Proceeding of 1st International Conference on Environmental Protection and Disaster RISKs

Part One

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PART ONE

АЗ·БУКИ
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Part One of the proceeding book presents texts on the following topics: *Air Pollution, Climate and Health; Biodiversity; Informatics, Remote Sensing, High Performance Computing and GIS for Environmental Monitoring and Management*.

In Part Two of the proceeding book will be presented texts on the following topics: *Natural Hazards and Risks; Water Resources, Human Activities and Management.*

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Georgi Gadzhev
Nina Dobrinkova

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GIS IN CRISES MANAGEMENT USE OF SMART PHONE GIS APPLICATION IN THE EVENT OF NATURAL DISASTER

Aleksandar Petrovski, Nenad Taneski, Jugoslav Ackoski
University "Goce Delchev" Shtip
Military Academy "General Mihailo Apostolski" – Skopje, North Macedonia

Abstract. Today it has become both the government and citizens concern to care human beings against ever-increasing crisis around the globe. There are so many natural disasters like: forest fire incidents, earthquakes, floods, eruptions, tsunami and etc. despite all this kinds of natural and man- made disasters from a social perspective, it their potentiality to seriously and irreversible damage regions. In addition the extent and severity of such incidents may significantly affect the population. For that reason and the fact that Geographic information system is recognized as a useful system for alleviation the risk during the crisis management we develop the idea to promote a new model to have a practical and applicable method of GIS adoption within the crisis management in order to save as many lives as it can be done. This study aims to come out with a model that will not allow drop links. Each smart phone will have application in the event of natural disaster and it switched due to the change of the vital function of man in trouble. This will help departments respond as soon as they can and save lives as many as they can and to reduce the percentage of people who could not call for help. This work highlights the design challenges and required technical innovations towards the goal of making GIS much more useful.

Keywords: GIS, disaster, crisis management, rescue, emergency response.

INTRODUCTION

The risks posed by climate change are real and its impacts are already taking place. The UN estimates that all but one of its emergency appeals for humanitarian aid in 2007 were climate related. Climate change is best viewed as a threat multiplier which exacerbates existing trends, tensions and instability. The core challenge is that climate change threatens to overburden states and regions which are already fragile and conflict prone. The effects of climate change are being felt now: temperatures are rising, icecaps and glaciers are melting and extreme weather events are becoming more frequent and more intense[1]). The following section outlines some of the forms of conflicts driven by climate change which may occur in different regions of the world. Some impacts from increasing temperatures are already happening: Ice is melting worldwide, especially at the Earth's pole. Sea levels are rising faster over the last century. Precipitation (rain and snowfall) has increased across the globe, on average. Other effects could happen later this century, if warming continues. Sea levels are expected to rise between 7 and 23 inches (18 and 59 centimeters) by the end of the century, and continued melting at the poles could add between 4 and 8 inches (10 to 20 centimeters). Hurricanes and other storms are likely to become stronger. Floods and droughts will become more common. Some diseases will spread such as malaria carried by mosquito. Forest fires will became everyday situation, because of the rising temperatures caused by climate changes and will be real danger in every place on the earth, which will increase people movement in northern countries. This is a huge problem for all of us, and if we don't use all our technological resources and knowledge to small the effects of climate changes and to put all investments in prevention and reduction on it.

GIS IN CRISES MANAGEMENT

Climate change is a geographic problem, and we believe solving it takes a geographic solution. GIS has a long history of driving environmental understanding and decision making. Policymakers, planners, scientists, and many others worldwide rely on GIS for data management and scientific analysis. GIS users represent a vast reservoir of knowledge, expertise, and best practices in applying this cornerstone technology to climate science, carbon management, renewable energy, sustainability, and disaster management. When natural disasters alter the world around us, high-quality data must be collected and examined to accurately assess the damage and plan restoration efforts. Rapid response and attention to detail are both of the utmost importance. Through the use of mobile GIS, these often-opposing objectives can be achieved simultaneously. Operating PDAs equipped with Arc Pad and GPS, trained field personnel can take advantage of custom forms and other time-saving data entry features that render obsolete the use of pen, pad, and paper map. Upon return to the office, field data is integrated into the project geo-database with no additional data entry needed, allowing more time to analyze the data and develop maps and reports.

SMART PHONE GIS APPLICATION IN THE EVENT OF NATURAL DISASTER

For that porpoise it should be made a complex system of software for managing crisis situations and disasters. The system it will be able to help in all aspects of crisis management.

The system must comply with the objectives, functions and powers of the territorial bodies of executive authorities and departments of the countries, in the field of prevention, combating and elimination of criminal crises, terrorism, natural and manmade, anti-terrorist and anti-criminal protection, safety and security. Creating a system should be comprehensive interdepartmental aimed at improving information technology and information and communication infrastructure of public administration in general. To create a comprehensive system is to ensure the safety of protection by reducing the probability of threats of natural, man-made, criminal, terrorist and other situations due to:

– Effective monitoring of the current situation and providing information for the authorities;

– Providing information about the current state of security facilities, protection services and operational headquarters;

– Providing analysis and management of the threats, natural, man-made, criminal, terrorist and other character crisis;

With an integrated system must be provided:

– Development of technical regulations (conditions) to equip the objects of protection (and their components) technical means of security and control, as well as the functioning of the monitoring tools and equipment (systems).

– The ability to monitor the status of security protection objects (their elements), as well as the movement of persons and transport facilities for protection;

– Automation of the process of collecting and transmitting information to the monitoring objects of protection (their elements);

– The possibility of collecting and transmitting information from existing and emerging security products to protect and control objects;

– The possibility of collecting and transmitting information to the services of territorial bodies;

– The possibility of sharing information between services (including situational centers) with the task of ensuring human safety both on a bilateral and multilateral basis;

Must be implemented automated control mechanisms, information analysis monitoring, forecasting situations. Integrated system it will be based on geographically distributed principle and will be consisting of a single point of management, transport network, as well as places of gathering, processing and analysis of information.

The whole system it will consists of four phases.

• Phase one: Software that helps in locating, guiding and directing the people;
• Phase two: Flying drones that search and detect disasters and people;
• Phase three: Specialized machines for helping people;
• Phase four: human resources or specialized people working on field.

1st phase: Is to create a GIS software that will detect the crisis situation or disaster and to classify it. (What sort of disaster (crisis situation) and the proportions of it).

Then it will be created an appropriate application for all types of smart phones, for all types of operating systems (Android, IOS, Microsoft ....). The application it will have access to the location of the smart phone, calls, messages, emails and the phone contacts. This will allow locating phones in crisis areas and access to vital content on the phone (name of the user, numbers of the closest or most used phone calls), for those phones that are turned on (operational)[2)].

The application will consist of three main functions / tools:

• Prevention or procedures and actions what to do before the disaster,

• Instructions what to be done during the crisis and

• Instructions after the crisis, how to take un appropriate measures and procedures.

1. The first function of the application will inform the users about the possible natural disaster, what to do and how to do it. Directions on how to protect provide or avoid possible situation (flood, forest fire, tsunamis, NHB pollution ...). It will inform the consumers where to head, with the appropriate address, phone numbers and how to reach the place with a particular map.

2. The second function it will be based on the morale and stability during the disaster. How the users to remain calm and not to panic, but to think realistically and rationally. Of course, the application will have all the previous functions, where, how and what to do. The most useful part in this phase is that every person can send real time SMS to crises centre with useful geo-data information that will help to people on the ground about them and their condition.

3. The third tool will consist of basic survival manuals with pictures. And measures where people to go and how to reach the most basic needs.

For all non-smart phones and cell phones that don't have GPS, this will also be possible. It can still be tracked. This is because a cell phone is basically an advanced two way radio in which communication are made via cell towers. These cell towers are within a network of cell towers which its main function is send and receive the radio signals emitting from your phone. And cell phone is basically transmitting radio signal to the nearest cell tower. The closer your phone to a cell tower, the stronger the signal that is emitted. So, by measuring the signal strength and also through triangulation method with other cell tower; that is by measuring how strong or weak signal emitted by your phone, your phone location can be pinpointed almost accurately. However, there are some disadvantages to this technique as big buildings or trees can affect the signal and therefore affect the signal strength. All users of these phones will receive un SMS and MMS with instructions.

2ndphase: The second phase will be consisting of a series of little flying drones which it will be equipped with a various sensors and cameras (video live stream, thermal scanning, structural laser scanning, Wi-Fi hotspots servers, signal scanner and receiver). Sensors for identifying the crisis and sensors for tracking and founding people. All flying drones will be communicating with one HQ that will control the drones.

Figure 1. Parrot beob drone

3rdphase will be for those who cannot reach the emergency centers and basic needs. On them will be sent help from ground and air with adequate machines (robots and drones) in the form of food, water, first aid and medicine. The machines will choose where to go alone and where to deliver the packages.

4thphase will consist of specialized teams for different kind of disasters and teams dedicated for managing crisis situations. Every team will be equipped with equipment and tools for dealing with every situation on field and in every HQ. This phase will have an option of including the Army of the country that has a crisis situation or every available people.

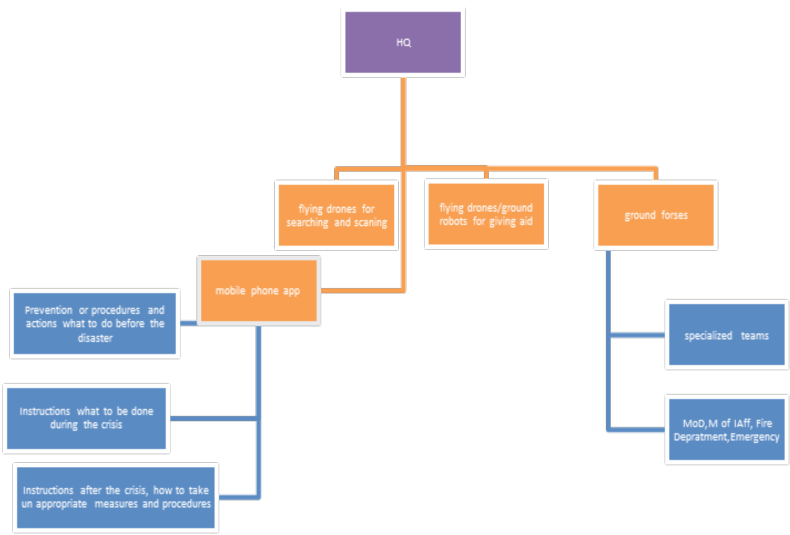


Figure 2. Structure of Geo HQ organization

NAMED DISTANCE MODEL

The second model ***named distance model*** is more complex and its without UAV, the position of the soldier is send via the VHF military radio from the built-in GPS. The distance and the angle to the target is determinate by the two team members using Laser Rangefinder and send to the TOC using voice communication[3)]. There will be addition to the algorithm that will calculate the coordinates of the target using the coordinated of the rescue member, and the known distance to the target. This is done using simple geometry to determine third point when two points and all sides (distance) are known (Charles & Grinstead) and is calculating the coordinated of the victim and send them as an input to the algorithm with the received GPS data from the radios. The following steps are same as the UAV model.

System architecture of this model is represented in the following figure. Two team members use standard radio and laser rangefinder, and then the data is send via land mobile radio, to the team leader, and forwarded via Harris RF7800M and VHF Radio network to the TOC where the algorithm calculates the coordinate of the victim and makes the decision in accordance to the created algorithm.

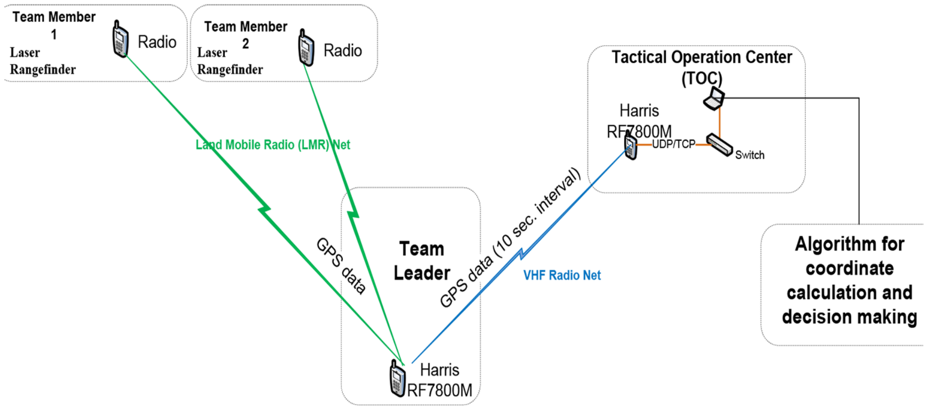


Figure 3. System architecture for the distance model

ALGORITHM

Steps of the algorithm:

First: for all our team members we are checking the visibility to the goal by our GIS connected by UAV orvoice communication.

Second for team member that have visibility we measure the distance to the victim.

Third we get the information for weather conditionsfrom nearby weather stations or our meteoritical data.

Fourth from the appropriate tables we get the appropriate probabilities to save the victim.

Fifth (and finally) the team member with the biggest probability to save the victim gets an order to save the man in trouble.

EXPLAINING ONE REAL SITUATION ON THE GROUND

We are giving real description of our algorithm. We have five team members and for them we know the number of saves to the goal from 100 attempts. Also we have number of saves in different weather condition: sun weather, haze weather, poor rain, and straight rain. Another important characteristic that we must to now is distance from the team member to the man in trouble.

Table 1. Sun weather

SUN WEATHER			
Soldier 1	100 attempts	600 meters	0,93 goal
Soldier 2	100 attempts	800 meters	0,749 goal
Soldier 3	100 attempts	800 meters	0,89 goal
Soldier 4	100 attempts	800 meters	0,91 goal
Soldier 5	100 attempts	500 meters	0,98 goal

Table 2. Haze weather

HAZE WEATHER			
Soldier 1	100 attempts	600 meters	0,793 goal
Soldier 2	100 attempts	800 meters	0,65 goal
Soldier 3	100 attempts	800 meters	0,79 goal
Soldier 4	100 attempts	800 meters	0,79 goal
Soldier 5	100 attempts	500 meters	0,86 goal

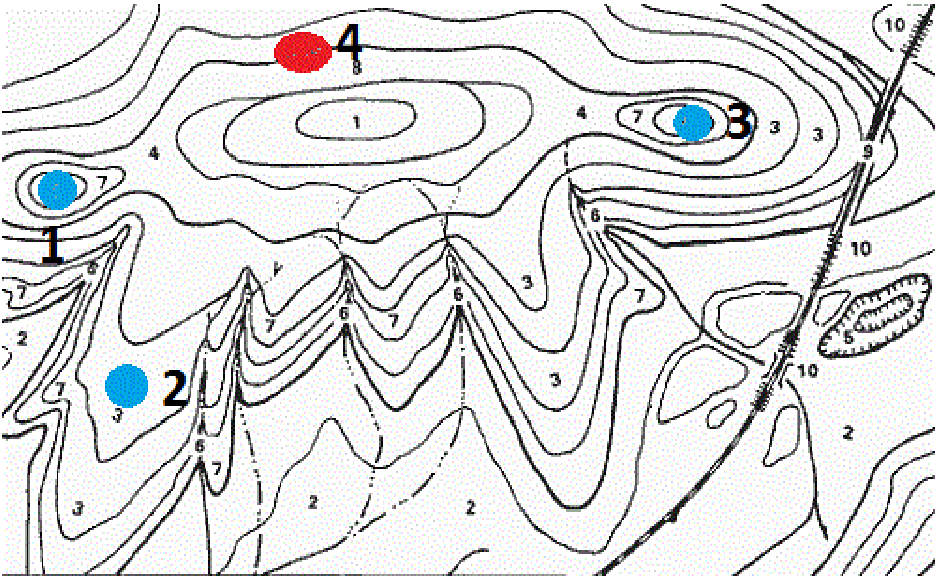
Table 3. Poor rain weather

POOR RAIN WEATHER			
Soldier 1	100 attempts	600 meters	0,80 goal
Soldier 2	100 attempts	800 meters	0,82 goal
Soldier 3	100 attempts	800 meters	0,89 goal
Soldier 4	100 attempts	800 meters	0,85 goal
Soldier 5	100 attempts	500 meters	0,73 goal

Table 4. Straight rain weather

STRAIGHT RAIN WEATHER			
Soldier 1	100 attempts	600 meters	0,39 goal
Soldier 2	100 attempts	800 meters	0,41 goal
Soldier 3	100 attempts	800 meters	0,31 goal
Soldier 4	100 attempts	800 meters	0,55 goal
Soldier 5	100 attempts	500 meters	0,54 goal

On the this picture we have example of one possible situation on the field. Our three (blue circle) and one man in trouble (red circle) team members are at the positions.



Picture 1. Real position on the field

ALGORITHM WORKFLOW

First: From the ground situation team member with number 1 and 3 have visibility to the goal.

Second: The distance from team member with number 1 to the victim is 600 m and the distance from team member 3 to the victim is 800m.

Third: The team member from the field reports us that the weather is sunny, and we are checking weather condition on android application.

Fourth: From the tables, we can see that probability for team member with number 1 is 0,93 and 0,89 for team member with number 3. This calculating will be automatically done by the application in our TOC center.

Fifth: Algorithm gives us final result that team member with number 1 is most suited to finish the task.

Six: The commanding centar gives the executive order.

CONCLUSION

This integrated system should allow:

– Ensure compatibility of existing and emerging information and technical systems to improve the efficiency of management in the field of safety of life of the population;

– Increase the effectiveness of control objects with mass stay of people and critical facilities;

– Improve the efficiency of solving the territorial problems;

– Increase the effectiveness of measures to eliminate the consequences of natural and man-made disasters;

– To reduce the loss of life in emergencies, fires, earthquakes.

Every day, we are confronted with disasters of varying degrees. Those that have adequately developed, maintained, and exercised their contingency plans will survive. Yet many people continue to take the uninhibited operations of their lives for granted. They remain complacent, assuming that the power will always be available, the telephone system will not fail, there will be no fire or earthquake--everything will always be normal. Very few people plan for their own, if we want to survive, organizational “strategic” and “tactical” battle planning is essential. However, it is only as good as the foundation upon which it was built. The foundation is, of course, the concept.

This document is the means by which a particular mission, program, or policy directive is translated into a fundamental organizational and operational methodology. Once the system is developed, and is sanctioned by both management and the operating elements, construction of the contingency plan may commence. A fundamental premise of successful contingency planning is that plans are developed by those who must actually carry them out in the event of an actual disaster. Disaster planning is truly a vital part of the overall business plan. With every year rising disasters the people are more and more threatened. We are hoping that with this software will help them all. The software is expected to decrees the casualties all around the world, in the crisis areas. And also organize the management in these situations. The low cost of the software is a big advantage in the development of the system (Petrovski, Bogatinov & Boshkovski, 2017).

NOTES

1. http://environment.nationalgeographic.com/environment/global-warming;
2. http://myphonelocater.com/category/triangulation;
3. Disaster Recovery Plan Strategies and Processes February 2002 pp 11-12.

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✉ **Dr. Aleksandar Petrovski, Assoc. Prof.**
ORCID iD: 0000-0002-5265-5813
University "Goce Delchev" Shtip
Military Academy "General Mihailo Apostolski"
Vasko Karangjeleski bb
Skopje, North Macedonia
E-mail: aleksandar.petrovski@ugd.edu.mk

✉ **Nenad Taneski**
https://orcid.org/0000-0002-6471-0189
University "Goce Delchev" Shtip
Military Academy "General Mihailo Apostolski"
Vasko Karangjeleski bb
Skopje, North Macedonia
E-mail: nenad.taneski@ugd.edu.mk

✉ **Jugoslav Ackoski**
https://orcid.org/0000-0003-2782-3739
University "Goce Delchev" Shtip
Military Academy "General Mihailo Apostolski"
Vasko Karangjeleski bb
Skopje, North Macedonia
E-mail: jugoslav.ackoski@ugd.edu.mk

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The main areas of environmental management covered by the conference are: Natural Hazards and Risks, Air Pollution, Climate and Health, Water resources, human activities and management, Biodiversity, Biotechnology for environmental management, Informatics, Remote sensing, high performance computing and GIS for environmental monitoring.

Co-organizers of the conference are:
– the National Geoinformation Center (NGIC) of the Republic of Bulgaria, Project "NATIONAL GEO-INFORMATION CENTER", financed by the National Road Map for Scientific Infrastructure 2017-2023, Contr. No D01-282 /17.12.2019 (http://ngic.bg/);
– the Crisis Management and Disaster Response Centre of Excellence (CMDR COE - https://www.cmdrcoe.org/), located in Sofia, the Republic of Bulgaria
– and the Bulgarian Academy of Sciences (http://www.bas.bg/en/).

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