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Hybrid Video Surveillance Systems Using P300 Signal

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Abstract: The Comprehensive Integrated Border Management System (CIBMS) aims at reducing infiltration at countries' borders and at overcoming risk. It is an integration of the solutions for manpower, sensor, networks, intelligence, control and control. Through the Brain Computer Interface (BCI) application, this research work aims to create a reference library on threat signature using cognitive technology which will enhance the intelligence for CIBMS to reduce human effort. The method aims to use an Electroencephalogram (EEG) cap to track brain signals from operators when operators see any suspicious border area movement, and then capture the precise video frame when the observer senses a danger. The combination of cognitive algorithm and EEG filtering not only reduces false alarms but also helps operators detect signs of threats that would be overlooked, such as flying birds, swaying branches or non-threatening object according to action recognition. This work aims to suggest a better technique of optimization on P300 brain signals and create a hazard signature operating library that is used with greater accuracy for potential automatic surveillance system.

Keywords: Brain Computer Interface (BCI), Fast Independent Component Analysis (Fast ICA), Comprehensive Integrated Border Management System (CIBMS), Event Related Potentials (ERP), Human computer Interaction (HCI).

INTRODUCTION

Border policing is the high-risk activity among all cross-border activities that results in higher operating costs and life loss. With the use of sensors and GPS system, GIS knowledge and wireless access to positions via Unmanned Aerial Vehicle (UAVs), however security personnel and soldiers are expected to patroll at the borders [1]. Research organizations and security agencies have begun to develop increasingly advanced security systems that reduce human life and ammo wastage by lowering the false alarm and growing target detection precision. Several countries have begun work on a comprehensive boundary monitoring solution called the Comprehensive Integrated Boundary Management System (CIBMS) [2]. This works on the basis of the concept of near-line defense and has suggested construction of a new radar network in the border regions that will transmit a 120 degree view of the area to the control room. Once the control room receives any information about an attempted infiltration, the specialist border cameras will automatically set themselves to capture images of militants trying to sneak in according to available coordinates.The successful execution of this system lies purely in reducing false alarms and subsequent automatic weapons miss hits. The automated monitoring of suspicious cross-border behavior used in the security system to identify potential threats such as an individual with weapons or throwing explosive or any dangerous behavior [3].

The human brain is one of the universe's most complex systems and nowadays, there are various technologies for recording brain signals. Electroencephalogram (EEG) is one of the brain signals capturing and processing techniques that enables the brain's complex internal mechanisms to be gained and understood. It records brain-generated electrical signals, and any abnormal brain waves shown in EEG monitoring devices are associated with specific brain disorders. One of the brain signals P300 used for and storing Event Related Potential (ERP) for decision making. ERP is a neural reaction produced by motor event, focus [4].

In this research we suggest a real-time video frame capturing algorithm that catches the frame that includes irregular activity based on the strongly peeled P300 brain signals observers as observers recognize the abnormal activity from the video frame and build the library for potential monitored automated systems. The system not only reduces the false alarm for threat identification, but

also analyzes the accuracy between the observer and the monitoring system, so that the computer vision algorithm can be improved for greater accuracy.

Abnormal Activity Detection in Video

Image abnormality detection is one of the prominent fields in the field of surveillance system and many researchers have been focusing on the subject using and refining different algorithms. Scientists have established a pedestrian detection system that incorporates both activity and presence. At first moving objects are observed several methods introduce a general pipeline-based structure, then they are identified and monitored over a certain number of frames. Finally, the resulting paths are used to distinguish between' normal' object behavior and' abnormal' behavior.In the study, an algorithm was used in surveillance videos to merge learning for identification with high structure redundancy [5]. The approach obtained by them is a sparse mixture based on constructing a temporal space circle. Researchers have implemented automatic motion tracking with twenty-four hour surveillance video in sequence of video frames using static video capture. Through observing the difference of gray rates in successive pictures, it is almost difficult for a human observer to stay alert round the clock and therefore moving object detection is achieved.

Threat Detection using P300 EEG Signal

Brain is the main and dynamic organ that governs the human body, composed of different substances and electrical signals flowing by nerves, and the EEG detects this signal / waves. It is used in the medical field and experts are implementing it along with Artificial Intelligence (AI) also known as cognitive science. There are many techniques and demonstrating processes for recording, synthesizing, and interpreting EEG signals.A pattern matching algorithm using a template-based approach for extracting morphological knowledge from EEG Signals and implementing linear discriminating pattern classification rule. Video segmentation as discussed in the research is categorized as segmentation of static camera and segmentation of movable camera. Static camera performs Gaussian Mixture Model (GMM) on background subtraction, segmentation by tracking, while dynamic camera performs temporal difference and optical flow. Image classification addressed using the following classification method, namely Sliding Hierarchical Discriminant Classification Method (sHDCA), Artificial Neural Network (ANN), and Dynamic Time Wrapping (DTW) [6].

Space Time Volume (STV), Model-based, and contextual descriptors used to derive features for segmented objects. The last step is to identify the image or a video utilizing classification algorithms such as Dynamic Time Wrapping (DTW) for comparing between two temporal sets, Generative models for dynamic classification, and Discriminative models for static classification. BCI research is in the evolving stage and it was only used by researchers to analyze brain disorder and the medical area. Many researchers proposed the EEG signals to identify the characters instead of analyzing decision patterns. The work is ideal for combining brain signals to recognize the potential threat from video sequence and to build a database for use in the future [7].

LITERATURE REVIEW

This paper looks at the recent development of relevant technologies from the computer vision and pattern recognition perspectives. The topics covered include multi-camera configuration, camera network topology computation, multi-camera monitoring, target re-identification, multi-camera behavior review, and integrated video surveillance with both active and static devices. It provides detailed descriptions of their technical challenges and a comparison of different solutions.This paper offers a detailed account of intelligent video applications and automation in principle and practice. This describes the structures, activities, and associated analytical methods of the video system. This clearly shows the significance of the role played by smart camera systems and analytics used in a number of domains such as transportation and surveillance. Research directions are outlined with a focus on what is critical to achieving the objectives of smart video systems and analytics. This paper not only presents an update that extends previous related surveys but also focuses on contextual abnormal detection of human behavior, especially in video surveillance applications. The primary purpose of this survey is to identify extensively existing methods and to characterize the literature in a way that brings attention to key challenges[3].His report provides a comprehensive summary of current state-of - the-art wireless video monitoring technology, focusing on an in-depth analysis of the specifications and limitations of current systems.

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The actual network infrastructure is directly evaluated for video transmission over wireless cable. This outlines the key video capture techniques and tentative perception activities. The ultimate goal for video compression and delivery over the wireless networks is to optimize the video quality obtained under the resource constraint.In this article, the survey presented attempts to cover the absence of a complete description of the most important public databases for video-based human activity and action detection, and to assist researchers throughout choosing the most suitable dataset to test their algorithms[5].An attempt is made in this report to chart the current status of the video surveillance devices. Presentation and thorough study of the main components of a surveillance system. It provides algorithms for image enhancement, object detection, object tracking, object recognition, and re-identification of objects. In terms of available resolutions and modern processing techniques, such as High Dynamic Range imagery, the most important modalities used by surveillance systems are addressed, with focus on images.In this article, we are interested in studying the two key measures that make up a video surveillance system that are interpretation of actions and simulation of behavior. Techniques pertaining to extraction of features and description for representation of behavior are reviewed. Classification approaches and structures are also provided for behavior analysis. In comparison, accessible databases and success evaluation measures are provided. Lastly, descriptions of existing video surveillance systems are identified which are used in the real world[7].This paper concisely examines the historical development and current state of the modern surveillance systems of three different generations. Recently, in addition to the use of the ever-expanding variety of sensors, the inclination has been to use more intelligence and situational awareness capabilities to assist human supervisory staff. The latest generation is broken down into multi-sensor environments, video and audio surveillance, wireless sensor networks, distributed intelligence and awareness, architecture and intermediate ware, and mobile robots use.A review article thoroughly examines current progress in acceptance of video-based human activity [8]. Three aspects for recognizing human activity are addressed including core technology, systems for recognizing human activity, and applications from low to high-level representation. In core technology, three critical processing stages are mainly discussed in depth: segmentation of human objects, extraction and representation of features, detection of activity and algorithms for classification[9].This article summarizes the results of an exploratory qualitative research review in which the writers attempted to investigate whether two public libraries have adopted video security systems, and why one of those libraries has reversed course and recently removed a previously installed surveillance system. We observed that one library originally implemented the device in different branches as an ad hoc response to specific crime events without formal institutional supervision, while the other deployed the program as an integral part of planning and building its main library site and worked on security issues with local police and qualified consultants[10].

METHODOLOGY

The approach suggested, discussed in figure 1. Consists of live video analysis and detection of P300 signals interpreted and registered by the EEG signal processing to data set. The device first takes border area camera input video frames and displays the real-time video on the monitoring center screen to recognize threats.

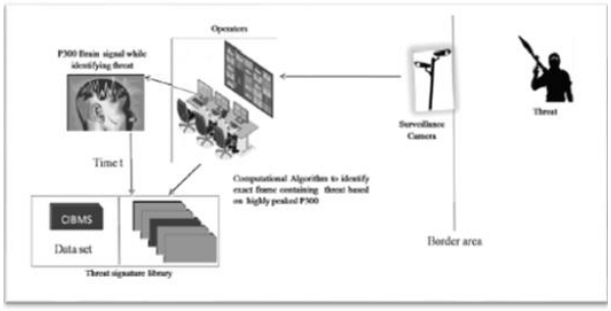

Figure 1: Block diagram for cognitive threat warning system

A parallel process that uses frame difference algorithm to perform a frame difference between two consecutive frames. W4 algorithm is used for sequencing video frames extracted after the difference between frames.The proposed system utilizes non-invasive procedure to collect brain waves, as it costs small and needs minimal operation to be done through intrusive and partly invasive techniques. The listener wears the EEG helmet to catch the Event Related Potential (ERP) such as odd behavior, under-fence creeping etc.

Many researchers used non-invasive brain wave recording devices for various applications such as capturing alphabet on computer screen, wheelchair for disabled

people is a recent innovation in the field of neuroscience using non-invasive EEG headset-capturing brain waves.

EEG Processing

A raw P300 signal is then processed under Matlab which is produced from the EEG hat. A Hierarchical Discriminant Principal Component Analysis (HDPCA) algorithm for all Dual-RSVP-induced single-trial ERPs for a specific subject component classification between target and non-target classes. HDPCA is enhanced more in terms of accuracy than Hierarchical Discriminant Principal Component Analysis (HDCA).The P300 signals are created while the irregular event detection in the video frame activates the threat alarm and then stored in the dataset to build the library for potential threat detection and activate the threat alarm and suggested Template Matching (TM) in conjunction with LDA (TMLDA) needs just 15 tests to achieve a 100% recognition rate.A user using EEG helmet detects the video frame that shows an unexpected occurrence, and the detected Video frame is retained in the data archive. Using classification and function extraction method, the transmitted EEG signal undergoes signal processing and produces an alert after identifying suspicious behavior from video frame sets and being deposited in library for potential detection.

CONCLUSION

By using EEG signal segmentation, filtering algorithms and BCI, it is possible to detect a suspicious behavior according to the suggested technique for analyzing the surveillance video. P300 allows users to connect with the device via a series of video frames and to boost video quality in all bad conditions such as heat, storm etc. The system uses an EEG mask to track brain signals from users, and then tracks when a hazard is identified by the observer. The use of statistical algorithm and EEG P300 signals not only eliminates false alarms but also lets observers identify indicators of risks that would be ignored. The device saves the video frame that includes potential threat recorded by video camera while P300 brain waves observers have been strongly peered into the dataset for a period of time since preparing for the specific area to use it further without human interaction to making the machine guy portable. The sHDCA algorithm activates the warning automatically when the dynamic camera captures some suspicious behavior under that region using data set P300 signal. The basic threat signature library is made available under supervised learning, and is enabled in future with unsupervised mode.

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