-accident/articleshow/11956779.cms</a>	64-yr-old killed in road accident
18	Pirated DVDs seized, 2 held	<a href="http://timesofindia.indiatimes.com/city/ludhiana/Pirated-DVDs-seized-2-held/articleshow/11956766.cms">http://timesofindia.indiatimes.com/city/ludhiana/Pirated-DVDs-seized-2-held/articleshow/11956766.cms</a>	Pirated DVDs seized, 2 held
19	Students do their bit for polio awareness	<a href="http://timesofindia.indiatimes.com/city/ludhiana/Students-do-their-bit-for-polio-awareness/articleshow/11956766.cms">http://timesofindia.indiatimes.com/city/ludhiana/Students-do-their-bit-for-polio-awareness/articleshow/11956766.cms</a>	Students do their bit for polio awareness
20	Near death experience makes Jeevan appreciate life more	<a href="http://timesofindia.indiatimes.com/city/ludhiana/Near-death-experience-makes-Jeevan-appreciate-life-more/articleshow/11956750.cms">http://timesofindia.indiatimes.com/city/ludhiana/Near-death-experience-makes-Jeevan-appreciate-life-more/articleshow/11956750.cms</a>	Near death experience makes Jeevan appreciate life more
21		<a href="http://timesofindia.indiatimes.com/city/ludhiana/Winning-is-no-hurdle-for">http://timesofindia.indiatimes.com/city/ludhiana/Winning-is-no-hurdle-for</a>	

Figure 1 - RSS feed news data in Google spreadsheet

2) A new table is created in Google documents using the import from Google spreadsheet option. The final spreadsheet which contains the location attribute in

addition to other attributes is converted to a fusion table as shown in Figure 2.

Location	Details	Source	Link	Date
Jawahar nagar,ludhiana	तहखाने में छुपि रखी थी नशीली दवाइया	<a href="http://www.bhaskar.com/article/PUN-LUD-had-hidden-in-the-basement-2751626.html">http://www.bhaskar.com/article/PUN-LUD-had-hidden-in-the-basement-2751626.html</a>	<a href="http://www.bhaskar.com/article/PUN-LUD-had-hidden-in-the-basement-2751626.html">http://www.bhaskar.com/article/PUN-LUD-had-hidden-in-the-basement-2751626.html</a>	16/01/2012
Civil Hospital,ludhiana	महिली की मौत, भडके परजिनो ने काया हंगामा	<a href="http://www.bhaskar.com/article/PUN-LUD-womans-death-has-sparked-2754951.html">http://www.bhaskar.com/article/PUN-LUD-womans-death-has-sparked-2754951.html</a>	<a href="http://www.bhaskar.com/article/PUN-LUD-womans-death-has-sparked-2754951.html">http://www.bhaskar.com/article/PUN-LUD-womans-death-has-sparked-2754951.html</a>	16/01/2012
Basti Jodhewal,ludhiana	वभिन्नि क्शेत्रो से शराब सहति 3 पकडे	<a href="http://www.bhaskar.com/article/PUN-LUD-cars-doi-is-now-wine-2744303.html">http://www.bhaskar.com/article/PUN-LUD-cars-doi-is-now-wine-2744303.html</a>	<a href="http://www.bhaskar.com/article/PUN-LUD-cars-doi-is-now-wine-2744303.html">http://www.bhaskar.com/article/PUN-LUD-cars-doi-is-now-wine-2744303.html</a>	13/01/2012
Jawahar nagar,ludhiana	वभिन्नि क्शेत्रो से शराब सहति 3 पकडे	<a href="http://www.bhaskar.com/article/PUN-LUD-cars-doi-is-now-wine-2744303.html">http://www.bhaskar.com/article/PUN-LUD-cars-doi-is-now-wine-2744303.html</a>	<a href="http://www.bhaskar.com/article/PUN-LUD-cars-doi-is-now-wine-2744303.html">http://www.bhaskar.com/article/PUN-LUD-cars-doi-is-now-wine-2744303.html</a>	13/01/2012
MBD Neopolis,ludhiana	शोरूम कर्मचारी को घायल कर सड्डे पांच लाख लूटे	<a href="http://www.bhaskar.com/article/PUN-LUD-showroom-worker-robbed-and-injured-five-and-a-half-million-2732564.html">http://www.bhaskar.com/article/PUN-LUD-showroom-worker-robbed-and-injured-five-and-a-half-million-2732564.html</a>	<a href="http://www.bhaskar.com/article/PUN-LUD-showroom-worker-robbed-and-injured-five-and-a-half-million-2732564.html">http://www.bhaskar.com/article/PUN-LUD-showroom-worker-robbed-and-injured-five-and-a-half-million-2732564.html</a>	10/01/2012
Ghumar Mandi,ludhiana	आईएस की पत्नी का परस छीन फरार हुए झपटमार	<a href="http://www.bhaskar.com/article/PUN-LUD-iass-wifes-purse-was-2725606.html">http://www.bhaskar.com/article/PUN-LUD-iass-wifes-purse-was-2725606.html</a>	<a href="http://www.bhaskar.com/article/PUN-LUD-iass-wifes-purse-was-2725606.html">http://www.bhaskar.com/article/PUN-LUD-iass-wifes-purse-was-2725606.html</a>	08/01/2012

Figure 2 – Data in Google Fusion Table

3) Using the option (visualize as a map) available in the Google fusion tables the table is visualized as a map as shown in Figure 3. One point location is generated automatically for each row in the table. The geocoding is done based on the location attribute in the table. Geocoding is the process to convert the address in text format to point location in the GIS. The location of all the geocoded points is checked. Further, the export to KML (Keyhole Markup Language) option is used to save the generated points on your system.

4) This point layer is generated daily to map the crime in the area of interest.

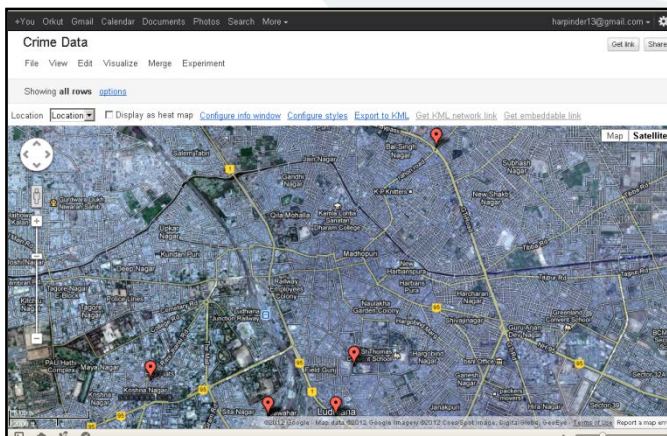


Figure 3 – Google Fusion Table data visualized as a map

## V. RESULTS

It is proposed to build a blog which will have daily, weekly and monthly crime maps which will help to identify crime patterns and clusters. The crime will be categorized into theft, murder, snatching and other classes. The main objective of these maps is to identify crime prone areas. It is also proposed to map ancillary information like location of police stations,

police infrastructure, fire brigade, hospitals, and telecommunication network setups, entry/exit points of the city and other main landmarks of the study area using Google imagery. This collective information can be useful for emergency planning, preparedness, warning, relief and mitigation. Google API's will be used to automate the tasks. Data mining techniques [14] will be used to automatically extract the crime related news from the collected news data and arrange it in the desired format.

An efficient and cost effective decision support system will be created for the administrators. To develop this system no satellite data, application and GIS software is required on the developer's computer only an internet connection is required. The same methodology can be used to map accidents and other events.

The only limitation of this study is that the location of the crime specified in the news is generalized therefore the generated point location is not very accurate and comparable to the point location taken by a GPS.

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