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An Autonomous Vision Based Object Tracking Robot

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Abstract--The aim of this project is to detect a specified object and then track it based on the color of the object. This is a real time vision based project, where video is continuously captured with a camera located on the robot chassis. The camera is connected to the Raspberry Pi. Object detection in videos involves verifying the presence of an object in image sequence and possibly locating it precisely for recognition. A robot is designed which can be controlled by the Raspberry Pi. This robot is used for tracking purpose left or right and forward or backward according to the object movement. Here only a single object is detected. The motion of the robot can be viewed from a computer connected with the Raspberry Pi through Wi-Fi. Robust image processing algorithm is developed to recognize and detect the target object.

Index Terms--Object Detection, Object Tracking and Open CV.

1 INTRODUCTION

AFTER several attempts, a fully autonomous machine appeared only in the 20th century. This led to the evolution of the robotics in modern era. Nowadays, reduction of human source for surveillance system is aimed. This is done with the help of fast processing videos. Many smart systems serve this purpose. Spotting suspected cars and people, smart traffic control systems, unmanned surveillance are few applications and examples can be increased in the areas of space, military, urban security application and medicine. Additionally, it provides input to higher level vision task such as 3D reconstruction and 3D representation. It also place an important role in video database such as content- based indexing and retrieval. There has been considerable studied for object tracking for specific purpose. This object can be either in motion or not. When human operators monitor a real-time video, they might miss an important event due to boredom. These facts strengthen the importance of automated visual surveillance. Real-time motion detection and color recognition of moving image is a fundamental in many vision systems.

2 VIDEO CAPTURING

The object to be tracked is captured using Logitech HD webcam C270. This camera captures upto 1280*720 pixels videos. This Logitech webcam software supports motion detection which is required for tracking applications. The video is captured continuously using the camera and sent to the raspberry pi for processing. The processed video is used to detect the object based on its color and shape. In this paper, color-based object detection is used. Color provides essential information for object recognition. The importance of color for image processing is very high. Fig.1, illustrates the camera of the system used.

Fig.1, Camera of the system

3 SYSTEM DESIGN

3.1 Hardware Design

The proposed system is designed with five hardware that are Webcam, Moving Robot, Motor Driver, raspberry pi along with the power supply unit. When the object moves, motion information of the specific object is sent to the motor driver with the help of raspberry pi. The motor driver controls the motors which are placed on the platform where the camera is placed. Fig.2, illustrates the block diagram of the object tracking robot.

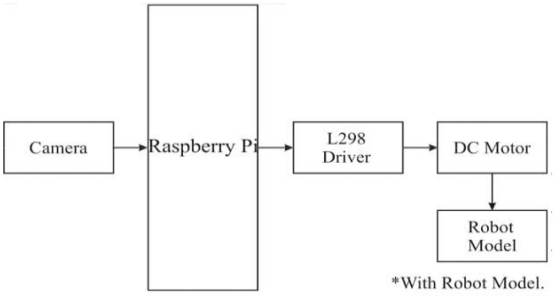

Fig.2, Block Diagram of the object tracking robot

The Raspberry Pi is a series of credit card sized board computers. There are currently five Raspberry Pi models that is the model B+, the model A+, the model B, the model A and the computer module. All module uses the same SoC (System on Chip- combined CPU and GPU), but hardware features differ. Image processing is done using Raspberry Pi.

The features of the raspberry pi are low cost, low power, high availability and high reliability. Image processing is done using raspberry pi3 model B. Fig.3, illustrates the raspberry pi of the system.

Fig.3, Raspberry Pi of the system

Since all electronic circuit work only with low DC voltage we need a power supply unit to provide the appropriate voltage supply. This unit consists of a regulator. The output from a 12V battery is given as the input to the regulator. A regulator circuit uses this DC input to provide regulated 5V to the raspberry pi. The obtained DC voltage that not only has much less ripple voltage but also remains the same DC value even though DC voltage varies somewhat, or the load connected to the output DC voltages changes. Fig.4, illustrates the power unit of the system.

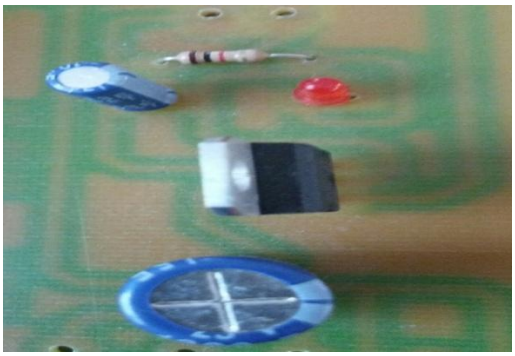

Fig.4, Power unit of the system

Motor driver ICs are primarily used in autonomous robotics only. L298N is a motor driver which enables us to control two different motors with their velocity and turning directions separately. L298N also has two different input voltages (5V12V) to drive motors. Fig.5, illustrates the driver circuit of the system.

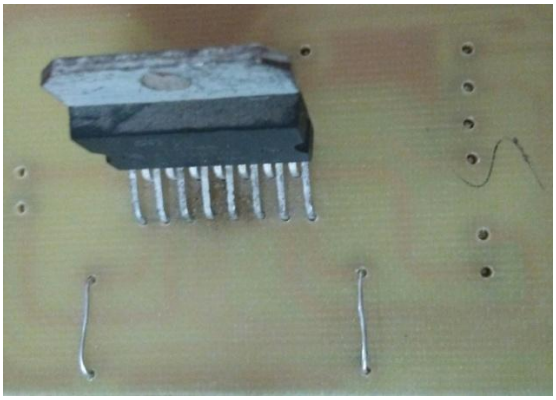

Fig.5, Driver circuit of the system

The L298 is an integrated monolithic circuit in a 15-lead Multiwatt and power SO20 packages. It is a high voltage, high current dual full- bridge driver designed to accept standard TTL logic levels and drive inductive loads such as relays, solenoids, DC motor and stepper motor. Two enable inputs are provided enable or disable the device independently of the input signals. The emitters of the lower transistor of each bridge are

connected together and the corresponding external terminal can be used for the connection of an external sensing resistor. An additional supply input is provided so that the logic works at a lower voltage. Fig.6, illustrates another driver circuit of the system.

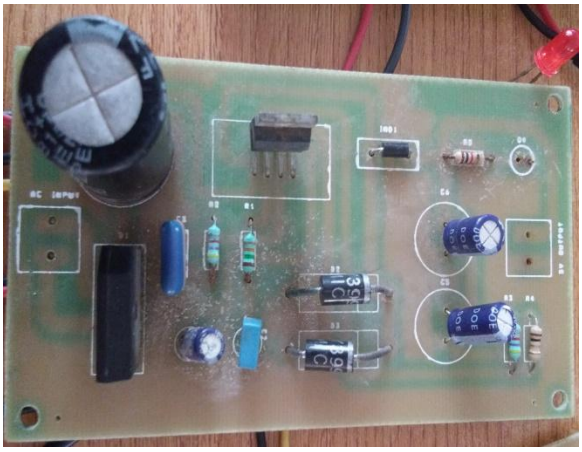

Fig.6, Driver circuit of the system

The features of the driver circuit consist of operating supply voltage up to 46V, low saturation voltage, total DC current up to 4A, logical input voltage up to 1.5V(high noise immunity) and over temperature protection.

3.2 Software Design

The operating system used in the raspberry pi is Raspbian Jessie which is an updated stable version of Debian. The algorithm for object detection and object tracking is written in python language. Initially, the lower and the upper boundaries of the color green in the HSV color space are defined. These color boundaries will allow the detection of the green ball in front of the camera.From this the access to the camera point is grabbed. Then the reference to the webcam is done. A call was made to the read method of the camera pointer which returns a 2- tuple. The first entry in the tuple is a Boolean indicating whether the frame was successfully read or not. The frame points the video frame. The frame is resized to have a width of 600 pixels for fast processing. The frame is converted into HSV color space. Actual localization of the green ball is handled by making a call to the cv2.inrange(). The output of the cv2.inramge() is a binary mask. The contour of the green ball is drawn and the centroid located. There is a variation in the pixel values according to the direction of the motion of the object. This pixel variation aids in detecting the direction in which the object is moving. Further any small blobs that are left on the mask are removed. The detected object can be viewed on the computer. The contour and the centroid of the object are drawn on the computer. After detecting the object the robot moves according to the location of the object. Finally any key presses are detected and then the camera pointer is released. The video frame captured by the camera can be viewed on the computer connected with the raspberry pi through Wi-Fi. Fig.7, illustrates the flow chart of the proposed object tracking algorithm.

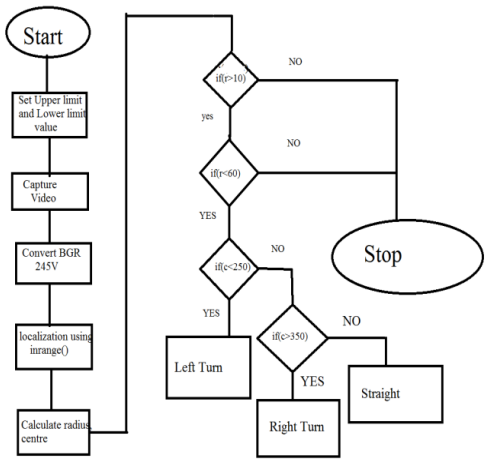

Fig.7, Flow chart of the object tracking system

4 EXPERIMENTAL SETUP AND RESULTS

An iron setup attached to the wheels is developed. The object to be tracked which is a green ball in this case was placed at various distances. The robot was able to detect and track the object when it was 35 cm away from the robot. Thus a positive result was obtained. Further, when the ball moved away from its initial position the robot also moved according to the ball in either left or right direction. Fig.8, illustrates the experimental setup of the object tracking system.

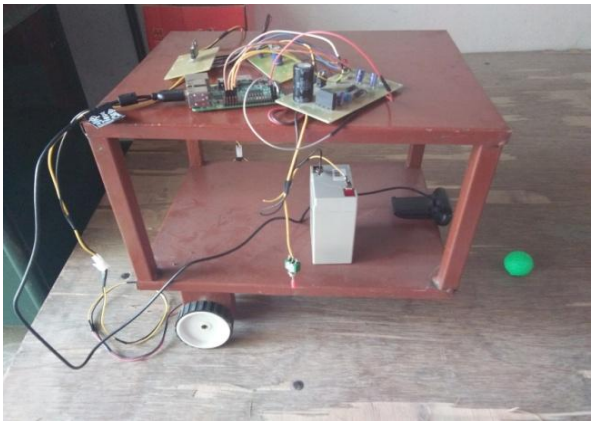

Fig.8, Experimental setup of the object tracking system

5 CONCLUSION AND FUTURE SCOPE

In this paper, real- time moving object detections and tracking system is presented. This system is an efficient and autonomous combination of detecting and tracking. The system uses a simple algorithm based on pixel variation to detect and track the specified object. The designed system can be used for security purposes. Multiple and multicolored objects can be detected by modifying the algorithm in future.

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