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Public Safety through Video Surveillance System in Smart Cities: A Survey

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Abstract: ***This paper outlines concept of smart city and various areas to which services can be provided for making a city smart. Various approaches are also identified to maintain the public safety in smart cities. Author of this paper has critically reviewed the necessity of the public safety from any disaster or suspicious and how it can be resolved by using video surveillance. Video surveillance among other aspects is explored which leads to a smart city with high quality of life by providing safety to citizen. Existing video surveillance methodology was recognized and addressed for quickly analyzing the circumstances or object captured in the form of video even when the visibility is not so clear. But ultimately, security through video surveillance with an immediate action has not been resolved yet and this challenge has also been duly considered during critical review of existing system. Finally, it is concluded that a smart city can be planned for public safety by integrating information communication technology with video surveillance to interpret various suspicious activities or recognizing facial expression and improve the necessary response from detection to corrective action which will be reported automatically to the concerned authorities.***

Keywords: Smart City; Video surveillance; WSN; ICT; Public safety.

I. INTRODUCTION

Smart city is a concept emerging from globalization. Smart city is essentially based upon advanced technology, integration of various technology, sensors and networking combined with computerized system to provide the services related to the weather information, traffic management, infrastructure, transportation, power, water Consumption etc.

Smart city is a developed area which provides high quality of living to the citizen. Smart city results in high quality of life by promoting excellent work in six key areas which is strongly based upon ICT (Information & Communication Technology) infrastructure i.e. economy, governance, mobility, living, environment, and people [3]. Smart city requires the highest levels of security [8]. ICT Technology is composed of various technologies integrated with computer systems and can respond to the disaster in real time to improve the public safety. Centre of Regional Science, Vienna University of Technology has presented a final report on "Smart Cities- ranking of European Medium- sized Cities" in 2007 and introduced the concept of Globalization [14]. In that report, it was observed that fast technological changes are altering the relations of production, distribution and consumption for making the city smart.

Cisco aims to link energy, communications, traffic and security systems into one smart network. Gordon Falconer & Shane Mitchell have presented the "Smart City Framework" to elaborate the concept of systematic process for enabling smart and connected communities [5]. They have highlighted the issues regarding increased population, polarized economic growth,

strategies for energy generation & huge budgetary constraints. They observed that these issues can be mitigated by taking the advantage of Information & communication Technology which increases efficiency, reduce cost and enhances the quality of life. Cities based upon this approach are referred as smart cities.

According to the survey report of Yang Jin-Hyeok [18], 50 percent of urban cities are rapidly changing to smart city and adapting the smart phone & 4G mobile networking infrastructure. A. Bartoli and J. Hernandez [2] have observed that smart city is using the ICT composed of internet of networks, sensors and cellular system which makes cities more efficient and reliable in terms of various resources for citizen. Wireless network sensors are basically used for detecting the event and information that can be sent on internet to take action in response to the event detected.

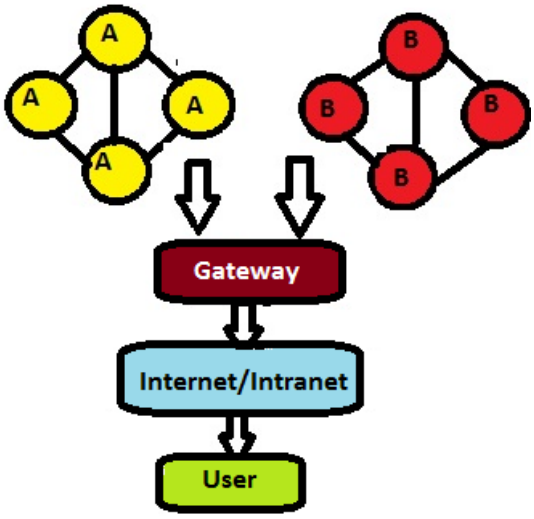

Figure 1: Wireless Sensor Network Schema [Swami A, et. al., 2007]

According to the Wireless Sensor Network Schema, network of sensors is formed and base Station of each wireless network sensor networks are attached with the sensor/access node which act as a gateway to detect the various environmental events as shown in figure 1[17]. But, the greatest challenge is to manage them. They found that these systems have great effect on human lives. Key observation identified was high security requirement to avoid third party abuses in context of privacy and security. IBM Global Technology services has presented a report on "Becoming a Smarter City" and introduced Public safety projects which were focused on automatic capturing and analyzing the information by application of intelligent approaches [13]. These approaches help to address the unpredictability and coordinate the response in real time to improve the quality of life for citizens. In this paper, idea of Smart Surveillance has been introduced to monitor the public areas to keep them safe and accessible. This smart Surveillance Solutions is comprised of intelligence, automation and analytics to proactively prevent and swiftly detect and react to suspicious events.

II. Public Safety in Smart City

A smart city is one that uses a smart system characterized by the interaction between infrastructure, behaviors and cultures, achieved through their integration. Yet, public safety influences where do they live and work. It is the most challenging task to make the city more secure to prevent the crime and/or terrorist threats by providing real time response in any emergency. Public safety issues like crime, natural disaster, robbery etc. have great effects on high quality living, environment and social development which public don't expect from smart cities. One intelligent approach is required to focus on automating, capturing and analyzing information from all kinds of activities.

A drastic change in technology simultaneously causes challenges for urban development. In addition, population requires extensive surveillance to protect railway stations, airports, bus stands and any other crowded area of the city from terrorism, vandalism, robbery and face recognition for forensic purpose etc. These challenges have an impact on quality issues such as economy, environment, society and human conditions. People demand for social assistance, quality living and better outcome of

all resources. Many social organizations have started working to modernize the cities by using ICT to provide high quality services with more efficiency, effectiveness and responsiveness.

Today, we've various technologies which perform activities in order to maintain the public safety. Technologies are integrated to make interaction between public or community and public safety departments. Using these technologies, public safety officials can collect important information and share in various forms like images, videos or text to the citizen for making alerts to them. These technologies are given as follows:

- Video surveillance
- Wireless Communication e.g. Smart phones
- Internet e.g. Email, online resources, group discussion forum etc.
- Etc.

Thus, smart city requires the highest levels of security (Leonidas, Theologis, 2012) to maintain the high quality living [8]. Therefore, smart city need more effective mechanism to deal with these public safety issues by integrating with other technologies to prevent, analyze, and cope with various levels of public safety events with the capabilities to provide secure communications and execute prior alert to an event more efficiently using cross department cooperation.

III. VIDEO SURVEILLANCE

Nowadays, urban area of any country is rapidly converting in to the smart cities by providing all above specified factors to improve the efficiency, reliability, safety of roads and make the city safe, secure and environmentally green by implementing the concepts of existing technology, Databases, tracking and decision making algorithms.

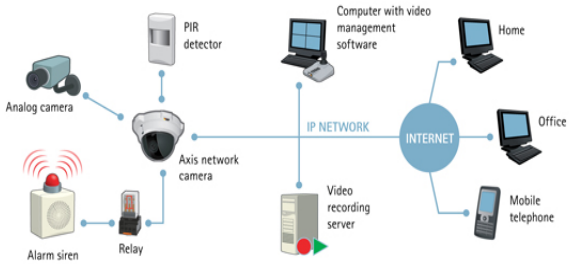

Figure 2: Video Surveillance System [*Norbert, 2011]*

The above video surveillance system shows the integration of event management and intelligent video which enables a surveillance system. This system can constantly analyze the inputs to detect any suspicious events and automatically respond with actions such as video recording and sending alerts [11].

Basically, smart surveillance solution captures the video of every moment in real time. It dynamically integrates related events for different cameras, sensors and detection system. Video sequences are continuously analyzing the location based situation with the help of the intelligent algorithm to monitor the movement, activity of the object and verifying the face/suspicious activity against established patterns. It then sends alert to Security Information center. Specialized searches are required for specific event based upon different criteria like area, facial, object color or any personal characteristics. This intelligent strategy can be used as forensic point of view for public safety application.

Video surveillance is provided by mounting number of cameras in most of the locations to capture all the events/activities. However, it is not sufficient to improve the safety risks as it is very difficult to capture the facial expression or any suspicious activity and to perform immediate action. Sometimes, it is very difficult to review all the information to match particular image or activity to find any evidence for providing public safety in smart city.

IV. SAFETY THROUGH VIDEO SURVEILLANCE SYSTEM

Video surveillance and analytical approach incorporate IT security for any of the sensitive areas of the city. It will provide the ability to view, Capturing of video, monitor, digitally record and analyze the video of pedestrian or other activity with real time access and send information to the security information centers to execute the reliable event. It can enhance the forensic capabilities by monitoring attribute based search of video event to match any particular object such as people or any vehicle.

In analytical approach, video facial or any other doubtful events recognition algorithm will be implemented for efficient, reliable and optimized pattern matching in various facial expressions or uncertain events and immediate alert will be given to the security centers by sharing the information. A tracking system could also be involved for generating the event. If it is integrated with video surveillance, it would be easy to track the object and could take the action accordingly. Any method can be used to keep track of objects and direct for correct action to be taken. Therefore, we need intelligent video surveillance to capture the video with high and analytic approach which can do immediate action after analyzing the object using efficient algorithm and can share the information with the entire security information center.

V. CHALLENGES IN VIDEO SURVEILLANCE

However, the greatest challenge is to use the integrated solution from ICT/other technologies for efficient, reliable and optimized public safety applications for any smart city. These systems can have great advantage on public safety in city. The new challenge is to accomplish forensic searches for specific objects, colors, activities and human attributes across millions of indexed video clips and retrieve results in seconds and minutes with more efficiency, reliability and optimization to make the smart city secure and public safe. Video cameras are presently used to capture the events but are not enabled to recognize any unpredictable activity which is to come about. Not even this, these cameras are able to decide corresponding action to be done.

Main challenge of video surveillance is facial/object recognition, verification and understanding of any suspicious activity. Moreover, facial/activity recognition task acquired by camera in an uncontrolled environment is very challenging. Face Recognition is generally based upon face identification and face verification. According to Gorodnichy [4], two justifications have been given. First, photographic facial data is considered as a hard biometric trait whereas face recognition in video is soft biometric as it may have behavioral traits like one's facial expression or talking dynamics. Second, faces in a video are often of significantly lower resolution compared to photographic facial images just because of its bandwidth, real-time nature, and environmental constraints. So, it is very difficult to recognize the face or any other object. Moreover, in a survey [15], all the proposed methods for overcoming the difficulties encountered in recognizing the facial expression are categorized and key research challenges are also discussed. Finally, it was observed that the field of automatic face recognition from video requires large scale of study to implement the algorithm more efficiently and correctly for recognizing or getting cues from facial expression or movement on speech.

Another challenge is the quality of images in video which is likely to be uncontrolled as it is located too far from the camera, low resolution, open environment or at an angle which makes recognition difficult. In consideration of the challenges identified, an efficient, reliable and optimized algorithm needs to be developed to recognize the facial expression or any other activity which would be capable of comparing images and allowing assessing the effect of adverse conditions. Usage of quality information for video surveillance, a systematic approach is required to analyze the video and perform the corrective action quickly.

In order to create an intelligent video surveillance system, system framework should have video surveillance with low processing time & high performance. Analytic approach for Smarter City should have high ability to analyze the real time videos and understand the doubtful behavior captured in the form of images. Thus, it will provide the safety to the population efficiently in any anticipated incident by the use of efficient, reliable and correct algorithm of object recognition patterns. System framework connects with the internet and transforms the collected information to provide automated operation to

respond the suspicious events or threats. The main challenge is to provide public safety in Smart city by application of the advanced technologies, intelligent analytical approach and automated real time operations in response to an emergency.

VI. CONCLUSION

Smart City requires the highest levels of security. As in the case of ICT, the greatest challenge is to make them in use for efficient, reliable and optimized public safety applications. These systems can have great advantage for public safety in city. Video cameras are just used to capture the events but not enabled to deal with crime committed at real time. The new challenge is to conduct forensic searches for specific objects, colors, activities and human attributes across millions of indexed video clips and retrieve results in seconds and minutes with more efficiency, reliability and optimization to make the smart city secure. The challenge is to develop an intelligent video surveillance with optimized analytic approach for smart cities. It will be having the potential to understand the suspicious activity and help in development of actionable information resulted from analysis after transforming the data captured and intelligent automation for fast detection and reaction or report those suspicious events in the real time.

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Geeta Nagpal is pursuing her Ph.D in computer Science Engineering from Staffordshire University, U.K.. She has completed her M.Tech degree in Computer Science Engineering in 2008 and B.Tech in Information Technology from Kurukshetra University, Kurukshetra in 2004. She has also done post diploma of one and half year in Computer Application and diploma of 3 and half years in Electronics and Communication Engineering from State Board of Technical Education, Chandigarh. She is associated with APIIT SD India since last 9.8 years and working as an Assistant Professor cum Head of the department for Computer Science Engineering.

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