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Object Tracking System on Ultrawide Video from Double Camera using Motion Detector

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Abstract. This research aims to design, test, and analyze the object tracking application system using a motion detector method that is able to take the output image of several cameras by combining the output images of the two cameras into a wider field of view (FOV). This research uses 2 cameras, i3-6006U laptop camera and Logitech C270 HD webcam using OpenCV and python programming language. The stitching results from the initialization of the two cameras are able to detect the motion of objects performed on panoramatic videos in realtime by showing time in detail starting from days, dates, hours, minutes and seconds. This object tracking application system has been tested in Adi Sucipto airport exactly in the area of arrival and departure of passengers. The system can detected the motion in the stitching images by exploring it in red rectanguler in the real time video.

1. Introduction

Technology is developing rapidly in the current era, especially technology that leads to image processing. Developing image processing technology increasingly facilitates human work, for example object detection, feature extraction, and facial recognition can be done by computers without human intervention. With the purpose of it cannot be denied that the image processing technology is able to bring up a variety of interesting and sophisticated tools to help and facilitate human life.

The airport is one of the places that plays an important role in the aviation industry with overcrowded air traffic coming and going from or to an airport both from within and outside the country. It is undeniable that airports certainly also have a high level of risk in crimes such as goods smuggling, theft, or other criminal acts. Thus, the role of Closed Circuit Television (CCTV) is very necessary in every corner of the room at the airport. But sometimes CCTV is still not maximal in monitoring one's movements because they have a limited perspective. The role of security is very much needed to help security at the airport by optimizing existing CCTV.

From the existence of some of these problems, the author will make an application at the airport that is used to facilitate airport security to monitor a person's movements with a wider perspective by combining 2 videos (2 cameras) into a panoramatic video sequence. Applications at the airport are used to expand the field of view (FOV) in order to develop the CCTV that has been installed previously. It aims to the detected object can be tracked further because the camera's viewpoint effect becomes wider. Besides expanding FOV with panoramic video, the application detects objects using

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motion detectors. OpenCV is used as a basic framework for developing the applications. The programming language used is Python using the Windows operating environment. The purpose of this study is to apply and analyze the moving object detection process in panoramatic video sequences in real-time.

2. Literature review

Several studies that have been used as references in this paper were obtained from (Suresh & Lavanya, 2014), (Ojha & Sakhare, 2015), (Singh, Deepak, Sethi, & Murthy, 2015), (Supriana, 2015), (Alzughaibi, Hakami, & Chaczko, 2015), (Manchanda & Sharma, 2016), (Sukanya, Gokul, & Paul, 2016), (Supriyatin, Rafsyam, & Jonifan, 2017), (Rumaksari, 2017), who have conducted research related to motion detection based on several techniques [1]–[9]. Where as, the tracking object research can be shown in table 1.

Table 1. Related researchs in object tracking

Researchers	Year	Methods	Results
		Background substraction	81.27%
B.S.L and Akbar (2014)	2014	Kalman Filter	85.2%
Wijayana (2015)	2015	ASIFT dan Mean Shift	30%
		Multiple Object Tracking	81.72%
		Position estimate	87.95%
Supriana (2015)	2015	Object detection	76.38%
		Gaussian Mixture	
		Recall	71%
Prabowo (2015)	2017	Precission	72%

B.S.L and Akbar (2014) conducted research on Background Substraction and Kalman Filter-Based Object Tracking. The study combine these two methods to assist in object tracking on video. The results obtained were that the object substraction method was successfully tracked at 81.27%, and with the addition of the Kalman filter method, estimation of object movement can be done up to 85.2% accuracy [10].

Wijayana (2015) conducted a study of the use of the Affine Scale Invariant feature Transform (ASIFT) and Mean Shift methods in the analysis and implementation of object tracking. The research stems from the increasing human need for tracking-based security systems that work automatically that are resistant to various conditions. In the object tracking system, feature extraction is one of the main tasks in tracking an object, in this case the characteristics used are required to be able to withstand various conditions because the object is always moving freely in the video. The results of this study indicate that the environmental conditions of the object against the number of possibilities of the object are detected correctly. Controlled environmental conditions tend to have better results than uncontrolled environments. In addition, the threshold and radius values used also greatly influence the results of object matching. Based on research, the threshold with a value of 0.9 and radiun 10% has a tendency to detect objects correctly. The results also show that the ASIFT and Mean Shift methods can overcome the problem of changing the point of view that occurs in objects with an accuracy of 30% [11].

Supriana (2015) conducted research on home security systems that are supported by multiple object tracking methods and position estimation. To find out the events on CCTV footage, records must be checked from the beginning to the end. This will be a problem if the record is very long. Therefore, a system was proposed that can automatically track events that occur on the record. The system proposed in the study was a system that processes multiple object tracking and position estimation. The process of multiple object tracking was a process of tracking all moving objects recorded in the video. The test parameters were the accuracy of the system in tracking an object and the average time needed to track one object. From the test, the average detection accuracy was 76.38%, tracking

accuracy was 81.72%, and the accuracy of position estimation was 87.95% with the average tracking time per object [8].

Prabowo (2015) conducted a study that gave the output of a system of detecting objects on video in water. In detecting objects in water, the background is always changing because of the influence of the intensity of light and underwater current waves. Therefore we need a background maker method that can adapt, namely the Gaussians Mixture Model. The success rate of this method is evaluated based on recall and precision values, where the average value of the three videos is 71% for the recall value, and 72% for the precision value [12].

3. Methodology

3.1. System Design

System is designed for motion detection in the airport, namely object tracking applications from two cameras that are used to capture images at a particular location. The camera used is the i3-6006U camera laptop and Logitech C270 HD webcam. Both cameras are connected to a laptop to capture images in real time. In designing this system, the output images of the two cameras are processed using image processing techniques namely image stitching. Output of the image stitching process is come out to be wider images due to it joined the both output image camera together. After the image stitching process, an image processing technique is performed to the output image to detect the movement of the object from the output of the image. Software in this process is used to give commands to hardware to carry out commands. The following software will be used to support the Object Tracking application software:

- Operating System: Windows 10 Pro 64 bit Operating System
- Programming Language: Python
- Editor / Compailer: IDLE Python 2.7
- Prototyping: IDLE Python 2.7
- Designing: IDLE Python 2.7, OpenCV, and JetBrains PyCharm Community Edition 2018.3.

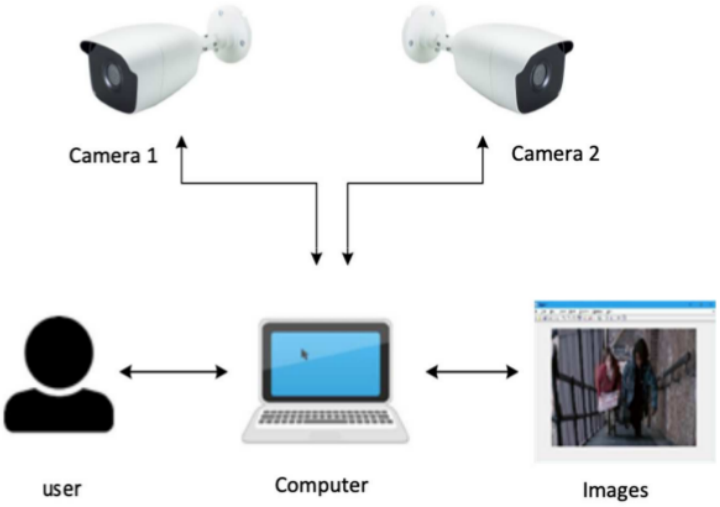

Figure 1. System Architecture.

The system architecture built in this research is shown in figure 1. In figure 1, the user (airport user / visitor) will be in a room that has been initiated by cameras 1 and 2 with stitcher and motion parameters. The application will retrieve data from the camera initiation and start doing resize images that have been recorded from both cameras, then detect contours, merge images (image stitching), grayscaling process, then detect for any motion detected. The application will get an object point in the form of a rectangle which then shows the image display.

3.2. System Testing

After the system design is complete, the data retrieval process is carried out to accept the system that has been designed. Several conditions were tested for the system. There are 3 conditions chosen for data analysis. The system testing is done in Adi Scipto airport. This data analysis aims to analyze or regulate the data obtained, in accordance with or not with the objectives obtained from this study, namely promoting the movement of objects in images that have been equipped with renewal of their views.

3.3. Results Analysis

Contains an analysis of the results of a system application that has been carried out a trial with an image with various results thus obtained in order to fit or not with the purpose of this study.

3.4. Is it appropriate?

Filled with checking the system whether the approved system has worked in accordance with the results expected or not carried out analysis.

3.5. Finished

The process of this research is done with a system that can run to change the image that has been widened.

4. Results & Analysis

The capturing image area at Adi Sucipto Airport, Yogyakarta was conducted on April 11, 2019 around 10.00 AM where exactly in the area of arrival and departure of passengers with the condition of the laptop and webcam stand in a small table as shown in figure 2.

Figure 2. Positioning of camera 1 and camera 2 at Adi Sucipto Airport.

4.1. Testing 1

In testing 1, the case that was raised was when cameras 1 and 2 both detected moving objects. The results of testing 1 are shown in figure 3 while the results of testing 1 stitching process can be seen in figure 4.

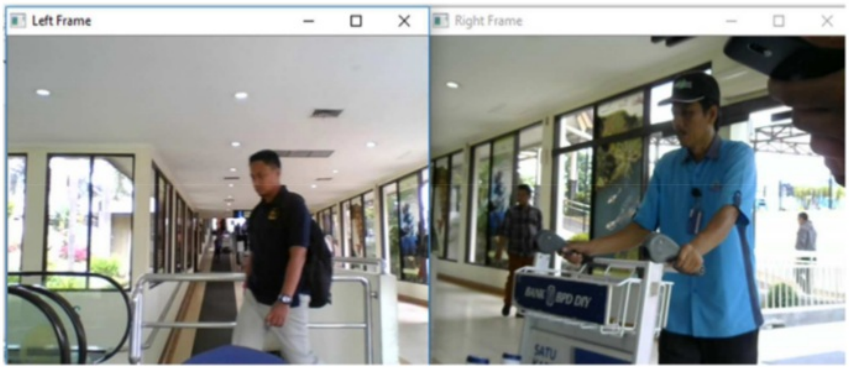

Figure 3. Result of video image from camera 1 and camera 2 in condition 1.

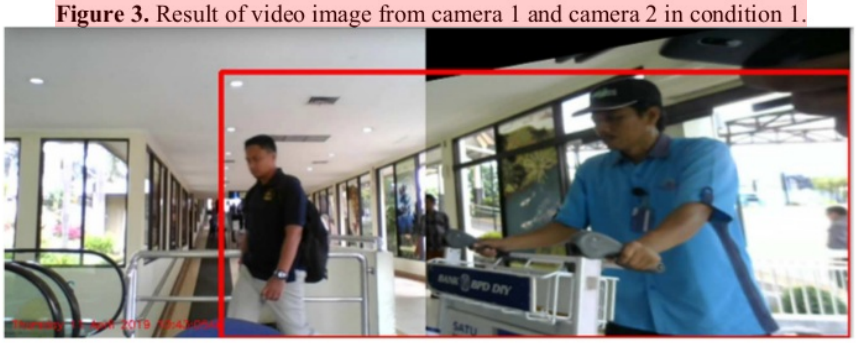

Figure 4. Stitching results from both cameras 1 dan 2 in condition 1.

In the testing 1, it can be seen that the stitching results from the two cameras look good even though they are not perfect because the result frame is not maximal. This obstacle is not maximal because there is still a blank spot in the result frame. This blank spot occurs because there is the same match point between the image formed by camera 1 and camera 2. The point of this match indicates that if camera 1 has detected the image of the object, then the image will not be detected in the image recorded camera 2. For testing 1, the coding of the datetime command works well. In addition, the motion detector method works well by detecting the red box when a movement appears.
It can be concluded that in testing 1 with the case when both cameras 1 and 2 detect moving objects produce a system that is capable of detecting object tracking by giving rise to a large red box that surrounds moving objects initialized in camera 1 and camera 2.

4.2. Testing 2

In testing 2, the case that is raised is when camera 1 (left frame) detects a moving object while camera 2 (right frame) does not detect moving objects. The results of testing 2 are shown in figure 5 while the results of the stitching process in the testing 2 can be seen in figure 6.

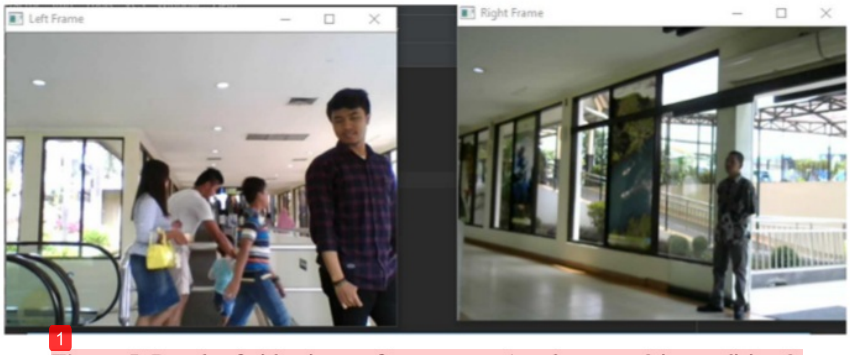

Figure 5. Result of video image from camera 1 and camera 2 in condition 2.

Figure 6. Stitching results from both cameras 1 dan 2 condition 2.

In testing 2, it can be seen that the stitching results of the two cameras look good qualitatively even though they are not perfect because the result frame is not optimal. The obstacle that occurs in this second experiment is the same as the first experiment where for testing 1, the coding of the datetime command also works well. In addition, the motion detector method here works well by detecting the red box when a motion is detected. However, in the testing 2, it was seen that the red officer on the right side was not detected by the red box because this officer did not do any movement.

It can be concluded that in the testing 2 with the case when camera 1 (left frame) detects a moving object while camera 2 (right frame) does not detect a moving object produces a system that can detect object tracking by displaying 1 red box (result frame) on the camera part 1 only. This is because the system does not detect any object movement on camera 2 so that the result frame does not bring up a red box.

Discussion of difficulties in the system, it is undeniable that this system is still simple and requires a lot of development, especially in hardware development. The result frame is able to form perfectly when the two cameras are arranged so that the parallel height then has a match point that is parallel and precise. In the camera settings need some time lapse, but when the second position of the camera is patent and able to produce a maximum result frame, this system is not easily changed and can be monitored in realtime. The motion detection system of objects in this system is characterized by 1 red box both object motion initialized on camera 1, camera 2, or on both cameras.

5. Conclusion

Object tracking application system in this research is able to take images from 2 cameras which then combine them into panoramatic videos that have a wider field of view (FOV) by using the image stitching method. The object tracking application system is capable of showing video in realtime and able to detect every movement of objects that appear from both cameras with a red box indicator that appears in the result frame with several conditions. Things that greatly affect the accuracy of the

results of the object tracking application system are the location of the two cameras that must be arranged so that the parallel height then has a match point that is parallel and precise. Suggestions that can be used in developing this object tracking application system by setting and selecting better hardware so that it will provide comfort for the user.

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