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Recognising Human Vision Vector in 3d Using Stereo Vision System

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ABSTRACT: Because there is no deterministic technique to discover a face in a given image, human face detection and identification has grown to be a significant area of interest in current research. Furthermore, the algorithms used to recognize faces in photos are quite precise in the types of images they accept as input. Finding faces in the provided, colored class group photo is the challenge. We employ a method that combines established algorithms and heuristics. We can string together several straightforward rejection blocks in order to find faces. The more specifically it can be educated to eliminate non-faces, the deeper the rejection block.

KEYWORDS: Face detection, Face identification, Face recognition.

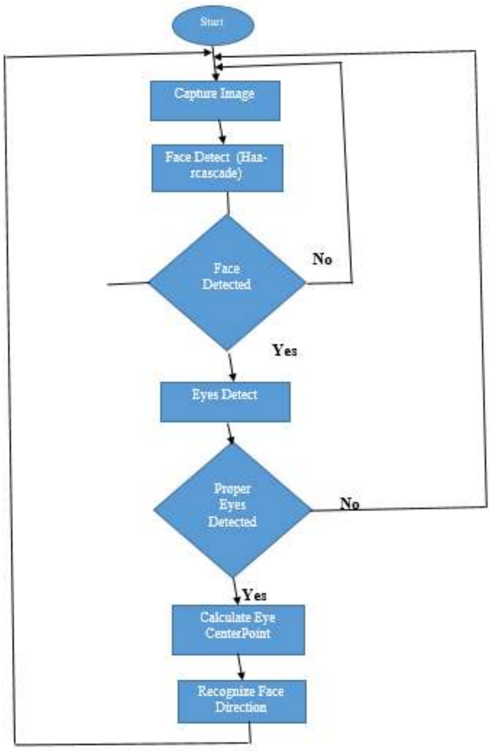
I. INTRODUCTION

Early in the 1970s, machine vision technology began to be used in industry, but because of high computer costs, adoption has been slow. The machine vision industry is somewhat fragmented, and tiny technology firms are vying for repeat business in certain industry verticals. Because technology businesses are unwilling to assume all of the associated risks and because end users are accustomed to purchasing tried-and-true technology for their manufacturing facilities, many novel application areas with associated hazards remain unaddressed. The Information Society Technologies (IST) initiative, which is sponsored by the European Commission, has actively supported the transmission, use, and study of machine vision technologies. The technique is called machine vision, and procedures employed to provide applications with automated inspection and analysis based on imaging such as robotics, process control, and automatic inspection guiding, typically within the industrial setting. The term "machine vision" covers a broad range of hardware, software, and technologies items, combined systems, procedures, with knowledge. Machine vision is a subfield of systems engineering, whereas computer vision is a subset of computer science. It makes an effort to use already available technology in creative ways to deal with issues in the real world. The term is usually used for these tasks when industrial automation is involved, but it is also used for related tasks when vehicle guidance is involved. Thanks to machine vision technology, industrial machinery can now "see" what it is doing and make decisions swiftly depending on what it observes. In addition to visual inspection and problem detection, machine vision is most typically utilized for product identification, sorting, and tracking.

PROBLEM DEFINITION

A robot that has a screen at the background, we want to make the robot identify the vector of the human eye standing in front of it.

II. SYSTEM DESIGN



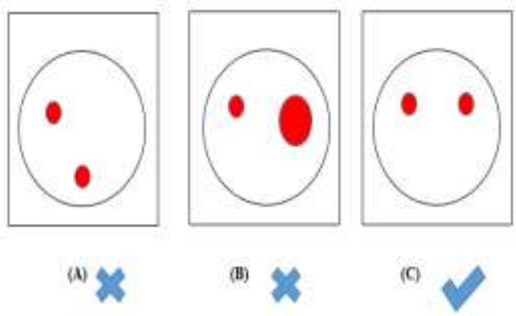
System Flowchart

As shown in the figure above, firstly, the system starts, then images are been captured by the capturing device, then the system tries to detect the face using the haarcascade algorithm, if a face is successfully detected, eyes are detected next in the face, if a face isn't detected, the system jumps back to start the process all over again. After the eyes have been detected, the system makes sure the eyes detected are rationally proportional being the proper eyes. If proper eyes are not detected, the system jumps back to start the process all over again. But if proper eyes are detected, centerpoint is been calculated then the face direction is being recognized, which means the system process and transition is successful.

Haarcascade

A snapshot or live video may be used to identify a face using the Haarcascade acquisition technique. The research article "Fast Detection with the Advanced Casual Cascade," written by Viola and Jones in 2001, makes use of edge or line detection characteristics. The program generates lots of stunning pictures that don't show faces. Negative pictures without any faces you may practice on. (Viola P., and Jones M., "Fast Detection with the Advanced Casual Cascade". 2001). A classifier is trained using the machine learning technique known as Haar Cascading using a large number of both positive and negative images. Michael Jones and Paul Viola advance the algorithm.

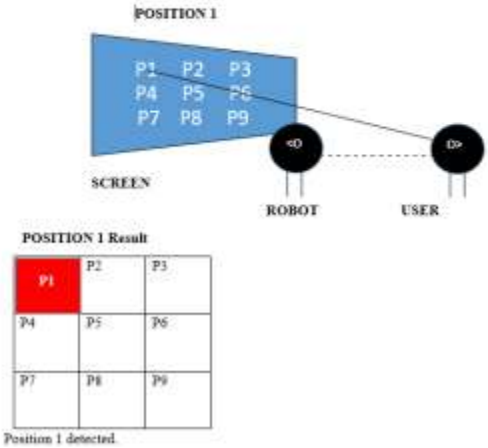
Eye Detection

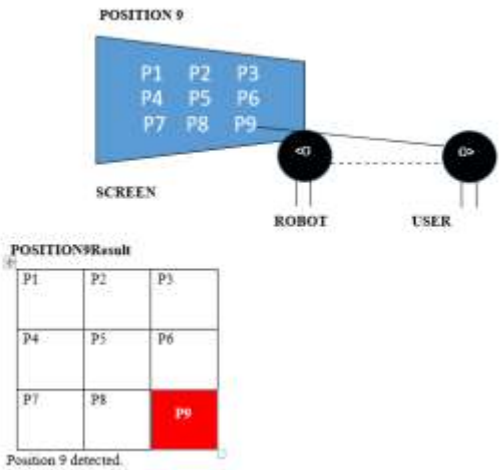


As shown in the figure above **A, B, C** are illustration sample of 3 detected faces with the eyes detected. In A, the eyes has been detected wrongly because one eyes detected properly on the eye window region while the other has been detected outside the eye window region but on the lip region. In B, the eyes has also been detected wrongly because both eyes, though in the right eye window region, they are widely different in size and proportion. In C, the system detected the eyes correctly in the eye window region and the eyes are same sizes or slightly different in size proportion which makes the detection correct.

Using C, the system that will detect the eyes inside the detected face will get the face from the image and this face will detect the eyes, if the eyes are found in the way it is on the illustrated diagram C using the library called haar-cascade, the center point can be accurately calculated.

Recognize Face Direction





In the figures above, the user is sitting in front of a robot with a big screen behind the robot. The user looking at the direction of position 1 (P1), and position 9 (P9) respectively, calculating the angle of eye with respect to head movement, the robot detects the use is looking at position 1 and position 9 respectively. The robot detected the user sitting in front of it is looking at position 1 and 9 respectively, and the results are been reflected on the result tables indicator.

Calculate Centerpoint

To calculate the center point of the eye, add all the points gotten from both left camera and right camera, then X, Y, Z for both right eye and left eye on the face together and divide by 2, thereby getting the average which serves as centerpoint for eye, both left and right.

III. LECTURE REVIEW

S/N	Name	Authors	Year	Results
[1]	Uncertainty evaluation of camera model parameters	G. Di Leo and A. Paolillo	2011	Camera calibration is an important task for vision-based measurement systems since it estimates the values of camera model parameters. The uncertainty of these parameters is required in order to evaluate the uncertainty of vision-based final measurements. This paper deals with a procedure for the propagation of the uncertainty through calibration algorithms and mainly focuses on the algorithms for the localization of target points in calibration images. Numerical results will be reported highlighting the

				usefulness of the method in the set-up of a vision-based measurement system.
[2]	A robust layered control system for a mobile robot	R.A. Brooks	1986	A new architecture for controlling mobile robots is described. Layers of control system are built to let the robot operate at increasing levels of competence. Layers are made up of asynchronous modules that communicate over low-bandwidth channels. Each module is an instance of a fairly simple computational machine. Higher-level layers can subsume the roles of lower levels by suppressing their outputs. However, lower levels continue to function as higher levels are added. The result is a robust and flexible robot control system. The system has been used to control a mobile robot wandering around unconstrained laboratory areas and computer machine rooms. Eventually it is intended to control a robot that wanders the office areas of our laboratory, building maps of its surroundings using an onboard arm to perform simple tasks.
[3]	A stereo vision systemfor real time obstacle avoidance in unknown environment	F. Ferrari,, E. Grosso,, M. Magrassi, and G. Sandini	1990	Ground plane obstacle detection is a general problem for mobile robots. A number of different approaches have been investigated in previous research; however, none is suitable for use with an active stereo vision system. In this paper, we present a real-time approach to obstacle detection for an active stereo vision system based on plane transformation. By modeling the ground plane transformation between a stereo image pair captured by a common elevation stereo head, then identifying the related camera intrinsic parameters, we demonstrate that the ground plane

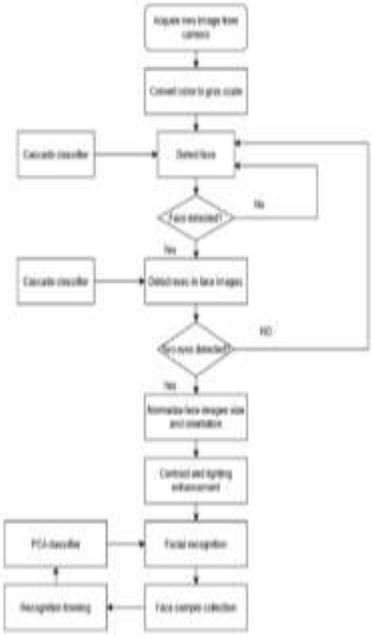
				transformation can be computed in real-time using the identified parameters and the head feedback state. Hence it is possible to use it to detect ground plane obstacles in real-time. We also show that this formulation of ground plane obstacle detection unifies previous approaches based on predicted ground plane disparities or on a predicted ground plane transformation for stereo cameras with fixed geometry.
[4]	Three-dimensional object recognition	P. J. Besl and R. C. Jain	1985	A general-purpose computer vision system must be capable of recognizing three-dimensional (3-D) objects. This paper proposes a precise definition of the 3-D object recognition problem, discusses basic concepts associated with this problem, and reviews the relevant literature. Because range images (or depth maps) are often used as sensor input instead of intensity images, techniques for obtaining, processing, and characterizing range data are also surveyed.
[5]	A Comparative analysis between active structured light and multi-view stereo vision technique for 3D reconstruction of face model surface	H. Chen and W. Cui	2020	In some application fields, such as reverse engineering or ancient cultural protection, to collect surface information from objects to generate 3D data is necessary. In this work, active structured light and multi-view stereo vision approach are compared for 3D face reconstruction. The comparison is performed by projecting coded structured light and taking multi-view images for face model. The final point cloud from each sensor is compared in terms of measurements in the scanned objects, to determine which sensor is best suited depending on the environment. For a fair comparison, a preliminary analysis of the performances of the two techniques is produced. Our results can be

				used as a reference for further comparisons in the analysis of other 3D techniques and algorithms.
[6]	A flexible new technique for camera calibration	Zhang Zhengyou	2000	Proposed is a flexible technique to easily calibrate a camera. It only requires the camera to observe a planar pattern shown at a few (at least two) different orientations. Either the camera or the planar pattern can be freely moved. The motion need not be known. Radial lens distortion is modeled. The proposed procedure consists of a closed-form solution, followed by a nonlinear refinement based on the maximum likelihood criterion. Both computer simulation and real data have been used to test the proposed technique and very good results have been obtained. Compared with classical techniques which use expensive equipment such as two or three orthogonal planes, the proposed technique is easy to use and flexible. It advances 3D computer vision one more step from laboratory environments to real world use.
[7]	3D object recognition in cluttered environments by segment-based stereo vision	Sumi, Yasushi, et al	2002	We propose a new method for 3D object recognition which uses segment-based stereo vision. An object is identified in a cluttered environment and its position and orientation (6 dof) are determined accurately enabling a robot to pick up the object and manipulate it. The object can be of any shape (planar figures, polyhedra, free-form objects) and partially occluded by other objects. Segment-based stereo vision is employed for 3D sensing. Both CAD-based and sensor-based object modeling subsystems are available. Matching is performed by calculating candidates for the object position and orientation

				using local features, verifying each candidate, and improving the accuracy of the position and orientation by an iteration method. Several experimental results are presented to demonstrate the usefulness of the proposed method.

IV. METHODS

FACE DETECTION USING HAARCASCADE



The figure above, displays the Haar cascade classifier's flowchart. The camera turns the image to grayscale once it has captured it. When a face is discovered, the cascade classifier checks to see whether both eyes are there. If both eyes are present, the classifier normalizes the size and orientation of the face picture. The picture is then subjected to face recognition processing, where it is compared to a library of face samples. Although people find it simple to identify someone by their face, vision-based automated systems find it difficult. It has been a focus of current research in a number of fields, including anthropometry, neural networks, statistics, pattern recognition, and computer vision are all related to image processing. Facial recognition and facial identification, automatic systems with vision can be utilized in a variety of commercial contexts, including interaction between humans and computers, surveillance, video games, and multi-media entertainment. Face recognition is a very accepted biometric because it is non-invasive and requires no direct physical touch between the user and the device. The four processes of face recognition using vision-based automated systems are Face detection, picture pre-processing, feature extraction, and matching are some of the techniques used.

Faces belong to a comparable because facial features such as the eyes, lips, nose, and chin generally share the same geometrical arrangement, detecting faces can be challenging. It is possible to pre-process the face image after it has been captured to correct for lighting differences.

The method of feature extraction involves assembling significant characteristics displayed on the face into a geometrical or vectorial representation. Three methods of feature extraction exist: holistic, feature-based, and hybrid. Examples of a holistic approach include fisher discriminant analysis, principal component analysis, and support vector machines. The geometric relationship of the face characteristics is the foundation of the feature-based approach. Applying an active shape model, gathered significant data from certain of the facial features. In the matching step, the characteristic

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vector can be compared to other classes (individuals) using statistical classifiers like Mahalanobis distance, Euclidian distance, Bayes classifier, and neural classifiers.

The ViolaJones object detection framework's contribution to the application of haar-features has enhanced the speed of face detection. Implementations of this framework, like OpenCV, offer many face classifiers developed by authors who used various training datasets. These classifiers' efficiency and dependability vary greatly, assessed certain classifiers' accuracy as well as their performance.

This study focuses on assessing facial classifiers in light of facial traits present in the discovered face. We propose a method that rates each facial characteristic identified in the located face with a range of values. Two separate face databases were used to assess ten face classifiers (FEI database and Yale face database).

1. Yale Face Database

The Yale Face Database features photos of 15 persons, with an average of 11 photographs taken under varied lighting conditions. The participants' faces show a variety of expressions (with glasses, sad, sleepy, surprised, wink). Each picture measures 320x243 pixels.

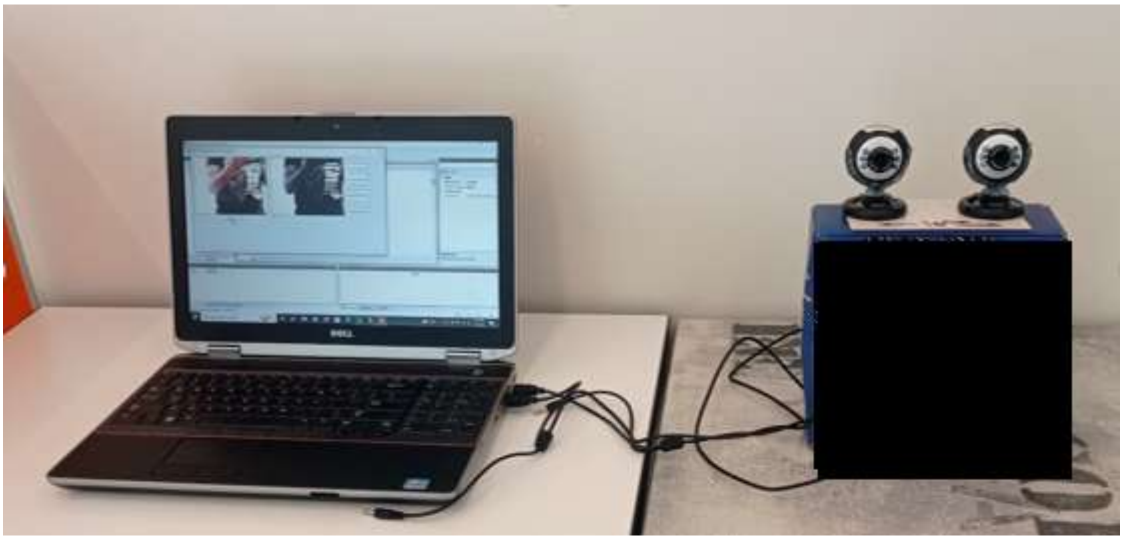
2. FEI Face Database

With a total of 2800 images, the FEI face database is a Brazilian database, 14 photographs for each of 200 different people. The photos have neutral, smiling, and non-smiling emotions and are vibrant in various rotations. With regard to both happy and frowning expressions, we used two frontal photographs of each person out of a total of 400. Each image's original dimensions are 640x480 pixels.

There are various techniques for detecting faces. The haar cascade is one of these.

A camera that is outfitted with high-tech capabilities is no longer a novel idea in this era of modern technology. The most significant advancement in the biometric system is its capacity to distinguish each component of the face as an item. Face detection is still actively being researched by locating a specific object within a digital image, then examining, comparing, and evaluating its pattern. As far as we are aware, a person's face is a genuine thing that reflects their self-identity and sets them apart from one another. To discover and index images and videos with backdrop, size, and position, face detection can be employed. It enables the system to identify a person's face in various lighting conditions.

V. RESULTS



The Machine

As shown in the figure above, the computer and cameras connected together to make up the machine. The image cameras being the capturing devices and the computer is the processing and display device.

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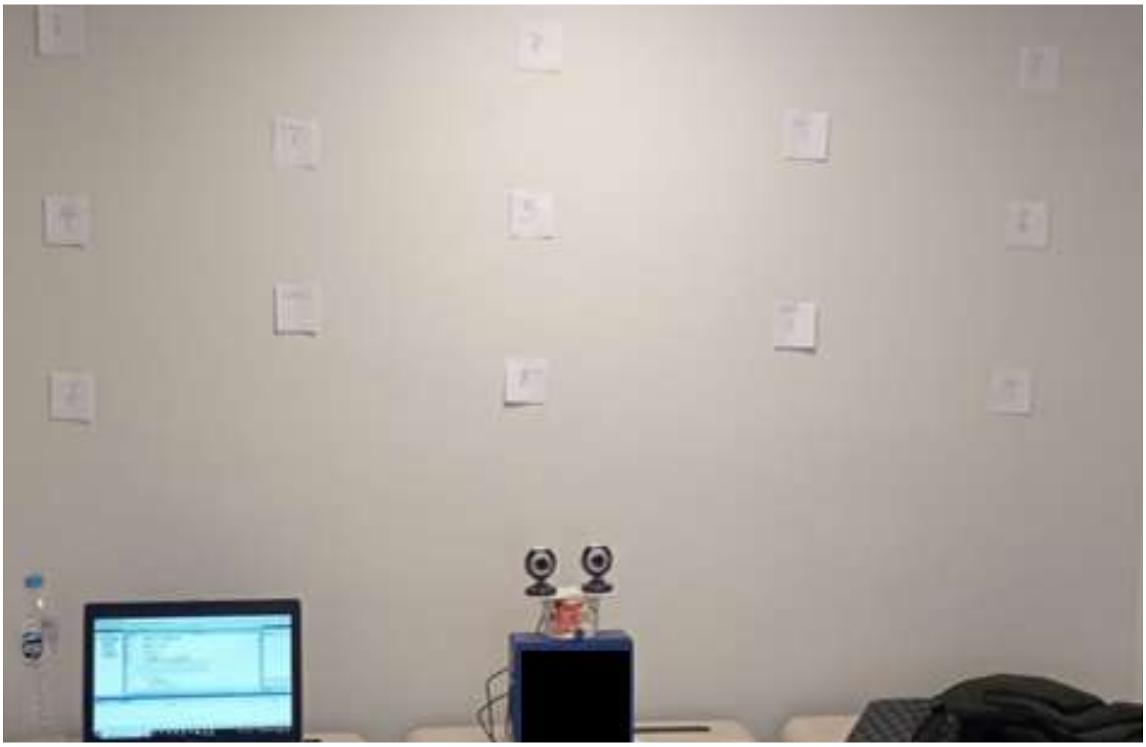
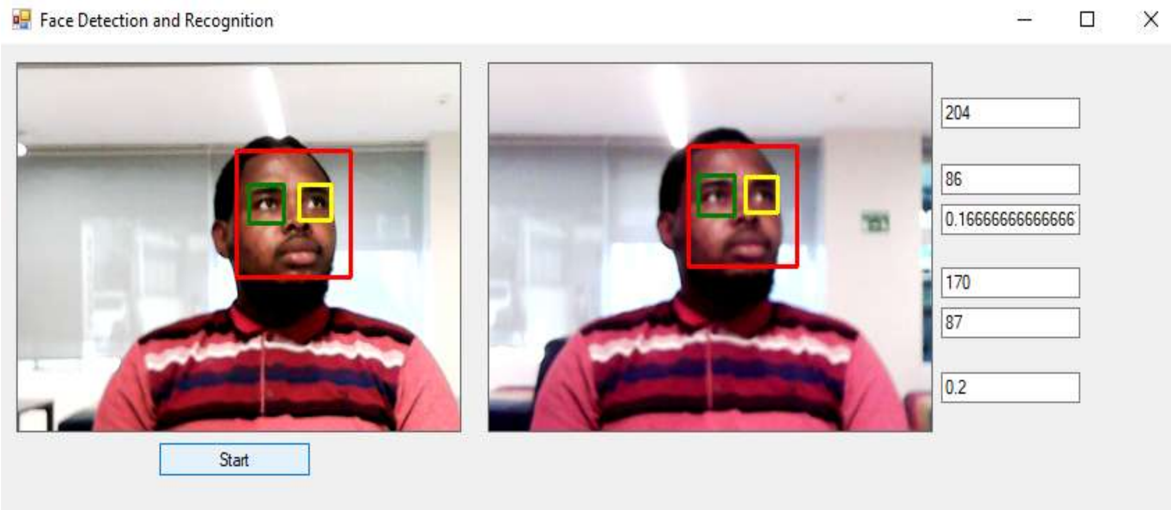
TRAINING PROCESS



Point 1 to 9 during training. Points pinned on the wall representing positions.

As shown in figure above, pinning of numbers on the wall, numbers representing positions numerically. This is a procedure during training. Point 1 to 9 are being pinned on the wall, with the midpoint of p1,p2,p4,p5 labelled as centerpoint1, the midpoint of p2,p3,p5,p6 labelled as centerpoint2, the midpoint of p4,p5,p7,p8 labelled as centerpoint3 and midpoint of p5,p6,p8,p9 labelled as centerpoint4.
Horizontal distance between points 70cm
Vertical distance between points 23cm
Each point (from 1 to 9) is being captured, calculated and the data is been saved as the output of the procedure.



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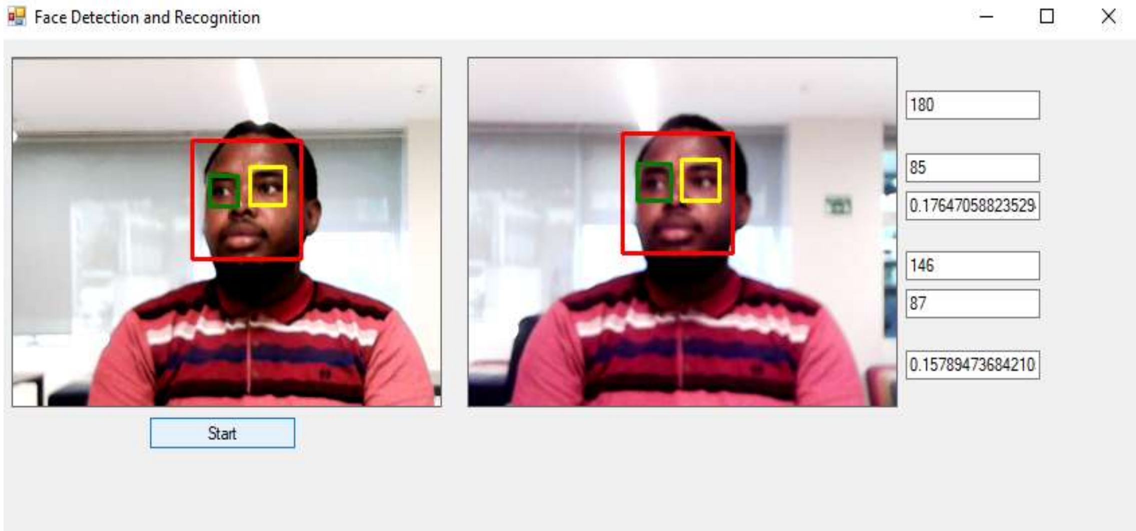

In the figures above, as shown, training procedures are being processed, the user sitting in front of the machine looking at position 1 and 9 (P1) and (P9) respectively, his face has been captured and both eyes (right and left) has been captured in the appropriate proportion and sizes. The face is been captured and indicated by a red coloured squared shape, while the right eye is captured in a green small square shape and the left eye is captured in a yellow small square shape. Both eyes differentiated by colours are in appropriate proportion and right positon. And the results are been generated.

The result gotten are represented as XYZ for the right eye and XYZ for the left eyes as shown in the text boxes. The robot captures the face and eyes, and calculates the angles with respect to movement.

For position 1, the result of the capture states;
X of Right eye = 204,
Y of Right eye = 86,
Z of Right eye = 0.1666,
X of Left eye = 170,
Y of Left eye = 87,
Z of left eye = 0.2.

For position 9, the result of the capture states;
X of Right eye = 180,
Y of Right eye = 85,
Z of Right eye = 0.1764,
X of Left eye = 146,
Y of Left eye = 87,
Z of left eye = 0.1578.

TESTING (Verification Process)

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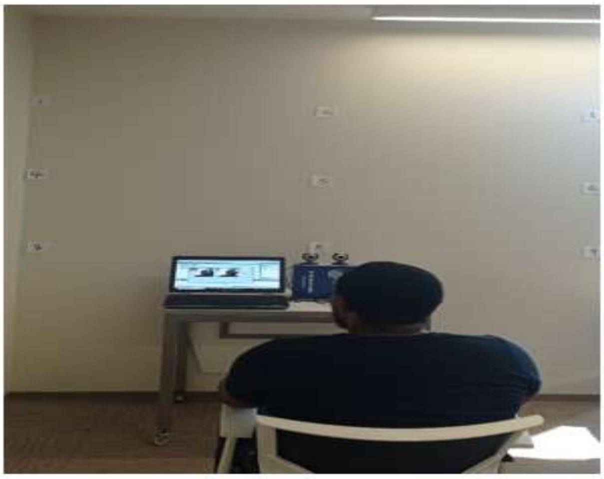

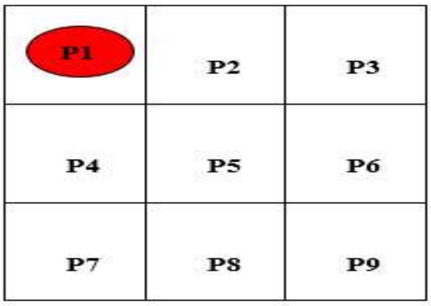

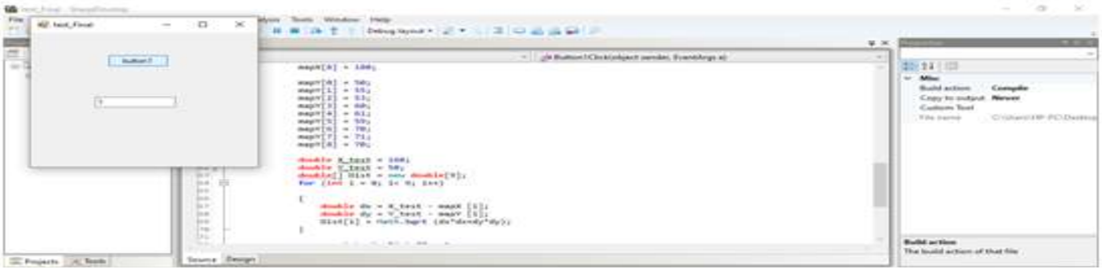

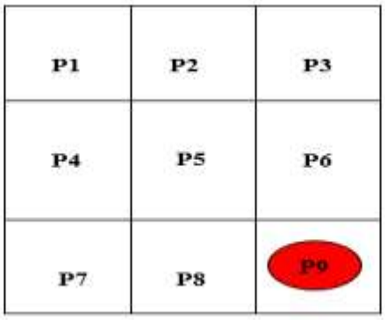

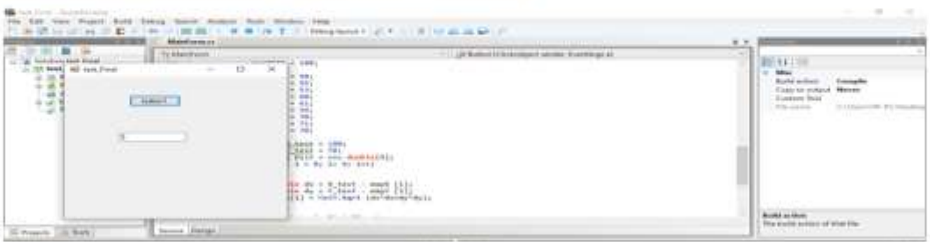

Verification process and procedure for position 1 and 9 (P1) and (P9) as shown in the figures above.
The mean of the training generated figures are been saved and the mean of the testing generated figures are been verified simultaneously on the machine, when the figures are entered and checked, the machine automatically calculates the vector and tells the possible position the user is looking at from the figures generated and inputted. From the result above 160,50 and 161,51 for position 1, and180,70 and178,74 for position 9 respectivelyare been used as the parameters and the machine automatically detected the user is looking at

position 1 because the outputs are 1 and 9 respectively.

(160,50) Position1	**(170,55) Position2**	**(180,53) Position3**
(161,60) Position4	**(172,61) Position5**	**(182,59) Position6**
(161,70) Position7	**(171,71) Position8**	**(180,70) Position9**

The table above shows the mean values for positions 1 to 9 in tabular form.

GRID MODELS

The table above is a 3-by-3 grid model of proving idea of a precise vector. More grids could be added in the future 5-by-5, 7-by-7, 9-by-9 are also model type of grid. But on this project, a 3-by-3 grid model because I have a low resolution camera, when higher resolution cameras are gotten in the future, other high grid model could be experimented. Low resolution cameras cannot give accurate eyes location, thereby cause limitations to accurate results.

The solution to this limitation is getting an higher resolution cameras. By getting those, the grids could be increased from 3-by-3 to 5-by-5, 7-by-7, 9-by-9 to get more precise vectors.
Grid numbers are meant to always be odd and not even because of the center-line.

VI. CONCLUSION

This paper studies Face detection which has received a lot of interest recently from researchers in the domains of biometrics, pattern recognition, and computer vision. Face recognition technology are needed in various security and forensic applications. As you can see, face detection technology is crucial to our daily lives. The most accurate biometric system is the face detection and recognition system. We have offered a survey of face detection methods in this post. It's great to see face detection technology being used to more products and applications in the real world. Face detection applications and difficulties were also mentioned, which inspired us to conduct face detection research. The most straightforward future line of action is to improve face identification when there are problems like facial occlusion and uneven illumination. Face recognition in the presence of occlusion and non-uniform lighting is the focus of current research in the subject of face detection and recognition. Face detection has received a lot of attention, and then not when there is a problem with occlusion and inconsistent illumination. If it does, it will greatly aid in the recognition of faces and facial expressions, among other things. Many businesses now offer facial biometrics on mobile phones for access purposes. It will be utilized in the future for things like payments, security, healthcare, advertising, and criminal identification.

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