International Journal of Electrical, Electronics and Computer Systems
ISSN: 2347-2820
Volume 15 Issue 01 (2026) | Pages: 74-80

A Comprehensive Result Paper on NeoBord: AI Based Futuristic Learning Software – Black Board

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Peer Review Information

***Type**: Article*
***Received**: 22 March 2026*
***Revised**: 06 April 2026*
***Accepted**: 24 May 2026*
***Published**: 05 June 2026*

Abstract

NeoBoard: AI-Based Futuristic Learning Software – Blackboard is an intelligent digital learn-ing platform designed to transform traditional education methods through advanced artificial intelligence and inter-active technologies. The system integrates speech recog-nition, gesture control, computer vision, and AI-based tutoring to provide a seamless and engaging learning expe-rience. Developed using Python and Streamlit, NeoBoard enables users to interact with a digital blackboard using voice, text, and hand gestures.

The platform leverages Natural Language Processing (NLP) and multimodal AI models to deliver accurate, step-by-step explanations for academic queries. It supports real-time voice-to-text conversion, gesture-based drawing, and AI-powered analysis of images and documents. The system also includes secure authentication and role-based access for teachers and students.

NeoBoard uses MongoDB for data storage and allows users to save, manage, and share notes efficiently. Its modular architecture ensures scalability and flexibility for future enhancements. Overall, the project demonstrates how AI and interactive technologies can be combined to create a smart, efficient, and futuristic educational environment.

Keywords: Artificial Intelligence; Smart Blackboard; Gesture Recognition; Speech Recognition; Natural Language Processing; AI Tutor; Multimodal AI; Streamlit Application; Computer Vision; OpenCV; Voice Interaction; Real-Time Learning System; Educational Technology; Interactive Learning; MongoDB; Human–Computer Interaction.

How to Cite This Article

Takawale, P. S., Deshmukh, R., Bhapkar, J., Shelar, A., & Chavan, A. (2026). A comprehensive result paper on NeoBord: AI-based futuristic learning software–black board. *International Journal of Electrical, Electronics and Computer Systems*, 15(1), 74–80.

Introduction

NeoBoard is an AI-based learning system de-veloped to modernize classroom interaction and improve digital education. With the rapid growth of artificial intelligence, there is a need for smart systems that enhance learning through automation and interactivity. NeoBoard addresses this need by providing an intelligent digital blackboard.

The system allows users to write, draw, and interact using voice commands, text input, and hand gestures. It integrates speech recognition for voice input, computer vision for gesture detection, and AI models for answering queries and solving problems. This combination creates a natural and user-friendly interface.

NeoBoard is designed for both students and teachers, offering features like note saving, AI tutor-ing, and gesture-based control. The system is easy to use and can be extended with advanced features in the future, making it a scalable and efficient educational solution.

Literature Survey

1. Multimodal AI Models for Intelligent Systems Google DeepMind [4] introduced Gemini, a multi-modal AI model capable of processing text, images, and audio inputs. Their work demonstrates how a unified AI system can handle diverse data types, enabling applications like NeoBoard to perform intelligent analysis of images, documents, and text-based queries.

2. Large Language Models for AI Tutoring Sys-tems Brown, T. et al. [2] and OpenAI [3] explored large language models such as GPT, which can gen-erate human-like responses and provide step-by-step explanations. Their research forms the foundation for AI-based tutoring systems that assist users in solving complex problems interactively.

3. Gesture Recognition using Computer Vision Zhang, D. and Lu, J. [5] conducted a survey on gesture recognition techniques using computer vi-sion. Their work highlights methods for detecting and interpreting hand movements, which are essen-tial for implementing gesture-based interaction in NeoBoard.

4. OpenCV for Real-Time Image Processing Bradski, G. [6] introduced the OpenCV library, which provides efficient tools for real-time image processing and computer vision. It plays a crucial role in enabling gesture detection and visual inter-action in the system.

5. Speech Recognition using Neural Networks Graves, A. et al. [7] proposed deep recurrent neu-ral networks for speech recognition, improving ac-curacy in converting voice input into text. This technology is fundamental for enabling voice-based interaction in NeoBoard.

6. Speech Processing Systems Paliwal, K. K. et al.[8] discussed speech recognition techniques using neural networks, emphasizing their effectiveness in building robust voice-controlled systems. Their work supports the implementation of speech-to-text features in the platform.

7. Computer Vision Fundamentals Szeliski, R.[11] presented core concepts of computer vision, including image processing and feature detection. These techniques are essential for gesture tracking and visual data analysis in interactive systems.

8. Streamlit for Interactive Application Develop-ment Streamlit Inc. [9] provides a framework for building interactive web applications using Python. It enables rapid development of user interfaces, which is used in NeoBoard to create a dynamic and user-friendly blackboard system.

9. Database Systems for Data Management Mon-goDB Inc. [10] introduced a NoSQL database sys-tem designed for scalable and flexible data storage. It is used in NeoBoard for managing user data, notes, and application state efficiently.

Limitations of Existing System

Through comprehensive analysis of existing liter-ature and current digital learning platforms, several critical research gaps have been identified that the proposed *NeoBoard: AI-Based Futuristic Learning Software – Black Board* aims to address:

- Integration Challenges Existing educational tools often operate as standalone systems, lacking seamless integration between voice input, gesture control, AI assistance, and note management. This results in fragmented learning experiences and re-duced productivity.
- Limited Interactive Learning Traditional digital boards and e-learning platforms primarily support static content input (typing or drawing) with mini-mal real-time interaction.
- Inefficient Voice-to-Text Systems Many exist-ing systems provide inaccurate or delayed speech recognition, especially in diverse accents and noisy environments, limiting usability in real classroom scenarios.
- Lack of Intelligent Assistance Current black-board or whiteboard applications lack advanced AI capabilities for solving

problems, explaining con-cepts, or analyzing uploaded content, making them passive tools rather than active learning assistants.

- Gesture Recognition Limitations Existing gesture-based systems are either hardware-dependent or lack precision and reliability, restricting their adoption in practical educational environments.
- Poor Note Management and Accessibility Many platforms do not provide efficient mecha-nisms to store, organize, and retrieve notes, espe-cially across devices or users, leading to loss of important learning materials.
- Context Awareness Deficiency Most systems fail to maintain contextual understanding across interactions (voice, text, or images), resulting in less accurate AI responses and reduced learning efficiency.

Problem Statement

Traditional and existing digital learning systems lack interactivity and intelligent assistance. Most systems depend on manual input and do not support real-time voice or gesture interaction. This reduces engagement and efficiency in learning.

Additionally, these systems fail to integrate multi-ple technologies such as AI, speech recognition, and computer vision into a unified platform. They also lack proper note management and personalization features.

Hence, there is a need for a smart system like NeoBoard that provides an integrated, interactive, and AI-powered learning experience.

Proposed System

NeoBoard is an AI-powered interactive learning platform that combines voice, gesture, and AI tech-nologies. It provides a digital blackboard where users can write, draw, and interact naturally.

The system includes an AI tutor that can an-swer questions, analyze images, and process docu-ments. It also supports voice-to-text conversion and gesture-based drawing.

The platform ensures secure user authentication and allows saving and sharing notes. Its modular design makes it scalable and adaptable for future enhancements.

System Requirements

Database Requirements

- MongoDB (for user data and notes storage)

Software Requirements (Platform Choice)

- Operating System: Windows 10 / Windows 11
- IDE: VisualStudioCode, PyCharm
- Programming Language: Python 3.7 or higher
- Required Libraries: SpeechRecognition, PyAudio, OpenAI, OpenCV, pyzbar, qrcode, pygame, Flask/FastAPI, Tkinter/PyQt
- Web Browser: Chrome, Edge, or Firefox (for web-based features and API testing)

Hardware Requirements

- Processor: IntelCorei3 or higher
- Speed: 2.4GHz or higher
- RAM: 4GB minimum (8 GB recommended for smooth performance)
- Hard Disk: 200GB minimum storage
- Audio Devices: Microphone and speakers/-headphones for voice interaction
- Camera : Webcam for face recognition and emotion detection
- Internet Connection: Stable broadband for on-line features like AI chat, news, and weather updates

Methodology

The project follows a structured methodology that begins with requirement analysis, followed by system design and iterative implementation of the Alfred X Wayncore Assistant.

Data Collection and Preprocessing

The system depends on multiple real-time and stored data sources.

Voice and Command Data

- User voice input is captured using a micro-phone and converted into text using speech recognition libraries.
- Command datasets and predefined queries are stored for accurate response generation.
- Data is preprocessed to remove noise and im-prove recognition accuracy.

Image/Data Input

- Images and PDFs uploaded by users
- Processed using AI models

AI Processing Engine

Speech Recognition

- Converts voice input into text using speech-to-text techniques.
- Uses NLP to understand user intent

AI Tutor System

- Uses Gemini AI for accurate responses
- Handles text, image, and document queries

System Development and Integration

User Interface Layer

- A simple interface allows users to interact through voice or text commands.
- Provides feedback through audio responses us-ing text-to-speech.

Application Logic Layer

- Python-based backend handles speech recogni-tion, NLP processing, and task execution.
- Libraries such as SpeechRecognition, opencv , and APIs are used for functionality.

Data Storage Layer

- Stores user data and notes using MongoDB like note etc

Gesture Recognition Module

- Uses OpenCV and cvzone
- Detects hand gestures actions like drawing, erasing, and color change

System Workflow

User Workflow

1. User logs in
2. Interacts via voice, text, or gestures
3. System processes input
4. AI generates response
5. Output displayed on blackboard

System Workflow

1. Input is received through microphone or text.
2. Speech-to-text conversion is performed.
3. Ai/NLP processing identifies user intent.
4. Task execution module performs the required action.
5. Output displayed

Result Discussion

NeoBoard successfully demonstrates the imple-mentation of an AI-based interactive learning sys-tem. The platform allows users to write, draw, and interact using voice and gestures. The AI tutor provides accurate and helpful responses, improving learning efficiency. The gesture recognition system works effectively under proper lighting conditions, enabling intuitive interaction. Voice recognition performs well but may be affected by background noise. The system provides a smooth and user-friendly interface.

However, performance depends on internet con-nectivity for AI features. Some limitations include gesture accuracy in complex environments and de-pendency on external APIs. Overall, NeoBoard proves to be a powerful and practical solution for modern education,

with strong potential for future improvements.

Result Output

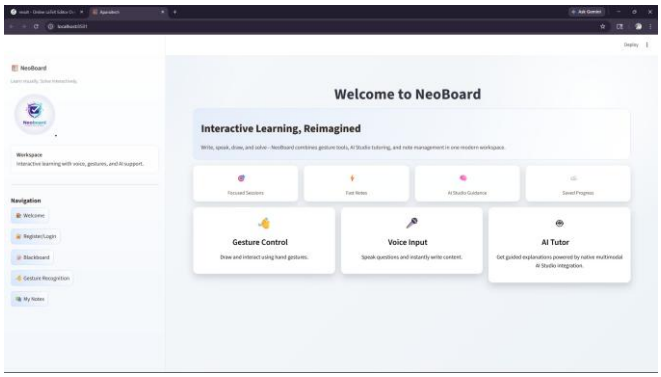

Fig. 1. *Result 1*

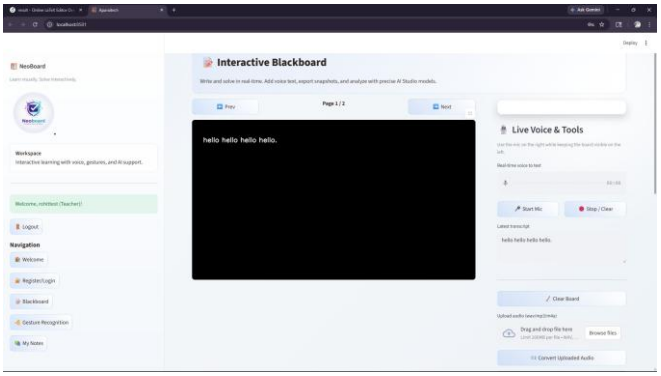

Fig. 2. *Result 2*

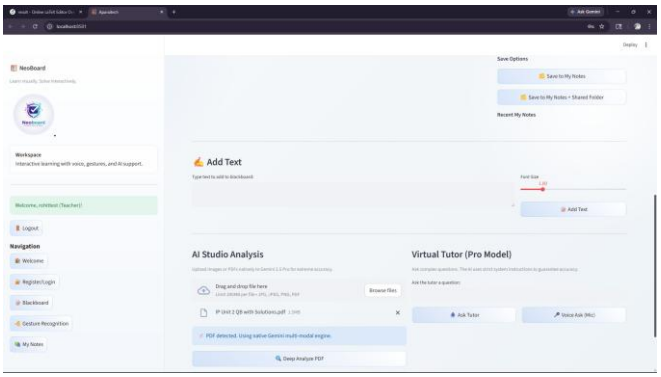

Fig. 3 *Result 3*

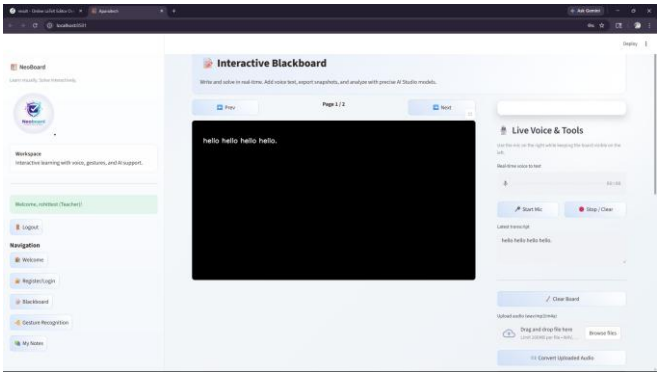

Fig. 4. *Result 4*

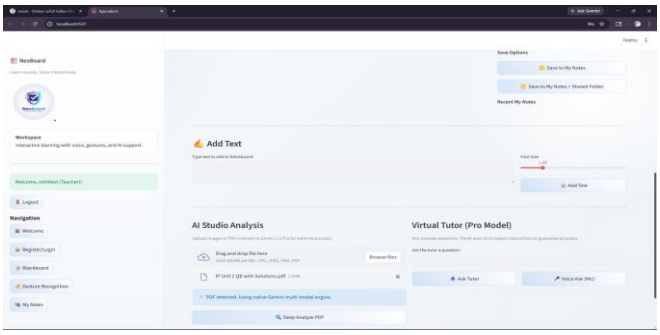

Fig. 5. *Result 5*

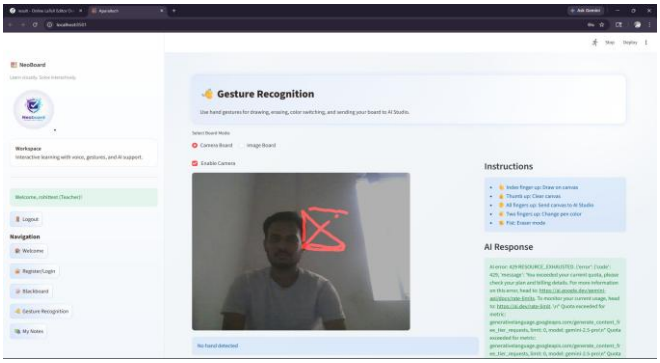

Fig. 6. *Result 6*

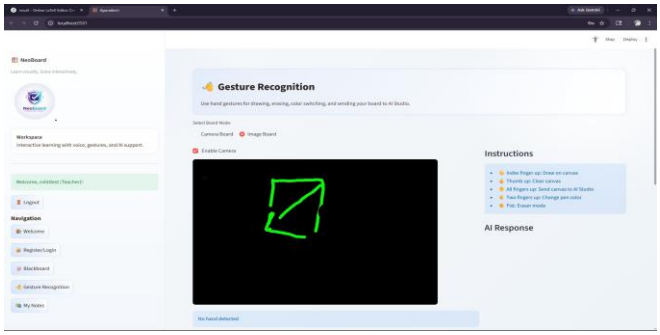

Fig. 7. *Result 7*

It also provides a scalable foundation for future advancements in smart learning systems.

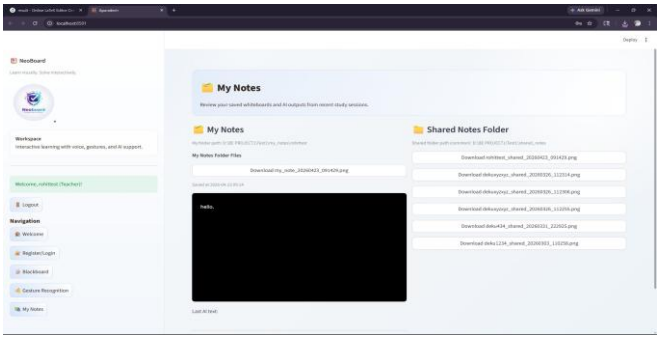

Fig. 8. *Result 8*

Conclusion

NeoBoard is a futuristic AI-based learning plat-form that enhances digital education through intel-ligent and interactive technologies. By combining speech recognition, gesture control, and AI tutoring, it provides a unique and efficient learning experi-ence. The system successfully demonstrates how artifi-cial intelligence can be integrated into education to improve accessibility, engagement, and productivity.

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