Genetic Algorithm towards Flood Avoidance in Android Application

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***Abstract*--During a flood disaster, its reporting is an important issue for the possible victims and similarly important about the place of disaster for the rescuers. Android applications are working well to help the victims and rescuers to know the exact position of flood. Localization about place of flood and possible direction of expansion is a big issue to design a perfect alert application. In order to provide the accuracy in localization and route selection, genetic algorithm may play an important role for route optimization. One mobile application used for the disaster reporting using the same kind of concept, referred as MyDisasterDroid(MDD). This application helps to provide actual position of disaster to relief them and rescuers, but its improvement is possible through a correction in its methodology. This paper provides idea to make it better after point out its some common drawbacks. This paper, also suggested a parameter, to be added for better approach in order to route optimization. As a parameter, slop has considered with distance to find initial solution in the way to find path to nearest reservoir. In this, work researchers uses geo-location as a initial input while optimal route is a expected output.**

Keywords--Genetic Algorithm, Traveling Salesman Problem, Flood Disaster.

I. INTRODUCTION

Recently, rainfall induced disasters including rainfall and landslide have claimed about 120 lives during 27 July 2016 to 31 July to 31st July 2016 in Kathmandu region[1,2].Statistics reveals due to rainfall induced disaster at various places, India has lost overall 89 lives in the year 2016. Generally, during the flood all the paths going out from affected area are blocked hence victims have no option but to stuck. In addition, communication failure makes the situation far worst. This is the reason victims are not able to even communicate with each other to find out the ways to go outside the affected area.

MDDdeveloped byFazardoet al [3, 4, 5]can work better in this situation as the authors claim. This Application finds optimal route between locations using genetic algorithm with specific formula. As Disaster Management includes four phases namely planning preparedness, Mitigation and Response/ Recovery, the App works in Response phase.

This phase of disaster management includes search and rescue operations as well as provision of emergency relief.The phase requires efficiency as time is of much importancein this kind of situation. Delay of even a second may claims many lives. Thus a system that determines the most optimum route for the volunteers and rescuers in order to serve the most of the people and provide maximum coverage of the affected area in the shortest possible time is beneficial. Though the App is very useful, but it fails to address the work in this paper, address few shortcomings of the app and adds some functionality to make it featurerich.

II. RELATED WORK

To help during disasters, mobile technology plays an important role for providing communication through connectivity between devices or through voice call / chat between devices. During disaster,communication setup generally goes down due to the failure of infrastructure network setup. Hence, in absence of infrastructure network, the mobile technology and Adhoc networks may play important role. Some tools have been developed to overcome the problem. Let ushave a little sight on these tools:

Smartphone apps for Disaster:

Various kinds of apps have been developed for different OS including Android, BlackBerry, iPhone, iPad etc. few of them are helpful victims and few are for rescuers.However, some apps are useful to both for rescuers as well as for possible victims.Table 1 listout some apps helpful for rescuers whereas table 2 lists out some apps helpful for victims.

TABLE 1: APPSHELPFULFOR VICTIMS

APP	*USE*
WISER [9]	• Provides information on biological, chemical and radiological threats.
Shelter Finder [10]	• Displays shelter information from the National Shelter System (NSS) in U.S.
Preparis [10]	• Provides expert information, response rules, communications and training for disasters.
ubAlert[10]	• A Social network compatible with e-mail, twitter and Facebook. • Provides knowledge sharing. • Alerts contain event details, maps, images, videos.
Earthquake-ARC[11]	• Provides instructions on what to do before/during/after an earthquake. • Provides "I'm Safe" feature to notify family.
Hurricane byARC[11]	• Provides access to local and real time information on what to do before, during and after hurricanes. • Provides "I'm safe" feature to notify family.
Tornado ARC [11]	• Issues Tornado Warning & Alert. • Suggestionsto prepare for a tornado based on interactive quizzes and simple step-by-step advice.
Wildfires ARC [11]	• Issueswildfire warnings, • Issues “Blaze Alerts" to notify new wildfire, • "Blaze Path Tracker" gives view of the wildfire's track and perimeter.
ARC: Shelter View [11]	• Maps the locations and shelters from American Red Cross National Shelter System (NSS).
SOS Android [11]	• Provides step-by-step video narration. • Allows people to quickly respond to emergency situations.

In addition, few more apps have been identified to help victims as well as rescuers.The apps are enlisted in table 2. All the apps either used by rescuer, or by victims or by both are generally connected through internet or Adhoc networks. Apps which are using internet facility as a basic requirement may be useful to minimize risk using disaster preparedness by issuing alert.

TABLE 2: HELPFUL APPS FOR VICTIMS AND RESCUERS

APP	*USE*
Disaster Alert [11]	• Provides an interactive map of Active Hazards occurring around the globe.
Radar Now[12]	• Provides National Weather Service (NWS) images from the NOAA WSR-88D NEXRAD Radar sites.
WeatherBug[12]	• Forecasts weather information.
GPS Essentials[12]	• Navigates, manages waypoints, tracks, routes, and builds own dashboard from 45 widgets.
Backpacker GPS Trails Lite[12]	• Uses offline maps for navigation. • No cell signal needed.
SOSGPS [12]	• Sends a user’s GPS coordinates to a predefined list of peoplein emergency.
MDD [3,4,5,13]	• MDD works on the basis ofgeolocation to provide help to Victims and Rescuers both.

Apart from these apps, researchers are continuously trying to provide better way to detect the disasters and issue fast alert.

III. THEORY USED FORM_2D_2

In Modified MyDisasterDroid (M_2D_2), researchers tried to find out best possible route for water traversed during the flood using inspiration taken by Travelling Salesman Problem (TSP) and Genetic Algorithm alongwith Geo-location. On the other handM_2D_2 may prove to be a very useful for rescuers as well as victims during flood. To provide best possible route to rescue, it can use Travelling Salesman Problem (TSP) and Genetic Algorithm alongwith Geo-location just as per MDD.

Travelling salesman problem (TSP)

To find out a route for water flow in order to avoid flood or excess amount of stored water at a place, researchers have used the concept of travelling salesman problem. The travelling salesman problem is a permutation problem with the objective of finding the path of shortest length on an undirected graph that represents cities as nodes to be visited. The concept of travelling salesman is that the travelling salesman starts from a node, visits all other nodes successively only one at a time, and finally returns to the starting node.

*TSP for MDD:*In the work of Fazardo et al, TSP has been assumed to calculate the distance between two points in MDD. In this they were use Euclidean formulae to find distance however indicated formulae in their paper is not doing work well for few situations described in section IV in this article.

*TSP for M_2D_2:*Incase of flood,water has not return at starting point. Determining a bestroute to divert the flow of water along different geographic locations is similar to the travelling salesman problem wherein geographic locations represent city coordinates and the water represents the travelling salesman. The TSP in this case provides nearest all the possible paths to the empty pond or reservoir in the city as destination. These possible paths are useful to choose the optimal paths from these with the help of GA.

Genetic Algorithms

GA in MDD: Genetic algorithm has been used by MDDto generate initial solution. This algorithm provides the initial solution after taking location as an input for the algorithm. MDD works on the basis of concept of geo-location to provide inputs to the genetic algorithm. It finds points of location, using application installed in MDDfor sending location via text or SMS to MDD. Based on TSP, distances between locations are calculated. MDD uses GA with flow diagram used in it [5] not having the possibility to detect the failed route in disaster that is a big possibility. Failed route by the disaster initialization is a big problem for every

disaster. It is sometimes a big problem. MyDisasert Droid can use GA [14] efficiently after removal of possible damaged routes in initial steps before start of GA.

In disasters, especially in rainfall triggered type, routes are generally damaged or blocked. These routes are not having important until its reinstallation for use. MDD installed on Android OS uses google map to show its feature MapView. MapView provides different map images like satellite view, street view and traffic view. Due to different kind of delays google map is unable to provide real time images so My Disaster Doid also have more delay that is important in disaster management. This delay is the basic reason of inefficiency to provide real time picture of incident. MDD provides the facilities of dynamic recalculation of route based on calculation for TSP using Euclidean distance formula in equation 1 discussed by fazado [5]. But this concept has several problems to use Euclidean formula for the situation like a disaster. Though, sometimes this concept works efficiently but in case of rainfall induced disaster or in landslide it has probability of route failure due to cause of route damage. In landslide or rainfall induced disaster path break or defected path are generally a big problem. Euclidean distance formula can provide better distance between two points when it will use with the sea height and slope of location with algorithm in some steps.

*GA in M_2D_2:*GA used by M_2D_2 is assumed to be used to choose an optimal route among all the possible routes. GA just assumed to be used as per the flow chart given in figure 1.

Use of Geo-location in MDD:

To find a geographic location of victim there is a need to find the coordinate of this place in general. MDD provides two application, in which first is the position of installed application on android i.e. MDD and second by sending location via text or SMS to MDD. World Geodetic System 84 or WGS84 used by GPS to find geolocation also implemented in android OS. WGS 84 helps to find distance between geolocations that is further used by MDD.

*M_2D_2 versus MDD:*The main difference between MDD and M_2D_2 is that MDD has been used to help victims as well as by victims and rescuers to find safe path while on the other hand M_2D_2 supposed to be used by possible victims and authorities to prevent the disaster. MDD presumes the possibility, How water can be redirect through possible route to an empty place where it can be stored. For the purpose, the MDD has been modified.

IV. CHANGES IN MDDTO DESIGN M_2D_2

MDD is an application to help victims and rescuers. While with additional features methods useful to create MDD can be used to provide instructions to avoid disaster using M_2D_2, particularly for flood disaster. There should be an additional mode to avoid flood through provision of flood water diversion from one place to nearest reservoir. This diversion is important to reroute the flood water in order to manage it in better way. Betterment of MDD app makes a feature rich Smartphone application referred here as M_2D_2 including flood avoidance as well as to help victims and rescuers. Certain steps considered to be involved to make changes in MDD in order to design M_2D_2, which are enlisted below:

1. Remove the difficulties to use formula to find distance using Fazardo's equation (1).
2. Develop another mode in app to find route to divert water into nearest possible reservoir.
3. Implement algorithm to find optimal path of waterflow from a point to another reservoir to be used by app.
4. Local volunteers should be aware to use it.

V. GA FOR ROUTE OPTIMIZATION

Optimization is the problem of today's world, while various techniquesare useful in optimization. Researchers prefer GA over classical approaches to find out optimize solutions due to generation of a population then a point in a single iteration. GA chooses best point from a full population in iteration to find out the optimized solution that is why a simple assumption is that it can provide a better optimized route for flood water from a point to nearest reservoir. As we know genetic algorithm uses three kinds of rules to generate solution of next generation at every step after getting current population as an input. These three steps are Selection rules, Crossover rules and Mutation rules. Idea to find route of water flow is same as the route finding for victims or rescuers in MDD. We have introduced a new parameter suitable for water flow referredas slope from water point to the nearest reservoirs. This slope will be utilized with distance to calculate initial solution.The value of slope has been considered from negative to positive as per slope from one point to another. Coordinates of two points to provide distance, and slope are three variables as inputs to GA for a solution. Many routes from a point to reservoir might be possible, either these are direct route or may be indirect from a particular route. In this case we have to choose an optimized route from a point to reservoir, and this route selection still a problem that can be solve by the use of GA.

Figure 2 shows the working of genetic algorithm in which, to find optimized route, GA checks fitness, and finally provides solution after crossover and mutation. In genetic algorithm optimization basically a process performed by fitness computation. Here, each iteration tries to find out minimum fitness after applying it on an individual that is considered sometimes as a gene in genetic algorithm. In case of flood management through movement

of water to nearest reservoir are the subject to find minimum route, it means all the routes along with slope are individual. In this row all the possible solution of initial state are considered as a population which may be an array of individuals in GA, which is applied to generate a new population that will be better than the old one. Here diversity should be high to generate a good solution. In this, solution will be selected according to their fitness to form a new solution, that is, offspring.

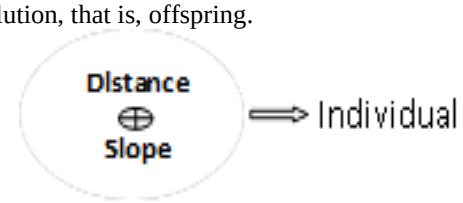

Fig. 1. Generation of individual

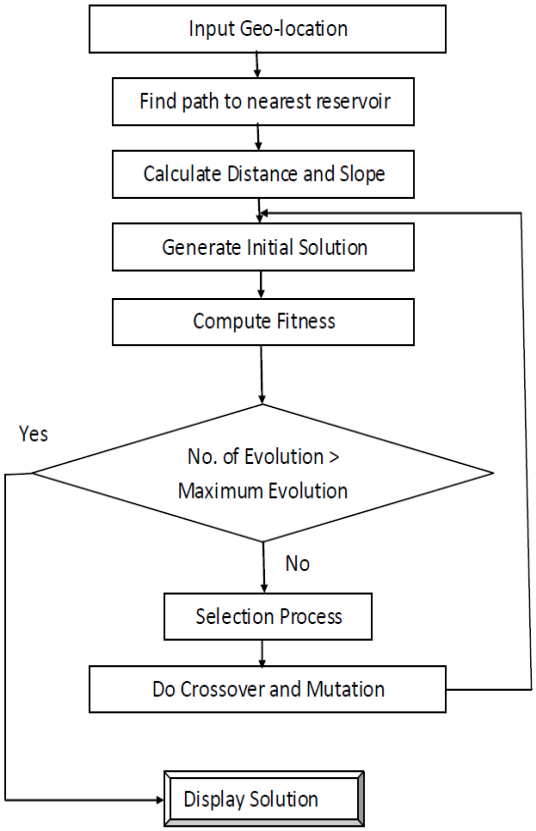

Fig.2. GA in M_2D_2

Just as MDD, approach for M_2D_2 considers various parametersfor GAsuch as no. of evaluation, selection operators, mutation rates and priorities with additional parameter considered known as slope. With the help of these parameters GA will provides aoptimal route to the MDD for water flow but it uses only data collected. Location name, latitude micro-degrees, longitude micro-degrees and slope can be collected from the API of Google MAP to provide MDD to find optimal route of water flow by GA. Here acceptability of GA to provide a solution depends on number of evaluations. As per increments in evaluation GA provides better optimum solution.

VI. Conclusion

On the basis of analysis of graphs we can say, in disaster management system, accuracy and time consumption of processing sometimes may be crucial. MDD provides map view through the Google map. But in this Google map or MDD not provide any information about failed route. It means with the all discussion we can say MDD can be better after removal of some problems of the MDD.

(1) Change in the formula discussed by Fazardo et al[5].

(2) Use the angle to find the correct distance in geographic locationbase height before GA to find correct distance.

(3) Remove route that are failed from the set of routes before applying it in GA.

(4) Minimize the average time of estimation of finding an optimum solution for quick processing and transmission of alert message to the affected parties.

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