ISSN (ONLINE): 2454-9762
ISSN (PRINT): 2454-9762
Available online at www.ijarmate.com

International Journal of Advanced Research in Management, Architecture, Technology and Engineering
(IJARMATE) Vol. 3, Special Issue 12, March 2017

Novel Vision Based Algorithm for Human Following Robot

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Abstract- Today visual tracking of objects has good importance. Since it can be use for assistance, security, office purposes. This paper presents a human following robot, which use a camera and the video frames is analyzed for detecting and tracking. Tracking of the object is done by continuously processing each frame. It will compare the reference point and current position to make error signal. Using the error signal the tracking object (in our case robot) is guided. In the proposed method, background subtraction is combined with viola-jones algorithm to initiate human tracking automatically. Since the operation is real time it need to be done in fast. Special algorithms are used for the background subtraction.

Keywords: human following Robot, object tracking

I. INTRODUCTION

Visual tracking can be used in security [1], rehabilitation in hospitals [2] guidance in museums [3], assistance in offices [4], and other military applications. In such applications, a mobile robot not only needs to detect the human but also needs to track it continuously in a dynamic environment where the usual background subtraction could not be used. It is also necessary to be able to give motion commands to the robot at regular intervals in order to maintain a continuous and smooth motion of the robot, even when the image processing may take more time than the permitted interval. In such a case, it would be necessary to predict the human location in the image plane based on an approximate human motion model [5]. The primary sensor used for human tracking in robotic applications is a vision sensor, such as a camera [6]. Vision is an attractive choice as it facilitates passive sensing of the environment and provides valuable information about the scene that is unavailable through other sensors. Owing to this fact, many algorithms have been developed that detect a human in color images by extracting features such as face [7], skin color [8], and cloth color [9] and have been implemented on mobile robotic platforms. Although the algorithms developed using a single feature (e.g., face, skin, or cloth color) are computationally effective, they fail to detect the human robustly in dynamic environment. For example, the algorithm in [10], which uses face detection for tracking a human, fails to detect a human when implemented on a mobile robotic platform. As in practical scenarios, when a robot starts tracking a human, the face is actually not available to the robot. Therefore, researchers have started to combine the multiple visual features to make the human detection robust. Darrell et al. [11] have combined multiple visual modalities for real-time person tracking. Depth information is extracted using a dense real-time stereo technique and is used to segment the user from the background. Skin color and face detection algorithms are then applied on the segmented regions.

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Figure 1: Application plan of mobile robot

Their algorithm assumes that the user will be nearest to the stereo and human face is visible to the robot. Gavrila [12] has presented a multi-cue vision system for the real-time detection and tracking of pedestrians from a moving vehicle. The algorithm integrates the consecutive modules, such as stereo-based region of interest (ROI) generation, shape-based detection, texture-based classification, and stereo-based verification. The algorithm has high computation time as stereo is used for disparity map generation. In the literature, the human detection algorithm developed by Dalai and Trigs is one of the most robust algorithms. They have used histograms of oriented gradient (HOG) descriptors and a support vector machine classifier to detect the human. Although the algorithm is robust, its high computation time limits its application for real-time systems. In, Li et al. have proposed the integration of multiple vision models for robust human detection and tracking. They have combined the HOG- and stereo-based human detections, through mean-shift tracking. Combining the multiple vision models makes the human detection robust, but simultaneously increases the computation cost of the system. To meet the real-time requirements of human tracking, most existing systems employ either a laser sensor or combine the laser sensor information with the color camera information.

II. PROPOSED METHOD

In the proposed approach, the robot is assumed to be initially static; therefore, background subtraction can be applied for the initial human detection. We have used a Gaussian mixture model for background, which gives satisfactory performance in indoor environments. The moving objects are detected by comparing each new frame with it. And thus we get idea about moving object. Then we apply viola-jones algorithm. The Viola–Jones object detection framework is the first object detection framework to provide competitive object detection rates in real-time proposed in 2001 by Paul Viola and Michael Jones. Although it can be trained to detect a variety of object classes, it was motivated primarily by the problem of face detection. This algorithm is implemented in matlab as vision.Cascade Object Detector.

```
function [ ] = Viola_Jones_img( Img )
%Viola_Jones_img( Img )
% Img - input image
faceDetector = vision.CascadeObjectDetector;
bboxes = step(faceDetector, Img);
figure, imshow(Img), title('Detected faces');
hold on
for i=1:size(bboxes,1)
    rectangle('Position',bboxes(i,:),...
        'LineWidth',2,'EdgeColor','y');
end
end
```

Figure 1:Matlab code for face detection using viola- jones algorithm

The camera in the robot will constantly monitor the objects and can find the moving objects by monitoring adjust and frames. Look the block diagram for details about background subtraction algorithm.

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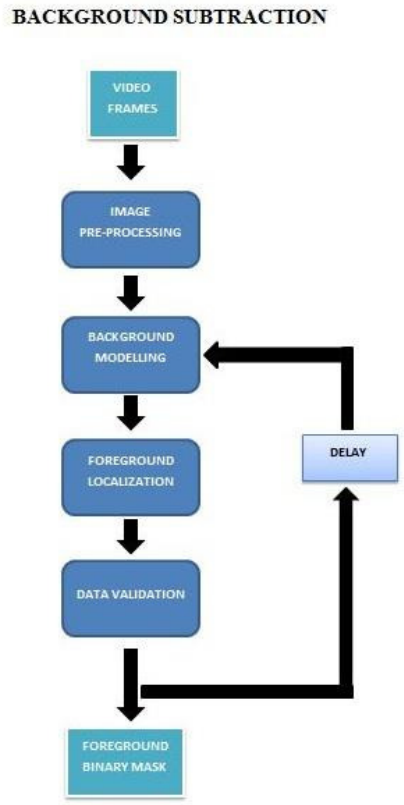

Figure 2: background subtraction algorithm block diagram.

The snapshots taken by matlab will analyze for human body using viola Jones algorithm. The viola jones algorithm working will be look shortly. After the upper body detection systems output will be a bounding box consisting the upper body part. The center of the bounding box is put as reference and will compare with the next frames bounding boxes center. And from the changes of center points we got the idea about the objects motion
.it can be treat as error signal to the microcontroller to control the robots motion. The microcontroller used is atmega32A and RS232 protocol is used for the communication between robot and matlab.

III. VIOLA JONES ALGORITHAM

The Viola-Jones algorithm uses Hear-like features, that is, a scalar product between the image and some Hear-like templates. More precisely, let I and P denote an image and a pattern, both of the same size N ×N. it's features were compared to get the body detection .In matlab using the command vision. Cascade Object Detector we can detect eyes, nose, mouth, face, upper body consisting head and shoulders can be detect.

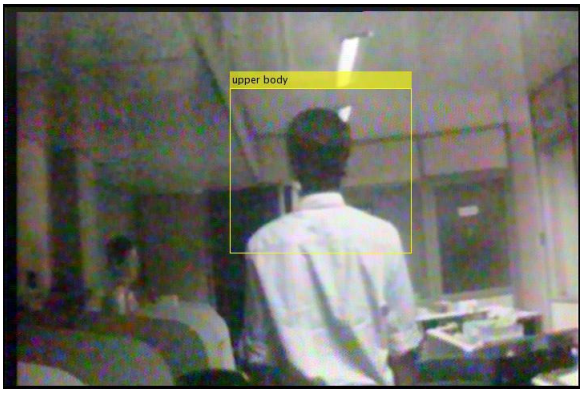

Figure 3: A person detected using viola-jones algorithm.

To compensate the effect of different lighting conditions, all the images should be mean and variance normalized beforehand. Those images with variance lower than one, having little information of interest in the rest place, are left out of consideration.

Figure 4: Haar-like features. Here the background of a template like (b) is painted gray to highlight the pattern's support. Only those pixels marked in

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black or white are used when the corresponding feature is calculated.

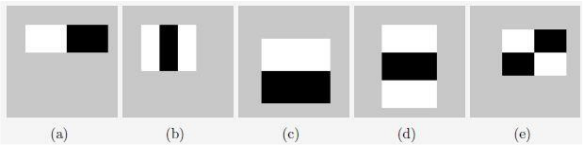

Figure 5: Five Haar-like patterns.

In above figure each pattern is laid above the figure to get eyes, nose, and mouth like features. The viola jones uses a pre image to compare with original image.

IV. EMBEDDED SYSTEM

It uses an atmega32A controller to control the following robot. It has 2KB ram and 32KB programming memory. Which works on voltage ranging from 3.3V to 5V? The control signal to the robot is given wirelessly the matlab and wireless module is communicated on the basis of RS232 protocol. Zigbe used as a wireless module. It use 2.5
GHz carrier to modulate the message bit stream. A serial port object is created in matlab to communicate with the robot. The direction commands given to the robot will check and necessary moving instructions will generate. The robot supposed to follow a human so it need to move forward, turn left and right. L293D is a motor driving IC which used to control the robot. It consists of 2 h bridge so that it can control 2 motors indecently. 12V 60 rpm geared dc motors are used so that it can deliver sufficient mechanical power.

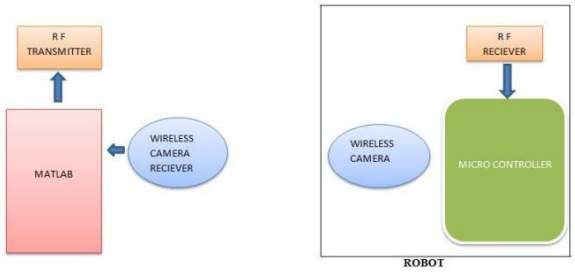

Figure 6: system block diagram.

In the above system there is a moving robot. The robot is used to follow the human. The camera is placed on the robot. It is a wireless camera which can deliver signals up to 100 meters. The signals from it are analyzed using matlab for detecting the objects movement. Using that necessary commands are given to robot using zigbee.

V. CONCLUTION

A human following robot is introduced in this paper which can be used for security purposes, as a guide for visitors. The humans are detected using viola-jones algorithm. The proposed method is worked out and it is found to be good. Using wireless camera the system have able to find out the human and its motion to follow the human.

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