Eye Gaze Based Model for Anxiety detection of engineering students

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Abstract. Education is a vital component for country development, particularly in the engineering or technology field. The engineering students must maintain their focus and attention due to the complexity of their study. In this research, we took student anxiety as our research concentration. Students with anxiety disorders show moderate interest in learning, have a weak performance on exams and assignments. Stress can be detected from the eye gaze. It has a pattern that represents the anxiety condition of engineering students. This study aims to deal with the anxiety experienced by engineering students using eye gaze by identifying eye movement patterns from students. The eye gaze pattern is divided into 16 areas (A1, A2, A3, A4, B1, B2, B3, B4, C1, C2, C3, C4, D1, D2, D3, and D4). The research results show 85.5% accuracy. These results provide a novel, how teachers can comprehend the anxiety condition of students rapidly and perform a particular action to help student gain their optimum learning result.

Keywords: Student Modeling, Engineering Students, Eye Gaze, Anxiety Detection System

1 Introduction

The development of education is a critical issue for every country. It is also found in Indonesia, thereby triggering a lot of research on developing an e-learning or education system to support students in getting their excellent education with an intelligent tutoring system one of them is research conducted by [1] which uses metacognitive approach.

The anxiety/ Mood disorders factor is one essential element that engineering students mostly faced during their study [2]. Mood disorders in older people are an increasingly serious health and social problem, and their prevalence increases with age [3], so the problem of anxiety becomes something that needs attention in higher education. Thus

giving rise to research conducted by Destarianto et al. focused on modeling the student's motivational system by encouraging their study to obtain success and evade failure[4, 5].

A mood disorder can be an obstacle during the learning process, and it also can strive for severe health and social life[6]. The e-learning reflects the study through an online platform, so it has altered the education system platform. Online learning uses the internet as its backbone communication to deliver educational content[7, 8]. This technology is beneficial to abandon the limitless of humans in terms of time, place, and suppleness.

This study aims to deal with the anxiety experienced by engineering students using eye gaze by identifying eye movement patterns from students. The eye gaze pattern is divided into 16 areas (A-1, A-2, A-3, A-4, B-1, B-2, B-3, B-4, C-1, C-2, C-3, C-4, D-1, D-2, D-3, and D-4). For every determined area, coordinates of the points are chosen then grouped into two central regions known as inside and outside. The inner part is A-1, B-1, C-1, and D-1, while the outside area is A-2, A-3, A-4, B-2, B-3, B-4, C-2, C-3, C-4, D-2, D-3, and D-4.

2 Related Works

Jirotka, M and Stahl, B.C. discuss that responsible technology practically is a technology designed to help humanity achieve happiness. The need for reliable technology such as Artificial Intelligence (AI) and big data against the COVID19 has shown the closed interaction between humans and technology[9]. Furthermore, online learning can also monitor students' dropout rates early by proactively tracking students who have a high risk of leaving the course. It also can help to recognize the issue that student-facing during the learning process[10]. They used Logit Leaf Model (LLM) to measure achievement and clarity. The enthusiasm of study at engineering faculty is a critical factor for every student because of the nature of courses in an engineering field that is quite hard. Student motivation monitoring is essential to maintain their performance. They use a coaching role model and a plan-based approach[11].

Maintaining student motivation for engineering faculty is a challenging task where the workload is quite heavy, such as an initial planetary mission plan [11]. The other study focuses on investigating the classroom layout that may affect student learning experience, refer to Fig. 1. Researchers study the correlation between student learning environment and their engagement toward academic performance[12]. The other researcher focused on improving the learning behavior by an improved e-book system affiliated with social media such as Facebook to boost students' motivation. They analyze the student's behavioral pattern, comments in the e-book system[13]. Their result concluded that their finding encourages low participation students. The assimilation of social media and learning platforms has shown an increment of alleged interactivity of students. They express their likeness by sharing, liking, or posting their

opinion in the system[13]. The researcher agrees that digital information technology is responsible for helping students with their learning process to obtain more efficient results. Their finding argued that common skills have tremendous positive encouragement[14]. Based on the critical analysis of the previous work on the e-learning field and its correlation with human achievements. We can conclude that there is a strong correlation between the e-learning system, student behavior analysis as responsible technology to help students in particular, or humanity in general, refer to Table 1 for summarisation.

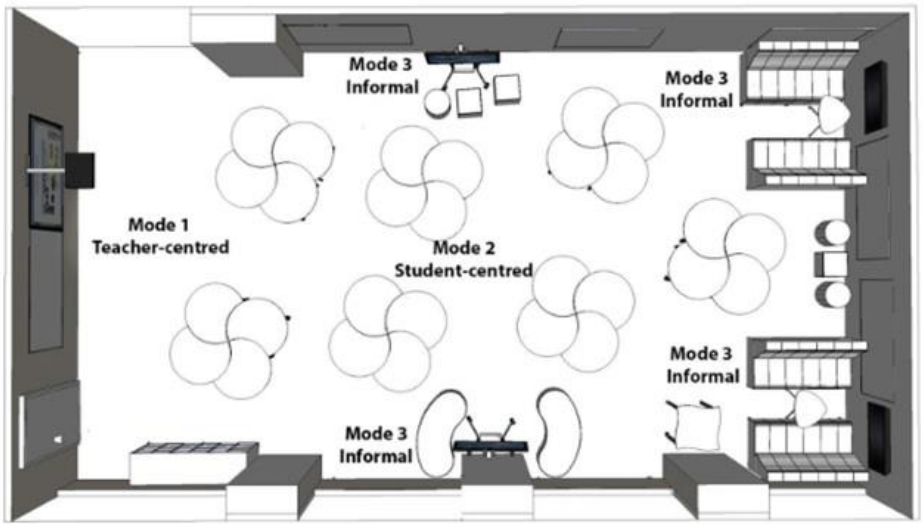


Fig. 1 Various typical Classroom Layout

Table 1. E-learning analysis as responsible technology

Authors	Finding	Correlation with responsible technology
[7, 8]	E-learning is a technology to overcome the limitlessness of humans in terms of time, place, and suppleness.	E-learning has a significant factor in boosting student performance.
[11]	Improve motivation of engineering student	E-learning analysis may help in detecting students that already bored and less focused.
[13]	Utilize social media to attract student active engagement	Assimilation between social media and e-learning increase student participation.
Proposed approach	Early anxiety detection through eye gaze model	Eye gaze technology and e-learning have a strong correlation as responsible

anxiety. We are passionate about making extreme classes, and this is with the aim of the system to quickly identify engineering students who experience anxiety.

3 Research Method

Since the literature review has been completed, the next phase is collecting data. The dataset in this study was obtained by identifying the patterns of eye movement from students. Then the eye gaze pattern was divided into 16 areas of the monitor screen (A-1, A-2, A-3, A-4, B-1, B-2, B-3, B-4, C-1, C-2, C-3, C-4, D-1, D-2, D-3, and D-4), in the form of X and Y values. The Resolution of the monitor was 1365x767. The boundary of the areas depicted is shown in Fig. 2 below.

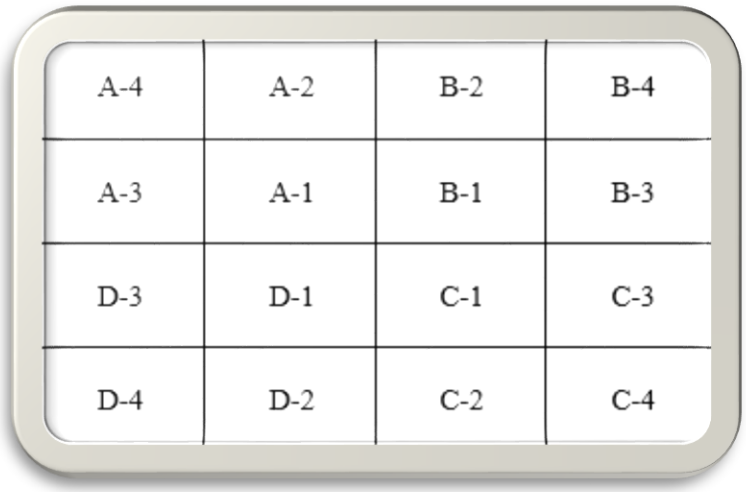


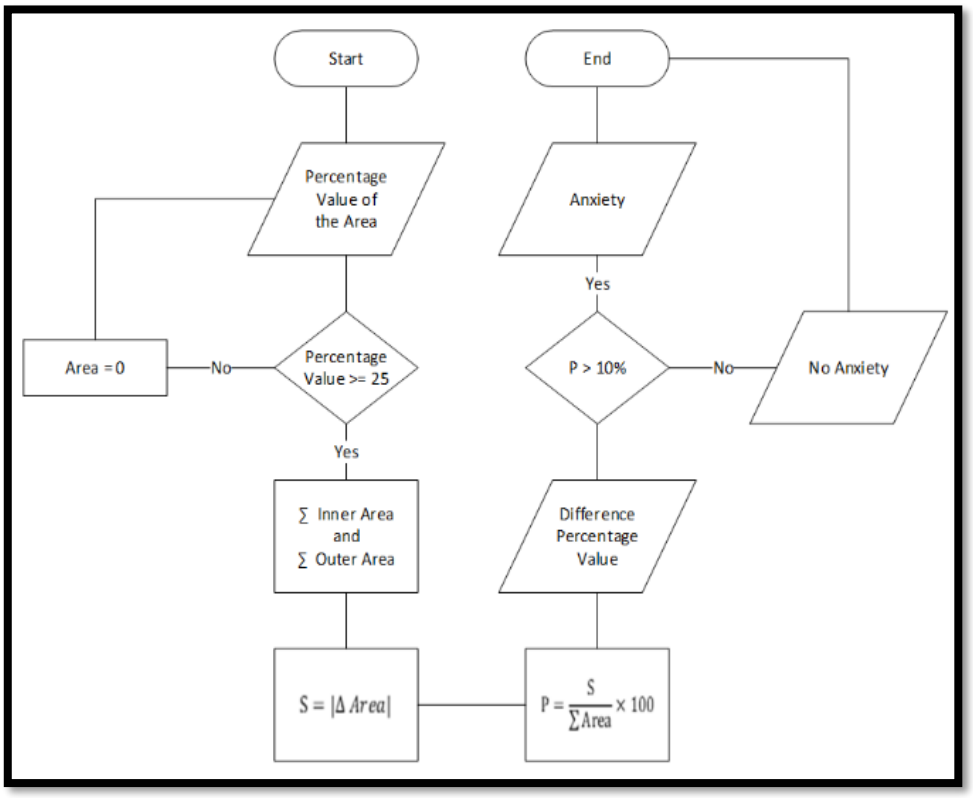
Fig. 2. Areas boundaries of the monitor screen

The designated area is classified into two main groups: inner and outer. The internal space is A-1, B-1, C-1, and D-1, while the outer region is A-2, A-3, A-4, B-2, B-3, B-4, C-2, C-3, C-4, D-2, D-3, and D-4. Table 2 represents the X and Y values of each area. For example, area A1 where X value is between 351 and 687 while Y value is between 192 and 393.

Table 2. X and Y values of each area.

Area name	X values	Y Values	Area
A-1	351 – 687	192 – 395	Inner area
A-2	351 – 687	1 – 191	Outer area

Area name	X values	Y Values	Area
A-3	1 – 350	192 – 395	Outer area
A-4	1 – 350	1 – 191	Outer area
B-1	688 – 1030	192 – 395	Inner area
B-2	688 – 1030	1 – 191	Outer area
B-3	1031 – 1365	192 – 395	Outer area
B-4	1031 – 1365	1 – 191	Outer area
C-1	688 - 1030	396 – 583	Inner area
C-2	688 - 1030	584 – 767	Outer area
C-3	1031 - 1365	396 – 583	Outer area
C-4	1031 - 1365	584 – 767	Outer area
D-1	351 - 687	396 – 583	Inner area
D-2	351 - 687	584 – 767	Outer area
D-3	1 - 350	396 – 583	Outer area
D-4	1 - 350	584 – 767	Outer area



5	100cm	30 minutes	284
6	100cm	30 minutes	284
7	100cm	30 minutes	295
8	100cm	30 minutes	285
9	100cm	30 minutes	298
10	100cm	30 minutes	300
.			.
.			.
.			.
81	100cm	30 minutes	292
82	100cm	30 minutes	290
83	100cm	30 minutes	283
		Total	23.560

The duration of data taken was 30 minutes, and approximately the distance between the monitor screen to the respondent's eye is 100 centimeters. Fig.6 below shows the variance of data in this study. The x-axis of the graph is the respondent to this study, while the y-axis represents the amount of data obtained.

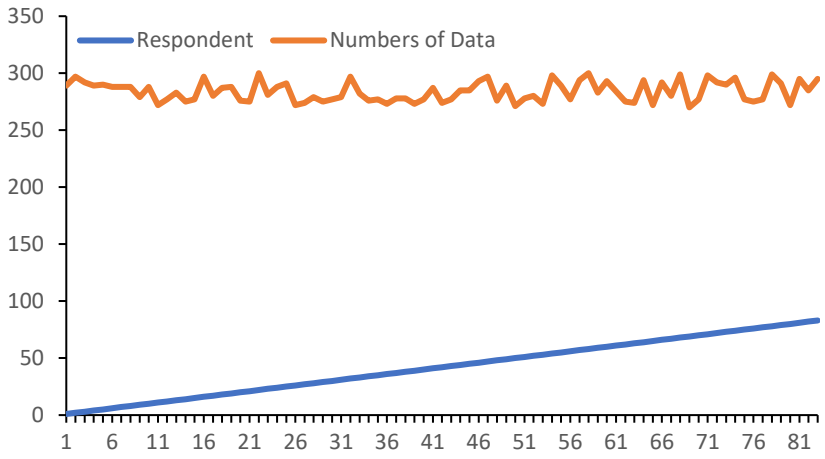


Fig. 6. The variance of data in anxiety detection

Table 4. The system evaluation by the psycologist

Resp.	System Res	Psycologist Res	Evaluation Res
1	Anxiety	Anxiety	Succeed
2	Anxiety	Anxiety	Succeed

3	Anxiety	Anxiety	Succeed
4	Anxiety	Anxiety	Succeed
5	No Anxiety	No Anxiety	Succeed
6	Anxiety	Anxiety	Succeed
7	Anxiety	Anxiety	Succeed
8	Anxiety	No Anxiety	Failed
9	No Anxiety	Anxiety	Failed
10	Anxiety	Anxiety	Succeed
.			.
.			.
.			.
81	No Anxiety	No Anxiety	Succeed
82	No Anxiety	No Anxiety	Succeed
83	Anxiety	No Anxiety	Failed

The evaluation of the anxiety detection system involved a psychologist. The discovery of anxiety by the psychologist was carried out on eighty-three students. From the system evaluation, around seventy-one of the eighty-three respondents had similar results to the psychologist's analysis result—the score around 85.5% accuracy. Table 4 shows the result of the system evaluation by the psychologist. The difference between the detection results by the system and the psychologist could be due to the difference between the factors used. The psychologist might not only use eye gaze as a consideration in determining the outcome of detecting anxiety but also several other factors that he knows can influence anxiety.

4 Conclusion

The study was initiated to detect the anxiety of engineering students during their research. Sensing student anxiety in the early phase of study might give the teacher time to help students. The instrument used in the detection process was an eye-tracking device and WebGazer application. This study's primary purpose is to help students aware of their anxiety and give them a suggestion to overcome their fear to achieve optimum performance. The detection process is conducted by looking at the results of the dominance of eye movements. When the respondent's eyes are more often facing the outside area, the person can be anxious, and if it is more often looked into the inner room, that person can be said to be focused or not worried. The result had been evaluated by comparing its products with the analysis from a psychologist expert. The results of this comparison obtained an accuracy value of 85.5%. Therefore, results provide a novel finding of how teachers can understand students' anxiety conditions early. Then offer a policy to help student gain their best performance. Future works might have physiological sensors such as sweat or heartbeat sensors to capture student physiological signals during their study.

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