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Design and Implementation for Human Face Detection with Surveillance Camera

Thitiphan Anakkawet
Waris Rattananimit
Faculty of Engineering and Technology
Siam Technology College, Bangkok, Thailand
Email: warisr@siamtech.ac.th

Abstract

Current security systems using surveillance cameras are needed nowadays for safety and accuracy of data under investigation. Surveillance cameras in some areas are with very limited functions. On the devices, a wi-fi module is mounted and interfaced with a Raspberry Pi. Raspberry Pi receives signals from a wi-fi module and decodes the signals in the Raspberry Pi for video transmission. Face detection is a python *program* running in Raspberry pi with Open CV libraries capturing and locally storing images in real time from USB cameras to match a face pattern in the detecting frame. If any intruder enters the area, *the program* will capture the image of the person and checks with his images already stored on the Cloud. The study reports the subjects in 4 groups and 9 different face detections being tested. The test involved sending a total of 50 times shot commands and 89.72% shots were detected correctly. The accuracy of recognition can be affected by such noises as image, light, and the blurring. These factors need to be examined in further studies.

Keyword: *Design and implementation, face detection, image processing, Raspberry pi, surveillance camera*

1. Introduction

Security cameras are needed nowadays for safety and accuracy of data under investigation. This trend for safety has led to an increasing need for surveillance, which is recognized as a daunting task. There are surveillance cameras in some public areas, but with limited spanned vision.This is not of much use as the view can get obstructed easily (Dumbre, 2015). During emergency situations and specifically urban disasters, different forces are deployed, like policeman, fire fighters and medical assistants. They need to cooperate to save lives, protect structural infrastructure, and evacuate victims to safety (Gauswami & Gupta, 2016). It is important to have a webcamic vehicle for surveillance purposes. This webcamic vehicle is controlled via the Internet to cover the area it surveys (Dumbre, 2015). There should be a mobile system for effective surveillance (Priyanka et al., 2017). This webcam should have a little casing, and with light weight, to observe movements (Ghosh et al., 2015). Such a system can be built easily to recognize intrusion and alert the owner of the property in absence (Sagar et al., 2017).

2. Literature Review

Khan et al. (2017), Ghosh et al. (2015) and Sagar et al. (2017) conducted research on web controlled surveillance webcam for a person/ object to enter profoundly risky

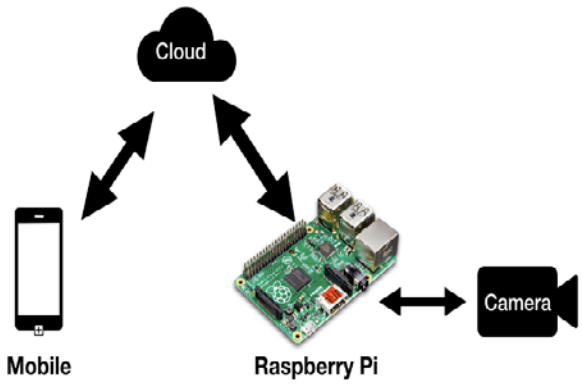
zones and convey data with respect to their surroundings to a remote server (Ghosh et al., 2015); it was to implement a webcamic home security system using image processing techniques to detect an intruder. Sagar et al. (2017) studied Webcam movement, signboard recognition, face detection and notification techniques. Khan et al. (2017) further studied WI- FI Based Webcam Controlling by Webpage Interface and Video Monitoring, Designing of the system requires the knowledge of physical components, sensors, embedded system and decision algorithm. Priyanka et al. (2017) and Dumbre (2015) investigated the use of Webcamic Vehicle Control via the Internet, Webpage and Keyboard with surveillance cameras in specific areas. The webcamic vehicle was controlled via internet thus increasing the area it surveys. Dumbre (2015) used automatically controlling surface transitions, and provided the controlling user with surveillance of its location. Priyanka et al. (2017) developed RASPBERRY Pi BASED OBSTACLE AVOIDING Webcam by building an autonomous webcam using raspberry pi as a processing chip. An HD camera was used to provide and detect the obstacle from the real world to the webcam.

Swathi & Fernandes (2015) and Gauswami & Gupta (2016) studied Disaster Autonomous Webcam-Finding People through Face Detection Using ARM-11, presenting the implementation of an autonomous mobile webcam capable of avoiding obstacles and aiming to find human faces and human body. Raspberry Pi Based Human Face Detection has its focus on finding whether or not there are any faces in a given image and, if present, returns the image location and content of each face. Swathi & Fernandes (2015), Pagar et al. (2015), and Pannu (2015) worked on Design and Implementation of Autonomous Car using Raspberry Pi; the project aimed to build a monocular vision autonomous car prototype using Raspberry Pi as a processing chip. An HD camera along with an ultrasonic sensor was used to provide necessary data from the real world to the car (Pannu, 2015).

3. Methodology

In this section, the researchers described a webcam in the user's device with the application of the webcam's device and the subsequent functions on both. On the webcam, a Wi-Fi module is mounted which is interfaced with a Raspberry Pi as shown in Figure 1. The controller is a client sitting on a computer or a laptop in range of Wi-Fi administering the webcam. Whenever a client sends the control signal, it is transmitted wirelessly and is captured by the Wi-Fi module mounted on the webcam. This signal is transmitted to Raspberry Pi attached to it.

Figure 1: Overview System



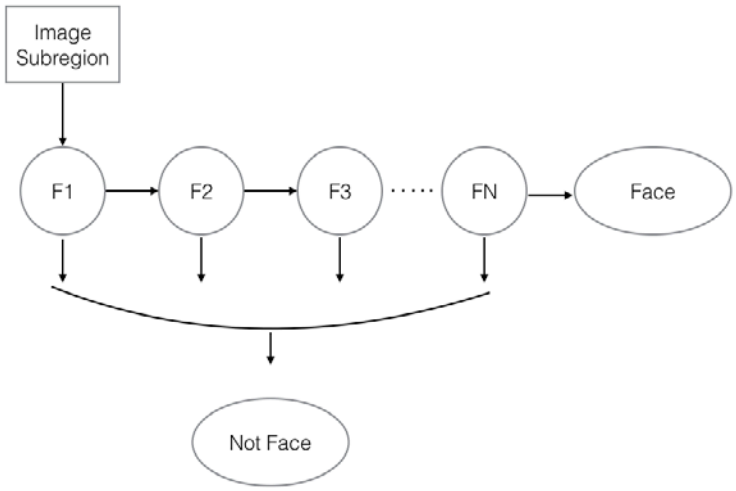
A Wireless Camera mounted on the Webcam captures the video and transmits it to the client, which gives the current position of the webcam. The video can determine whether we need to move the webcam forward or backward. Keys pattern are designed on a webpage through which the webcam will be controlled (Ghosh et al., 2015), as shown in Figure 2

A Webcam Server is the code run on the Raspberry Pi to capture the images and stream them over the Internet. Images are compressed into .jpg format to reduce their size prior to their transmission over the Internet (Dumbre, 2015). A Webcam Client is displayed on the monitor at a rate closer to 12-20 images per second so that they appear like a continuous video (Dumbre, 2015).

An Open CV (Open source Computer Vision) is a library of programming functions, mainly aimed at real time vision. It has over 2,500 optimized algorithms and the state of the art algorithms in a computer vision, which can be used for image processing, detection, face recognition, object identification, classification actions, traces and other functions. This library allows these features to be implemented on computer with relative ease in providing a simple computer vision. It is based on Python but wrappers are available in python as well (Nikam et al., 2017). This algorithm for Raspberry Pi face recognition using haar-like features. It finds faces in the camera and puts a red square around it. Algorithm in OpenCV is used for face detection. This algorithm detects the face from the frames obtained from the camera in real-time (Sagar et al., 2017). In the researchers' project, it is used to detect the face of an Intruder.

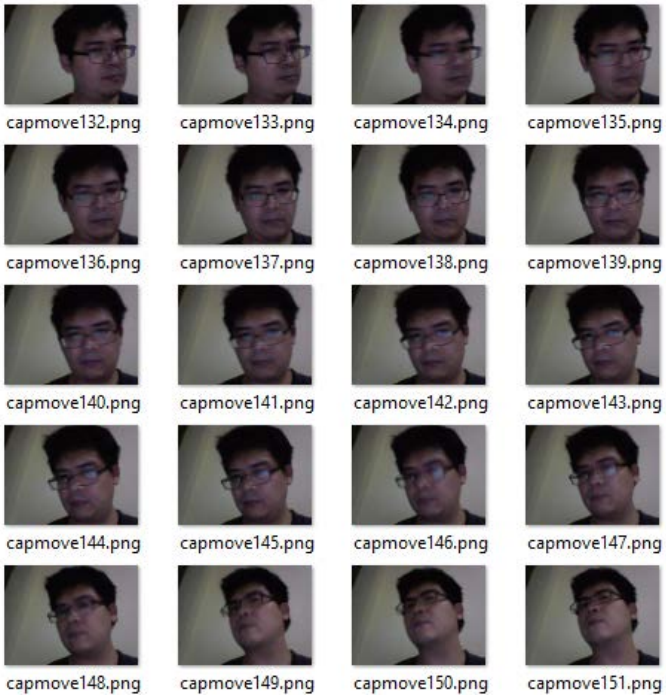
Figure 2 shows the cascade classifier consisting of the number of stages, where each stage is a collection of weak learners which are simple classifiers known as decision stumps. Boosting is used to train the classifiers. It provides the ability to train a highly accurate classifier by taking a weighted average of the decisions made by the weak learners (Sagaret al., 2017).

Figure 2: Cascade Classifier



Each stage of the classifier shows the region defined by the current location of the sliding window as either positive or negative. *Positive* indicates an object being found and *negative* indicating object (Sagaret al., 2017). The detector reports an object found at the current stage when the final stage classifies the region as positive (Sagaret al., 2017).

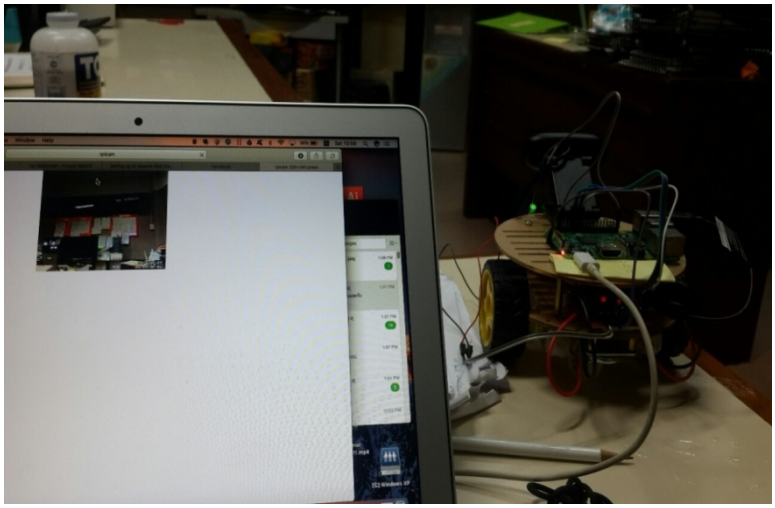
Figure 3: Face Image Sheet



The sample set of input different images and detected images using *the proposed algorithm,* which has major facial expression variation is displayed in Figure 3. Also shown is a comparison of performance of the proposed algorithm on various standard face datasets (after Swathi & Fernandes, 2015).

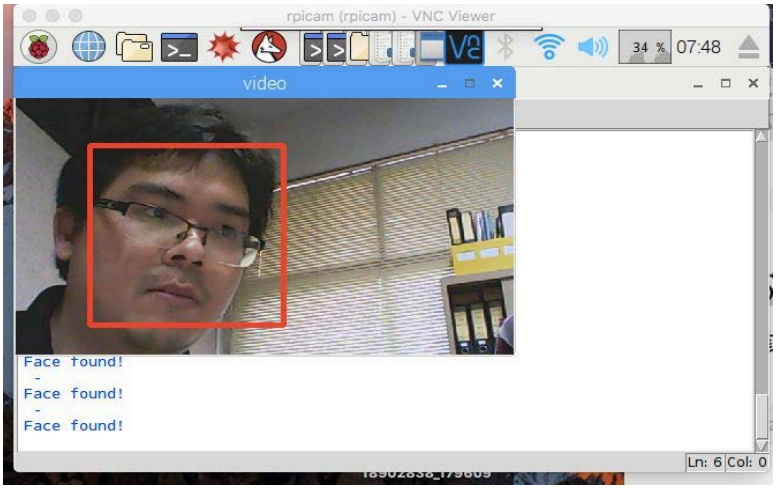
4. Results of the Study

Figure 4: VDO Broadcast from Webcam



For Real time face detection, the webcam was connected tothe Raspberry Pi to capture the real time video as shown in Figure 4. The output video window was set to defined size and the video was displayed in it (after Swathi & Fernandes, 2015).

Figure 5: Face Detection of Intruder

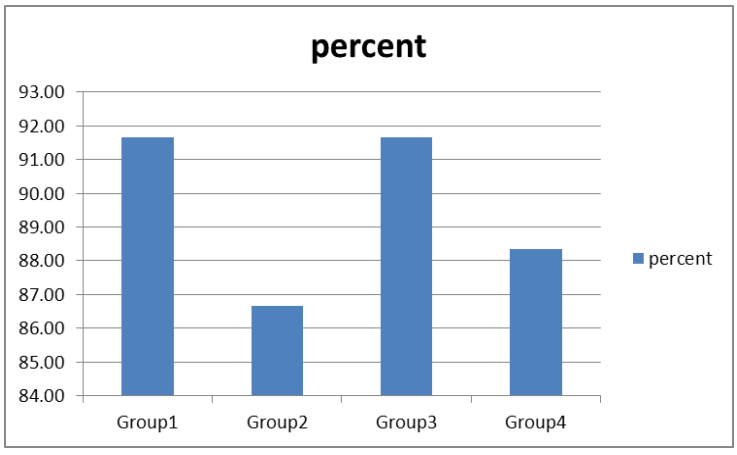


A face detection python program running on Raspberry pi with Open CV libraries can capture and locally store the images in real time from USB camera when a face pattern in the frame is detected as shown in Figure 5.

If any intruder enters the designated area, the Webcam will capture the image of the person and checks with the images already stored on the Cloud as shown in Figure 5.

The graph in Figure 6 shows the response of the face detection capturing commands. The tests in the study involved 48 times; the trails were conducted with people with different faces. The tested subjects were in 4 groups and 12 different images per person for faces detection. The test captured a total of 48 times and the result was that 89.72% captured were face-detected correctly. When a command was not able to detect correctly, the software ignored the command and did not transmit any signals to the device control modules. The accuracy of recognition was affected by noise of image, light condition, and the blurring image. These factors need to be studied further in more details by conducting more tests.

Figure 6: Face Detection Rate



5. Concluding Point and Future Work

In this paper, the researchers studied the use of webcams as investigated, explored and trialed by other preceding researchers. The earlier webcams studies reported various

approaches with improved results in terms of quality of the video transmission and time taken by face detection video transmission.

This study reports the test conducted to capture a total of 48 times of face detection and the result was that 89.72% captured were face-detected correctly. The software ignored the non-working command by not transmitting any signals to the device control modules. The researchers found accuracy of recognition being affected by noise of image, light condition, and the blurring image. To the researchers, such noises or shortcomings should be studied further in more details by conducting more tests. It is expected that the use of webcam and camera module will ignite more interest of those who wish to further explore the area of recognition and face detection for safety and crime investigation.

6. The Authors

Thitiphan Anakkawet and Waris Rattananimit are staff members of the Faculty of Engineering and Technology, Siam Technology College, Bangkok, Thailand. They have their keen interest in robotics skills development and coaching, particularly with a focus on design and implementation for human face detection with surveillance camera.

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