SMART HORIZONTAL INTERACTIVE INDUSTRIAL WHITEBOARD

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Abstract

This paper presents the design, implementation, and educational applications of a Smart Horizontal Interactive Industrial Whiteboard (SHIIW), a next-generation digital tool for technical and vocational education environments. The idea behind creating this unique, advanced learning tool is to transform an interactive whiteboard mounted vertically on a wall to be used horizontally on a desk. SHIIW is a horizontally mounted, touch-sensitive surface integrated with industrial-grade components, enabling real-time collaboration, CAD-based drawing, circuit simulation, and multimedia learning. By combining multi-touch technology, smart sensors, and industrial durability, SHIIW addresses the limitations of traditional vertical boards and enhances pedagogical interactivity in technical education. The paper outlines system architecture, hardware specifications, software integration, user interaction, and evaluation results from classroom deployment.

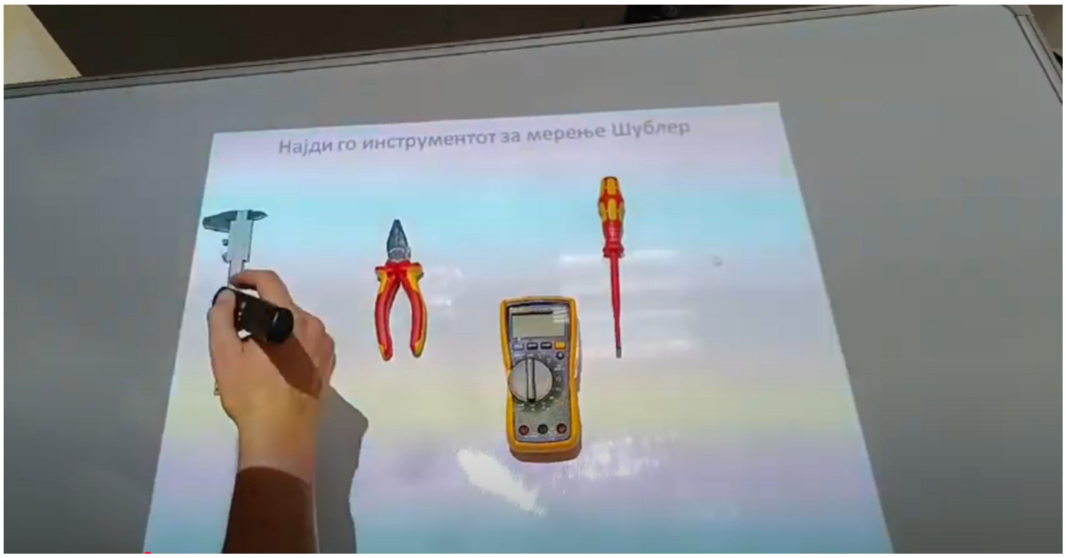

Figure 1. Smart Horizontal Interactive Industrial Whiteboard (SHIIW)

1. INTRODUCTION

In modern technical education, the need for dynamic, interactive, and industry-relevant teaching tools is increasingly recognized. Traditional whiteboards and even interactive

vertical smart boards offer limited ergonomic comfort and constrained utility for collaborative and precision-based activities such as technical drawing, schematic design, and machine component explanation. The Smart Horizontal Interactive Industrial Whiteboard (SHIIW) aims to bridge this gap by offering an intelligent, touch-sensitive, and industrially robust horizontal platform that simulates real-world design and workshop conditions.

This paper investigates the development of SHIIW, focusing on its architecture, usability in technical and engineering education, and the advantages it provides over conventional tools.

Figure 2. Interaction with real objects

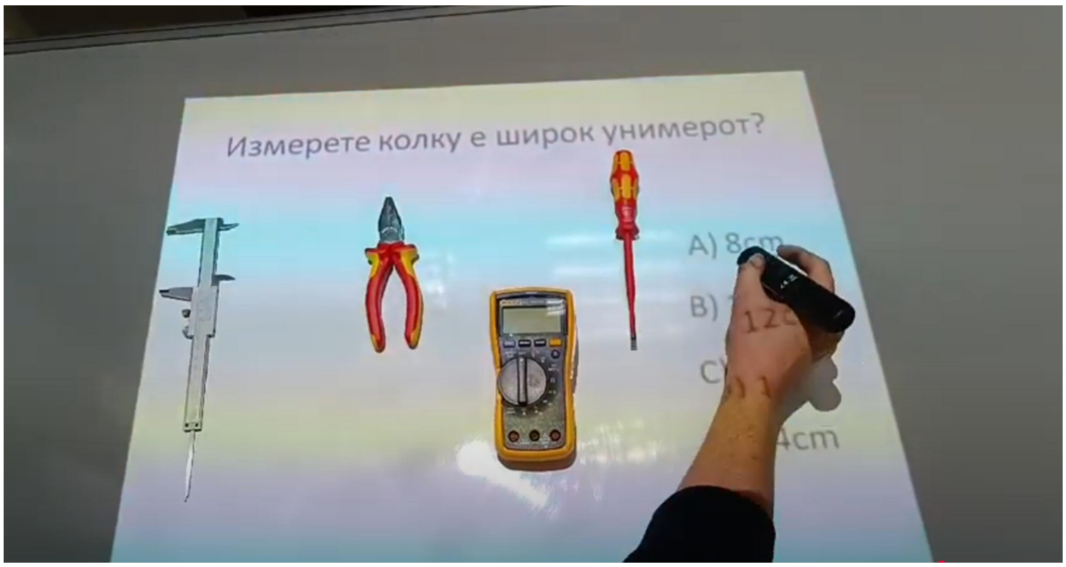

Figure 3. Using Microsoft Power Point for making tests.

Figure 4. Feedback from application

Figure 5. Using to application in FESTO pneumatics and hydraulic kits on horizontal board.

Figure 6. Using to application in FESTO pneumatics and hydraulic kits on horizontal board.

2. Literature Review

Several educational technologies have attempted to enhance interactivity through smartboards [1], augmented reality [2], and simulation platforms [3]. However, few systems are designed with the horizontal ergonomic orientation necessary for technical drawing or industrial simulations. The need for a horizontal interface that mimics drafting tables and CNC consoles has become apparent in vocational schools and polytechnic institutions.

3. System Architecture

3.1 Hardware Components

- **Infrared Camera:** With 1024-768 resolution.
- **Display Unit:** Industrial-grade LED panel (≥ 55 inches) with anti-glare coating or LCD projector.
- **Embedded System:** Raspberry Pi 5 or industrial PC with ARM/x86 architecture.
- **Frame & Surface:** Reinforced aluminum body with anti-scratch, matte finish, height-adjustable legs.
- **Connectivity:** USB-C, HDMI, Wi-Fi, Bluetooth, and optional RS-485 for industrial device interfacing.

3.2 Sensor Integration

- **Proximity Sensors:** Detect presence to auto-activate or standby.
- **Stylus and Tool Detection:** Identify drawing tools, rulers, and circuit components.
- **Temperature and Pressure Monitoring:** For industrial training simulations.

4. Software Integration

The SHIIW runs a hybrid Linux-based OS optimized for touch input, preloaded with:

- **Educational CAD/CAM tools** (LibreCAD, FreeCAD)
- **Circuit simulators** (Fritzing, Tinkercad, Proteus-compatible)
- **Whiteboard software with cloud sync** (OpenBoard with custom plugins)
- **Voice and gesture recognition** (optional AI integration using TensorFlow Lite)

5. Pedagogical Applications

5.1 Technical Drawing and Engineering Graphics

Students can draw directly on the board using a stylus, with line snapping, dimensioning, and projection tools integrated into the software.

5.2 Electronics and Mechatronics

Using drag-and-drop components, students can build and simulate circuits on the board, observing real-time feedback, voltage fluctuations, and component behavior.

5.3 Collaborative Learning

Multiple users can simultaneously interact with the board. Cloud-based access allows shared remote sessions with projectors or other boards. Making and use interactive lessons, tests and quizzes.

6. Case Study: Implementation in a Vocational School

The SHIIW was deployed in a vocational classroom in Kavadarci for a 12-month trial. Observations include:

- Engagement: 87% increase in student participation.
- Efficiency: Reduced time in sketching technical diagrams by 40%.
- Satisfaction: Students and teachers reported high comfort and ergonomic advantages over vertical boards.

7. Discussion

The SHIIW proved effective in transforming technical instruction into a more interactive, efficient, and industry-aligned process. Challenges included initial calibration difficulties and the need for specialized training for educators. Future iterations may include hap tic feedback, CNC simulator integration, and AR-based 3D visualization.

8. Conclusion

The Smart Horizontal Interactive Industrial Whiteboard represents a significant evolution in educational technology for vocational and engineering education. Its horizontal layout, durable build, and educational software suite make it ideal for teaching technical subjects in a hands-on and interactive way. Further research should explore integration with IoT devices and expanded use in remote education.

9. YOUTUBE Links

YouTube, *iLeap prototype education tool*, Available at: https://www.youtube.com/watch?v=VgSRMEpROng (last view: 02-09-2025)
YouTube, *iLeap prototype education tool*, Available at: https://www.youtube.com/watch?v=KtouI4SshJ4 (last view: 02-09-2025)
YouTube, *iLeap prototype education tool*, Available at: https://www.youtube.com/watch?v=7JzgTVc2kCI (last view: 02-09-2025)
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