Live Video Colour Recognition and Object Tracking using MATLAB

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ABSTRACT

In this paper, we discuss the use of live video streaming to detect RGB colors and in the process, try to track the movements of different objects in a stationary background. This colour dependent tracking is achieved through MATLAB'S image processing toolbox. A live video is segmented and each video frame is used to detect red, blue or green colour and keep track of the object in subsequent frames using the average shift observed in the frames. The applications of this system include robotics, colour related segregation or detection, analysis and surveillance tech. devices, and security systems.

Keywords: *MATLAB, colour recognition, Image processing toolbox, Video Segmentation.*

1. INTRODUCTION

A live video is just a sequence of images projected in extremely short time intervals. Colour is a significant part of any video under detection through image processing. The segmented images consist of pixels which have a specific RGB value. The primary objective discussed in this paper is the recognition of specific colours and in the process, tracking certain objects. MATLAB'S Image Processing toolbox is used for recognition of a red, blue or green objects in a real-time video.

In the field of technology, there is a significant rise in the need for object tracking, especially in real time. This growing demand for video analysis has led to the development of several tracking and analysis algorithms. High frame rates of the high-resolution pictures present major challenges to colour recognition and object tracking.

The working of a colour and motion detection system has to be very quick for it to be successful in real time. The processing speed is a major factor for this kind of a system. A number of frames are input to the system in real time which have to be processed simultaneously. Segmentation of primary colours from the RGB frame is done for colour recognition. Segmentation of real-time sequence of images has been subject to plenty of research. The principal aspects of colour detection in a video are video and colour segmentation.

Video segmentation and tracking have opened many doors for the future, especially with the growth of Artificial Intelligence. Current applications of colour recognition and object tracking include medical imaging, traffic management, face indexing, and biometric identification. Security in sensitive areas like banks and borders can be more efficient now through video surveillance.

1.1 MATLAB

MATLAB (matrix laboratory) is a multi-paradigm, high-performance numerical computing environment. Developed by MathWorks as a programming language, MATLAB allows matrix manipulations, plotting of data, implementation of algorithms, the creation of user interfaces, and interfacing with programs written in other languages, including C, C++, C#, Java, Fortran, and Python. MATLAB contains a special image processing tool box which provides various features and algorithms. An image is a matrix of pixel values and every input is considered as a matrix in MATLAB. Therefore, pixel values of different image matrices can be accessed and changed easily.

1.2 RGB Colour Model

RGB Model is a combination of the three primary colours- Red, Green, and Blue. Diverse colours can be obtained by taking these 3 colours in different proportions. The RGB Colour Model has various applications in various image processing and rendering devices as it is hardware oriented. A unit cube can be formed by representing the RGB model using a Cartesian coordinate system.
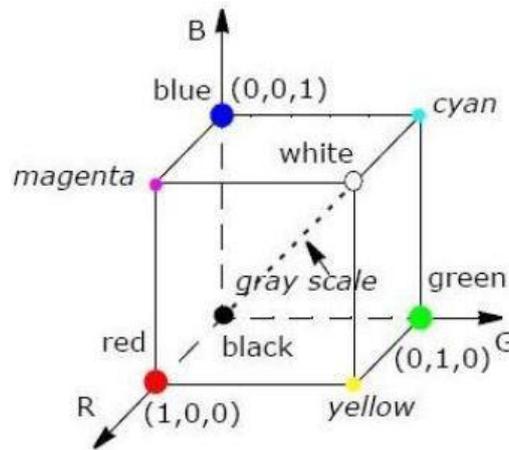
2. FLOWCHART
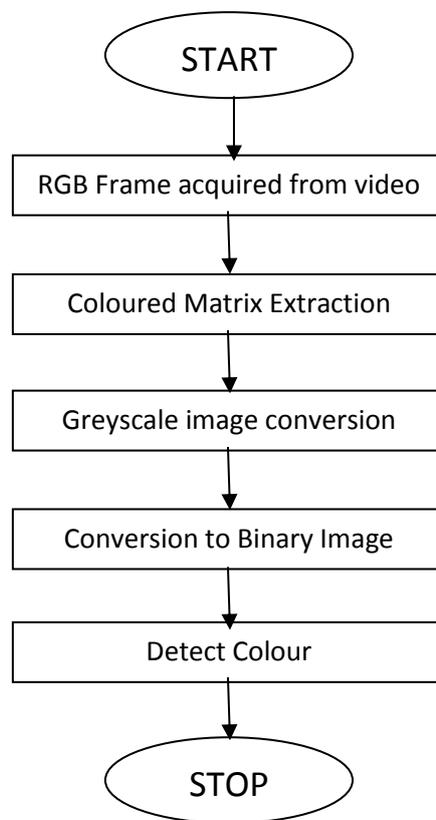
3. HARDWARE AND PROCESSORS

High computation power is needed for fast processing of the video frames. The amount of processing required per pixel depends on the image processing algorithm. The processing requirements fill increase more and more as high-resolution video qualities become more common as they have about 4 times more pixels per frame.

Image processing applications require multiple Digital Signal Processors (DSP) or a single high-end DSP for high computation loads. FPGA's can also be used in these cases for real-time image processing. FPGA's are capable of withstanding high levels of parallel-processing data flow structures, those which are essential for the systematic implementation of image processing algos.

4. METHODOLOGY

4.1 Colour Recognition

We start the colour recognition process by extracting the image from the live video. The input to the image processing toolbox's algorithm comes from the webcam or the chosen camera device. This is followed by the segmentation of the primary colours out of the multiple colours present in the acquired image. In MATLAB, image pixels are represented in the form of code. Using these codes after analysis, Colour recognition is achieved by labeling these pixels with the defined primary colours (red, blue, green). This completes our first step of acquiring the RGB framework from a real-time video source. This can further be used to extract the matrix of a particular colour.

The next step involves the conversion of the RGB frame to a grayscale frame. The grayscale format is a matrix representation of the intensity of pixels in an image. This step is basically done to simplify visualization, decrease complexity by converting the 3-D

image into a 2-D image, and most importantly to help in increasing the processing speed or frame rates, which is a potential hindrance due to the large size or resolution of the frames. The 24 RGB bits of a pixel are divided equally among the three primary colours. The bits of the required colour can be subtracted from this grayscale frame so that the desired colour is detected. This subtraction is done to obtain the components of the desired colour from the grayscale frame.

In the third step, we convert the image into binary form i.e. representing each frame pixel in the form of 0's and 1's. This is done so that the output is focused on a particular area of interest. A threshold value is set and any pixel value greater than the threshold value is assigned 1(white), otherwise, it is assigned 0(black).

Finally, a rectangular or circular pointer can be used to mark or outline the area where the desired colour is detected in the real-time video.

4.2 Object Tracking

Colour detection also requires tracking of the particular object or area which is outlined in the output. Object tracking is achieved by frame differentiation method where the delay between the current and the background frame is considered. The frame is separately taken in two parts – a foreground or object part which is the focus of our experiment and the background frame. The new or current frame and the background frame are contrasted pixel by pixel to obtain the frame differences. Usually, two or three continuous frames are used for this method. This helps in coping with the rapid changes in video or frames which are being processed continuously. Pixels which are not found to be shifting during the comparison are taken as the background frames.

5. CONCLUSION & FUTURE SCOPE

The paper presents a method for detecting red, blue and green colours in a live video using the image processing toolbox in MATLAB. The above steps can be easily applied to recognize colours and track objects within a video. The accuracy of the algorithms used is quite high and consistent. However, there are some obstacles and drawbacks with this approach. It is difficult to detect colour and track objects if the background has matching colours and cannot be easily distinguished. Multiple objects and unknown exposure or illumination can also have a negative effect on the system.

The scope of colour recognition and object tracking in the future is magnified by the vast development and rapid growth in artificial intelligence. Colour detection has various applications in fields like robotics, security and surveillance systems, medical science, object segregation, and biometric identification.