

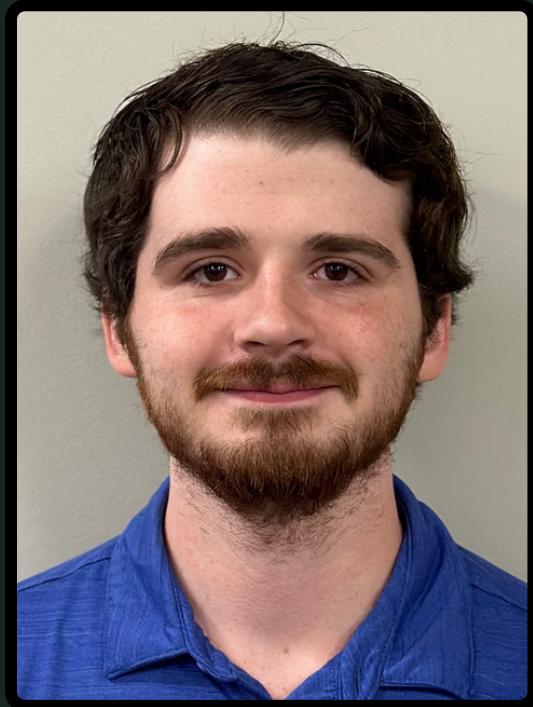
FINAL DESIGN PRESENTATION

The Workout Buddy

Brought to you by Bravo Builders



THE WORKOUT BUDDY TEAM



Austin Polk



Logan Dubuisson



David Lock



Marlon Sims



Joseph Taylor

THE WORKOUT BUDDY ADVISORS



DR. ALI GURBUZ

PRIMARY ADVISOR



DR. JOHN BALL

SECONDARY ADVISOR



Bradley Johnson

- 54-year-old retired retail manager
- Tight on money, can't afford a personal trainer
- Wants to get in shape to play with his two grandkids
- Occasionally forgetful
- Looking to start a workout routine, but inexperienced

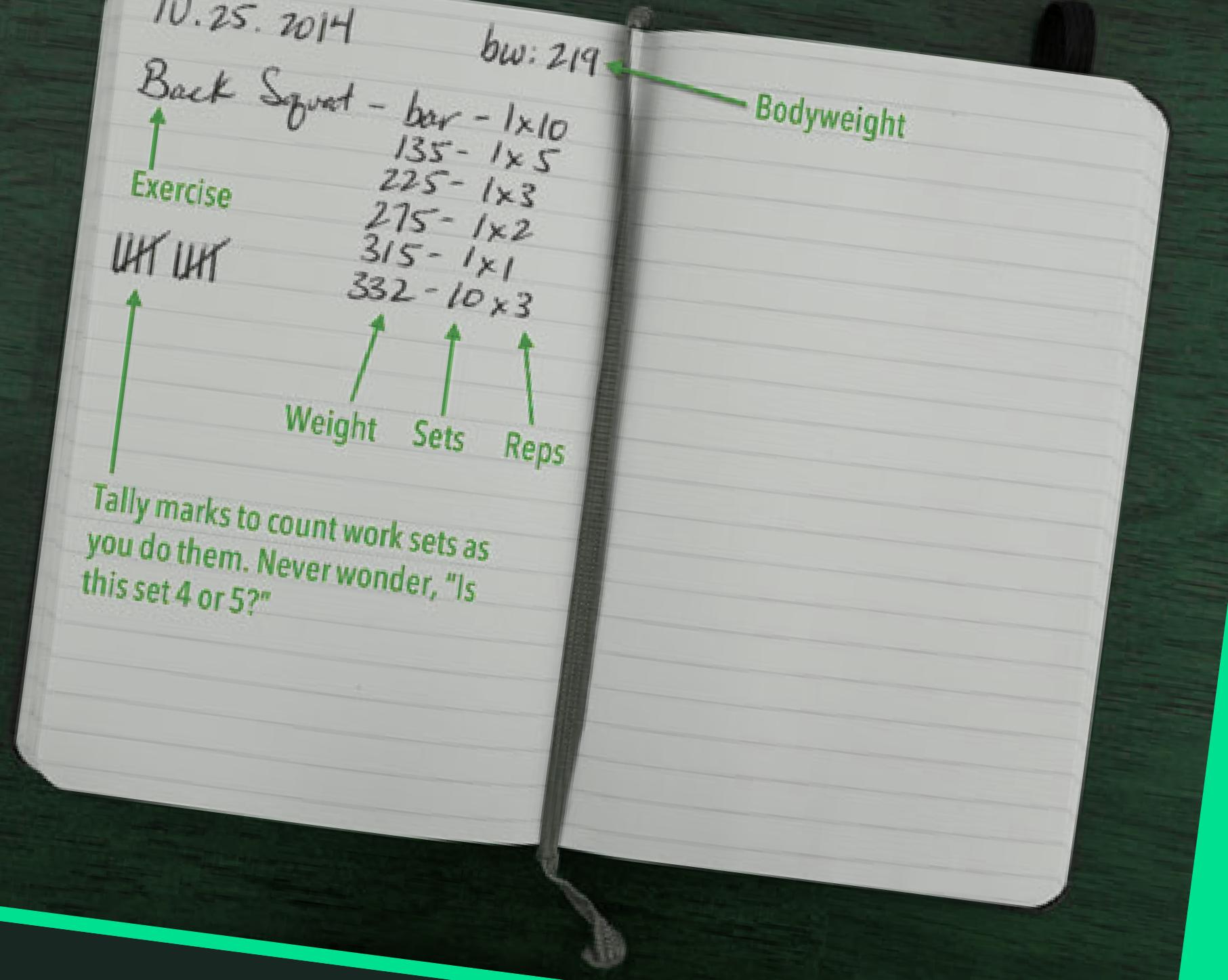


Figure 2 adapted from [1]

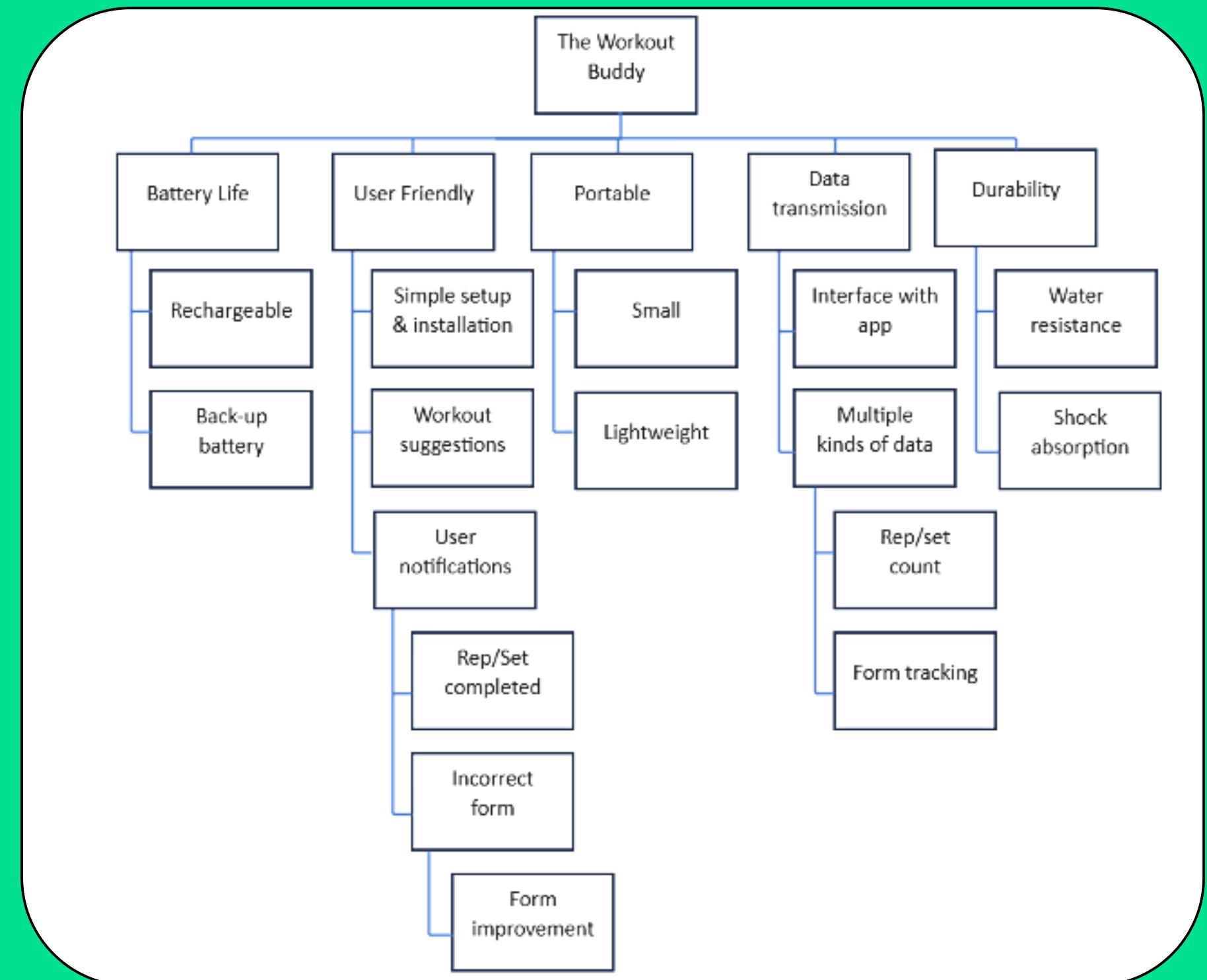
The Problems

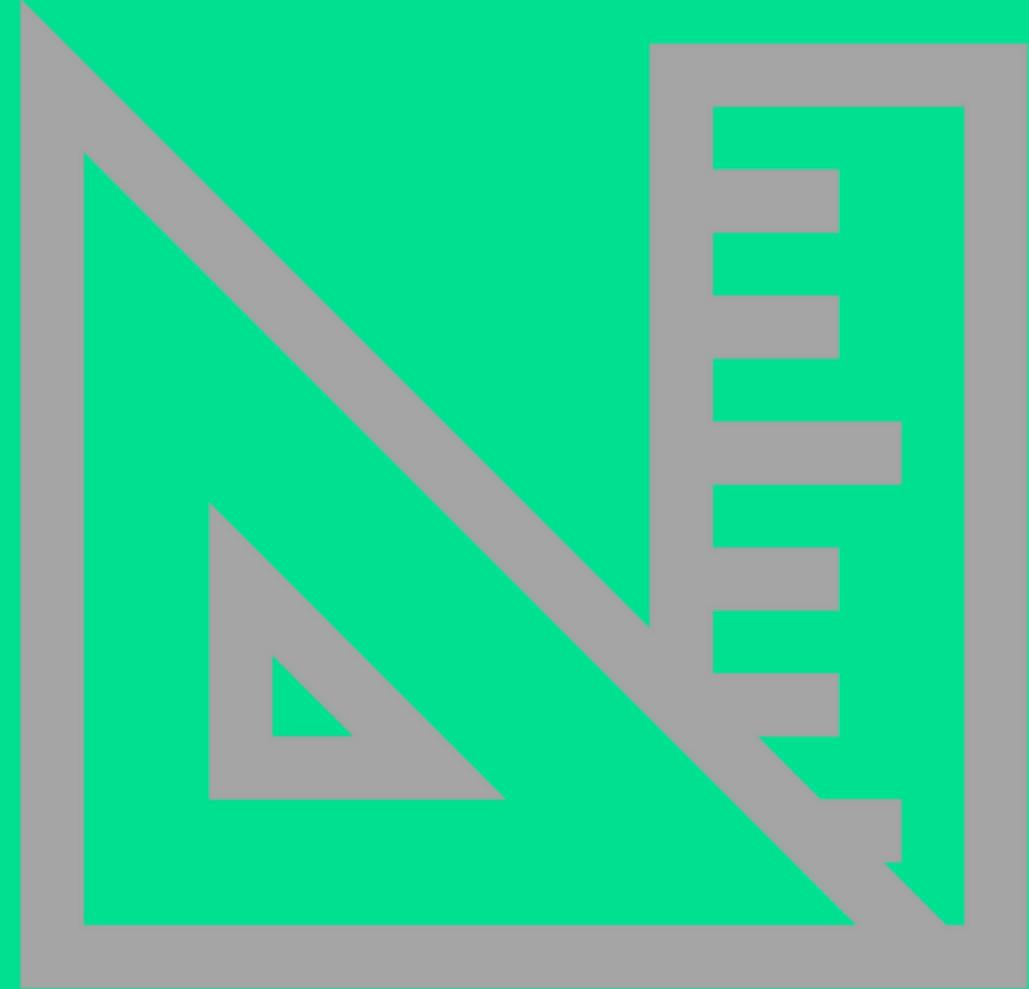
The Workout Buddy

- Newcomer gym anxiety
- Risk of injury (overloading weights, poor form)
- Loss of repetition & set count
- Uncertainty in exercise choice
- Lack of equipment

Marketing Requirements

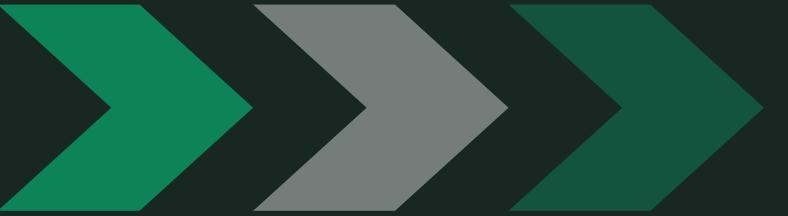
1. The Workout Buddy has a long-lasting battery life.
2. The device collects data from the sensor module and transmits data to the user.
3. The device is portable.
4. The device is durable.
5. The device is user-friendly and accessible.





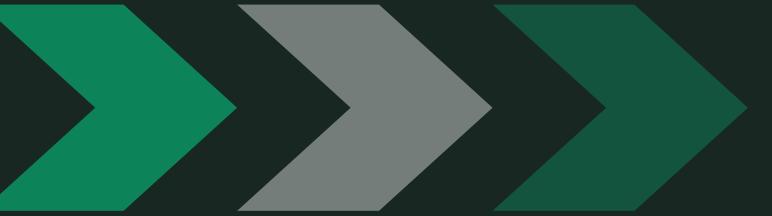
Design Requirements

Engineering Requirements



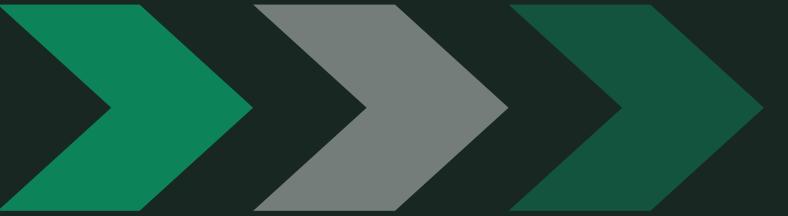
Marking Requirements	Engineering Requirements	Justifications
2 & 5	The product meets or exceeds 96% accuracy in rep detection and logging.	This accuracy ensures that the user receives an accurate number of reps and sets.
1	The average battery life of the product is at least 4 hours in active use and 24 hours in standby mode.	The Workout Buddy has a long battery life so that the user is not required to charge the battery,
2 & 5	Product does not exceed safe levels of electromagnetic (EM) radiation at proximity.	This limit ensures that the user can safely use The Workout Buddy without adverse effects.
3 & 4	The sensors are housed in a protective casing for environmental resilience.	The sensor system is in a case that protects it and any wires from user sweat or other liquids, such as water.
2 & 5	The product includes a visual output for feedback to the user as each rep/set is completed.	The device outputs a notification sound letting the user know that the set or workout is done.

Constraints



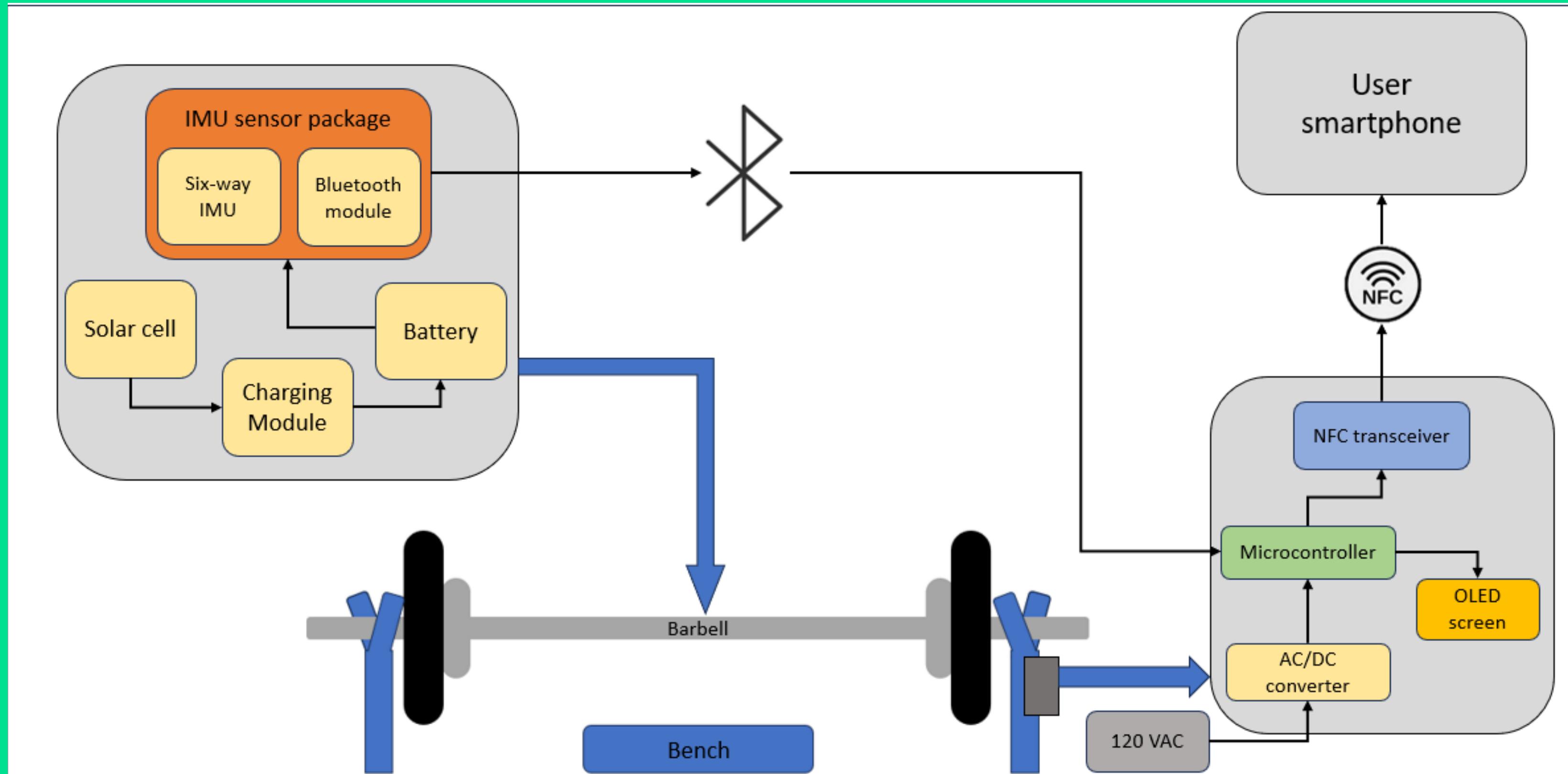
Type	Name	Justifications
Economic	Cost	The Workout Buddy has a \$1,000 development budget provided by Mississippi State University.
Economic	Time	The design team has two semesters in which to complete a working prototype.
Manufacturability	Size	The equipment dimensions do not interfere with the use of a standard 1-inch barbell.
Manufacturability	Weight	The total weight of equipment on a barbell does not exceed 2.5 pounds.
Health and Safety	Safety	Wires and equipment are isolated and protected from the user/environment.
Technical	Communication	The NFC transmitter has a maximum range of 4 cm.

Engineering Standards



Specific Standard	Standard Document	Specification/Application
IP-67	IEC (International Electrotechnical Commission) Standard 60529	The Workout Buddy is water and sweat proof. This ensures the safety of the equipment and user.
ISO/IEC 18092:2013(E)	NFCIP-1	The data is transmitted from the base station to the user's smartphone.
IEC 61960-3:2017	IEC standards for battery power electronics	This standard ensures that the battery is safe for consumers to use.
IEEE 829-2008	IEEE (Institute of Electrical and Electronics Engineers) standard for software and system test documentation	This standard is for software testing when using a software-based system.
Bluetooth Core Specification Version 5.4	Bluetooth Core Specification Version 5.4	This standard is used to communicate between the sensor and the home base.

Approach Overview Design



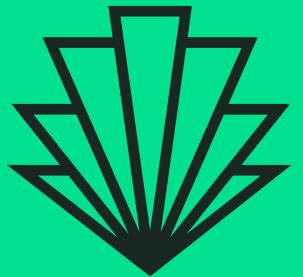
Subsystems



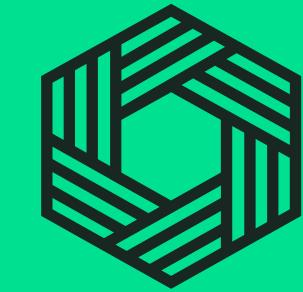
SENSORS



**POWER
DISTRIBUTION**



SOFTWARE



FITTING SYSTEM

Sensors

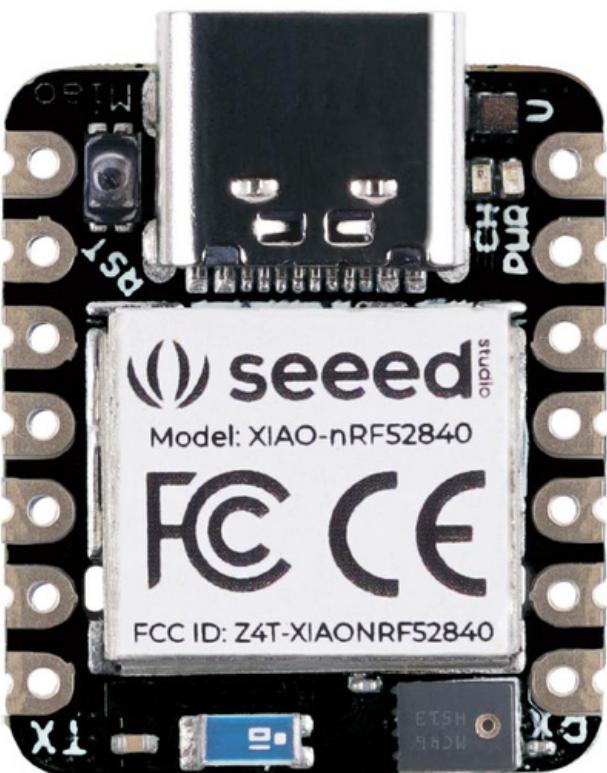


Figure 3 adapted from [8]

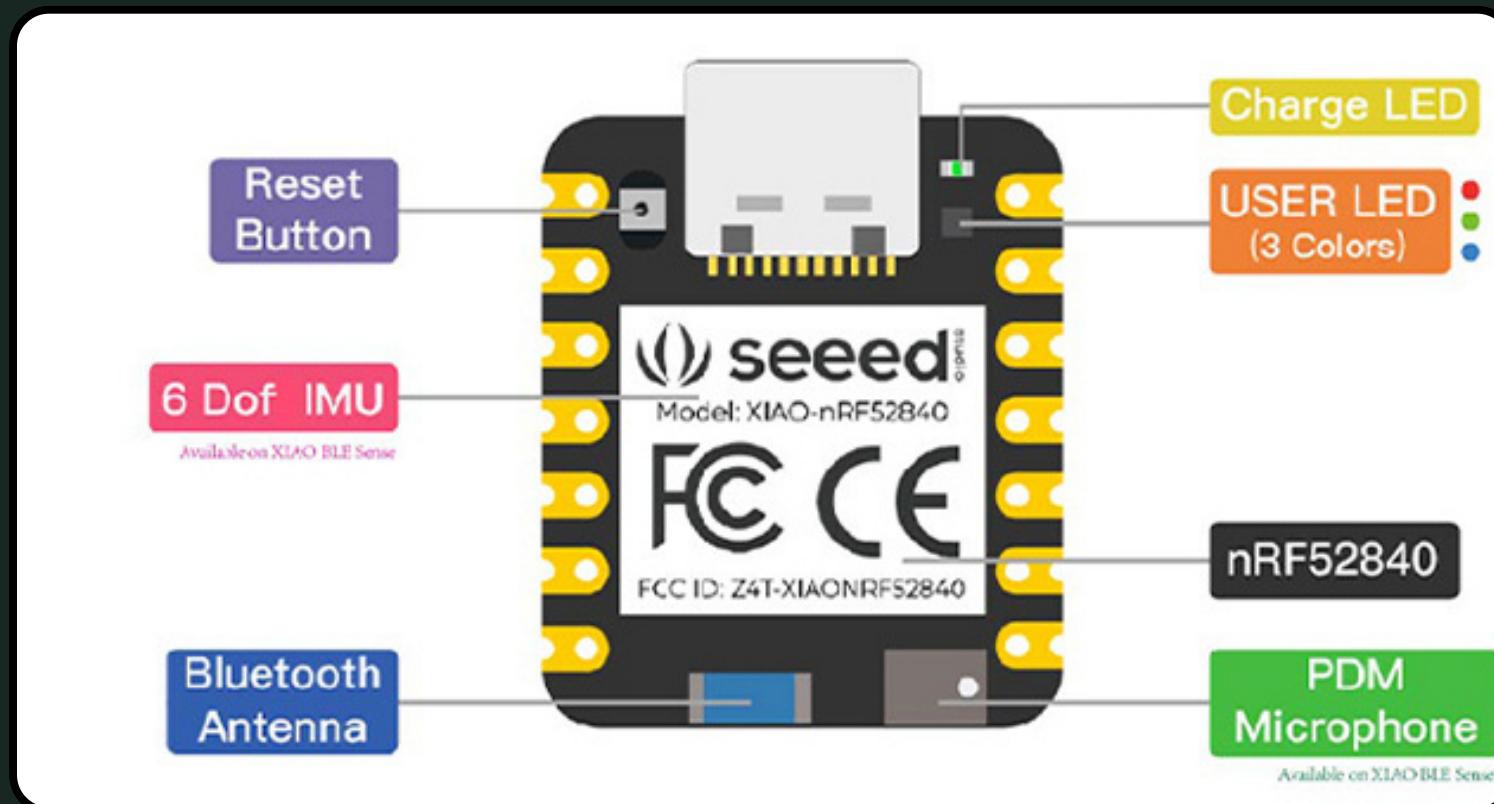


Figure 4 adapted from [8]

- Microcontroller
- Data transmission
- Ultra low power consumption ($5\mu\text{A}$)
- Three-axis orientation data based on the circumference
- Tracking of angular velocity and linear acceleration vectors
- Repetition counting
- Analysis of barbell path metrics
- Bluetooth connectivity

OLED Screen

- Yellow-blue, white, blue color display
- Organic light-emitting diode
- High contrast and brightness
- Low power consumption
- Wide viewing angle
- Fast response time



Power Distribution

The microcontroller is powered through a normal United States 120VAC outlet.

The sensor is powered by a 3.7V Lithium battery with solar cells as a backup power source and battery charger.

Figure 6 adapted from [2]



Figure 5 adapted from [3]



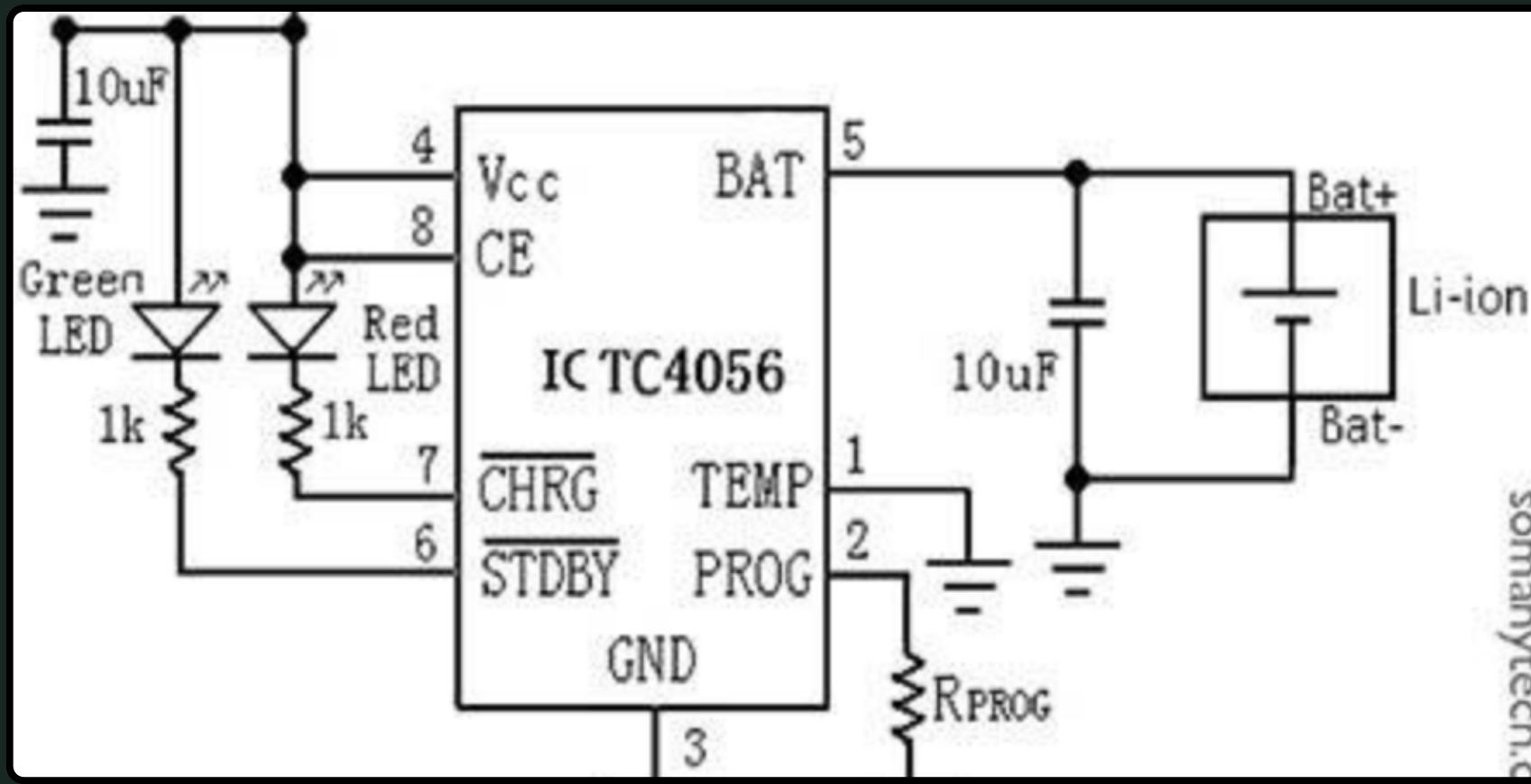


Figure 11 shows the circuit of the charger module that will help keep the battery fully charged.

Figure 11 adopted from [9]

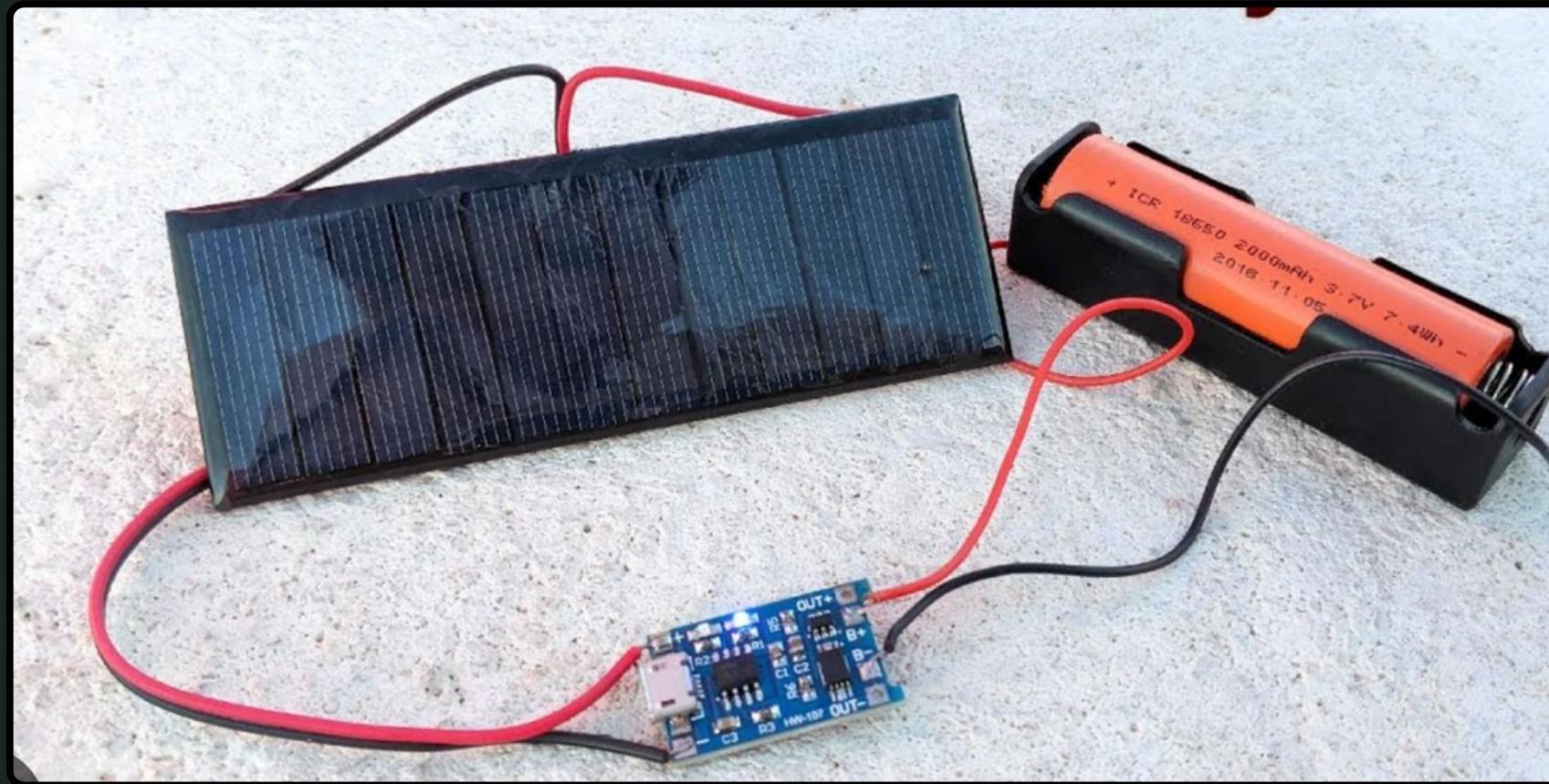


Figure 12 shows how the sensor will be powered.

Figure 12 adopted from [10]

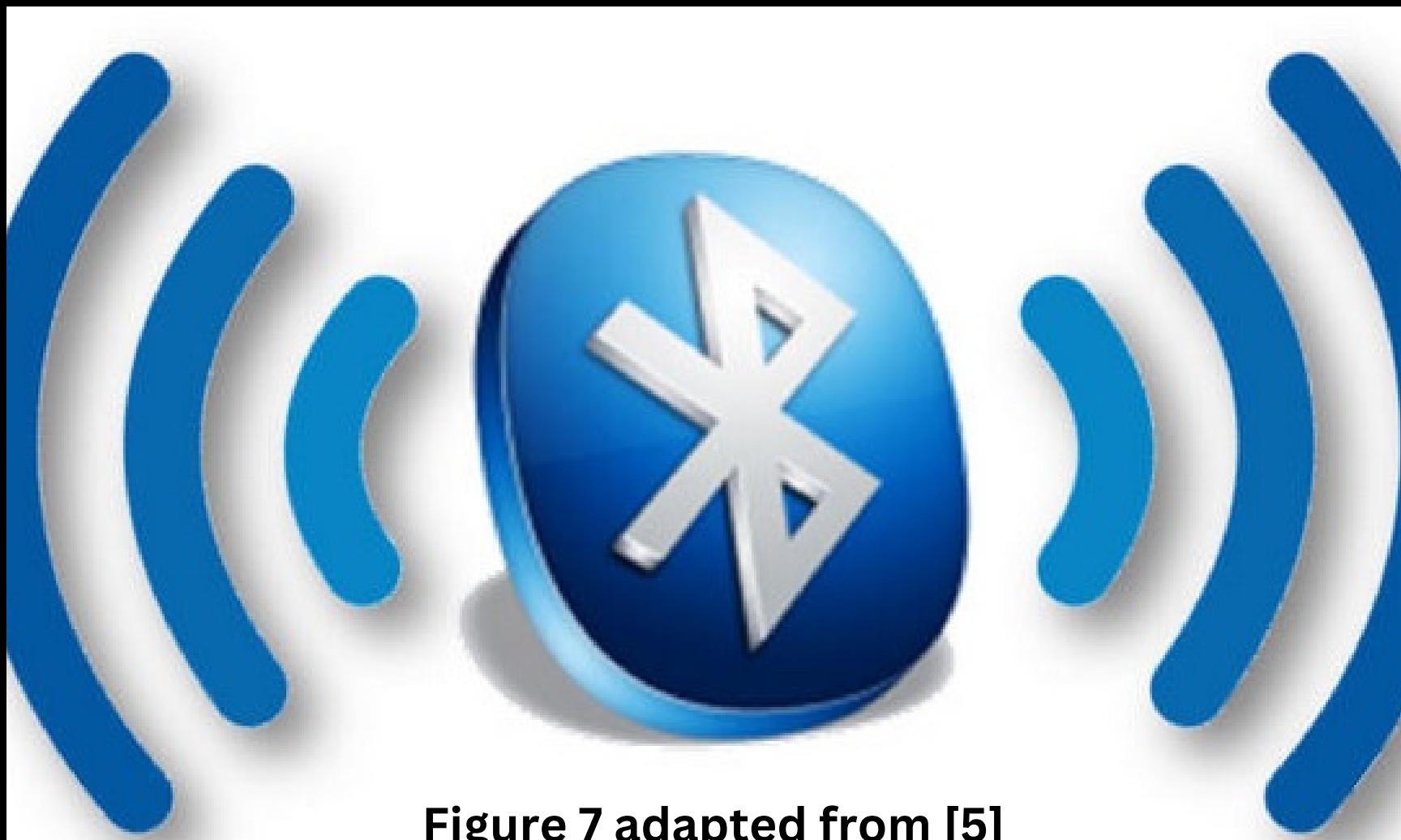


Figure 7 adapted from [5]

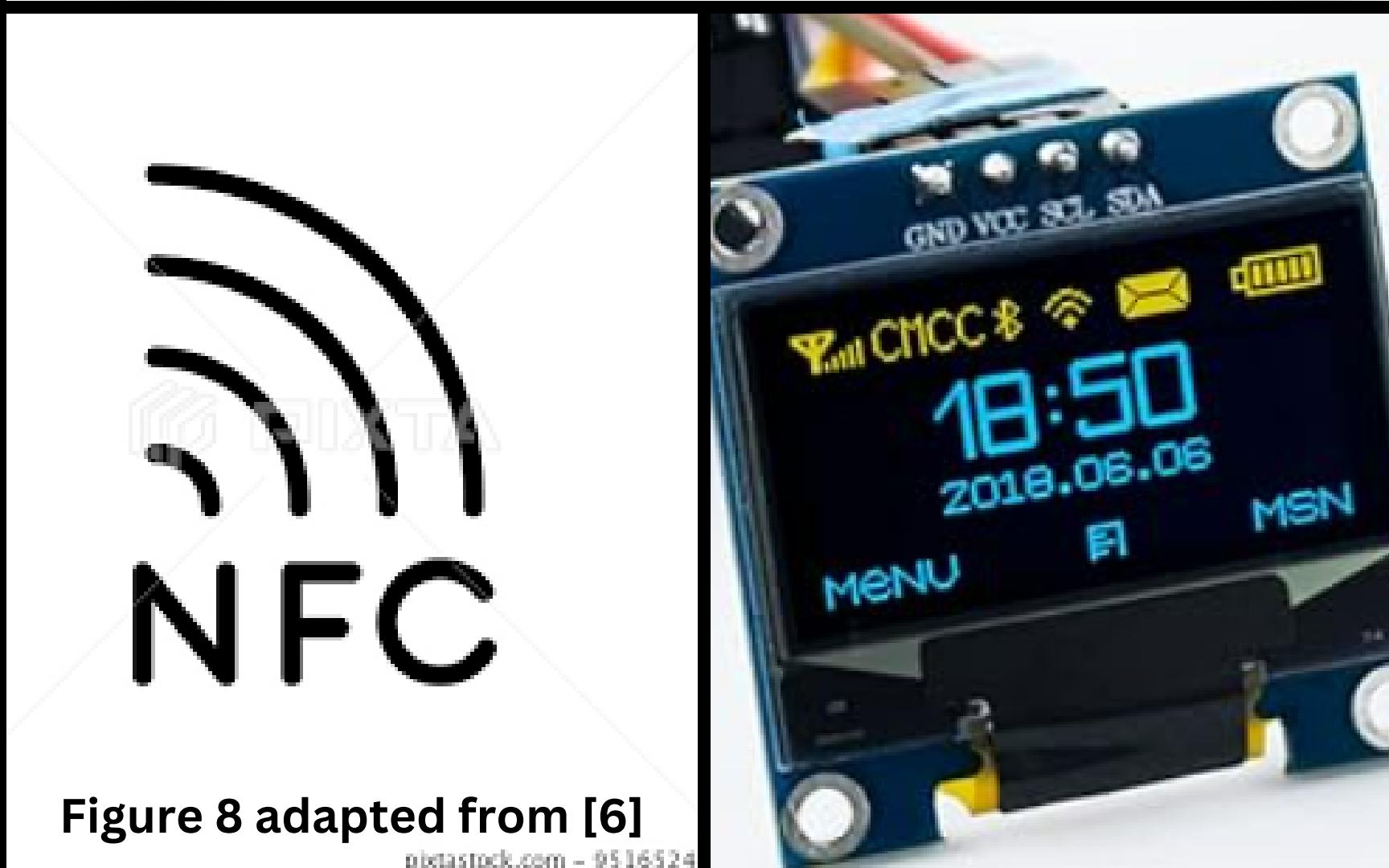


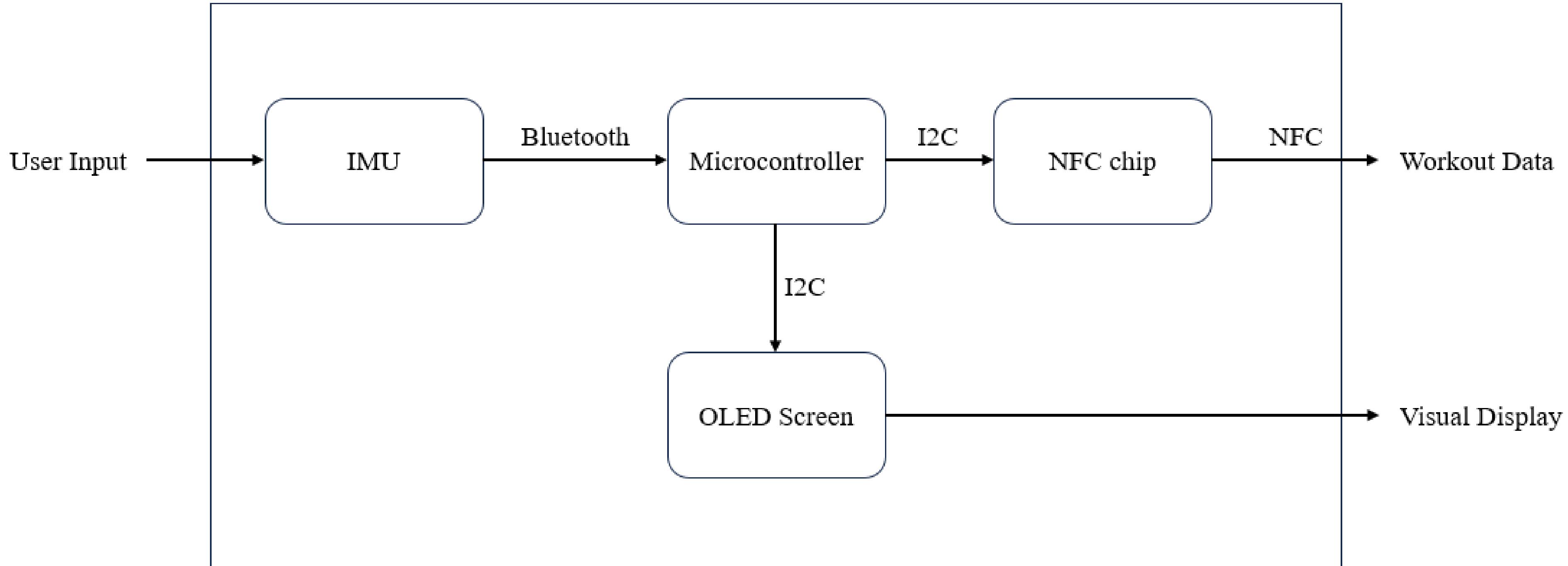
Figure 8 adapted from [6]

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Communication

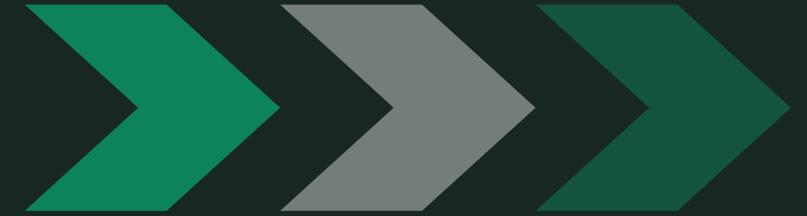
- IMU sensor with built-in Bluetooth module
- Bluetooth communication between the sensor system and fitting system
- OLED screen (I2C)
- RFID Transponder IC 13.56MHz ISO 15693, NFC PWM 1.8V ~ 5.5V

Figure 9 adapted from [7]

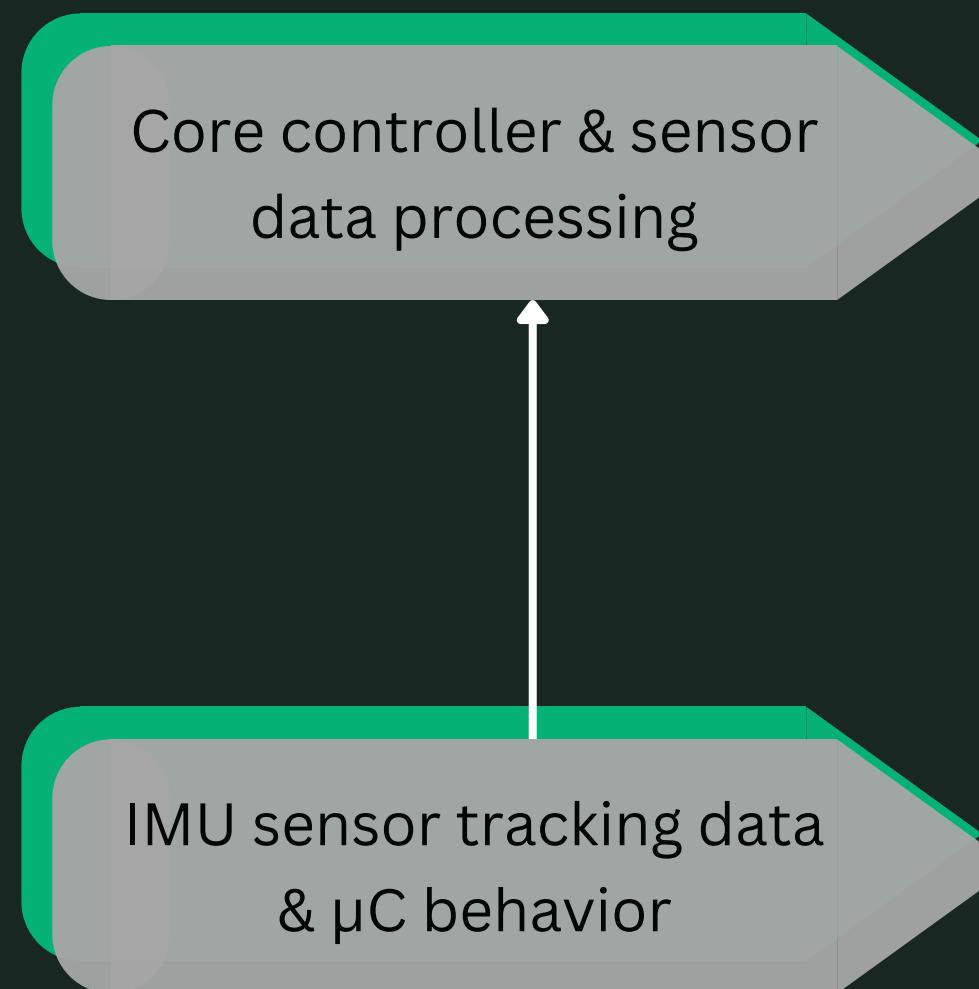


Communication Overview

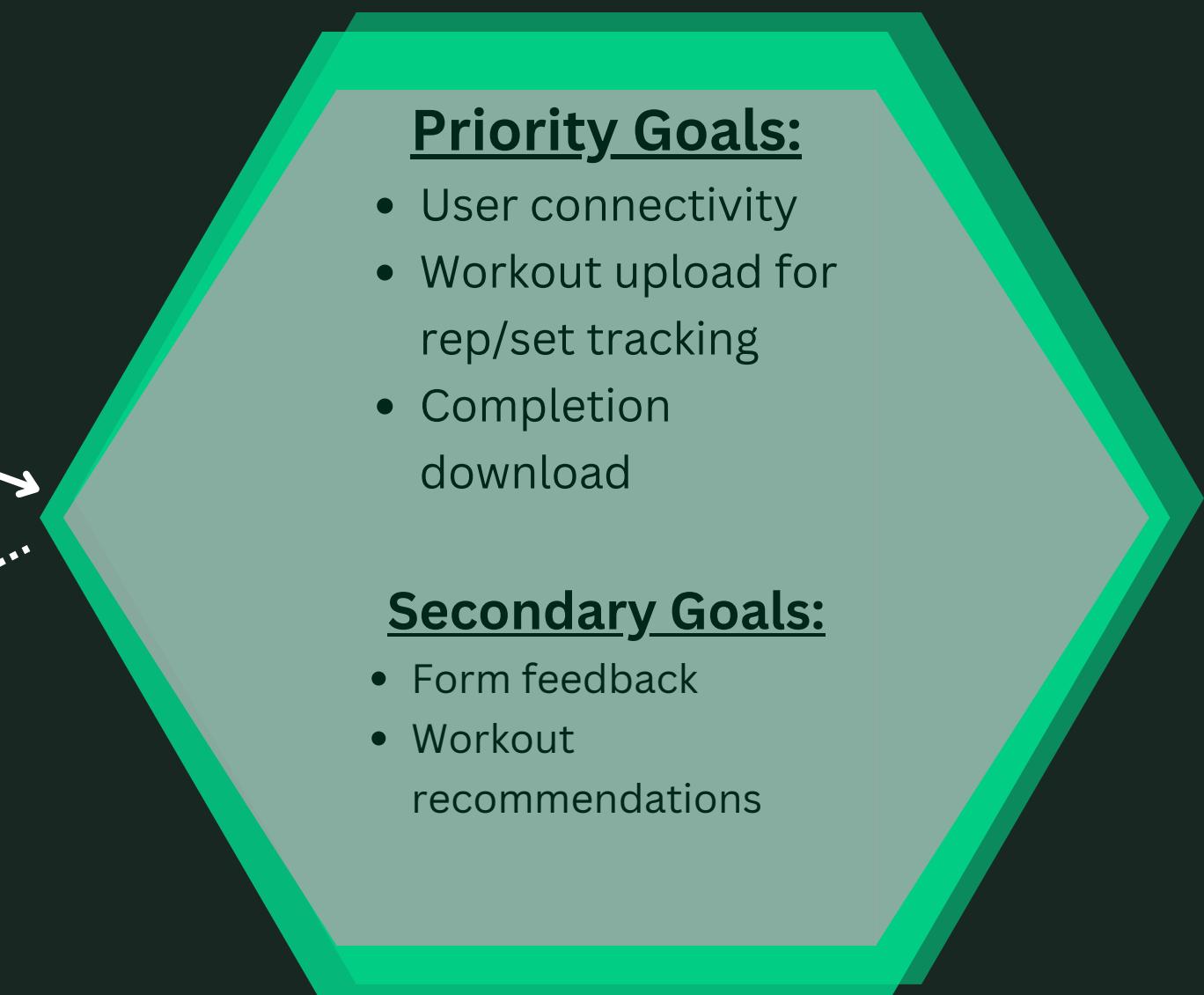
SOFTWARE DEVELOPMENT



System Software



Smartphone Application

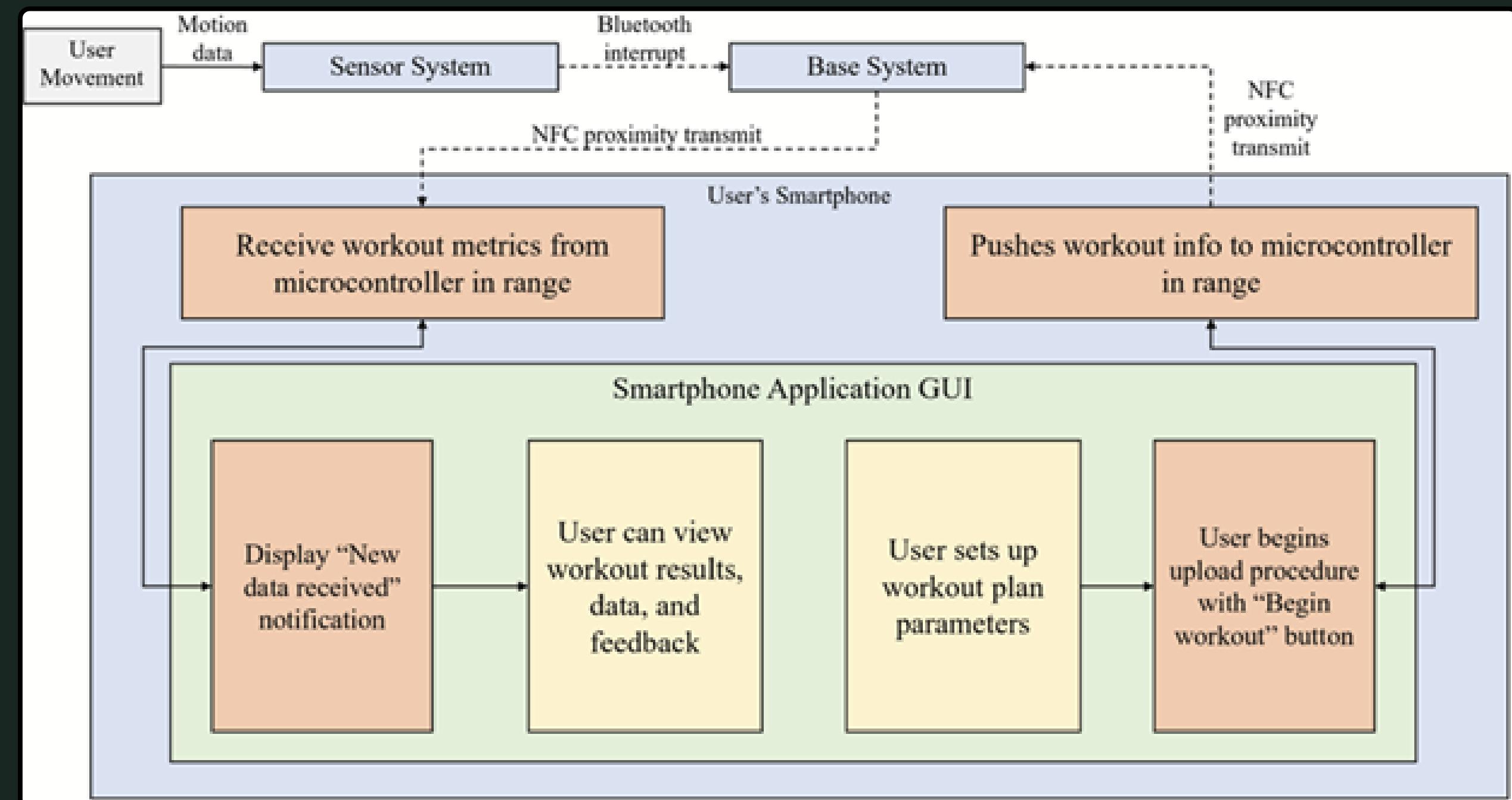


SOFTWARE DEVELOPMENT

App-Side Design

The Workout Buddy incorporates an app-based control interface for workout planning and post-workout review.

These data points are transmitted to and received from the base system's NFC chip, respectively, upon proximity detection.



SOFTWARE DEVELOPMENT

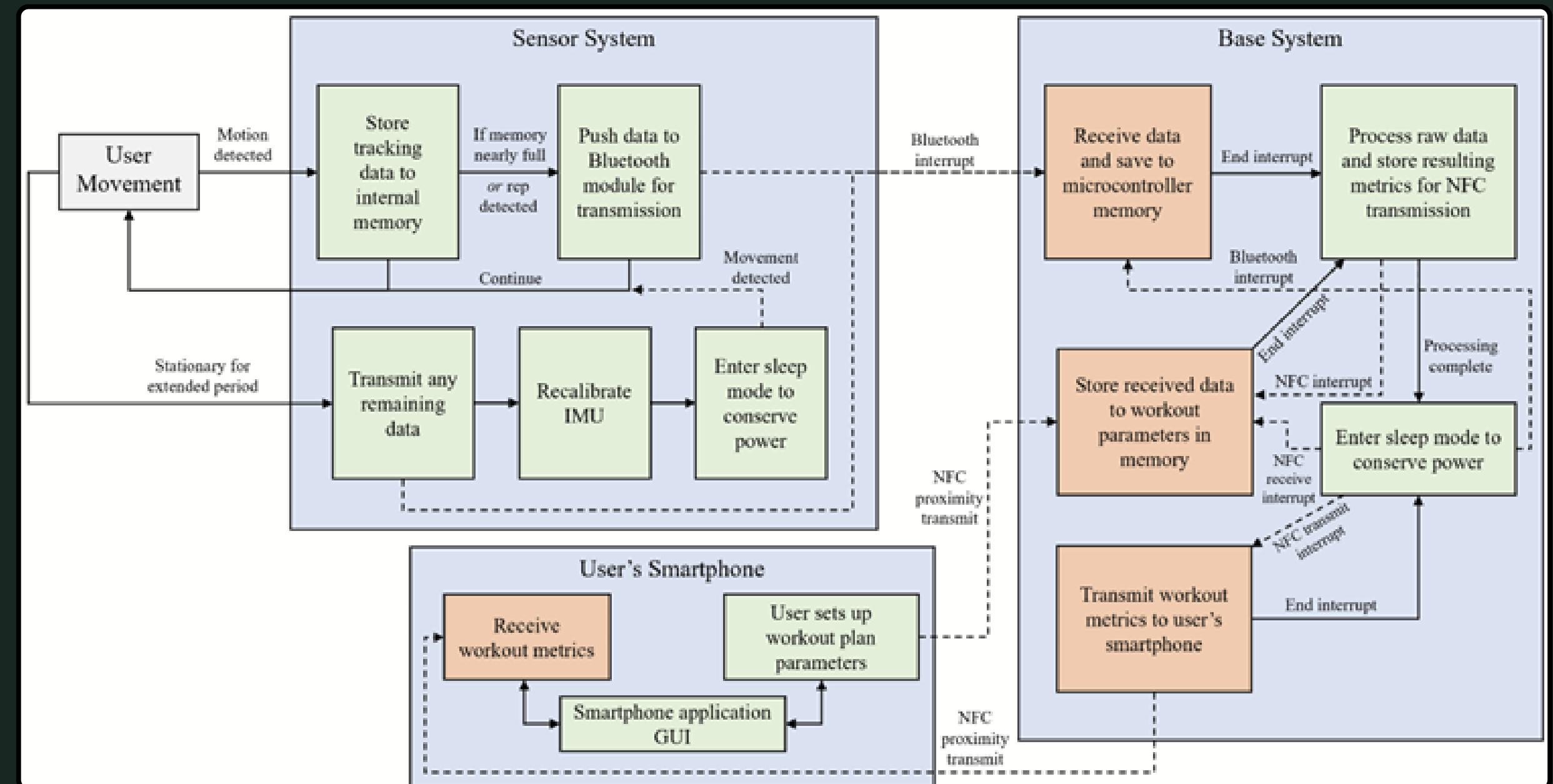


Full Integration

The Workout Buddy smartphone application interfaces directly with the base system, which then receives tracking data from the sensor system.

This data is processed by and stored locally on the microcontroller.

The stored metrics are then relayed back to the user's smartphone upon workout completion via NFC contact.



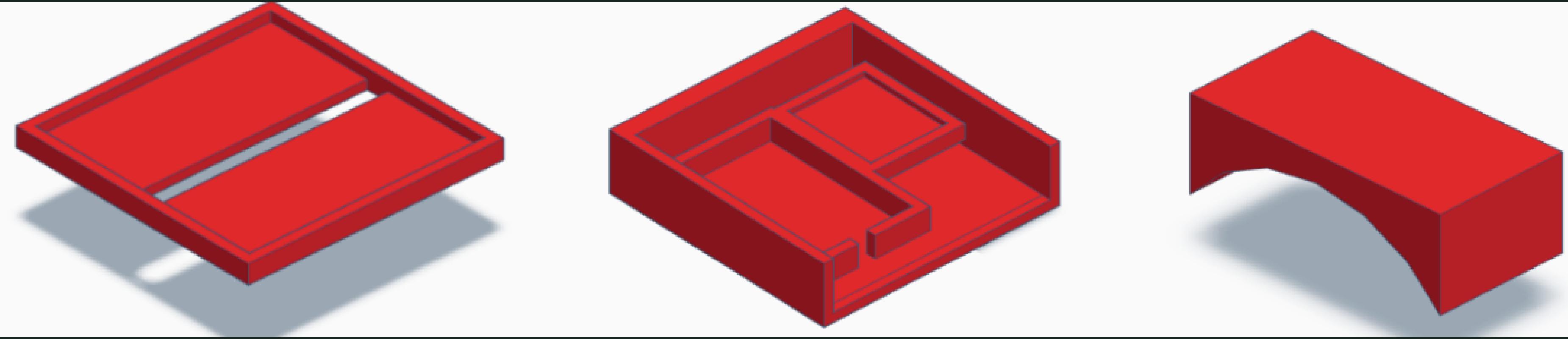
Fitting System

- Wires fit into rack as to be concealed to improve overall safety
- Circuit components are housed to protect each component from outside factors, such as sweat dust and pressure
- Sensors mounted to a position that does not interfere with the user at any time during use
- Cords attaching to exterior points in the system do not run across the floor
- System universally fits both new and old equipment



Figure 10 adapted from [4]

Bar-Mounted Housing



TOP

Houses the solar cell used to charge the battery supplying power to the sensor.

MIDDLE

Houses the battery and IMU sensor giving access to the solar cell above.

BOTTOM

Joins with the circuit housing above and couples the entire housing to the barbell.

Future Plans



Application:

Make improvements to visual design and improve workout suggestions



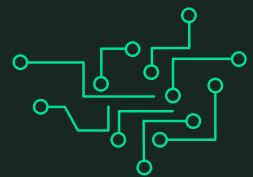
Power:

Research other solar cells and batteries to use



IMU:

Research other IMU data to track



Connection:

Build a printed circuit board (PCB) to minimize footprint



Enclosure:

Improve aesthetics and durability



Communication:

Research compression methods for faster and more power-efficient transmissions

REFERENCES

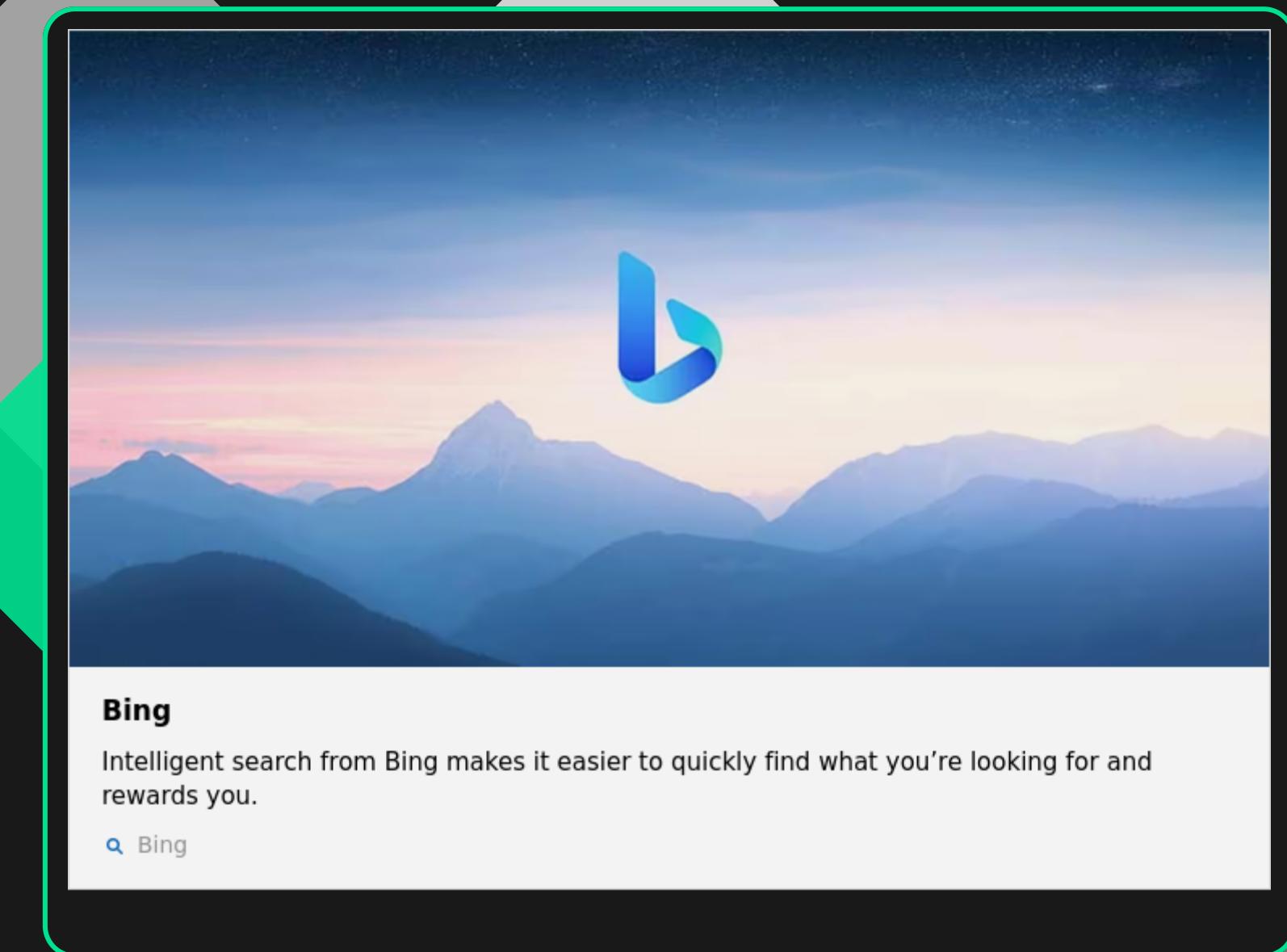
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- [7] S. Sweet, “What’s the difference between Bluetooth and Wi-fi?,” The Solid Signal Blog, <https://blog.solidsignal.com/tutorials/whats-the-difference-between-bluetooth-and-wi-fi/> (accessed Oct. 6, 2023).
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- [10]

AI USE ACKNOWLEDGEMENT

Bravo Builders acknowledge the use of Microsoft Bing Image Creator in the preparation of this assignment for image generation.





Q&A DIRECTORY

Marlon Sims

Sensors Lead

David Lock

Power Lead

Austin Polk

Comms Lead

Logan Dubuisson

Software Dev. Lead

Joseph Taylor

Fitting Design/Team Lead