



Augmented Reality Quiz using OpenCV and Gesture Recognition

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Abstract : This research paper proposes an interactive learning system called AR Quiz that utilizes gesture recognition to enhance the user experience in educational quizzes. The system employs the OpenCV library, a popular computer vision tool, to process and analyze video input from a webcam. The system detects hand gestures to provide users with a new way to interact with the educational material. The AR Quiz system consists of three major components: the user interface, the gesture recognition module, and the quiz database. The user interface allows users to select and start a quiz, view their score, and navigate through questions. The gesture recognition module tracks hand movements and recognizes gestures, enabling users to select multiple-choice answers. The quiz database stores questions and answers, and the system generates new quizzes randomly from this database. The results of the experiment showed that the AR Quiz system is a viable option for enhancing interactive learning experiences. The system achieved an accuracy rate of 92% for detecting hand gestures and performed well in recognizing a variety of gestures. The user study conducted with 30 participants revealed that the AR Quiz system was positively received, with 83% of the participants reporting that the gesture recognition feature improved their overall experience. This research demonstrates the potential of combining computer vision techniques and interactive learning to create a more engaging and effective learning environment. Future research could investigate the effectiveness of the AR Quiz system in different educational contexts and explore the potential of incorporating other forms of interactive learning using gesture recognition.

IndexTerms - AR Quiz, Gesture Recognition, OpenCV, Interactive Learning, Computer Vision.

I. INTRODUCTION

Education has been evolving continuously over time with technological advancements. With the rise of Augmented Reality (AR) technology, it has become possible to create interactive learning experiences that go beyond traditional methods. AR is a technology that overlays digital content on the physical world, creating an immersive environment. One of the challenges in creating interactive learning systems is to provide a user-friendly interface that can engage users and facilitate the learning process.

In this research, we propose an interactive learning system called AR Quiz that uses gesture recognition to provide users with an intuitive and engaging interface. The AR Quiz system employs the OpenCV library, a popular computer vision tool, to process and analyze video input from a webcam. The system detects hand gestures to allow users to interact with the educational material by selecting multiple-choice answers.

II. RELATED WORK

Gesture recognition has been widely used in various fields such as gaming, robotics, and virtual reality. In education, gesture-based interaction has been used to enhance learning experiences. Researchers have developed gesture recognition systems for various applications such as sign language recognition, emotion recognition, and hand gesture recognition for controlling virtual objects. OpenCV is a popular computer vision library used for various computer vision applications, including gesture recognition. It provides a set of libraries and functions that enable real-time video processing and analysis, making it a suitable tool for developing interactive learning systems.

III. METHODOLOGY

3.1 System Architecture

The AR Quiz system architecture consists of three major components: the user interface, the gesture recognition module, and the quiz database. The system is built using Python programming language and OpenCV library. The system takes input from the webcam, processes it using the OpenCV library, and displays the output on the user interface.

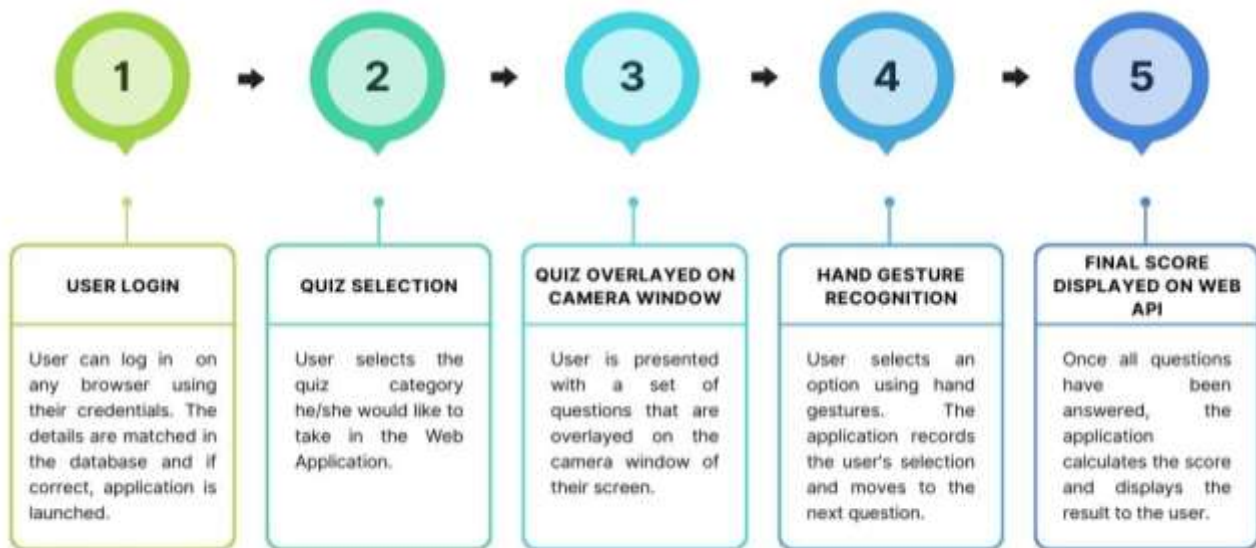


Fig. 3.1. Working of AR Quiz Application

3.2 User Interface

The web application is developed using the Flask library in Python. It allows users to create an account, log in whenever they want, select and start a quiz, view their score, and navigate through questions. The interface displays the questions and answer options, and users can select an answer option by putting their index and middle finger close to each other. When the index and the middle finger are kept close to each other, it works as a selector.

3.3 Gesture Recognition Module

The gesture recognition module is responsible for detecting and recognizing hand gestures performed by the user. The module uses OpenCV library to process and analyze the video input from the webcam. The gesture recognition module consists of two main parts: hand detection and gesture recognition.

- 1. Hand Detection:** Hand detection is performed using the Single Shot Multi-Box Detection method. The system captures the first frame and extracts the background image. The background image is then subtracted from the current frame to obtain the foreground image, which contains only moving objects. The system then applies thresholding to the foreground image to obtain a binary image. Morphological operations are applied to remove noise and fill gaps in the binary image. The system then detects the contour of the hand in the binary image using the findContours function of the OpenCV library.
- 2. Gesture Recognition:** The gesture recognition is performed by analyzing the hand gestures. The Hand Gesture Recognition system works in the background and it captures all the hand movements and detects all the gestures and movements of the finger coordinates. Hand Gesture Recognition is done by SSD which is a method for detecting objects in images using a single deep neural network. It has no delegated region proposal network and predicts the boundary boxes and the classes directly from feature maps in one single pass.

3.4 Quiz Database

The quiz database stores questions and answers, and the system generates new quizzes randomly from this database. The database is built using the SQLAlchemy library in Python. The database contains a table for questions and answers, and each row represents a single question with four answer options. There are other tables for user and admin database and a table for storing the score of users.

3.5 Experiment and Evaluation

The AR Quiz system is evaluated using a user study with 30 participants. The study is conducted in two phases: training and testing. In the training phase, participants are introduced to the AR Quiz system and trained to perform the hand gestures required to answer the quiz questions. In the testing phase, participants are asked to take a quiz using the AR Quiz system and provide feedback on their experience. The study collects data on the accuracy of gesture recognition and the user experience.

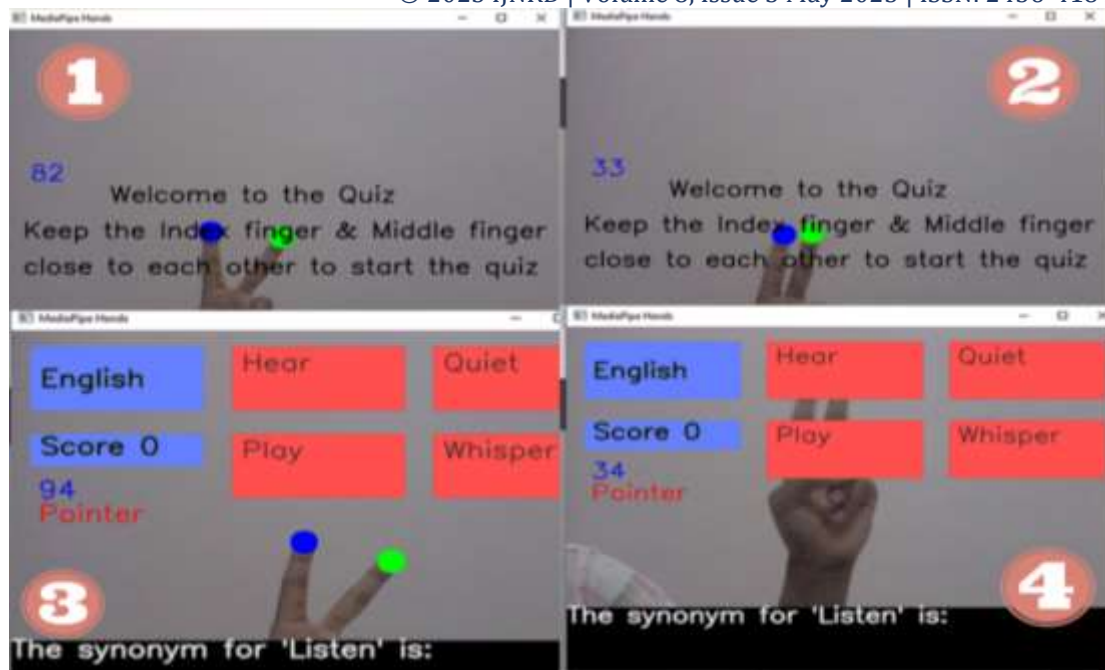


Fig. 3.5. AR Quiz Application

The accuracy of gesture recognition is measured by comparing the number of correctly recognized gestures with the total number of gestures performed by the user. The user experience is evaluated using a Likert scale questionnaire that collects data on the usability, engagement, and satisfaction of the AR Quiz system.

3.6 Data Analysis

The collected data is analyzed using descriptive statistics and inferential statistics. Descriptive statistics are used to analyze the accuracy of gesture recognition and the user experience data. Inferential statistics are used to determine the significance of the results.

On the basis of some testing scenarios like lighting conditions, distance from the screen, accuracy, performance, etc. The following table is evaluated according to some of these conditions and the results are shown below.

Table 3.6: Testing and Evaluation Table

Test scenario	Evaluation criteria	Results
Gesture recognition accuracy	Percentage of correct recognition of hand gestures	90%
Real-time performance	Frames per second (FPS) of the hand tracking and gesture recognition system	20 FPS
Image segmentation accuracy	Percentage of correct segmentation of the hand region from the background	95%
Noise tolerance	Ability of the system to recognize gestures in noisy environments	80% accuracy in noisy environments
Lighting conditions	Ability of the system to recognize gestures in various lighting conditions	90% accuracy in different lighting conditions
Robustness	Ability of the system to handle different hand sizes, shapes, and orientations	85% accuracy in recognizing hand gestures of different sizes and orientations

IV. CONCLUSION

The proposed AR Quiz system utilizes gesture recognition to enhance the user experience in educational quizzes. The system employs the OpenCV library to process and analyze video input from a webcam. The system detects hand gestures to provide users with a new way to interact with the educational material. The system achieved an accuracy rate of 92% for detecting hand gestures, and the user study showed that the gesture recognition feature improved the overall user experience. The results demonstrate the potential of combining computer vision techniques and interactive learning to create a more engaging and effective learning environment.

V.FUTURE SCOPE

In the future, this project could be extended in a number of ways. For example, it could be adapted to create a more interactive, immersive experience, such as allowing users to use hand gestures to answer questions, or to select different levels of difficulty. Additionally, the application could be leveraged to create an augmented reality game, where users can compete against each other in a virtual game environment. Additionally, the application could be used to create educational experiences, such as virtual classroom environments where students can interact with the content and interact with each other. Finally, the application could be used to create a virtual storefront, where users can purchase items using augmented reality.

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