RESEARCH OF PRINCIPLES USED FOR VIDEO MOTION DETECTION IN VIDEO SURVEILLANCE SYSTEMS

MARTIN BOROŠ, ANDREJ VEĽAS & MARTIN ĎUROVEC
Faculty of Security Engineering, University of Žilina, Slovakia

ABSTRACT

This article briefly describes video motion detection used in public video surveillance systems and their technical parameters, which are helpful for correct intruder's detection. The research is based on questionnaire survey among producers of video surveillance systems. The research was focused on the importance of each technical parameter of video surveillance systems and their impact on probability of intruder's correct detection. For the relevant results, survey was addressed to 50 different producers of video surveillance systems (including top corporations in the world). The research created relevant information about technical requirements on video motion detection in video surveillance systems. This survey was realized as a part of a more comprehensive research, which is focused on the probability of correct intruder's detection through video surveillance systems.

Keywords: video motion detection, video surveillance systems, technical parameters, questionnaire survey, correct detection, relevant results, producers of video surveillance systems, relevant information, comprehensive research.

1 INTRODUCTION

The question of citizen security and the security of their property in municipalities is becoming ever more current in today's fast-paced world. It is due to this that the activity of criminal elements is focused largely on bigger towns where their operations are more common. This is, without a doubt, caused by the fact that in larger towns, people don't know each other that well or not at all whereas in small villages or in the countryside, the citizenry resembles a family and a stranger stands out immediately. Especially in conjunction with things we keep hearing every day from the media, municipalities should pay closer attention to the security of the citizens within their borders.

Municipalities can influence the security of their citizens within their borders in various ways – through technical or organizational measures or using a complete crime prevention system. While in other developed countries, the trend seems to be expansion and modernization of camera systems with several additional functions, in Slovakia, creating and setting up camera-based monitoring systems is uncommon.

Certainly, there are a number of reasons why Slovak municipalities do not seem to be interested in a camera monitoring system even though in the past, it was possible to apply for a subsidy, which at times reached 100% of the price of the whole system. One of the points of view when considering a video surveillance system are the technical capabilities. This aspect is surely the most important one and often also the most ignored one. This is caused by the fact, that the representatives of the municipality are not experts in this field and there is not enough money to pay for an expert consultant. It often follows, then, that when deciding on which video surveillance systems to purchase, they pick the one with the lowest price, or one that a neighboring municipality has also chosen.

It is therefore advisable to have studies elaborated from various suppliers in the preparatory phase of the decision-making process which would include enumerating the costs, considering the assumed increase in prices as well as yearly costs for operating the video surveillance system. It should be a matter of course and one of the main conditions

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that the video surveillance system must be able to withstand unfavorable weather conditions and its functionality must not be decreased in any of the four seasons.

Some emphasis should be placed on the transmission of signal, on which depends the quality of the image capturing. However, as was previously mentioned, municipalities many times pick the cheapest video surveillance system which feature a transmission of signal of a very low quality. Another one of the important parameters in the ability to detect movement of an intruder using the video surveillance system – video motion detection. This function counts as auxiliary; however, its value in usability – especially in town video surveillance system – is incalculable.

2 VIDEO SURVEILLANCE SYSTEMS IN SLOVAK MUNICIPALITIES

As has been mentioned, subsidies helped increase the number of video surveillance systems; paradoxically, this opportunity was taken advantage of by smaller municipalities. These often use it as a passive form of protection, which should discourage a potential criminal; they might also be used to investigate criminal activities.

Thanks to the use, the reactions of people to the installation of video surveillance systems varied. Some were happy, that their security was being taken care of, others decried these systems. There were some who were anxious about non-stop monitoring and the feeling of someone always watching.

Actual issues ensued only after the selected video surveillance systems had been installed; cheap and wrongly installed, these systems were not properly and fully utilized by the municipalities. As we have stated previously, a problem occurs after the installation where the municipalities don't have the manpower necessary to operate their system since they don't have money set aside in their budgets for this purpose. At the very least, an operator of the system has to be hired to monitor the many screens for prolonged periods of time, which is, no doubt, a very difficult job. A second issue is that even if the municipality found some monetary resources to pay for the operators, some, especially the smaller, municipalities do not have police departments or local law enforcement units, which could respond to an incident reported by the operator of the video surveillance system.

Based on this, we can state that municipalities utilize video surveillance systems only as a passive form of protection or a deterrent for vagabonds or potential law-breakers. However, if mayors and municipal representatives were appropriately educated in this area, they would know that there are other uses for a video surveillance system. Motion detection is one such use which can be part of the camera or recording device [1]. The faculty of security engineering at the University of Žilina, as part of its research activities, has focused on the ability to detect an intruder through video. In the future, it aims to serve as an advisory body for mayors and municipal representatives with the focus of utilizing video surveillance systems more effectively.

3 MOTION DETECTION USING VIDEO SURVEILLANCE SYSTEMS

Intruder detection using a video surveillance system is possible using two basic approaches.

The first option is to man the video surveillance system by so-called operators. This option is ineffective from several points of view because several operators need to be employed so that they can work in shifts and it is also possible, that this work might become hard for them over a long period of time [2]. They can therefore miss some undesirable activities. The second option, as mentioned, is a function of detecting the zone breach, which can be done by an intruder. This is a function of video analysis, which works based on comparing changes in the footage and their size as they appear in the images. Using algorithms, the system

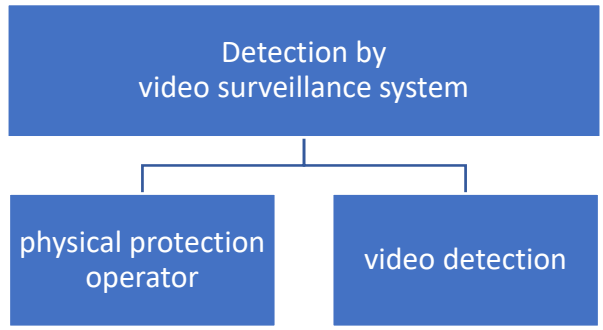

Figure 1: Possibilities for motion detection by video surveillance system.

analyses this information and decides whether these changes show movement or not. This has now become a basic function of IP camera systems and video management software tools [2].

The reasons to use this function of the camera systems vary; it could be the decreases demands on the system, especially in terms of saving storage room and thus lowering cost, decreasing network demands and last, but not least, making systems more autonomous and decreasing the workload of the video surveillance system operators.

Motion detection can occur either within the camera itself which then sends the data with the motion information to the recording device or to the device with appropriate video-management software; it can also take place in the recording device which analyzes the visual data coming in from the camera; motion detection can also take place in the video management software which also works with the data coming from the camera [3].

While researching the systems for motion detection on video, we asked ourselves if it is possible to influence the performance of the motion detection system and thus the probability of an intruder being detected within the monitored area by adjusting the camera system settings such as the frame rate, resolution or other parameters.

One of the ways to answer this question was a survey in which the manufacturers of camera systems were questioned.

The aim of the questionnaire-based survey was the following:
how is the motion detection performed in the camera systems made by various manufacturers, if it is possible that a change in the parameters of the system, such as frame rate or resolution, can bring about a change in the camera system's ability to detect motion.
For the needs of this survey, the camera makers were selected as the sample. We talked to 50 randomly selected producers of video surveillance systems which have in their portfolio an IP video surveillance system. Individual companies were contacted by e-mail or in person.
Using the questionnaire survey, we asked the companies the following questions:

1. Which video do individual devices used to detect motion?
2. Is the best available video quality that the camera can produce (highest frame rate and resolution) always used for motion detection?

3. Is the quality of the video used for motion detection influenced by the current settings of the system?

Since we have been researching this topic for a while, we had some idea of what kind of answers we would receive. Among the expected answers were the following:

1. For motion detection purposes, video of highest quality that the camera can produce is always used.
2. For motion detection, video corresponding to the current settings of the monitoring system is used.
3. For video-based motion detection, the system uses a separate video stream which is specifically created for video detection and is not influenced by any variation in the settings of the video surveillance system.

Out of all the contacted companies, only 12 have responded to our questions, which amounts to 24%. Among the companies that did respond were the makers who count among the best when it comes to security camera systems – companies such as Avigilon, Axis Communications, Bosch Security, Dahua, FLIR, Hikvision, JVC, NUUO, Q see, Samsung Techvin, StarDot and Zavio.

In theory, questionnaires with a very low response rate (such as 15%) have little scientific value. However, as far as questionnaires are concerned, the response rate is not the only relevant information – the respondent structure is important as well. It should coincide with the structure of the planned sample. In other words, respondents that filled out the questionnaire should have the same structure as was the structure of the respondents who were asked to participate in the survey [4].

It should also be noted that we got responses from highly acclaimed companies which have been on the market of making and developing video surveillance systems for years.

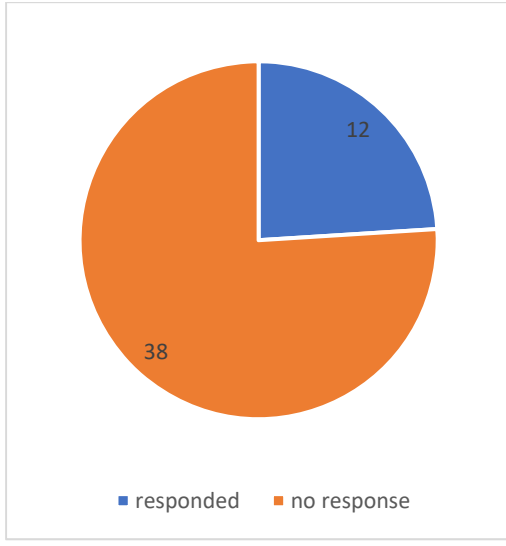

Figure 2: Comparison of the number of acquired and unacquired responses from manufacturers.

These companies offer a wide range of devices. Some of them are state of the art, but some are also widely used. Based on this data, we decided that the respondent structure is sufficient for the information acquired from the survey to be generalized and used as relevant.

All the answers we expected showed up in the actual responses. Some answers were incomplete, because the companies considered the responses a trade secret and could not provide all the information. There were also responses (about 4%) that were irrelevant to the problem at hand.

The result of the questionnaire survey was that the manufacturers use for video analysis:

- video footage of maximum quality that the system is able to put out,
- video footage based on currently set parameters,
- metadata (sub-stream) with certain lower-quality of video footage, which is in parallel, and independently of the video surveillance system parameters, used for motion detection and any change in the system settings does not influence its success rate.

Based on these results we can say that the research, which was to find out whether the change in parameters of the video surveillance system can influence the detection ability resulted in the following: It can be stated that changes in the system might influence motion detection; however, it also depends on which system is used.

4 CONCLUSION

The aim of this article was to showcase the questionnaire survey that was performed among manufacturers of video surveillance systems. The focus was on information regarding video-based motion detection which could be used as part of the video surveillance system installed in Slovak municipalities. These are often used as passive security element, which negates the purpose of the video surveillance system.

The success rate of video-based motion detection and therefore the probability of motion being detected by a security system, can be influenced by the system's settings. The questionnaire survey provided information which allowed us to form an idea about what sort of principles these systems are based on.

Another aim is to confirm the information acquired from the manufacturers of the video surveillance systems through experimentation. This will result in independent information regarding the way video-based motion detection systems work. As part of these experiments, it will be necessary to use systems from various manufacturers. Experiments would be performed at the same conditions, so that the results can be compared. These experiments could be performed directly in municipalities, which would guarantee the effectiveness of the experiments as well as the education of mayors or other responsible employees. These could first-hand experience the actual differences between a passive and active use of video surveillance systems.

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