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Hadis, Muhammad Sabirin	3D.3	393	Design of Smart Lock System for Doors with Special Features Using Bluetooth Technology
Handayani, Tri	4C.7	512	A Text Classification on The Downstreaming Potential of Biomedicine Publications in Indonesia
Hanif, Arrijal	5A.5	625	Sliding Window Method for Eye Movement Detection based on Electrooculogram Signal
Hanifa, Aini	5D.5	732	Detection of Unstable Approaches in Flight Track with Recurrent Neural Network
Hardi, Muhamad	1D.3	53	Leaf Morphological Feature Extraction Based on K-Nearest Neighbor
Hardiyati, Ria	4C.7	512	A Text Classification on The Downstreaming Potential of Biomedicine Publications in Indonesia
Hari Purwanto, Febryan	3D.2	387	Design of Server Room Temperature and Humidity Control System using Fuzzy Logic based on Microcontroller
Harimurti, Rina	4A.4	445	Predicting Student's Psychomotor Domain on The Vocational High School Using Linear Regression
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Harja, Yuda	6B.1	811	Determine The Best Option for Nearest Medical Services Using Google Maps API, Haversine and TOPSIS Algorithm
Harjoko, Agus	1D.1	42	Classification of Cell Types In Acute Myeloid Leukemia (AML) of M4, M5 and M7 Subtypes With Support Vector Machine Classifier
Hartanto, Rudy	3C.10	352	3D Human Face Reconstruction Using Depth Sensor of Kinect 2
Hartono, Yusuf	4A.1	426	LINGO-Based on Robust Counterpart Open Capacitated Vehicle Routing Problem (RCOCVRP) Model of Waste Transportation in Palembang
Hassan, Nurhaffizah	5D.2	727	Modelling of Driver`s Steering Behavior Control in Emergency Collision Avoidance by using Focus Time Delay Neural Network
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Hayashi, Kunioki	2D.13	223	Deep Reinforcement Learning for Recommender Systems
Hendra, Akbar	3D.3	393	Design of Smart Lock System for Doors with Special Features Using Bluetooth Technology
Herdjunanto, Samiadji	5B.3	653	Design of Fractional-Order Proportional-Integral-Derivative Controller: Hardware Realization

	5B.4	658	<i>A Remedy Design of PI Controller for Liquid Level Control</i>
Herlina, Herlina	5A.7	636	<i>Similarity Measures of Object Selection in Interactive Applications based on Smooth Pursuit Eye Movements</i>
Hidayat, Bambang	5A.3	614	<i>Granuloma Image Detection Through Periapical Radiograph by Using Gabor Wavelet Method and Support Vector Machine Classification</i>
Hidayat, Risanuri	3C.3	334	<i>River Body Extraction And Classification Using Enhanced Models of Modified Normalized Water Difference Index At Yeh Unda River Bali</i>
	3C.14	376	<i>Improvement of MFCC Feature Extraction Accuracy Using PCA in Indonesian Speech Recognition</i>
Hin, Sholihin	5B.2	648	<i>Xbee Pro Module Application in to Organize and Monitoring Earthquake Disaster Locations with the Robot Control System</i>
	3D.4	398	<i>Design of Robot Control System With the Use of Hand Gesture Based Wireless</i>
Huda, Miftakhul	6A.7	799	<i>Dual-Stage Flyback Inverter Controlled by Sensorless Current for Microinverter</i>
Hudaya, Chairul	4B.11	503	<i>Effects of Depth Burial on Current Carrying Capacity of XLPE 86/150 (170) kV Underground Cable</i>
Hussien, Hazrul Izwan	6A.5	790	<i>Optimal bonding arrangement for protection of communication signals in the oil and gas industry</i>
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Ikhwan, Muhammad	6A.3	781	<i>Model Predictive Control on Dual Axis Solar Tracker using Matlab/Simulink Simulation</i>
Ilham, Amil Ahmad	3D.3	393	<i>Design of Smart Lock System for Doors with Special Features Using Bluetooth Technology</i>
Imron, Chairul	6A.3	781	<i>Model Predictive Control on Dual Axis Solar Tracker using Matlab/Simulink Simulation</i>
Indrawati, Indrawati	4A.2	433	<i>LINGO-Based Optimization Problem of Cloud Computing of Bandwidth Consumption in the Internet</i>
Insap Santosa, Paulus	3A.5	272	<i>Metrics Analysis of Risk Profile: A Perspective on Business Aspects</i>
Irhamah, Irhamah	5C.2	692	<i>Transportation Choice Modeling on Commuter in Jabodetabek Using Bayesian Network and Polytomous Logistic Regression</i>
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Kartika, Vinda	3D.7	415	<i>Spoiled Meat Level Classification Using Semiconductor Gas Sensor, Image Processing and Neural Network</i>
Kasana, Reena	2C.4	177	<i>Reliable Geographic Routing Protocol for Vehicular Ad-hoc Networks under Shadowing and Multipath Environments</i>
Kesumo Siregar, Tito	5C.6	706	<i>Interaction Between Fluid and Solid Body Surfaces in Fluid Simulation using Material-Point Method</i>
Khabib, Achsanul	6A.8	805	<i>A Double Stage Micro-Inverter for Optimal Power Flow Control in Grid-Connected PV System</i>
Khalil, Muhammad	1C.3	33	<i>Combined Economic Emission Dispatch with Cubic Criterion Function Considering Various Price Penalty Factor Using Cuckoo Search Algorithm</i>
Khotimah, C.	3B.10	323	<i>Additive Survival Least Square Support Vector Machines and Feature Selection on Health Data in Indonesia</i>
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Kusuma, Hendra	4D.8	594	<i>Audio Beam Steering With Array Phased Method</i>
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Lestari, Destina	4D.5	576	<i>Adaptive DOCR Coordination in Loop Distribution System With Distributed Generation Using Firefly Algorithm-Artificial Neural Network</i>
Lestari, Fera	5C.9	716	<i>Wavelet Based-Analysis of Alpha Rhythm on EEG Signal</i>
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Lubis, Fadly Anshori	6C.5	876	<i>Data Partition and Hidden Neuron Value Formulation Combination in Neural Network Prediction Model Case Study: Non-Tax Revenue Prediction for Indonesian Government Unit</i>
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Luthfi, Emha Taufiq	4C.12	534	<i>Text Mining Based on Tax Comments as Big Data Analysis Using SVM and Feature Selection</i>
	2A.8	117	<i>Analysis of Evaluation Quality Website From Developers Perspective For Build Website</i>
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Mardi Susiki Nugroho, Supeno	5D.8	744	<i>Problem Transformation Methods For Prediction of Opinion and Exceptions In Financial Statements Audit Reports: Case For Financial Statements Audit In Central Kalimantan Province</i>
	4A.5	451	<i>Classifying Beneficiaries of Islamic Boarding School Rehabilitation Aid Based on Neural Network Approaches</i>
	4A.6	457	<i>Improving the Cluster Validity on Student' s Psychomotor Domain Using Feature Selection</i>
Mardlijah, Mardlijah	6A.3	781	<i>Model Predictive Control on Dual Axis Solar Tracker using Matlab/Simulink Simulation</i>
Mareta, Affix	5A.2	609	<i>Herbal Leaf Classification Using Images in Natural Background</i>
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Mbuyu, Sumbwanyambe	2A.7	111	<i>An Analysis and a Comparative Study of Cryptographic Algorithms Used on the Internet of Things (IoT) Based on Avalanche Effect</i>
Meidyani, Biandina	4C.16	552	<i>Time and Cost Optimization Using Scheduling Job Shop and Linear Goal Programming Model</i>
Mekarsari, Yudit Arum	5A.4	620	<i>Non-Blind RGB Image Watermarking Technique using 2-Level Discrete Wavelet Transform and Singular Value Decomposition</i>
Mercado, Lester	2B.18	149	<i>Model Development Of Students' Scholarship Status At First Asia Institute Of Technology And Humanities (FAITH)</i>
Mihuandayani, Mihuandayani	4C.12	534	<i>Text Mining Based on Tax Comments as Big Data Analysis Using SVM and Feature Selection</i>
	4C.15	546	<i>Food Trend Based on Social Media for Big Data Analysis Using K-Mean Clustering and SAW</i>
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Milosevic, Hranislav	5D.12	766	<i>Dynamical characteristics of the FSO transmission capacity in the presence of Rician turbulence</i>
MohamadTahir, Hatim	2A.1	75	<i>Wireless Service at Public University: A Survey of Users Perception on Security Aspects</i>
Muljono, Muljono	5A.4	620	<i>Non-Blind RGB Image Watermarking Technique using 2-Level Discrete Wavelet Transform and Singular Value Decomposition</i>
Munemasa, Isshu	2D.13	223	<i>Deep Reinforcement Learning for Recommender Systems</i>
Munir, Rinaldi	2C.3	171	<i>Intrusion Detection Against Unauthorized File Modification by Integrity Checking and Recovery with HW/SW Platforms Using Programmable System-On-Chip (SoC)</i>
	5C.6	706	<i>Interaction Between Fluid and Solid Body Surfaces in Fluid Simulation using Material-Point Method</i>
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Munoto, Munoto	4A.4	445	<i>Predicting Student's Psychomotor Domain on The Vocational High School Using Linear Regression</i>
Murad, Dina	6C.4	869	<i>Development of Smart Public Transportation System in Jakarta City based on Integrated IoT Platform</i>
Muslim, Much Aziz	2B.16	138	<i>Improving Accuracy of C4.5 Algorithm Using Split Feature Reduction Model and Bagging Ensemble for Credit Card Risk Prediction</i>
Mustafa, Syahrul	6A.2	775	<i>Optimal capacitor placement and economic analysis for reactive power compensation to improve system's efficiency at Bosowa Cement Industry, Maros</i>
Mustafid, Mustafid	6B.6	841	<i>Inventory Control System with Safety Stock and Reorder Point Approach</i>
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Nadhiroh, Irene	4C.7	512	<i>A Text Classification on The Downstreaming Potential of Biomedicine Publications in Indonesia</i>
Nasution, Bahrul	3B.9	318	<i>Robustness of Classical Fuzzy C-Means (FCM)</i>
Ng, Qi-Guan	4D.7	588	<i>Failover Mechanism During Upgrading Process for Software-Defined Networking</i>

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Ntyo, Efan	2D.8	217	Design and Development Smart Industrial Training Management Software with Artificial Neural Network (ANN) on Java
Nugraha, Kristian	5C.4	698	The Effectiveness of Peripheral Interaction Concept for Mobile Phone Usage while Driving
Nugraha, Putu Virga Nanta	3C.3	334	River Body Extraction And Classification Using Enhanced Models of Modified Normalized Water Difference Index At Yeh Unda River Bali
Nugroho, Lukito	3A.5	272	Metrics Analysis of Risk Profile: A Perspective on Business Aspects
Nurjanah, Dade	4C.13	540	Indonesian Twitter Cyberbullying Detection using Text Classification and User Credibility
Nurlaili, Afina	4A.7	463	Determining Linear Temporal Logic Formula for Decomposed Process Model
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Nurrahmi, Hani	4C.10	522	Twitter Data Transformation for Network Visualization Based Context Analysis
	4C.13	540	Indonesian Twitter Cyberbullying Detection using Text Classification and User Credibility
Nurtanio, Ingrid	3B.6	301	Classification on Passion Fruit's Ripeness using K-Means Clustering and Artificial Neural Network
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Nurzam, Fariz	5C.10	721	Implementation of Real-Time Scanner Java Language Text with Mobile Vision Android Based
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Palantei, Elyas	3D.3	393	Design of Smart Lock System for Doors with Special Features Using Bluetooth Technology
Palgunadi, Sarngadi	1D.1	42	Classification of Cell Types In Acute Myeloid Leukemia (AML) of M4, M5 and M7 Subtypes With Support Vector Machine Classifier
Pambudi, Dwi	4B.2	474	Detection of Organic Solvent Compounds Using Optical Fiber Interferometer Array and Neural Network Pattern Recognition
Pamungkas, Bayu Putra	1D.3	53	Leaf Morphological Feature Extraction Based on K-Nearest Neighbor
Pamungkas, Wahyu	6D.1	896	Doppler Effect in VANET Technology on High User's Mobility
	4D.9	598	Correlated Double Ring Channel Model at High Speed Environment in Vehicle to Vehicle Communications
Panić, Stefan	5D.12	766	Dynamical characteristics of the FSO transmission capacity in the presence of Rician turbulence
Penangsang, Ontoseno	1C.3	33	Combined Economic Emission Dispatch with Cubic Criterion Function Considering Various Price Penalty Factor Using Cuckoo Search Algorithm
Permadi, Vynska	6C.1	852	Efficient Skyline-based Web Service Composition with QoS-awareness and Budget Constraint
Permatasari, Desi Indah	4A.1	426	LINGO-Based on Robust Counterpart Open Capacitated Vehicle Routing Problem (RCOCVRP) Model of Waste Transportation in Palembang
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Pradipta, Andri	2C.14	199	Power Flow Control of Battery Energy Storage System Using Droop Voltage Regulation Technique Integrated with Hybrid PV/Wind Generation System
Pradipta, Ayudha Nandi	4B.11	503	Effects of Depth Burial on Current Carrying Capacity of XLPE 86/150 (170) kV Underground Cable
Pramono, Eko	3D.2	387	Design of Server Room Temperature and Humidity Control System using Fuzzy Logic based on Microcontroller
Prasetiyo, Budi	2B.16	138	Improving Accuracy of C4.5 Algorithm Using Split Feature Reduction Model and Bagging Ensemble for Credit Card Risk Prediction
Prastyo, Dedy	3B.10	323	Additive Survival Least Square Support Vector Machines and Feature Selection on Health Data in Indonesia
Pratama, Gilang	5B.3	653	Design of Fractional-Order Proportional-Integral-Derivative Controller: Hardware Realization
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Pratama, Irfan	3B.7	307	Data Level Approach for Imbalanced Class Handling on Educational Data Mining Multiclass Classification
Pratami, Niken	6B.2	817	Cooling Load Calculation of Cold Storage Container for Vegetables, Case Study C Campus-UISI, Ngipik
Pristyanto, Yoga	3B.7	307	Data Level Approach for Imbalanced Class Handling on Educational Data Mining Multiclass Classification
Pujiantara, Margo	4D.5	576	Adaptive DOCR Coordination in Loop Distribution System With Distributed Generation Using Firefly Algorithm-Artificial Neural Network
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Purbaya, Muhammad Eka	3C.11	357	Leaves Image Synthesis Using Generative Adversarial Networks With Regularization Improvement
Purhadi, Purhadi	5D.10	756	Spatial Probit Regression Model: Recursive Importance Sampling Approach
Purnami, Santi	3B.10	323	Additive Survival Least Square Support Vector Machines and Feature Selection on Health Data in Indonesia
Purnomo, Mauridhi	4D.5	576	Adaptive DOCR Coordination in Loop Distribution System With Distributed Generation Using Firefly Algorithm-Artificial Neural Network
	4A.5	451	Classifying Beneficiaries of Islamic Boarding School Rehabilitation Aid Based on Neural Network Approaches
	4A.6	457	Improving the Cluster Validity on Student' s Psychomotor Domain Using Feature Selection

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	5A.4	620	Non-Blind RGB Image Watermarking Technique using 2-Level Discrete Wavelet Transform and Singular Value Decomposition
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Rahardi, Gamma	3D.6	409	Design of Olfactory Mobile Robot for Detecting the Leak of Gas Sources by implementing Hot-Wire Anemometer
Rahardika, Ano	3C.9	345	Global Features Selection for Dynamic Signature Verification
Rahayu, Dwi	2A.8	117	Analysis of Evaluation Quality Website From Developers Perspective For Build Website
Rahayu, Santi	5D.9	750	Modeling The Household Milk Consumption Data by Endogenous Bayesian Tobit Quantile (BTQ) Regression in Sidoarjo
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Rahmah, Isna	1D.2	47	Indonesian Traffic Sign Detection and Recognition Using Color and Texture Feature Extraction and SVM Classifier
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Rahmanto, Andre	5D.11	762	The Implementation of E-Government Through Social Media Use In Local Government of Solo Raya
Rahmatullah, Daeng	4D.5	576	Adaptive DOCR Coordination in Loop Distribution System With Distributed Generation Using Firefly Algorithm-Artificial Neural Network
Rahmawati, Tri	5B.4	658	A Remedy Design of PI Controller for Liquid Level Control
Rais, Muhammad Rais	4D.3	569	Optimization of Grounding Resistance to Minimize Transient Currents at 150 kV Sulseirabar System
Ramandita, Herda	4C.15	546	Food Trend Based on Social Media for Big Data Analysis Using K-Mean Clustering and SAW
Ratnaningsih, Tri	1D.1	42	Classification of Cell Types In Acute Myeloid Leukemia (AML) of M4, M5 and M7 Subtypes With Support Vector Machine Classifier
Ratnasari, Vita	5D.10	756	Spatial Probit Regression Model: Recursive Importance Sampling Approach
	2A.6	105	Comparison Performance Between Rare Event Weighted Logistic Regression And Truncated Regularized Prior Correction On Modelling Imbalanced Welfare Classification In Bali
Rftn, Rosita Febriani	5B.2	648	Xbee Pro Module Application in to Organize and Monitoring Earthquake Disaster Locations with the Robot Control System
	3D.4	398	Design of Robot Control System With the Use of Hand Gesture Based Wireless
Riawan, Dedet	2C.14	199	Power Flow Control of Battery Energy Storage System Using Droop Voltage Regulation Technique Integrated with Hybrid PV/Wind Generation System
Rintyarna, Bagus	4B.8	492	Automatic Ranking System of University based on Technology Readiness Level Using LDA-Adaboost.MH
Ritfhs, R A Halimah Tussadyah	3D.4	398	Design of Robot Control System With the Use of Hand Gesture Based Wireless
Rivai, Muhammad	4B.2	474	Detection of Organic Solvent Compounds Using Optical Fiber Interferometer Array and Neural Network Pattern Recognition
	3D.6	409	Design of Olfactory Mobile Robot for Detecting the Leak of Gas Sources by implementing Hot-Wire Anemometer
	3D.7	415	Spoiled Meat Level Classification Using Semiconductor Gas Sensor, Image Processing and Neural Network
	4D.8	594	Audio Beam Steering With Array Phased Method
Robo, Salahudin	6B.3	824	An Identification of Success of Academic System Application Using Delone and McLean Design
Rosmansyah, Yusep	2B.17	143	Gamified Mobile Micro-learning Framework: A Case Study of Civil Service Management Learning
Rozie, Andri	4C.10	522	Twitter Data Transformation for Network Visualization Based Context Analysis
Rumiati, Agnes	2A.6	105	Comparison Performance Between Rare Event Weighted Logistic Regression And Truncated Regularized Prior Correction On Modelling Imbalanced Welfare Classification In Bali

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Sari, Christy	<b>2C.10</b>	183	<i>An Improved Message Capacity and Security using Divide and Modulus Function in Spatial Domain Steganography</i>
	<b>1D.3</b>	53	<i>Leaf Morphological Feature Extraction Based on K-Nearest Neighbor</i>
	<b>5A.4</b>	620	<i>Non-Blind RGB Image Watermarking Technique using 2-Level Discrete Wavelet Transform and Singular Value Decomposition</i>
	<b>2C.11</b>	188	<i>Simple and Secure Image Steganography using LSB and Triple XOR Operation on MSB</i>
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Sari, Shanti	<b>6B.2</b>	817	<i>Cooling Load Calculation of Cold Storage Container for Vegetables, Case Study C Campus-UISI, Ngipik</i>
Sarno, Riyanarto	<b>2D.15</b>	231	<i>Application of Analytic Hierarchy Process (AHP) and Simple Additive Weighting (SAW) Method In Singer Selection Process</i>
	<b>2D.17</b>	241	<i>Optimizing Time and Cost using Goal Programming and FMS Scheduling</i>
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# Similarity Measures of Object Selection in Interactive Applications based on Smooth Pursuit Eye Movements

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**Abstract**—Gaze-based interaction in various digital technologies is a rapidly growing research area. Eye tracking provides an alternative input modality to control interactive contents in computers. Nowadays, eye tracking is not only expected to be a personal assistive technology, but also to be a controller for interactive contents in a public display. Instead of fixational eye movement, smooth pursuit eye movement has been used for object selection in gaze-based interactive applications. However, previous works did not consider various similarity measures for spontaneous object selection. Hence, no information on how different similarity measures affect performance of object selection. To fill this gap, we compared two similarity measures—Euclidean distance and Pearson’s product moment coefficient—for object selection. We presented simple interactive applications containing four dynamic objects, each of which was presented subsequently or simultaneously. The participants were asked to select the objects by gazing and following the trajectory of the moving objects. Our results show that object selection with Euclidean distance achieved superior accuracy (78.65%) compared with object selection with Pearson’s product moment coefficient (57.38%). In future, our results maybe used as a guideline for development of spontaneous gaze-based interactive application.

**Index Terms**—smooth pursuit, eye tracking, Euclidean distance, Pearson’s product coefficient, gaze-based interaction

## I. INTRODUCTION

Gaze-based interaction in digital technologies is an important research area because it provides a faster and effortless input modality to interact with multimedia contents. Eye tracking is expected to do various actions normally performed by mouse and keyboard, such as object selection, navigating, and modification across various multimedia contents [1]–[5].

Gaze-based interfaces typically implement one out of three eye movements to control the contents: fixation, saccade, and smooth pursuit eye movement [6]. Fixation is the most common eye movement used in gaze-based interactive applications [7]–[10]. Fixation is detected during stationary gaze, in which the eye observes a particular object of interest with 200–300 ms of duration. Saccade represents a change of attention from one point to other point with 30–80 ms of duration. Saccadic eye movement has been used as a gaze-based control for video games that require quick navigation [11], [12].

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Finally, smooth pursuit is a condition during which the eye follows a dynamic object with velocity about  $10^\circ - 30^\circ/s$ . In recent studies, smooth pursuit was implemented in various interactive applications [13]–[18].

On the other side, the usage of eye tracking has expanded from personal assistive technology to interactive applications in public display [19]–[21]. Zhang et al. [19] proposed a method to identify gaze position for spontaneous interaction in public display. This work was subsequently followed by a proposal of interactive assistance during interaction in public display [20]. Additionally, Khamis et al. [21] also proposed an interactive application in public display by giving some options to the users for error correction activities.

Although interaction in public display has been studied extensively, simple calibration procedure remains to be the main challenge of this research area. Unfortunately, many commercial eye trackers still implement fixation-based calibration to obtain precise spatial gaze point [6]. In case the result of calibration is poor, the user must repeat the calibration procedure—impractical for on-the-go interaction in a public display. In this case, smooth pursuit eye movement has been used as a controller during interaction by finding the best similarity between trajectory of the eye movements and trajectory of the moving stimulus [14]–[18]. However, previous works did not investigate effect of different similarity measures on performance of object selection in interactive applications.

To fill this research gap, we compared performance of two similarity measures—Euclidean distance and Pearson’s product moment coefficient—for object selection with smooth pursuit eye movement in interactive applications. We observed accuracy and success timing of selecting dynamic objects with various movement directions. We also investigated the effect of chinrest on accuracy and success timing of object selection. Results of this study is useful for development of more accurate spontaneous gaze-based interaction.

## II. MATERIALS AND METHODS

### A. Apparatus

In this study, we used a personal notebook Acer Aspire E5-475G with Intel Core i5 2.5GHz, 4GB RAM DDR4, and 22 inch screen HD LED display. The Tobii EyeX Controller eye

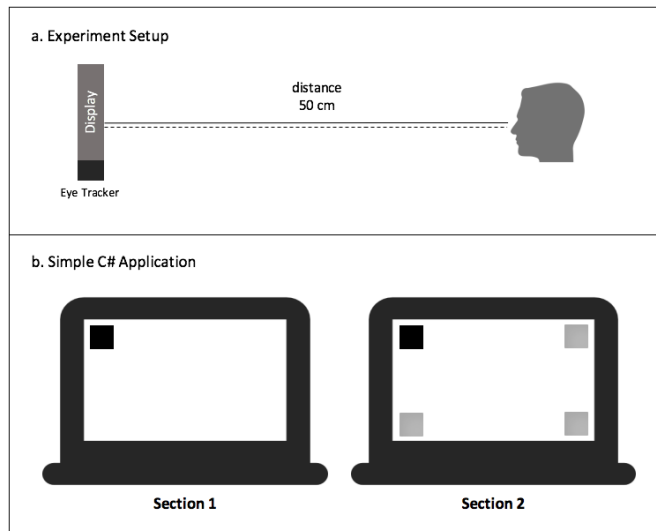


Fig. 1. Experimental setting: (a) The participant was positioned about 50 cm from the display. The eye tracker was installed beneath the display; (b) Simple C# applications presented stimulus for the experiment. There were two sections, each of which presenting objects subsequently or simultaneously. The objects were positioned at the corner of the display. Section 1 presented dynamic objects subsequently and section 2 presented four dynamic objects simultaneously. The participant was asked to follow the black object as an active object.

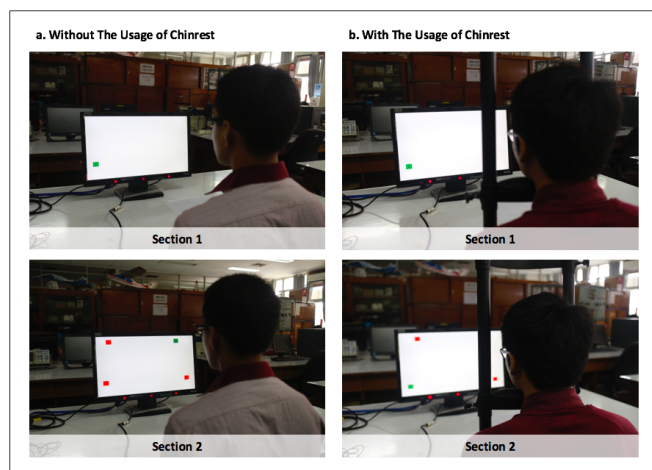


Fig. 2. Experimental setting: (a) Left panel shows section 1 and 2 without the usage of chinrest; (b) Right panel shows section 1 and 2 with the usage of chinrest.

tracker was used as a sensor of interactive applications. The eye tracker was installed beneath the display. The participants sit 50 cm in front of the display. The eye tracker was used to collect eye movements data with 70 Hz of sampling rate. A custom-built chinrest was used to gently hold participant's head. Figs. 1 and 2 present experimental setting in this study.

### B. Participants

Twenty three participants ( $N = 23$ ) were recruited on voluntary basis ( $M=12$ ;  $F=11$ ). Their ages ranged from 21 to 40 years (mean = 25.41 years,  $S.D.= 4.05$  years). The average

height of the participants was 163.59 cm ( $S.D.= 9.71$  cm). All participants were healthy, with normal or corrected eyes.

### C. Procedures of experiment

Authors confirmed that all experiment procedures were arranged according to WMA Declaration of Helsinki (*Ethical Principles for Medical Research Involving Human Subjects*). Before the experiment began, all participants were asked to read and to sign an informed consent explaining experiment procedures. Next, the participants were asked to fill in demographic data, such as gender, age, height, and usage of prescriptive glasses. A trial section was provided for each participant to provide a brief overview and a short practice of the experiment.

Figure 1 shows experimental setting. The experiment was divided into two sections. In the first section, the participants were asked to follow a dynamic object that appeared subsequently at different positions on the display: (i) top left, (ii) bottom left, (iii) top right, (iv) bottom right. The size of the dynamic object was 77 x 66 pixels of width and height, respectively. The object moved on 79 pixels of trajectory with 26.33 pixels/second of velocity. The horizontal and vertical distance between the top left pixel of the object and the border of the screen were 30 pixels. The object moved back and forth in horizontal direction while appearing at the top position. Conversely, the object moved back and forth in vertical direction while appearing at the bottom part of the display.

In the second section, four dynamic objects appeared simultaneously at the designated positions. The positions were similar as in the first session. The active object was set to be green color while the inactive objects were set to be red color. The participant was asked to follow the active object. The sequence of activation was: (i) top left, (ii) bottom left, (iii) top right, (iv) bottom right. The experiment was conducted with and without the usage of chinrest. Fig. 2 shows a participant performed the experiment without (left panel) and with chinrest (right panel). More information about the experimental setting can be found in <http://ugm.id/gazepursuit>.

### D. Methods of object selection

Object selection using smooth pursuit can be done by identifying a visual stimuli that has the most similar trajectory with the trajectory of eye movement in a particular time frame. In this research, two similarity measures were examined: Euclidean distance (ED) and Pearson's product moment coefficient (PPMC). The ED method is based on absolute distance between the position of the gaze point and the position of the stimuli. On the other side, the PPMC method is based on correlation of spatial position between the gaze point and the stimuli. Given more than one moving objects in an interactive application, the selected object should have the shortest gaze-to-object distance or the largest correlation value between the gaze point coordinates and the stimuli coordinates.

1) *Euclidean distance (ED)*: A sequence  $G$  of observed gaze points  $g = (g_x, g_y)_t$  during a time span  $t$  can be defined as:

$$G = [g_0, \dots, g_t] \quad (1)$$

Let  $L$  be a set of observation sequences  $L^o$  for  $N$  objects, by which  $o = 1, \dots, N$ . The location of the object  $o$  at time step  $t$  is denoted by  $l_t^o = \{l_x^o, l_y^o\}$ .  $L$  and  $L^o$  can be defined as follows:

$$L = [L_0, \dots, L_n] \quad (2)$$

$$L^o = [L_0^o, \dots, L_t^o] \quad (3)$$

To select an object  $o$  that was gazed by the participant during a time span  $t \in [i, k]$ , a distance  $D^o(G, L^o)$  between the observed gaze points  $G$  and the observed locations of the object  $L^o$  was computed:

$$D^o(G, L^o) = \sum_{t=i}^k \|g_t - l_t^o\| \quad (4)$$

Hence,

$$D^o(G, L^o) = \sum_{t=i}^k \sqrt{(g_{xt} - l_{xt}^o)^2 + (g_{yt} - l_{yt}^o)^2} \quad (5)$$

If the computed  $D^o(G, L^o)$  was smaller than a threshold  $D_H^o(G, L^o)$ , then the object  $o$  was selected. We empirically set  $C_H^o(G, L^o) = 100$  pixels.

2) *Pearson's product correlation moment (PPMC)*: PPMC has different perspective compared with ED. ED focuses on absolute distance between the observed gaze points  $G$  and the observed locations of the object  $L^o$ . However, PPMC focuses on the similarity of movement pattern between the observed gaze points  $G$  and the observed locations of the object  $L^o$ . If the object moves in X axis, we used the X coordinates for  $N$  last historical coordinates to compute the correlation value. Similar approach was used for Y coordinates.

Hence,

$$C^o(G, L^o) = \frac{N(\sum GL^o) - (\sum G)(\sum L^o)}{\sqrt{[N(\sum G^2) - (\sum G)^2][N(\sum L^{o2}) - (\sum L^o)^2]}} \quad (6)$$

If the computed  $C^o(G, L^o)$  was greater than a threshold  $C_H^o(G, L^o)$ , then the object  $o$  was selected. We empirically set  $C_H^o(G, L^o) = 0.2$ .

### III. EXPERIMENTAL RESULTS

#### A. Effect of Chinrest Usage and Similarity Measures on Accuracy and Success Timing of Object Selection

In the first section of experimental results, we compared effects of chinrest usage and similarity measures on accuracy and success timing of object selection. Object selection accuracy is presented as the percentage of an amount of

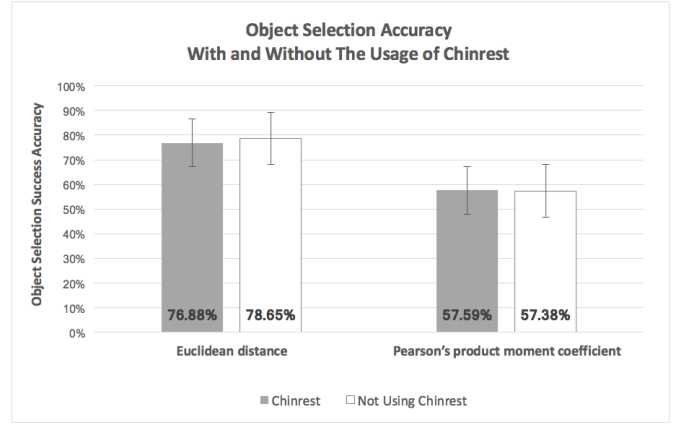


Fig. 3. The accuracy of object selection with Euclidean distance and Pearson's product moment coefficient during experiment with and without the usage of chinrest.

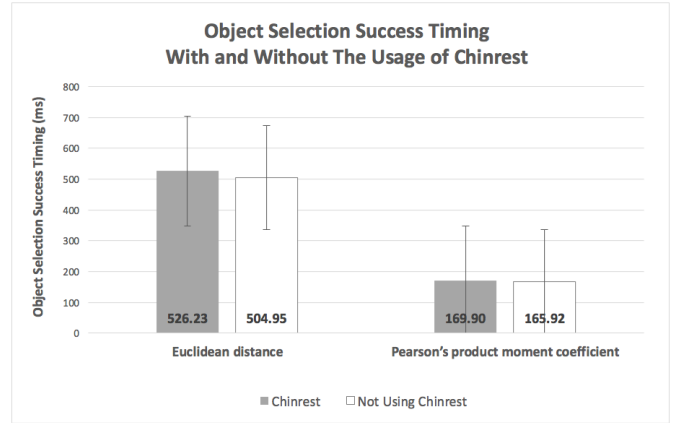


Fig. 4. The success timing of object selection with Euclidean distance and Pearson's product moment coefficient during experiment with and without the usage of chinrest.

successful object selection task in all sections of experiment. Object selection success timing is shown as time spent by the participant to successfully select an object of interest in all sections of experiment. We did not implement any signal processing filter on the eye tracking data.

Figure 3 shows the accuracy of object selection for different usage of chinrest—with vs. without—and different similarity measures—Euclidean distance (ED) vs. Pearson's product moment coefficient (PPMC). With the usage of chinrest, the average accuracy of object selection with ED and PPMC were  $76.88 \pm 14.54\%$  and  $57.59 \pm 3.29\%$ , respectively. On the other hand, object selection with ED shows better accuracy ( $78.65 \pm 11.95\%$ ) than object selection with PPMC ( $57.38 \pm 3.51\%$ ) when the participants did not use chinrest.

Figure 4 shows the success timing of object selection for different usage of chinrest—with vs. without—and different similarity measures—Euclidean distance (ED) vs. Pearson's product moment coefficient (PPMC). With the usage of chinrest, the average success timing of object selection using ED and PPMC were  $526.23 \pm 83.01$  ms and  $169.90 \pm 59.57$

$$\begin{aligned}
& \begin{bmatrix} 1 & 0 & 0.2 & 0 \\ 0 & 1 & 0 & 0.2 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix} \\
& \text{(A)} \quad \text{(B)} \quad \text{(H)} \\
& \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0.1 & 0 \\ 0 & 0 & 0 & 0.1 \end{bmatrix} \begin{bmatrix} 0.1 & 0 & 0 & 0 \\ 0 & 0.1 & 0 & 0 \\ 0 & 0 & 0.1 & 0 \\ 0 & 0 & 0 & 0.1 \end{bmatrix} \\
& \text{(Q)} \quad \text{(R)}
\end{aligned}$$

Fig. 5. Covariance matrix as parameter setting for Kalman filter. (A) is state transition matrix, (B) is input control matrix, (H) is measurement matrix, (Q) is action uncertainty matrix, and (R) is sensor noise matrix.

ms, respectively. Without the usage of chinrest, the average success timing of object selection with ED and PPMC were  $504.95 \pm 68.64$  ms and  $165.92 \pm 8.04$  ms, respectively.

Two way within-subjects analysis of variance (ANOVA) was performed on the experimental results. The independent variables were chinrest usage (with vs. without) and similarity measures (ED vs. PPMC). The dependent variables were accuracy and success timing of object selection. We found significant effects of similarity measures on accuracy ( $F(1, 22) = 100.29, p < 0.001$ ) and success timing of object selection ( $F(1, 22) = 636.98, p < 0.001$ ). We did not find significant effect of chinrest usage and interaction of chinrest usage  $\times$  similarity measures on accuracy and success timing of object selection.

### B. Effect of Signal Processing Filters and Similarity Measures on Accuracy and Success Timing of Object Selection

In the second section of experimental results, we implemented three signal processing filters on the eye tracking data: Moving average filter, Kalman filter, and Particle filter. We used five latest eye gaze data as input of the Moving average filter. Additionally, we used 100 particles as input for the Particle filter to calculate setting of parameters. For the Kalman filter, we used covariance matrices shown in Fig. 5. We observed the effects of signal processing filters and similarity measures on accuracy and success timing of object selection. From demographic data, 19 out of 23 participants (82.61%) stated that chinrest is not comfortable. Thus they opted not to use the chinrest whenever it is possible. Our previous analysis shows that there is no significant difference in accuracy and success timing of object selection performed with and without chinrest usage. Hence, all data in this section were taken from object selection task without chinrest usage.

Figure 6 and 7 show accuracy and success timing of object selection with Euclidean distance (ED) and Pearson's product moment coefficient (PPMC) under four filtering conditions: (i) raw (no filtering), (ii) Moving average filter, (iii) Kalman filter, (iv) Particle filter. We found that incorporating Kalman

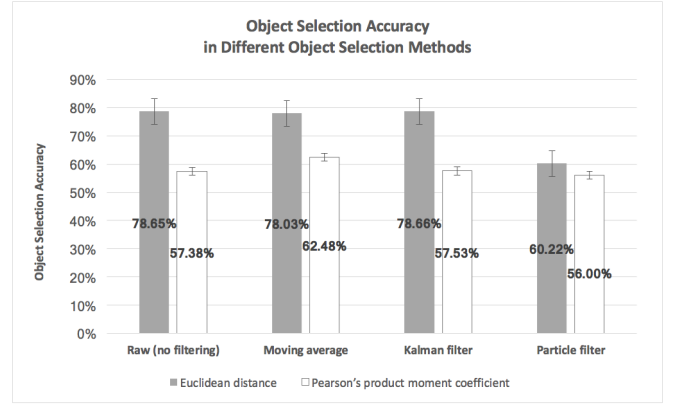


Fig. 6. The accuracy of object selection with Euclidean distance and Pearson's product moment coefficient under four filtering conditions.

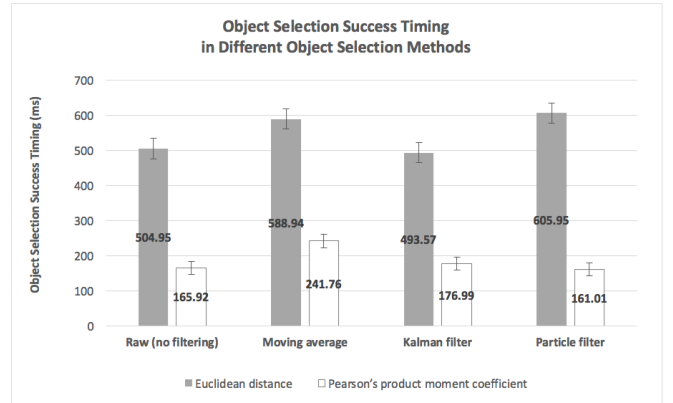


Fig. 7. The success timing of object selection with Euclidean distance and Pearson's product moment coefficient under four filtering conditions.

filter in object selection with ED yielded highest accuracy ( $78.66 \pm 11.68\%$ ). On the contrary, success timing of object selection was achieved faster when Particle filter was incorporated with PPMC ( $161.01 \pm 48.05$  ms).

Two way within-subjects analysis of variance (ANOVA) was performed on the experimental results. The independent variables were filtering conditions (no filter vs. Kalman filter vs. Moving average filter vs. Particle filter) and similarity measures (ED vs. PPMC). The dependent variables were accuracy and success timing of object selection. We found significant effects of filtering conditions ( $F(3, 66) = 11.61, p < 0.001$ ), similarity measures ( $F(1, 22) = 94.81, p < 0.001$ ), and interaction of filtering conditions  $\times$  similarity measures ( $F(3, 66) = 6.28, p < 0.001$ ) on accuracy of object selection. Furthermore, we also observed significant effects of filtering conditions ( $F(3, 66) = 7.42, p < 0.001$ ), similarity measures ( $F(1, 22) = 632.35, p < 0.001$ ), and interaction of filtering conditions  $\times$  similarity measures ( $F(3, 66) = 3.90, p < 0.01$ ) on success timing of object selection.

## IV. DISCUSSION

In the first section of experimental results, we show that there was no significant effect of chinrest omission on accuracy

and success timing of object selection. Indeed, the usage of chinrest limits head movements [22]. Compared with fixation-based eye tracking calibration, we argue that object selection using smooth pursuit eye movement can be implemented without restricting head movements. In this case, we also observed that Euclidean distance was more suitable for object selection as it achieved higher accuracy than Pearson's product moment coefficient ( $p < 0.001$ ).

Euclidean distance was more superior in accuracy than Pearson's product moment coefficient ( $p < 0.001$ ). Object selection with Euclidean distance achieved higher accuracy (21.27%) than Pearson's product moment coefficient. Euclidean distance measured the object selection based on absolute distance of the gaze point and the stimuli. Euclidean distance performed best when the object was positioned in a wide range.

On the contrary, Pearson's product moment coefficient estimated pattern similarity between trajectory of the gaze point and the stimuli. There was ambiguity on pattern similarity as there were more than one object moving in similar direction. This ambiguity led to decrement of accuracy of the Pearson's product moment coefficient. Based on our experimental results, we argue that accuracy of object selection based on smooth pursuit eye movement can be achieved by considering absolute distance of the gaze point and the stimuli while ignoring similarity of trajectory between the gaze point and the object.

On the other hand, we found that Pearson's product moment coefficient was more superior in success timing than Euclidean distance ( $p < 0.001$ ). Object selection with Pearson's product moment coefficient was 67% faster compared with its counterpart. On the other hand, Card et al. [23] has shown that applied psychology can be used to estimate the duration between a stimuli presented on the monitor and a response of user on the stimuli. During this short decision making, Card et al. stated that average reaction time of a user towards a stimuli is about 310 ms, with 130 and 640 ms for the fastest and slowest response, respectively. In this study, we found that object selection task with Euclidean distance required in average 526.23 ms (with chinrest, no filtering) and 605.95 ms (without chinrest, Particle filter). Therefore, we argue that object selection with Euclidean distance is still reasonable for wider interactive applications as it requires less than 640 ms to respond the presented stimuli.

The usage of signal processing filters enhanced the accuracy of object selection using smooth pursuit eye movement. We observed that object selection with Kalman filter achieved slightly higher accuracy (78.66%) than object selection with Moving average filter (78.03%). Object selection with Particle filter has the lowest accuracy, because Particle filter need at least two sources for the calculation to performs the best in accuracy. However, in this study, we used only one source (from eye tracker) and 100 particles for eye gaze filtering purpose. On the other hand, object selection with Kalman filter spent fewer time (493.57 ms) than object selection with Moving average (588.94 ms) and Particle filter (605.95 ms).

In fact, the low computational complexity of Kalman filter can be associated with the scarcity of the model matrix. Therefore, the algorithm simplifies matrix multiplications and inversion. In future, Kalman filter maybe used in various real-time interactive applications due to its low computational overhead.

## V. CONCLUSION

Smooth pursuit eye movement has been used as an alternative controller for on-the-go interaction on public display. Similarity measures are normally used to find the best match of eye movement's and stimulus' trajectory. However, previous works did not investigate effect of different similarity measures towards performance of object selection in gaze-based applications. In this research, we investigate the effect of chinrest usage (i.e. with and without chinrest) and different similarity measures (i.e. Euclidean distance and Pearson's product moment coefficient) towards accuracy and success timing of object selection. From our experimental results, we did not find any significant effect of chinrest usage on accuracy and success timing of object selection. Our results show that object selection with Euclidean distance achieved superior accuracy (78.65%) compared with object selection with Pearson's product moment coefficient (57.38%). Although Pearson's product moment coefficient was faster in success timing, implementing Euclidean distance was still reasonable as its average success timing (605.95 ms, without chinrest) was under the recommended estimation of normal cognitive response (640 ms). In future, our results can be used as a guideline for development of spontaneous gaze-based interactive application.

## REFERENCES

- [1] K. Arai and R. Mardiyanto, "Eye-based HCI with full specification of mouse and keyboard using pupil knowledge in the gaze estimation," Proceedings of The 2011 8th International Conference on Information Technology: New Generations (ITNG), Las Vegas USA, 2011, pp. 423–428, 2010.
- [2] M. Porta and A. Ravarelli, "Eye-based user interfaces: Some recent projects," in Proceedings of The 3rd International Conference on Human System Interactions (HSI' 2010), Rzeszow Poland, 2010, pp. 289–294.
- [3] C. Kumar, R. Menges, and S. Staab, "Eye-Controlled Interfaces for Multimedia Interaction," IEEE Multimedia, vol. 23, no. 4, pp. 6–13, 2016.
- [4] S. Wibirama and K. Hamamoto, "3D Gaze tracking on stereoscopic display using optimized geometric method", IEEJ Transactions on Electronics, Information and Systems, vol.134, no.3, pp. 345–352, 2014.
- [5] S. Wibirama, H.A. Nugroho, and K. Hamamoto, "Evaluating 3D gaze tracking in virtual space: A computer graphics approach", Entertainment Computing, vol.21, pp. 11–17, 2017.
- [6] K. Holmqvist, M. Nystrom, R. Andersson, R. Dewhurst, H. Jarodzka, and J. van de Weijer, Eye Tracking: A comprehensive guide to methods and measures. OUP Oxford, 2011.
- [7] P. Majaranta, K.-J. Raiha, "Twenty years of eye typing: Systems and design issues", Proceedings of the 2002 ACM Symposium on Eye Tracking Research & Applications (ETRA '02), New York USA, 2002, pp. 15–22.
- [8] S. Wibirama and K. Hamamoto, "Investigation of visually induced motion sickness in dynamic 3D contents based on subjective judgment, heart rate variability, and depth gaze behavior," in Proceedings of the 2014 36th Annual International Conference of the IEEE Engineering in Medicine and Biology Society, Chicago USA, 2014, pp. 4803–4806.

- [9] I. Jowers, M. Prats, A. McKay, S. Garner, "Evaluating an eye tracking interface for a two-dimensional sketch editor", *Computer-Aided Design*, vol. 45, no. 5, pp. 923–936, 2013.
- [10] C. Cig and T.M. Sezgin, "Gaze-based prediction of pen-based virtual interaction tasks", *International Journal of Human-Computer Studies*, vol. 23, pp. 91–106, 2015.
- [11] E. Gent, "For your eyes only [eye-tracking video gaming]", *Engineering & Technology*, vol.10, no.9, pp. 56–59, 2015.
- [12] S. Soltani and A. Mahnam, "A practical efficient human computer interface based on saccadic eye movements for people with disabilities", *Computers in Biology and Medicine*, vol.70, pp. 163–173, 2016.
- [13] I. Starker and R. A. Bolt, "Gaze-responsive self-disclosing display", in *Proceedings of CHI 1990*, New York USA, 1990, pp. 3–10.
- [14] M. Vidal, K. Pfeuffer, A. Bulling, and H. W. Gellersen, "Pursuits: Eye-based interaction with moving targets, " in *CHI '13 Extended Abstracts on Human Factors in Computing Systems (CHI EA '13)*, New York USA, 2013, pp. 3147–3150.
- [15] M. Vidal, A. Bulling, and H. Gellersen, "Pursuits: Spontaneous eye-based interaction for dynamic interfaces", *GetMobile: Mobile Comp. and Comm.*, vol.18, no.4, 2015, pp. 8–10.
- [16] J. Kangas, O. Spakov, P. Isokoski, D. Akkil, J. Rantala, R. Raisamo, "Feedback for smooth pursuit gaze tracking based control", in *Proceedings of the 7th Augmented Human International Conference 2016 (AH'16)*, New York USA, 2016, p. 6.
- [17] R.A. Warman, S. Wibirama, and A. Bejo, "Performance comparison of signal processing filters on smooth pursuit eye movements", in *Proceedings of 2nd International Conferences on Information Technology, Information Systems and Electrical Engineering (ICITISEE)*, Yogyakarta Indonesia, 2017, pp. 111–115.
- [18] M. Khamis, O. Saltuk, A. Hang, K. Stolz, A. Bulling, and F. Alt, "TextPursuits: Using Text for Pursuits-Based Interaction and Calibration on Public Displays," *Proc. 2016 ACM International Joint Conference on Pervasive and Ubiquitous Computing*, New York USA, 2016, pp. 274–285.
- [19] Y. Zhang, A. Bulling, and H. Gellersen, "SideWays: A Gaze Interface for Spontaneous Interaction with Displays," *Proceedings of the SIGCHI Conference on Human Factors in Computing System (CHI '13)*, New York USA, 2013, pp. 851–860.
- [20] Y. Zhang, J. Müller, M. K. Chong, A. Bulling, and H. Gellersen, "GazeHorizon: Enabling Passers-by to Interact with Public Displays by Gaze," *Proceedings of the 2014 ACM International Joint Conference on Pervasive and Ubiquitous Computing (UbiComp '14)*, New York USA, 2014, pp. 559–563.
- [21] M. Khamis, L. Trotter, M. Tessmann, C. Dannhart, A. Bulling, F. Alt, and L. M. U. Munich, "EyeVote in the Wild: Do Users bother Correcting System Errors on Public Displays?," *Proceedings of the 15th International Conference on Mobile and Ubiquitous Multimedia (MUM '16)*, New York USA, 2016, pp. 57–62.
- [22] Z. Zhu and Qiang Ji, "Novel Eye Gaze Tracking Techniques Under Natural Head Movement", *IEEE Transactions on Biomedical Engineering*, vol. 54, no. 12, pp. 2246–2260, 2007.
- [23] S.K. Card, A. Newell, and T.P. Moran, *The Psychology of Human-Computer Interaction*, CRC Press: Florida, 1983.