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Flood Prediction and Disaster Management (FloodAlert)

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Abstract: ***FloodAlert basically works in prototype phase, where it detects the potential flood levels and sends an alert to the residents for evacuation. In this, the user simply clicks a photo of the dam on his smart phone. The photos are clicked before the dam overflows and floods the nearby areas. By reading the float sensor data, the flood levels at the dams are detected. To locate a person's position, the GPS coordinates are coded using the marine codes. Satellite images are used for the terrain view and they are processed to find the cost of the route, availability, etc. Then, the GPS coordinates are decoded considering all the nodes to be equiprobable and using a suitable routing algorithm, an alert will be sent via sms to evacuate the place to go to the nearest safest spot.***

Keywords: Image Processing, GPS coordinates, marine codes, shortest route algorithm, alert generation

1. Introduction

Frequency of the flood events have significantly increased worldwide. It not only causes destruction to the surrounding environment but also affects the human life. Therefore, there is a need to enhance the awareness of potential flood levels in the local flood prone areas.[5]

Smart phones provide a feasible means with which it is easy to educate people about it. We present a working smart phone app to engage the public with local flood zones by visualizing the potential flood levels at the dams and alert them for evacuation.[5]

Our approach adapts to technologies like MATLAB to visualize the flood levels. The output will inform the users about the nearest and safest location via sms. Image processing will be used for water level detection and flood monitoring. The main advantage of this system is that it takes multi-modal input from the users, so it can be used by the disabled people.

2. FloodAlert System

FloodAlert uses GPS coordinates to collect information about user's location in the flood prone area. The GPS coordinates will be coded using Marine codes.

NMEA Marine codes: National Marine Electronics Association is a combined electrical and data specification for communication between marine electronics such as echo sounder, sonars, anemometer, gyrocompass, autopilot, GPS Receivers, etc.[3]

The photo clicked on the smart phone will be processed using image processing on MATLAB. There will be multiple pictures to be compared with the threshold.

Three water level sensors have been represented to provide real-time information to the flood control centre for processing purposes. Each sensor has a special function. The first sensor detects the normal level of water, while the second sensor detects the above normal, and the third sensor detects the dangerous condition. The system will compare these levels with the input pictures to predict the flood level and the total time for the flooding. [1]

The marine codes will be decoded and alert generation process will begin. If the water level exceeds normal level, the warning alert appears automatically "water Level is Normal". Finally, if the sensor detects water exceeding dangerous level, the warning alert message appears automatically on the main interface "water Level is Dangerous". Therefore, the flood monitoring services can monitor any changes of water level and give immediate response once water level reaches dangerous zone. [1]

3. FloodAlert System Architecture

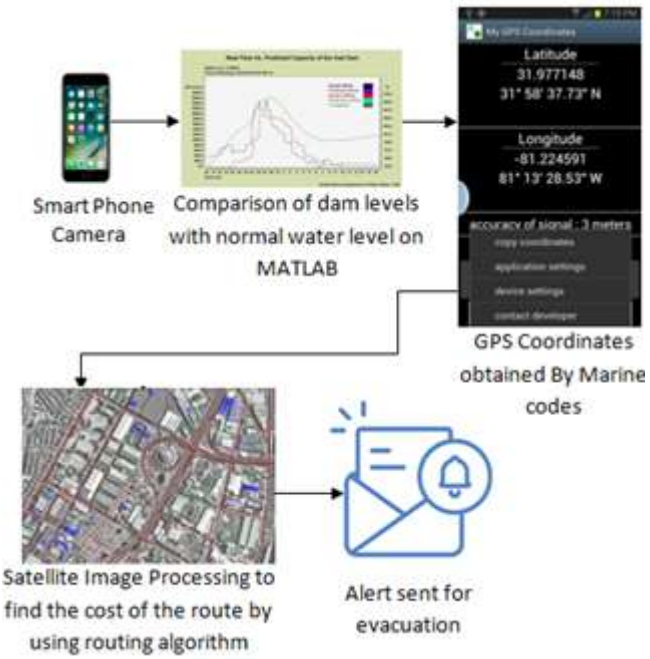

Figure 1: System Architecture

Environment: Just before dam overflows the photos need to be clicked. Measurement is done only after rains. Photos can be clicked in foggy, rainy or in broad sunlight.

User device: Android Smart Phone

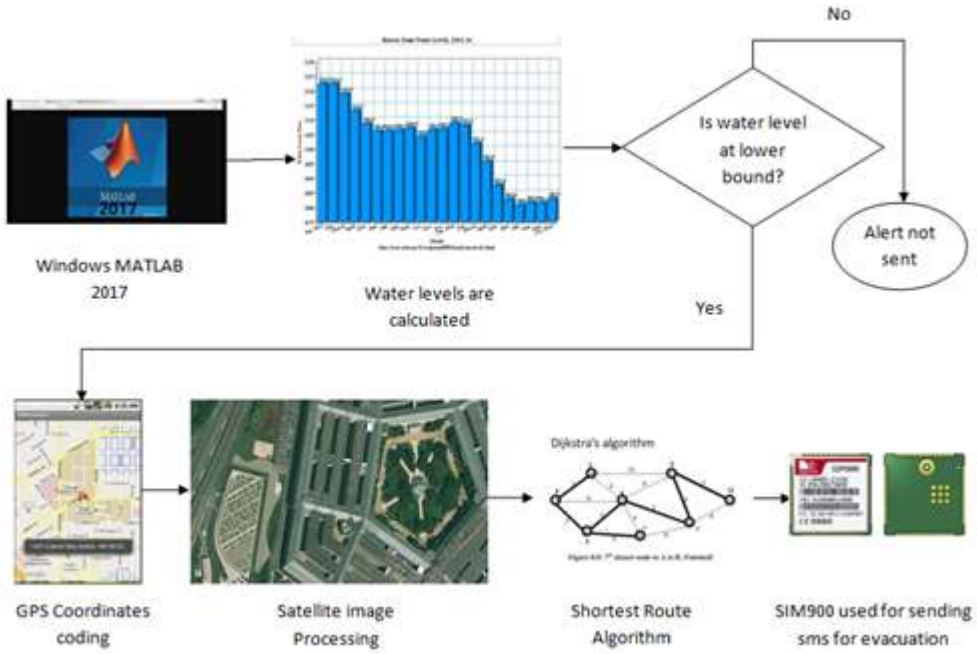

Figure 2: FloodAlert Server Module

FloodAlert Server: The server is responsible to check and compare the images in the database. The output screen will be divided into two parts: one will decode the GPS coordinates by considering all nodes to be equiprobable. The other will use an actual algorithm for the nearest safest location. The output will have several parameters such as:

- The rate at which the current level is rising
- How safe is the safest spot?
- Distance between that person and the safest spot
- Number of people reaching or present on the safe spot.
- Accessibility: It also provides the information about the number of people that are able to reach at the safe spot.
- If in case some people do not have smart phones, then the siren will help to alert them along with an sms alert to the other people.

4. FloodAlert Client Module

This module describes the client software which includes Android smart phone. The user has to take multiple photos on his smart phone. The photos of the dam could be clicked from different angles, distance, etc.

FloodAlert Server Module

This module describes the events that will occur when the input images are taken from the user. The images could be taken from top, bottom, and centre of the dam. Once the images are taken, they are processed using Windows MATLAB 2017. Several water levels are calculated such as current level, change in the water level, flood level, speed at which the current level is rising, overflow level, etc. The images are stored in the database and compared with the float sensor data available.

If the water level reaches the lower bound, then evacuation procedure begins. The GPS coordinates of the residents will be coded to detect their location. Using coordinates generation's simulation program, we will find the range of coordinates and their limits. Marine code will be written using the random functions.

Satellite images will be used for the terrain view.[4] And, these images will be processed to calculate the shortest route possible using an algorithm. Then, the GPS coordinates will be decoded in C for estimating time, location, etc. Once this process is completed, SIM900 will send an alert for evacuation.

SIM900: Generates messages directly through MATLAB.

FloodAlert Database: The features of each and every image will be stored in a database such as the edge levels, the interface between the water and land, etc. Live feed will be used to extract, process the image, and give the feedback.

5. Methodology

Float sensor data is an existing technology used in several disaster management systems. The limitation is that it is used to calculate only the change in time. But, FloodAlert uses the float sensor data not only to calculate the change in time but also to calculate the speed of the flood using the vertical scanning in image processing.

Since, we know the change in the flood level ($\triangle X$), current level, flood level, the system can also find when the flooding will take place as well as the speed at which the level is rising,

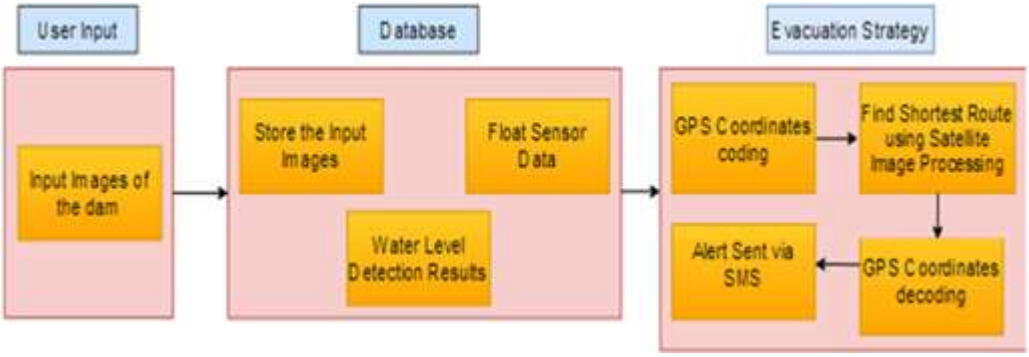

Figure 3: Block Diagram

$\triangle X = (\triangle X_1 + \triangle X_2 + \triangle X_3) / 3$

Level X= (level X_1+level X_2+level X_3) / 3

Speed= $\triangle X / t$; where t=1 / frame rate

Distance remaining = Level flood-Level X

No. of frames=distance remaining /$\triangle$ X

∴ Total time for flood= no. of frames* [FPS (1/25)] t

For location detection, marine codes decoding is done using MK87 for the location, speed, time, and acceleration. The decoding is done in C. The GPS library has a C code (Adruino Playground), also the NMEA (National Marines) gives the information for free from which we take 4 parts- North-South, East-West, longitude, latitude.

A shortest route algorithm is used such as Djikstra's, Open Shortest Path First, etc. for processing the cost of the route in terms of time and availability.

Since the events occurring are not high speed, we can do real time processing as well by flushing the data.

6. Conclusion

We are using Java to develop the Android based client software and MATLAB for the server application. A shortest route algorithm is used to calculate the best path for the data. The shortest route for the user to reach to the nearest safest spot will be displayed on the Android phone. Alert is sent in the form of sms and in case if a resident does not have a smart phone, they will be alerted through siren.

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[6] Images used in the diagrams are for representational purpose only. (Source: Google)