Real-time detection and tracking of human based on image processing with laser pointing

Mr. B. Karthikeyan M.E, (Ph.D) Associate Professor
Department of Electrical and Electronics Engineering
S.A. Engineering College (Anna University)
Thiruverkadu, Chennai – 600077, India
karthikeyanb@saec.ac.in

Mr. Lakshmanan. R
Department of Electrical and Electronics Engineering
S.A. Engineering College (Anna University)
Thiruverkadu, Chennai – 600077, India
lakshmanan71999@gmail.com

Mr. Kabilan. M
Department of Electrical and Electronics Engineering
S.A. Engineering College (Anna University)
Thiruverkadu, Chennai – 600077, India
kapiladithya11@gmail.com

Mr. Madeshwaran. R
Department of Electrical and Electronics Engineering
S.A. Engineering College(Anna University)
Thiruverkadu, Chennai-600077. India
madeshr681@gmail.com

***Abstract*—Real-time detection and tracking of a moving human task are sorts of challenging if the camera itself is moving or place, also with tracking and detection, we are going to point the human using a laser that is present on the system itself. This paper displays an execution of real-time detection and tracking of a human with 360 degree rotating camera and a stationery camera. Adaption of various tracking of object algorithms and their effect on Execution and implementation is also presented. The system explained in this paper has a camera, which is connected to an embedded system (raspberry pi board). This embedded system or Raspberry pi board runs an image processing algorithm, which identifies a person and then keeps tracking the person as long as it's within the sight of the camera. Otherwise in the video, the person is tracked when the camera is fixed as stationery. If the object being moved, the raspberry pi gives a signal to the stepper motor to rotate the camera for 360 degree tracking and also the laser points the person simultaneously.**

Keywords—Image processing, Object detection and tracking, opencv(open source computer vision), python, raspberry pi.

I. INTRODUCTION

Moving object detection is very important for all kinds of surveillance systems. A stationary camera can identify and follow an object as long as it is present inside the camera frame. Except if the object moves out of the frame, the camera stops following it, which is a significant disadvantage for the utilization of a static or stationary camera. This difficulty can be succeeded by employing a revolving or moving camera. This work illustrates a system within which a camera rotates consistent with the trail of an advancing object and tracks it. The work is additionally connected to a monitor or computer by which the user can keep an eye on the object movement.

To track and follow an object during a live video an embedded board that runs a simple algorithm is employed to trace and control the motor direction.

An object detection system aims to determine the object position within the image classification when the object is presented within the frame. Added with the supported application it should also determine the detailing of the data like orientation, area, and object shape. Likewise, the objective of an object tracing is to follow the identified object in every frame. It is a sort of challenging work. If the object travels away from the camera frame, then the camera has to advance in that path to follow the object as far as it gets to disappear from the vision of the camera. If the object comes in the frame of the camera, then it should be recognized and followed again, and also the tracked object is pointed by the laser mounted on the work setup. Object obstruction should be managed properly. Due to advancements and growth in the latest technology, the availability of cheap prize camera's in the market will increase the fulfillment of this sort of work at a low budget. And also it will become practicable.

For this we have taken an embedded board which can process real time data like video. There are many boards in the market which can do the process. So we went to the single board computer called Raspberry Pi which has GPIO's for connecting motors and USB ports for connecting cameras.

This board has an ARM based processor which supports various embedded operating systems. But we are going to use a linux based operating system called Raspian and also we are going to use python as a language for coding the board.

Using an open source computer vision library we are going to track and detect the object[7]. Open source computer vision library is launched under a certification of BSD and also it is free for both academic and commercial use in industries[7]. It

has C++, C, Python and Java programming interfaces and it also supports various OS like Windows, Android,etc. It was designed for computational expertise and with a robust target real-time applications.
Then we are fixing two stepper motors for tracking the object in x and y direction.
For object tracking we can use many different types of algorithms and also some algorithms use OpenCV libraries

II. METHODOLOGY

Raspberry Pi requires an image processing algorithm for the tracking of an object. Hereabouts we use object tracking using dominant color algorithms to trace and follow the object in a live video stream. This algorithm will use OpenCV libraries.

A. Object Tracking using Dominant Color

It is an algorithm which is developed by employing the open source computer vision library. It can be quickly and effectively run in embedded board platforms. Also, this algorithm uses low processing speed and limited RAM.

This algorithm uses dominant color to detect and track an object in the video frame.

Dress Recognition

The proposed segmentation method involves formulating several masks and employing these masks to the depth and Red Green Blue(RGB) images. The dress mask i.e the ultimate mask is connected to the Red Green Blue image to subdivide the color data of the dress of the followed human. This method executes the use of the person index data that is deliberately covered by the Kinect sensor within the image. The depth mask is the first mask and it is created by iterating over the depth image from the Kinect and calculating the person index value of each picture element; if the person index is a non-zero, it means they belong to the tracked person, the corresponding picture element in the depth mask is formed to 255 which is white and otherwise, it is fixed to zero which is black.

The polygon dress mask is the second mask and is developed completely from the data streamed from the joint spatial of the tracking algorithm using Kinect. While the depth mask establishes every player picture element by not selecting between non-zero player index values, the second mask will put on a 'player' distinct mask. The user can determine which 'player' is the person of importance and the mask will be imposed exclusively to that detailed person. The body of the shirt polygon is characterized. Dress polygon vertex positions in the image plane UV are taken from the joint coordinates reappeared from the Kinect's tracking algorithm and it is reconstructed into the co-ordinates UV of the Red Green Blue image plane.

Polygon dress and the corresponding links from which the polygon is developed[11]. The polygon dress mask is created by allocating a value of 255 that is for all white to all picture elements inside the polygon dress and a value of zero is for the black to every picture element's exterior to the polygon (the background). This mask will create a black and white image with a polygon dress of the particularized individual shown as white picture elements and others like black. As this approach is defined by considering the particular person is planned to be tailed or followed, during the 'dress segmentation' process the body of the person will be mostly looking at the sensor in the path where all eight joints are detectable.

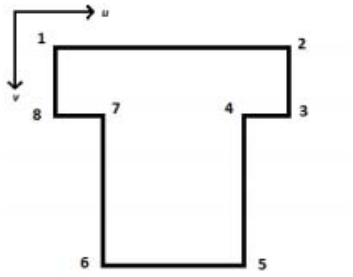


Figure 1. The Shirt Polygon Vertices

Vertex	*u*	*v*
1	Right Elbow	Shoulder Centre
2	Left Elbow	Shoulder Centre
3	Left Elbow	Left Shoulder
4	Left Shoulder	Left Shoulder
5	Left Shoulder	Left Hip
6	Right Shoulder	Left Hip
7	Right Shoulder	Right Shoulder
8	Right Elbow	Right Shoulder

Table 1. Shirt Polygon Mask Vertices Points

B. Stepper Motor Algorithm

Two types of algorithms are created for tracking an object using the stepper motor from the live video stream. These two approaches have a stepper motor hooked up to the general-purpose input-output pins of the raspberry pi board. For an accurate camera position, half-stepping is used in a stepper motor[8].

Boundary based object Tracking

Here in boundary based object tracking the object coordinates matches with the boundary. If the object moves away from the borderline, then the motor starts to rotates in the path of the moving object[8]. The main preference of this algorithm is that the work of the processor on the coordinates of object and comparison of boundary is less.

Centre based object Tracking

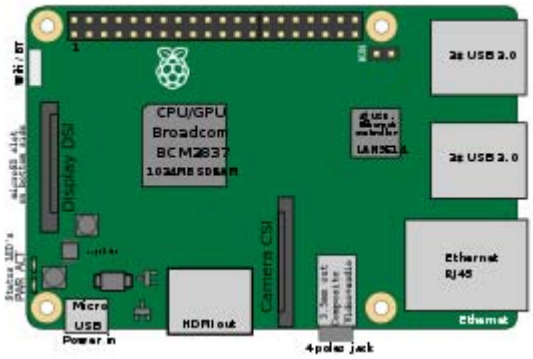
The object will be forever in the middle part of the video frame when we use this algorithm. Whenever the object tries to change, the stepper motor rotates and keeps the object in the center part of the video[8]. Thus the object will be

forever in the middle part of the video stream. Boundary based object tracking algorithm is not more efficient than this. Because the object will be at the middle for any occasion, so the occlusion of the object is minor. But the comparison becomes a bit complicated and processing will become high[8].

III. COMPONENTS

A. *Raspberry Pi*

The Raspberry Pi model 3b+ is a series of miniature single-board computers acquired within England by the Raspberry Pi Foundation. Processor speed of 700 MHz to 1.4 GHz and on-board memory of 1gb ram. And it has bluetooth and Wi-Fi on board. It has 28 GPIO pins and 4 USB slots. Also it has an ethernet and HDMI slot for display and internet purpose.



B. *Stepper Motor*

A stepper motor is a Direct Current (DC) motor that subdivides a full revolution into a variety of proportionate steps. The motor's location can then be given to move and hold at one of these steps without any position sensor for feedback like an open-loop controller, as long as the motor is used for the application in respect to torque and speed

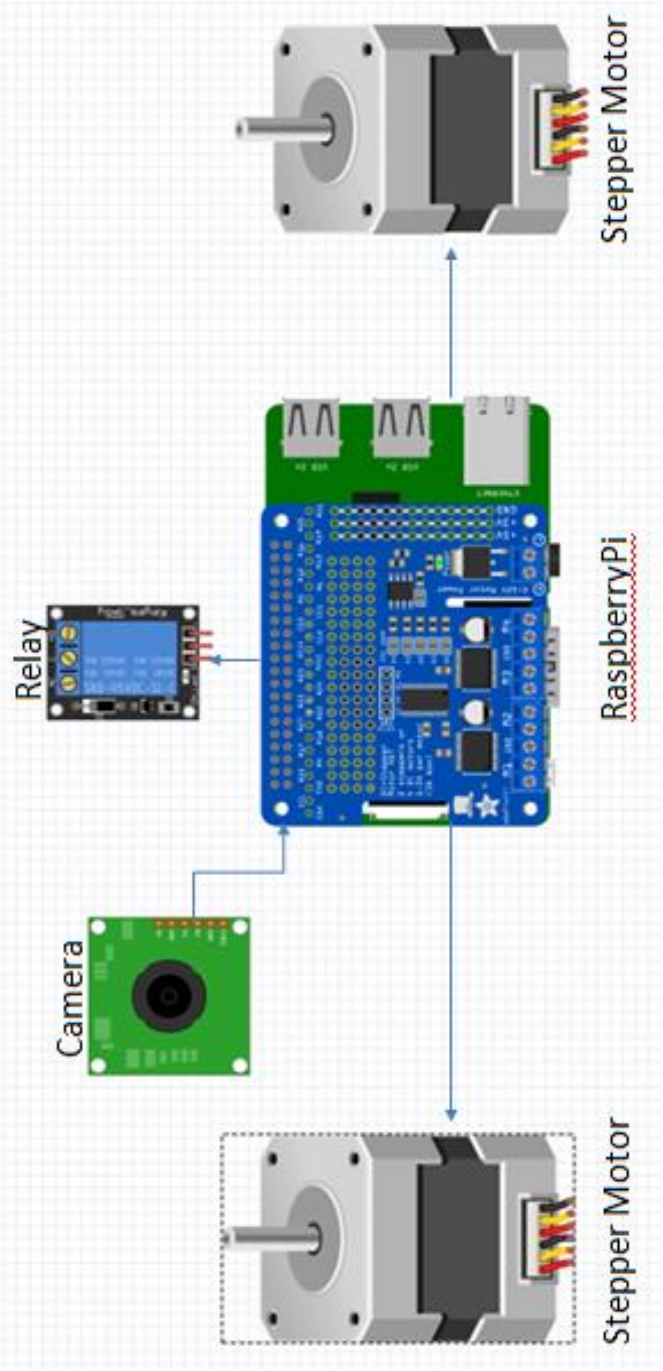
C. *Adafruit Motorshield Hat*

This is excellent for any kind gesture project as it can operate up to 4 direct current or 2 stepper motors with full pulse width modulation speed control. Raspberry Pi and motors aren't incorporated since the Raspberry Pi doesn't have many pulse width modulation pins, we use a fully-devoted pulse width modulation driver chip on board to control both motor path and speed. This chip deals with all the motor and speed controls over the integrated circuit. Only two General Purpose Input/Output (GPIO)pins (Serial Data & Serial Clock) are needed to drive the numerous motors, and since it's the integrated circuit you'll also connect the other integrated circuit devices or Hardware Attached on Tops (HATs) to the same pins. In fact, you'll even stack various Motor Hardware Attached on Tops, up to 32 of them, for governing up to 64 stepper motors or 128 direct current motors. Motors are controlled TB6612 metal oxide semiconductor field effect transistor (MOSFET) driver: with 1.2A per channel current capability, a huge advancement over L293D drivers and there are built-in flyback diodes as well. If connecting the hardware attached on top off-the Pi via jumpers, you'll need to connect ground and three 0.3v additionally to serial data and serial clock. We have even a bit of space so we added a polarity protection Field Effect Transistor (FET) on the power pins and a small amount of prototyping area. And the hardware attached on top is assembled and tested here at Adafruit so all you have to do is solder on the constituted 2x20 plain header and the terminal blocks[13].

D. *Camera*

We can use either a normal web camera or also we can use a raspberry pi camera.

IV. CIRCUIT DIAGRAM



In this system, we are going to connect the laser through a relay. So, the laser turns on and points whenever the human is detected and tracked by the camera. We have also attached two Stepper motors with raspberry pi through Adafruit-MotorHat for the rotation of the system. The above mentioned block diagram shows the connection of our system.

V. COMPARISON

	Existing System	Proposed System
Getting Ready	*3 Seconds*	*Expected for 2 seconds.*
Rotation Speed	*3.8 seconds*	*Expected for 2.5 seconds.*
Range	*500 meter*	*For the prototype we are expecting a range of 20 meters and the complete model can have 1km range.*
Elevation	*+85˚ to -25˚*	*Based on the resolution of camera footage.*
Transverse	*360˚*	*360˚*
Accuracy	*85%*	*Expecting 90% or above.*

VI. CONCLUSION

This work presents the outlining and improvement of human tracking and detection for security applications. The hardware of the suggested work system including both the mechanical part and the embedded system is based on easily available materials, making it a cheaper option for low-budget products or applications. We are able to redefine it with n number of modifications like with 3D cameras also with face recognition or object recognition. Also, we can add voice recognition passwords. It is often an open-source project work then possibly this is an honest place to find on AI algorithms to enhance the tracking and detection performance.

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