JITK (JURNAL ILMU PENGETAHUAN DAN TEKNOLOGI KOMPUTER)

VOL. 9. NO. 2 FEBRUARY 2024
P-ISSN: 2685-8223 | E-ISSN: 2527-4864
DOI: 10.33480/jitk.v9i2.5037

AN INNOVATIVE LEARNING ENVIRONMENT: G-MOOC 4D TO ENHANCE VISUAL IMPAIRMENTS LEARNING MOTIVATION

Rujianto Eko Saputro[1]; Berlilana[2]; Wiga Maulana Baihaqi[3]; Sarmini[4]; Yuli Purwati[5]; Fandy Setyo Utomo[6*]

Department of Information Technology[1,3], Department of Information System[2,4], Department of Informatics[5,6]
Universitas AMIKOM Purwokerto[1,2,3,4,5,6]
https://amikompurwokerto.ac.id[1,2,3,4,5,6]
rujianto@amikompurwokerto.ac.id[1], berli@amikompurwokerto.ac.id[2], wiga@amikompurwokerto.ac.id[3], sarmini@amikompurwokerto.ac.id[4], yulipurwati@amikompurwokerto.ac.id[5], fandy_setyo_utomo@amikompurwokerto.ac.id[6*]

(*) Corresponding Author

Abstract—*The proliferation of visual impairment among school-age children in Indonesia has prompted the need for specialized online learning solutions. The G-MOOC 4D platform, a novel Learning Management System (LMS), is designed to address this need by leveraging gamification and artificial intelligence to enhance accessibility for visually impaired users. This study reports on the development and testing of two AI models within the G-MOOC 4D framework: a facial recognition model for secure user authentication and a voice command model for interactive learning. User Acceptance Testing (UAT), conducted with expert users, namely teachers at a special needs school, showed high approval rates for the platform's features. The results show that all metrics, accuracy, precision, and recall reach their optimal values at a distance of 40 cm for face detection. The respective metric scores at that distance, precision: 100%, accuracy: 98%, and recall: 97%. Additionally, the voice command functionality tested achieved a 100% recognition rate, reflecting the platform's potential to significantly ease the learning process for visually impaired students. The findings underscore the importance of integrating assistive technologies into educational platforms to ensure all students have equal access to learning opportunities.*

Keywords: *artificial intelligence, e-learning, G-MOOC, speech recognition, visual impairment.*

Intisari—Peningkatan kasus gangguan penglihatan di kalangan anak sekolah di Indonesia telah mendorong kebutuhan akan solusi pembelajaran online yang khusus. Platform G-MOOC 4D, sebuah Sistem Manajemen Pembelajaran (LMS) yang baru, dirancang untuk memenuhi kebutuhan tersebut dengan memanfaatkan gamifikasi dan kecerdasan buatan untuk meningkatkan aksesibilitas bagi pengguna dengan gangguan penglihatan. Penelitian ini membahas pengembangan dan pengujian dua model AI dalam kerangka G-MOOC 4D: model pengenalan wajah untuk autentikasi pengguna yang aman dan model perintah suara untuk pembelajaran interaktif. Pengujian Penerimaan Pengguna (UAT), yang dilakukan dengan pengguna ahli, yaitu guru-guru di sekolah khusus, menunjukkan tingkat persetujuan yang tinggi untuk fitur-fitur platform. Hasilnya menunjukkan bahwa semua metrik: akurasi, presisi, dan recall, mencapai nilai optimalnya pada jarak 40 cm untuk deteksi wajah. Skor metrik masing-masing pada jarak tersebut, presisi: 100%, akurasi: 98%, dan recall: 97%. Selain itu, fungsionalitas perintah suara yang diuji mencapai tingkat pengenalan 100%, mencerminkan potensi platform untuk secara signifikan mempermudah proses pembelajaran bagi siswa dengan gangguan penglihatan. Temuan ini menekankan pentingnya integrasi teknologi bantu ke dalam platform pendidikan untuk memastikan semua siswa memiliki akses yang sama terhadap kesempatan belajar.

Kata Kunci: *kecerdasan buatan, e-learning, G-MOOC, pengenalan suara, gangguan penglihatan.*

INTRODUCTION

Visual impairment (blindness) is a type of disability that many school-age children experience. Based on the Central Java area census from the Central Statistics Agency Indonesia in 2021, 1626 school-age children were blind; East Java had 5987 residents in 2019, and 3650 residents in the province of West Java in 2021 [1]. School-age visual impairment children need special technological support to participate in the learning process, one

of which is using online learning technology such as the Learning Management System [2].

MOOC (Massive open online course) is an information technology that can be used to support online learning. MOOC is a form of online learning through web technology that provides users with access to learning experiences via the internet [3]–[5]. There are several categories of visual impairments, such as total blindness, partial blindness, and color blindness [6]. Learning Management System (LMS) or MOOC platforms need to consider the user interface (UI) and user experience (UX) so that people with visual impairments can access and operate the platform. The Web Content Accessibility Guidelines (WCAG) provide four critical principles for ensuring the accessibility of web content for users with disabilities: emphasizing the importance of providing content that is viewable, interoperable, understandable, and robust enough to be accessed by assistive technology. Therefore, LMS or MOOC platforms must follow these principles to provide a good learning experience for disabled people.

The existing LMS does not fully support the learning needs of students with special needs, such as visual impairment [7]. Research has shown that LMSs need to be adapted to be accessible to visually impaired students [8], as well as to have interesting and interactive learning features [9]. Several studies have tried to analyze various existing LMSs to see the need to develop LMSs for visual impairment. For example, previous research investigated the level of accessibility of the Coursera platform using web content accessibility guidelines (WCAG) [10]. The results showed that large learning platforms like Coursera still do not support disabled users. Apart from that, according to [11], the content in most LMSs is still in the form of videos, text, and images as well as uploaded PDF files, so a content distribution method that is friendly for blind people is needed. However, accessibility and blind-friendly content are still challenges in developing LMSs that can help students with special needs.

Several researchers have tried to create gamification-based interactive learning media to help blind people, as was done by [12] and [13]. A Previous study built a gamification-based interactive learning application on the Android platform for blind children, which increases their interest and enthusiasm for learning [12]. However, the application does not yet have a content management system. Similar to the limitations of previous research, Ramos Aguiar and Álvarez Rodríguez developed an interactive learning application using real objects with gamification that helps teach mathematics and geometry to blind people. However, this application also does not have a content management system.

Research by [7] developed an e-learning system for visually impaired individuals. The system manages all aspects of the learning process, including data, teachers, course materials, schedules, and so on. The second part of the model involves converting lecture material from a database into audio files for visually impaired individuals. Furthermore, [14] applied Artificial Intelligence to help blind individuals solve everyday problems through an Android mobile application focused on voice assistants, image recognition, currency recognition, e-books, chatbots, etc. The application allows users to interact with their environment using voice commands and to recognize text in physical documents. Therefore, a Learning Management System (LMS) with a minimalist and easy-to-access design, an integrated voice assistant, and voice command is proposed to provide more efficient and effective learning support.

Existing LMS and MOOC platforms are not friendly to people with disabilities, especially visual impairment. Previous studies indicate a need to develop new platforms that are more accessible for visually impaired students. State of the art in this study is the development of a new platform called G-MOOC 4D (Gamified Massive Open Online Courses for Disabilities), designed based on the MARC [15] framework to be easier to use by blind students. Based on these problems, this research aims to build a G-MOOC 4D application prototype, integrating voice assistant techniques and voice commands into the G-MOOC 4D application prototype to help blind people participate in learning on the MOOC platform.

MATERIALS AND METHODS

This section has several discussions, including research methods and data collection.

a. Research Method

There are several stages of research to achieve the research aim of building a G-MOOC 4D application prototype. These stages are described in Figure 1.

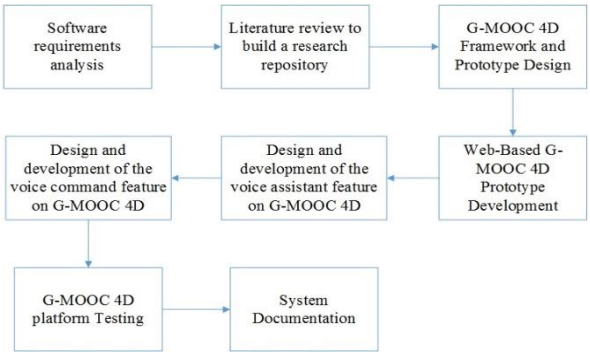

Figure 1. Research Method

Accredited Rank 2 (Sinta 2) based on the Decree of the Dirjen Penguatan RisBang Kemenristekdikti No.225/E/KPT/2022, December 07, 2022. Published by LPPM Universitas Nusa Mandiri

VOL. 9. NO. 2 FEBRUARY 2024
P-ISSN: 2685-8223 | E-ISSN: 2527-4864
DOI: 10.33480/jitk.v9i2.5037

Based on Figure 1, there are several research stages. Each stage can be explained as follows:

1. Software requirements analysis

Software requirement analysis is the systematic procedure of collecting, recording, and examining the desires and limitations of users in order to create software that fulfills their expectations [16]. In order to make sure the software meets the required standards, the analysis attempts to comprehend the quality attributes that the user desires [17], [18]. In this phase, we held discussions and asked questions to end users of the application for visual impairment students at the ABCD Kuncup Mas Special School (SLB), Banyumas Regency, Central Java, Indonesia.

Based on the results of our discussion, it can be concluded that the G-MOOC 4D platform that was built has the following functions:

a) **E-learning** features as an online learning media.
b) **Gamification Feature**. This feature integrates game elements in online learning facilities to increase the motivation of visual impairment students to participate in the learning and evaluation process in G-MOOC 4D.
c) **Voice Assistant feature**. The voice assistant feature on the G-MOOC 4D is used to provide audio information to visual impairment students. For example, computers can read test or evaluation questions to blind students.
d) **Voice Command feature**. The voice command feature is implemented in the G-MOOC 4D application so that visual impairment students can give voice commands to the application. An example of its application is that students can give voice commands to choose answers from several answer options on multiple-choice questions.

2. Literature review to build a research repository

A literature review is an essential element of scholarly investigation, functioning to elucidate, comprehend, explicate, and validate constructions and theories within a certain subject domain [19]. In addition, it has a role in advancing theoretical and conceptual frameworks by providing valuable perspectives on trends, themes, and textual patterns found in the material being examined [20]–[22]. At this stage, we conducted a review of the latest literature for MOOCs, voice command and voice assistant techniques and technology, as well as web technology.

3. G-MOOC 4D framework and prototype design

A framework is a systematic method or model that serves as a foundation for organising and integrating concepts, ideas, or processes in a particular field of study or practice. Moreover, in the field of education, frameworks are created to encompass many understandings of learning and evaluation, guiding educational and research approaches aimed at improving the acquisition of information [23], [24].

The G-MOOC 4D platform is constructed using the MARC architecture [15]. MARC is a gamification framework utilised for constructing Learning Management System (LMS) platforms that offer gaming encounters to students enrolled in online courses. The objective is to enhance students' motivation to enrol in and successfully finish the course through the provision of rewards. Figure 2 displays the MARC framework.

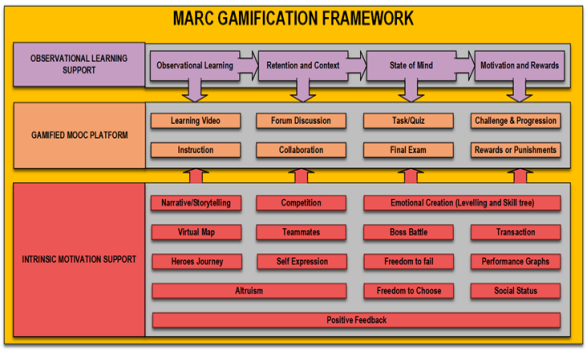

Figure 2. MARC Framework [15]

Next, we used the design thinking method to develop a web-based G-MOOC 4D prototype design. This approach entails a sequential procedure consisting of five steps: empathizing, defining, ideating, prototyping, and testing. Its objective is to generate solutions that are rooted in the user's experience, emotions, and circumstances [25], [26]. We use the Figma tool with the implementation of the design thinking method for prototype interface design.

4. Web-based G-MOOC 4D prototype development

In developing the web-based G-MOOC 4D prototype, we proposed a system scheme so that the prototype could operate well. A Schematic of the Proposed G-MOOC 4D Platform is shown in Figure 3.

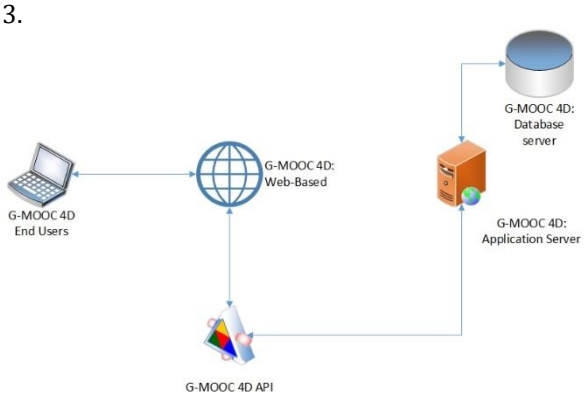

Figure 3. Schematic of the Proposed G-MOOC 4D Platform

Based on Figure 2, the front end of the G-MOOC 4D application prototype requests and sends data via the G-MOOC 4D service API (Application Programming Interface). The API is connected to the G-MOOC 4D server. The API provides 29 services. There are 2 intelligent services that we built in this research: (1) facial recognition-based user registration and login service and (2) voice command service based on speech recognition.

The application features and facial recognition services were built to make it easier for visual impairment students to register and access the G-MOOC 4D platform. Meanwhile, the voice command feature based on speech recognition was built so that students could interact with the platform. An explanation of voice commands and assistant development is discussed in the next section.

Visual-impaired students can register and log in to the G-MOOC 4D platform using facial recognition. There are two algorithms used to perform facial recognition, namely Convolutional Neural Network (CNN) and k-nearest Neighbor (k-NN). The CNN algorithm is implemented using the Keras library, while k-NN is implemented using the Scikit-learn library. Figure 4 explains the stages used for face recognition.

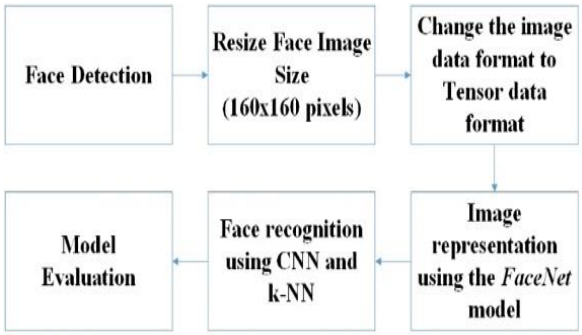

Figure 4. Face Recognition Method

Based on Figure 4, in this research we use image representation in the FaceNet model. This model is a neural network architecture developed for facial recognition purposes. The FaceNet algorithm consists of a number of convolutional layers and fully connected layers, which together form a Convolutional Neural Network [27]. Several measurement metrics are used to evaluate face recognition performance, such as accuracy, precision, recall, and F1 score metrics.

5. Design and development of the voice assistant and voice command features on G-MOOC 4D

Voice command (speech-to-text) and voice assistant (text-to-speech) features and services for visual impairment students use the Web Speech API library. This API is provided by the majority of browsers, including Google Chrome, Mozilla Firefox, and Microsoft Edge. The main function of this API is to integrate voice data into web applications. The Web Speech API has two main components, namely *Speech Synthesis* (Text-to-Speech) and *Speech Recognition* (Asynchronous Speech Recognition). This API supports the use of several languages, such as English and Indonesian.

Figure 5 shows the speech recognition processing stages implemented in this research.

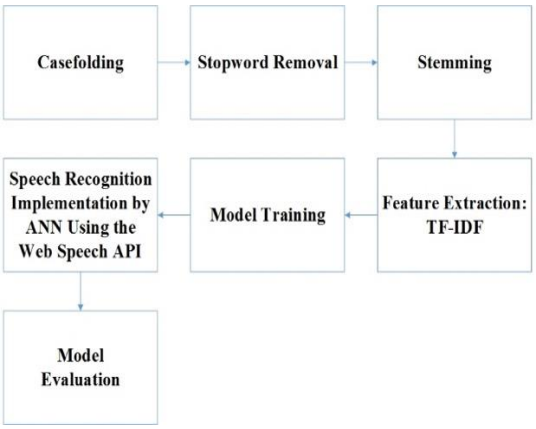

Figure 5. Speech Recognition Method

Figure 5 shows several stages for speech recognition: (1) **Casefolding** is the equalization of letter shapes in text documents; (2) **Stopword** Removal is a stage for removing common or unimportant words in the corpus. At this stage, we use the Natural Language Toolkit (NLTK) library to perform this operation; (3) **Stemming** is the process of changing affixed words into base words in a document. At this stage, we use literary stemmer for the stemming process [28]; (4) **Feature Extraction** with Term Frequency Inverse Document Frequency (TF-IDF). TF-IDF is a feature extraction method used to calculate the weight of each word; (5) **Model training** uses the Artificial Neural Network (ANN) algorithm; (6) **Speech recognition** implementation by ANN using the Web Speech API; and (7) **Model evaluation** stage: we used the *Rate Recognition Average* for the evaluation method.

6. G-MOOC 4D platform testing

We used functional testing to evaluate the performance of the G-MOOC 4D prototype. End users, namely visually impaired people from ABCD Kuncup Mas Special School (SLB), performed functional prototype testing. Fifteen main functions are tested for functionality by end users.

b. Data Collection

This research uses two datasets for experimentation and platform testing. These two datasets are used for face and speech recognition experiments.

Accredited Rank 2 (Sinta 2) based on the Decree of the Dirjen Penguatan RisBang Kemenristekdikti No.225/E/KPT/2022, December 07, 2022. Published by LPPM Universitas Nusa Mandiri

VOL. 9. NO. 2 FEBRUARY 2024
P-ISSN: 2685-8223 | E-ISSN: 2527-4864
DOI: 10.33480/jitk.v9i2.5037

1. Face Recognition

In the experimental phase, we used 35 different people's faces: 30 data as registered faces in the model, and the remaining 5 were used as unregistered data. This dataset was built independently by the research team.

2. Speech Recognition

In this research, we build a dataset of labeled voice commands in CSV format. The voice command data contains 24 labels with a total of 279 data. The twenty-four labels are searching for ongoing classes, search for easy classes, regular classes, search for finished classes, challenging classes, search for all classes, print certificates, stopping quizzes, explaining instructions, number of classes, taking quizzes, reloading the page, go home, go class, go ranking, report card, my ranking, choose a, choose b, choose c, choose current material, where am I, say class, and repeat questions. For experiments, the dataset is divided into training data and test data with a composition of 90% for training data and 10% for test data.

RESULTS AND DISCUSSION

In this study, two artificial intelligence models were developed to support the learning process for visually impaired individuals: one model for user face detection during the registration and login process on the G-MOOC 4D platform, and another model to capture voice from the user and translate user commands.

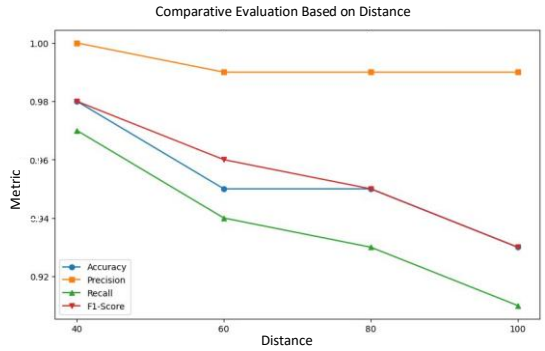

Figure 6. Performance of Face Recognition Model.

Based on Figure 6, the best results for face detection by the AI model occur at the closest range represented in the chart, which is at a distance of 40. At this distance, all metrics—accuracy, precision, recall, and F1-Score—reach their highest values, as indicated by the highest points on each metric line. These values decrease with increasing distance, showing that the model is more effective in accurately detecting faces when the subject is closer to the camera. In the context of login using face detection, this means the system will be most accurate and reliable at the shortest distance. High accuracy is important to ensure that legitimate users are granted access, while high precision reduces the chances of unauthorized individuals being granted access. A high recall indicates that the system rarely misses legitimate users, and a high F1-score reflects a good balance between precision and recall, indicating the system's overall reliability. In practice, for a login system that uses face detection, this optimal distance must be measured and implemented so that users can position themselves correctly relative to the camera to ensure a high success rate of login.

Voice assistant and command testing has been conducted, consisting of 72 tests of voice commands based on their labels, with each test of one label receiving 3 trials and with there being 24 labels, the total number of trials in testing reached 72 trials. The results of this testing show that the 72 trials produced outputs that matched their output and labels. Thus, to calculate the average recognition rate (RR) using formula (1).

$$RR = (NCorrect / NTotal) \times 100\% \quad (1)$$
$$RR = (72 / 72) \times 100\% = 1 \times 100\% = 100\%$$

Therefore, the Recognition Rate from the voice command testing results achieved an accuracy of 100%.

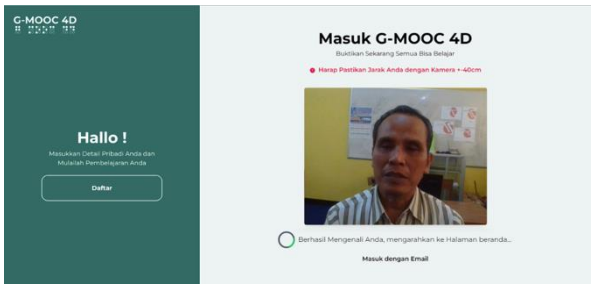

Figure 7. Login Page using Face Detection

Figure 7 shows a login page for a platform called G-MOOC 4D, which appears to be designed to accommodate visually impaired users by utilizing face recognition technology. The left side of the login page has a welcoming message with a prompt for users to register or enter their data. It features a minimalist design with a clean and straightforward layout, likely to make it easier to navigate for users with visual impairments.

On the right side, there is a section where users are instructed to ensure their face is within a certain distance from the camera—specifically, within 40 centimeters—to facilitate the face recognition process. There's an image of a man's face, presumably showing the live feed from the webcam to help the user position themselves correctly for the system to recognize their face.

Below the webcam feed, there's a message that probably serves as feedback to the user, indicating the system's current state or next steps required by the user. This type of interface is crucial for visually impaired users because it relies on other cues, such as audio feedback or clear textual instructions, which can be read by screen readers to provide information about the login process.

Figure 8. Home Page

Figure 8 shows a homepage for the G-MOOC 4D platform, likely the first screen a user sees after a successful login. The page features a welcoming and inclusive message, "Semua Berhak untuk bisa belajar," which translates to "Everyone has the right to learn." This statement reinforces the platform's commitment to accessibility and education for all. Once on this page, the role of voice and assistant commands is very significant in helping users, especially those who are visually impaired, to visit other pages and, in particular, to learn online on this platform.

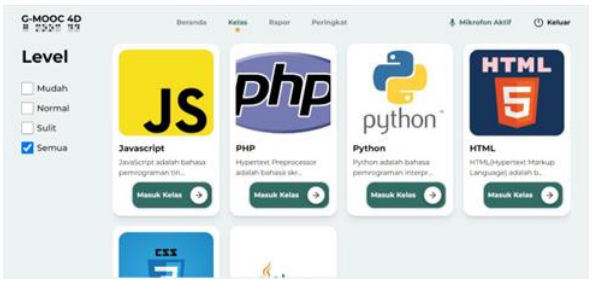

Figure 9. Class Page

The image depicts a web page from the G-MOOC 4D platform, showing a selection of classes that users can choose to enroll in. The classes are categorized by programming languages and technologies, each represented by its distinctive logo and a brief description.

On the left side, there is a filtering option titled "Level" with three difficulty levels: "Mudah" (Easy), "Normal" (Normal), and "Sulit" (Difficult), and a "Semua" (All) option, likely allowing users to sort the classes based on their skill level.

Each course has a "Masuk Kelas" (Enter Class) button, indicating that users can click on these to access the course materials. The layout is user-friendly and visually oriented, with large, colorful buttons and text, making it easy for users to navigate and select the courses they are interested in. The design suggests an emphasis on interactivity and ease of access, catering to a broad range of users, including those with visual impairments.

Figure 10. Learning Page

Figure 10 shows an e-learning platform interface, specifically from a course section. The layout includes a navigation sidebar on the left side, listing different types of content or sections available within the course, such as video lectures and quizzes. The main area of the interface shows a video player, indicating that video content is a significant part of the learning experience. The interface design suggests that users can interact with the content, likely by playing videos and completing accompanying quizzes to progress through the course. The overall design is clean and user-friendly, with clear visual indications for navigation and content interaction.

Figure 11. Quiz Page

Figure 11 illustrates an online learning platform's quiz interface, which is likely to be enhanced with voice command and assistant features. These features would enable users to interact with the quiz and other elements of the course using voice commands, making it more accessible, especially for users who may have difficulties with traditional navigation methods. With such functionality, a user could potentially navigate through the quiz options and select their answers hands-free, which would be particularly beneficial for users with visual impairments or mobility challenges. The integration of voice

Accredited Rank 2 (Sinta 2) based on the Decree of the Dirjen Penguatan RisBang Kemenristekdikti No.225/E/KPT/2022, December 07, 2022. Published by LPPM Universitas Nusa Mandiri

VOL. 9. NO. 2 FEBRUARY 2024
P-ISSN: 2685-8223 | E-ISSN: 2527-4864
DOI: 10.33480/jitk.v9i2.5037

technology into e-learning platforms represents a commitment to inclusive design, allowing a broader range of users to engage with the content comfortably and efficiently.

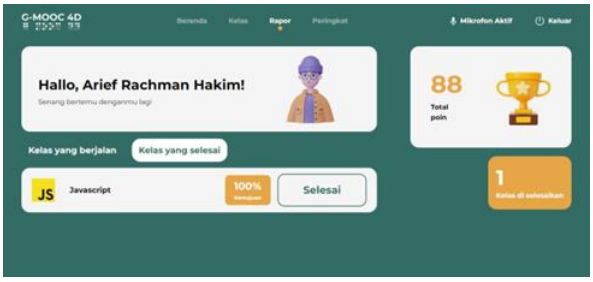

Figure 12. Report Page

Figure 12 displays a user dashboard within the G-MOOC 4D e-learning platform. This dashboard provides a personalized greeting to the user, Arief Rachman Hakim, indicating a friendly and welcoming user interface. The dashboard is designed to give an overview of the user's progress and achievements within the platform.

There are sections indicating the courses in progress and those completed, with progress bars showing the completion rate, such as 100% completion for a JavaScript course. Additionally, the dashboard includes gamification elements, as evidenced by the display of total points and badges or trophies, which serve to motivate and engage users by rewarding them for their learning activities. Gamification is often used in educational platforms like this to encourage continued participation and to make the learning process more enjoyable and rewarding.

The interface is clean and user-friendly, with information presented in a visually appealing and easily digestible format. The integration of gamification within the G-MOOC 4D platform suggests an emphasis on interactive and dynamic learning experiences, aiming to increase user engagement and motivation through game-like elements and rewards.

Figure 13. Leaderboard Page

Figure 13 shows a leaderboard section titled "Papan Peringkat" from the G-MOOC 4D platform, which is part of the gamification features of the system. A leaderboard is a common gamification element that ranks users based on their achievements, in this case, points earned through their learning activities. The name "Arief Rachman Hakim" is listed at the top of the leaderboard with 88 points, indicating this user has achieved the highest score.

Leaderboards motivate learners by introducing a competitive element, encouraging them to engage more with the material to gain points and rise in rank. It also adds a social dimension to the learning experience, as users can compare their progress with others. This can lead to increased user engagement, as learners often find it rewarding to see their name at the top of a ranking System. The use of gamification elements like leaderboards is a strategy to enhance motivation and improve the learning experience in online platforms.

G-MOOC 4D has been tested with users through the UAT (User Acceptance Test) method. This method serves to produce evidence that an application developed is acceptable and aligns with the initial goals set for its creation (Abraham et al., 2021). In its testing, this method uses questionnaires or surveys to get an overview of the system being built. This testing involved 14 expert users (individuals who pay great attention to this issue), specifically teachers at the SLB ABCD Kuncup Mas school, as questionnaire respondents to gain a real perspective on the learning environment for individuals with visual impairments. Ten questions are used to evaluate the performance of G-MOOC 4D, as listed in Table 1. Measurements carried out on application users used a Likert scale with a rating of A = strongly agree with a score of 5, B = agree with a score of 4, C = quite agree with a score of 3, D = disagree with a score of 2, E = strongly disagree with a score of 1.

Table 1. Lists of Questions

Code	Questions	Answer Codes				
		A	B	C	D	E
P1	Are the application installation steps with the implementation of screen shortcut technology to access the G-MOOC 4D application easy to understand?	?	?	?	?	?
P2	Did you have a good experience accessing the G-MOOC 4D application after the implementation of application shortcut technology?	?	?	?	?	?

Code	Questions	Answer Codes				
		A	B	C	D	E
P3	Can the G-MOOC 4D application be accessed with assistive technology for the visually impaired such as screen readers and voice commands?	?	?	?	?	?
P4	Has integration with screen reader technology and voice commands improved your accessibility in using this application?	?	?	?	?	?
P5	Does the implementation of screen shortcut technology shorten your time in accessing the G-MOOC 4D application compared to accessing it directly in a browser?	?	?	?	?	?
P6	Can the G-MOOC application display results in accordance with the commands given?	?	?	?	?	?
P7	Is the G-MOOC application's ability to present learning content fast?	?	?	?	?	?
P8	Are the navigation features of the G-MOOC application such as voice commands and screen readers easy to understand?	?	?	?	?	?
P9	Is the response from the G-MOOC application quick in responding to the actions given?	?	?	?	?	?
P10	Do the features and functionalities of the G-MOOC application support learning well?	?	?	?	?	?

After the questions were answered by the respondents, answers were obtained and each question received the following scores:

Table 2. Score of Question

Code	Averages	Percentage	Information
P1	58 / 14 = 4.1	4.1 / 5 * 100% = 82%	Percentage for question no. 1
P2	57 / 14 = 4.07	4.07 / 5 * 100% = 81%	Percentage for question no. 2
P3	57 / 14 = 4.07	4.07/ 5 * 100% = 81%	Percentage for question no. 3
P4	59 / 14 = 4.2	4.2 / 5 * 100% = 86%	Percentage for question no. 4
P5	58 / 14 = 4.1	4.1 / 5 * 100% = 82%	Percentage for question no. 5
P6	57 / 14 = 4.07	4.07 / 5 * 100% = 81%	Percentage for question no. 6
P7	57 / 14 = 4.07	4.07 / 5 * 100% = 81%	Percentage for question no. 7
P8	57 / 14 = 4.07	4.07 / 5 * 100% = 81%	Percentage for question no. 8
P9	58 / 14 = 4.1	4.1 / 5 * 100% = 82%	Percentage for question no. 9
P10	57 / 14 = 4.07	4.07 / 5 * 100% = 81%	Percentage for question no. 10

Based on the score calculation for each question, it was found that the average score obtained was 81.8%. After carrying out calculations in the test, the analysis obtained in the User Acceptance Testing (UAT) test uses score interpretation criteria with a Likert scale, namely:

1. Analyze the first question

In the detailed table of calculation test results, it can be seen that the percentage value is 82% with the score criteria being strongly agree. So, it can be concluded that the application installation steps with the application of shortcut technology to access the G-MOOC 4D application are understood.

2. Analyze the second question

In the detailed table of test result calculations, it can be seen that the percentage value is 81% with the score criteria being strongly agree. So, it can be concluded that users get a good experience in accessing the G-MOOC 4D application after the implementation of application shortcut technology.

3. Analyze the third question

In the detailed table of test result calculations, it can be seen that the percentage value is 81% with the score criteria being strongly agree. So, it can be concluded that the G-MOOC 4D application can be accessed with assistive technology for the blind such as screen reader programs and voice commands.

4. Analyze the fourth question

In the detailed table of test result calculations, it can be seen that the percentage value is 86% with the score criteria being strongly agree. So, it can be concluded that integration with screen reader

Accredited Rank 2 (Sinta 2) based on the Decree of the Dirjen Penguatan RisBang Kemenristekdikti No.225/E/KPT/2022, December 07, 2022. Published by LPPM Universitas Nusa Mandiri

VOL. 9. NO. 2 FEBRUARY 2024
P-ISSN: 2685-8223 | E-ISSN: 2527-4864
DOI: 10.33480/jitk.v9i2.5037

technology and voice commands has increased user accessibility in using this application.

5. Analyze the fifth question

In the detailed table of test result calculations, it can be seen that the percentage value is 82% with the score criteria being strongly agree. So, it can be concluded that the application of screen shortcut technology shortens your time in accessing the G-MOOC 4D application compared to accessing it directly in the browser.

6. Analyze the sixth question

In the detailed table of test result calculations, it can be seen that the percentage value is 81% with the score criteria being strongly agree. So, it can be concluded that the G-MOOC application can display results according to the commands given.

7. Analyze question seven

In the detailed table of test result calculations, it can be seen that the percentage value is 81% with the score criteria being strongly agree. So, it can be concluded that the G-MOOC application's ability is fast in presenting learning content.

8. Analyze question eight

In the detailed table of test result calculations, it can be seen that the percentage value is 81% with the score criteria being strongly agree. So, it can be concluded that the navigation features of the G-MOOC application such as voice commands and screen readers are easy to understand.

9. Analyze the ninth question

In the detailed table of test result calculations, it can be seen that the percentage value is 82% with the score criteria being strongly agree. So, it can be concluded that the response of the G-MOOC application is fast in responding to the actions given.

10. Analyze the tenth question

In the detailed table of test result calculations, it can be seen that the percentage value is 81% with the score criteria being strongly agree. So, it can be concluded that the features and functionality of the G-MOOC application support learning well.

11. Analyze total percentages

The total percentage is obtained by adding the percentage of question 1 to the percentage of question 10 and dividing by the total number of questions. So it can be concluded that the total presentation of questions is 81.8%. With the description of the score interpretation criteria, namely strongly agree. So it can be concluded that the functionality of the G-MOOC 4D application makes learning easier for the blind.

12. Suggestions

The advice given by the teaching staff who tested this application was to develop a native mobile application, especially for smartphone users. This is based on the understanding that many children can easily operate a smartphone, especially with the help of features such as talkback. By prioritizing the development of native mobile applications, it is hoped that this application can become a more efficient and child-friendly learning platform. The hope is that this application can make it easier for children to access learning materials, making the learning process more fun and interactive.

CONCLUSION

The research conclusively demonstrates that the G-MOOC 4D platform, a gamified learning management system, significantly enhances the educational experience for students with visual impairments. The successful integration of facial recognition and voice command technologies has established a more accessible and interactive learning environment, as confirmed by User Acceptance Testing (UAT). The AI models for user face detection and voice commands performed exceptionally, with optimal metrics achieved for face detection at the closest range and voice command functionality reaching a 100% recognition rate. This evidences the platform's capacity to facilitate a seamless learning process for visually impaired students, ensuring that accessibility is not a barrier to their educational advancement. The study's findings are a testament to the essential role that artificial intelligence and assistive technologies play in the democratization of education, further underscoring the necessity for continuous innovation in the field of educational technology to accommodate diverse learning needs.

REFERENCE

[1] B. P. Statistik, "Rekap Data Penyandang Masalah Kesejahteraan Sosial (PMKS) Provinsi Jawa Tengah 2021," 2021. https://jateng.bps.go.id/statictable/2022/03/22/2607/rekap-data-penyandang-masalah-kesejahteraan-sosial-pmks-provinsi-jawa-tengah-2021.html (accessed Nov. 14, 2022).

[2] L. E. Schimmelpfeng and V. R. Ulbricht, "Accessible Learning Management System (LMS) for Disabled People: Project Development Based on Accessibility Guidelines, Gamification, and Design Thinking Strategies," in *The Role of Gamification in Software Development Lifecycle*, IntechOpen, 2021, pp. 1–21.

[3] H. H. S. Ip *et al.*, "Design and Evaluate Immersive Learning Experience for Massive Open Online Courses (MOOCs)," *IEEE Trans. Learn. Technol.*, vol. 12, no. 4, pp. 503–515, 2019, doi: 10.1109/TLT.2018.2878700.

[4] A. Ntourmas, Y. Dimitriadis, S. Daskalaki, and N. Avouris, "Assessing Learner Facilitation in MOOC Forums: A Mixed-Methods Evaluation Study," *IEEE Trans. Learn. Technol.*, vol. 15, no. 2, pp. 265–278, 2022, doi: 10.1109/TLT.2022.3166389.

[5] Y. Tian, W. N. Huang, L. Zhang, and T. Wang, "Disclosing personal names in screen names predicts better final achievement levels in massive open online courses," *IEEE Access*, vol. 9, pp. 50926–50938, 2021, doi: 10.1109/ACCESS.2021.3069451.

[6] K. Veljanovska, N. Blazheska-Tabakovska, B. Ristevski, and S. Savoska, "User interface for e-learning platform for users with disability," *CEUR Workshop Proc.*, vol. 2656, pp. 68–81, 2020.

[7] Inayatulloh and A. F. Fachrul, "E-learning model for People with Disabilities," in *Proceedings of the International Conference on Industrial Engineering and Operations Management*, 2021, pp. 597–602.

[8] D. Satria, N. R. Feta, and F. Fitria, "E-Learning Implementation Barrier in Indonesia: a Case Study," *J. Techno Nusa Mandiri*, vol. 19, no. 2, pp. 87–95, 2022, doi: 10.33480/techno.v19i2.3034.

[9] E. Brito and G. P. Dias, "LMS accessibility for students with disabilities: The experts' opinions," in *Iberian Conference on Information Systems and Technologies, CISTI*, 2020, pp. 24–27, doi: 10.23919/CISTI49556.2020.9141046.

[10] A. Królak and P. Zając, "Analysis of the accessibility of selected massive open online courses (MOOCs) for users with disabilities," *Univers. Access Inf. Soc.*, no. 0123456789, 2022, doi: 10.1007/s10209-022-00927-2.

[11] Królak, A., Zając, P. Analysis of the accessibility of selected massive open online courses (MOOCs) for users with disabilities. Univ Access Inf Soc (2022). https://doi.org/10.1007/s10209-022-00927-2

[12] A. C. Sari, A. M. Fadillah, J. Jonathan, and M. R. D. Prabowo, "Interactive gamification learning media application for blind children using android smartphone in Indonesia," *Procedia Comput. Sci.*, vol. 157, pp. 589–595, 2019, doi: 10.1016/j.procs.2019.09.018.

[13] L. R. Ramos Aguiar and F. J. Álvarez Rodríguez, "Methodology for designing systems based on tangible user interfaces and gamification techniques for blind people," *Appl. Sci.*, vol. 11, no. 12, pp. 1–25, 2021, doi: 10.3390/app11125676.

[14] Hariharan, R.S., Abdul Gaffar, H., Manikandan, K. (2023). The Third Eye: An AI Mobile Assistant for Visually Impaired People. In: Sharma, N., Goje, A., Chakrabarti, A., Bruckstein, A.M. (eds) Data Management, Analytics and Innovation. ICDMAI 2023. Lecture Notes in Networks and Systems, vol 662. Springer, Singapore. https://doi.org/10.1007/978-981-99-1414-2_67.

[15] R. E. Saputro, S. Salam, M. H. Zakaria, and T. Anwar, "A gamification framework to enhance students' intrinsic motivation on MOOC," *Telkomnika (Telecommunication Comput. Electron. Control.*, vol. 17, no. 1, pp. 170–178, 2019, doi: 10.12928/TELKOMNIKA.v17i1.10090.

[16] A. R. Djamarullah and W. A. Kusuma, "Elicitation of Needs Using User Personas to Improve Software User Experience," *Ultim. J. Tek. Inform.*, vol. 14, no. 1, pp. 28–35, 2022, doi: 10.31937/ti.v14i1.2633.

[17] S. Dalal, K. Solanki, Sudhir, and Diksha, "Exploring the Essentials and Principles of Software Development," *Int. J. Adv. Trends Comput. Sci. Eng.*, vol. 8, no. 6, pp. 3504–3510, 2019, doi: 10.30534/ijatcse/2019/129862019.

[18] M. Gheisari *et al.*, "An Optimization Model for Software Quality Prediction with Case Study Analysis Using MATLAB," *IEEE Access*, vol. 7, pp. 85123–85138, 2019, doi: 10.1109/ACCESS.2019.2920879.

[19] W. Cram, M. Templier, and G. Paré, "(re)considering the concept of literature review reproducibility," *J. Assoc. Inf. Syst.*, vol. 21, no. 5, pp. 1103–1114, 2020, doi: 10.17705/1jais.00630.

[20] J. Vos, "Cardiovascular disease and meaning in life: A systematic literature review and conceptual model," *Palliat. Support. Care*, vol. 19, no. 3, pp. 367–376, 2021, doi: 10.1017/S1478951520001261.

[21] J. Alcantara, R. Whetten, E. Emmanuel, S. Grace, and S. Myers, "The chiropractic care of pregnant women: a scoping review of the literature," *Rheumatic.Theclinics.Com*, 2023, doi: 10.21203/rs.3.rs-2454751/v1 License:

[22] A. van der Wath and N. van Wyk, "A hermeneutic literature review to conceptualise altruism as a value in nursing," *Scand. J. Caring Sci.*, vol. 34, no. 3, pp. 575–584, 2020, doi: 10.1111/scs.12771.

[23] K. Kistler and D. E. Tyndall, "Application of

VOL. 9. NO. 2 FEBRUARY 2024
P-ISSN: 2685-8223 | E-ISSN: 2527-4864
DOI: 10.33480/jitk.v9i2.5037

the threshold concept framework in nursing," *Nurse Educ.*, vol. 47, no. 2, pp. 91–95, 2021, doi: 10.1097/nne.0000000000001041.

[24] F. Peck, R. Johnson, D. Briggs, and J. Alzen, "Toward learning trajectory-based instruction: A framework of conceptions of learning and assessment," *Sch. Sci. Math.*, vol. 121, no. 6, pp. 357–368, 2021, doi: 10.1111/ssm.12489.

[25] H. Herfandi, Y. Yuliadi, M. T. A. Zaen, F. Hamdani, and A. M. Safira, "Penerapan Metode Design Thinking Dalam Pengembangan UI dan UX," *Build. Informatics, Technol. Sci.*, vol. 4, no. 1, pp. 337–344, 2022, doi: 10.47065/bits.v4i1.1716.

[26] B. Suratno and J. Shafira, "Development of User Interface/User Experience using Design Thinking Approach for GMS Service Company," *J. Inf. Syst. Informatics*, vol. 4, no. 2, pp. 469–494, 2022, doi: 10.51519/journalisi.v4i2.344.

[27] A. S. Sanchez-Moreno, J. Olivares-Mercado, A. Hernandez-Suarez, K. Toscano-Medina, G. Sanchez-Perez, and G. Benitez-Garcia, "Efficient face recognition system for operating in unconstrained environments," *J. Imaging*, vol. 7, no. 9, pp. 1–21, 2021, doi: 10.3390/jimaging7090161.

[28] F. S. Utomo, N. Suryana, and M. S. Azmi, "Stemming impact analysis on Indonesian Quran translation and their exegesis classification for ontology instances," *IIUM Eng. J.*, vol. 21, no. 1, pp. 33–50, 2020, doi: 10.31436/iiumej.v21i1.1170.