Speed Detection using Image Processing:

---- Vikas Upadhyaya.

The paper mainly speaks about Speed detection with back ground subtraction, object detection and speed calculation. There are multiple background subtraction techniques we use Adaptive background subtraction. Back ground subtraction talks about removing the unwanted background from the image to extract only wanted object .this is done for all the frames of the video and then thresholding is done to get a final image.

Adaptive background subtraction similar to background subtraction the image keeps on updating i.e. new-image = P \* old-image +(1-p)f ; here the new image is updated with respect to old, previous image and the difference in each image is given as P if P = 0.95% its 95% similar to old image and 5% new. In this case the background also keeps on updating it must have different values with respect to time.

Object Detection and tracking is difficult because of shadows and noise in the image and we have to remove them. Object segmentation is algorithm to detect if the object is single object or multiple object this is important because it helps us identify the object clearly in the image. Shadow removal is done directly by **Adaptive background subtraction** when compared shadow and the image background have similar properties with condition if the current frame pixel value greater than or equal to 0.25 and pixel intensity of pixel less than 0.93 its considered background. The resultant image is passed thought **Convex hull** which is hole filling algorithm that converts all the connected objects to blobs with the final image is filled and noiseless image. Then final image goes though object labelling, bounding box and centre extraction the object is labelled uniquely which is useful in case of multiple small object based images. The image is bounded and the centre of the image is calculated and stored

Speed detection is done by calibrating the length of object in real life (cms) with respect to length if objects in frame (pixels) this is how the **calibration factor** is obtained by comparing both the aspects. This helps us map the real life object to and image obtained. The camera for capturing is placed at height H the resultant image is segmented to multiple smaller images like r1,r2,r3.. , only 2/3 of the original image is considered for segmentation. The object image are labelled and their length from camera to the respective image is considered as d1 ,d2 .

Speed is calculated using the formula ((a-e) 2+ (b-f) 2)1/2 let us consider the video being 30 FPS once every 15 frame the centroid of the object is tracked and stored (a-e) gives the centroid of the object in the starting frame , (b-f) is the centroid of the object at 15th frame. The time taken is calculated using frame rate V = c\*D/T here c is calibrating factor at particular region, d is distance the object travels in pixel and T is time taken for 15 frames. Speed is relational between distance travelled and time taken thus dividing D and V gives us speed

The merits can be noticed during different time of the day when the Adaptive background subtraction keeps on updating and works well on night times and during rainy, cloudy times. The speed detection works every half a second useful to monitor any sudden speed changes. The conventional radar gun has an error of 3% to 13% for the deviation of 150 to 300. The proposed method has 3% error in speed detection

Vehicle Speed Detection in Video frames using Corner detection

-----Kiran kumar KV, Pallavi chandrakant

The paper mainly talks about speed detection without any camera calibration using frame subtraction and masking technique to identify the moving object. Speed detection using time taken between frames and distance object travelled between the frames. Law enforcers use Doppler Effect to measure speed of the vehicle but due to radio interference they cause errors. Previous works on Speed detection using DIP uses frame difference, calibrated camera and motion trajectories. Currently GPS systems are used to track speed of a vehicle in US. In the proposed method we use .Avi file and the video is segregated to frames at 30 FPS we use only 3 FPS to reduce redundancy.

The Image is converted to grayscale to further reduce computation. The resultant image is passed though edge detection, object segmentation and corner detection.

Filter is applied to the input image (median filter) is used to reduce the noise. Filters like Gaussian produce don’t preserve the Edge of the image thus median is used. The resultant image is subjected to background subtraction here we don’t use calibration but use a reference frame to remove the background. The resulting image has only parts which have moved due to atmospheric changes even background can change and it’s to detected in the resultant image so we find region of interest using mask

Edge detection is applied to image to reduce impact of unwanted motion of leaves in the image. Edge detection contains smoothening of the image and gradient gives the image gives true edges.

Non maxima suppression is used to supress unwanted edges finally edges are determined only (true edges) certain edges are obtained.

The image now consist of rough edge’s we use **closing** to smooth out the edges closing is dilation followed by erosion. With a structural element varies with how much one wants to smooth the images here we use 8\*1

Masking is used on the image we have 3 masks in the image for horizontal, vertical and diagonal edge when we AND the mask’s with the image we get a clear image when compared to Edge detection and this also can be applied for Multiple vehicles at multiple lanes but we still have to consider the background edges so we use Corner detection. They use **Harris corner detection** the resultant images consist of all the corners in the image. We find the max corner for both the images max corner in this case is the lowest corner in both images we find the (X, Y) coordinate of max corner for both of the images then the distance formula between two pixel is used i.e.

Dp = ((x1-x2)2 + (y1-y2)2)1/2 ; (x1, y1)co-ordinates of max corner in frame 1

; (x2, y2)co-ordinates of max corner in frame 2

Speed can be calculated by = (Dp \*c \*5)/ (18 \* 0.344). ; 5/18 for conversion of Kmph to Mps

; C is sampling constant changes with respect to value of Y (0 to 135 c= 1.46) (135 to 205 c= 0.65)

(205 to 260 c= 0.47)(260 to 390 c= 0.26)(Else c=0.2); 0.344 is the sampling rate; Dp is the distance between two pixels.

Advantages: Less computational can be implemented on Mobile phones, cost of product is very less when compared to present day radars, Distance covered by this method is longer than Radar

Disadvantages: not suitable for all the climate, for real-time analysis we need high end processor (Laptop, desktop), efficiency fall down when we use multiple vehicles

Results: the algorithm has best results for single vehicle under normal conditions during cloudy days the shadow also becomes part of the image thus tampering with the corner detection algorithm

Vehicle Speed determination using Image processing

----- Shweta joshi

This paper talks about speed detection and vehicle tracking using Image processing techniques in matlab. The image processing technique has contingent factors like camera noise and illumination changes and tree waving the algorithm can be implemented for real-time surveillance. The paper uses background subtraction to find the movement of the object. The resultant image goes thought Region of interest to avoid **tree waving** further thresholding and morphological operation or used to reduce noise in the image.

The input video is pre-processed it’s converted to frames and frame rate and frame size are extracted and stored. The images are the processed through Object moving algorithm like **temporal differencing** method, optical flow algorithm and **background subtraction algorithm**. Temporal differencing method uses adjacent frames to identify the image the disadvantage is any slow movement in the object cannot be identified. **Optical flow** detects objects using camera movement. Background subtraction uses instantaneous frames to find the movement of the object. The image goes through Background extraction with ROI in mind here in this paper the road is considered as ROI. The image in order to reduce computation is converted to Grayscale. Using background extraction and extracted ROI the object is extracted that lies within the Region of interest thus avoiding Tree waving.

Thresholding is used to separate the ROI background from the object in motion. This results in image that has only the object on movement. The image goes though morphological operation like opening and closing. Opening being erosion followed by dilation and Closing being dilation followed by erosion. Closing and opening are used to remove holes in the image

**Feature extraction** is used to differentiate multiple objects in the image features like texture, colour, centroid, position of the object are stored. Feature extraction also helps us track speed of individual object

Vehicle tracking using mahalanobis distance. **Mahalanobis distance** is used here to find the similarities and dissimilarities between multiple objects. If the object matches all the features and mahalanobis distance then the Objects are matched. The speed is determined using mahalanobis formula = ((x1-x2)2 + (y1-y2)2)1/2

; (X1, Y1) are the x and y coordinates of the object in frame 1

; (X2, Y2) are the X and Y coordinates of the same object in frame 2

With the number of frames known and the FPS know we can find the time period between the frame 1 to the frame 2. Only frame with the ROI with the object in it consider as the frame 1 or initial frame to identify the object and 15th frame is the next frame so speed is relation between displacement and time so the amount of displacement of the object is obtained by Mahalanobis distance and the time is obtained using FPS and the total number of frames from the video.

Speed = (Distance/TF \* Frame rate) ; here TF is total number of frame

The Result, background subtraction is robust with illumination changes and we use ROI extraction to minimize Nosie and tree waving. The calculated speed is accurate to the actual speed

The algorithm also takes in consideration of multiple vehicles in a lane and uses feature extraction to differentiate them. The algorithm requires camera calibration and real-time implementation of the this method requires Core2Duo or higher processor and cannot be implemented on mobiles

Vehicle Speed detection system

----- Chomtip pornpanomchai

The paper talks about vehicle speed detection system using Digital image processing techniques.

The Algorithm has six parts Image acquisition, image enhancement, Image segmentation and labelling ,image analysis, speed detection, result and output display. The paper takes in consideration of three qualities **Usability** of the algorithm at specific conditions, **Performance**, **Effectiveness**. The use of video camera for speed detection is based on the radar model it uses Doppler Effect. The Doppler shift occurs when sound is reflected off a moving vehicle. This technique has few disadvantages like cost of equipment and accuracy, thus cameras are considered the next Devices in speed detection

The author talks about multiple Hardware realized speed detection techniques like Yong-Kul who used **double loop hardware** and visual C++ to measure vehicle speed, J.Pelegri who proposed **magnetic sensor**, H.Cheng who proposed **laser** based, Z.osman who proposed **microwave signal** based speed detection techniques.

Vehicle speed detection frame work is calibrated camera connected to a PC. The basic idea is to calculate the distance and time from the stating frame to the ending frame. The vehicle speed detection system has multiple components like Image Acquisition, Image restoration, Image segmentation, image analysis, speed calculation and the Result. Image Acquisition is done by using **Microsoft direct show** library it provides a tool called **filter graph manager** it’s a multimedia software uses on streams and video data the Filter graph tools is used to help change the format of the file and also has three filter source filter decoder filter and render filter. The filter graph is responsible for grabbing every frame from the video and storing it in memory

Image enhancement includes implementing smoothing and noise reduction algorithms on the image and the image is then scaled to required size. The colourer image is then converted to Black and white to reduce computational complexity. Image segmentation is used to segment the moving object out of the image using image differentiation technique here the first image in the frame is selected as reference frame and next frame is subtracted with the reference frame this happens for all the frames this results in image showing moment of the car. To determine the position we declare the biggest area in vertical and declare it as entry point the use hole filling algorithm the determine the position of the Vehicle

Image is then analysed to find the position of **mark points** in reference frame (ROI) .then thresholding is used to diffentiate between the image and background once the mark point is identified on image1 then mark points for each image are identified similarly. Using the marked points the image is segregated to starting point and end point

Speed detection is done by getting the difference in movement of the marked point from starting point to end point .Time is calculated by using Frames per second and total frames. The distance formula is = Df\*(D/Dx)\*(Pn-Pa);

Dx = distance between two marking points; X, Y = are the width and height of the frame; Po = right most of the vehicle at T=0; Pn = right most of the vehicle at T=n

Time = Tf\*(Tn-T0);

Tf = time conversion factor (Ms to hour) 1/1000; Tn = Timestamp at T=n; T0 = Timestamp at T=0

The performance result the algorithm uses the video from the point where the Vehicle appear at the frame rest of the frames are unused (Usability). The experiment works on different scenarios there are few things that change the accuracy of the algorithm image resolution, ratio of vehicle to image.

Based on the results the algorithm is still prone to Size of vehicle, size of video scene, stability in brightness level, number of colour in the image, the number of vehicles in each frame.