Safety Awareness Network

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Abstract

There has been great interest in developing the capabilities of smart cities. Not only the use of advanced technologies, but how the plans are executed, and how they are received by the people they are supposed to help, is important. To help cities stay secure, NEC is at the forefront with its various sensors and analytics technologies. It is also important to manage the scarce resource. NEC is a strong proponent of the smart pooling of resources, and has introduced technologies that enhance inter-agency collaboration, breaking down silos and strengthening teamwork. This paper talks about the Safety Awareness Network concept, providing a scalable platform for plugging in various analytic engines, and an information sharing mechanism.

Keywords

analytic engines, smart pooling, pervasive display network, BYO (Bring Your Own) engine, Big Data, M2M

1. Introduction

With safety and security on top of their minds, city planners today have begun deploying some of the most sophisticated technologies around, such as advanced video analytics, for tasks ranging from police surveillance to flood detection. Yet, the enduring question many might continue to ask is whether the technologies they have rolled out have been fully made use of to create a safe environment for citizens.

Through tighter inter-agency collaboration, there may be a way to achieve the same goals through a more sustainable, scalable manner. This begins by adopting the right technologies from start, an open platform that is future-proof. The solution must provide an open, seamless way to let agencies plug in their own analytic engines for their specific uses. The ideal is to have a "bring your own engine" concept, where the raw data is available on an open platform and can be easily picked up by analytic engines to be turned into actionable information, to improve city operations. With this, it also catalyzes a smart pooling of resources, which will help break down silos and empower a more efficient, sustainable way for city planners to solve complex urban problems.

In NEC's Inter-Agency Collaboration solution, the MAG1C Suite (Multi-AGencies, 1 Concert), we provide a Scalable Media Platform to allow agencies to plug in different analytic engines, not only from NEC but also from other vendors, and a Pervasive Display Network solution to display emergency messaging on the public displays.

2. Scalable Media Platform

2.1 Abstract

Rich media data such as video and audio acquired from surveillance cameras and microphones are useful to detect problems in large cities and facilities. Though the detection requires understanding of contents of the data, it is difficult and time consuming to check all the data manually in large scale surveillance systems that could contain hundreds or thousands of devices. Therefore, media analysis technologies such as video analysis and audio analysis are absolutely necessary to detect such problems automatically.

Though media analysis technologies are used in various domains, there are two problems in using them in a large scale city surveillance system; these are flexibility and scalability.

- **Flexibility**
  Different requirements for surveillance such as face recognition or human tracking, need separate, dedicated analytic engines. On the other hand, requirements for a surveillance system may be deferred depending on the locations to be monitored, even when the same device is used.
  For example, special attention is required when a festival is being held, or the crime rate is high in a specific area in the city. It is important for a large scale surveillance system to be able to comply with these various and variable requirements by making the configurations easy to change; thereby defining which analytics types will be used for each location.
- **Scalability**
  In general, media analysis is a high-load processing since its data size is big and its calculation algorithm is complicated. Therefore, a large scale surveillance system that analyzes data in real time requires a huge scale system that consists of many servers. When only limited computer resources are available, only limited areas can be monitored automatically. Therefore, it is important to execute many analytic processes with limited computer resources by streamlining processes efficiently.
  From the point of view of a large scale computer system, media analysis has the following features.
  - The processing load varies depending on the contents of the input data (ex: number of people in a scene).
  - Requirement for accuracy and speed of analysis varies depending on its use-cases.
  - It is possible to change the balance between accuracy and load via the analysis parameters.
  - The characteristics of change brought about by the above features will differ with each analytic engines

  In view of the above features it is not sufficient to use general technologies for a large scale computer system to achieve a flexible and scalable media analytic system.
  The Scalable Media Platform is a middleware specialized for serving the requirements of large scale media analysis of city surveillance projects. It provides flexibility to comply with the various monitoring requirements, as well as scalability by streamlining the process efficiently. This enables the automated monitoring of more devices with the limited computer resources available.

2.2 Technology

The Scalable Media Platform is a media analysis execution platform based on the Analysis Control Middleware (ASCOT) concept[1]. This makes it easy to develop flexible and efficient media analytic systems by executing various media analysis engines.

With ASCOT, media analytic engines and their control logic are modularized and ASCOT integrates them as an analytic flow and a control flow (**Fig. 1**).

A flow model is used to realize various monitoring requirements by combining multiple analytic engines, a procedure that is widely used in the stream computing domain. An engineer can easily develop an analytic system that meets the requirements of the users by designing and describing the analytic flow.

In addition to this, ASCOT can control the execution of the analysis, such as the parameter, timing, and location of the analysis, to achieve higher efficiency. With ASCOT, the way the execution of an analysis is controlled is described in the control flow, which integrates multiple control modules. It is easy to customize the control policy of an analytic system to adapt to device environments and security requirements. An engineer can use the same analytic flow with different control flows depending on the system environments.

In many cases it is easy to plug in an existing analytic engine on ASCOT. The analytic engines can be made available by adding a wrapper program, which converts the API of the engine to the API defined by ASCOT. An engineer can develop an analytic system that satisfies a user's monitoring requirements by adding various analytic engines provided by various vendors.

2.3 Case Study Application

Fig. 2 and **Fig.3** are examples of video analysis systems using ASCOT. Face recognition is being used to detect sus-

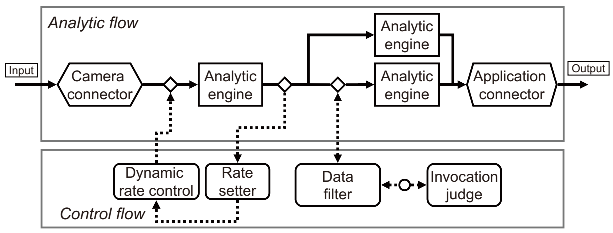

Fig. 1 Analytic and control flow.

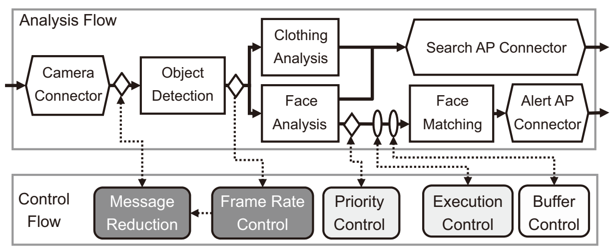

Fig. 2 System for a restricted area.

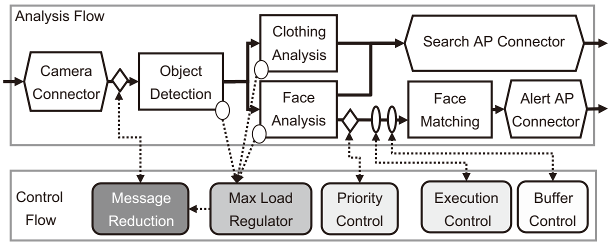

Fig. 3 System for a crowded area.

picious individuals, and also clothing features recognition to search through past video scenes to find a scene where the specific individual is captured by the camera. These are the same type of analysis, but the execution control is different. For this analysis process, the increase in the number of people captured in the camera can increase the work load of the server.

Fig.2 is a system for a location with little traffic, such as a restricted area. The control is set to lower the transaction level when there is no one in the area. This way, the system can process three times as many video scenes than when the control is not applied.

Fig.3 is a system for a crowded area. The control is set with higher priorities on the cameras in the locations that need to be heavily monitored. When there are a lot of people in the area, the video scenes from these cameras will be analyzed at a higher priority.

2.4 Analytic Engine Line-up

NEC offers the following video and audio analytic engines that can be used on the Scalable Media Platform.

- Face recognition: Identifies human faces. Compares faces from surveillance cameras against a database of previously enrolled face images, or captured face images from a different time and location.
- Human behavior detection: Recognizes movement of a person. Detects intrusion to a prohibited area or a person lingering in the same location for a long time, etc.
- Crowd density estimation: Estimates the number of people in crowded areas such as airports, stations, or stadiums.
- Unusual crowd behavior detection: Detects unusual behavior of a group of people such as loitering or running.
- Unusual sound detection: Detects unusual sounds in a public space such as glass crashing, people screaming, or playing of music.
- Age and gender estimation: Estimates age and gender of a person from the facial image.
- Clothing features recognition: Recognizes clothing features such as color or design pattern.

2.5 Crowd Density Detection Engine

The Crowd Density Detection Engine is a research prototype developed at NEC Laboratories Europe that provides a real-time estimation of crowd density in a selected target area. The estimation is based on the activation frequencies of inexpensive, privacy preserving sensors such as motion, CO_2 or sound pressure sensors. The goal is to create a platform for sensor fusion in general and for crowd estimation in particular. The platform must scale to large deployments with more cost efficiency than conventional, state-of-the-art platforms, while being compatible with strict privacy regulations. This approach compromises some of the accuracy of the existing video solutions, in favor of better privacy and reduced costs.

By placing sensors in “overflow” zones, that is, zones such as periphery of an area, where people would walk only if the area would already have a lot of people at its core, we obtain information on the activation frequency at such locations. This tells us not only about the amount of people in overflow zones of an area, but also about the amount of people in the area’s core that will typically be even more crowded. The system samples the area to monitor with carefully positioned sensors that measure human activity correlated to the density of the crowd present on the scene. Using supervised learning on the sensor data, the system models the regression between the sensor points and the actual crowd levels.

During the trial in Singapore, an area in a shopping mall was observed using 23 Sensors (16 distance sensors, 3 motion sensors, and one of each: CO_2 sound pressure, temperature and humidity sensors). Using the Crowd Detection Engine, the system estimated the crowd level in 4 discrete levels (from sparse to overcrowded) with an average accuracy of 90%.

The Scalable Media Platform enables the creation of an analytic system by integrating the above and other analytic engines flexibly to meet monitoring requirements quickly, and to execute it efficiently. It will contribute to keeping cities safer since the system can automatically monitor wider areas than conventional systems can.

3. Pervasive Display Network

Public displays are omnipresent in today’s cities, and due to the decreasing costs of large screen installations more and more public information and advertisement are presented on monitors instead of traditional paper posters. With NEC display control technology, any public display can now bring an additional benefit by providing important guidance to the public in situations of emergency like earthquakes or fires.

One of the key differentiators of the display control technology developed by NEC is that it seamlessly integrates with existing public screen installations. The NEC solution has a minimal level of intrusiveness and a low adoption barrier. It

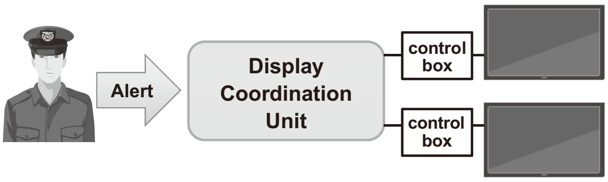

Fig. 4 Display coordination unit.

can be installed within minutes, and the display owners do not need to give up control over their screens.

To make their displays ready for emergency usage, the owners only connect a small control box to one of the input ports. During normal operation the control box remains inactive, and so the usual content is shown using another input port (**Fig. 4**). Only in situations of emergency, the control box will be activated and make use of the display to give guidance like evacuation routes or warning messages.

NEC has further developed a system to centrally coordinate all display control boxes available in a city area. By the display coordination unit, city authorities can make sure that the appropriate messages are shown on the right screen at the right time. The coordination can be executed manually, or, in case of larger installations, by semi-automatic routines. Displays control boxes can be dynamically added and removed during operation, as it is expected that the number of screens available for emergency messaging will gradually increase as the technology becomes more and more common.

4. Conclusion

The call to break down the walls between various agencies is not new. What has changed is that technologies are now available to solve these problems. More importantly, there is an urgent need to maximize benefits for more citizens with a limited amount of resources. The fusion of sensor data can now enhance situational awareness and help city planners avoid unintentional blindness in many situations.

The biggest change, one that brings more lasting benefits to citizens, could come from a smarter pooling of resources, to achieve safety and security while being sustainable and scalable. To do this, an open safety city platform is crucial in the years ahead.

Reference

1) T. Arikuma, et al.: Analysis control middleware for largescale video surveillance, Advanced Video and Signal Based Surveillance (AVSS), 2013 10th IEEE International Conference on

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