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Smart city, Safety and Security

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Abstract

Nowadays, cities across the world are one after another trying to become so called Smart Cities. In this paper we propose several ideas on how to define the concept of Smart City, including our own. However, our main focus will be on the question of the safety and security in such cities in the future. Our study of the Smart City program shows the lack of importance which is being given to this topic. Because of that, we are inspired to introduce our definition of a Safe City. Along with the topics of safety and security, we also provide the reader with an insight into the importance and use of the modelling and simulations in a Safe City.

1. Introduction

The development of cities or regions can have different forms. Great advance in technology of the last millennium pushed the world forward by enormous leaps. But by the time, also negative effects of this progress had shown up, and they are getting into the awareness of society by already changing the Earth. And according to authorities, for example from NATO, in the future such effects may become serious problems for population, as well as for the whole ecosystem. Those might be air pollution, global warming, population growth, and so on [1].

All of these changes lead to calls for innovative solutions of improvement, that would bring sustainability of mankind and nature along. There is an effort to find possibilities, that will keep society moving forward, but at the same time they will try to minimalize or eliminate risks and damage towards society and ecosystem. From this

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philosophy comes up the term of sustainable development. According to National strategy of long-term sustainable development of Slovak Republic it means such development, that ensures the possibility to satisfy basic living needs of generations of today and those to come, while the diversity of nature is not harmed, and natural functions of ecosystems are preserved [2]. However, from our point of view, concerning only the basic living needs is not the way we should see the future. We see it as a chance to grow, to improve our lives, even to afford luxury, but all in the safe, harmless way, described above by the strategy. Technologies, that enable sustainable development in cities and their application are matters of the Smart City concept.

In introduction to Smart City concept we need to answer some basic questions. First of all: what is the goal of this concept? We can say that the goal is to transform cities of today into smart cities, enabling sustainable development in the future. That leads us to another question: what makes the city „smart"?

Many authorities are trying to answer this question. Examples, which affected our work and views, are mainly Caragliu, Mohanty, Kumar, Finka and Fedorov. But the one, explicit definition is not agreed yet. Studied definitions of Smart Cities are general descriptions, mentioning various priorities, from the use of technology to smart use of natural sources [3, 4, 5, 6, 7].

2. Smart City Concept

According to Caragliu, the city becomes smart, „when investments in human and social capital and traditional and modern Information and Communication Technology (ICT) fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance." [3].

Mohanty considers Smart City as „a place where traditional networks and services are made more flexible, efficient, and sustainable with the use of information, digital and telecommunication technologies, to improve its operations for the benefit of its inhabitants. Smart cities are greener, safer, faster and friendlier." [4].

Based on those and more various sources, we formed our own characteristics of Smart City, to set a base ground for our further research. For us, the Smart City by the integration of technology and natural environment increases the effectiveness of processes in every field of its functioning, in order to achieve sustainable development, safety and health of inhabitants with the aim for increasing the quality of life of citizens, near community and environment.

Construction of Smart cities is a process, transforming cities to Smart Cities through implementation of Smart City concept systems.

3. Systems of Smart City Concept

Views and opinions on how the Smart City should look like, what concrete improvements it should bring and what problems to solve, differ in various parts of the world. For example, there would be different priorities in the city behind the polar circle with minimal criminality, than in the city near the equator, suffering from vandalism. But in general, solved problems can be summed up into main fields. In our study of this topic, we encountered lack of focus, given to the field of safety. Hence, we compiled our own list of Smart City systems, including safety aspect: Safe City, as it is pictured on Figure 1. Our thoughts on Smart City, influenced mainly by the work of Mohanty and Center of Regional Science in Vienna include these systems [4, 8]:

- Smart Transport,
- Smart Energy,
- Smart Technology,
- Smart Living,
- Smart Environment,
- Smart Citizens and Education,
- Smart Economy,
- Smart Government,
- Safe City.

Specific case is the position of Internet of Things and Cloud. Those are not independent systems, but rather basic tools to achieve described needs. Safe Cities as an important part of Smart Cities will be described more closely in
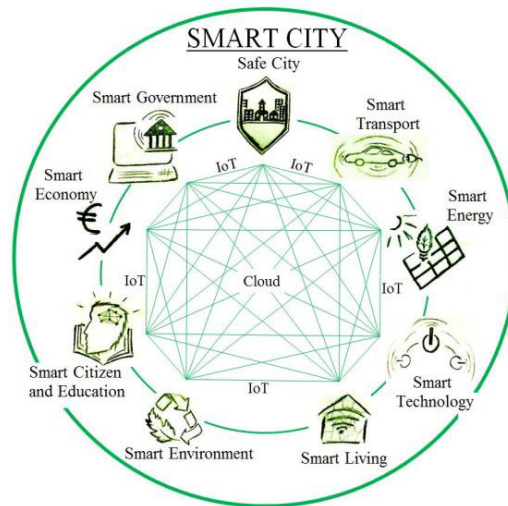
the following chapters.

Fig. 1. Systems of a Smart City

4. Safe City and its Features

The field of safety seems to be underrated in many studied works. But even back up from Maslow's hierarchy of needs we can see, that safety is a crucial component of life quality in every city. Therefore we can say that every Smart City must be a Safe City as well.

Intelligent development of cities in this field is the goal of program Safer City, launched at 1996 by organization UN-Habitat at the request of African Mayors. This program is characterized by more phases, in which the thought of Safer City was formed. The first phase was aimed at the urban crime prevention approach, mainly at three fields: institutional crime and violence prevention, social crime prevention and the physical environment. In second phase the view on the city safety expanded with two new fields. The first one was security of tenure and forced evictions, because the ownership of estates is the reason of conflicts and violence in some countries. Another part was the solution of natural disasters and the effort to prevent lawlessness during their duration. The third phase brings the use of planning, management and governance, while emphasising, that those three should not be divided components. They are connected, refining and enhancing each other in the aim of comprehensive approach on safety in the city. The last two phases are about integration of local authorities and their active approach towards safety and reviewing the state of safety in world cities conference [9].

At this point we should remind ourselves, that mentioned fields are not enough to consider those solutions to be complex. Natural disasters are just one of the subgroups of emergencies, that can threaten cities and their citizens. Forgotten types of emergencies, according to definitions of Slovak Republic are accidents, catastrophes, terroristic attacks, and threat to the public health of II. degree.

That is why we will introduce also our own perspective.We can see the Safe City as a part of Smart City, one of its subsystems, that covers all safety aspects within the city. Smart technologies have many purposes and those, used in the field of safety are building up the Safe City system. Our general description of a Safe City is influenced by the view of Fedorov et. al. from 2012 [7]. It will be similar to the description of a Smart City: Safe City is a city, that by the integration of technology and natural environment increases the effectiveness of processes in the field of safety, in order to reduce crime and terror threats, to allow its citizens life in healthy environment and simple access to healthcare, and to achieve readiness and quick response to threatening or arose emergencies.

Safe City system should include following features:
- healthcare,
- smart traffic systems and routes,
- smart safety systems for surveillance, search, detection and identification,

- smart systems of crisis management to support decision making, early warning, monitoring and forecasting emergencies and environmental situation,
- centrally operated units of police and Integrated Rescue System (IRS),
- safe internet connection and data protection,
- centres of data processing,
- and others.

5. Informational Components of Safe City System

Every feature can be further branched into concrete components, connected together by Internet of Things or by other means. Based on the application of those components, we can evaluate the level of smartness of the system, and city. That´s where the Smart City Indicator will take place. However, we still need to create a relevant method for this evaluation. Simple count of components, applied in the system can´t be used. Because the city with two components of the Safe City feature missing would be considered less safe, than the city with only one such component missing. Even though those two components in the first case are not really needed in first city and the one component, missing in the second case is crucial for the second one. That means we also have to take into consideration the results of risk analysis from each city.

To completely sum up the components of each feature is nearly impossible. The development of technologies, that might improve features and systems of Smart City is too fast to make a list of every possible solution. And even if we did it, the list would be outdated very soon. That is also why we left the Safe City system opened for other incoming features. But we can take a look at some of the components from the feature of smart traffic systems and routes that might bring many informational sources and possibilities, not yet used by crisis management.

Examples are smart cars themselves. Their ability to communicate between themselves and environment allows us to collect data about traffic flow, obstacles on the road, road condition and so on. But they can also analyse those received data by themselves and adjust to the situation. Those are base abilities in the development of autonomous driving.

Many supporters of this technology point out, that majority of traffic accidents are caused by driver´s fault. From the statistics, accessed by the police forces of Slovakia, 96% of every traffic accident in Slovakia is caused by human factor [10]. We can assume, that autonomous cars will reduce the amount of accidents by strictly following the traffic rules, but there are still another safety-oriented questions, yet unanswered, and causing controversy. For example: how are we going to deal with the cases of traffic accidents, caused by autonomous driving car? What should we expect from coexistence of human drivers with autopilots? Or: should we disable the chance of living passenger to turn off the autopilot and to take over the control of the car? Because we mustn't forget, that technology may suffer malfunction too, and that everything programmed can be hacked…

A contribution to individual safety for smart cars passengers is also the possibility of notification of predetermined mobile contacts and emergency call 112 about the traffic accident. Therefore, even in the case of traffic accident in abandoned route, ended in the fall of passengers unconscious, there will be a help coming. European Commision aims at making this system mandatory in cars from 2018, as previous attempt, with the deadline at 2015 was not successful [11].

When it comes to smart routes, those are not related to information systems so obviously, but are parts of smart solutions anyway. By those we mean the city to be built in such a way, that every citizen, even mothers with baby strollers or little children, or those bound on the wheelchair, will be able to get to every public part of the city with ease. Other components are routes for cyclists, by-pass highways, pedestrian subways, eventually green bridges for animals, in the case of need etc.

For effective use of gathered information it will be needed to create a central system, through which components, features and systems will communicate - local Cloud. We mentioned before, that Cloud is not a component, feature or system of its own, but a connecting tool. It is a virtual central storage that needs to be capable of affiliating a great amount of data and of quick administration to authorized requesters. Tools for data analysis need to be connected to the storage as well.

The use of this system would help not only in traffic, but in other Smart City systems as well. For Safe City system we can mention possibilities of use in crisis management:

- creation of informative sheets of dangerous materials, databases of available sources, personnel and possible threats,
- provision of early warning and notification system,
- support of decision making and salvage operations coordination,
- fast and reliable exchange of information during emergency reaction [12].

Generally, by the data storage in central Cloud, the work with information would be easier. That´s also the reason, why we can consider the urban Cloud system to be the core of Smart City concept.

6. Modelling and Simulations as Components in Crisis Management Feature

Among the Safe City features, there are cases, where component belongs to more than one feature. In this chapter we present an importance of component, that connects traffic feature mainly with systems for support of decision making in crisis management. In this field we are looking for ways to improve crisis management by using modelling and simulations in processes of preparation and solution of emergencies, using the laboratory of modelling and simulations of crisis phenomena in transport. The program we use in laboratory is VR Forces, which can be used to simulate traffic situation on selected map, to look for a way to simplify traffic flow, and the main purpose is to simulate different types of emergency phenomena.

6.1. Modelling and Simulations in Preparation Process

In this process our goal is to set up a place, where executives of crisis management of the city will be able to train their ability to react quickly on emergency. By modelling cases, where certain emergency will emerge and by letting executives deal with them, we hope to enhance their readiness – efficient and mental. By praxis, gained by solving simulated cases, operating team will find out weaknesses in their readiness, such as poor cooperation, knowledge and so on. The program will also simulate the results of their work in real time. Therefore members of the team will experience the stress of making decisions during the emergency, with possibility that their virtual "citizens" will "die". The program is able to set the phenomena in a real background, and it is possible to make it recognize the roads, so that our own vehicles, sent to solve the problem, will follow them.

6.2. Modelling and Simulations in Process of Emergency Solution

As a mean to support of decision making during the real emergency, simulation can be of use too. Our ambition is to present an informative connection, coherent with the philosophy of Smart and Safe Cities. Our vision of connection includes systems from every relevant source with the simulation engine. Concrete components are summed up in the model of proposed connection, shown in the figure number 2.
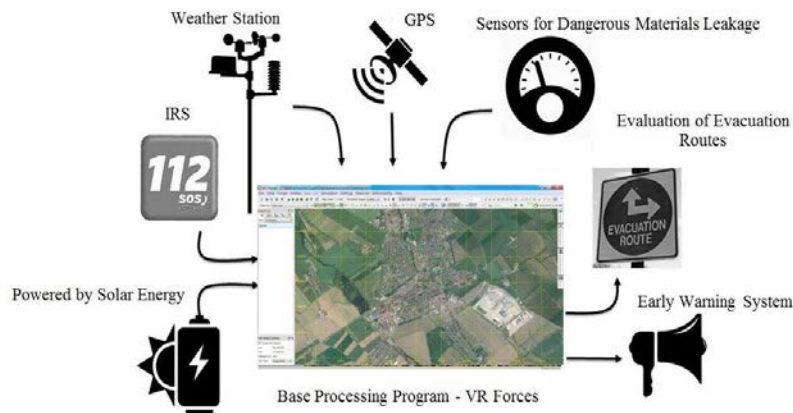

Fig.2. Model of Simulation Centre.

The idea is in the connectivity of all pictured parts. Thanks to this connection, simulation program will be able to identify the rise of emergency, to display actual state of situation on the map and to simulate its progress in real time or accelerated, while considering actual weather conditions. Because not every emergency starts at some facility, that would be connected with our system – for example traffic emergencies, there is also communication channel with IRS units needed. Through this channel, IRS personnel can let the system know about all the other serious emergencies, and also add to the simulation information, that will specify the situation – for example precise amount of civilians in the area, cars etc. To those subjects, which will offer their plans for evacuation, the program would be able to advise the best route to use in given situation.

Thanks to such simulation, the program might strongly help executives with decision making. As they would know, how the situation will develop, they would be able to come up with more adequate decisions.

To achieve those results is the goal of our ongoing research. It will focus on the creation of function connection between software, depicted in the model and on its implementation into the use of crisis management in the city of Žilina. It will also establish the method for safety rankings within cities of Slovakia.

7. Conclusion

To become a Smart City is a very broad task. We cleared out what it means for us and what systems Smart City should include. As we looked more closely at one system: Safe City, many other features inside of one system were revealed. This variety of possibilities in every system makes the whole concept of Smart City impossible to sum up in one article. Even in one system we had to choose only a few ideas, describing its intents. We focused more closely at transport field and at the topic of our own research: modelling and simulations. But to create a method for evaluation of Smart Cities, main components of every feature and every system will need to be defined, along with assignment of their importance in evaluated city. In this evaluation, cities will see their strengths and weaknesses and they will know what to improve. Generally, we should remind us, that in all the fields, the development of technology must be followed by the education of citizens about their use. Even the most advanced Smart City failed to fulfil its purpose, if the feature of Smart Citizen and Education will be missing. And that might become a task, more challenging, than one might anticipate.

Acknowledgements

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