Analysis of Region of Interest (RoI) of Multimedia Content using Eye-Tracker

B. Vinodh [1], **A. Sai Charan** [1], **R. Assfalg** [2], **H. Venkataraman** [1]

Indian Institute of Information Technology (IIIT), SriCity, India - 517588 [1]

Duale Hochschule Baden-Württemberg (DHBW) Heidenheim, Germany [2]

Abstract

- Each user typically focuses on certain parts/regions of a video frame
- This point of Gaze is analyzed using real-time Eye-Tracker
- Region-of-Interest (RoI) of a user analyzed during watching video - both 'static camera' and 'moving camera' scenario.
- **Critical Observation** - User's Gaze point and RoI from left to right (as well as top to bottom) followed a near-Gaussian distribution.

Introduction

- Encoding video with high-quality encoder results in humongous increase in data-rate.
- Data-rate requirement could be minimized (required particularly in wireless networks), by encoding video content with low bit rate.
- This however reduce the video quality.
- **Major challenge 1** - Encode video adaptively based on user's RoI
- **Major challenge 2** - Real-time adaptation should NOT cause change in perceptive video quality

Classification of Video Content

- **'Static Camera' Video** - Object of the camera moves, but not camera angle
- **'Moving Camera' Video** - Camera angle moves with the movement of main object in the video

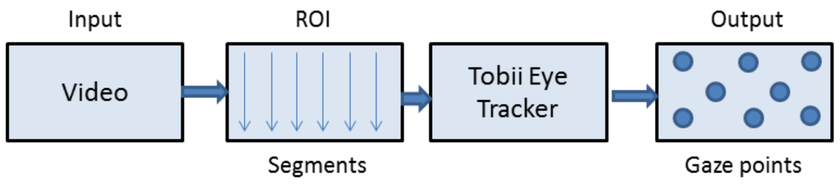

Figure 1: Block Diagram of Eye-Tracking based RoI Detection

Experiments and Observations

- Recording of eye position to determine the person's point of gaze.
- Experiment carried out across 35 users (18 male and 17 female).
- Each user asked to watch two videos (group-dance video for 'static camera' and cricket match video for 'moving camera')
- In order to do the tests, video content segmented into several rows and/or columns
- Gaze points of the user's identified in real-time.
- RoI calculated from the Gaze points.
- Each user's RoI analyzed using Tobii Eye-Tracker
- Heat Maps provide fixation positions and temporal changes of fixations as an overlay on a specific stimulus across different respondents.

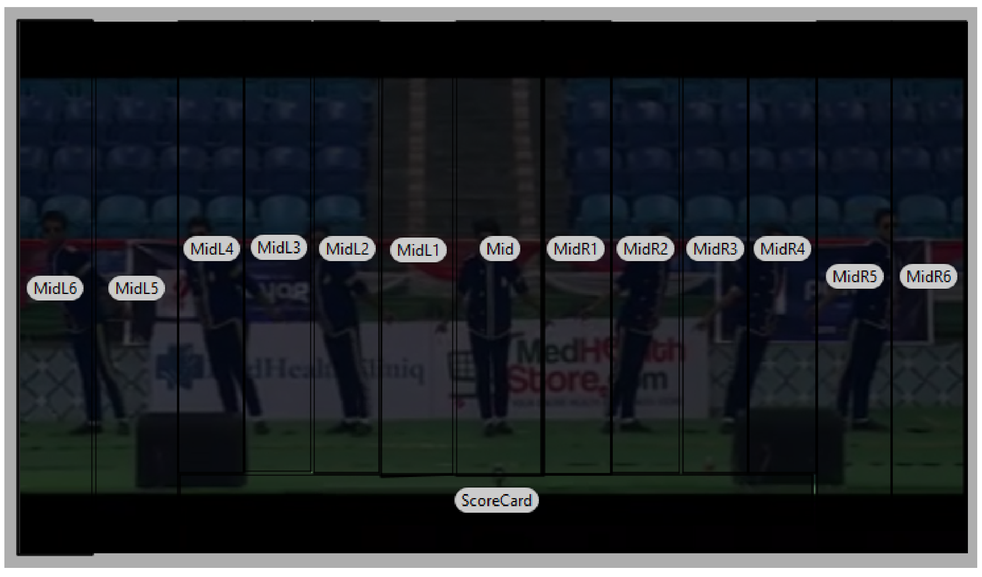

Figure 2: Vertical Segmentation of Video Frame

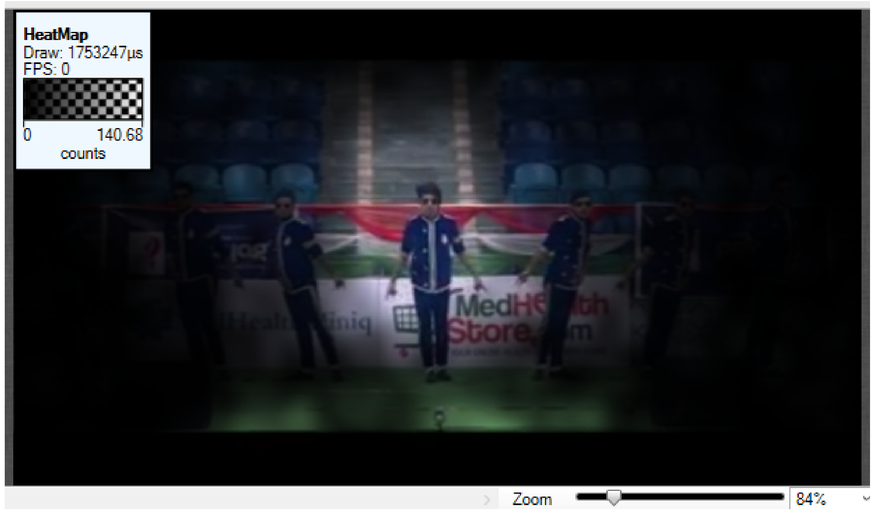

Figure 3: Heat-map of Static-Camera Video

Figure 4: Heat-map of Moving Camera Video

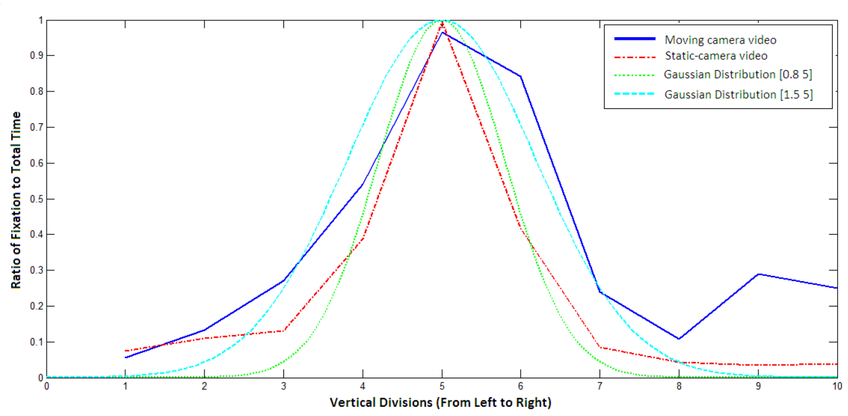

Figure 5: Comparison of Gaussian Distribution with Experimental RoI Results

Conclusion and Future Work

- Subjective investigation showed a significant result - Variation of user's RoI based on 'near Gaussian' distribution.
- Further, the authors intend to develop mechanisms for dynamic variation of video encoder using Gaussian-based RoI model.

Acknowledgement

The authors thank DST-DAAD Indo-German Grant for their research support.

References

[1] M. Kennedy, H. Venkataraman and G.M. Muntean, *"Energy Consumption Analysis and Adaptive Energy-Saving Solutions for Mobile Device Applications"*, Green IT, Springer-Verlag, 2011.

[2] B. Ciubotaru *et. al*, *"Subjective Assessment of Region-of-Interest -Aware Adaptive Multimedia Streaming Quality*", IEEE Transactions on Broadcasting, 60(1), pp. 50-60, March 2014.

[3] H. Venkataraman, T. Bi, T. Wu and G.M. Muntean, *"DEAR - An Energy centric Adaptive Region of Interest Mechanism for Wireless Mobile Devices"*, 18^{th} IEEE International Conference on Wireless Communication and Mobile Computing (WPMC), India, 13-16 Dec. 2015.

[4] Eye-Tracker, http://www.tobiipro.com/learn-and-support/ - Last accessed on 10^{th} May 2016.

Contact Email

vinodh.b13@iiits.in, charan.a@iiits.in, assfalg@dhbw-heidenheim.de, hvraman@iiits.in