



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 13, Issue 4, April 2024

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.423

 9940 572 462

 6381 907 438

 ijirset@gmail.com

 www.ijirset.com

Embedded System Design for Pinball Gaming Unit (Switch Board)

Tarun Singh, Dr. Hinal Shah

U.G. Student, Department of Electrical Engineering, Indus University, Ahmedabad, Gujarat, India

Associate Professor, Department of Electrical Engineering, Indus University, Ahmedabad, Gujarat, India

ABSTRACT: The goal of this project is to create and integrate a switch pad with several switches and a switch board that runs on an STM32 microcontroller. The main goal is to create reliable communication between the switch board and switch pad so that switch activations may be monitored in real time using the RS485 protocol on a laptop screen. By hitting different switches that correspond to different game events, players can interact with the pinball machine through the switch pad, which acts as the user interface. Switch activation signals may be processed and transmitted more easily thanks to the switch board's STM32 microcontroller. The design and construction of the switch board, which requires careful consideration of hardware components, circuit layout, and firmware development, is a crucial component of the project [1].

KEYWORDS: Switch pad, Switch board, STM32 microcontroller, RS485 protocol, User interface, Pinball machine.

I. INTRODUCTION

The switch board PCB serves as the nerve centre of the pinball machine, responsible for detecting switch activations that drive essential gameplay actions such as flipper control, bumper triggers, and target hits. Its seamless integration with other components, including the main control system and playfield elements, ensures cohesive and efficient operation, contributing to a smooth and responsive gaming experience for players of all skill levels [2]. Design considerations for the switch board PCB are paramount, encompassing careful component selection, layout optimization, and signal processing techniques. These decisions are made with meticulous attention to reliability, durability, and compatibility with existing hardware and software, ensuring the PCB meets stringent quality standards and can withstand the rigors of pinball gameplay.

Rigorous testing and validation procedures further validate the functionality, performance, and reliability of the switch board PCB, guaranteeing its suitability for use in the pinball machine. Factors such as component costs, manufacturing expenses, and long-term maintenance requirements are carefully assessed to ensure cost-effectiveness without compromising performance or reliability.

II. RELATED WORK

Recent advancements in switch board PCB design for pinball games have focused on enhancing durability, reliability, and functionality. Modern PCBs utilize durable materials and construction techniques, including gold-plated contacts and higher-rated switches, to withstand the rigors of gameplay. Signal integrity has improved through advanced processing techniques, minimizing interference and ensuring precise switch detection. Integration of circuitry allows for additional features like self-diagnostic capabilities and compatibility with LED lighting. Maintenance is simplified with modular components and connectors, enabling easier troubleshooting and repairs. Some PCBs feature microcontrollers for firmware updates and customizable switch behavior, enhancing gameplay flexibility. Overall, these advancements aim to improve the player experience by prolonging the lifespan of pinball machines and introducing new features for heightened enjoyment.

Developing a switch board involves two main steps: coding for different functions and designing the PCB file in Altium. Coding entails writing software to control switch activations, LED effects, and game logic. This code is typically written in languages like C or C++ and uploaded to microcontrollers. In Altium, engineers design the physical layout of the board, determining component placement, trace routing, and ensuring connectivity. Coordination between coding and PCB design ensures the board functions properly both electronically and programmatically.



III. METHODOLOGY

The methodology for developing the switch board design for the pinball game follows a comprehensive approach integrating hardware and software elements. Initially, the functional requirements of the pinball game, including scoring mechanisms and interactive features, are identified. Hardware components are then selected or designed to meet these requirements, considering factors such as layout, wiring, and connectivity to the pinball machine. Concurrently, software development focuses on coding the behaviours of game elements like flippers and bumpers, ensuring smooth interaction and accurate scoring. Iterative testing and refinement refine both hardware and software components, ensuring functionality and reliability. Documentation is then prepared to guide assembly, installation, and maintenance, facilitating successful integration of the switch board into the pinball machine. This systematic methodology ensures a robust design that enhances the gameplay experience of the pinball game.

IV. EXPERIMENTAL RESULTS

This project introduces a system to enhance pinball switch board functionality, enabling real-time monitoring and display of switch activations via RS485 communication. It connects a switch board with an STM32 microcontroller to a switch pad with multiple switches [3]. When a switch is pressed, a signal is transmitted to the switch board and then relayed to a laptop running Tera Term, displaying the switch name in real-time. This setup offers immediate feedback to players and facilitates diagnostics for technicians, ensuring smooth machine operation. Additionally, the system allows for easy customization of switch pad configurations, empowering game designers to create diverse gameplay experiences. Furthermore, the real-time monitoring capabilities open avenues for implementing advanced gameplay features, enhancing player engagement and retention in pinball gaming [4].

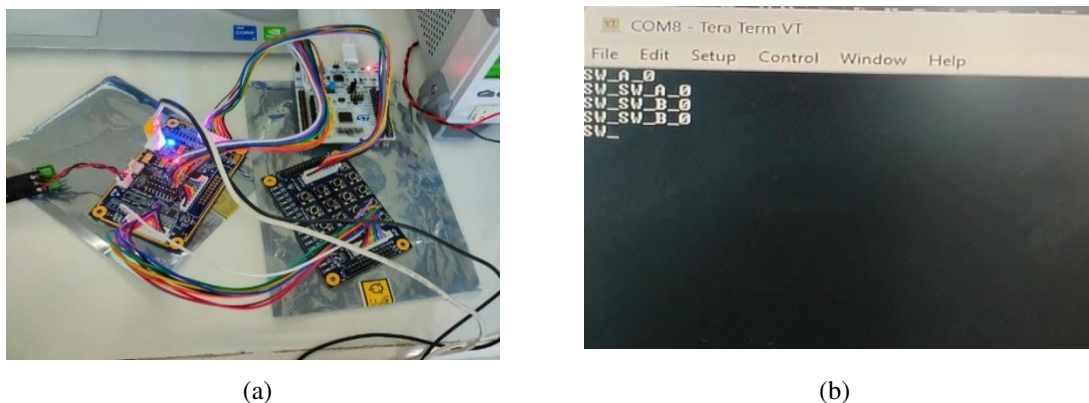


Fig. 1. (a) Switch pad signals transmitted to screen display via RS485 communication upon switch activation. (b) Tera Term Screen Showing which is pressed

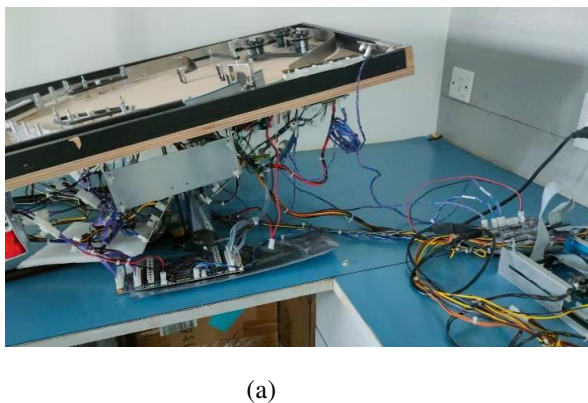


Fig. 2 (a) Testing Connection: The image depicts the interconnection between the mother, switch, and coil board in a pinball game



The design and coding of the switch board PCB for the pinball game represent a pivotal achievement in enhancing gameplay functionality and user experience. Through meticulous design considerations and coding of various functions, including switch activations and gameplay mechanics, the switch board PCB demonstrates its critical role as the nerve centre of the pinball machine. This integrated approach ensures seamless operation, reliability, and responsiveness, ultimately contributing to an engaging and immersive gaming experience for players [5].

V. CONCLUSION

The creation of a switch board for a pinball game that communicates seamlessly with the motherboard is a testament to the precision and ingenuity of arcade game developers. Through meticulous design and integration, this switch board serves as the vital link between the game's physical components and its central control unit. By facilitating real-time communication between switches, sensors, and the motherboard, the switch board enables smooth and responsive gameplay, enhancing the overall player experience [7].

This innovative system not only ensures accurate functionality of game features such as flippers, bumpers, and scoring mechanisms but also provides reliability and safety through error detection and reporting capabilities. The collaborative synergy between the switch board and motherboard represents a significant achievement in arcade gaming technology, elevating the enjoyment and satisfaction of pinball enthusiasts worldwide.

REFERENCES

- [1] About American Pinball. (2017., January 1). Retrieved from American Pinball: <https://www.american-pinball.com/about/>
- [2] BasuMallick, C. (n.d.). A motherboard is a circuit board inside computers that stores electrical components and helps them communicate. Retrieved from spiceworks: <https://www.spiceworks.com/tech/hardware/articles/what-is-motherboard/>
- [3] Eaton's. (n.d.). Switchboard structures. Retrieved from Eaton's official: <https://www.eaton.com/us/en-us/products/low-voltage-power-distribution-control-systems/switchboards/switchboard-fundamentals.html>
- [4] Elumalai, B. D. (2009, April). The Evolution of Art of Gaming – Pinball. Retrieved from Pinball machine: <https://www.sify.com/gaming/the-evolution-of-art-of-gaming-pinball/>
- [5] Fintelics. (n.d.). I in Game Difficulty Adjustment: Adapting Challenges to Player Skill Levels. Retrieved from Medium: <https://fintelics.medium.com/ai-in-game-difficulty-adjustment-adapting-challenges-to-player-skill-levels-b7f7767c96b>
- [6] HT School Web Desk. (n.d.). Pinball: A game inspired by the 18th-century game called Bagatelle. Retrieved from HT Web Desk: <https://htschool.hindustantimes.com/editorsdesk/knowledge-vine/pinball-a-game-inspired-by-the-18th-century-game-called-bagatelle>
- [7] Joseph Henry. (n.d.). Brief History of Pinball. Retrieved from "commons.princeton.edu: <https://commons.princeton.edu/josephhenry/brief-history-of-pinball/>
- [8] Kelly, J. (n.d.). RS-485 Serial Interface Explained. Retrieved from CUI Devices: <https://www.cuidevices.com/blog/rs-485-serial-interface-explained>



INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  ijirset@gmail.com



www.ijirset.com

Scan to save the contact details