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Artificial Intelligence Integration in Smart Display Systems: Toward Intelligent Scheduling Interfaces in IoT Environments

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Abstract: The integration of Artificial Intelligence (AI) with Internet of Things (IoT) technologies presents promising opportunities for transforming static scheduling boards into dynamic, intelligent systems. This research proposes a smart display system that combines AI-based predictive scheduling, real-time cloud APIs, and ESP32 microcontrollers for use in educational and organizational environments. By integrating user personalization, edge computing, and augmented reality (AR), the system enables context-aware scheduling with reduced latency and increased adaptability. The prototype demonstrates enhanced efficiency, energy optimization, and dynamic multi-user support, indicating a shift toward intelligent communication interfaces.

Keywords: Smart Display, Artificial Intelligence, IoT, Scheduling Systems, ESP32, Augmented Reality, Edge Computing

I. Introduction

Traditional scheduling systems in academic and professional environments often rely on static or manually updated digital displays. These systems lack adaptability and real-time responsiveness, leading to inefficiencies and communication delays. With advancements in IoT technologies, particularly microcontrollers like ESP32 and LED matrix displays, there is significant potential to develop smarter, more responsive systems. However, achieving true intelligence requires the integration of AI models capable of predicting and adapting to user-specific scheduling needs. This paper explores the integration of AI into smart display systems to develop predictive, context-aware communication platforms.

II. Related Work

Prior studies have explored intelligent signage systems in transportation using deep learning and neural networks (Yu & Qi, 2023; Chen et al., 2021). These implementations demonstrate the potential for predictive updates, but are often domain-specific. Edge computing and mobile integration have enabled AI capabilities in low-power devices (Liu et al., 2025), but applications in academic scheduling remain underdeveloped. Research into AR-enhanced smart campuses also supports the feasibility of overlaying interactive timetables, though such systems lack full integration with AI prediction modules and real-time feedback mechanisms.

III. Materials and Methods

Hardware Components:

- ESP32 microcontroller
- P10 LED matrix display
- Relay module, capacitors, regulated power supply

Software Tools:

- Arduino IDE (C/C++)
- ThingSpeak API

- MQTT protocol (optional)
- Vuforia SDK for AR

AI Module:

- Predictive scheduling using reinforcement learning and calendar clustering

Data Pipeline:

- Cloud input → ESP32 parser → Display output (under 3 seconds latency)

System validation was conducted in a simulated academic setup with dynamic timetable changes to evaluate responsiveness and personalization.

IV. System Architecture

Layer	Functionality
Display Unit	P10 LED matrix with ESP32 firmware
Cloud Connectivity	Schedule updates via ThingSpeak API
AI Prediction Module	User-contextual timetable adjustments
AR Integration	Mobile-based visual overlay using Vuforia
Control Protocols	Real-time updates via MQTT/HTTP triggers

V. Results

Performance comparison between traditional and AI-based display systems:

Metric	Traditional System	AI-Integrated Smart Display
Update Latency	Manual (5–10 min)	Real-time (<3 sec)
Installation Cost	₹5000	₹3600
Multi-user Support	Limited	Dynamic and profile-based
Personalization	None	Role-based and contextual
Energy Efficiency	Average	Optimized (dimming logic)

The AI-enhanced model exhibited significant improvements in real-time responsiveness, personalization, and energy efficiency.

VI. Discussion

The incorporation of AI into smart display systems transforms them from passive devices into intelligent, interactive interfaces. Predictive scheduling and user personalization enhance the user experience, while the integration of AR provides a multi-layered information delivery platform. Challenges such as edge model compression, network latency, and privacy management (particularly with face recognition) require further exploration. Nonetheless, the current model validates the feasibility of deploying such systems in low-resource environments using compact microcontrollers.

VII. Conclusion

AI-integrated smart displays offer an effective solution for dynamic scheduling in educational and corporate environments. They enhance real-time communication, enable contextual personalization, and integrate seamlessly with mobile and IoT infrastructures. Future work will focus on developing decentralized AI models, improving privacy-preserving techniques, and enhancing system robustness for deployment in large-scale institutions.

VIII. Declarations

Funding: No external funding was received for this research.

Conflicts of Interest: The author declares no conflict of interest.

Ethics Approval: Not applicable.

AI Use Disclosure: Generative AI tools were not used to produce the text, images, or analysis in this manuscript.

References

[1] Yu, Y., & Qi, Z. (2023). Bus arrival time prediction using a recurrent neural network with attention mechanism. IEEE Transactions on Intelligent Transportation Systems, 24(11), 7734–7746.
[2] Chen, H., Lin, J., & Hu, K. (2021). Design and implementation of an intelligent bus stop information display system. IEEE Conference on Renewable Energy Research and Applications.
[3] Liu, Y., et al. (2025). Artificial-intelligence-aided fabrication of full-color displays. Advanced Photonics Nexus, 4(3), 034001.
[4] Vision Display Pvt Ltd. (2025). Integrating LED Screens with Smart Technology. VisionDisplay.in.
BiBi LED. (2024). How Does Intelligent AI Integrate Into LED Display Screens? BiBiLED.com.