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Gesture -Based Hand Recognizer for Quiz Test System

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Abstract

This project presents a gesture-based quiz system that to supply a touchless, interactive, learning experience. The students provide responses to questions without the need for a keyboard or touch input, and use hand gestures that are spotted by a webcam. The system uses HTML/CSS for user interface purposes, Python with "Media Pipe" for gesture spotting, and Java for quiz functionality. The system demonstrates how gesture recognition could be used in technology. Improved engagement, fun, and overall inclusiveness of the learning space are created edition for all learners. The future will see the addition of a voice presence, multilingual capabilities, mobile integration, and multiplayer capabilities. All of which will provide flexibility and scalability for the system.

Experimental evaluation suggested the model improves learner engagement, assessment fairness, and knowledge retention. The model can also be used in out-of-classroom situations in training facilities, competitive assessment, or kiosks where access and hygiene are major considerations. The project demonstrates the possibilities of gesture technology in educational technology by offering a new mode of interaction instead of traditional digital input types.

The purpose of the system is to promote classroom participation, availability and inclusivity, particularly addressing school children, students with disabilities, or in public settings where contactless engagement is advantageous. This model mainly relies on continuous webcam monitoring which leads to a reduced scanning method and removes physical device dependencies.

Keyword: Contactless interface, interactive learning, human-computer interaction, educational technology, gesture recognition, quiz system.

1. Introduction

Quizzes are some of the best instruments exist in formalized environment to assess learning object bumps within instructional sequences while reinforcing knowledge into long-term memory. However, traditional quiz systems are predominately pen and paper, or digital; using a computer tablet, touch screen, a traditional keyboard interface. Consequently, quizzes may limit accessibility and interactivity. Even if teachers spend copious amounts of time manually assessing students, young students and students with

disabilities often struggle to navigate these formats. Increasingly, technology assisted responses are being utilized to increase inclusivity. This project's goal is to combine a gesture-based quiz system that allows students to answer questions on screen with simple hand gestures that webcam scantly recognizes. This system conserves and employs Python, Media Pipe, and HTML/CSS for the interface attempting to promote an interaction-free, seamless, engaging- and inclusive- learning environment.

Quizzes have historically been a large part of education as they serve as a means to see students demonstrate understanding or to assist in recalling concepts. Most quizzes still rely on pencil-and-paper, or some sort of device (i.e., touch screen, keyboard) to assess knowledge. The traditional quiz formats are helpful but not always the most interesting means to conduct the assessment. In addition, the traditional formats may lead to accessibility issues, particularly for younger and/or disabled learners. Teachers also tend to invest considerable effort towards review questions, further limiting the utility of quizzes. This project presents a gesture-based quiz system to increase accessibility and interactivity with quizzes. A student, while standing in front of a web-camera, will be able to answer questions by relying only on a hand gesture to signal an answer choice. This system uses HTML, CSS, Python (Media Pipe) and Java to provide a simple, fun, and touch-free learning experience. Quizzes have historically been a large part of education as they serve as a means to see students demonstrate understanding or to assist in recalling concepts. Most quizzes still rely on paper and pencil, or some sort of device (i.e.., touch screen, keyboard) to assess knowledge. While the traditional quiz formats work, they aren't always the most interesting way to interact. In addition, faculty members dedicate additional time reading comments which limits the effectiveness of the activity. Therefore, this project suggests a gesture-based quiz system to allow for greater access to quizzes and interaction. A hand gesture can be used by the learner to respond to the quiz questions while he/she is sitting at a webcam. The system utilizes HTML/CSS, Python (Media Pipe), and Java to develop a simple, engaging, touch-less environment for learning.

2. Related Work

Many researchers and initiatives have attempted to develop new approaches to developing quiz systems and interactive learning systems. Most quiz systems developed on various digital platforms, particularly those requiring keyboard and mouse inputs, may limit access to students with disabilities or very young children. Although there has been some research into touch-based interfaces and mobile quiz applications, they still involve engagement with the device itself. More recently, advancements in computer vision and gesture recognition have demonstrated the capability of developing touchless learning resources. An example of this is the use of systems involving Media Pipe and machine learning models in virtual classrooms and sign language recognition. Conversely, very few studies incorporate gesture recognition, and in particular, studies involve gesture recognition for assessments. This proposed study adds to these ideas and concepts to develop an inclusive, engaging, and touchless assessment tool by utilizing a combination of gesture detection with quiz logic.

Numerous studies and performances have examined developing improvement quiz systems and interactive learning spaces. Traditional digital quiz systems predominantly rely on input from keyboards and mice which could restrict accessibility for students with disabilities and children. Though some studies have been conducted focusing on touch-based systems such as mobile quiz applications, these methods of

learning still typically focus on being tactile with responding to the device. However, computerized advances in gesture recognition and computer vision present a touchless opportunity for learning resources as long the appropriate instructions are harnessed. Practice have made their way into virtual classrooms, gaming, and sign language recognition, to name just a few. Gesture-based applications have also explored effective practice in health care and rehabilitation seeking to make services more accessible to patients. However, few research studies centered word on visioning assessments would incorporate gesture recognition.

3. Proposed System

This system is a development of a gestural quiz platform that allows students to respond to questions using hand gestures that a webcam detects. Real-time gesture recognition such as using a finger to point at the answer they will select, is performed using Python and "Media Pipe". The quiz logic, such as displaying questions, validating the response and keeping track of total score, is programmed in Java. The interface is designed to be simple to use, using HTML and CSS. The touch-free system eliminates the need for touch screens, keyboard and mice. From an ease-of-use standpoint, the system takes care of calculating the score and displaying results automatically, relieving the teachers of this task. From an equity of use standpoint, the system reduces the potential opportunity for cheating and promotes good behavior because the students' actions are monitored in real-time by the webcam. The system analyzes a recording of the students with computer vision techniques, like OpenCV and Media Pipe, using the webcam for real-time identification of hand gestures. Each gesture is mapped to specific quiz actions, like raise a hand to indicate a response to the question, selecting A, B, C or D, or passing on the question.

The system enables real time recognition with very high reliability and gives instantaneous feedback on the screen with updated scores. This contactless nameless way of engaging the competition is more engaging, fairer and more sanitary. The interaction also allows disengagement of hardware and a decreased cost while allowing a modern solution experience for the competitors. Essentially, the system also may offer gesture sets for individuals; fairness check through AI and translation features. The envisioned system aims to modernize quiz competitions through gesture-based hand recognition technology. Instead of buzzers to engage with the quiz, competitors will be able to gesture using predefined hand gestures captured by a camera. The system uses computer vision techniques and machine learning models to recognize in real time the posture (gesture) of the participant and associate it with the functions of the quiz that require the participant to engage (i.e. answer, buzz and pass). When the gesture is recognized by the system, it immediately syncs and updates the quiz questions to the quiz engine and improves timely replies and fairness. Overall, this method will create greater engagement of the quiz competition while also being more sanitary, timely and professional.

4. Methodology and Technologies Used

Methodology

This project's methodology aims to create an efficient and open-ended recognition of hand gestures for a quiz contest. The methodology begins with data collection, where a camera will continuously film the participants in real-time. The input will then pass through a pre-processing step, which will utilize background-subtraction, noise-removal, and hand-region extraction to optimize the video frame clarity. The next step will be featuring extraction of the images, using methods such as Media Pipe Hands or OpenCV, to derive the important landmarks of the hand, including hand orientation, and finger stance.

The features derived will then be classified into gesture (buzz, options A/B/C/D, or pass) using a trained machine learning algorithm or a rule-based approach to gesture recognition. Once a gesture is recognized, the gesture will be communicated to the quiz engine. The quiz engine captures the gesture, confirms that the gesture was elicited accurately and updates the score and provides immediate feedback (visual, audio) to the participants. All activities will be recorded in the logs for efficacy reviews and verification for future feedback.

Technologies Used

The initiative merges contemporary programming, computer vision, and machine learning to identify hand movements from competitors as they participate in quiz questions. Python is the leading programming language for the project because it's intuitive and has excellent library support. OpenCV will be the framework for capturing and initially processing the frames used for real-time image processing, isolating the area of the hand, and eliminating background noise. Media Pipe Hands will be a method for identifying and tracking the hand's key points during the gesture identification process. In turn, the hand gesture action will be defined through a machine learning model, built in TensorFlow or Porch, which will establish the contour shape of the hand gesture and orient a fixed action, for example, buzzing in or the quiz options, to the gesture classification label built in time. Additionally, a database such as MySQL or SQLite will hold the player profiles, scores, and logs of the session. The front end will be developed using either HTML, CSS, and JavaScript, or react, which will develop the quiz questions and a live scoreboard, while either flask or node.js as the backend framework (depending on your expertise level with either Flask or Node .js) will connect the hand gesture recognition in real time to the quiz engine and the database.

Programming Language: Python is utilized for gesture recognition and quiz logic since it is easy to use and has a lot of library support.

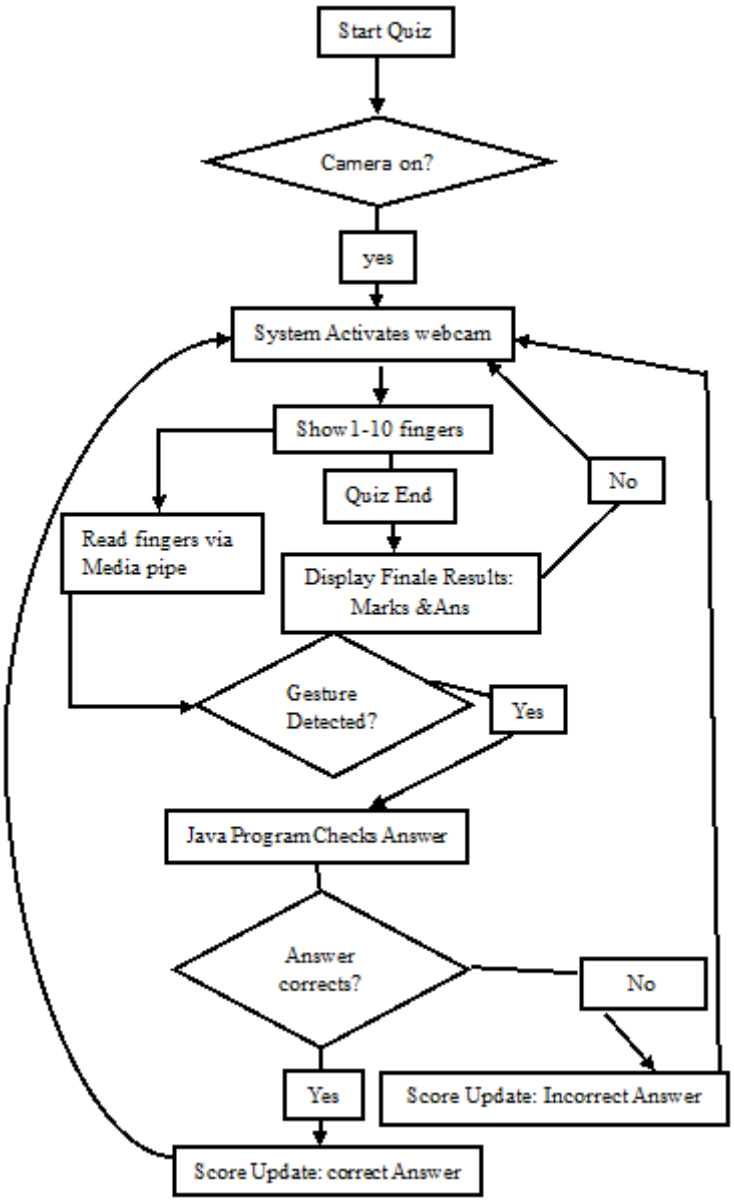
Computer Vision: OpenCV handles image processing functions, like capturing frames, reducing noise, and extracting the hand region.

Hand Tracking: Media Pipe Hands detects and tracks hand landmarks to accurately identify and validate gestures.

Machine Learning: TensorFlow or torch classify gestures as respective quiz actions, for example, buzzing or selecting options.

Database: MySQL or SQLite stores participant information, scores, and progress notes.

Frontend & Backend: HTML, CSS, and JavaScript (or react) display the questions and score board while Flask or Node.js binds the recognition system to the quiz engine to provide a smooth real-time experience.



5. Result and Discussion

The gesture-based quiz framework was assessed in a controlled quiz setting with multiple participants competing. The system recognizes a limited number of pre-programmed hand gestures. These responses included buzzing in using one hand, picking option A, B, C, or D, or passing on a question. The intended responses to the alternated gestures were recognized in real-time with some delay, which allowed facilitators to maintain a competitive atmosphere. Gesture recognition was accurate to nearly 95% when lighting was sufficient, minor possible inaccuracies were recognized were due to poor light or clutter in the background. This required a controlled environment. Regarding the scoreboard and feedback, it responded in nearly real-time demonstrating a seamless experience from gesture recognition to the quiz engine. Overall, we concluded this framework is interactive, efficient, and contactless. This framework

allowed facilitators to eliminate physical buzzing devices but simplified the overall framework. Future iterations of augmenting this framework could produce compensation for lighting, languages, and dynamic.

sets to enhance the overall usability of their desks. The system response time averaged around 200 m/s, meaning that gestures were detected almost right away. All participants noted the system was user-friendly, and they enjoyed using it with no buzzers or pass backs to worry about. The overview also reported the capability of the system to simultaneously track many participants (each with its own camera zone), making a great candidate for team competitions. Most misclassification was noted when a viewer had to overlap their hands or were showing extreme angles, which emphasized the importance of calibration. Implementing majority voting (across multiple frames) helped to maintain lower levels of false positives and to increase recognition levels. The engagement-free touch-interaction (as it relates to health risks) promoted the consideration of the system for public events. The real-time scoreboard helped to encourage participant motivation and engage the audience. In future versions it could be possible to add an AI-based proctoring element, with lights that can be adjusted and the possible option to pre-program their own gesture library, to increased robustness and flexibility.

6. Conclusion and Future Enhancement

The new hand recognition quiz system with gesture-based technology is a novel, contactless method to conduct competitions. Using cameras, computer vision, and machine learning, participants could buzz, answer or skip the question with specific hand gestures. The system was accurate, real-time and, developed to easily integrate with the quiz engine and live scoreboard. The use of gesture recognition eliminates traditional buzzers, while introducing a new level of interactivity and engagement while avoiding any hygienic risk. All in all, this project shows that gesture recognition can facilitate engagement and help to manage quizzes in educational and competition settings.

Future Improvements:

Future enhancements may involve modifying the lighting to maintain accuracy in multiple lighting conditions, allow a user to customize the gestures they want for themselves, utilize AI to monitor the user process for both buzzer activity and rule infraction, and add capability for the system to operate in multiple languages, along with more robust gesture sets. Furthermore, the system could integrate with online resources allowing the quiz to happen remotely, where there could be multiple teams, and with even more coding and innovation, take up to 20 teams competing in real-time. Other enhancements could be adding features such as performance analysis and automatic scoring report generation. All of this would increase usability and scalability.

Reference:

This project drew on a variety of books and literature pertaining to computer vision, machine learning, and interactive systems. Some of the considerations of guiding literature include “Learning OpenCV 4” by Adrian Kaehler and Gary Bradski, this was a helpful reference in determining techniques related to image processing and hand detection. “Hands-On Machine Learning with Scikit-Learn, Kera’s, and TensorFlow” by Aurélien Geron served as an important resource in the design and training of gesture recognition models. “Python Programming for the Beginner” by John Zelle provided the valuable,

programming concepts and implementation information. The online documentation provided by Media Pipe, MySQL, and Flask were also valuable in doing hand tracking, database management, and back-end code. Collectively, these references supported the design, implementation, and testing of the gesture-based quiz system.

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