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Advance Video Analysis System and its Applications

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Abstract

This research aims at developing an Advance Video Analysis System (AVAS) which can be used in wide range of video surveillance applications as well as to detect moving objects and human beings. The AVAS is able to detect and track interested objects along with human. It recognizes activities in an application environment, such as in a room, supermarket, car, or security checkpoint. Designing a real-time video analysis system is a complex task, as many factors including processing speed, system cost, accuracy, and robustness, need to be carefully balanced. This research has focused these factors at two levels, algorithm level and software level. Background elimination algorithm is proposed in this paper to enhance the performance of Smart Camera systems in changing background and varying lighting condition environment. Among the main features of this research some are, Event Id, Video Id, and Human Id which give detail information about the events, videos and other tracked objects. Finally, the software implementation of AVAS is applied to detect motion and then to trigger alarm for the security purposes. The system will trigger alarm once the motion is detected and when it exceeds the desire threshold value it will give warning to prevent any loss or mass destruction. Finally, we have given a number of recommendations that need to be addressed for the future growth of surveillance technologies and meeting the end-users' diversified and dynamic requirements.

Keywords: Object detection, Object classification, Smart surveillance, Video analysis, Occlusion.

1. Introduction

Optical flow can be used to study a large variety of motions, moving observer and static objects, static observer and moving objects, or both moving [1]. The optical flow field is the velocity field that represents the three-dimensional motion of object points across a two-dimensional image [2]. A basic CCTV video surveillance system consists of a collection of video cameras, mounted in fixed positions, or on pan-tilt devices, and has coverage of a circumscribed area defined by the fields of views of the cameras. The video streams are transmitted to a central location, displayed on one or several video monitors and recorded. The person in charge observes the video to determine if there is ongoing activity that warrants a response [3].

Most of the camera networks deployed today are realized as closed-circuit television (CCTV) networks in which the video cam eras stream images over a high-bandwidth communication link to a set of TV monitors [4].For real-time analysis, this becomes an unreliable and error-prone task as it is well known that the hum an attention span drops rapidly within the first 10 to 30 minutes [5, 6].An operator will miss up to 95% of scene activity after approximately 22 minutes [6].The next generation of research in surveillance is addressing not only issues in detection and tracking but also issues of event detection and automatic system calibration [7]. By tracking objects and then using the trajectories, events of interest, for instance people entering a prohibited region or people entering through an exit only door, can be detected [8]. Kettnakcr and Zabih [9] present a method to track objects in an environment monitored by multiple non-overlapping cameras. Owens and Hunter present a method to detect unusual movements, which analyzes trajectories in a model-free fashion. A trajectory description vector is used as input to a self organizing feature map neural network, which is trained to recognize normal trajectories [10].

2. Hardware and Software Selection

Table 1: Shows Necessary Hardware

Components	Description	Quantity
7. Outdoor Box Camera	1/3" Sony Super HAD, 380TVL / 0lx / 3.6mm / 22IR LEDs / 12VDC	3
8. Dome Camera	1/3" Sony Super HAD	1
9. DVR Card	4 Channel 3rd Party DVR Card	1
10. Cable	Lay coaxial cable	50 ft
11. DVR	DVR configuration	1
12. Workmanship	Workmanship	1
13. Main Server	High Speed CPU	1

2.1. Software Selection

The minimum software requirements for this project are:

- Windows Vista.
- Microsoft Visual Studio 2008
- SQL Server
- Task Manager (Testing Tool Server)

2.2. Necessary Camera Parameters

The following parameters are very important to consider for selecting a camera. For any surveillance system these are the fundamental requirements.

Table 2: Necessary Camera Parameter

Name	Symbol	Default Value
Focal Length	fc	1000 px
Number of Image	N	20
Camera Zenith	θc	90
Camera Azimuth	Φc	0

3. Key Technologies, Applications of Smart Surveillance System

3.1. Human Detection

In this mode, user can connect to all available cameras, and change the surveillance settings for each camera, such as motion detection, human detection, security settings and secured parameters.

Figure 1: Shows the detected different person with different Id and blob color.

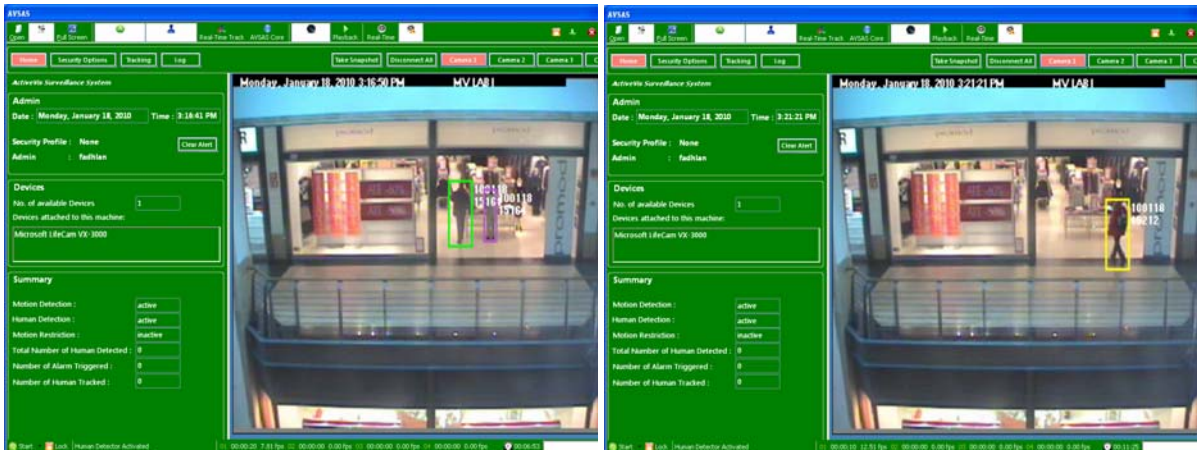


Fig.1 shows details of human detection using blob analysis. It gives an identical ID for each Human. From the figures it is clear that the system automatically can assign human id at any time for every single human. This mode also enables administrative control such as system lock, password management and profile selection. It summarizes all the running components and the result of each component such as number of motion detected, number of human detected, camera frames per second, and intruder detection. It also has full screen mode.

3.2. Video and Event Analysis

Figure 2: Video and Event details of the surveillance system.

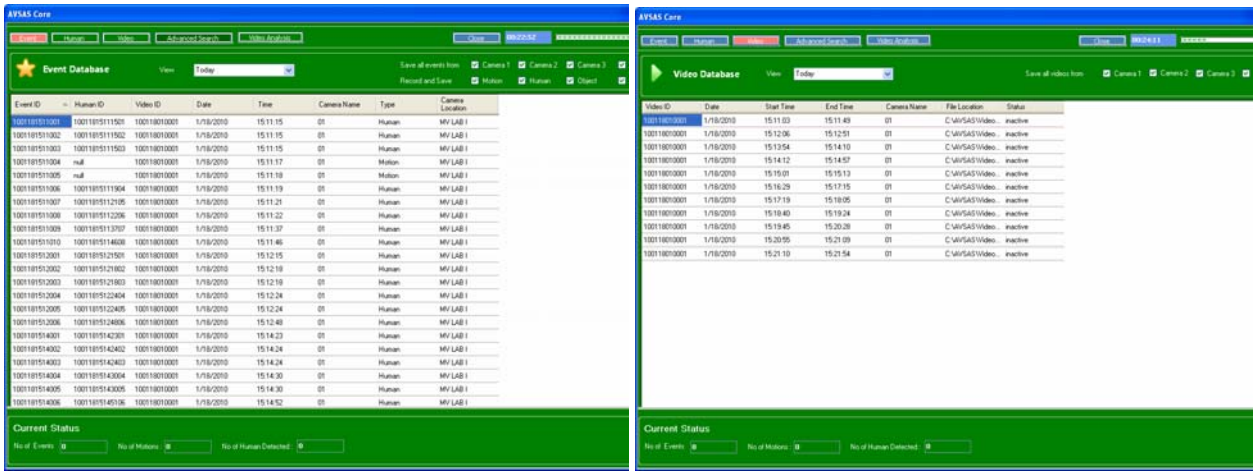


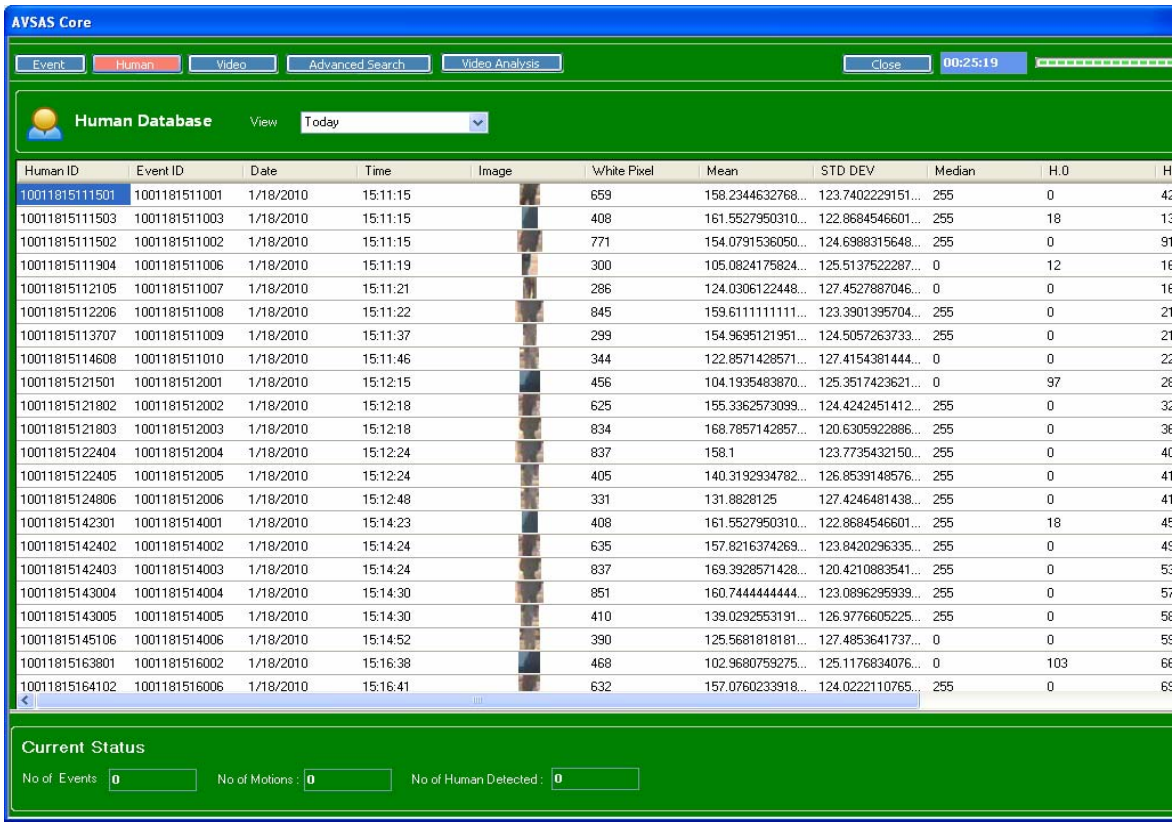
Fig.2 gives detail information about video and event for advance analysis. All events and videos are saved into the hard disk and their locations are saved into the event and video database. This database keeps track of any event detected by the surveillance systems and linked the events to corresponding videos as in Fig. 4. This will enable the user to easily s open the video automatically and this feature can manage large volume of videos and reduces laborious work of searching tasks for single piece of video from terabytes of data.

3.3. Human Database

Fig.3 shows the database for human tracking. We can track human for the latest date or for all the dates whose videos are stored in the system. As from the figure it is visible that there is an option for image. Once we click on the image we will see the clear picture by adjusting the image size.

It becomes easy to track the exact human from the image. It saves time and gives better solution. This also shows the human id which gives another option to search the human using this id.

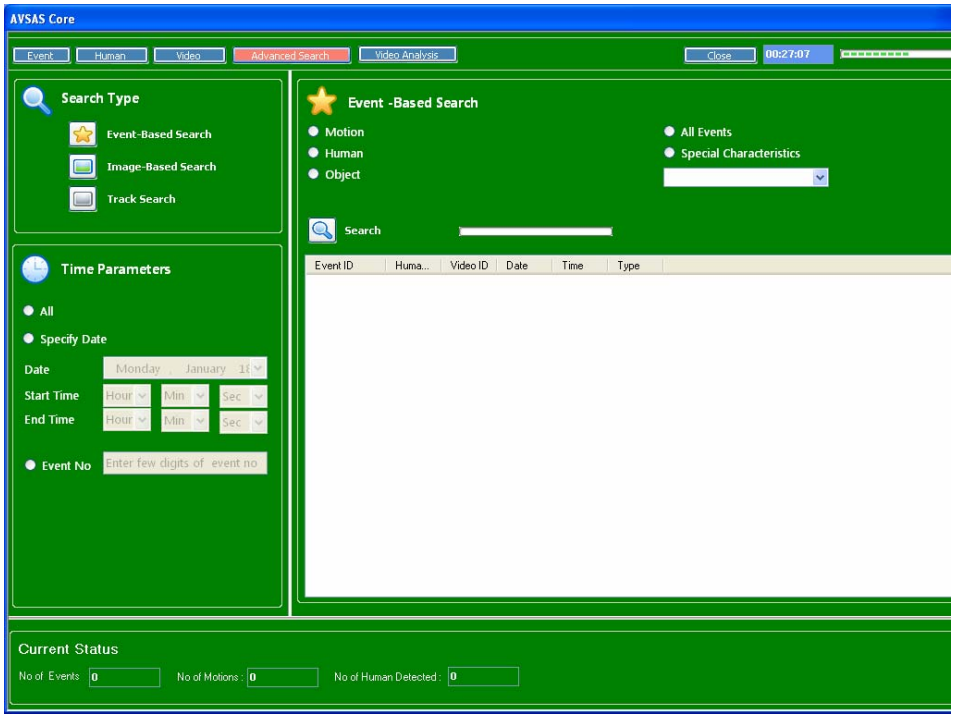
Figure 3: Shows stored human databases.



3.4. Event Data Analysis

This data model represents the events that occur within a space that may be monitored by one or more cameras.

Figure 4: Details of Event based advanced search mode.

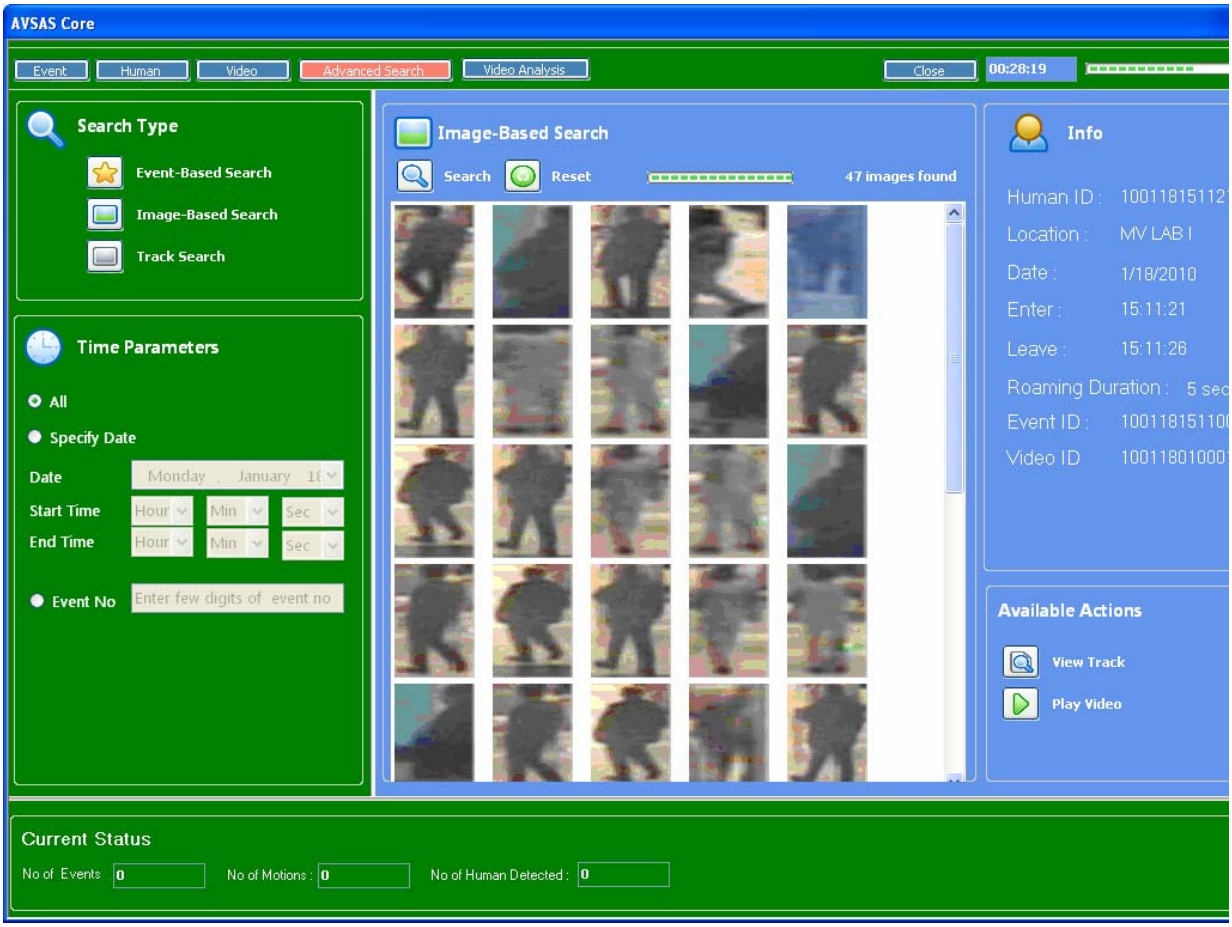


Bellow is given few key points of the Event Data:

- Event: An event is defined as an interval of time.
- Start Time: Time at which the event starts.
- Event ID: This is a unique number which identifies a specific event. We can see in our software the Event Id.
- Video Id: We can search an object also using Video ID.
- Date/Time: From the figure 11, we can see that with the Even and Video Id we can also get the event date and exact time for the desired search.

3.5. Image Based Search

Figure 5: Details of the Image based advanced search mode.



In fig.5 it has shown the image based search result. It shows the color and the shape clearly. Also can be recognized either human or not. We can search the image in a specific date, time or using event id.

3.6. Tracking

3.6.1 Real Time-Tracking

This shows the real-time motion tracking for the real –time video surveillance system. This plot a motion path according to the camera placement Show in details where the moving objects pass through. Different colors indicate different person or object in the graph.

Figure 6: Real-time motion tracking for single camera.

3.6.2. Advance Tracking

Figure 7: Advanced human/motion tracking mode.

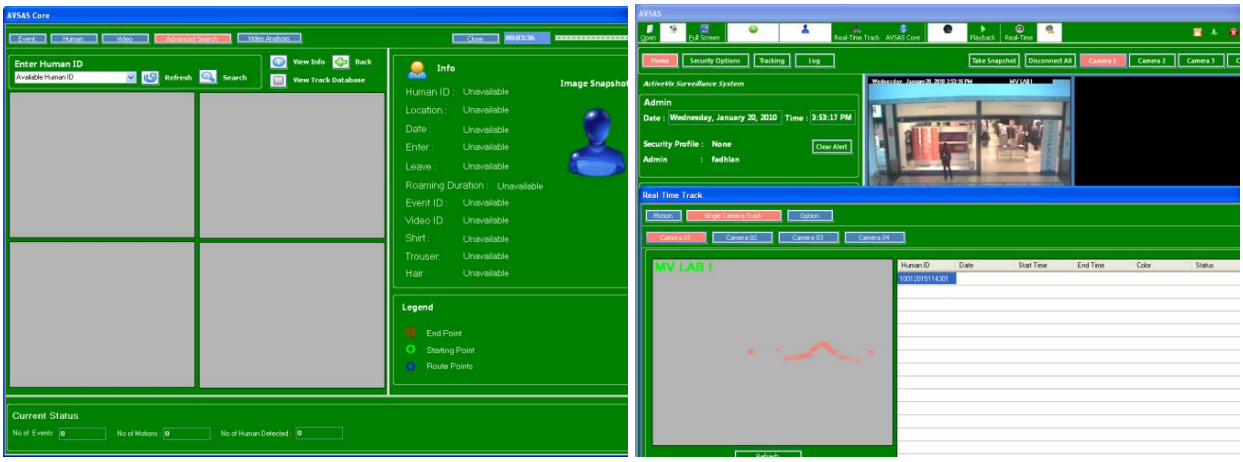


Fig.7 gives the tracking result in using different color. Starting point is indicated by green color while route and end points are indicated by the blue and red colors respectively. From the path we can easily track the motion of human/moving object successfully.

4. Discussion

Our developed software works very efficiently with the real time video surveillance system. The software is a great tool to classify and track the movement of any object under the camera focus area. The software has details display mode like time, place, human or non-human, how many object, trajectory path of the moving object, video retrieve using search index, playing past videos from the hard drive and so on. The details of those features have been discussed in details in the previous.

4.1. Tracking Database

Figure 8: Details Surveillance Mode

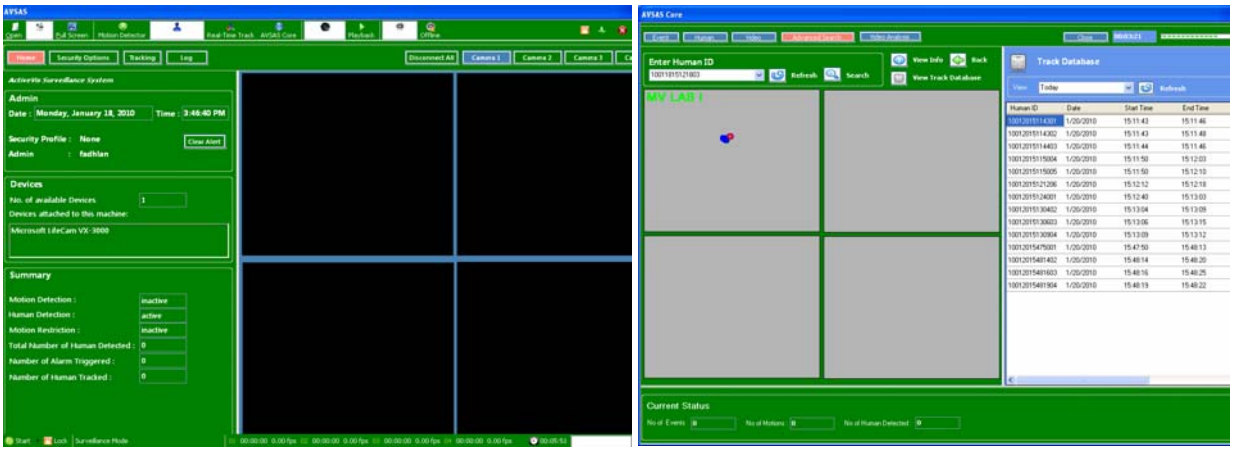
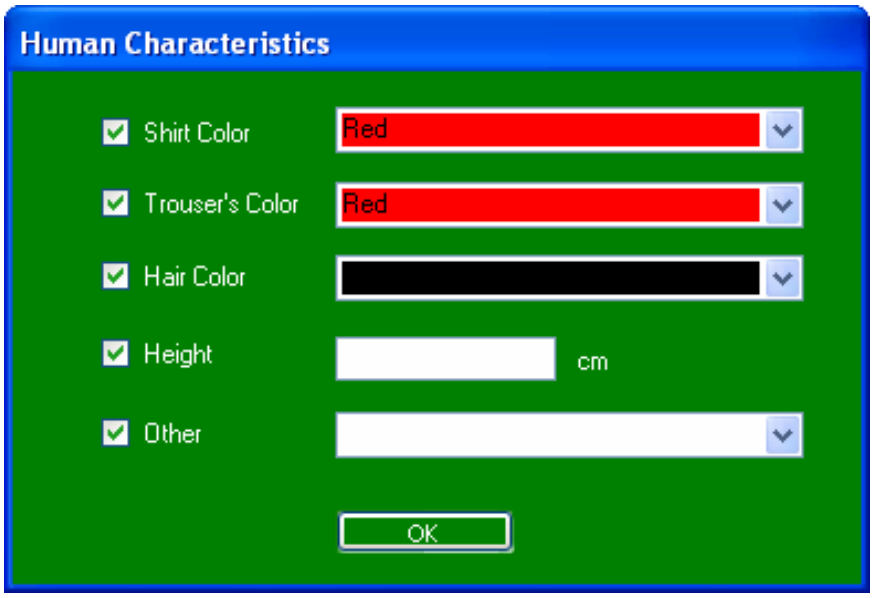


Fig.8 gives detail information for surveillance options and tracking for the moving human being or object.

4.2. Human/Motion Racking using Color

Fig.9 tells us the details features of advanced search. We can track human using the color of shirt, trouser and hair. Also height of the moving object can be used to track the human, car, animals by the developed software. This gives more precise and accurate searching results for the surveillance system in the practical applications.

Figure 9: Human search using color code.



4.3. Playback Mode

Playback mode as in Fig.10 can carry out several video analysis such as video searching according to time constraints, video searching according to video IDs or locations. It has playback feature from normal surveillance system such as play, pause, stop, fast forward, and rewind with adjustable magnitude. The user can open up to maximum 4 video at a time where each video window have the same time stamp but corresponds to different camera locations.

Figure 10: Displays stored video and playback mode.

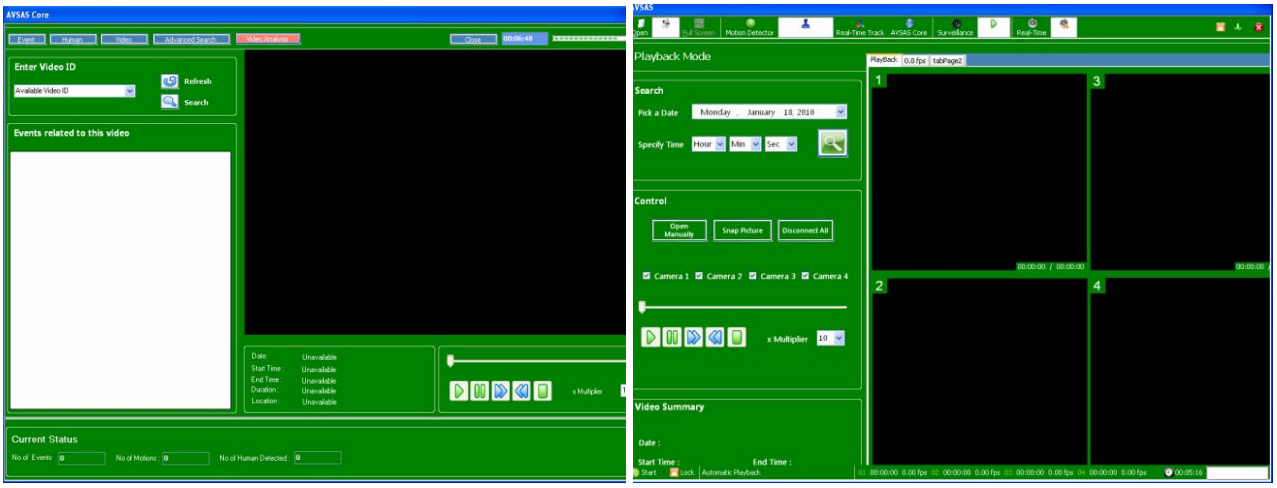
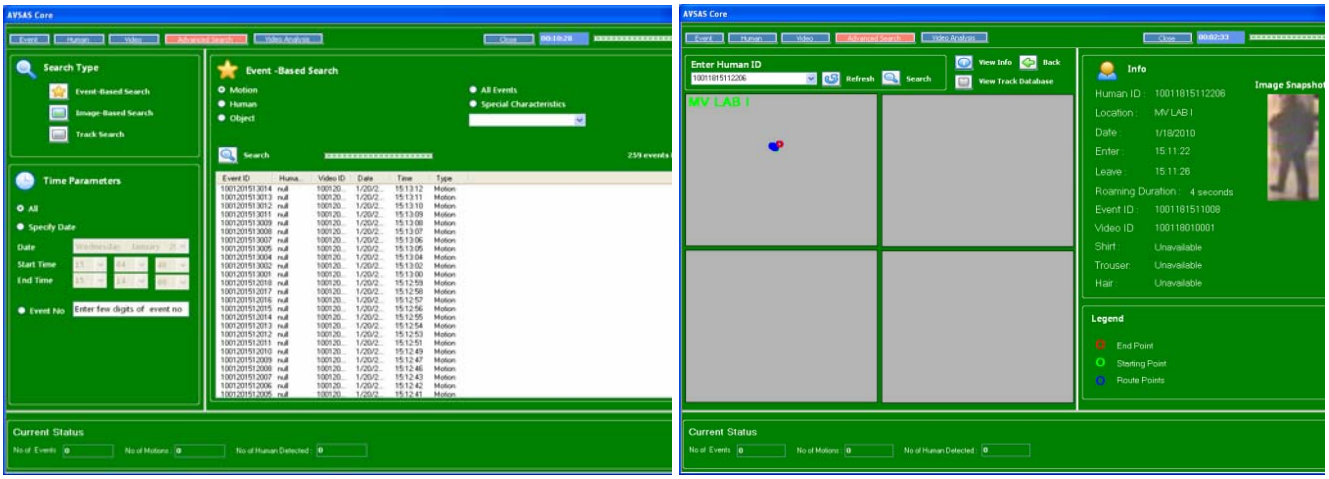


Fig.10 also describes the advance playback option in the developed system. We can play the video back as forward, backward, slow or fast from the stored video database.

4.4. Movement Search

In fig11.it is shown that if anything has a motion under the surveillance area then immediately the system stored the motion by assigning the identical id to the moving object/human.

Figure 11: Shows the motion search option and image based tracking



4.4.1. Object Detection

This software can detect moving objects in a video sequence generated by a static camera.

Figure 12: Shows a detected car as a moving object.

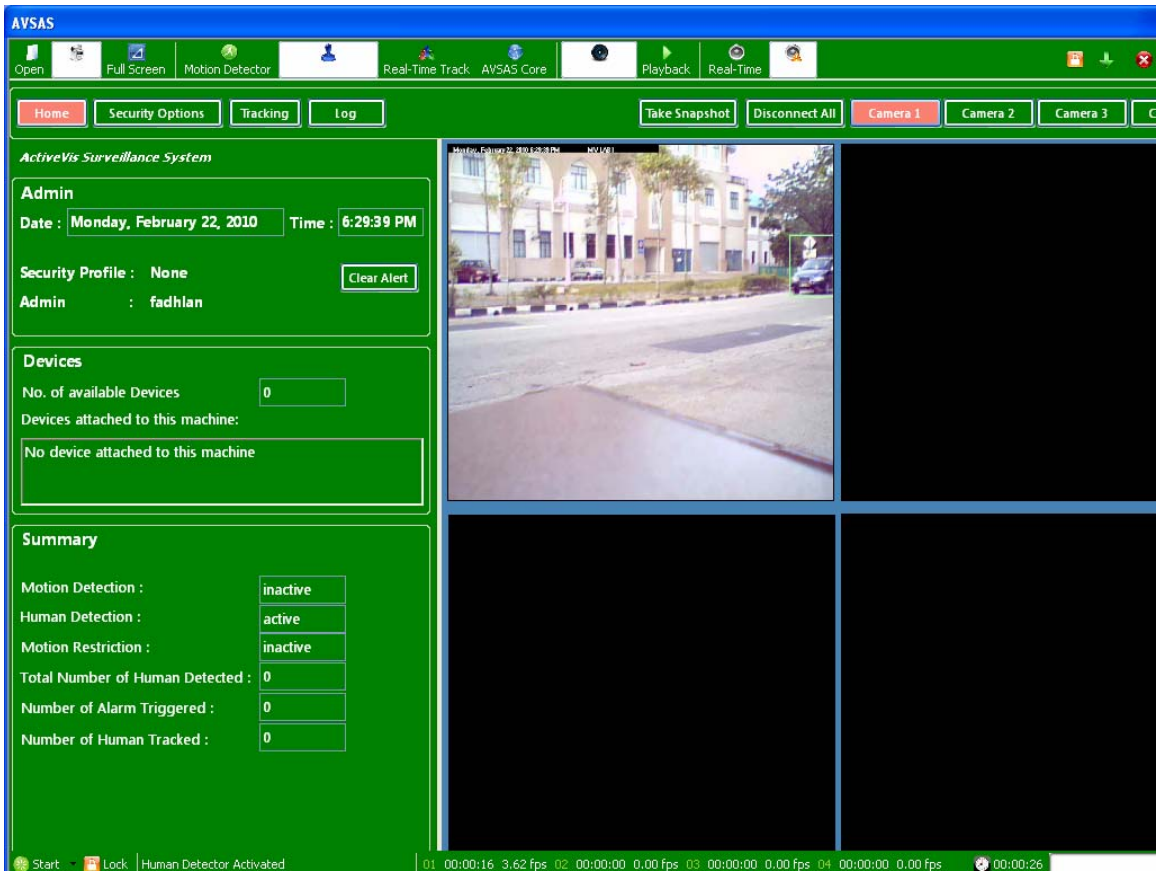


Fig.12 shows a moving car, detected by the system which serves as a means of advance surveillance application for highly secured purposes. The detection techniques are invariant to changes in natural lighting, reasonable changes in the weather, distraction movements and camera shake. Several algorithms are available in this software including adaptive background subtraction with healing which assumes a stationary background and treats all changes in the scene as objects of interest and salient motion detection [10] which assumes that a scene will have many different types of motion, of which some types are of interest from a surveillance perspective.

4.4.2 Object Tracking

This software can track the shape and position of multiple objects as they move around a space that is monitored by a static camera.

4.4.3. Object Classification

This software uses various properties of an object including shape, size and movement to assign a class label to the objects. Our system fulfills the following criteria for advance search:

i. Search by *Time* retrieves all events that occurred during a specified time interval.
ii. Search by *Object Presence* retrieves the last specified number of events from a live system.
iii. Search by *Object Size* retrieves events where the maximum object size matches the specified range specified in the programming part.
iv. Search by *Object Speed* retrieves all objects moving within a specified velocity range as the user desired for their own verification purposes.
v. Search by *Object Color* retrieves all objects within a specified color range.
vi. Search by *Object Location* retrieves all objects within a specified area in a camera.
vii. Search by *Activity Duration* retrieves all events with time durations within the specified range.
viii. Joint Search combines one or more of the above criteria as specified by the user.

5. Key Challenges in Surveillance System

Three important key challenges for Smart Camera:

5.1. The Multi-scale Challenge

This is one of the biggest challenges of a smart camera. Multi-scale techniques open up a whole new area of research, including camera control, processing video from moving object, resource allocation, and task-based camera management in addition to challenges in performance modeling and evaluation.

5.2. The Contextual Event Detection Challenge

This challenge is mostly on using knowledge of time and deployment conditions to improve video analysis, using geometric models of the environment and other object and activity models to interpret events, and using learning techniques to improve system performance and detect unusual events.

5.3. The large System Deployment Challenge

It has several challenges include minimizing the cost of wiring, meeting the need for low-power hardware for battery-operated camera installations, meeting the need for automatic calibration of cameras and automatic fault detection, and developing system management tools.

6. Conclusion

We have presented our developed software for the surveillance and security purposes. Also we have introduced a smart video surveillance system, which relates the computer vision algorithms for surveillance system. All these methods are linked with the surveillance system. From the practical point of view we found the developed software is more effective compare to the traditional surveillance system as well as it has a detail “Display Mode” which helps us to track the moving object in an easier way.

7. Recommendations for Future Works

There are few recommendations for further research:

(i) High resolution camera should be used where clear images are necessary.
(ii) For dark place and at night, day/night camera best suits for surveillance purposes.
(iii) Wireless camera can be used to reduce wiring and maintenance cost.

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