# Eklavya - A Smart Combat Coach

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**Abstract:** Traditional punching bags have been the most common training tools in martial arts for centuries. However, they cannot provide real-time feedback on performance, hindering effective training and making error detection and correction challenging. To address this limitation, we propose a smart punching board integrated with a mobile application that offers real-time feedback on a user's punching technique. The system comprises two major components: a high-tech punching board and a mobile app. The high-tech punching board includes sensors that track such different parameters as pressure, speed, and accuracy. These sensors are connected to a microcontroller that processes the collected data before wirelessly transmitting it to the mobile application. The mobile application serves as an interface for providing real-time feedback and data analysis. It presents performance information through an intuitive user interface, utilizing visualizations to help users understand their progress. This smart punching board system aims to enhance martial arts training by offering immediate feedback and tailored guidance. Combining sensor technology with data analysis and mobile connectivity provides a more effective and personalized training experience than traditional punching bags.

## INTRODUCTION

"Smart Punching Board: A Comprehensive Review of Mobile-Integrated Systems with Real-Time Feedback." In today's fast-moving world, the need to be efficient in self-defense and fighting techniques is so much more of a requirement than ever before. To fulfill this requirement, our mobile application has been designed to be more than just a training guide. It will be your coach who provides a customized and immersive experience that evolves with your progress. The application provides an extensive library of tutorials covering an expansive range of fighting.

This review analyzes a mobile-integrated smart punching board system for improved martial arts training. The app serves as a personal coach, providing varied tutorials by instructors, and responding to users' progress with real-time feedback. The bag contains high-precision sensors that record punch data, relayed to the app for

instant review and adjustment, establishing a data-driven system. Customized training schedules, gamification, and progress monitoring encourage users.

This system utilizes technology to provide an interactive martial arts training experience. The combination of tutorial instruction from experts, real-time sensor feedback, and customized feedback provides users with a complete and adaptive learning experience. The emphasis on data-based improvement, coupled with gamification, increases user motivation and engagement. In addition, the system's capability to offer instant correction and customized training plans enables effective skill acquisition, making it an effective tool for beginners and experienced fighters alike.

## I.OBJECTIVE

1)To design and develop a smart punching board capable of capturing real-time data on punch characteristics.

2) To integrate various sensors and a microcontroller within the punching board for accurate and efficient data acquisition and processing.

3) To establish seamless wireless communication between the smart punching board and a mobile application using a Bluetooth module.

4) To develop a user-friendly mobile application that receives, visualizes, and provides real-time feedback on the user's punching performance.

5)To incorporate a 7-segment display on the punching board for immediate, basic feedback during training sessions.

6)To evaluate the functionality and performance of the integrated smart punching board and mobile application system through testing and user feedback.

7)To explore the potential of this IoT-enabled system to enhance combat sports training methodologies and provide data-driven insights for skill improvement.

## II.LITERATURE SURVEY

According to the authors [1] Review on a "smart punching bag". Proceedings of the IEEE. The article talks about several innovative solutions, primarily to help boxers keep track of punching speed, precision, and the power involved during training. An intelligent punching bag with various punching exercise modes at various levels will be available through a mobile application.

The authors truly said [2] Review on a "Wearable Device Utilizing Flexible Electronics". The wearable device could comprise a flexible matrix material and could further comprise sensors that measure a biometric of a person, a measure of the acceleration of a body part attached to the wearable device, a wireless transmitter, a flexible power source, and a microcontroller. Review on an "A Wearable System for Real-Time Feedback and Performance Analysis in Boxing". This study explored the use of wearable sensors to track boxing performance metrics such as punch power, speed, and accuracy. The researchers developed a system that provided real-time feedback to boxers, helping them improve their technique and training.

The authors truly said [3] A review on "Assessing a Punching Bag Feedback Performance Device". The study aims to evaluate the effectiveness of an audio/visual feedback package for boxing workouts. The package will include real-time feedback on crucial dimensions of a boxing workout, such as heart rate, speed, and power. The study will compare the effectiveness of this package to a standard punching bag workout using a multiple baseline design across subjects. The goal is to determine if the audio/visual feedback package can improve workouts and athletic performance in boxing.

According to the authors [4], A review on "Fitness Mobile Application". A well-rounded mobile application aiming at fitness solutions will achieve the health and wellness goals of the users through personal workout plans, nutrition tracking, gym equipment recommendations, and certified personal trainers. SMART enables users to achieve a routine that is customized, keeps out of disorderly eating, finds the right equipment, and gets help from an expert to stay motivated and headed toward fitness objectives.

The authors truly said [5] in A review on "Xtreme Fitness" that the Xtreme Fitness application aims to automate manual processes, store data efficiently, and provide personalized fitness plans. It eliminates the need for gym trainers and offers easy-to-use features for optimal results. The

application ensures data security, accuracy, and efficient management, allowing users to focus on their fitness goals.

## III. ANALYSIS OF LITERATURE SURVEY

The reviewed literature highlights the technological landscape of smart combat training. [1] and [3] focus on instrumented punching bags providing real-time feedback on punch metrics like speed and power, often integrated with mobile applications. [2] broadens this with wearable flexible electronics capable of measuring biometrics and acceleration, applicable to tracking punch dynamics. The domain of fitness applications, as seen in [4] and [5], emphasizes personalized workout plans, data tracking, and user motivation through mobile interfaces. "EKLAVYA" aligns with this trend by integrating sensors and a microcontroller into a punching board, leveraging Bluetooth for mobile app connectivity to deliver real-time punch feedback, aiming to enhance traditional combat training with data-driven insights.
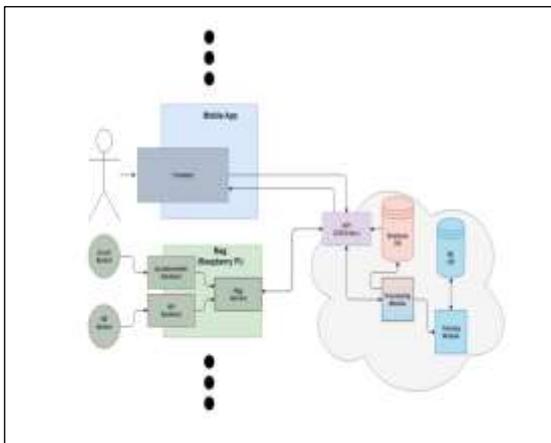
## IV. ARCHITECTURE



## V. Images/Screenshot



Fig.1. EKLAVYA – A Smart Combat Coach



Fig.2. A Smart Punching Board



Fig.3. Internal View Showing Microcontroller-Based Circuit Setup

## VI. METHOD OF IMPLEMENTATION

The implementation of "EKLAVYA" will follow a phased approach. Initially, the mobile application will be developed with user authentication, a tutorial, and a basic interface for connection. Simultaneously, hardware design will focus on sensor selection, microcontroller integration, and Bluetooth communication prototyping. The physical punching board will then be constructed, followed by rigorous hardware testing and calibration. Subsequently, the mobile app will be enhanced to process and visualize real-time punch data received via Bluetooth. Data storage and optional training features will be implemented. Comprehensive system integration and end-to-end testing will ensure seamless functionality. Finally, user testing will drive refinement and iteration, culminating in project documentation. This iterative method prioritizes user experience and robust system integration.
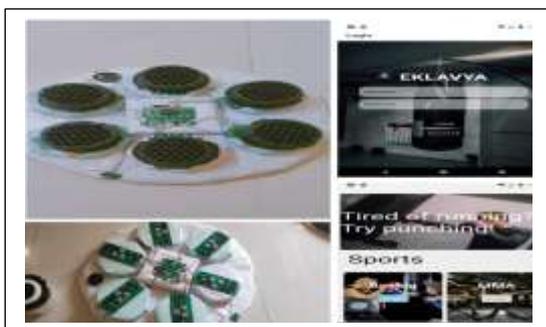
1. **User Authentication and Profile Setup:** Implement secure Login/Registration and Profile Creation within the mobile application, including the initial step of connecting to the smart punching board by enabling Bluetooth/Wi-Fi and selecting the device.

2. **Workout Selection and Initialization:** Enable users to select pre-defined or create custom workout programs within the app, initiate the chosen workout, view instructions/countdown timers, and begin workout time recording.

3. **Real-Time Data Acquisition (Punch Impact & Sensor Activation):** Design and implement the hardware and software to accurately detect and record punch impacts through sensor activation on the smart punching board.

4. **Real-Time Analysis and Processing:** Develop algorithms within the microcontroller and/or mobile application to analyze the raw sensor data in real-time, calculating relevant punch metrics (e.g., force, speed).

5. **Real-Time Feedback and Visualization:** Implement the display of immediate feedback on punch metrics within the mobile application during the workout, potentially using numerical values, visual graphs, or other intuitive representations.

6. **Hardware Design and Integration:** Design the physical structure of the smart punching board, integrate the selected sensors and microcontroller, and ensure robust wiring and power supply.

7. **Bluetooth Communication Protocol:** Establish a reliable and efficient Bluetooth communication protocol for seamless data transfer between the smart punching board and the mobile application.

8. **Data Storage and Workout History:** Implement local or cloud-based data storage within the mobile application to record detailed workout data, allowing users to review their history and track progress.

9. **Workout Completion and Summary:** Define the criteria for workout completion, automatically stop data recording, and provide users with a comprehensive summary of their performance metrics at the end of each session.

10. **System Integration and Testing:** Conduct thorough end-to-end testing of the integrated hardware and software to ensure accurate data acquisition, reliable communication, and correct feedback delivery across all functionalities.

11. **User Testing and Iteration:** Perform user testing with the target audience to gather feedback on usability, accuracy, and effectiveness, and iterate on the design and implementation based on the received insights.

12. **Documentation and Refinement:** Document the entire implementation process, including hardware schematics, software architecture, communication protocols, and user manuals, while continuously refining the system for optimal performance and user experience.

## VII.CONCLUSION

In summary, the intelligent punching board, in conjunction with a mobile app, represents a revolution in boxing and combat sports training. This technology surpasses the confines of conventional training, providing an effective combination of customized guidance and data-based information. The combination of high-accuracy sensors and real-time feedback systems allows users to develop a detailed insight into their performance, which enables them to pinpoint and correct weaknesses with unprecedented precision.

The impact of the project goes beyond simple performance monitoring. It creates a dynamic and interactive training environment through gamification and customized workout routines, improving user motivation and compliance. By making professional-level training accessible to everyone, the smart punching bag system eliminates geographical and economic barriers, opening up advanced coaching to more people.

As this technology continues to develop, we can anticipate further improvements in sensor precision, data interpretation, and user interface. Future models can include AI-powered coaching, adaptive learning, and virtual reality simulation, making the distinction between physical and digital training increasingly obscure. The widespread use of smart punching board guarantees to bring with it a new generation of boxing training, which will be one of ongoing enhancement, customized guidance, and information-driven feedback. This transformation will not just raise the levels of boxing but also have the potential to impact other sports and fitness fields, proving the digital age's converting power in redefining human performance.

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