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A Public Cloud-Based CyberFlood Warning as a Service (CyberFlood)

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Abstract: Flooding is one of the most bad natural disasters globally, frequently causing huge loss of life and economic damages to a country. Recent Chennai flooding was the eighth-most expensive natural disaster of 2015. Flood disasters has significant impacts on the development of communities globally. In order to predict and prevent such flood disasters, we propose a Public Cloud-based CyberFlood warning web application, The existing rain forecast systems mainly focus on the analysis and forecast of huge areas but do not provide precise instant alert feedback for respective river areas and sections. this free apps allows the public to freely visualize global and place based maps and time series of climate and remote sensing archives together and their location based study in real-time. This idea of location-based eventful visualization as well as statistical analysis and graphing capabilities can give the public alert messages in smart phones about the possible occurrence of floods at their respective locations. The objective is to provide scientific data on global climate trends by allowing Google map-based queries and summaries, according to the live post. In the proposed system, we develop a web based application that allows the public to freely visualize global and placed based maps and time series of climate archives together in real time. This Project relies on disaster management server, GPS, supported android mobile, Google Maps API, and Google Earth Engine. Google App Engine is linked to Google Earth Engine through the Python API and allows for on demand parallel Cloud Computing.

Keywords: Natural Disaster, Google Map, Flood Disaster Warning, GSM, Android.

1. INTRODUCTION

A flood is the over excessive submergence of land by unusually large amounts of water. Floods are often caused by excessive rainfall which causes rivers and waterways to overfill their normal channels and spread out across the adjacent land. The recent Chennai floods have been the eighth-most expensive natural disaster to have hit the world in November 2015, says UK reinsurance broker Aon Benfield. India is said to have suffered a $3 billion loss to its economy from severe rainfall and flooding in November and early December, the company said in its monthly report on global catastrophes. As per the Wall Street Journal report it states that wildfires in Indonesia in January cost the Southeast Asian economy $14 billion, thus making it the most costly natural disaster of 2015. As far as the recent rain and flood in Tamil Nadu, especially in Chennai, Aon Benfield's. The objective is to provide scientific data on global climate trends by allowing Google map-based queries and summaries, according to the live post. In the proposed system, we develop a web based application that allows the public to freely visualize global and placed based maps and time series of climate archives together in real time. This Project relies on disaster management server ,GPS, supported android mobile, Google Maps API, and Google Earth Engine. Google App Engine is linked to Google Earth Engine through the Python API and allows for on demand parallel cloud computing. This system is also an android platform based smart phone application used to deliver location based services which will help in providing alerts to the users of upcoming disaster if user is in or near to the disaster affected area and provides nearest safe place on map of application. As it delivers both audio and text messages, it is useful for normal as well as blind peoples.

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2. RELATED WORK

Every countries have their own flood forecasting system. However, we don't have a fully firewalled India Cloud. Having a firewalled protected cloud is really important for security purposes. Another is that there are a lot of network users so it automatically leads to network congestion. If network congestion happens, then it will automatically lead to the failure in starting of the service. They don't have a centralized database and also then there are many systems like weather forecasting ,fire alert systems which are not integrated ,Flood forecasting systems owes its failure only to one main reason that is required efforts were not done to integrate the component's and also there were no coordination between the multiple institutions. Now a day's mobile phones play important role for disaster management in many ways: monitoring, communication, evacuation and relief aid. Moreover, the approach of smart phones supporting GSM functions beneficial in disaster management. Short Message Service (SMS) is used to collect the upcoming flood warning and sends to all citizens from the server. But lots of SMS transfer can cause the network congestion which may lead to breaking of the voice call communication through the same network. Make the evacuation process difficult. In order to avoid this, Cell Broadcasting Service is used to directly send messages to the users in a specific area with no network congestion . Still it fails to help in evacuation process which provides information about safe place. GSM alarm device for early disaster warning have been proposed to place those devices in the local police or fire brigade station, which will take warning from weather office and make three different types of warning. Then evacuation process is controlled by the police station or fire brigade station . Though it can avoid network congestion, the GSM alarm is not a faster way for evacuation process. We can integrate the river modeling system into a GSM. All the data related to those rivers would be stored in the cloud. The GIS helps to provide with a map-based data and presentation module, so that user could see the current scenario of the particular area. Flood watch system would allow for the automatic import and export of real time data and can be linked to the existing real time database currently.

Very few researchers worked to provide location based services for disaster management on mobile phones. Early works on lo*c*ation based services have been done for the disaster management which never was able to distinguish between normal people and blind people. So considering this, here we propose a location based early warning and evacuation system. This system would be able to estimate any impending disasters, circulating understandable visual and audio warnings that would be useful to both normal and blind people, thereby providing evacuation guidance in response to the warnings.

3. CLOUD-BASED CYBERFLOOD WARNING AS A SERVICE

A. Background

Faster communication is one of the most important things that has to be there in times of disaster. Nowadays with the advent of the technology, much if the telecom services have been of no use when it is needed the most. At the time when it is needed the most, the systems is not able to be used due to lots of network traffic.. Failure to load due to network traffic has led to a lot of unwanted causalities..With the increasing network epidemics, one need to look beyond the those telecom services. to create these components, incorporating Internet is the best thing that have happened in today's world. However if it does not have security, a cyber attack can plague the country anytime. So in order to avoid that cloud computing services can be availed for all types of internet related work.

B. Proposed System

User can register on C2DM server. After registering on the server, application receives a registration id which is stored in Disaster Management Server. Then the device, user can get automatic updates from C2DM server if there are updates about any impending /forthcoming floods. Basically C2DM is a Google

server which helps in taking messages from the weather-monitoring system. This service is such a light-weight mechanism that will not put much pressure on server or the internet service in loading or sending the messages .However, it can be made to transmit just like emergency messages are sent.

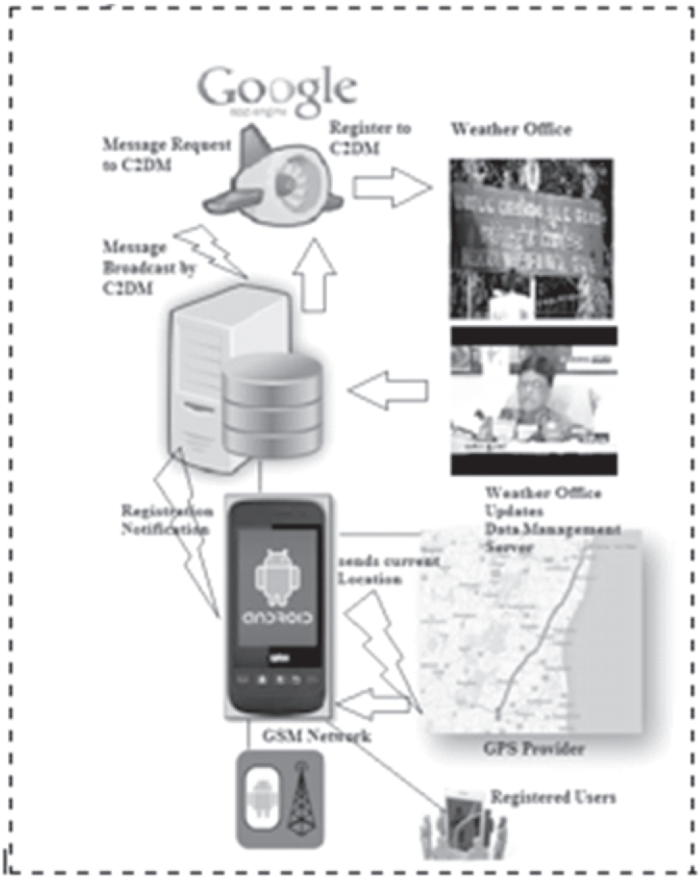

Figure 3.1: Proposed public cloud based cyber-flood warning as a service

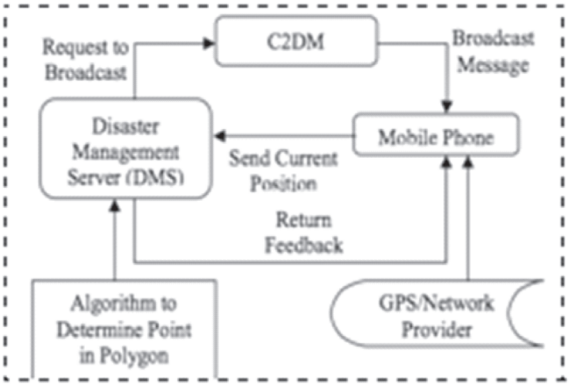

Figure 3.2: Communication with Disaster Management Server

4. RAY-COSTING AND WINDING NUMBER ALGORITHM

The disaster management system server runs a Ray casting algorithm in order to determine the area which could have been probably been affected by flood related distaters. The Ray casting algorithm is the one of the most efficient algorithm in the PIP alogrithms. However it has still its own limitations.

So in order to surpass those limitations we would recommend the use of Winding number algorithm technique along with the usage of Ray casting algorithm to serve the purpose. In winding number algorithm,

if the number is zero then the point lies inside the polygon. It's computation part involves the technique of summing up the angles subtended by sides of the polygon. This involves the inclusion of inverse trigonometric functions but inclusion of these functions would only slow down the algorithm. However there is no need to include since it ranges from 0 to 2 pi.

Hence it is enough to track through the quadrants the polygon winds. One of the flaws of the Ray casting algorithm is that it results into floating point error. While the winding number algorithm its more accurate when all the points are really very close to a polygon line. If the user is in the region affected by the disaster, then the application will start another service that will help in sending the coordinates of the location to the authorites. Once the location is identified, it sends the data to the disaster management server to keep the track of the evacuation process. Once the victim is successfully rescued, the service will automatically get closed and its details will be stored in the real time database.

The Pseudo code for winding number algorithm:

```
Count=0
For each side in polygon:
If count=0
Then point_outside
Else
Point_inside
```

The Pseudo code for ray casting algorithm is :

```
Count=0
For each side in polygon
If ray_intersects_segment(P,side)
Then
Count=count+1;
If point is on the an horizontal polygon boundary
Then
Return boundary
Then
If is_odd (count)then
Return inside
Else
Return outside
```

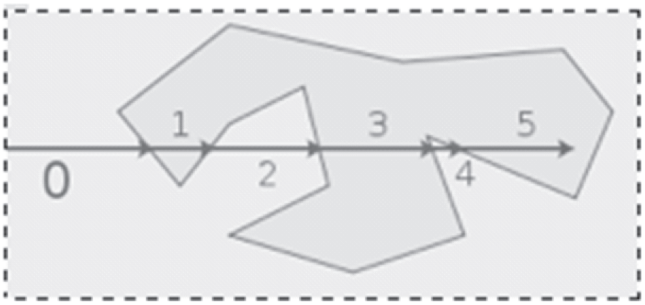

Figure 4.1: Point in polygon for finding if a person is inside a disaster area

One has to compare each side of the polygon to the Y (vertical) coordinate of the test point, and now compile a list of nodes, where each node is said to be a point where one side crosses the Y threshold of the supposed test point. In this ,the eight sides of the polygon crosses the Y threshold, while the other six sides is not able to do so. If N is said to be odd number of nodes on every side of the test point, then it is inside the polygon else it is outside the polygon

GPS based distance formula: This makes use of the Haversine formula in order to calculate the great circle distance between two points of the circle. For any two points on a sphere, the haversine of the central angle between them is given by:

$$\mathbf{hav} = \mathbf{hav}(\phi_2 - \phi_1) + \mathbf{cos}(\phi_1)\,\mathbf{cos}(\phi_2)\,\mathbf{hav}(\lambda_2 - \lambda_1)$$

Where hav is the haversine function:

d is the distance of the person in the disaster area(along a great circle of the sphere; see spherical distance), *r* is the radius (sphere), φ_1, φ_2: latitude (point 1) and latitude(point 2), λ_1, λ_2: longitude(point 1) and longitude (point 2). The left side of the polygon equals sign d/r is the central angle, which assumes that angles are always measured in radians

5. SYSTEM IMPLEMENTATION

1. **C2DM:** This Google Cloud Messaging Service registers the user for sending the intimations for the user. Once the user is able to register on the server, the user device is then added to the server's database. In order to send any messages to the device, the server has to create the message and then it sends to the Google Cloud which forwards it to devices which have been registered with the server database.
2. **Location Tracking of Victim:** System when it gets initialized, it starts to detect the current position of the mobile which is being used by the user & hence it fetches the latitude of that location and longitude by the use of android phone's GPS Device. Device then starts to connect to Google map in order to get the location name from it's current position.
3. **Flood Warning:** The Server is able to send Flood warning through Google cloud server to registered users . Server needs to have a connection established with Google cloud server and messages are push type of messages.
4. **Define Evacuation Points in the City:** Whenever a Flood warning has been declared ; the admin should define areas meant for evacuation purposes in the city. People will be able to get the evacuation area listed on their phone and nearest area from the current places available will get highlighted.
5. **Victim Notification:** Whenever there is a flood disaster, user will be able to get the notification about the flood disasters. Notification will b*e* consisting of details of disaster an*d* evacuation areas. User then gets to click on each area and will be able to view the roadmap on Google map.
6. **Location Tracking of Victim:** Determines victim's device location in GPS/NON-GPS devices and reports to admin via server application.

A disaster victim can access the victim page. This page has aid request, emergency details, and missing person options. The Aid Request options page has three choices of food, clothing, and water. When an individual clicks one of the options, he is shown the closest help organizations giving that kind of aid. It also depicts the organization's name, measure of aid goods available, and location. At that point the victim picks the closest help organization and the application takes his coordinates and needs and sends it to the central database. Here data will represent the victim's location, mobile number, and the sort of aid requested. The emergency details option demonstrates five choices like home, emergency vehicle, medicine, medical

team, or civil service. At the point when people choose this option, the application takes the current location and need and stores it in a central database. Here data will represent the victim's location, mobile number, and the type of aid needed. Missing individual alternatives give a user a missing form to report a missing person, and this data is spared to a central server database.

Figure 5.1. Proposed diagram for victim interaction

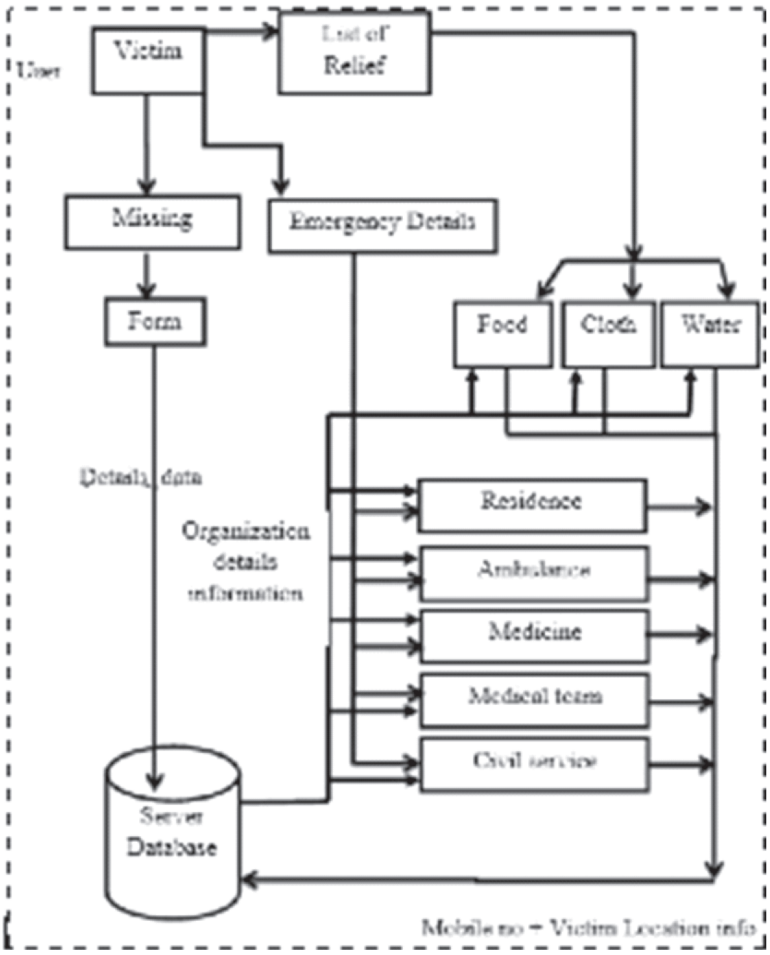

Figure 5.1: Proposed diagram for victim interaction

6. CHENNAI FLOOD FORECASTS ANALYSIS REPORT

In Chennai, the floods happened due to clogging and insufficient no. of drainage pip*es* available. Also then, a lot of land has been claimed by destroying natural swamps. As a result, it led to flood. However since we all know that rivers does not have any fixed trajectory of flowing in a constant direction. The present forecasting systems should take care of such intricate details and should work upon it in order to avert any such flood in future. Also then meterological and hydrological department should work together. This will allow to convert the information on rainfall, hydrological status of the soil moisture and snow cover into a forecast of amount of water the river may discharge and then it will them anticipate as to what secondary effects it can lead to. Further then, it takes weeks for the waves of the flood to be formed. So this gives us ample amount of time to prepare a response for an impending flood. So an hydrodynamic flood routing model can be used which allows visualization via GIS of the forthcoming inundation in downstream cross-sections This will lead to an increase in forecast accuracy and also providing them with sufficient time to provide a useful warning. There is an important difference between flood alerts and flood warnings. The latter have much shorter lead times that must be accurate to maintain public confidence.

Figure 6.1: Flood disaster affected area in Chennai along with specific warning

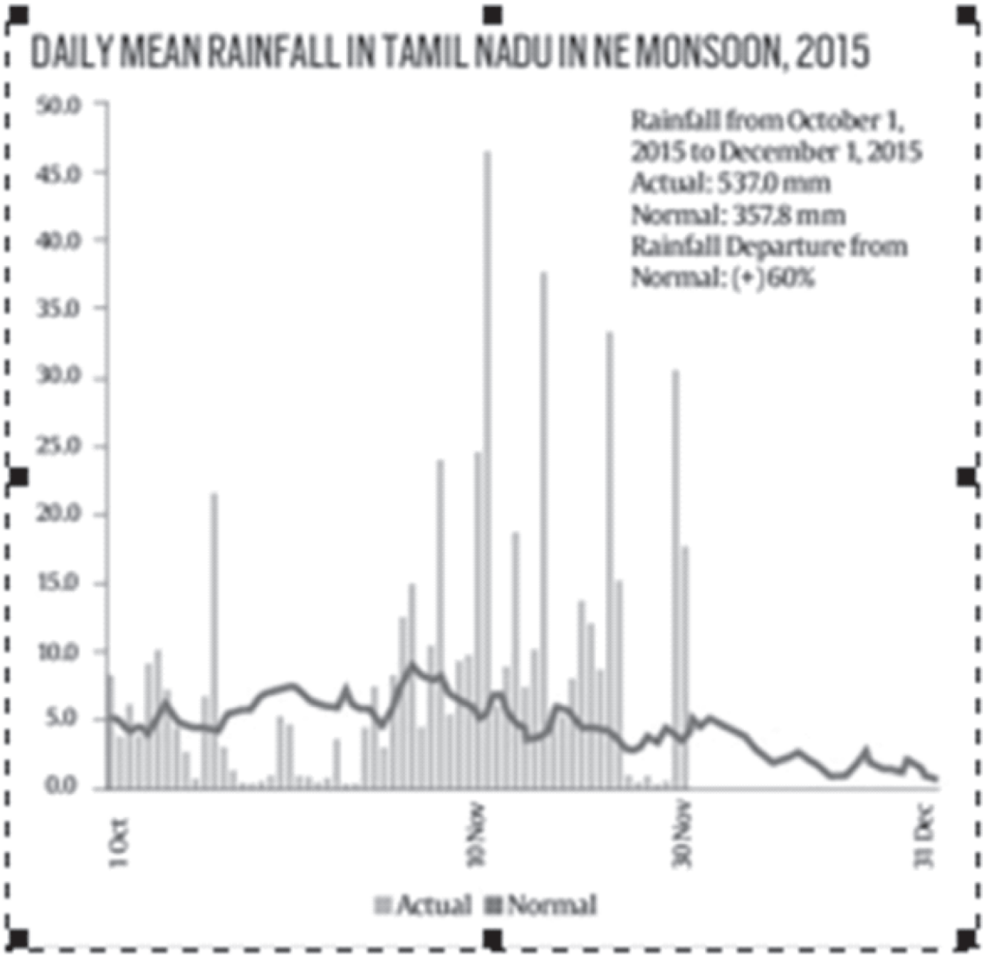

Figure 6.2: Daily Mean Rainfall in Tamilnadu 2015

7. CONCLUSION

Floods are one of those disaster that fall under two categories that is natural as well as man made Chennai floods is one of the example caused due to negligence of mankind .Our public cloud based cyber flood warning as a Service is a phone application that's employs the use of Google C2DM server, Disaster Management Server. If the user is in the probable disaster affected area considering the user's current location. It will help both the normal and blind people to go the safe area just before the disaster strikes. This application will also be able facilitate the authorities to track the progress of the evacuation so that they can take any immediate measure if necessary. Moreover, we have a future plan to implement the feature of audio/video which will help even the blind people to use this app with utmost ease.

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