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Serial Communication Based Interfacing of MATLAB with Arduino for face detection and Tracking Algorithm

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Abstract—This paper mainly describes the proposed model, face detection and tracking using MATLAB software interfacing with Arduino board. The aim of this paper is to develop a real-time application like security system that is necessary in several platforms. In this paper the real-time face detection and tracking is implemented using hardware devices like Webcam and Arduino board with Microcontroller as input and output devices respectively. The face detection algorithm has been developed on the MATLAB platform which was proposed by Paul Viola and Michael Jones. The methodology used to detect a face using some parameters of image and tracking of the detected image are clearly demonstrated in this paper. Index Terms- Human face detection; image tracking; arduino; matlab;

I. INTRODUCTION

Coming up with an effective and quicker identification and tracking algorithm has always been a tough challenge, but the need for video and audio surveillance is constantly on the rise owing to the huge increase in terrorist operations [3]. A number of alternative methods have been suggested. An effective approach for quicker face detection and tracking is presented in this study. Because of its precision and compatibility with image processing techniques, MATLAB has been employed in this study [5]. One of the main benefits of MATLAB is its extensive set of built-in image processing tools. Another perk is how easy it is to connect with items like cameras and boards like ARDUINO IDE and Raspberry Pi. Facial recognition using cameras is the focus of this research. In this work, we attempt to identify the use of front and centre. The initial step in developing a detection system was creating a novel way to describe images, known as an integral picture, which allows for the rapid and easy selection of image elements [10]. After that, the procedure outlined in this article is used to pick facial traits. Following this, the identified image must be followed [6]. The detected item is brought within camera range by manipulating control signals corresponding to the axis values, which are sent to the Arduino board via serial connection. This board then adjusts the vertical and horizontal axis of the detected picture [7]. The Arduino board was chosen for this work because to its status as an open-source browser electronics component with both software and hardware components. Also, it's great for beginners who are looking for a more social setting. It has several programming options.The IDE software in question is also

programmed by MATLAB using special function, it has analog and digital input output pins. In this paper, section 3 describes about the Proposed Algorithm and section 4 with methodology followed by simulation and results. The last section concludes the paper.

II. RELATED WORK

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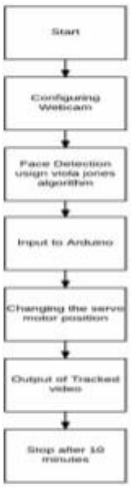
Paul Viola and Michael Jones [1] proposed a method for object detection using Haar features. In this paper the comparison of accuracies of various methods for object detection such as Viola-Jones, Rowley-Baluja-Kanade, SchneidermanKanade, Roth-Yang-Ahuja. In this first the features of an image are calculated and then these are cascaded to form a strong classifier. This paper is a machine learning approach of detection of objects. These features are then applied for a classifier to identify the object. Chathrath and Gupta et.al [2] proposed a method of detecting the face in an image. This paper presents a set of detailed experiments on difficult face detection and tracking data set which has been widely studied. This data set includes faces under a wide range of conditions including: illumination, scale, pose and camera variation. Divya George and Arunkant [8] proposed a method for face detection and tracking in a video using optical flow techniques. The tracking is implemented using different methods of optical flow such as block based methods, Discrete optimization methods, Differential methods. In the work Pyramidal Lucas-Kanade Feature Tracker optical flow method is used for tracking the face. Zhu Liu and Yao Wang [9] proposed aapproach to monitoring and detecting faces. The approach relies on dynamic programming-based template matching. The face tracking and clustering approach shows promise, and the face identification algorithm is both quick and reliable, according to preliminary testing findings. Section Three: Suggested Method The process of implementing face identification and tracking using MATLAB and Arduino begins with the initialization of the camera location in this work. The footage is then sent into MATLAB via the camera. Matlab is able to identify faces in the video feed from the webcam. In order to keep the camera in place while tracking the face, MATLAB transmits data to the Arduino, which in turn moves the servo motors. Figure 1 shows the proposed algorithm's flow diagram. Figure 1: Method Flow Diagram



III. METHODOLOGY

Below is a description of the algorithm that is used for human face detection. The four critical stages are outlined in the section below A. Features of Har There are two main categories of images.

two systems: one based on pixels and the other on features. Due to their much quicker operation, feature-based systems are preferred over pixel-based ones. There are typically three kinds of features used in face detection procedures: two-rectangle, three-rectangle, and four-rectangle features. The characteristics are computed by subtracting the total of the white-part pixels from the

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total of the black-part pixels. The four-rectangle feature finds the discrepancy between the total of the rectangles' diagonal pairings. In the same way, a three-rectangle feature finds the midpoint by subtracting the total of the rectangle's edges from it. Last but not least, a two-rectangle feature is the difference in pixels inside two identically shaped and sized rectangles that are either horizontally or vertically next to each other.

Tracking of face

At startup, the servo motor position is configured to put the camera to its default state, which is zero degrees. Next, the movie is sent into MATLAB, which uses the viola jones method to find faces. finds a face in the live video feed and adds a bounding box face to it. The calculation of the bounding box centroid is now underway. A string containing the centroid's coordinates is sent to the Arduino Micro controller via the serial wire that links the computer and the controller. The servo motors' positions are communicated with the Arduino microcontroller. For horizontal face tracking, a pan servo motor is used, and for vertical face tracking, a tilt servo motor. Currently, the frame is split into four sections: the top, left, right, and bottom half. The Arduino microcontroller determines whether the centroid is in the upper or lower right corner of the frame. When the centroid is in the upper right corner of the frame, the camera pans to the left; when it's in the lower left corner, the camera pans to the right. In a similar vein, the camera is angled by using the upper and lower parts of the frame. Lastly, the camera is adjusted so that the centroid and the centre of the picture always line up.

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Fig. 5. Tracking of Face

IV. SIMULATION AND RESULTS

VI. CONCLUSION

Facial recognition is the basis of our work's tracking system [4]. The method for detecting faces is developed in MATLAB and then interfaced with a camera by a specific command. The video is then read by the Arduino microcontroller, which then tracks the face's movement. As seen in the findings, the Viola Jones algorithm is superior to other methods for face detection due to its efficiency and speed. First, the image was detected using the algorithm, and then the face's coordinates were sent to the Arduino microcontroller. We programmed the Arduino controller such that it would send control signals to bring the face's coordinates back within a certain range if they were to move outside of that range. It is possible to modify the parameters of the

Viola Jones method that is used here.

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