

# Eye Tracking Technique for Controlling Computer Game Objects



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## ABSTRACT

The study explored the employment of associate in accessible eye tracer with keyboard and mouse input devices for video games. An interactive game has been developed using unity with multiple balls objects and by hitting they could collect more point for each player. It has been used different techniques to hit the balls using mouse, keyboard, and mixed. Eye tracker input has been help to increase the performance of collected the player points. The research explains how the eye tacking techniques can be used in widely in video game and it is very interactive. Finally, we examine the use of visual observation in relevancy the keyboard and mouse input control and show the difference. Our results indicate that the employment of a watch huntsman will increase the immersion of a computer game and considerably improve the video game technology.

**Index Terms:** Computer Games, Eye Tracking, Eye Gaze Interaction, Facial Expressions as Game Input, Evaluating Peripheral Interaction

## 1. INTRODUCTION

It has been described two experiments that examine our technique of selecting eye objects using traditional mouse selection. We have already looked at how people behave when interacting with their eyes in the demos. The next step is to show that our method can withstand tougher use and that people like to select objects using their gaze for an extended period.

We rated the overall performance of gaze interaction with that of a widely used and widely used device: The mouse. The interaction of the eye requires different hardware and software. It's a question of whether it's worth it. If it works properly, we could also get some secondary benefits that

are difficult to quantify through an additional, passive, or mild input channel. For example, we've found that when the visual interaction works well, the device senses almost as if it were waiting for user controls. Just like you are studying the mind of the user. You want no more guidance input and you have your palms free from various tasks. It slows down the interaction and can "cover costs" in a simple experimental comparison with the mouse, regardless of the immaturity of current eye tracking technology.

The eye interaction approach is faster, but we see it as an advantage; however, it is not now the primary motivation for using eye monitoring in most environments.

Our experiments have measured the time required to perform simple and representative direct manipulative arithmetic tasks. One asked to select a highlighted circle from a circle grid. The second asked the test person to select the named letter on a loudspeaker from a letter grid. Our results show a wonderful and measurable pacemaker benefit for searching the mouse in the same experimental setting, persevering in every

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experiment. The key points of the test allow us to understand how our method of visible interaction works and why it is effective. As expected, the method is a little faster than the mouse. Our search suggests that the eye can also go faster than the hand. Our method verification is how our entire interaction method and algorithm preserve this eye speed advantage on a proper object. We study the physiology of the eye and use these records to extract useful facts about the user's overall intentions from noisy and fearful eye movement data. Even if it does, this algorithm is primarily based on understanding eye movement. It used to be no longer clear that our eye interaction approach would keep pace with the eye, as the eye monitoring hardware entails additional latencies [1]. The overall performance of any interaction science results from its software and hardware program. The previous experiments show that keyboard, mouse and joystick considered as traditional game inputs and there are many new techniques need to be considers [2], [3], [4].

Manipulate the voice [5] and monitor the head [6]. For the past few years, while using various entry level techniques, the goal of researchers has been to find out which technique is most accurate, most immersive, and most convenient for users. Here, we explain the benefits of using eye movements as a game controller. The eye tracking techniques have been compared to mouse input and have showed the results. Eye tracking technology has been shown to increase immersion and make games more fun for the player. As in Ivanchenko *et al.* [7], Almansouri [8], it shows that eye tracking as game input is very precise. The comparison of mouse, keyboard, and appearance in Jiménez-Rodríguez *et al.* [9] is also used as an entry level solo controller.

In contrast to these studies, which deal specifically with the comparison between mouse and eye control in terms of precision and effectiveness, many studies have focused on investigating the game experiment. In article [10], you focused on this immersive evaluation and the user experience. However, their research showed that when comparing the game with mouse data, the players were more immersed in the game, but in paper [11], they achieved a reliable questionnaire evaluation and a high score in terms of stamina. Feelings of fluidity and immersion in gaze-controlled play compared to the study by Modi and Singh [10], the result of which had to be further investigated. The way people treat the computer as human-computer interaction (HCI) has user actions on three different levels: Physical, cognitive, and emotional; however, the emotional level is a new topic that not only tries to make the interaction experience pleasant but also affects the further use of the machine by the user [12].

However, to better understand the emotional level at HCI, that is, the user's involvement in the machine's use, an evaluation of the user is required for the use of a peripheral device with test emotions. Emotional use of a peripheral device at the same time is difficult. Research [13] examined this primary function that requires continuous interaction and secondary work that takes place on the periphery. Some research on HCI has used emotions as a starting point. In research [14], Bernhaupt *et al.* designed an emotion flower set and used facial emotions as input. They used positive emotions (joy and surprise) to grow flowers and negative emotions (disgust, anger, sadness, and fear) to slow growth. Their game was intended for the workplace and they understood that their game improved the player's emotional state while playing, while the game did not affect people's general mood, but their work has become a fundamental work for Lankes *et al.* group [15]. His research works alongside the redesign of the emotion flower game; they tried wearing it in a mall and examined the player's emotional feedback to add more contrast to their basic work. Our approach is to combine existing input techniques such as (mouse, keyboard, and eye tracking). Add more facial emotions (joy, anger, and surprise) than inputs to a main game used in the proposed game [16]. The user can choose one. The game is using all three types of inputs such as (mouse, keyboard and eye tracker). Later, the damaged balloons are collected, and the score is increased. However, the emotion of the face has a peripheral role that helps the user control the speed of the balloons and gets more points in a time [17].

In addition, evaluation and effectiveness are important to us; measure effectiveness by comparing recorded results from different users. However, the assessment is made by comparing the input parameters in two different categories (emotional and unemotional).

## 2. RELATED WORK

### 2.1. Review Stage

Since there is extensive research on evaluating emotions and emotions with the help of users, research on emotions is not limited to facial expression, as the ability to become aware of people's emotions has an impact on social interaction and human behavior [18], moreover, some researchers worked on the body as in Ghareb [19] argue that recognition of emotions through non-verbal communication can be achieved by sensing body expression. However, our research on facial emotions touches a small portion of this area.

Ekman in Chittaro and Sioni [20] defined that facial expression is an example of things one can do through the face, his dialogue focused on the set of facial expressions – happiness, surprise, anger, sadness, worry, and disgust – that are culturally international and on which cultures depend to decide, to show rules. As in Emotion Recognition and its Application in Software Engineering [21], it examines a number of scenarios to assess the possibility of applying emotional cognition strategies in four areas: Software programming, website personalization, school, and games. Video games are contingencies that can dynamically respond to the emotions of the diagnosed contemporary gamer. Massive investigations worked on a specific reenactment for capturing emotions as discussed in Ekman *et al.* [22] an open-source EVG (Emotion Evoking Game) and a first and formative comparison strange end result ordinary variations were determined by comparison and facial expressions of surprise, joy, and disappointment been. There is a lot of research on recovery that has been used in focusing emotions in deferent approaches [18], [23], [24]. In addition to the emotion, the evaluation of peripheral units is a trend phase that has led to extensive discussions, countless findings focused on a unique type of peripheral evaluation. Some of the systems in the literature were evaluated on the basis of studies of test subjects [25], [26]. In addition, a learnable subject [27] using unique modalities (tangible, tactile, and hands-free); however, for the peripheral interaction, all peripheral works are ultimately a simple interaction, unless the focus is on controlling the audio participant. Collecting the points using user friendly method and easy way for evaluation different technology in the game. Besides working on the contrast of consumer emotions at a certain point in the game, our device focuses on evaluating the input devices (keyboard, mouse, and gaze); some research has observed the usefulness of the gaze as an access system [28], [29], [30], [31], [32], [33]. The rating of the normal mouse with momentary was examined in Almansouri [8], among the recently introduced (adult, middle aged, and the elderly) the rating of the eye over size for middle aged and the elderly; while Jacob [34], the evaluation was equated and the operability, in contrast to the menu resolution selection technique of a developed web browser, was experienced again as an operator together with the component, because it results in the system's operability. In Roose and Veinott [3], Ivanchenko *et al.* [7], Sibert and Jacob [35], Murata *et al.* [36], as a tutorial on how the view can be combined with different input methods. However [9], he worked on using the gaze as a solo input and studied the general performance variations for gaze, mouse, or keyboard for a similar project in the game. Today, the most common

structure of the eye tracker is the “corneal reflection” unit of the laptop. These structures place the surroundings of the user's gaze as a display screen coordinate on a monitor. To decide where the consumer is looking. These structures sing to one or each of the eyes they look at with a digital camera equipped with an infrared (IR) filter. The previous game have configured the input of eye using eye cornea and most be configured near the eye using new camera. Because the user's corneal floor is roughly spherical, the corneal reflex area remains constant as the user's eyes move relative to the head, the role of the student in relation to this reflex creates the position of the wearer's eye. A calibration sequence is used to map eye movements to display screen coordinates. There are also portable structures that are beneficial for ubiquitous computing scenarios. These structures use the same method as computer systems, but the archive view as a coordinate in a digital camera built into the user's head [37]. There are several games has been research of have performance issues of using keyboard and mouse as an input. By testing eye input versus mouse input in three extraordinary PC games, Smith and Graham [40] concluded that using eye monitoring can guarantee the player an additional immersive journey using the eye tracker in first-person shooters. Each test participant was asked to play the same sport using three specific input techniques: (1) Mouse, keyboard, and eye tracker; (2) mouse and keyboard only; or (3) a console gamepad. The results are not exactly encouraging now, suggesting that the overall performance with the eye tracker was once well below the two different ones. However, Isokoski and Martin attributed these results to the players' greater experience and expertise. The concern about the players who using typical input methods and when offering alternating input for playing the game it need further training. Other studies came to comparable results. The authors in research [39] created a simple look in which the participant was once asked to remove 25 balloons that were moving across the screen at extraordinary speeds. The participant would move the mouse or the eye tracker over the pointer and remove the balloons with the help of a mouse click. Two prerequisites were tested: With and besides the time limit for completing the task. The results confirmed that besides the time limit, the accuracy and time to complete the task were earlier worse when using the eye tracker than when using a mouse [40]. Performance was once based solely on the percentage of balls that the player wiped out. Michael The paper [43] ended with clearly contrary results. Players also mentioned that the eye tracker used to be exceptionally fun to use. These contradicting research consequences suggest that exercising and the approach to enhancing fair recreation are key factors in achieving a continued satisfactory outcome [44], [45].

## 2.2. Designing a Proposed Game

The comparison of peripheral interplay requires at least two tasks: A foremost task, which must be the focal point of the participant's attention, and a secondary task, which needs to be carried out in the periphery. This secondary project is normally a given: The assignment supported using the peripheral gadget being evaluated.

### 2.2.1. Designing the primary task

The tasks are to tell the player to play with keyboard first, then focused on playing with keyboard and mouse if possible, then calculating the results and timing from the players. How many balls have been crashed and how much point has been collected with timing for each techniques. Later on, it has been concentrated on eye tracking for each ball movement and how can control the speed of the ball to hit and crash as much balls as possible. Most of the players have been collected full points but with more time is needed it.

## 3. METHODOLOGY

The methodology of this study is to observe the players interaction with the games before and after using eye tracking as an input methods for the game. The players all have experience in gaming which they have training for using this game and how can used eye tracker device. The eye tracking techniques help the players to be more interaction with the game. The observation has been conducted and extracted the data from the player before and after using the eye tracker and illustrates the difference between the results using several statistical measurements.

### 3.1. Game Scenario

The game is designed and implemented to destroy difference color balloons to collect points. The balloons have been destroyed by three means of inputs, mouse, keyboard, and eye. The main objective of the game is finding the difference efficiency of several inputs such as mouse, keyboard, and eye focused.

#### 3.1.1. Hardware requirements

The game has developed on PC with these requirements, CPU Intel i7-2600, 3.6 GHZ, Ram 4GB, Hard desk 512 GB, and graphic card NVID QUARD 600. Tobii Eye Tracker has been used in this game. The only devices are capable of tracking both head and eye movements for game interaction, exports training, and streaming.

The Tobii 4C eye tracker is the hardware device which will track eye movement in the game. It has a driver define it and

then define the eye of the player and later will detect the eye movement in the game and program it in game source code.

Fig. 1 shows the Tobii 4C eye tracker.

#### 3.1.2. Game design

The figures below have been explained the game interface and game rules how player can use the game and what is the interactive with players. Final figure explain how the interaction between eye tracker with ball movement to score point for the player.

The game has been developed using Unity version 18.3, C# ultimate 2012 and using Microsoft Windows 10 64 bit. Fig. 1 shows the game interface and how can user hit the balloons and collects points. Fig. 2 explains users using mouse and Fig. 3 shows how user can use eye movement to hit the balloons and score point.



Fig. 1. Tobii 4C eye tracker device.

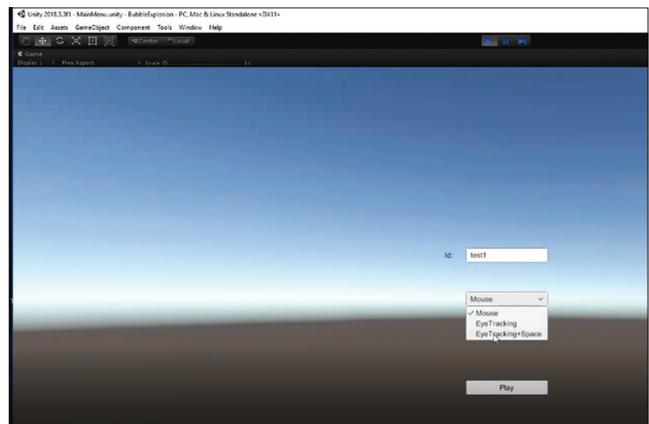


Fig. 2. Users select input option for playing the game.

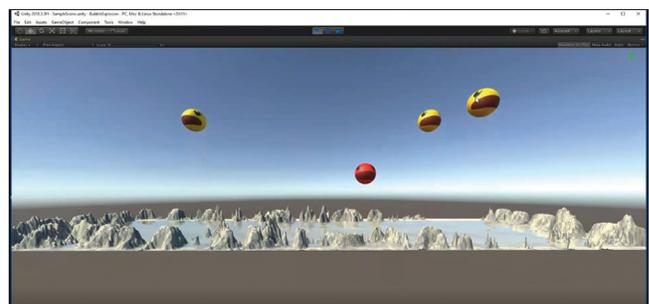


Fig. 3. Mouse input for users.

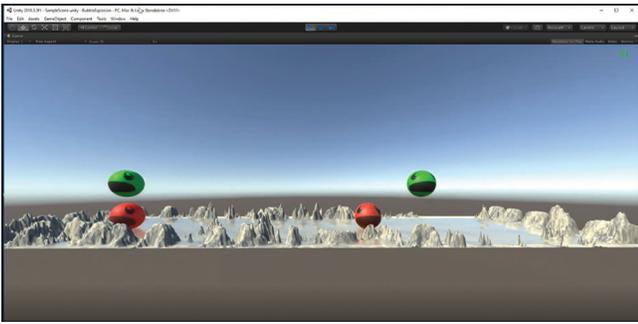


Fig. 4. Eye input for users.

## 4. DATA COLLECTION

Collecting data about the player have been conducted selecting 48 users. The player was undergraduate students from computer science department and all have been trained to use the game. Each user has been played with mouse, eye, and eye with space for collecting the points. Table 1 shows the time collected using mouse, eye, or combination of the two.

The results have been showed that 45% eye input performance is better than mouse input and the performance of eye input is 66% which is better performance than combination input. This indicates that the eye input has acceptable values as input for the players.

The linear Pearson's correlation has been used for this study. We have been used Pearson correlation coefficient (PCC) to measure a liner correlation between eye control dataset and mouse and other two correlations between eye and eye input control. The measure calculates the covariance of two variables and the product of standard deviations. The results are between  $-1$  and  $1$ . The covariance only can reflect the relationships or correlations.

Pearson correlation coefficient =  $\rho(x,y) = \frac{\sum[(x_i - \bar{x}) * (y_i - \bar{y})]}{(\sigma_x * \sigma_y)}$  [46]

Table 2 has shown that the PCC [46] between mouse and eye input is 0.44 which indicates that the timing for eye input is related to mouse and has acceptable values as input.

Table 3 has shown that the PCC [46] between eye and eye space is 0.54 which indicates that the timing for eye input is related to mouse and has acceptable values as input.

Table 4 shows the regression statistics of difference between eye and mouse tracker and has been generated using SPSS statistical tool. All the results indicate significant results for

user timing compare to mouse input. These statistical results indicate that eye input has slightly better performance than mouse. This means that game industry can use eye interaction techniques beside mouse input. P values show significant values of eye movement regarding effect of the eye input to the user interaction in the game with mouse input also.

Table 5 shows the regression statistics of difference between eye tracker input and keyboard input; these results have been extracted from SPSS statistical tool. All the results indicate that eyes tracker input slightly has less performance for user timing compare to mouse input. These statistical results indicate that eye tracker input has slightly slower performance than keyboard. This means that game industry can use eye interaction techniques beside mouse input.

Descriptive statistics for the three games input for mean, standards error, median, standard deviation, sample variance, and confidence level are explained in Table 6. Fig. 4 has been explain the using of eye tracking as it shows the ball speed has been changes according of eye focus. The results explain better results for eye tracker in some of statically factors. These results indicate that users can use eye tracking and eye tracking with keyboard combination and make it the game more interactive and better performance.

Figs. 5-7 have shown the histogram for speed performance of three different method of game input eye, mouse, and eye keyboard.

## 5. RESULTS

An evaluation of Pearson correlation [46] and regression records used to be carried out on the overall performance measures for every sport to realize any big variations between the two entry modalities. Users carried out visually well. However, no sizable overall performance variations had been found for each mouse and keyboard. For pointing tasks, for example, the consumer will frequently appear at the goal and then go the cursor solely when he picks a target. However, with the eye pointer, the cursor strikes every time the consumer strikes their eyes. These effects in a widespread expand in the quantity of remarks the person receives from the game, even if the person does now not consciously raise out an express action. Users additionally confirmed a robust choice for the eyepiece tracker throughout playback. We suppose this is because of the decreased quantity of effort it takes to go through the persona when the use of the eyes. To entire the task, customers had to make over one cursor

**TABLE 1: Player time difference for different inputs**

No. of players	Mouse	Eye	Combination of two
1	46.29168	50.68896	72.26347
2	49.36595	45.9901	47.98271
3	47.02565	54.16142	74.47321
4	35.69894	96.90728	64.29069
5	36.75071	45.54176	39.36242
6	40.79372	68.80875	63.11514
7	47.87828	43.61938	55.02164
8	62.88597	52.35537	52.68043
9	65.5258	70.47275	56.20034
10	42.11875	44.93463	43.45302
11	63.0501	77.57199	90.01323
12	42.8105	24.0855	41.06178
13	39.97028	72.89788	71.18179
14	64.43954	70.54054	52.99361
15	80.71351	91.87479	83.32175
16	36.42005	23.09589	46.32096
17	47.7062	64.47396	60.83725
18	66.36465	61.36431	44.36486
19	69.42387	72.35069	81.43118
20	49.9991	70.50659	78.45703
21	44.26379	51.86754	60.57484
22	57.42333	24.09982	67.70646
23	48.06614	38.37986	46.19806
24	76.02664	64.09002	102.3053
25	40.44497	40.8985	38.73352
26	81.27607	79.20071	38.13029
27	32.56762	24.599	27.99892
28	60.89792	43.21954	81.91699
29	66.81228	53.31702	69.39323
30	68.82234	31.56778	62.89731
31	80.09913	62.05175	74.31324
32	48.12384	81.68127	84.82584
33	30.01091	58.38366	60.69171
34	56.67857	54.97182	62.73943
35	63.83644	77.20864	98.52775
36	71.37659	63.88522	73.57787
37	32.53166	34.77013	40.04244
38	70.75024	47.13963	51.47002
39	84.64526	61.72007	73.09223
40	47.7101	70.00181	76.68742
41	31.31399	39.43198	34.08674
42	35.38079	36.04421	48.4115
43	47.42	53.64031	40.08095
44	38.87392	46.62032	55.43325
45	53.62331	53.33913	58.65588
46	133.2718	85.60275	62.73277
47	48.19358	67.05249	62.56892
48	64.12367	58.64465	68.15075

**TABLE 2: Pearson correlation between mouse and eye input**

	Mouse input	Eye input
Mouse input	1	0.44
Eye input	0.44	1

**TABLE 3: Pearson correlation between eye and eye space input**

	Eye	Eye space
Eye	1	0.54
Eye space	0.54	1

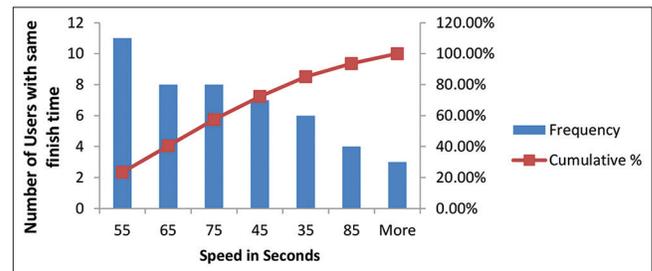


Fig. 5. Players eye game input performance.

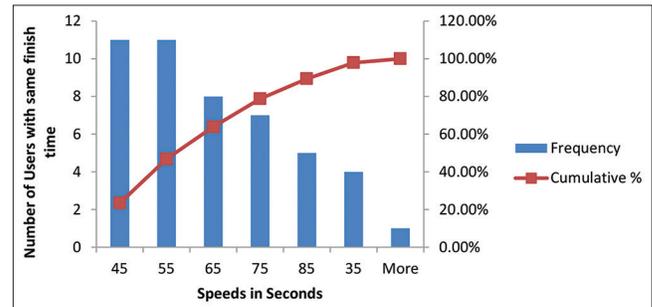


Fig. 6. Mouse game inputs performance.

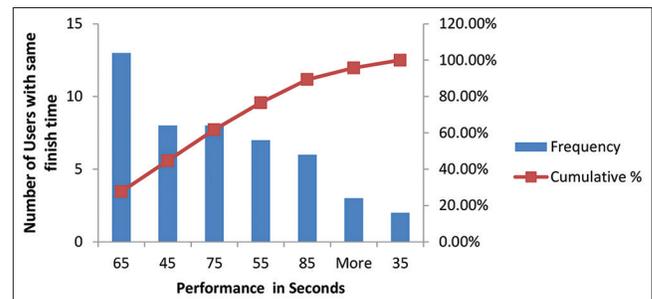


Fig. 7. Eye and keyboard input performance.

moves throughout the whole screen. When the use of the mouse, the consumer appears at the favored goal and then explicitly acts with the mouse to pass the cursor. However, with the eye pointed, truly searching at the favored spot shifted the cursor, casting off the want for any hand motion. A participant commented that, “I ought to discover with the view freely and only clicked on the mouse in case of need.” People naturally use eye actions to factor when speaking with

**TABLE 4: Regression statistics for eye and mouse inputs**

Regression statistics								
Multiple R	0.442484013							
R square	0.195792102							
Adjusted R square	0.178309321							
Standard error	17.0641992							
Observations	48							
ANOVA								
	df	SS	MS	F	Significance F			
Regression	1	3261.042739	3261.043	11.19914	0.001638			
Residual	46	13394.59714	291.1869					
Total	47	16655.63987						
	Coefficients	Standard error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	29.07932151	8.185906615	3.552364	0.000895	12.60195	45.5567	12.60195	45.55669665
Eye input	0.463467353	0.138492678	3.346512	0.001638	0.184696	0.742239	0.184696	0.742238651

**TABLE 5: Regression statistics for keyboard and eye tracker input**

Regression statistics								
Multiple R	0.549515							
R square	0.301967							
Adjusted R square	0.286792							
Standard Error	15.17813							
Observations	48							
ANOVA								
	df	SS	MS	F	Significance F			
Regression	1	4584.343	4584.343	19.89942	5.23E-05			
Residual	46	10597.28	230.3757					
Total	47	15181.62						
	Coefficients	Standard error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	20.99721	8.226233	2.55247	0.014081	4.438661	37.55576	4.438661	37.55576
Eye space	0.577334	0.129422	4.460877	5.23E-05	0.316822	0.837846	0.316822	0.837846

**TABLE 6: Descriptive statistics for the three game input mouse, keyboard, and eye tracker**

Mouse		Keyboard		Eye tracking	
Mean	55.20413	Mean	56.36817	Mean	61.26604458
Standard error	2.717134	Standard error	2.594117	Standard error	2.469118725
Median	48.77977	Median	54.56662	Median	61.703085
Standard deviation	18.82486	Standard deviation	17.97257	Standard deviation	17.10655632
Sample variance	354.3753	Sample variance	323.0133	Sample variance	292.6342692
Kurtosis	4.833343	Kurtosis	-0.42544	Kurtosis	-0.35056645
Skewness	1.58376	Skewness	0.050186	Skewness	0.27816714
Range	103.2609	Range	73.81139	Range	74.30638
Minimum	30.01091	Minimum	23.09589	Minimum	27.99892
Maximum	133.2718	Maximum	96.90728	Maximum	102.3053
Sum	2649.798	Sum	2705.672	Sum	2940.77014
Count	48	Count	48	Count	48
Largest (1)	133.2718	Largest (1)	96.90728	Largest (1)	102.3053
Smallest (1)	30.01091	Smallest (1)	23.09589	Smallest (1)	27.99892
Confidence level (95.0%)	5.466169	Confidence level (95.0%)	5.21869	Confidence level (95.0%)	4.967226088

different people and eye monitoring permits the identical visible cues to be prolonged in the digital world. We consider that the distinction in overall performance between the eye tracer and the mouse throughout the sport is because of the latency that took place when taking pictures on a target. Remember, it took about a 2d for a shot to attain the place it was fired. Users regarded to have a hard time getting “led” the missiles through searching out into empty area in the front of the cellular target.

## 6. CONCLUSION

This paper has focused on introducing new input for video games. Eye movement is one of the important inputs in video games it increases the interactive between the players and makes it more interesting and challenging. The case study has been conducted on 48 players (undergraduate BSc students) to test the game with different input mouse, keyboard, mouse keyboard, and eye movement. The outputs have been shown the significant effect on the playing the game regarding scoring the point using eye input techniques and this adds privilege to using more input and makes the game more interactive. However, the game will slow down but this depends on game scenario. Finally, the results show significant correlation between all inputs eye, mouse, and keyboard.

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