SMARTBOXING

Stay one punch ahead in your boxing workouts

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Hardware

Master Module:

• Controlling several sub-modules, it comprises of an nRF52832 Bluetooth-enabled microcontroller that communicates with onboard positional sensors with gyroscopic and accelerometer capabilities to interface with external sub-modules at scale.

SMARTBOXING is an intelligent punching bag and accompanying Android application that allows users to train and receive valuable data-driven insights into their boxing training sessions. In the current market of combat training equipment, it can be difficult for an individual to track their own progress or gauge progress. In most cases, a personal trainer would be required for immediate feedback on how the user can improve. With SMARTBOXING, the sensors are used to deliver live metrics from the punching bag to an app that uses intelligent algorithms to compute valuable performance metrics for the user, maximizing their sessions. Using information from previous sessions, SMARTBOXING provides an easy way for a user to measure their own improvements, helping to motivate their continued exercise journey.

Sub-modules:

• Built using the nRF52832 microcontroller and collect data via Bluetooth connection while communicating with additional accelerometers.

Wireless Connection

- The BLE connection between the smart punching bag and our smart app using a custom service and TX/ RX characteristics.
- The connection is optimized for sending acceleration data for processing by algorithms on our app.



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Overview



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Software

Microcontroller:

• It collects and parses session data from submodules and forwards it to the smart device's software.

Android APP:

- The app handles accelerometer and gyroscope data computations.
- Presents stats in a user-friendly graphical UI to the user. Metrics such as punch count, strike interval, speed, force, and calories are available through customizable workout sessions.

Algorithms

- The algorithms are developed for detecting punches, as well as handling strike forces, strike speed, and calorie burn rate calculations.
- All data is processed live during a workout session.
- User biometric data is used to tailor the results to be as accurate as possible.



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TEAM: ONE PUNCH MEN



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BACKGROUND

The smart fitness equipment market has seen rapid growth in the last two years due to a huge spike in the number of people opting to workout in their homes rather than gyms, especially after the pandemic. As a result, there is a growing need for smart & innovative solutions that can help people monitor and improve their fitness / skills at home. Boxing is a popular form of exercise that offers a range of physical & mental benefits. However, the traditional punching bag which is used in training, lacks the technology to measure and provide key performance metrics such as strike force, speed & interval, which makes it difficult for users to track their progress at home.



OUR PROJECT

accompanying Android application.

- Allows users to train and receive valuable data-driven insights into their boxing training sessions.
- punching bag.
- Punching bag houses a nRF52832 Bluetooth-enabled microcontroller with onboard sensors.
- · Sensors are used to deliver live metrics from the punching bag to the app
- Uses intelligent algorithms to compute performance metrics such as strike count, force, & speed.

SMARTBOXING

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Optimize your workout by monitoring your performance in real-time.



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- SMARTBOXING is an intelligent punching bag &
- Through a phone app, wirelessly connect to the smart

SOFTWARE

The software component of this project is divided into two parts:

- 1. Firmware on the microcontroller (master module) and submodules (sensors)
 - Responsible for recording session data
 - Combine collected data into packets and transmit to the smart application.
- 2. Software running on a smart device
 - Receive data packets from the Microcontroller over Bluetooth.
 - Compute real-time session parameters into performance metrics such as punch count, speed, and estimated calories burned

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Let's get your new SMARTBOXING punching bag setup! Connect the punching bag to a power source & enable your smartphone's Bluetooth



 Click "Connect" to pair the bag from your device's Bluetooth Settings.

Connect SMARTBOXING Bag

SOFTWARE





Login Sign up

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Hello BOXERS!

Let's get you set up

Email

9:41

Password

Confirm Password



HARDWARE

The nRF52832 module collects data from an on-board accelerometer via SPI transmissions. This data is then sent over the Bluetooth chip antenna to a connected smart device.

- Receives data from the accelerometer.
- Three-dimensional info allows for accurate tracking of movement.
- The raw 6 byte accelerometer data is transmitted to the smart device where the conversion to mG is then calculated.
- The data output from the accelerometer is 14 bits and is then converted to a float (sized 4 bytes).



CUSTOM PCB DESIGN

• nRF52840

- 32-bit ARM 64 MHz cortex M4
- 1MB flash, 256KB ram
- 2.4 GHz transceiver
- 2MBPS, 1MBPS long range
- Bluetooth Low Engery
- +8 dBm TX power
- -103 to -89 dBm RX sensitivity
- UART, SPI, I2S
- 12-bit ADC, 200 ksps ADC

