International Journal of Scientific and Technical Advancements
ISSN: 2454-1532

Detection and Response to External Stimuli

Mohsina Ishrat[1], Kusam Pawar[2], Pawanesh Abrol[3]
[1, 2]Department of Computer Science & IT, University of Jammu, J&K
Email address: [1]mohsina.ishrat@gmail.com, [2]kusam2univ@yahoo.co.in, [3]pawanesh.abrol@gmail.com

***Abstract*—**Gaze based systems require analysis and precise estimation of eyes of the subject in order to carry out series of instructions. The gaze estimation system may include sensor based devices, IR based devices, static and video based image capturing devices. Certain gaze based applications require detection and responding to stimuli generated in the environment. These stimuli can be internal or external. However there are various research issues related to detection and generation of response to a stimuli, while analyzing dynamic frames of images. In this research paper video streams from image capturing devices have been analyzed for detection of change in the content and generation of corresponding response. The detection and the response can be controlled by using statistical measures and adjusting the threshold parameter. This study can be further extended for analyzing the effect of external stimuli on eye movement, building and optimizing high response video surveillance systems, motion detection, virtual reality and gaming.

***Keywords*—**Stimuli; statistical measure.

I. INTRODUCTION

Capturing motion and interpreting its meaning for diagnostic or interactive purpose has been the growing research area. Video serves the purpose of capturing motion of any object. According to Cisco by 2017, video will account for 69% of all consumer internet traffic. Although detection of objects is possible through images but object or motion tracking can be efficiently carried out through sequences of frames of a video [1]. Video processing has been a part of numerous applications. The development of high speed cameras and video processing has attracted people's attention in sports video analysis [2]. Video analysis has been recognized as an important resource of education and training in medicine [3]. There has been considerable amount of work done in the field of agriculture based on video [4]. Different methods have been developed for recording video in a classroom [5].

External stimuli can be defined as an external change or disturbance in an environment that tend to generate response by a system. There have been studies carried out in many fields on the effect of external stimuli and associated responses. The experimental study has been carried in many fields like medical [6], [7], sports [8], assistive driving [9] etc.

Different methods can be employed to detect change or motion across frames of a video. Different techniques like edge detection, kalman filtering or camshift algorithm have been used to detect change or track motion in a video [10-12]. Various statistical measures like mean, mode, variance and standard deviation, kutosis have been applied in wide range of research problems. The measures have been used in varied areas of digital image processing for image enhancement, noise reduction, and edge detection [13]. In the context of digital image processing mean is classified as spatial filtering and used for noise reduction. Amongst various types of mean i.e. arithmetic, geometric and harmonic mean, arithmetic mean is simpler [14]. Although statistical measures have been applied on images for various purposes, they have not been used in video processing. In this paper presence of external stimuli is detected in an environment. Video is recorded by a capturing device. The video captured is analyzed for the presence of external disturbance i.e. stimuli. If an external stimulus is detected in a frame, a response in the form of system sound is generated till the presence of stimuli. The presence of external stimuli is detected by one of the statistical measures.

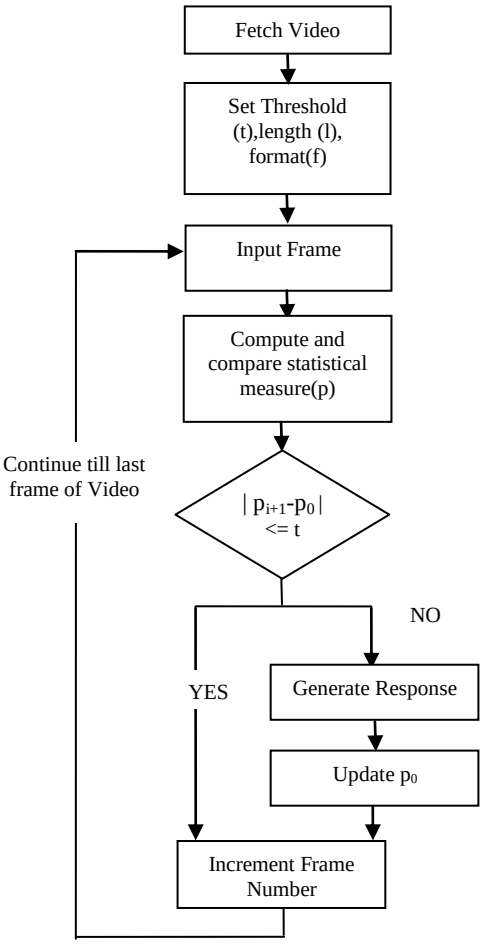

Fig. 1. Work flow for detection of external stimuli and response generation. t-threshold set on statistical parameter, p- statistical measure, l-length of video, format- RGB/grayscale, p_0- p value of template frame , p_{i+1}- subsequent frame value.

Mohsina Ishrat, Kusam Pawar and Pawanesh Abrol, "Detection and response to external stimuli", *Journal of Scientific and Technical Advancements*, Volume 1, Issue 3, pp. 97-99, 2015.

II. METHODOLOGY

To achieve the objective of detecting stimuli in an environment through video streams and generating associated response, a working model is developed. In this work different videos are recorded through capturing devices. Each of the video is bifurcated into individual frames. Statistical measure is applied on each frame. Each of the frames is compared with template frame in terms of statistical parameter. A threshold value is set. Different threshold values will lead to different response to external stimuli. Lower or no threshold will make system sensitive to all the variations in a video leading to generation of system response for almost all frames. The workflow of the experiment is shown in Fig. 1. The statistical measure (p) applied on video frames in this experiment is mean. Threshold value (t) is set, since p is a very sensitive parameter. Frames can be of different formats (f) i.e. RGB or grayscale.

The analysis has been done on different videos with different threshold values and results have been collected. The frames in the videos captured ranged from 20 to 500 frames. Most of the videos are captured through MATLAB interface.

III. RESULT AND DISCUSSION

As specified in the methodology, a working model is developed to detect change in the environment that triggers the corresponding responses. Some videos are captured with no external change in the environment. For other videos external stimuli is induced in the environment during the capturing of video. Since p is a sensitive statistical measure, it is observed that p varies across all frames. The variation could be due to noise, distortion or changes at pixel level. With no threshold specified, p cannot be used to detect presence of external stimuli across video frames. During the experimental study threshold was changed from values 0 to 6. The higher the threshold, lower the sensitivity. However videos of shorter duration tend to be more sensitive towards p. Based on different threshold values different responses were generated.

The values tabulated below are of two video streams of 350 frames each. In video 1 no change is induced in the environment. In video 2 external stimuli in the form of an object is induced in the same environment during capturing of video. The p values are of the last 20 frames of the video stream. The threshold value for the generation of response varied between 1-5. Statistical measure difference exceeding threshold values (t) between successive frames will generate response in the form of system sound. As seen in the table the change in mean values is not more than 1 in the absence of external stimuli. As observed in the table on threshold t=0 response will be generated on each frame due to sensitivity of the statistical measure. By increasing or decreasing the threshold values, response to changes in the external environment can be controlled.

Table I. Value of statistical parameter, response generation on different threshold values, δ_i -difference between p values of successive frames to template frame value (p_0).

Frame Number	Value of $\delta_{i=\lvert p_{i+1}-p_0\rvert}$ in video stream 1 without external stimuli on different t values and status of response (R)generated. R= 1 represents response generation and R=0 shows no response				Value of $\delta_{i=\lvert p_{i+1}-p_0\rvert}$ in video stream 2 with external stimuli on different t values			
	δ_i	R			δ_i	R		
		t=1	t= 3	t=5		t=1	t= 3	t=5
1	0.3111	0	0	0	0.1334	0	0	0
2	0.3865	0	0	0	0.4808	0	0	0
3	0.6270	0	0	0	0.1252	0	0	0
4	0.5767	0	0	0	0.7865	0	0	0
5	0.3475	0	0	0	0.4373	0	0	0
6	0.8438	0	0	0	0.1455	0	0	0
7	0.6002	0	0	0	0.3577	0	0	0
8	0.6255	0	0	0	0.2631	0	0	0
9	0.3150	0	0	0	0.3674	0	0	0
10	0.9812	0	0	0	0.5842	0	0	0
11	0.5835	0	0	0	0.2848	0	0	0
12	0.8191	0	0	0	0.5184	0	0	0
13	0.2140	0	0	0	0.3483	0	0	0
14	0.5343	0	0	0	0.3470	0	0	0
15	0.2811	0	0	0	0.7224	0	0	0
16	0.4317	0	0	0	0.4085	0	0	0
17	0.6483	0	0	0	1.6377	1	0	0
18	0.6428	0	0	0	6.2213	1	1	1
19	0.3865	0	0	0	6.3538	1	1	1
20	0.3865	0	0	0	3.3626	1	1	0

Mohsina Ishrat, Kusam Pawar and Pawanesh Abrol, "Detection and response to external stimuli", *Journal of Scientific and Technical Advancements*, Volume 1, Issue 3, pp. 97-99, 2015.

The values in the table show varying values on all 20 frames. Therefore some threshold needs to be set to generate response on desired stimuli. Threshold can be set with different values depending on the need of application. Desired results can be acquired by varying threshold values.

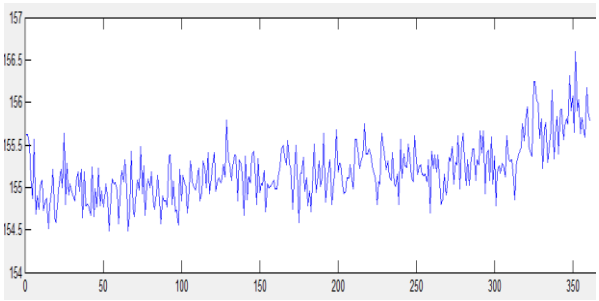

Fig. 2. Snapshot of video stream without external stimuli.

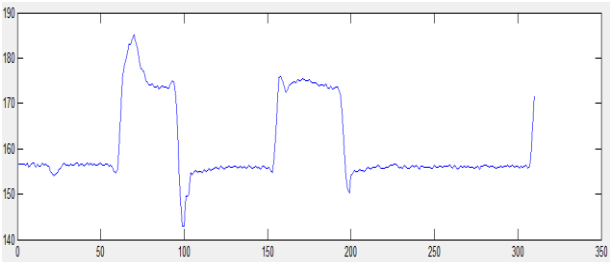

Fig. 3. Snapshot of video stream with external stimuli.

The snapshot of the video stream of 350 frames without external stimuli is shown in Fig.2. The threshold set is t=2 and the plot is drawn. X axis represent the frame number values while Y axis represent corresponding statistical parameter value of each frame. Since there is no major external disturbance and threshold is set at 2, no response is generated during the analysis of the video stream. Fig. 3 shows the snapshot of 350 frames video stream with external stimuli induced in the environment. The major changes occurring as seen in the snapshot are due to external disturbance induced in the environment.

The experimental results on various videos show that the detection of external stimuli in a video and generation of corresponding response is affected by factors like video duration, format, capturing device etc.

IV. Conclusion

Detection of external stimuli in an environment and generating corresponding response has numerous applications in the field of human computer interaction, medical sciences, social and behavioral sciences etc.

In this experimental study various videos are analyzed for the presence of external stimuli. External stimulus is detected in the video stream by controlling associated statistical parameter of each video frame. Different factors like duration of video stream, illumination conditions, format (RGB / Grayscale), video capturing application etc affected mean value of individual frames. Statistical parameter associated with each frame is sensitive to minor changes even at pixel level. A threshold needs to be set on the difference generated between successive frames and template frame on statistical parameter used. The threshold set, will make system react to only external disturbances occurring in the environment. Higher threshold will forsake minor disturbances and lower threshold will generate system response even on slightest movement. Depending on the application threshold can be set to acquire desired results.

The experimental study carried out can be extended by adding more statistical or non statistical parameters, filtering and noise reduction of different frames. Extensive study on different factors like video length, noise, video format, image capturing device/ application etc affecting different statistical measures can be worked upon for efficient detection of external stimuli or any change in the environment. Response to stimuli depends on the need of applications involved. The response can be controlled by setting different parameters in the experimental study.

References

[1] A. W. M. Smeulders, D. M. Chu, R. Cucchiara, S. Calderara, A. Dehghan, and M. Shah, "Visual tracking: an experimental survey," *IEEE Transactions on Pattern Analysis and Machine Intelligence*, vol. 36, pp. 1442-1468, July 2014.

[2] J. R. Wang and N. Parameswaran, "Survey of sports video analysis: research issues and applications," *in Proceedings VIP '05, ACM*, pp.87-90, 2004.

[3] C. Heath, P. Luff, and M. S. Svensson, "Video and qualitative research: analysing medical practice and, interaction," *Medical Education*, vol.41, pp. 1109–116, 2007.

[4] Y. Yang, B. Peng, and J. Wang, "A system for detection and recognition of pests in stored-grain based on video analysis," *Computer and Computing Technologies in Agriculture IV*, Springer, vol. 344, pp. 119-124, 2011.

[5] C. Jewitt, "An introduction to using video for research," *National Centre for Research Methods*, NCRM Working Paper, 2012.

[6] L. A. Brown, A. Cook, and M. H. Woollacott, "Attentional demands and postural recovery: the effects of aging," *Journal of Gerontology: Medical Sciences*, vol. 54, pp. 165-171, 1999.

[7] R. S. A. Khan, G. Tien, M. S. Atkins, B. Zheng, O. N. Panton, A. T. Meneghetti, "Analysis of eye gaze: do novice surgeons look at the same location as expert surgeons during a laparoscopic operation?," *Surg. Endosc. (SAGES)*, Springer Science and Business Media, 2012.

[8] K. D. Dahl, "External factors and athletic performance," Senior Thesis, Liberty University, Lynchburg, USA, 2013.

[9] T. Hirayama, K. Mase, and K. Takeda, "Analysis of Temporal Relationships between Eye Gaze and Peripheral Vehicle Behavior for Detecting Driver Distraction," *International Journal of Vehicular Technology*, pp. 1-8, 2013.

[10] Dr. K Rameshbabu, J. Swarnadurga, G. Archana, and K. Menaka, "Target tracking system using kalman filter," *International Journal of Advanced Engineering Research and Studies*, vol. II, pp. 90-94, 2012.

[11] J. G. Allen, R. Y. D. Xu, and J. S. Jin, "Object tracking using camshift algorithm and multiple quantized feature spaces," *In Proc. Pan-Sydney area workshop on visual information processing'04*, pp. 3–7, 2004.

[12] A. Sharma and P. Abrol, "Comparative analysis of edge detection operators for better glint detection," *IEEE 2nd International Conference on Computing for Sustainable Global Development*, pp. 973-977, 2015.

[13] V. Kumar and P. Gupta, "Importance of statistical measures in digital image processing," *International Journal of Emerging Technology and Advanced Engineering*, vol. 2, pp. 56-62, 2012.

Mohsina Ishrat, Kusam Pawar and Pawanesh Abrol, "Detection and response to external stimuli", *Journal of Scientific and Technical Advancements*, Volume 1, Issue 3, pp. 97-99, 2015.

ISSN: 2454-1532

Mohsina Ishrat, Kusam Pawar and Pawanesh Abrol, "Detection and response to external stimuli", *Journal of Scientific and Technical Advancements*, Volume 1, Issue 3, pp. 97-99, 2015.