A New Moving Object Classification and Estimation Based on Extreme Learning Machine (ELM)

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***Abstract*— Analyzing of video images could define as a process of detecting moving objects to get meaningful and interpretable information using via various analyzing technics on the video datas which gotten from different video display devices. The purpose of this study is to analyze video images including moving objects to get meaningful datas and then using analysis results with extreme learning machine (ELM) for estimation and classification. The Study has three steps. In first the step ''detection of moving objects, estimation of the objects movement with Kalman filter and lastly appointment to estimated point with Hungarian algorithm'' which are steps of the video analyzing. in second step ''parting video frames and making an attribute schedule which contains each one of this frames shape, location, speed etc. datas .İn the third step made estimation and classification of outputs as against for the objects characteristics datas for ELM. Method had used successfully on video which contains various vehicles also pedestrians and results had evaluated**

***Keywords*—Video Analysis, Background Subtraction, Kalman Filter, Hungarian Algorithm, Extreme Learning Machine.**

I. Introduction

İnterpretation and analysis of video images subject is developing in many application areas such as settlements safety, military applications and medical image processing. Dynamic images represent integrated data with objects components which are; sound, event, place and time [1]. Making different inferences to estimate about feature and making classification after the detection and tracing of moving object in this vast data content is the aim of the computer vision applications via computers. Making evaluations on images with image processing applications via computer reduces making mistakes which cause from human factor and also increases computer control and datas accuracy. Analyzing of video images can define as processing video datas which are obtained from various displaying devices via image process technics; and getting meaningful and interpretable information from this processed images[2].First step of the video analyzing is getting shape, location etc. datas with detection and tracing process of the moving object [3].

Second step is classification, shape, location etc. datas moving objects in the video via smart classifiers or making estimation about future situation. There is a lot of application for the detection and tracing of the movement. Determinative of this applications success is the detection of the movement. Detection of the movement based on the principle of the decomposition of the active area from the other areas in the simulacrum. According to this principle; Decomposition of the movement from backscreen can doable via analyzing differences of the studied simulacrums and reference simulacrums either comparison on previously determinate reference threshold value or could make statistical approaching of this differences [4]. There are seven methods and twenty nine applications derivated from this principle in the literature [5]. There is flow diagram which shows this step of the background extraction algorithm in the figure 1 [6].

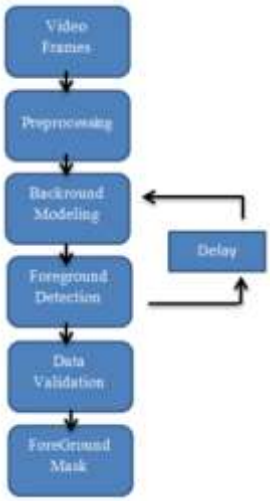

Fig. 1. A background subtraction algorithm processing steps.

Methods have based on the formula in the equation 1 [7]

$$X_t(s) = \begin{cases} 1 \text{ if } d(I_{s,t}, B_s) > T \\ 0 \text{ otherwise} \end{cases} \quad (1)$$

A sequential simulacrum sequence I or in another explanation video consists of simulacrum frames which is named static background B and objects which are moves in this background frames. Every moving objects color dispersion is different than backgrounds color dispersion and because of that pixel differences is bigger than threshold value at the moving objects which are color dispersions different than background frames. The situation in the formula is the pixel difference bigger than threshold value which is ''1'' background pixel do tag as a ''0''

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meaning moving objects other situations (smaller or equal) in the formula. İn the equation 1, ‘’Xt’’ means objects moving pixels which are moving at the time ‘’t’’, ’’T’’ means threshold value, ’’s’’ means pixels, ’’d’’ means color or color differences between background pixels at time ‘’t’’ [5, 7]. There are seven basic methods in schedule 1. The main difference between in this seven methods is the modeling method of the background ‘’B’’ and how calculated ‘’d’’ which is the color or color difference between pixels [7].

TABLE 1: THE BASIC METHOD OF BACKGROUND SUBTRACTION TECHNIQUES.

1	Basic Motion Detection (Basic)
2	One Gaussian (1-G) – (Running Gaussian average)
3	Minimum, Maximum and Maximum Inter Frame Difference -(Min Max)
4	Gaussian Mixture Model (GMM) -(Mixture of Gaussians-MOG)
5	Kernel Density Estimation (KDE)
6	Codebook (CBRGB)
7	Eigen Backgrounds (Eigen)

The purpose is the estimation of the objects orbit after the decomposition of the object (which is moving in the video) from the background to determinate exact location [8]. Kalman filter can use as estimation correctly of the moving objects (in the video) orbits. It is a station estimation method although defines as a filter in the literature. Kalman Filter reduces estimation mistakes at the ‘’recursive’’ steps which are results from itself [9]. İt works on two steps which are estimation and fixing. Estimation step uses situation model to estimation objects new situation. Updating step is updates the objects status according to observation value [10].Program uses Hungarian Algorithm to designation of the moving objects to following orbit after using Kalman Filter to estimation moving objects in the orbit. The basic purpose of the using Hungarian Algorithm is making appointments with minimum process [11]. İn figure 2 could see the steps of proves such as ;using of the method via subtraction of the backscreen to determinate of objects shape which is in the video, Using Kalman Filter to determinate objects orbit(coordinates in the video) and making appointment with Hungarian Algorithm according to this estimation.

Fig. 2. The moving object detection and tracking process steps on video

After the first step (which is the determination and pursuit of the object) Second step is with using of Extreme Learning Machine (ELM) to make classification or estimation about future situation. ELM is a feedforward artificial neural network model (ANN) which has only one secret layer [16-19].İn learning process inputs weight choosing randomly output weights calculating statistically unlike the ANN which is coefficients regenerates gradient based. An Analytic learning process reduces of denouement period also mistake ratio and possibility of the larking on a local minimum. We can use a linear function or nonlinear function (sigmoid, Sinus, Gaussian) to activate the cell which are belong in the secret layer of the ELM.

Also we can use non-differentiable or discontinuous functions in this cell [19].

II. MATERIALS AND METHOD MATH

The purpose of this study in consecutive simulacrum series first step is getting the location, shape and area datas via determination and persecution process of the moving objects with fewer mistakes. Second step is classification this objects via ELM with using this datas or making estimation about future situations of this datas. first step is using the Mixture of Gaussians (MOG) method which is subtraction of the background to determination of moving object and have had used the Kalman Filter to estimation objects direction in the orbit and have had appointment on this chosen spots via Hungarian Algorithm for the estimate. Objects coordinates at moving situation and objects characteristics have has shown at schedule 2.

TABLE 2: OBJECT ATTRIBUTE DATA.

Object attributes	*Obtained object attribute*
Last Coordinate Information - First Coordinate Information	Movement Direction
Last coordinate value - First coordinate value	Substitution
Instant coordinate value	Location
(Last Coordinate Information - First Coordinate Information) / Time	Speed

At second step; using various statistical process on the objects characteristic to get input datas for ELM and with this datas we could estimation objects future situation or with ELM we could make a classification about objects class.

TABLE 3: ESTIMATION WITH ELM

Input (Object properties)	*output (estimation)*
Moving Direction	next situation of the object
Substitution	
Location	
Speed	

TABLE 4: CLASSIFICATION WITH ELM

Input (Object properties)	*output (classification)*
Substitution	Object classification (vehicles, motorcycles and pedestrians)
Speed	

İn the proposed method analysis a video-A. in fig 3 indicate 3 frames of video-A

Frame 1 Frame 2 Frame 3

Fig. 3. Sample video-A

At figure 4 have had appointment to estimation spot with Hungarian Algorithm after estimation the objects directions in the orbits via Kalman Filter and moving objects detection via the subtraction of their background via MOG method .At figure 5 has shown frames have had tagged via using of Kalman Filter and Hungarian Algorithm to pursuit.

Frame 1 Frame 2 Frame 3

Fig. 4. MOG background subtraction method applied images.

Frame 1 Frame 2 Frame 3

Fig. 5. Marking objects moving on the frame

At table 3 and 4 has shown for the sample video. Input and output parameters for the estimation and classification process of the ELM classificatory .This schedule could show differences about solution of this problem. We could use objects features as an input data (Substitution, location, speed, shape) if we want to detect situations in the video like faulty parking's peed, lane violation. If ''location'' is chosen as output data it could classification and tag vehicles which are made lane violation and made faulty parking or which ones have reached over the speed limit. learning parameters of the ELM network

III. Experimental Result

At table 5 has shown learning parameter of the ELM network.

TABLE 5: LEARNING PARAMETERS OF THE ELM NETWORK

Number of Layers	Input:4
	Hidden Layers:1
	Output Layers:1
Activation Functions	sigmoid, Sinus, Gaussian
Learning Algorithm	Single-layer forward
Error Sum	0.0001

TABLE 6: DETECTED OBJECTS CLASSIFICATIONS

Detected Vehicle type	ELM	View
Car	8	8
Pickup	3	3
Motorcycle	2	2
Pedestrian	4	4
Other	5	5

TABLE 7: DETECTED OBJECTS ESTIMATION

Detected Vehicle type	Next 5 min	Next 10 Min	Next 15 Min
Car 1	No Change	No Change	No Change
Car 2	No Change	Faulty Park	Faulty Park
...	2	2	2
Car 8	Faulty Park	overspeed	overspeed
Pickup 1	No Change	No Change	overspeed
Motorcycle 1	No Change	No Change	No Change
.....	-	-	-

The classification and estimation results with ELM has shown in Table 6 and Table 7.System success rate of object classification is 100% and predicting the next state is 87%

IV. Result

Getting meaningful data from video images and classify them is getting more easy with various algorithms, methods and image processing software's blocks and rapid development of technology. Reaching this success level of the technologies which are using on this domain has reduced human faults and increased correction of datas. İn this study has researched the determination of the moving objects from video images and has tested seven basic methods twenty nine applications software. Made backscreen extraction from a video with Mixture of Gaussians (MOG) which is the most effective method and had tested the other seven methods. Had shown characteristics of the detected object with pursuit of the moving object via Kalman Filter and Hungarian Algorithm. Video analyzing doesn't mean only detection of the moving object or getting datas with pursuit. Made various estimation and classification on objects to get meaningful and interpretable results from datas which have had gotten via using Extreme Learning Machine (ELM) which is using mostly and effectively in the literature.

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