DWIT COLLEGE

DEERWALK INSTITUTE OF TECHNOLOGY

EARTHQUAKE ANALYZER

A MINI PROJECT REPORT

Submitted to

Department of Computer Science

DWIT College

Submitted by

Nischal Badal

26 April, 2019

DWIT College

DEERWALK INSTITUTE OF TECHNOLOGY

Supervisor's Recommendation

I hereby recommend that this project prepared under my supervision by NISCHAL BADAL entitled **"EARTHQUAKE ANALYZER"** in partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Information Technology be processed for the evaluation.

……

Amrita Rai

Associate Project Manager

Deerwalk Services Pvt. Ltd.

DWIT College

DEERWALK INSTITUTE OF TECHNOLOGY

Student's Declaration

I hereby declare that I am the only author of this work and that no sources other than that listed here have been used in this work.

……

Nischal Badal

26 April, 2019

DWIT College

DEERWALK INSTITUTE OF TECHNOLOGY

LETTER OF APPROVAL

This is to certify that this project prepared by NISCHAL BADAL entitled **"EARTHQUAKE ANALYZER"** in partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Information Technology has been well studied. In our opinion it is satisfactory in the scope and quality as a project for the required degree.

……	……..
[Supervisor]	[Examiner]

ACKNOWLEDGEMENT

I would like to express my deepest appreciation to all those who provided me the possibility to complete this project. A special gratitude I give to our project supervisor, Ms Amrita Rai, whose contribution in stimulating suggestions and encouragement, helped me to coordinate my project and also in writing this report.

Furthermore I would also like to acknowledge with much appreciation the crucial role of Mr Sunil Chaudhary, who gave the permission to use all required equipment and the necessary materials to complete the task "Earthquake Analyzer".I have to appreciate the guidance given by other supervisor as well as the panels especially in our project presentation that has improved our presentation skills thanks to their comment and advises.

Nischal Badal
Roll no:- 631
26 April 2019

ABSTRACT

This project is based on research and representation of damages caused by earthquake 2015. It is a web application that analyze the occurrence of earthquake (precisely in 2015) through epicenters, damage patterns and resources. The information is represented through map of Nepal through API available from mapbox. The project helps in quick retrieval of earthquake patterns and damages represented in map of Nepal through different factors as magnitude, location and scaled through infographics. Data is one of the major player in this project and data are accessed through Open Data Portal as well as Seismology Nepal websites. This project aims to provide an open web application and open data to researchers and general people who want to study about the earthquake occurred in 2015.

Keywords: research, *representation, mapbox, infographics, data;*

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LIST OF ABBREVATIONS

CSS	Cascading Style Sheet
CSV	Comma Separated Value
DFID	Department for International Development
HTML	Hypertext Markup Language
JS	JavaScript
JSON	JavaScript Object Notation
OSOCC	On-Site Operations Coordination Center

CHAPTER 1: INTRODUCTION

1.1. OVERVIEW

Earthquakes cannot be predicted but we can reduce the damages caused by it. This project is based on visualization of earthquake data (precisely data of 2015) on map and charts. It contains a situation analysis which was done after 10 days of the devastating earthquake occurred in 2015. It also contains statistical data representing the total damages, no of life-losses and injuries. Furthermore, explore section is built in which variation of earthquakes in 2015 is represented in map of Nepal and charts based on different choices. The Data is the main part of this project and they are collected from the official website of Seismology Nepal.

1.2. BACKGROUND AND MOTIVATION

After the devastating earthquake occurred on 25 April 2015, many research took place to calculate the number of deaths and damages. The earthquake was studied on the basis of different parameters as epicenters, magnitudes, latitude, longitude, time. There is no specific application which provides downloadable data and visualize them building charts and maps. Open Data Portal was a research carried out by DFID's Evidence for Development Program implemented by The Asia Foundation and Development Initiatives. The data was collected between Jan 2016 and May 2016. This project was inspired by Open Data Portal by setting up an objective to build similar application with prior focus on dynamic visualization techniques.

1.3. PROBLEM STATEMENT

Nepal is a country facing frequent aftershocks. We are at high risk of them. As discussed earlier, earthquakes cannot be predicted but we can be aware of them. We face a lot of earthquakes at narrow time intervals. The main problem statement behind this project was to build a platform to analyze the occurrence and variations of earthquake. This project is build on 2015 earthquake data and it can be extended to build of most recent ones. It is a prototype for creating a web-based platform to represent data through infographics for quick retrieval of information and analysis procedures.

1.4. OBJECTIVE

The main objective of this project is to learn data visualization techniques. There are many ways to create charts and visualize data into geographies. This project is totally dynamic as if we change the data into different formats, the graphs, visualizations and charts all are dynamically changed. Moreover, this project aims to help other researchers to prepare a report on 2015 earthquake by providing them data, charts and visualizations.

1.5. SCOPE

The scope of this project was 2015 earthquake. Displaying them into map by scaling according to their magnitudes, locations and creating infographics as pie-charts, bar graphs, area charts was the main scope. After completion, it would be a complete web-application or information center for all the analysis to be made and information to be collected about the 2015 earthquake occurred in Nepal.

1.6. OUTLINE

To wrap up all the above contents, Earthquake Analyzer is focused on visualization of geographical data with coordinates into map of Nepal, create charts and graphs of the data and demonstrate a complete info-graphical representation of data.

CHAPTER 2: BACKGROUND RESEARCH

2.1. LITERATURE REVIEW

Since it is a research-based project, there were many papers and similar applications published before. Two of them were very useful for the making of this project as one contained the demographics and other contained the situation analysis with actual statistical data.

Open Data Portal (https://opendata.klldev.org/)

Open Data portal was similar application as Earthquake Analyzer was meant to be build. It contains data with household demographics which helps to study different things as Educational attainment, security, migration, earthquake damages, etc. It also represents damages on eleven major earthquake affected districts of 2015. It was supported by DFID's Evidence for Development Program implemented by The Asia Foundation and Development Initiatives. The data was collected between Jan 2016 and May 2016. Earthquake Analyzer was inspired by Open Data Portal review so that the data can be represented properly with epicenters and magnitude. One drawback of Open Data Portal was that it contained some unnecessary demographics which was not related with earthquake concept.

Situation Analysis Nepal Earthquake

(https://reliefweb.int/report/nepal/situation-analysis-nepal-earthquake-15052015)

It was a paper published by OSOCC, which contains the situation of people and places after Earthquake on 25.04.2015. It was the most recent situation analysis which contained statistical demographics of damages and relieves. It is the situation analysis of places after 10 days to the Devastating Earthquake 2015. Also contains the nearby threats as landslides and floods which can cause surplus damages to the victims. This paper explained in-depth about the life-losses, injuries and expected disasters which were making their way to Nepal. It was an appeal to the social-welfare organizations to work on the relief and restoration of earthquake affected places and to provide funding for their treatment and living.

Seismology Nepal (http://seismonepal.gov.np)

This is the official website for all the earthquakes occurred in Nepal. It contained Microseismic monitoring, which is a very fast and efficient tool to understand the seismotectonics of the region. It is an instrument for seismic surveillance allowing a fast post earthquake rescue operation. For regional and global earthquake location and related seismological studies it provides a valuable database. Moreover, all the data used in the project was obtained form this website and the concept of visualization was also chosen form them.

2.2. CURRENT SYSTEM

The similar system with Earthquake Analyzer is Open Data Portal. It is bigger version of this project as the data used in it is big and is of multiple dimension which helps in better analysis and visualization.

2.3. THE PROBLEM WITH CURRENT SYSTEM

The current system only displays information across one region rather than pointing out the exact earthquake epicenter marker. It displayed the range of damages and restoration info graphics. The occurrence of earthquake was not displayed on the current system which Earthquake Analyzer visualizes on the basis of multiple criteria.

CHAPTER 3: SPECIFICATION AND DESIGN

3.1. REQUIREMENT ELICITATION AND ANALYSIS

The basic requirements of this application is a browser and internet connection. It is build on JavaScript and web-designing languages. It is a clean web application which doesn't display any other contents rather than data visualization and charts. This web-application contains data of precisely earthquakes that occurred between 2015 January to 2015 December. Search for recent earthquakes is not supported by this project. As stated earlier, this project depends upon data. If we can append the data with latest earthquake records, that option can be made available.

3.1.1. Functional Requirement

Functional requirements of Earthquake Analyzer can be:

- The User should open the web application and browse through available criteria
- The system should display the map of Nepal with different markers
- The main user should click on display charts to view the charts
- The user should be explore the data on the basis of different parameters
- The user should be able to understand the infographics and draw conclusions out of them

3.1.2. Non-Functional Requirement

Similarly, some of the Non-functional requirements are:

- The data must be in CSV or JSON format to represent them
- The format of data must be in correct order as it is places
- The connection and service must be reliable
- The browser must enable js to run this web-application

3.2. SYSTEM DESIGN

The design of this system was easy compared to other system. This project did not contain any databases so diagrams like ER, Relational can be omitted. The system was designed using web markup languages and the processing and visualizations was done using JavaScript.

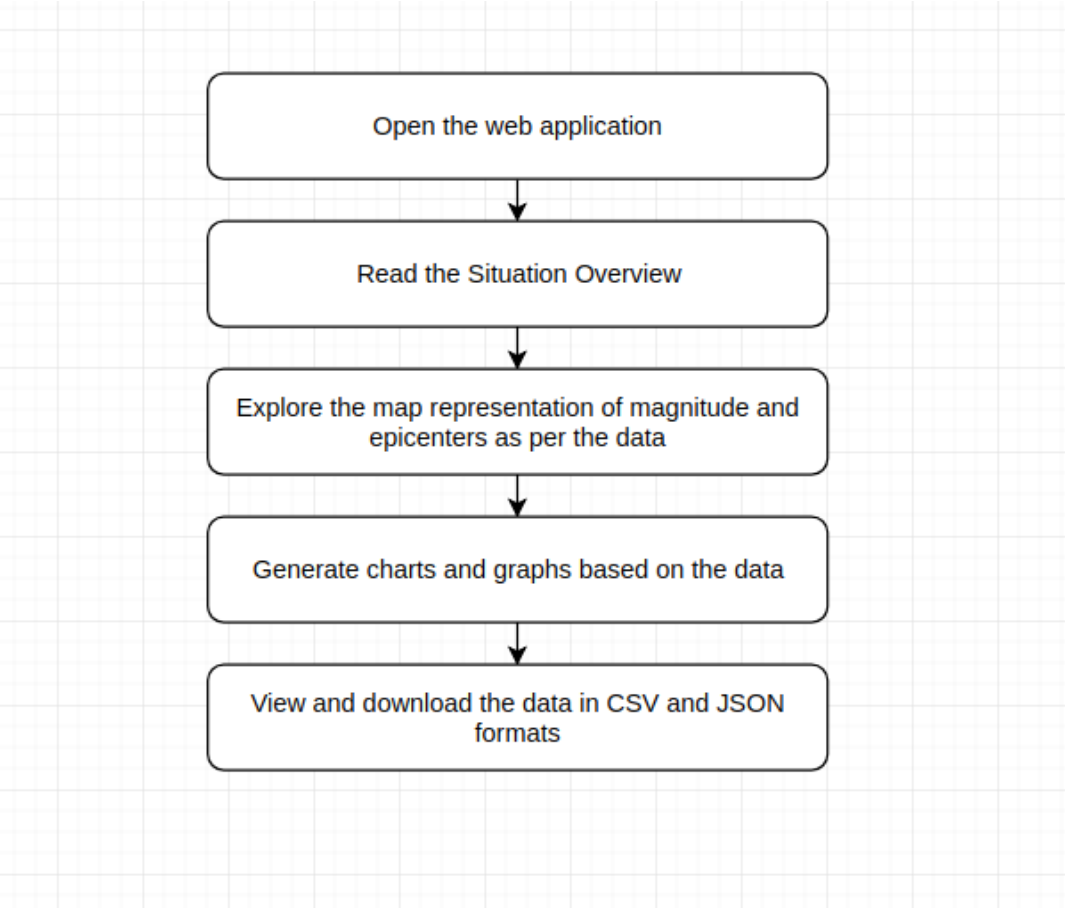


Figure 1: Workflow diagram of Earthquake Analyzer

There is a situation overview placed on the beginning of the application which was cited from the paper published by OSOCC, which contains the situation of people and places. User can read the overview and jump into map navigation and chart navigation selecting the criterias. Further data are displayed in the table format which can also be downloaded in CSV and JSON formats. This is a basic workflow of the system.

3.3.1. Use Case Diagram

There are two actors involved in the Earthquake Analyzer. The user has access to open the application, navigate between the map visualizations and view charts as well as data. And the developer or the person behind the system can update or delete the data used in the application and change the visualizations for the users.

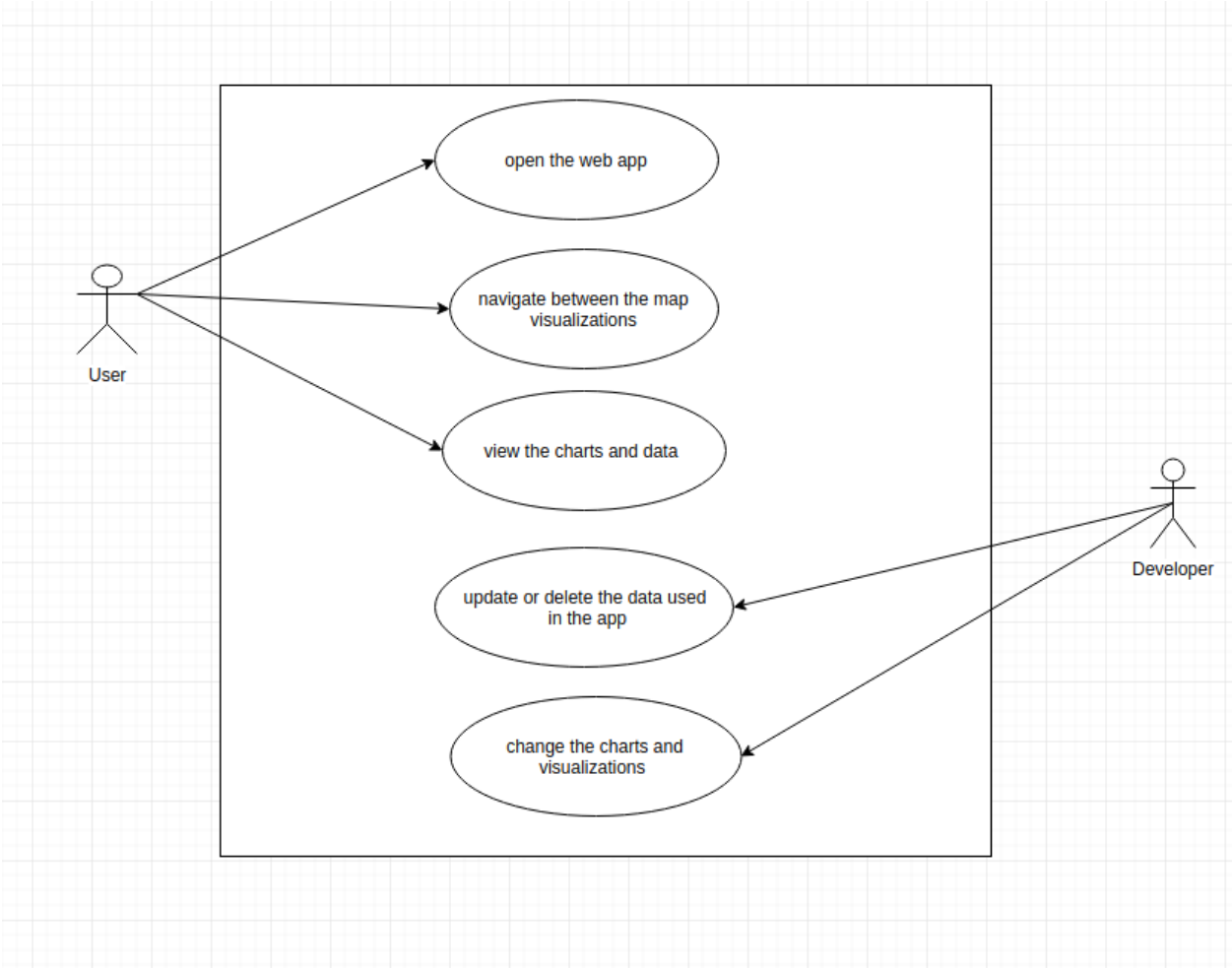


Figure 2: Use-Case Diagram of Earthquake Analyzer

CHAPTER 4: IMPLEMENTATION AND EVALUATION

4.1. TOOL AND TECHNOLOGY

The tools and technologies used in this project along with their explanations are listed below:

- Mapbox API for displaying map of a fixed coordinate with certain zoom level
- p5.js for plotting data into map
- map vectors to scale the locations on map according to magnitudes
- JSON implementations to link map-vector to the HTML file
- chartJS to create charts based on CSV and JSON files
- HTML, CSS to design the outline of the webpage
- jQuery to list the data into table format

4.2. IMPLEMENTATION

The implementation of this project had all to deal with visualizations. Mapbox provided API to insert map into your web-application. Creating the map was simple but projection and locating the points with coordinates was a challenging task. Map projection needs to be done which was done by Web Mercator. It added some mathematics to the application. Mapbox allowed to create map vectors which helped in easier location of data into the map. It was published as an URL and we can simply link that to our application. That helped in locating points to the map using two criteria as magnitude and location which was one third of the task of the project.

The next challenge was to create pie-chart, bar diagram and other related diagrams dynamically from the CSV file. One major problem faced was because of the length of data and attributes which were to be chosen for the graphs. It resulted in vague and unsettled graphs through which retrieval of information was very difficult. This resulted in changing of the file format from CSV to JSON. ChartJS created an area-diagram with Magnitude vs Time which represented the magnitude variation with time in a chart. The next pie-chart and point-diagram was based on magnitude frequency variation which was done by sorting out magnitudes and creating a different file.

Since this is a data-based project, data plays a major role in it. If we change the data, the map and charts are updated with the latest data. The data selection was done carefully omitting the unnecessary data so that the visualization is more clarified.

4.3. EVALUATION AND RESULT

The web-application was intended to show navigation through geographies and it was made so. Hover option on magnitude could have been more detailed about the application. It only shows big circles and small circles. The charts option was same as it was intended and more charts can be added by the developer. The main purpose of this project was to make decisions and conclusions about the 2015 earthquake. One analysis that can be made from Earthquake Analyzer could be that the occurrence of earthquake in 2015 was focused on 14 districts of Nepal , namely Gorkha, Kavrepalanchok, Dhading, Nuwakot, Rasuwa, Sindupalchok, Dolakha, Ramechhap, Okhaldunga, Makwanpur, Sindhuli, Kathmandu, Bhaktapur and Lalitpur. Similarly, the highest magnitude was measured to be 7.6 Richter scale. On 10 May, an additional nine affected districts were added by the government; Tanahu, Kaski, Nawalparasi, Chitwan, Syangja, Parsa, Lamjung, Palpa and Parbat.

CHAPTER 5: CONCLUSION

Earthquake Analyzer is a data visualization and representation project which maps the data of 2015 earthquake on map and charts with the help of different infographics. The main aim of the project was to provide a platform to users who are searching for quick retrieval of information about all the earthquakes that occurred within 2015 in Nepal. This was successfully completed using different methodologies. Moreover, learning data visualizations and dynamic charts was the main learning motto of this project which was successfully accomplished.

Browsing through the Earthquake Analyzer, one can have a quick visualization and can extract information through them. It can be used by others to apply other visualizations as well. We are in a country where we face different earthquake shocks frequently. After one big shock there are subsequent after shocks of minor magnitudes that is shown in the project. As we can see in 2015 Nepal received a total of 485 earthquake shocks and 7.6 was maximum among them while most frequent was 4 Richter scale counting total of 100 shocks. Similar to this other many information can be extracted from the project.

CHAPTER 6: LIMITATION

There are certain limitations of this project that could have been made better. One major limitation is that it is based only on 2015. But it is dynamic representation so that if data is appended, the visualizations are changed. Other limitations can be that there are limited number of map variations and charts. Because of the various attributes in data which do not have interrelation, formation of charts have been limited. More charts can be made from the same data. The Hover option is also not available but the data is listed in tabular format from where we can search the respective data.

REFERENCES

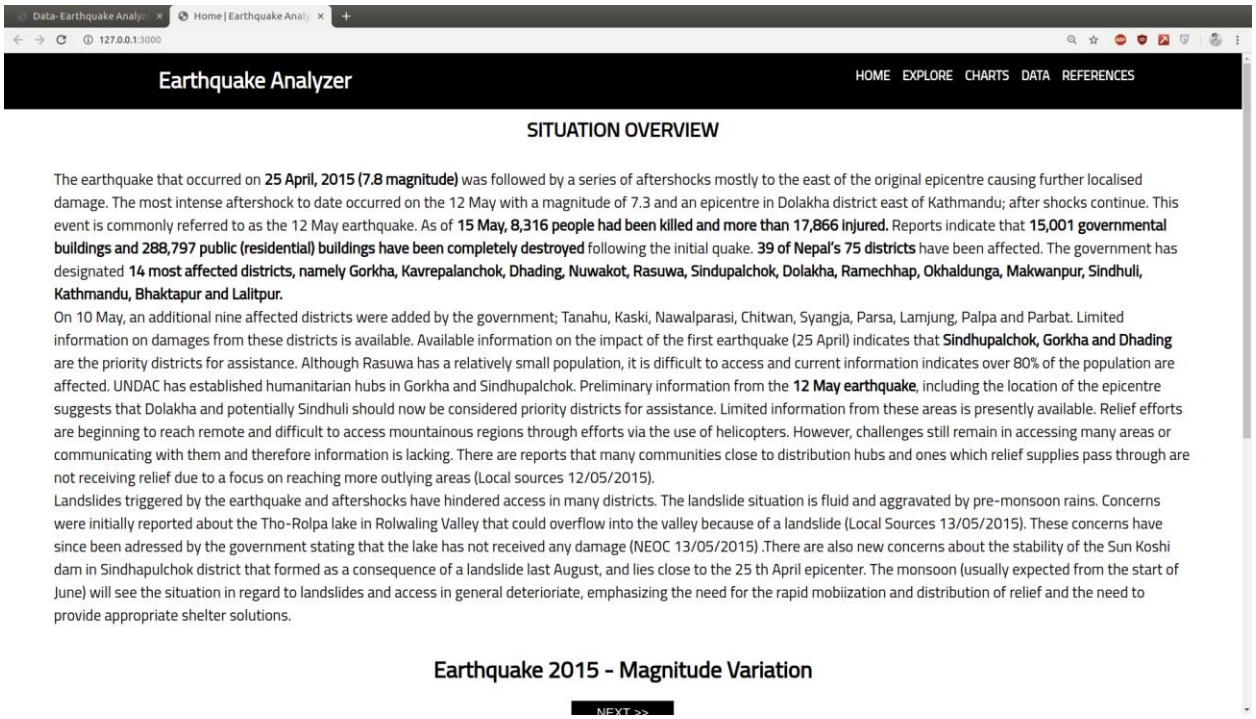
[1] “Earthquake data.” [Online]. Available: http://seismonepal.gov.np/earthquakes.

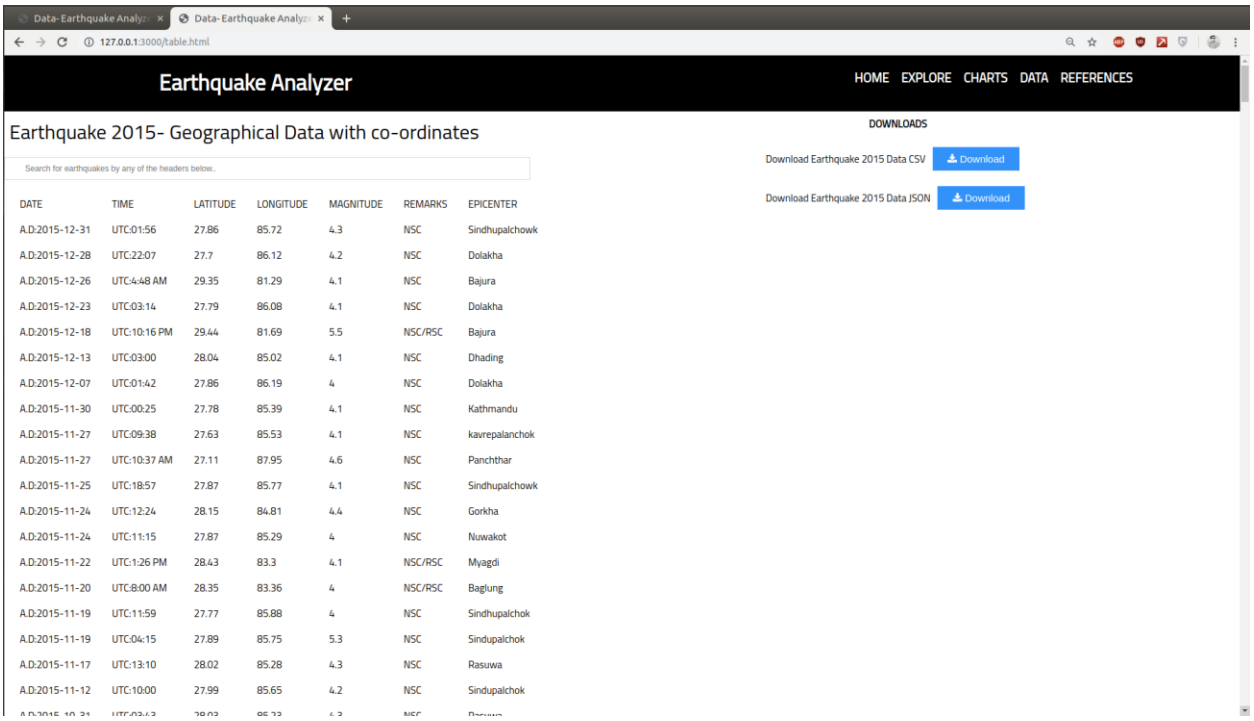
[2]D. Shiffman, *Earthquake Visualization p5.js*. https://www.youtube.com/watch?v=ZiYdOwOrGyc: The Coding Train, 2019.

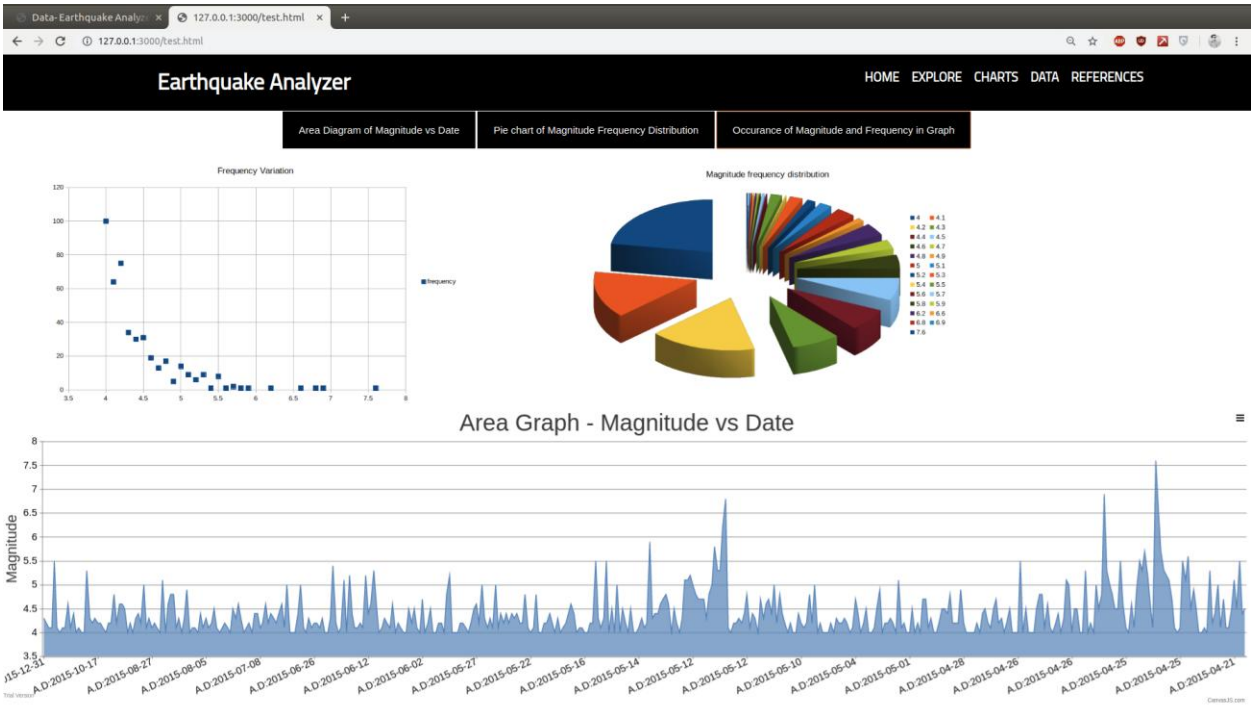
[3]"Chart.js ·Chart.js documentation", *Chartjs.org*, 2019. [Online]. Available: https://www.chartjs.org/docs/latest/.

[4]"Situation Analysis Nepal Earthquake, 15.05.2015 - Nepal", *ReliefWeb*, 2019. [Online]. Available: https://reliefweb.int/report/nepal/situation-analysis-nepal-earthquake-15052015.

APPENDIX I


Earthquake Analyzer
HOME EXPLORE CHARTS DATA REFERENCES
SITUATION OVERVIEW
The earthquake that occurred on 25 April, 2015 (7.8 magnitude) was followed by a series of aftershocks mostly to the east of the original epicentre causing further localised damage. The most intense aftershock to date occurred on the 12 May with a magnitude of 7.3 and an epicentre in Dolakha district east of Kathmandu; after shocks continue. This event is commonly referred to as the 12 May earthquake. As of 15 May, 8,316 people had been killed and more than 17,866 injured. Reports indicate that 15,001 governmental buildings and 288,797 public (residential) buildings have been completely destroyed following the initial quake. 39 of Nepal's 75 districts have been affected. The government has designated 14 most affected districts, namely Gorkha, Kavrepalanchok, Dhading, Nuwakot, Rasuwa, Sindupalchok, Dolakha, Ramechhap, Okhaldunga, Makwanpur, Sindhuli, Kathmandu, Bhaktapur and Lalitpur.
On 10 May, an additional nine affected districts were added by the government; Tanahu, Kaski, Nawalparasi, Chitwan, Syangja, Parsa, Lamjung, Palpa and Parbat. Limited information on damages from these districts is available. Available information on the impact of the first earthquake (25 April) indicates that Sindhupalchok, Gorkha and Dhading are the priority districts for assistance. Although Rasuwa has a relatively small population, it is difficult to access and current information indicates over 80% of the population are affected. UNDAC has established humanitarian hubs in Gorkha and Sindhupalchok. Preliminary information from the 12 May earthquake, including the location of the epicentre suggests that Dolakha and potentially Sindhuli should now be considered priority districts for assistance. Limited information from these areas is presently available. Relief efforts are beginning to reach remote and difficult to access mountainous regions through efforts via the use of helicopters. However, challenges still remain in accessing many areas or communicating with them and therefore information is lacking. There are reports that many communities close to distribution hubs and ones which relief supplies pass through are not receiving relief due to a focus on reaching more outlying areas (Local sources 12/05/2015).
Landslides triggered by the earthquake and aftershocks have hindered access in many districts. The landslide situation is fluid and aggravated by pre-monsoon rains. Concerns were initially reported about the Tho-Rolpa lake in Rolwaling Valley that could overflow into the valley because of a landslide (Local Sources 13/05/2015). These concerns have since been adressed by the government stating that the lake has not received any damage (NEOC 13/05/2015) .There are also new concerns about the stability of the Sun Koshi dam in Sindhapulchok district that formed as a consequence of a landslide last August, and lies close to the 25 th April epicenter. The monsoon (usually expected from the start of June) will see the situation in regard to landslides and access in general deterioriate, emphasizing the need for the rapid mobiization and distribution of relief and the need to provide appropriate shelter solutions.
Earthquake 2015 - Magnitude Variation
NEXT >>


Earthquake Analyzer
HOME EXPLORE CHARTS DATA REFERENCES
Earthquake 2015- Geographical Data with co-ordinates
Search for earthquakes by any of the headers below..
DATE TIME LATITUDE LONGITUDE MAGNITUDE REMARKS EPICENTER
A.D:2015-12-31 UTC:01:56 27.86 85.72 4.3 NSC Sindhupalchowk
A.D:2015-12-28 UTC:22:07 27.7 86.12 4.2 NSC Dolakha
A.D:2015-12-26 UTC:4:48 AM 29.35 81.29 4.1 NSC Bajura
A.D:2015-12-23 UTC:03:14 27.79 86.08 4.1 NSC Dolakha
A.D:2015-12-18 UTC:10:16 PM 29.44 81.69 5.5 NSC/RSC Bajura
A.D:2015-12-13 UTC:03:00 28.04 85.02 4.1 NSC Dhading
A.D:2015-12-07 UTC:01:42 27.86 86.19 4 NSC Dolakha
A.D:2015-11-30 UTC:00:25 27.78 85.39 4.1 NSC Kathmandu
A.D:2015-11-27 UTC:09:38 27.63 85.53 4.1 NSC kavrepalanchok
A.D:2015-11-27 UTC:10:37 AM 27.11 87.95 4.6 NSC Panchthar
A.D:2015-11-25 UTC:18:57 27.87 85.77 4.1 NSC Sindhupalchowk
A.D:2015-11-24 UTC:12:24 28.15 84.81 4.4 NSC Gorkha
A.D:2015-11-24 UTC:11:15 27.87 85.29 4 NSC Nuwakot
A.D:2015-11-22 UTC:1:26 PM 28.43 83.3 4.1 NSC/RSC Myagdi
A.D:2015-11-20 UTC:8:00 AM 28.35 83.36 4 NSC/RSC Baglung
A.D:2015-11-19 UTC:11:59 27.77 85.88 4 NSC Sindhupalchok
A.D:2015-11-19 UTC:04:15 27.89 85.75 5.3 NSC Sindupalchok
A.D:2015-11-17 UTC:13:10 28.02 85.28 4.3 NSC Rasuwa
A.D:2015-11-12 UTC:10:00 27.99 85.65 4.2 NSC Sindupalchok
DOWNLOADS
Download Earthquake 2015 Data CSV Download
Download Earthquake 2015 Data JSON Download


Data- Earthquake Analyz
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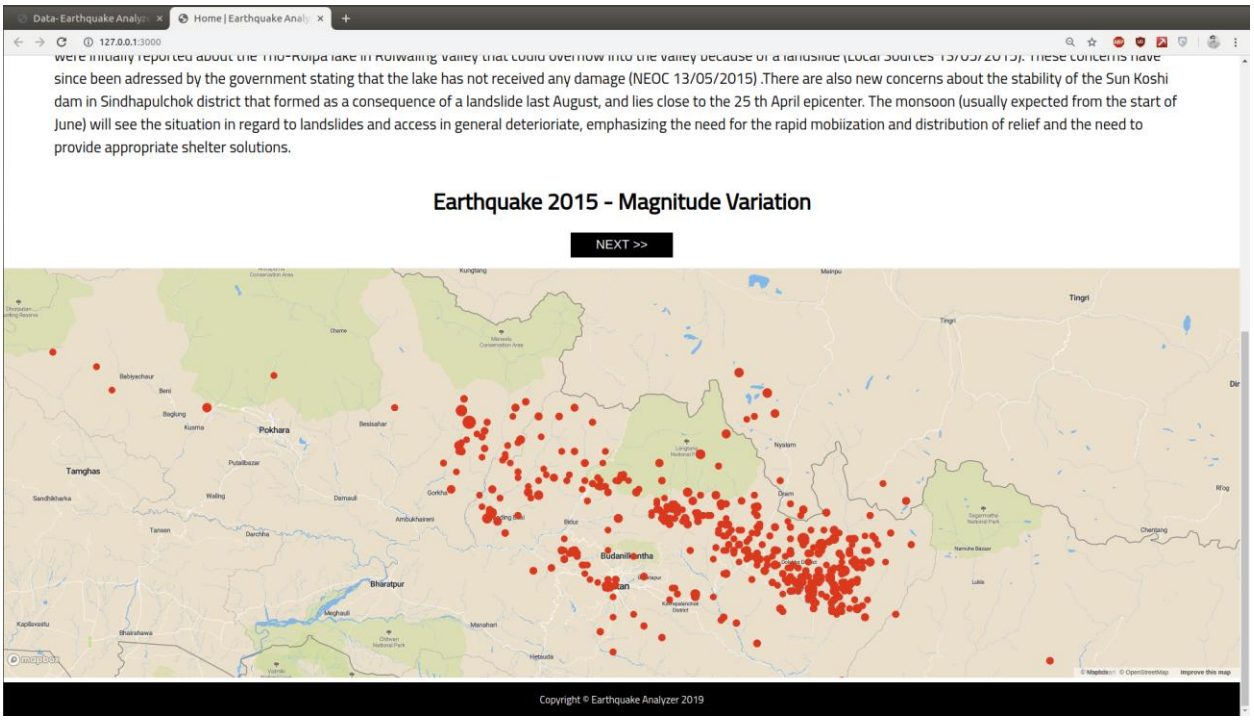
127.0.0.1:3000/test.html
Earthquake Analyzer
HOME EXPLORE CHARTS DATA REFERENCES
Area Diagram of Magnitude vs Date
Pie chart of Magnitude Frequency Distribution
Occurance of Magnitude and Frequency in Graph
Frequency Variation
frequency
Magnitude frequency distribution
Area Graph - Magnitude vs Date
Magnitude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Earthquake 2015 - Magnitude Variation
NEXT >>
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Tamghas
Bhiratpur
Tingri
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