7 METHODS FOR SUPPORTING THE FLOW OF INFORMATION ABOUT THE ENVIRONMENTAL FACTORS IN EMERGENCY SERVICES AND PREVENT ACTION

7.1 Introduction

As the systems forming the human environment, such as production systems, energy, transport, information and increases the impact of the crisis situations on their operation. Currently, for example, the density of transport infrastructure means that small events can significantly impede traffic movement, particularly in urban areas, as far as the creation of complex systems, increases the impact of crisis events on the stability of systems.

The basis for the smooth operation of prevention and rescue services in countering the effects of crisis events (such as mass events) is the close coordination and cooperation. This coordination and cooperation is achieved through organizational solutions based on the integrated decision-making (centralization of decision-making) and the supporting tools are available [1, 2, 3]. Currently, this ensures that the power of prevention and rescue services are widely developed, when an event of crisis and when there are indications of such an event (public events).

Successful operation of emergency services and prevention requires efficient decision-making at all levels of rescue. In general the existing organizational arrangements, aided tools are available, based on a central decision-making system ensure efficient coordination and cooperation between emergency services and preventive measures.

Far different shape of the critical events, especially the multiplicity and diversity of environmental factors affecting the success of the activities performed by the prevention and rescue services reveals that the important role played by access to information about environmental factors directly in the event of crisis. The unpredictability of operating area makes the reliability and precision of information about environmental factors are the basis for correct decision-making at all levels of the rescue operation.

The publication, in the context of the organization of prevention and rescue services, we focus attention on providing information critical for decision-making system rescue. Dynamics and rescue environment imposes specific requirements on access to information. To be successful rescue operation at all levels of the organization, from the operational to the divisional level must be quickly made the right decisions. Access to information, appropriate to the type, location of the rescue operation is here an essential condition for the efficiency of the rescue operation.

Integration of preventive and emergency services at divisional level, improves the flow of information between the centers of decision. Integration based on the structure of CPR (Emergency Notification Center) are discussed in the first and second chapters of the publication. The solution is currently the basis for the smooth operation of the emergency services and preventive measures. Integration does not exhaust the problem of access to information during an emergency. In sections 2.3 and 2.4 shows the concepts of computing tools Assist the CPR structure. Section 2.3 shows the concept of vertical information flows supporting

GIS tools. Section 2.4 shows the concept of supporting the horizontal flow of information tools based on expert (knowledge base). GIS tools and expert tools provide solution to the problem of collecting information on environmental factors such as terrain maps, factors of the crisis, the cast of potential disaster events (eg in case of mass events).

Currently, the development of methods and tools AR (Augmented Reality) allowing transmission of information to support decisions on a wide range of activities undertaken by man. Decision support tools for AR is an important contribution to this need. In the third and fourth chapters are discussed the concept of applying this technology to aid the flow of information at the operational level rescue organization. While the fifth chapter provides a case study application of GIS tools, both as a source of information for the operational level of crisis as shares and tools to gather information on the progress of such action. The target information so gathered and organized can be used to support the operational level of crisis.

7.2 Prevention in a mass event

Currently, the scale of mass events is significantly expanding the scope of the prevent services. The organization and protection of mass events of various types of service involved. The cooperation of many departments of emergency and prevent services due to the nature of their operation is dynamic. Each service will carry out their activities independently. The reason for this is that the preventive measures for the protection of mass events require substantial resources, broadly defined preventive services operating in the area with a high density of the event.

Autonomy does not rule out close cooperation and coordination. Details of the services branch cooperation in various situations are prevention knowledge to identify critical decisions for the conduct of rescue and preventive, and determine future consequences of those decisions. Until now widely understood world of sports and entertainment to offer customers a dedicated cultural events, an event which (despite their participation in world famous) had a local character. The tasks faced by the organizers of mass events require security event run on a local scale. To protect the course of events are used in power and resources, which are sources of local origin.

In this situation, planning and organizing preventive measures requires the dispatchers serve emergency and preventive local security forces and resources. Addressing this task requires the cooperation of ranking the various branches of law enforcement and rescue services. As shown in practice - field research and literature author of the paper - often this kind of "manual control" is sufficient but does not provide 100% certainty, predict the development of crisis situations. And thus does not provide the use of adequate forces and means to prevent the development of adverse events. Often, the allocation of forces and resources from outside the local to the disaster event occurred is not possible in the course of public events. The reason for this is the distance stationing of emergency services and prevention of the event occurred and the need for the organization requiring the time.

The existing approach of scheduling events and manually assigning them with the necessary forces and resources provides force and preventive measures. And development of events during the event requires observation, analysis and reaction commanders of all the emergency

services and preventive measures in place and close communication and cooperation between them.

These days are organized mass events that are global nature. For example, in 2012 in store for Poland and Ukraine, the organization of one of the biggest sporting events which is to host the European Championships. The organizer of this event is the Union of European Football Associations, in short UEFA - Union of European Football Associations. However, at the European Championship in football, the possibilities of our country is not the end, you can consider the organization of European Championships and even the world in various sports, using the resulting, on the occasion of the European Championships in football, infrastructure.

In this light, the new situation with the organization of mass events of a continental or even global level requires a new approach for their organization and of security by the emergency services and law enforcement. The organization of the European Championships while on Polish territory and Ukraine poses to the organizers of a new approach, the application will get better results. In this new situation, which is the organization of the event having a global planning and organizing preventive measures requires the dispatchers serve emergency and preventive security forces on a global scale and resources. The solution of global tasks require cooperation between the different branches of emergency services and preventive deployed throughout the country.

7.3 The organization of emergency services and preventive in Poland

7.3.1 Emergency Call Center – ECC

In the modern organization of the state, structure and activity of emergency services and prevention are integral components of urban areas, industrial zones, natural areas. The field of emergency services and preventive measures are events caused by natural factors, the activities of industry, transport, and human activity, which lead to threats and emergencies. In Poland, the emergency services and preventive measures include the following: National Fire Service, Police, Ambulance, Municipal / Communal Police and other emergency industry: electricity, gas, etc., acting according to certain legal requirements and the specific area of their activities. Due to the implementation of actions in terms of threats and disasters requires the use of methods of organization and command staff as in the military. On the other hand, implementation of activities in the civilian area requires the use of emergency procedures, with clearly defined legal conditions that determine the primary objective, which is saving lives, followed by property.

Therefore, the organization of services should be continuously optimized to work best in a specific area in possession, in general, limited resources. In achieving this goal in recent years made the integration of emergency services and preventive Emergency Call Center – ECC. The basic functions of ECC is to coordinate the activities of emergency services and preventive measures on the basis of notifications and information about the dangers of dispose resources.

The organization of emergency services and prevention is built on a hierarchical structure which consists of: the strength and resources organized in local units subject to their commanders, and the dispatcher, which coordinates the actions of individuals located in the oper-

ated area. The dispatcher manages subordinate resources (forces and resources) and sends them to the rescue and prevention.

Notification of the occurrence of an event requiring the use of forces and resources, affect the dispatcher. The dispatcher determines the scope of activities and resources needed to minimize the risk occurring. Commanders of units receive information from the dispatcher to undertake rescue and prevention. The structure and information flows in the basic organization of emergency services and preventive measures is shown in fig. 7.1.

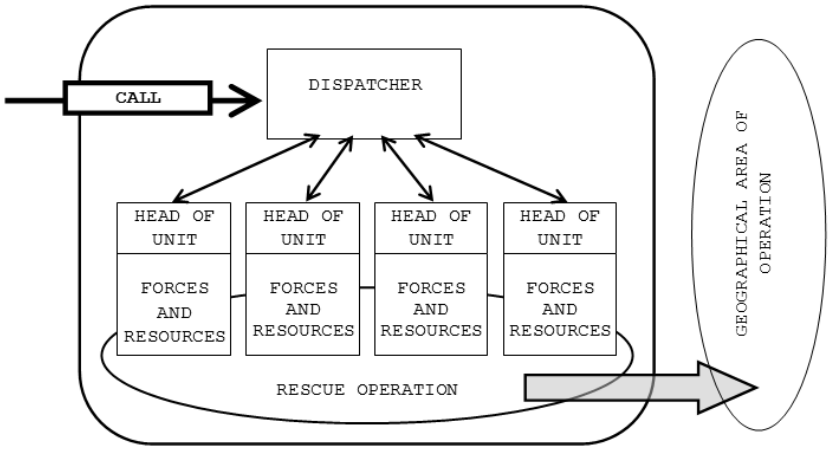

Fig. 7.1 Structure of Poland organization, and information flow in the basic organization of emergency services and prevention

An integrated system of emergency services and preventive merges hitherto independent rescue operations in the services organization with a common dispatcher. The integration is based on a common proving all the emergency services and preventive measures that are part of the ECC. Integrated system of the diagram in fig. 7.2..

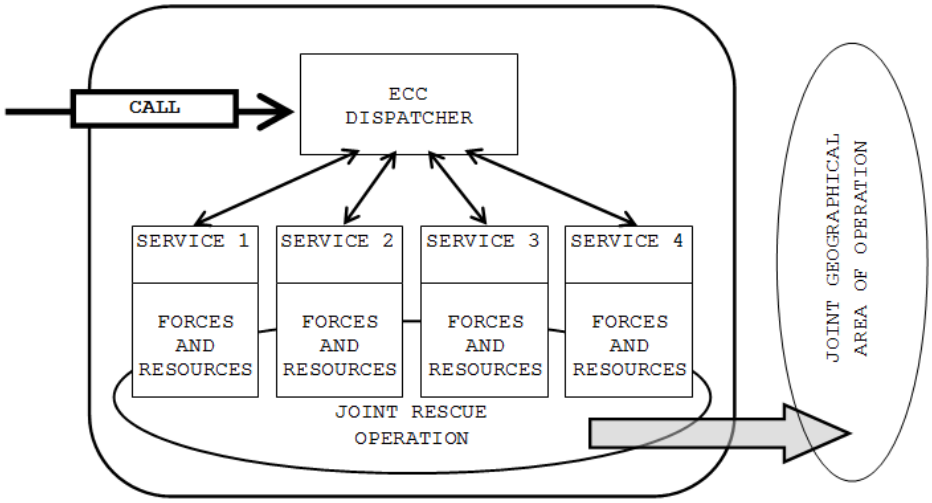

Fig. 7.2 Structure of organization and information flow to emergency services and preventive integrated by Emergency Call Center (ECC)

In order to integrate the joint was responsible for all services dispatcher dispatchers tasks of the services. The integrated management system is having the resources of all available

emergency services and preventive measures. Notification requiring the intervention effect (by phone - call number 112) directly to the dispatcher Emergency Call Center (ECC). The tasks of the dispatcher is selecting the resources under his emergency services and preventive measures required for the application

Integration of preventive and emergency services requires the creation of the organizational structure of the sub ECC. The flow of information in this structure must allow the ECC ability to implement all relevant processes through emergency services and preventive measures.

7.3.2 Operational model the emergency services and preventive

Fig. 7.3 shows the model of the integrated structure of the ECC and its subordinate organization of the emergency services and prevention. The illustration shows the flow of information and the allocation of forces and resources from where they are stationed at the place of the event. Onlooker forward to ECC information about the event taking place in the activities of subordinate ECC staff. Based on the incoming dispatcher ECC application decides to send the action appropriate emergency services and preventive announcing the alarm. Announcement of the alarm causes the allocation of resources from where they are stationed (depot fire, the command / police station) to which the event occurred in the area of operation.

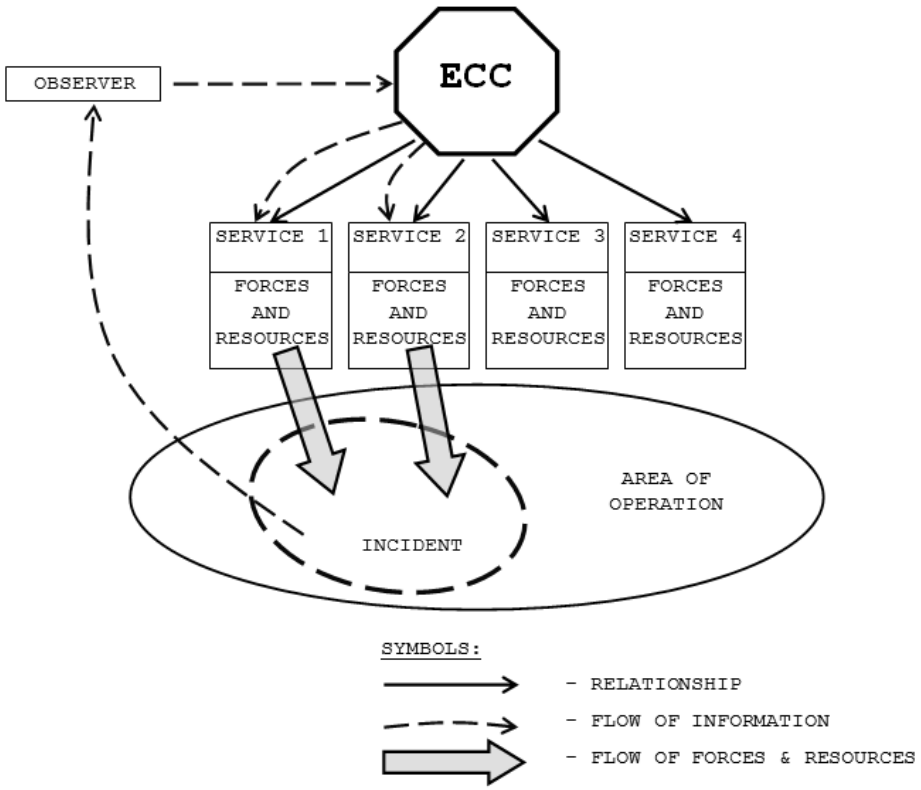

Fig. 7.3 Integrated organization model of ECC

7.4 Support ECC by GIS technology

Fig. 7.4 shows the GIS system in supporting the ECC. GIS is a database of models here for rescue and preventive measures, which are divided into basic and thematic layer repre-

sented as 2D and 3D models and photos of the real world. GIS is entering information about the event, which identifies potential risks factors induced crises. By factors of crises we understand all the factors that influence the course of rescue and preventive changing boundary conditions of shares in such a way that dispatcher ECC does not have a ready roadmap aimed at addressing the crisis situation. The output of GIS is the information about the event, potential risks (factors of crisis) and the forces and resources needed to counter the threat environment.

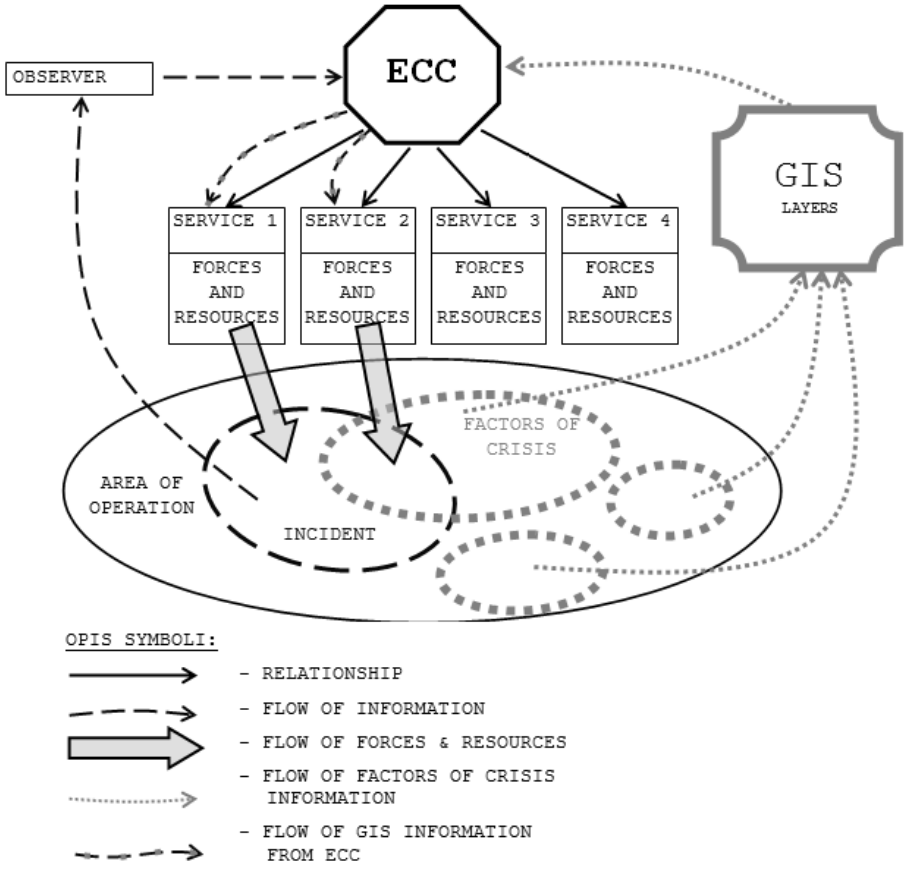

Fig. 7.4 Support ECC by GIS technology

To enhance the effects of ECC proposed information systems using GIS technology to collect information on the operations of the emergency and preventive measures used in the structure of ECC. Fig. 7.4 shows the flow of information about factors crisis, which is the basis of decisions taken by the commanders of the various departments of the use of specialized rescue equipment and qualified staff. The transfer of these decisions to the ECC requires a method of forecasting the impact of the action when an emergency event. We assume that the decisions of the ECC will use the information on the factors of crisis in order to effectively counteract them. GIS is therefore proposed as a source of information about factors in emergency rescue and prevention.

ECC support system using GIS technology can perform the following functions:

- The flow of information about events will ensure that the system of emergency services and preventive integrate previously independent rescue services and preventive,

- for planning and controlling operations forces units and emergency measures and preventive,
- The allocation of forces and sources of prevention and rescue services in the area of operation,
- Minimizing of losses by analyzing the effects of planned decisions.

7.4.1 The concept of supporting the mass events organization

Mass Events Organiser (MEO) is available forces and means of such emergency and preventive services, such as police, fire brigade, municipal police, ambulance services, security sports facility, a number of professional services such as gas emergency, ambulance, water, energy and others. The use of GIS technology: digital maps, layers, relational databases, supplemented by 2D and 3D models, images and videos is designed to support MEO activities in the field. In this light, it is important (in terms of the success of the mass event), what information is required for proper operation: prevention and intervention. Concept to solve this problem is the availability of maps, which is compiling the information needed for MEO. Map availability implemented in the GIS to be an active tool support MEO.

Fig. 7.5 shows the concept of the use of GIS technology in supporting events.

Protection mass events requires the MEO organization of activities of command divisional with a clear hierarchy of responsibility. The planning of preventive measures is proposed to use the simulation to create a scenario of possible events in the course of variants: a peaceful and aggressive (and, where appropriate: a few in between).

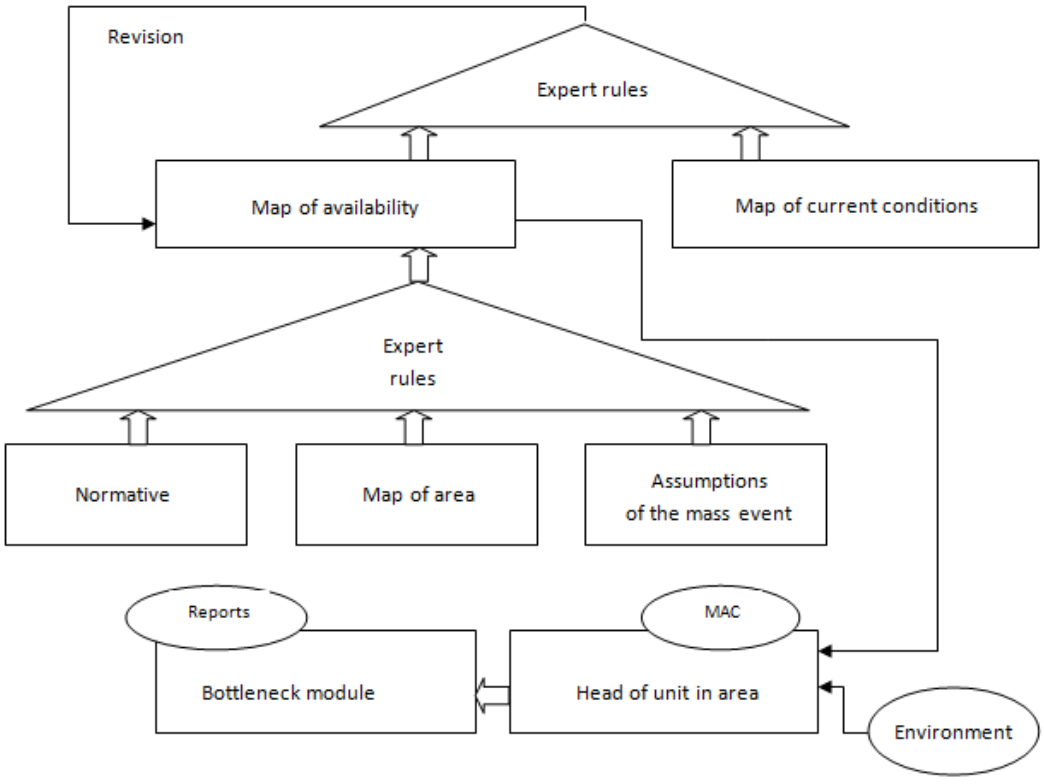

Fig. 7.5 The use of GIS technology in supporting mass events

In order to secure the event must be allocated forces and resources for the implementation of both (and indirect) scenarios in the event. To achieve this goal are required norms stored in a database. The use of a computer system based on GIS technology as a tool for constructing scenarios in the context of territorial and geographical of mass event is geographical and territorial map. GIS system must be complemented by the security norms of the mass event emergency services and preventive measures to take part in activities included in the relational database. The end result of the use of GIS technology supplemented by norms (like police, fire, ambulance, etc.) will map the availability of necessary forces and resources to secure the mass event - as the application of normative with specific indicators to mass events.

For Map of availability provides another support system module, which is map the boundary conditions. Map of the boundary conditions is a map for current conditions of mass events, which include fixed factors and variable factors. The permanent conditions are in particular include topography, infrastructure, organization of public events, access roads, environment variables, etc. The conditions of the mass event should include, inter alia, time of year, month, day, weather conditions, unforeseen changes in conditions of permanent change.

Module Map of current conditions will include expert rule gives the normative questions arising from the map of availability. The task of map of current conditions is to verify the through expert rules the map of availability. Projected Mobile Agent Communications - MAC - which is the use of MEO during a mass event will check and verify the boundary conditions of the event. MAC - in reference to the prototype system solutions running application propose to build a computer system based on the web. MEO Dispatch Center and centers of decision-making at all levels, and above all the service operating in the area as police cars, municipal, special vehicles and emergency ambulances, field command centers should have access to intelligent integrated system. It is, therefore, provide these services with the computers that are connected to the central system. With the MAC all services know how to allocate forces and resources in the field with real-time presented resolve the situation, the escalation and ways of prevention.

The third module of the system - proposed to develop in the future - is the Bottleneck module. The module will be removing the bottleneck caused by a collision prescriptive normative questions. The next task will be to sign the decisions to construct possible future Map of availability. The bottleneck module tests are carried out - identifying conflicts and critical events that occur during the course of public events. In the event of an incident a "bottleneck" in the local commander makes decisions on the spot. Module development bottleneck should go towards answering the question whether this module is able to remove the same type of event "bottleneck".

7.5 Augmented Reality

Augmented realist (AR) (augmented reality based on information technology) is a concept of a computer system linking the real world with real-time generated virtual world. Typically such a problem using the image from the camera, which is superimposed in real-time generated graphics to supplement the real world seen by the information in accordance with the context of the observer. For example, you can AR with translucent goggles to observe the ongo-

ing life on the streets and at the same time, computer-generated elements applied to the real world. Perceiving reality as the system expanded to distinguish the three characteristics: they combine the real world and virtual reality, interactive real-time and allowing the user freedom of movement in three dimensions. The use of AR in different areas of science and business is today not only curiosity but a necessity. Examples are areas such as:

- Medicine - medical imaging, combined with modern techniques as nuclear magnetic resonance imaging, doctors can have access to information on the structure and function of internal organs of the patient,
- Aviation - the instruments on-board pilots show important data on the state machine of flight conditions and terrain,
- Training - ar provides trainees the necessary data about the objects over which the training is carried out,
- Museums - exhibited items may be marked with information such as historical context or place of discovery of the artifact,
- Marketing - ar markers used during marketing campaigns complement your product for additional information.

7.6 Implementation of AR in LAYAR technology

LAYAR is the name of a dedicated real-time browser for mobile handsets. Use your browser LAYAR aims to introduce the extended reality - AR for use by the users of these mobile devices. LAYAR application was designed and constructed by the Dutch company SPRXmobile and immediately gained popularity with the introduction of a free browser to the Android Market (Google now Play) designed for mobile phones based on Android operating system. Only later the application was also introduced to the iPhone and is available free of charge in the Apple AppStore.

Application requires the cooperation of the built-in phone: compass, accelerometer, GPS and cameras. The application displays the real image on the screen of the camera phone for additional information. This kind of support is actually called augmented reality. Information dedicated to mobile phones with working application are LAYAR such as the location of nearby restaurants, service outlets, museums, shopping, public transport and other information entered by the application developers point briefly called POI - Points of Interest.

Browser using the following steps: built-in camera, compass, GPS and accelerometer using them together to identify the user's location and field of view. Depending on the geographical location of different forms of data are shown in the camera's view. Presented in this way are called dedicated layers. The data in the browser are stored in the form of layers.

The Layar architecture basically has 5 components shown on fig. 7.6:

- The Layar App: Client on the mobile device of the user
- The Layar Server: The heart of the Layar service, which provides the interfaces to the Layar App, the Layar Provisioning platform and the external Layar Service Providers.
- The Layar publishing (provisioning) Website: A website on which developers can submit new layers, manage their layers and accounts.

- The Layar Service Providers that will be created by the developers. Layers based on Funda, Hyves, Flickr are examples.
- The layer Content Sources that provide the content to be viewed in the Layar browser, like Flickr.com for example. Layer Content Sources are not necessarily separated from the Layar Service Providers, but will in general be different logical entities, as existing geo-coded databases and web services don't support the Layar Developer API.

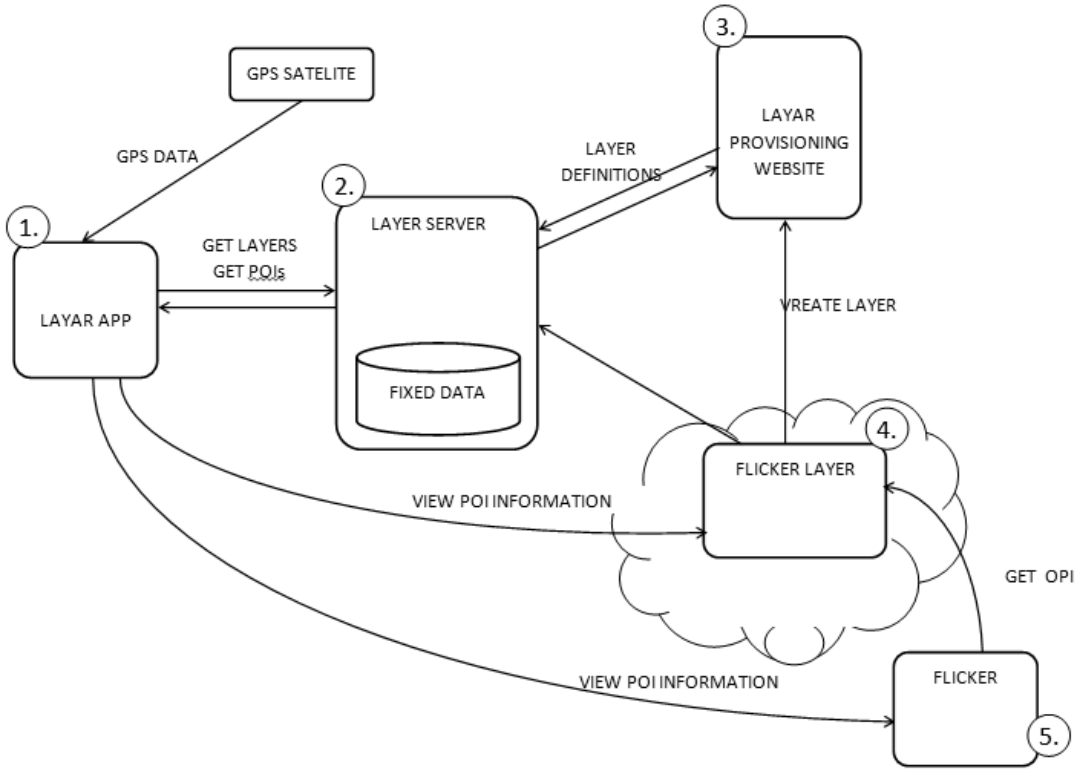

Fig. 7.6 Architecture of LAYAR technology

7.7 Data collection of support the rescue system

7.7.1 GIS as a source and tool for collecting information on the crisis situations

Current performance and capacity of computer systems allows you to collect and share data sets with large sizes. Given the decision support in a crisis becoming a problem to obtain data describing the potential crisis situations. These data must be comprehensive and reliable to decisions based on them led to the rapid and proper completion of the rescue operation.

For data collection about an emergency we offer recording the progress of such a situation in GIS. Suppose that the ECC unit as with the emergency services and prevention is assisted by GIS. This support is intended to provide geographic information needed to drive the forces of the dispatcher services during a crisis. Geographic information in GIS is stored in layers. This gives a basis for gathering information on relevant factors of an emergency. The information collected in GIS, arranged in layers, you can then make available for decision support at all levels of the organization during a crisis.

The GIS system assist of dispatcher ECC are shown in the course of an emergency and information supplied by the GIS system. This crisis scenario runs as follows:

- The place of action,
- Surrounding the place of action,
- Rescue operations,
- Information from the gis as the visualization of the action,
- Information about potential environmental hazards,
- Location of facilities and chemical plants, gas, power, thermal, nuclear, etc.,
- The deployment of road transport of dangerous substances,
- Gis as the visualization of the area of environmental hazards.

At various stages of an emergency GIS system is a source of information. With the development of this situation, new information about the crisis are stored in the GIS system on the new layer in the context of an existing geographic information.

7.7.2 Flow of information during emergency

7.7.2.1 The place of action

Telephone call (application number 112) to ECC by an eyewitness/observer. Dispatcher ECC on a digital map (GIS) locates the object covered by the fire on the basis of the verbal description of the applicant and the specified address. At this stage it is possible to verify the reliability of reporting by comparing the information from the applicant to address GIS database - an example in fig. 7.7.

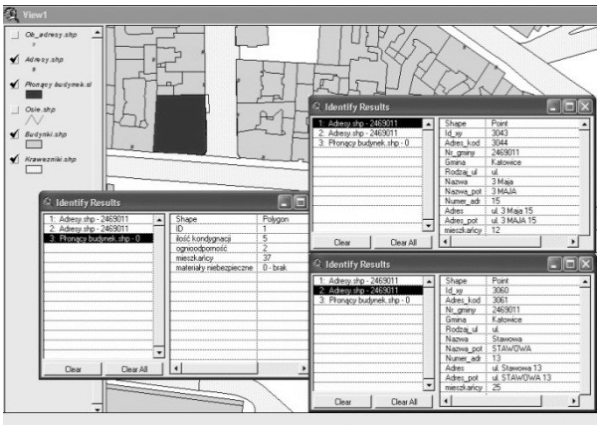

Fig. 7.7 Layer of the object at risk

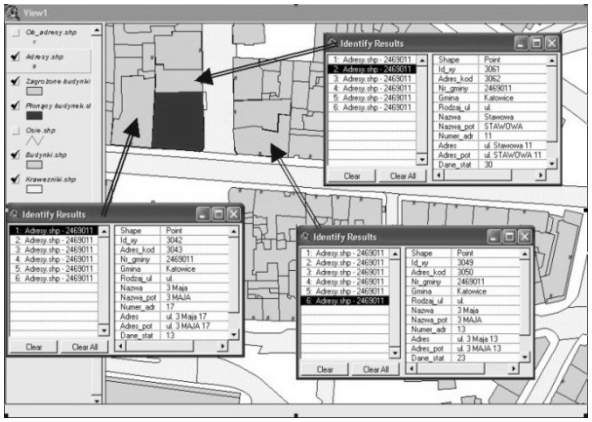

Fig. 7.8 Layer facilities combined

Tasks for GIS layers "The place of action":

- Verification of address / addresses of the building on fire,
- Determine the number of inhabitants of the building (for a possible evacuation of residents)
- To establish the fire resistance of the building in order to determine the degree of risk,
- Determine the number of stories in order to determine the difficulty of rescue,

- Determine the type of hazardous substance stored in the building to assess the impact of the environment.

7.7.2.2 Surrounding the place of action

GIS technology will automatically give the dispatcher information about objects that are associated spatially (geographically), which is directly adjacent to the building on fire. For objects at risk may also include buildings that the fire in front of the building across the street. Their display can be done automatically in GIS or through selection by the dispatcher. Example in Fig. 7.8, fig. 7.9 and fig. 7.10.

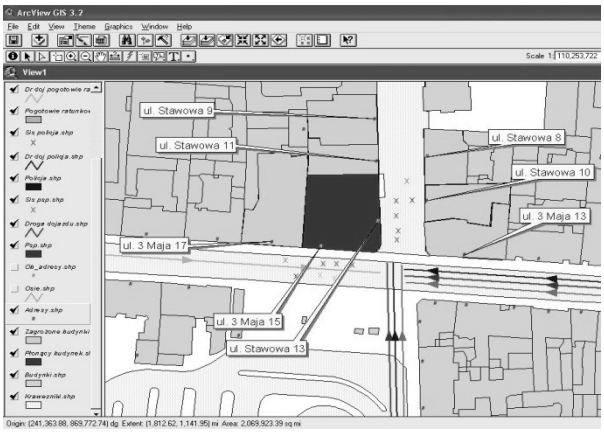

Fig. 7.9 Layer of addresses

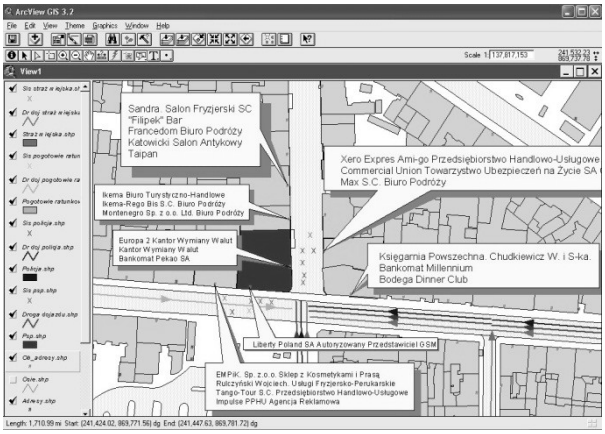

Fig. 7.10 Layer of extended addresses

Tasks for GIS layers "Surrounding the place of action":

- Indication of the imminent (surrounding) danger of buildings,
- Determination of number of residents provided to evacuate,
- Determination of hazardous substances are located in buildings.

7.7.2.3 Rescue operations

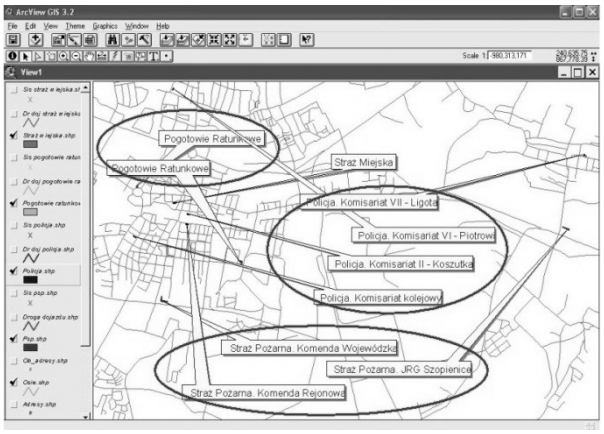

Fig. 7.11 Layer of forces and resources

Based on the input data, which include: the type of hazard, a place of danger zones, a kind of distress places, the impact of hazards on the environment, direct vicinity of buildings

at risk. The dispatcher takes the salvage and prevention through the selection and indication of the strength and resources. Fig. 7.11 shows an example.

Tasks for GIS layers "Rescue operations":

- Visualization of forces and resources of rescue services and preventive,
- Indication of the emergency services units and preventive.

7.7.2.4 Location of the State Fire Service

GIS technology automatically shows the dispatcher the nearest fire brigade unit. Dedicated software determines the shortest access route from the place of stationing Rescue and fire fighting units, while proposing alternative directions for each group of vehicles. On this basis, generate "Layer of road to…" - an example in fig. 7.12. The proposed route directions can be different due to the time of day, week or year, the current state of traffic, the presence of local restrictions of movement (repair of roads, detours, etc.).

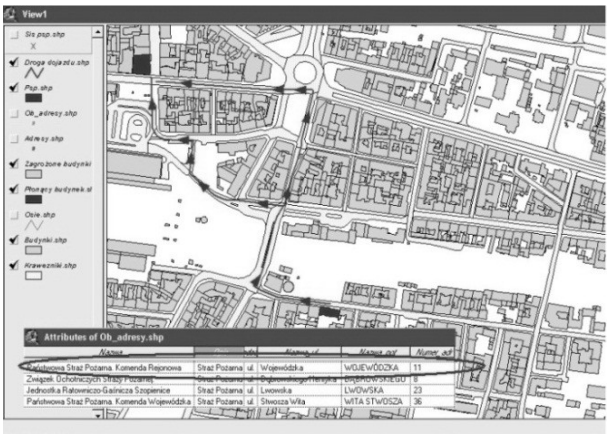

Fig. 7.12 Layer of road to…

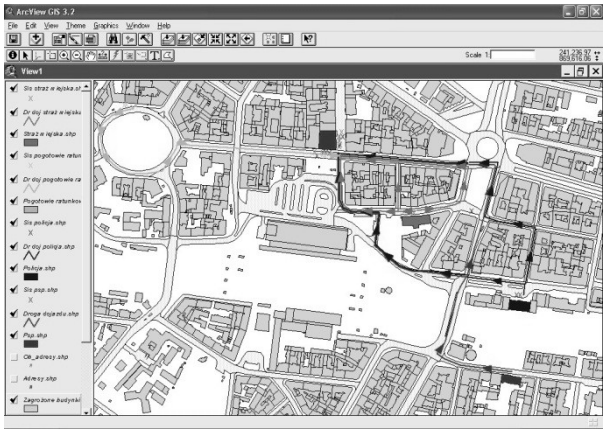

Fig. 7.13 Information from the GIS as the visualization of the action

Tasks for GIS layers "Location of the State Fire Service":

- Presentation of the available forces and resources,
- Indication of the forces and resources,
- Visualization of traveling to the action.

7.7.2.5 Information from the GIS as the visualization of the action

For illustrative purposes, fig. 7.13 shows an illustration of all the GIS layers that were used to create the model, the course of rescue and preventive.

7.7.2.6 Information about potential environmental hazards

Development of environmental hazard information on the area of ECC is to identify objects that are a potential source of danger. Given the type of area of operation ECC, if this is the type of city, you can identify the following sources of potential hazards:

- Warehouses of dangerous substances,
- Gas installations, power, thermal, nuclear, etc.
- Road transport of dangerous substances.

Using information about the sources of risk can be presented in a GIS to estimate the area of environmental impact. Examples of GIS developed for localized sources in urban areas.

7.7.2.7 Location of facilities and chemical plants, gas, power, thermal, nuclear, etc.

Fig. 7.14 shows an example of the location of landfills for hazardous chemical substances. Different color marker "X" correspond to different substances, as follows:

- Red - flammable fuel, gas stations,
- Pink - general chemicals,
- Green - toxic chemicals,
- Orange - radioactive substances.

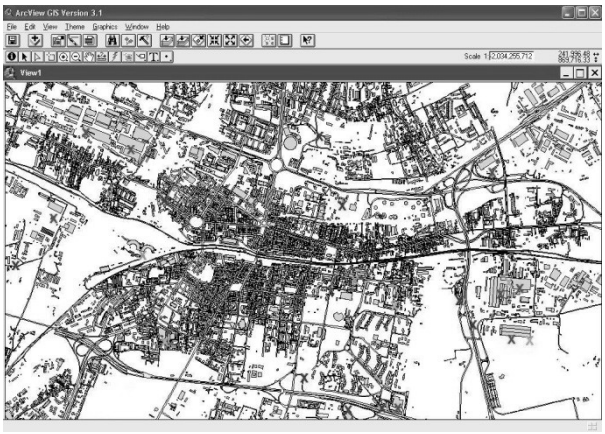

Fig. 7.14 Hazardous substances

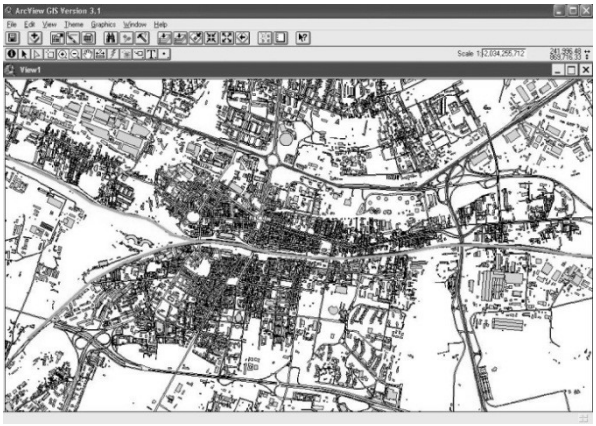

Fig. 7.15 Road transport

7.7.2.8 The deployment of road transport of dangerous substances

In fig. 7.15 are located in the road transport of hazardous materials. Red routes are marked with road transport – road transit – hazardous materials. Are marked in green rail road.

7.7.2.9 GIS as the visualization of the area of environmental hazards

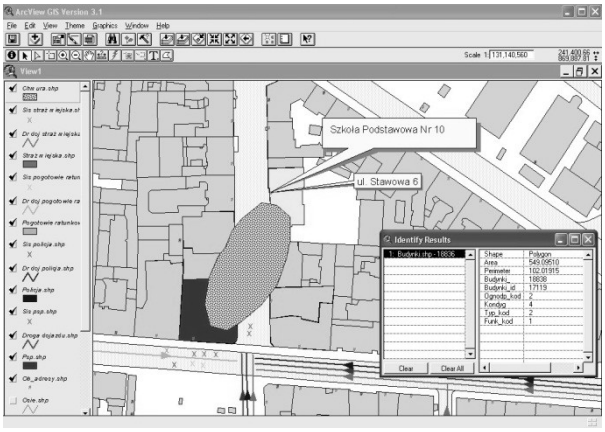

Fig. 7.16 Fire caused cloud

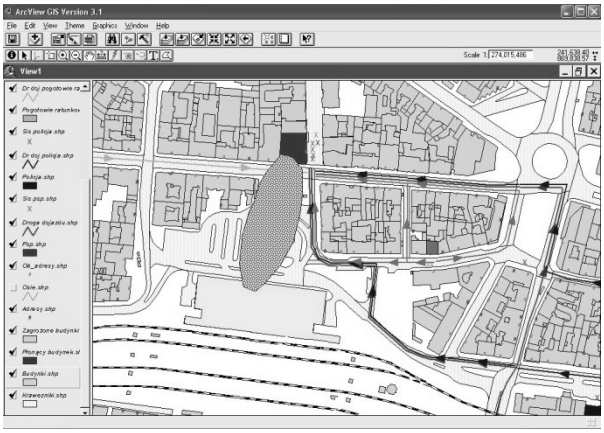

Fig. 7.17 Fire caused cloud – after-effects

Fig. 7.16 is shown the area covered by the GIS visualization of environmental risks, which is a fire. Rising from an object in burning cloud of toxic substances directly affect objects in close proximity, in this case the primary school building.

Fig. 7.17 is shown the area covered by the GIS visualization of environmental risks, which is a fire. Rising from an object in burning cloud of toxic substances can act directly on the objects in the immediate vicinity and further accordance with the development events, which is a fire. The illustration shows the effect of clouds on the railway station and bus hub transport.

7.8 Summary

Crises caused by the complexity of systems created by humans, are essentially unique. This puts special demands on the organization of emergency services and preventive measures. The smooth operation of services depends on both their organization and flow of information. The paper discusses the problem of the flow of information needed for decision making at all levels of an organization. Dynamics and rescue environment imposes specific requirements on access to information.

Currently, the development of methods and tools allowing transmission of AR information to support decisions on a wide range of activities undertaken by man. Decision support tools for AR is an important contribution to this need. The paper presents the concept of applying this technology to aid the flow of information at the operational level rescue organization. Discussion of this concept has been extended to the case study application of GIS tools, both as a source of information for the operational level of crisis as shares and tools to gather information on the progress of such action. The target information so gathered and organized can be used to support the operational level of crisis. On this basis, one can consider that the tools AR may significantly contribute to the success of the operation of the emergency services and police.

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