

Future of the surveillance systems - examining the mobile robots influence on people's collective behaviour in the social area of an international airport

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Abstract. This paper presents the objectives of the project, as currently executed in the Industrial Research Institute for Automation and Measurements PIAP, which is focused on examining the mobile robots influence on the people's collective behaviour. The main objective is to identify and interpret the factors, which can drive or impede the common mobile robots application in a busy human environment. The paper also explains the necessity of mobile robots application in systems dedicated to the public safety and security, which would increase the level of necessary surveillance of the infrastructure and people, at specific social area of the international airport. Mobile robots operating in the airport space can enable the security staff to detect the suspicious and dangerous events in a more efficient way. Complementing existing surveillance systems with such devices would significantly enhance the processes of perception and decision making, in reference to preventing or reacting to probable threats.

Keywords: mobile robot, acceptance, airport, collective behaviour, surveillance, public safety.

Introduction

This paper illustrates the current phase of the research, aimed at testing and describing the possible patterns in collective human behaviour connected with introduction of the mobile robot into the international airport area.

Modern society is exposed on many crisis situations as well as public safety threats. Currently range of operations limiting influence of growing threat are undertaken in compound city environment. Conduct of scientific research in a range of process evolution of threat and seeking manners of holding off them should be included as an important task in this range. Development of surveillance as well as monitoring of collective human behavior systems, particularly spontaneous crowd, are challenging researches for constructing supporting decision making information system and systems of crisis situation management.

Current issue of projects of the European Defence Agency and the framework programmes in security priority focuses on creating new technologies that will contribute to more effectively protect European forces responsible for protection against sudden and hidden threats. We can rate to them inter alia the development of improved surveillance systems, which implies increasing capacity defensive maneuvers European forces responsible for security as well as developing tools to help perception and decision making.

Currently in Industrial Research Institute for Automation and Measurement are carried out studies on the mobile robots influence for collective human behavior. These researches can serve as an effective tool for decision-making in crisis situations, in which significant role has spontaneous crowd (e.g. organization movement of large numbers of people and evacuation etc.) and where robotic device can be applicable.

Researching of people's acceptance level is key question of project, how far can move surveillance and control of people, so that sense of safety and comfort was balanced properly.

It was recognized in project, that one of most natural environment of work and implementation of mobile robots is social area of the international airport.

A key issue is therefore whether augmented surveillance airport systems enriched and extended by mobile robots will meet with the approval of travelers in the social area of airport.

Research carried out under the project are to answer the question whether passengers are aware that increased checks are to increase safety and are able to give a part of their privacy? Indirect object of the project and research in its framework is the education of people and enhancing their awareness that the presence of automation and mobile robots is among people in the future inevitable.

Adopted task flow will determine individual elements that make up the threat, which in turn will build robots implementation scenarios aiding in real situations of danger.

Current project

The growing threat of terrorism and continuous development of techniques and methods used by terrorists, influencing the growth requirements and expectations towards devices which support actions of special services. Industrial Research Institute for Automation and Measurement is the only Polish manufacturer of superior quality mobile robots for counter-terrorism. From the beginning of construction work on different types of counter-terrorism robots an active role was taken by their future users, by giving opinion to applied solutions at any stage of the construction.

Testing and evaluation of existing surveillance systems will allow decision-makers and services responsible for protection and safety, for better adjustment of both procedures and usage of technology to the needs of society and a better reaction and acceptance by citizens.

This is particularly important because surveillance affects fundamental man rights and is subject to public discourse on issues of privacy, anonymity and security.

The main research within the current project will involve the introduction anti-terrorist mobile robot SCOUT into the departures hall and observation execution as well as study of collective behaviour and human response to different behaviors robotic device, according to developed project scenarios (static and dynamic behavior). Reaction analysis is conducted using visual system, consisting of a camera equipped with an intelligent image analysis, executing observation of movement of persons, completely preserving their anonymity.

The main thesis of the project is an introduction of a mobile robot into human environment of an accidental crowd capacity, change behaviour, both for each individual and for all of the tested population as a result of direct contact with the mobile robot, for example in the departure hall.

Within project to implement research works are planned, to enable the creation of a dynamic model of crowd in contact with mobile robot.

Moreover, a series of experiments and surveys are planned to answer the essential questions and key aspects of the project:

1. Testing robot acceptance for inspection at the airport, which initially controls the cabin baggage and passengers regarding hazardous materials.

2. Survey testing travelers awareness knowledge that any of their traffic is supervised?
3. Test Survey: why people don't use the self check – at the airport? Why people don't use the facilities of the technology, accelerating check-in?
4. Test issues: whether there is a field for service robots at the airport? Will it have any application? What capabilities would they have?
5. Test issues: what is the importance of the presence of the robot against the place in which it operates, where is the actual need for the presence of the robot.

Results will also be a starting point for subsequent research on human behaviour, reactions and feelings in contact and bilateral communication with mobile robots of varying degrees of autonomy.

Furthermore, examining the level of acceptance of robot, as a permanent element of human surveillance at the airport, the goal is to amend law, help to increase flexibility in procedures and contribute to enhance the actual interest about presence of mobile robotics in airports.

Future of the surveillance systems and mobile robots implementation condition.

The increasing threat of terrorist attacks that research is ongoing on the understanding of the aggressive crowd dynamics and organization in order to reduce the risk of participants death and injury.

From hitherto carried out researches on prediction and modeling crowd behaviour, it may be concluded that the study should be more improved by increasing their methods with the latest available technical possibilities, for example image processing from camera containing intelligent video analysis system.

The almost ubiquitous application of Closed Circuit TV (CCTV) for security purposes (e.g. facility security such as manufacturing plants or banks, surveillance of public areas such as transportation hubs, etc.) has steered researchers to the obvious path of investigating the application of image processing techniques while making use of an already existing infrastructure.

Image processing follows a specific process chain that starts with raw images (coming for example from an optical camera) and concludes with some form of intelligence about a particular object. To achieve the automatic perception of images, software tools have to be capable of detecting patterns from frame to frame in order to detect

objects and people. Then, these have to be recognized as such. At this point in the chain, it's possible to determine the type of target present in the image. Subsequent steps include object/target tracking and the determination of parameters for behavioural analysis. At the end of the chain complete identification of the target based on its recognition, past actions and current behaviour can be achieved. The regular process path for image processing increases in complexity with each step as shown in Figure 1:[2]

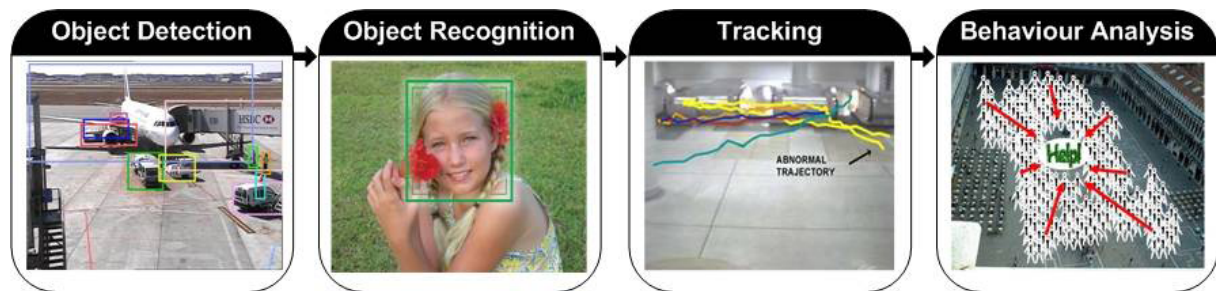


Figure 1. Image processing example

Crowds - One of the most important functionalities for security purposes is analyzing crowds. When a human looks at a complex video scene, he/she intrinsically understands the interplay between objects in the scene. Humans know how people and vehicles look like and can distinguish one object from another. Automatic detection however requires that computers perform this function. Machines still can't distinguish one object from another when there is a complex jumble of motion in a scene. The actual effort is in determining crowd behaviour, understanding its actions through the ability to detect motion flow, speed, and direction of elements of the crowd itself. These parameters can be used to infer what is happening: if a crowd moving too fast, this may indicate that something dangerous is happening; a crowd avoiding a particular area may indicate something unsafe there or a crowd moving to an epicentre may indicate someone or something attracting crowd attention.[1]

Intelligent image processing technologies are a good tool for critical decision support, ensuring a comprehensive and effective detection of events for the decision maker, along with the alarming system. The system of intelligent processing of the digital images significantly improves safety, by constant recording of events in the monitored area.

Development of the surveillance systems towards application of the most recent solutions in the field of mobile robotics, would allow to identify the threats and predict people's behaviour, especially the aggressive one. The whole joint mechanism, supported with the knowledge concerning the pre-incident signals, will enable determination of the

unusual human behaviours and the signals of possibility for occurrence of the aggressiveness or a criminal attack.

The most typical, easily noticeable warning signals, foreshadowing the possibility of a terrorist attack on the airport, which could be detected and verified by a mobile robot operating in the airport space, are for example:

- unusual behaviour of individuals/groups of people
- unattended objects: bags, suitcases, packages etc.
- individuals dressed unsuitably to the weather conditions
- cars (particularly vans) parked in unusual or restricted areas

PIAP is leading Polish public research institute specialized in development of robust and reliable systems for security applications. Our Institute is responsible for coordination TALOS project (Transportable Adaptable Patrol for Land Border Surveillance) - an international research project co-funded from EU 7th Framework Programme funds in Security priority. The main objective of TALOS project is to develop the innovative concept of a mobile, autonomous system for protecting European land borders. (Especially Polish east border). Since 2000 PIAP is a permanent supplier of mobile robots and robotic devices for special forces (Police, Army, Border Guard, Government).

We presume that the best mobile device for airport reconnaissance is small robot named SCOUT, which was successfully work out in Industrial Research Institute for Automation and Measurements.

The robot is designed for quick reconnaissance of field and places difficult to access, i.e. vehicles, chassis, places under seats in means of transportation, narrow rooms or ventilation ducts.

Solid construction of small dimensions and small weight with dynamic driving system provides high maneuverability and high speed of the robot (10 km/hr).

Application of the robot can be multiplied by mounting additional devices on its mobile base i.e.: manipulator with a grip, cameras, additional front

caterpillars, handle and cabling for recoilless disrupter, digital camera and cabling for recording the vision and microphone signals, chemical contamination detector, X-ray device, fibre-optic cable with active automatic roller.



Figure 2. SCOUT robot

SCOUT robot can be adapted to various applications: [3]

- use by special squads: neutralization of explosives, negotiations with terrorists, recording of operation course, taking Roentgen images,
- use by commercial firms: inspection of ventilation ducts, inspection of areas exposed to chemical and biological pollution, support in location of defects in places difficult to access by a man.

Condition of robot implementation in social area of the airports, as a permanent element of surveillance system is easy information for travelers that is robot a standard procedure, which aimed at improving the safety of travelers and airport critical infrastructure.

In the early stages of robot implementation it should stand at one point in the airport, at some standard check – in point, that travelers wait for as well as are aware that they must go through it.

If not, this would be another element that adds to their stress and anxiety. Setting robots to a specific location, ensure, that each man will not be omitted.

At the beginning people must be aware of robot's presence. It must be in a known point, as a procedure that travelers already know as well as what they are prepared. Main condition of faster implementation of mobile robot to the social area of the airport is proper and adoptive information in consequence provide social awareness and acceptance to this new procedures.

Conclusion

The project aims to execute study, thanks to which will be able appropriate adaptation of existing models of robots to changing needs, which result from their use in different work environments. Is also followed by developing assumptions concerning robotic devices implementation standards with wide autonomy into the human environment, especially in areas with significant potential for their use, both now and in the future.

Because key areas of using counter-terrorism robots are, inter alia, the areas of airports, ports, railway stations and other public spaces, there is a justified need to conduct research in these environments.

For the Institute as a leader in the field of mobile robots studies for safety needs, the results of the project will have a key role in developing strategies for the development of products, which contribute to improving both safety and comfort of users.

References

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