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NeoBord :AI Based Futuristic Learning Software – Black Board

Prof. P. S. Takawale[1], Deshmukh Rohit[2], Bhapkar Jeet[3], Shelar Aditya[4], Chavan Abhay[5]

Department of Computer Engineering

SB Patil College of Engineering, Indapur, Pune, India[1,2,3,4,5]

takawalepriya5@gmail.com[1],rohitn2018@gmail.com[2],jeetajinathbhapkar@gmail.com[3] ,adishelar1230@gmail.com[4] , chavanabhay2002@gmail.com[5]

Abstract: Education often struggles with engagement, inclusivity, and adaptability to diverse learning styles. NEOBOARD addresses this by offering a gesture-driven intelligent platform that integrates AI, computer vision, and speech processing to create an immersive environment for solving problems. Learners interact with a Virtual Blackboard using hand gestures, voice commands, or text inputs. Real-time gesture recognition and speech-to-text conversion allow Google Gemini AI to interpret queries, solve problems instantly, and provide immediate feedback. Developed with Streamlit and MongoDB, the system ensures an intuitive, secure, and scalable interface suitable for classrooms and remote learning. By combining AI with interactive, multimodal learning, NEOBOARD enhances accessibility, engagement, and personalized education experiences.

Keywords: Artificial Intelligence, Computer Vision, Gesture Recognition, Hand Tracking, Virtual Blackboard, Speech-to-Text Conversion, Real-Time Processing, Interactive Learning, Educational Technology, Multimodal Input, Human–Computer Interaction, Google Gemini AI, Streamlit Framework, MongoDB Integration.

I INTRODUCTION

In the rapidly advancing field of education, technology has become a crucial tool for enhancing engagement, inclusivity, and learning efficiency. Mathematics, being a core

subject, often poses difficulties for students because of its abstract symbols and conceptual complexity. Traditional instructional methods—whether chalk-and-board teaching or static digital lessons—frequently fail to accommodate diverse learning preferences and accessibility requirements.

To bridge this gap, NEOBOARD: AI Based Futuristic Learning Software – Black Board introduces an innovative multimodal learning platform designed to revolutionize Problem interaction. The system integrates Gesture Recognition, Speech-to-Text, and Artificial Intelligence to create a highly interactive and dynamic problem-solving environment. Its primary objective is to modernize the traditional blackboard experience by combining intuitive gestures, voice commands, and intelligent automation.

With NEOBOARD, learners can draw equations or symbols in the air using hand tracking powered by OpenCV and CVZone, or verbally express problems through the Google Speech Recognition API, which are then converted into text. The inputs are processed by Google

Gemini AI, providing real-time analysis, solutions, and feedback. The user interface,

developed with Streamlit, ensures simplicity and accessibility, while MongoDB manages secure authentication and data storage.

II LITERATURE SURVEY

A. Hand Gesture Recognition for Interactive Learning:

Smith & Lee proposed a gesture-based framework using computer vision (HSV skin segmentation, contour detection) to recognize hand gestures like selecting, writing, and zooming. Implemented with standard webcams, it avoids specialized sensors, ensuring scalability and cost-effectiveness. Preprocessing techniques improved robustness under varying lighting. Tests in middle schools showed increased engagement, learning speed, and motivation, supporting AI-driven gesture recognition for interactive education.

B. Problem Solving Using Vision-Based Gesture Recognition:

Kumar & Patel developed a webcam-based system for problem-solving via hand gestures. Using background subtraction, YCbCr skin filtering, contour analysis, and Hu Moments, gestures were mapped to arithmetic operations. Adaptive thresholding and Gaussian filtering improved accuracy under variable lighting. Evaluations with grades 5–8 showed better engagement, comprehension, and confidence, supporting inclusive, kinesthetic learning and potential AI tutoring integration.

C. Mobile Applications for Gesture-Based Education:

Chen & Gomez reviewed mobile apps using gesture recognition to enhance learning across domains. They emphasized simplicity, real-time feedback, and adaptive difficulty. Intuitive gestures (swiping, pinching) reduce interface complexity, while instant feedback fosters reflection and self-correction, improving engagement and supporting differentiated instruction.

D. Deep Learning Approaches to Gesture Recognition:

Johnson & Singh explored deep learning, particularly CNNs, to enhance gesture recognition in dynamic environments, addressing limitations of traditional methods such as sensitivity to lighting, limited adaptability, and restricted gesture vocabularies. Challenges like inter-user variability, occlusions, motion blur, and background clutter were tackled using architectures like LeNet, AlexNet, MobileNet, and ResNet, achieving higher accuracy than SVM, Random Forest, and KNN. MobileNet excelled on mobile platforms with over 90% real-time accuracy. Techniques like transfer learning, data augmentation, quantization, pruning, and on-device acceleration improved deployment practicality. The study highlights applications in education, enabling gesture-controlled interfaces for math, science, and language learning, supporting inclusive interaction for children, neurodiverse learners, and individuals with physical impairments.

III LIMITATIONS OF EXISTING WORK

Current Education relies heavily on traditional methods like paper exercises, static tutorials, and basic calculators, offering limited interactivity and intuitive learning. These approaches lack natural, gesture-based interaction, making it harder for students to visualize complex concepts. Existing tools often provide delayed or non-personalized feedback and may require specialized hardware, limiting accessibility. Key issues include limited availability of gesture- based tools, high cost, technical complexity, and inconsistent recognition accuracy. While interactive methods can boost engagement, motivation, and support diverse problem types, current systems remain insufficient for modern, inclusive, and immersive Learning.

IV MOTIVATION

Effective education benefits from interactive learning, which improves engagement, retention, and understanding. Traditional methods often fail to accommodate diverse learning styles, leading to disengagement. NEOBOARD addresses this by combining hand gestures, speech input, and AI-driven feedback to create an intuitive, multimodal platform. It supports inclusive learning for students with motor or speech impairments and provides real-time guidance via Google Gemini, enabling self-paced, accessible, and engaging education through a user- friendly Streamlit interface.

V PROPOSED SYSTEM

NEOBOARD is a web-based platform that enables students to solve problems using natural hand gestures, offering an **interactive and engaging learning experience.**

A. System Architecture

1. Gesture Recognition: Captures live video and uses computer vision and machine learning to detect hand gestures for Problem inputs.

2. Problem Solver: Converts gestures into expressions and computes solutions for arithmetic, algebra, and basic calculus.

3. User Interface: Displays gestures, expressions, and results in real time, with guidance and feedback to enhance learning.

4. Data Management: Stores user interactions and performance metrics for personalized learning.

5. Scalability & Security: Supports additional topics while ensuring user data privacy.

B. Technology Stack

Python, NumPy/SymPy, MongoDB, TensorFlow Lite, MediaPipe, OpenCV (via Flutter), with development in IDEs like VS Code, PyCharm, or Jupyter.

C. Workflow

1.Capture live video → preprocess frames → extract hand features
2.Recognize gestures → convert to Problem expressions
3.Solve problems → display results and feedback
4.Log interactions for tracking and personalization

VI DISCUSSION / BENEFITS

The proposed system offers several key advantages for enhancing learning. By enabling physical engagement through hand gestures, it promotes a deeper understanding of Problem concepts. The interactive nature of the platform also helps to increase student motivation, making learning more engaging and enjoyable. Additionally, it supports a wide range of Problem problem types, from basic arithmetic to algebra and calculus, allowing for diverse learning experiences. The system provides real-time feedback and adaptive learning, helping students to identify and correct mistakes immediately, which fosters self-paced learning. Furthermore, its compatibility with mobile platforms enhances accessibility and convenience, enabling students to use the system anytime and anywhere.

VII CONCLUSION

NEOBOARD integrates gesture recognition, speech-to-text, and AI into a web-based platform to transform Learning. Using hand gestures or voice input, students can interactively solve problems, with generative AI providing instant solutions and real-time feedback. The system enhances engagement, motivation, and accessibility, supporting learners with diverse needs. NEOBOARD showcases how AI-driven human-computer interaction can create intuitive, inclusive, and personalized education, laying the groundwork for future intelligent learning tools.

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