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Real Time Object Tracking System

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Abstract:
Tracking objects in video sequences is a central issue in many areas, such as surveillance, smart vehicles, human-computer interaction, augmented reality applications, and interactive TV etc. It is a process that always involves two steps: detection and tracking. A common approach is to detect the object in the first frame and then track it through the rest of the video. Video Tracking is the process of locating a moving object over time using a camera module. The objective of video tracking is to associate target objects in consecutive video frames. The association can be especially difficult when the objects are moving fast relative to the frame rate. Another situation that increases the complexity of the problem is when the tracked object changes orientation over time. For these situations video tracking systems usually employ a motion model which describes how the image of the target might change for different possible motions of the object. In this project an algorithm is proposed to track the real time moving objects in different frames of a video with high accuracy and efficiency.

Keywords: Camera module, Classification, Detection, Real time video, Tracking.

I. INTRODUCTION

Tracking can be defined as the problem of estimating the trajectory of an object in the image plane as it moves around a scene. There are three key steps in tracking namely video analysis, detection and classification of interesting moving objects, tracking of such objects from frame to frame, and analysis of object tracks to recognize their behavior. Our main aim is to track the real-time moving objects in different video frames with the help of a proposed algorithm. Different methods of tracking exist utilizing different characteristics e.g., shape, texture, or color, etc. The tracking methodology discussed in this paper is focused on locating and tracking an object on the basis of color.

II. TOOLS USED

Hardware Specifications

The system requires some hardware components such as Raspberry pi, Raspberry Pi camera module, Power supply, Ethernet cable, SD card, DC motors, Motor driver IC, Wheels.

- Raspberry pi: The design of this model uses Raspberry pi 2 (model B). It has upgraded Broadcom BCM2836 processor which has ARM Cortex A7 based quad core processor and CPU of 900MHz with a memory of 1GB RAM. It boots from MicroSD card, running a version of Linux OS. Other connections such as Ethernet, Video Output (HDMI), Audio Output, USB, GPIO connector are available.

- Raspberry pi camera: The Raspberry pi camera board plugs directly into the CSI connector on the Raspberry pi. The Raspberry pi camera module attaches to Raspberry pi by way of a 15 pin Ribbon cable to the dedicated 15-pin MIPI camera serial Interface (CSI) which was designed especially for interfacing to cameras. It's able to deliver a clear 5 mega pixel resolution image or 1080p HD video recording at 30frames/sec.

- Power supply: The power supply on Raspberry pi is quite simple. This uses a Micro USB connection to power itself and the micro USB connection ability of supplying at 5Volt. Probably normal mobile phone charges are appropriate and do not efforts to power of Raspberry pi from a USB port of another computer or hub because they are frequently not capable of supplying the required current.

- Motor driver IC: The motor driver IC used is L293D to drive the DC motors simultaneously. The L293D is assembled in a 16 lead plastic package which has 4 center pins connected together and used for heat sinking. The L293D is assembled in a 20 lead surface mount which has 8 center pins connected together and used for heatsinking.

Software Specifications

Software implementation of this work uses Raspberry pi and MATLAB (R2017a) software. The present model is developed in Simulink. Raspberry pi support packages for MATLAB and Simulink are used in building the model. Simulink provides an interactive graphical environment and customizable set of block libraries not only signal, image, video processing systems but also communication and control systems. Simulink let users, design, simulate, implement and test their projects.

III. METHODOLOGY

The basic block diagram of the proposed algorithm is shown in Figure 1.

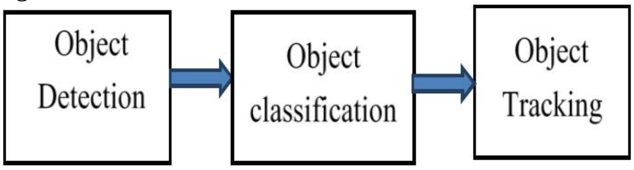


Figure.1. Basic block diagram

- Object Detection is to identify objects of interest in the video sequence and to cluster pixels of these objects. This is done by converting a RGB image into a binary image with green component. This is done by using Data acquisition and pre-processing block.

- Object can be classified as vehicles, birds, floating clouds, swaying tree and other moving objects. Here a green ball is used as an object. Thresholding and Blob analysis is done to locate the object.

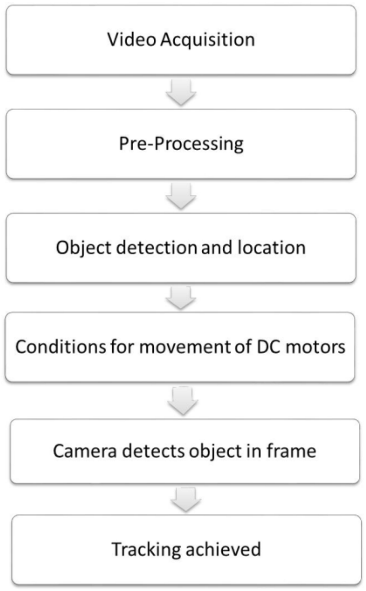
- The inframe tracking is achieved using Raspberry pi. Next the condition is given to DC motors which are attached to wheels and metal chassis. When the signal is given the whole setup moves in a particular direction. Thus object tracking is achieved.

IV. IMPLEMENTATION

The input video taken from a camera module is captured by V4L2 video capture. A block parameter in dow lows a device name, image size, pixel format and sample time to be configured. The default device name is set to '/dev/video0' in which video0 is automatically created by a Linux kernel driver once a compatible USB camera is connected to the board, however, the driver needs to be installed if using a camera module. Video viewer enables us to view binary, intensity or RGB image or a video stream. The block provides simulation control for play, pause and stop while running the model. The block also provides pixel region analysis tools. The separate RGB signals from video are concatenated to form a single multidimensional image. The RGB multidimensional image is converted to HSV plane. HSV is selected because real time videos vary with brightness and human perception of color is different. The dimensions of HSV geometries is simple transformations of the not-perceptually-based RGB model that are not directly related to the photometric color- making attributes of the same names. The minimum and maximum value for each channel of HSV is set which results in a binary image and a composite masked RGB image.

The morphological structuring elements perform an erosion operation followed by a dilation operation using a predefined neighborhood. Selecting the right feature plays a critical role in tracking. The feature selection is closely related to the object representation. This is done on the basis of the region properties of the object using blob analysis. Blob analysis produces the region properties of the object such as Boundingbox, Area, and Centroid. Here centroid property is used to track. Centroid of a physical object is the location on the object where the center of mass exists. We can calculate the Centroid of the binary image. The result of this operation is a set of integers which determine the position of the moving object in the given frame. Hence as the object moves different locations in the video, different values of centroid are obtained. The x mark for centroid is drawn using draw marker block. This block can draw multiple circles, x marks, plus signs, stars, squares on the image by over writing pixel values. Overwriting pixel values embeds the shape. It uses Bresenham's line drawing algorithm to draw the markers. These outputs can be viewed in video viewer block. The conditions based on coordinates of the centroid are given from Raspberry Pi to DC motor through L293D IC. Two DC motors for right and left wheel respectively are connected to the motor driver IC. The IC prevents back current from high voltage battery and protects Raspberry pi. A 9V battery is used to power the DC motors. Thus the green colored object tracking is achieved.

V. FLOWCHART OF PROPOSED ALGORITHM



VI. RESULTS

- The real time video acquired from the camera module

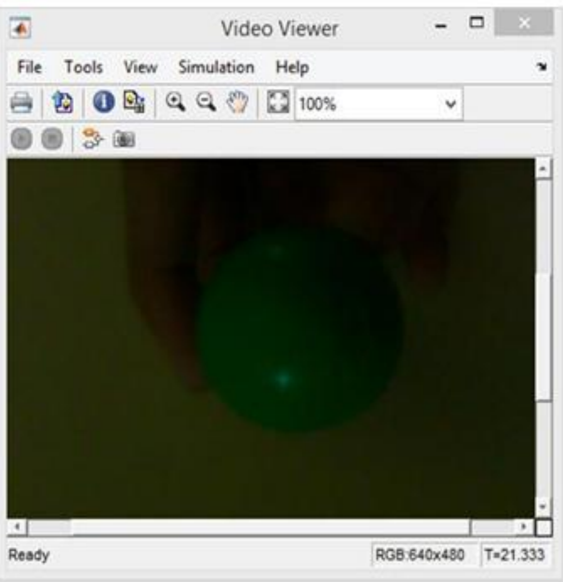


Figure.2. Input video

- **Image after erosion and dilation**

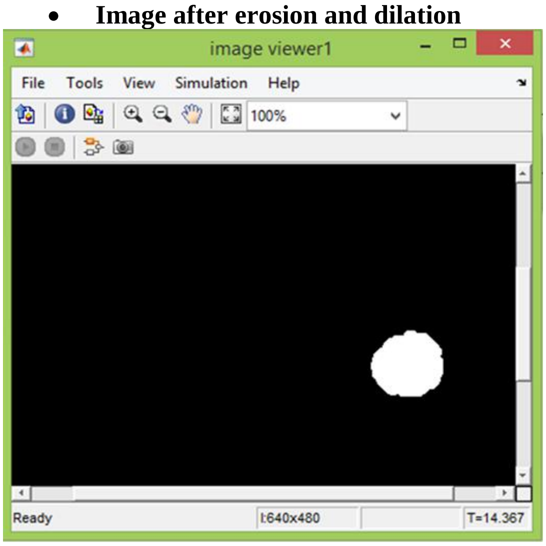


Figure.3. Image after erosion and dilation

- **Centroid marked image**

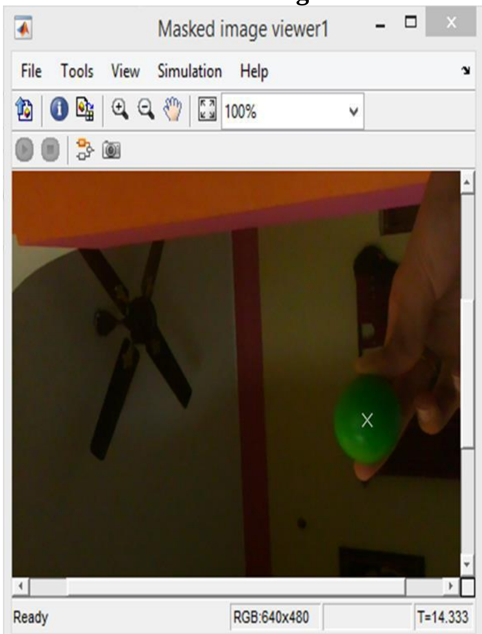


Figure.4. Centroid marked image

This algorithm is very efficient for single colored object and based on the real-time applications and its requirements this can further classified and tracked. This is a robust system because where ever the green colored object moves, the robot moves in that direction. This can be further implemented for other colored objects. This can also be done for tracking different shaped objects such as square, diamond, rectangle etc. The objective of tracking is to associate target object in consecutive video frames. It is more useful for military entertainment, sports, and medical applications and for validation of computer vision and robotics. Videos and images from open source can be accomplished and so it can be easily implemented and its usage is wider. Implementation of this methodology using Simulink blockset is more useful for security and video surveillance. This system also provides additional services such as information about the location and identity of objects at different points in time is the basis for detecting unusual object movements. Tracking the objects true position is done by tracking its state using region filtering and this uses information from the current blob and the previous object state to create an estimate of the objects new state. This work emphasis a system in which there are much scope for future investigation and analysis based on the performance on tracking the objects.

- **Robot setup**

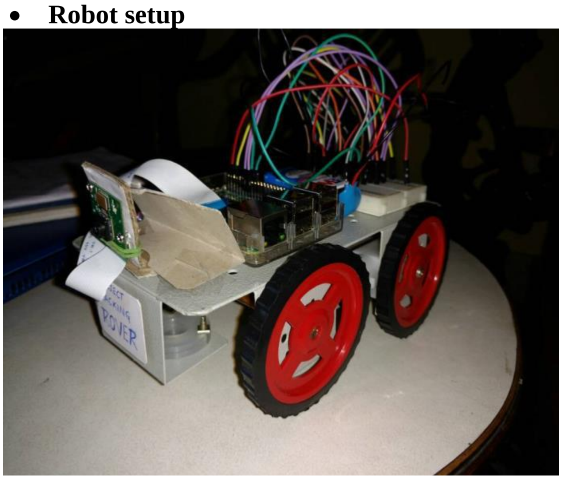


Figure. 5. Robot setup

VII. APPLICATIONS

- Automated video surveillance: In these applications computer vision systems are designed to monitor the movements in an area, identify the moving objects and report any doubtful situation. The system needs to discriminate between natural entities and humans, which requires a good object tracking system.
- Robot Vision: In robot navigation, the steering system needs to identify different obstacles in the path to avoid collision. If the obstacles themselves are other moving objects, then it calls for a real-time object tracking.
- Traffic Monitoring: In some countries highway traffic is continuously monitored using cameras. Any vehicle that breaks the traffic rules or is involved in other illegal act can be tracked down easily if the surveillance system is supported by an object tracking system.
- Industrial applications: Some of the applications are process control systems, industrial automation systems, and robotic equipment.
- Military applications: Typical defense applications of real time systems are missile guidance systems, anti- missile systems and satellite-based surveillance systems.
- This can be used in mars mission for detection of life and other rover operations. It is also used in aerospace for satellite tracking systems, security and surveillance, augmented reality, video communication and compression, medical imaging and video editing.

VIII. CONCLUSION

The proposed algorithm efficiently tracks single colored object and the system is handy, cost effective and can be extended based on requirements. Significant progress has been made in object tracking during the last few years. Several robust trackers have been developed which can track objects in real-time in simple scenarios. However, it is clear that the assumptions used to make the tracking problem tractable, for example, smoothness of motion, minimal amount of occlusions, illumination constancy, high contrast with respect to background, etc., are violated in many respective scenarios therefore limit the trackers usefulness in applications like automated surveillance, human computer interaction, video retrieval, traffic monitoring and vehicle navigation. Thus tracking and associated problems of feature selection, object representation, dynamic shape and motion estimation are very active areas of research and new solutions are continuously being proposed. May the contents discussed here can give valuable insight into this important research topic and encourage new research.

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