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Usability Evaluation of Facial Emotion Recognition System

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Abstract: Face detection can identify and verify faces from images, videos, and other forms of face graphics. It tracks facial features, contours, and textures to analyze individuals' unique biometrics and demographic details. Humans can express thousands of facial expressions, all of which vary in intensity, complexity, and meaning. Facial emotion recognition is a type of facial recognition system, and it is a technology that can detect human emotions through facial expressions. In the past few decades, real-time facial emotion recognition systems have been an active area of research. Due to the Covid-19 pandemic, most learning methods have changed from physical learning to online learning. Therefore, it is difficult for teachers to understand students' emotions in the teaching process, and some emotions constitute obstacles to students' classroom participation and test scores. Nowadays, as students, we also know that it is difficult for lecturers to capture the emotions of students through the online learning mode and change the learning mode according to the emotions of the students. As a result, most of the time students feel bored and cannot concentrate in class because they are not interested in the lecturer's learning mode. Therefore, the learning materials prepared by the lecturer will become invalid due to the inattention of students in class. In this project, we will use a facial landmark to detect real-time facial expressions via a webcam. The purpose of the project is to establish a facial emotion recognition system to recognize the emotions of students in class and view the report of the emotions of the students. The result of this project is to allow lecturers and students to better understand their emotions during class. By doing so, we can recognize emotions and classify learners' participation and interest in topics that are mapped as feedback to the lecturer to improve the learner's experience. In addition, after students use the system, there will be emotional results. For example, students can learn about their emotional changes during class hours.

Keywords: biometric, emotion recognition, identification

1. Introduction

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As we all know, students' emotional experience affects their learning ability, participation in school, and career choices. Due to the Covid-19 pandemic, most physics learning has been changed to an online learning mode. Therefore, it is difficult for teachers to understand students' emotions in the teaching process, and some emotions constitute obstacles to students' classroom participation and test scores [1].

Nowadays, as students, we also know that it is difficult for lecturers to capture the emotions of students through the online learning mode and change the learning mode according to the emotions of the students. As a result, most of the time students feel bored and cannot concentrate in class because they are not interested in the lecturer's learning mode. Therefore, the learning materials prepared by the lecturer will become invalid due to the inattention of students in class.

In recent decades, more interactive learning methods have been created to solve these problems, but a better mechanism for analyzing emotions in real time in an e-learning environment has not yet been discovered [2]. Therefore, there is a need for a system for evaluating student emotions in online learning mode [3, 4]. If there is no facial expression recognition system, most lecturers will face the problem of poor online classroom effects because they do not understand the emotions of the students and choose suitable learning materials for the students. Therefore, this project is very important for lecturers and students.

For lecturers, they can understand the emotions of students through this system, and they can have interactive learning methods that are more suitable for their students. For example, through the detection of facial expressions, the lecturer can know whether the student is lost or does not understand the subject, and then the lecturer can repeat it so that everyone can understand in the next class. Students can better understand their emotions in class. Face detection can identify and verify faces from images, videos, and other forms of face graphics. It tracks facial features, contours, and textures to analyze individuals' unique biometrics and demographic details. Humans can express thousands of facial expressions, all of which vary in intensity, complexity, and meaning [5, 6].

Pranav et al. (2020) proposed algorithms that perform facial expression detection, extraction, and evaluation, and will allow real-time emotion recognition [7]. Its purpose is to recognize faces. The expressions are stored in the database, and then human emotions such as happiness, sadness, surprise, neutrality, and disgust are identified. The method proposed by the author utilizes three deep learning methods based on convolutional neural networks (CNN), which are (AlexNet CNN), commercial Affdex CNN solution, and customized FER-CNN), and two traditional directional gradient histograms (HOG) feature classification methods, that is, the support vector machine (SVM) of the HOG feature and the artificial multilayer perceptron (MLP) the neural network of the HOG feature.

When both students and lecturers understand their emotions, they can know which learning style is most suitable for them, thereby improving their learning habits. For example, when a student knows that he is bored with the topic taught by the lecturer, he can try to take a break or wash his face to refresh his mind. As a result, in this project Facial Emotion Recognition System (FERS), a web-based system is designed, developed, and evaluated. The study helps to clarify the system requirements for such a system and may serve as a benchmark for academics and developers looking to further emotion recognition technology.

2. Methodology

The methodology that will be used in this project is Iterative Development. The reason for using this method is that the requirements are not well-defined, but it is easy to understand. Besides, there may need to change or add to the requirements in the future.

The first stage is planning. In this step, the requirements in the system are listed where there are two main requirements, to enable facial emotion detection in order to detect the emotion of students in

real-time and to generate a report that will be submitted and viewed by the individuals. The second stage is analysis and design. For the analysis part, the database model of the system was identified and analyzed. The database model that is used is The Extended Cohn-Kanade Dataset (CK+) as it is the most used laboratory-controlled facial expression classification database available and is used in the majority of facial expression classification methods. In the design part, JavaScript is used as it implements several CNNs (Convolutional Neural Networks) to solve face detection and face recognition.

The next stage is implementation and coding. The system is coded according to the plan of the previous stage. The system is hosted on an online server in order to make it accessible online. A prototype of a system for facial emotion detection and view report named Facial Emotion Recognition System was developed. It stands for the specifications given in the preceding subsection. Software prototyping is a common practice for displaying software requirements so that users may provide further feedback and recommendations based on their interactions with the prototype. Visual Studio Code was used as the main integrated development environment (IDE) tool. Additionally, MySQL was utilized as the development platform to simplify critical operations like user authentication and database for data storage. The Facial Emotion Recognition System's interface is seen in **Figure 1**.

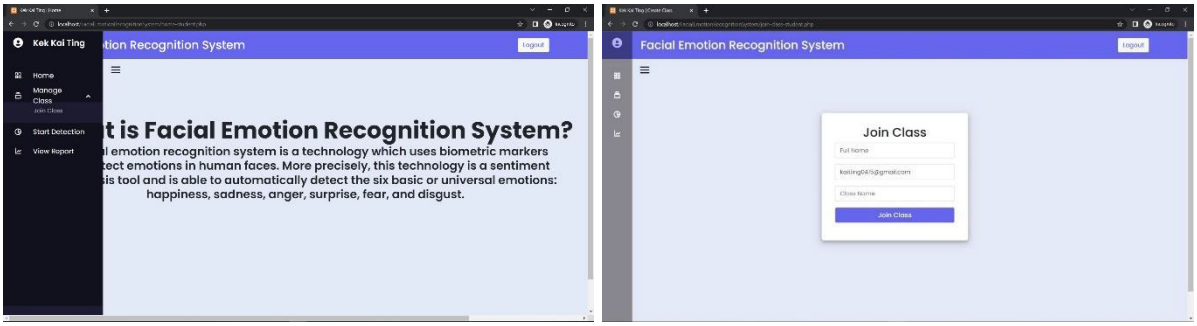

Figure 1: Facial Emotion Recognition System interface

The fourth stage is testing. In this phase, potential errors or problems that may have been overlooked during the implementation and coding stage were identified. The system was tested by various people from different backgrounds to see the accuracy of detection and display of emotions as shown in **Figure 2** where it detected the face and current emotion.

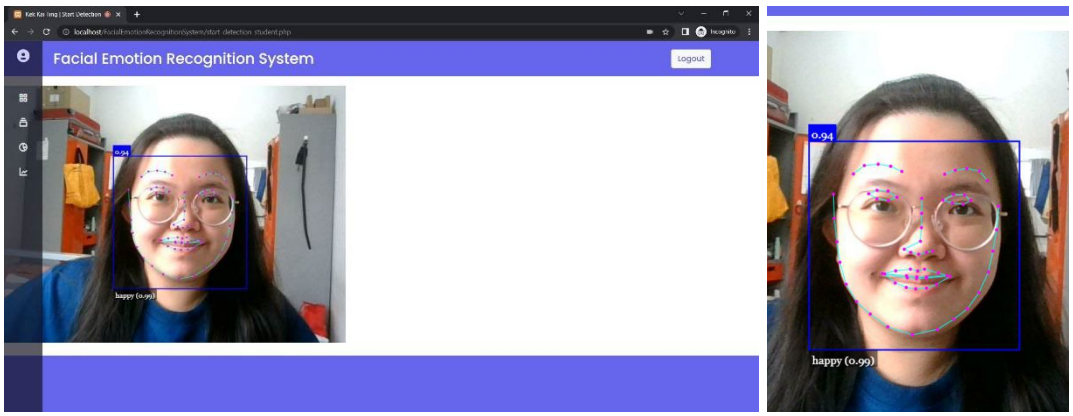

Figure 2: FERS emotion detection

The last stage is evaluation. Feedback from users such as lecturers and students was acquired. When they are using this system, they may have some problems with the functions of this system. Therefore, after collecting feedback, the system will be modified accordingly.

3. Results and Discussion

3.1 The Evaluation Setting

In this evaluation, we used to test the system's usability assessment. to achieve the evaluation's objectives, which include gauging the system's impact and usability as well as increasing its effectiveness. For this evaluation, we were able to effectively find 30 participants from various backgrounds. We provided participants with a Google Form to fill out in order to evaluate an application, along with instructions on how to do so. The type of evaluation we used was a general evaluation with the goals of assessing the system's usability, impact, and effectiveness using a 5-Likert scale ranging from strongly agree, agree, neutral, strongly disagree, and disagree. The questionnaire is divided into five sections, user demographic, user satisfaction, ease of use, user usability, and user feedback.

3.2 The Respondents' Demographic Information

Analysis of the respondents' demographic information revealed that 18 (60.0%) of them are aged between 19-24, 10 (33.3%) of them are aged 40 and above, and only 2 (6.7%) of them are aged between 25-29. Of these 30 respondents, 18 (60.0%) of them are female while 12 (40.0%) of them are male. Besides, 14 (46.7%) of the respondents are Malay, 12 (40.0%) are Chinese and 4 (13.3%) are Indian. (20) 66.7% of respondents are students and 10 (33.3%) of them are lecturers.

3.3 Application Evaluation

22 (73.33%) respondents strongly agree that the system was very easy to use and 15 (50%) strongly agree that the system was easy to learn to use. Besides, there are 16 (53.33%) respondents who strongly agree that the system was easy to do what they want to do, and the system had very clear prompts for input. Overall, in terms of ease of use, the majority of the respondents found it easy to navigate and use the system as intended. 19 (63.33%) found the system's interface attractive whereas further investigation found that 16 (53.33%) were satisfied with the system's layout and strongly agreed that they were able to navigate the pages without confusion.

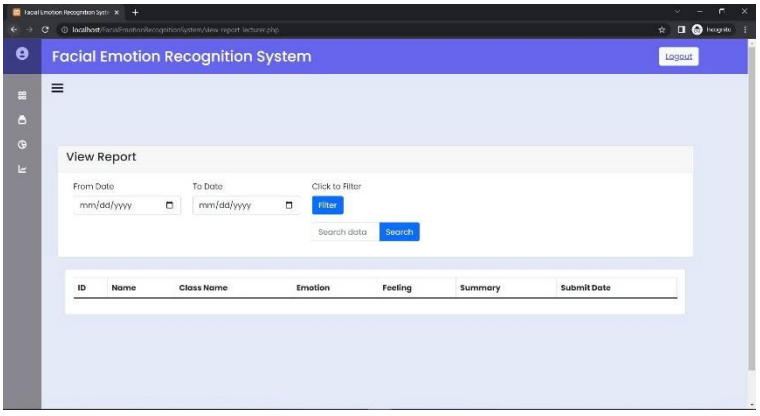

Figure 3: FERS emotion report

In terms of usefulness, 15 out of 20 (75%) who were students strongly agree that the system helps them to know their emotions better, while 5 out of 10 (50%) of the lecturers who were part of the respondents strongly agree that FERS enables them to know their students' emotions better as the system produces a report based on the students' emotions captured as shown in **Figure 3**. Thus, this can be concluded that facial expressions detection can be used as an indicator to understand the individuals' current emotions. This can be used as a rough estimation that reflects the student's ability to focus and understand the level of learning. Facial emotion recognition is an important emotion detection that can be used during online classes to replace face-to-face human contact during traditional classes.

4. Conclusion

All requirements have been satisfactorily met by the system's design. This system is designed for the students to know their emotions better and for lecturers to understand the emotions of their students in order to enhance the quality of education while having an online class. In the future, we plan to add more functions that extend the facial emotion recognition system by providing various functions in it. In the emotion detection section, we plan to add the name and location displayed when detecting. Additionally, we plan to automatically update the report after students complete the detection. By having this feature, students do not need to manually enter reports. Not only that, but we also plan to add a feature that scans students' attendance through face detection in this system. With this feature, lecturers can more easily know directly who is absent, saving lecturers time to check them one by one.

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