911 Emergency Calls Analysis

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Abstract— **This paper describes the distribution of 911 emergency calls and what effect it has on the local statistics like home values, small business trend, etc. of an area. The project is focused on implementing and deploying a web application which gives a comparative analysis of different types of emergencies along with its frequency distribution on the the globe.**

Keywords— **911 Emergency Analysis, Overview, Emergency Concentration Maps, Trends , Comparisons, Home Values, Small Business, Traffic Incidents, Fake Calls, APIs, HTTP Authentication**

I. Introduction

This document is a final report for Spring 2017 Enterprise Software Platforms as Graduate students under the guidance of Prof. Rakesh Ranjan from the department of Computer Engineering at San Jose State University. He advised us to include the correlation of the small business and home value data with crime in our web application.

The web application aims to analyse the 911 emergency calls data to help Emergency Services to deploy their resources in an efficient and cost-effective way by comparing the various emergencies. Moreover, general public can take advantage of the application to see the local statistics of an area they live in or want to move in or start a business in. The data used is for Montgomery county, Pennsylvania.

The web application is built using Angular JS, Bootstrap, nvd3 and Python Flask. For the client-server communication, Express routing framework is used. On the server side, python3.6 is used to extract and analyse data. All the services are exposed as APIs which are protected using HTTP Basic Authentication. The application is made modular to accommodate new enhanced features.

II. Server Side of Flask AngularJS Web App

The server side of the application includes Data extraction and analysis using Python. The main python libraries used are Pandas, Flask, HTTPBasicAuth, SQLAlchemy. All the services are exposed as RestAPIs and they have been protected using HTTP Basic Auth. The user information is stored in a SQLite Database which is referred for user verification and validation. Exception handling is used to deal with all possible errors and validate and sanitize all the user input data. All the services are provided as APIs. Any number of services can be added or removed from the application without affecting other services. According to the client's input, the data is extracted, consolidated, structured and customized and sent to the client in JavaScript for presentation on the GUI. For instance, the Traffic accident data for every hour of the day for a year is segregated and then displayed on the GUI as a Heat Map which can be analyzed by the user.

III. Client Side of Flask AngularJS Web App

The client side GUI includes Data presentation using AngularJS, Bootstrap, nvd3, Google map API. For user authentication and validation, HTTP Basic Authentication is used. The user is presented with a list of services to choose from. The user is offered drop-downs to select various combination of inputs for a particular service. Various graphical interactive charts are displayed using nvd3 that helps the user to visualise the data more efficiently. The user is prompted with a login page if he wishes to access some secured services.

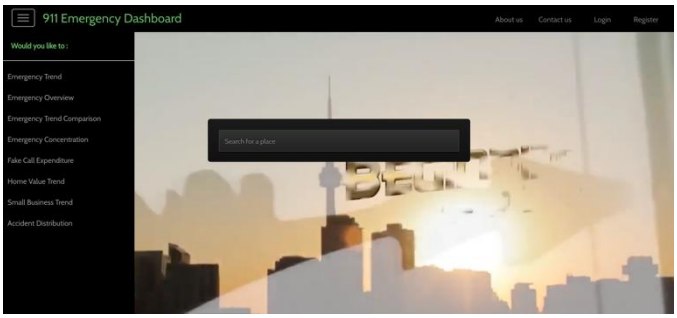

Fig. 1 Home Page and menu of Web Application

IV. Deployment Of Web Application

The application is deployed and hosted on Amazon Web Services (AWS) using Docker. The Virtual machine used is Ubuntu Server 16.04 LTS (HVM). This helps in easy deployment and enhances portability. While development, virtual environment is used as the application works on python3.6 to prevent system dependency. For deployment, the Docker container is used to set the environment for the application. The container used is Ubuntu Xenial 16.04 with Python3.6. The Docker image (manika15/python3.6ubuntu:latest) can be downloaded from Docker hub repository. The application runs using the latest

version of the application in GitHub automatically when built. This helps in easy deployment and maintenance of the application. Application's Public DNS is http://ec2-52-24-147-67.us-west-2.compute.amazonaws.com.

V. Services Offered By The Application

Many services are offered by the application which can be used by Emergency Services and General Public to their advantage. Following are the services offered:

A. *Emergency Overview*

This service provides the overview of the three types of emergencies namely EMS, Fire and Traffic in an area for a particular year. The user is presented with a donut chart consisting of the percentage of each type of emergency. The user can select year in range 2015 to 2017. It was found that the percentage increase of the three emergencies over 3 years is not that significant. But, as compared to the year 2016, the percentage increase increase in EMS in 2017 mid-March is around 2%. On analysing the demography of Montgomery Pennsylvania, it can be predicted that the EMS emergencies may increase further as the old age population (>60 years of age) in the area has increased over the years.

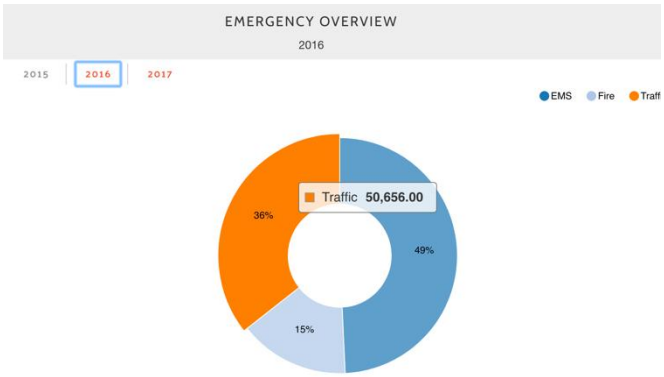

Fig. 2: Emergency Overview for year 2016

B. *Emergency Trend*

This service presents the trend overview of a particular sub-emergency type for any emergency type (EMS, Fire or Traffic) for a particular year. This gives an idea to the Emergency services about the requirement of the resources for that sub-emergency. For instance, the Cardiac Emergency of type EMS is increasing over the months in an year. It gives an overview of its trend for the future months so that the emergency services can be prepared accordingly.

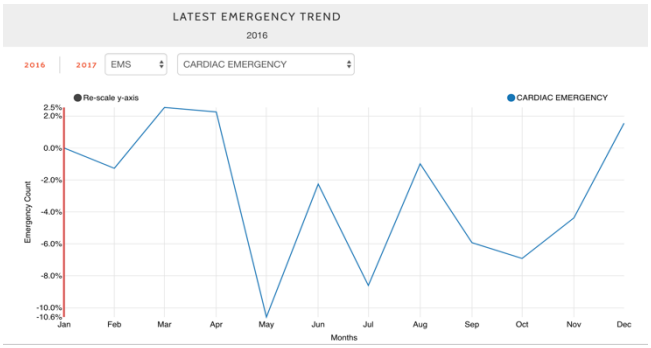

Fig. 3 Emergency Trend Cardiac Emergency (EMS)

C. *Emergency Trend Comparison*

This service compares the trends of two sub-emergency types under one emergency type (EMS, Fire, Traffic). This helps in accessing the number of resources that can be reallocated among them. The sub-emergency showing increasing trend can be allocated more resources and funds. This helps in effective resource allocation and cost reduction. For instance, cardiac emergencies are more frequent than the Bomb Device found emergency. So, resources kept for latter can be used for former. The graph will be similar to emergency trend with two plots.

D. *Emergency concentration*

This service provides the distribution of various emergencies on the Google map. The Google map API is used to plot this. The pink spots show the highest concentration, and blue the lowest. By analysing the distribution, it is found that the maximum number of calls were made from Norristown, PA. This may be due to high Population density in the area.

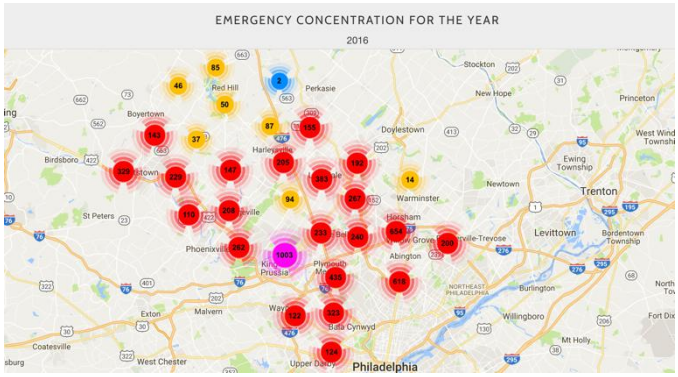

Fig. 4 Emergency Concentration for year 2016

E. *Traffic Accident Distribution*

This service shows the monthly distribution of vehicle accidents for each hour of the day for a year in the form of a Heat Map. This graph helps in visualising the hour of the day when maximum accidents occur. The intensity varies from red to blue, red being the highest.

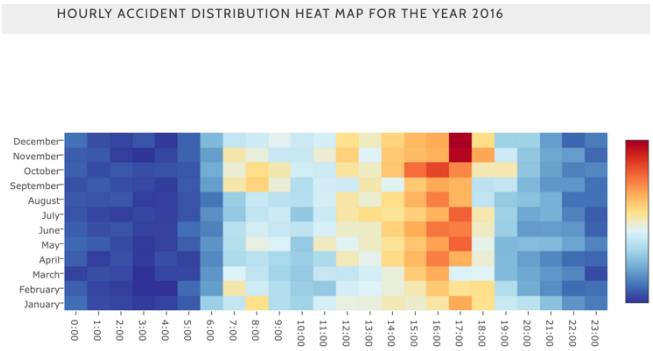

Fig. 5 Accident Distribution for year 2016

By analysing the traffic accidents data, it is found that Norristown is the area with maximum vehicle accidents as it has the maximum population and serves as the junction of several major roads in Philadelphia region which is the industrial hub of Montgomery County. Moreover, it is also the largest multi-modal transportation hub in Montgomery County.

F. *Home Value Trend*

This service provides the trend of Home values in comparison with the trend of the number of emergency calls. It was observed that the percentage increase in home values increased whereas the percentage increase in emergency calls decreased over four years. On further analysis, it was found that the population of Montgomery county increased by a higher percentage and also the industrial sector flourished over the years which led to increase in home values. On analysing the demographics of Montgomery over the years it was found that the working population of the area increased by manifolds un past four years. Also, Montgomery shares it's boundary with Philadelphia, the largest city of Pennsylvania and is the home for twelve Fortune 500 corporations, which attracts home buyers to invest in properties in nearby areas such as Montgomery county thus increasing the demand and in turn the prices.

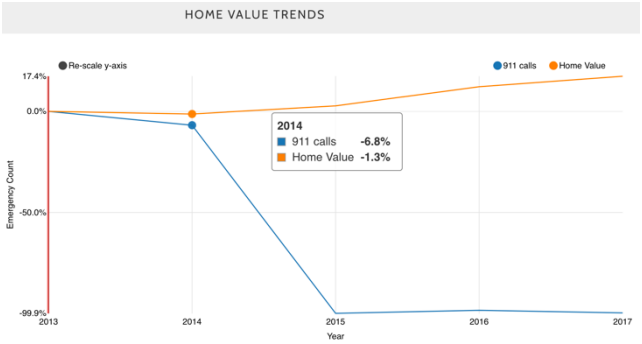

Fig. 6 Home value and emergency calls comparison

G. *Small Business Trend*

This service provides the comparison of small business with the emergency calls. Small business is the one which employs less than 500 employees. According to this, there are four small business categories in Montgomery namely Cleaning and Maintenance, Material Moving, Personal Care and Food and Serving. The analysis shows that over the years Cleaning and Maintenance has decreased but the decrease is not significant. The decrease in Material Moving is significant (11.2%). Moreover, the Personal Care and Food and Serving flourished. The percentage increase in emergency calls decreased over the years. This has a negative correlation with the small business.

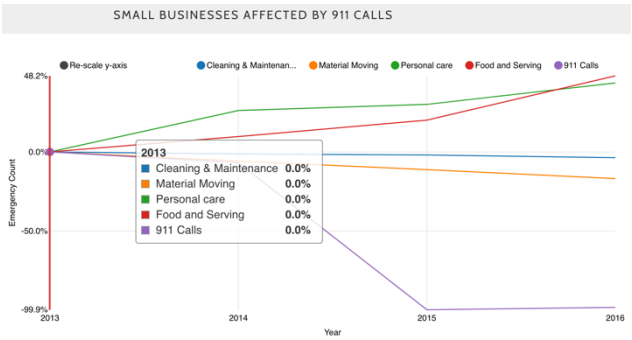

Fig. 7 Small Business vs Emergency Calls

H. *Fake Call Expenditure*

This service provides the comparison between the expenditure done on handling the fake calls and the total expenditure incurred by the Public safety department. The analysis showed that every year around 20-30% of the calls are fake which result in revenue loss. To reduce these fake calls, the government has put fine on the fake calls made. the majority of the fake calls were made because of misdialling, automatic dialling and hang-up calls.

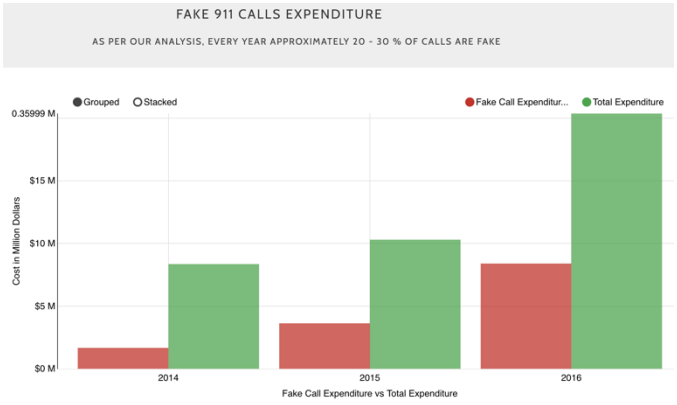

Fig. 8 Fake Call Expenditure

VI. Conclusions

The web application developed provides a single platform for Emergency Services to get the overview of trends and distribution of emergency calls and help them to predict the future resource requirement. Also, it provides the General public with the local statistics and how they are affected by the change in the distribution of emergency calls. This helps them to make crucial decisions.

ACKNOWLEDGMENT

Thanks to Prof. Rakesh Ranjan for his devoted guidance. The clarity of his comments helped us to make the web application more useful so that it can be used not just by emergency services but also general public.

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