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Amir Hasanudin Fauzi[1]
Fat'hah Noor Prawita[2]
Akhmadi[3]

VIRTUAL REALITY-BASED LEARNING APPLICATION FOR SENSOR PROGRAMMING PRACTICUM MODULE

Abstract
This research aims to develop a learning application utilizing Virtual Reality (VR) technology for a sensor programming practicum module. By applying VR, it is expected to enhance students' conceptual understanding and practical skills in sensor programming more interactively and immersively. The application is designed to provide a virtual practicum environment where students can perform sensor programming experiments and practice without spatial and temporal limitations. The evaluation involves students and lecturers as users to measure the application's effectiveness in improving conceptual understanding and practical skills. The research results are expected to deliver an effective VR-based learning application that enhances students' conceptual understanding and practical skills in sensor programming. Additionally, it is expected that this application will receive positive feedback from users, indicating high satisfaction with the immersive learning experience offered.
Keywords: Virtual Reality, Learning Media, Immersive, Sensor Programming Practicum

INTRODUCTION

In the current digital era, information and communication technology (ICT) continues to develop and significantly impact various aspects of life, including education. One technology that is increasingly being utilized in education is Virtual Reality (VR), which offers an immersive and interactive learning experience. VR has the potential to enrich the learning process by providing realistic and interactive simulation environments, thereby enhancing understanding of concepts and practical skills.

On the other hand, sensor-based programming is an important and relevant field to current industry needs. Sensors are used in various applications, from mobile devices, home automation systems, to industrial applications. Therefore, the ability to understand and develop programs that can integrate sensors is essential for students in the D3 Software Engineering Application program.

However, challenges in learning sensor-based programming are often related to limited access to equipment and practical labs, as well as difficulties in understanding the abstract concepts involved. This creates a need for learning methods that can overcome these limitations and support a more effective learning process. Based on this background, this research aims to develop a VR-based learning application for the sensor programming practicum module. By utilizing VR, it is expected that students can access a virtual practicum environment that is not limited by space and time and can gain a more in-depth and interactive learning experience. This research is expected to provide an innovative solution to improve the quality of sensor programming learning while contributing to the use of VR technology in education.

Research Benefits

The results of this research are expected to provide the following benefits:

1. Provide insights and references on the utilization of Virtual Reality (VR) technology in the learning process, particularly for the sensor programming practicum.

[1,2)] Department of Applied Software Engincering, School of Applied Sciences, Telkom University, Bandung, Indonesia
[3] Department of Interior Design, School of Creative Industry, Telkom University, Bandung, Indonesia
email: amirhf@telkomuniversity.ac.id[1], fathah@telkomuniversity.ac.id[2], akhmadi@telkomuniversity.ac.id[3]

2. Provide alternative solutions to overcome the limitations of practical facilities and equipment often faced by educational institutions.
3. Enhance the effectiveness of teaching by utilizing immersive technology that can increase students' motivation and conceptual understanding.

METHODS

Application Development

The development of a VR-based learning application for the sensor programming practicum module was carried out in several stages:

1. Planning and Preparation: Establishing research objectives and the VR learning application, conducting literature reviews, and determining research subjects.
2. Needs Analysis: Identifying learning needs through surveys and interviews with students and instructors.
3. Design and Development: Designing user interfaces, interactions, and immersive experiences of the application, and developing learning content.
4. Testing and Iteration: Conducting internal (alpha) and external (beta) testing and making improvements based on feedback.

Use of VR Devices

The VR device used is Meta Quest 2, which facilitates the use of learning applications with intuitive motion controls and interactions. The application was developed using Unity Game Engine and the XR Interaction Toolkit package.

Research Results or Practicum Simulations Using VR Devices

In the sensor programming practicum (PBS) using VR devices, students can perform simulation experiments with various types of sensors such as temperature, light, and motion sensors. These simulations include sensor programming, testing results, and real-time data analysis in a virtual environment. The research results show that the use of VR in the PBS practicum provides a deeper and more interactive learning experience. Students can understand sensor programming concepts better and perform experiments independently without spatial and temporal limitations.

Characteristics of Respondents and Questionnaires

The respondents in this research are D3 Software Engineering Application students who are taking courses related to sensor programming. A total of 20 students participated in the VR application testing. Most respondents were aged between 18-22 years old with similar educational backgrounds in information technology. The questionnaire used in this research was designed to collect data on students' perceptions, understanding, and satisfaction with the VR-based learning application. This questionnaire includes several aspects:

- Understanding of sensor programming concepts
- Practical skills after using the VR application
- Motivation and learning satisfaction
- Ease of use of the VR application
- Overall learning experience
- Side effects such as motion sickness

Data Collection and Analysis Methodology

Data were collected through questionnaires given to students after they used the VR-based learning application. These questionnaires consisted of closed-ended questions with a 5-point Likert scale, ranging from "Strongly Disagree" to "Strongly Agree." The collected data were analysed using descriptive statistical methods to see the distribution of answers and calculate the percentage of respondents who agreed or disagreed with each statement. The data analysis results show that the majority of respondents felt the VR application helped them understand sensor programming concepts and skills better.

Questionnaire Results

Table 1. Questionnaire Results

Question	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
The VR application increased my understanding of sensor programming	0	2	2	6	10
Using VR made learning more interesting	0	2	2	4	12
I feel more skilled in sensor programming after using the VR application	0	2	2	8	8
The VR application interface is easy to use and understand	0	2	2	5	11
I feel more motivated to learn using the VR application	0	2	2	6	10
I experienced motion sickness while using the VR application	2	4	4	6	4

RESULTS AND DISCUSSION

1) Conceptual Understanding

Most respondents (80%) agreed that the VR application helped them better understand sensor programming concepts. This shows that the use of VR is effective in enhancing students' conceptual understanding.

2) Practical Skills

A total of 80% of respondents felt more skilled in sensor programming after using the VR application. This indicates that virtual practicum simulations in VR provide real benefits in improving students' practical skills.

3) Motivation and Satisfaction

The use of VR increased students' motivation and learning satisfaction, with 80% of respondents stating that learning became more interesting, and they were more motivated to learn. The VR application interface, which is easy to use, also received positive ratings from most respondents.

4) Acceptance of VR Technology

The acceptance of VR technology as a learning tool is very positive, with feedback indicating that VR can be an effective solution to overcome practical facility limitations and improve the quality of learning.

5) Motion Sickness

However, around 50% of respondents experienced motion sickness symptoms while using the VR application. These symptoms included dizziness, nausea, and discomfort when using the VR headset for extended periods. This indicates the need for more attention to application design to minimize these side effects. It is recommended to focus on ergonomic aspects and provide sufficient breaks for users during learning sessions.

CONCLUSION

Main Conclusions

1. The VR-based learning application is proven effective in enhancing students' conceptual understanding and practical skills in sensor programming.
2. The use of VR in learning significantly increases students' motivation and learning satisfaction.
3. VR technology is well received by students and lecturers, indicating great potential for adoption in education.

4. More attention needs to be given to motion sickness symptoms experienced by some respondents, focusing on ergonomic application design and shorter usage sessions to reduce side effects.

Recommendations

1. Further Development: The application needs further development by adding new features and improving based on user feedback.
2. Curriculum Integration: It is recommended to permanently integrate this VR application into the sensor programming learning curriculum.
3. Further Research: More research is needed to measure the long-term impact of VR usage in education and explore other potential applications.
4. Ergonomic Improvement: Improve the ergonomic aspects of the VR application to minimize motion sickness and provide sufficient breaks during learning sessions.

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