PROJECT TITLE

HabiTrack

STUDENT/TEAM INFORMATION

Team Name if any: **Team # on Canvas you have self-signed-up for: 12**	**The Barker Bros**
Team member 1 (Team Lead) *(Barker, Henry; hbarker2947@sdsu.edu)*:	*Barker, Henry – hbarker2947@sdsu.edu* 
Team member 2 *(Barker, Teddy; tbarker5031@sdsu.edu)*:	*Barker, Teddy – tbarker5031@sdsu.edu* 

ABSTRACT (15 points)

(Summarize your project (motivation, goals, system design and results). Max 300 words).

HabiTrack is a habit tracking device and system designed to provide users with a simple and intuitive way to log their daily habit sessions while offering visual analytics to help maintain consistency and motivation. The motivation behind this project was to create an alternative to mobile based habit trackers, focusing on reducing distractions and offering a dedicated physical tool that seamlessly connects to a cloud-based dashboard.

The system is built around the ESP32 microcontroller, which is good for its low power consumption and built-in Wi-Fi capabilities. Users interact with the device through a single push button, which supports short and long press logic to start, pause, and stop tracking sessions. An OLED display provides real time feedback by showing elapsed time. Additionally, the system is designed to support accelerometer based gesture input, allowing future versions of the device to activate tracking with a simple lift motion, offering one-handed operation.

Data from each session, including timestamps and durations, is uploaded via Wi-Fi to a cloud server hosted on AWS. The accompanying web based dashboard visualizes this data using bar charts, breaking down the time spent on habits daily and weekly. This dashboard helps users track their consistency and spot trends over time.

The project successfully met its core goals: building a functional prototype that tracks habits through both hardware and software components, and visualizing data in an accessible online interface. Challenges during development included fine-tuning button press detection logic and formatting timestamp data correctly for visualization. Future improvements could include adding more detailed analytics, such as streak tracking and habit recommendations, as well as expanding input methods for broader accessibility.

INTRODUCTION (15 pts)

Motivation/Background (3 pts)

(Describe the problem you want to solve and why it is important. Max 300 words).

In today's world, building and maintaining positive habits is more important than ever, yet many people struggle with consistency due to distractions and lack of effective tracking tools. While there are countless mobile apps designed to help users log their habits, these often compete with notifications, social media, and other digital interruptions. The reliance on smartphones for habit tracking can ironically become a source of distraction, pulling users away from their intended focus.

HabiTrack was created to address this gap by offering a dedicated, physical habit tracking device that simplifies the process and minimizes friction. Our goal was to design a tool that encourages daily use without adding digital clutter or requiring complex interaction. By focusing on a single purpose device, users can engage with their habit tracking in a mindful and distraction-free way, making it easier to build consistency over time.

Additionally, providing real time feedback through a display and backing the data up to a cloud server allows users to see their progress in a more tangible form. This combination of physical interaction and cloud based analytics bridges the gap between traditional pen-and-paper tracking and modern digital tools.

With the rise of the Internet of Things, we saw an opportunity to leverage Wi-Fi connectivity and lightweight sensors to create a smarter habit tracker that could be expanded with gesture input, personalized analytics, and remote access through a web dashboard. HabiTrack not only tackles the problem of habit tracking but also serves as an example of how IoT technology can be applied to enhance personal well being and productivity.

Project Goals (6 pts)

(Describe the project general goals. Max 200 words).

The primary goal of HabiTrack is to create a simple, effective, and distraction-free system for users to track time spent on their daily habits. By offering a physical device with intuitive controls, the project aims to help users build consistency without relying on smartphone apps that can introduce distractions.

Our specific goals are:

- Designing a standalone IoT device based on the ESP32 microcontroller that can track habit sessions with a push button and display real time progress on an OLED screen.
- Implementing wireless data logging by connecting the device to a cloud server via Wi-Fi, allowing users

to store and access their habit history remotely.

- Developing a web based dashboard to visualize tracked data in the form of clear and motivating bar charts, showing daily and weekly breakdowns.
- Enhancing input methods by adding accelerometer-based gesture control, enabling convenient one-handed activation and improving accessibility.
- Ensuring reliability and ease of use, so that users can interact with the device quickly and without confusion, promoting daily engagement.

Ultimately, HabiTrack is designed to not only make habit tracking more seamless, but also to demonstrate the practical application of IoT technologies in supporting personal productivity and well being.

Assumptions (3 pts)

(Describe the assumptions (if any) you are making to solve the problem. Max 180 words).

- We assume that the device will be used by a single user at a time and will track individual habits rather than supporting multiple concurrent users.
- We assume that the Wi-Fi connectivity is stable and available wherever the user intends to track habits, as cloud syncing depends on reliable internet access.
- The system is designed under the assumption that habit tracking sessions will be moderate in frequency, meaning the user will interact with the device a few times per day, rather than performing hundreds of rapid session starts and stops.
- For cloud storage and dashboard performance, we assume that data storage and processing will remain efficient for up to a few years' worth of daily logs without noticeable slowdown.
- We also assume that the gesture input via accelerometer will be used in reasonably controlled environments where false positives from random movement can be minimized.

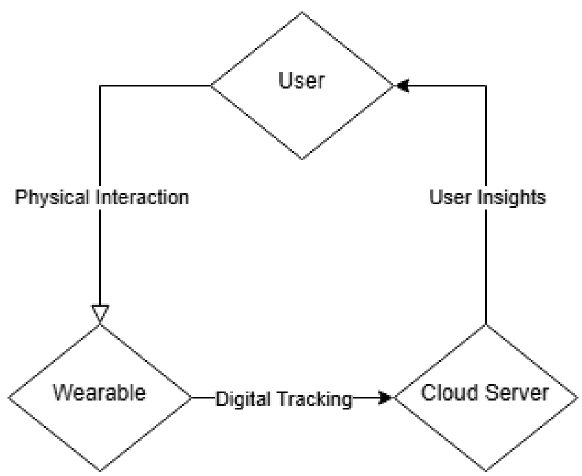
SYSTEM ARCHITECTURE (20 pts)

(Describe the final architecture you have implemented listing sensors, communication protocols (Wi-Fi, BLE, ...), cloud services and user interfaces. Include a block diagram of the system. Max 300 words).

The final architecture of HabiTrack is designed around a simple yet effective loop between the user, the wearable device, and the cloud server, as illustrated in the diagram. The system consists of three main components:

1. Wearable Device:
    a. Built using an ESP32 microcontroller for wireless connectivity and processing.
    b. Equipped with an MPU6050 accelerometer sensor to detect user gestures (e.g., tapping or shaking) that signify habit tracking events.
    c. Communicates over Wi-Fi to send data to the cloud server.
2. Communication Protocols:
    a. Uses Wi-Fi to connect the wearable to the internet and transmit tracking data.
    b. Data is sent in real-time or in short bursts to minimize latency and power usage.
3. Cloud Server:
    a. Implemented using Adafruit IO, which receives and stores tracking data from the wearable.
    b. Hosts a dashboard that visualizes habit streaks, frequencies, and trends, providing user insights.
    c. Allows users to view their progress remotely on any device with internet access.

This architecture ensures that user interaction starts with a simple physical action, gets digitally recorded via the wearable, and is transformed into meaningful insights through cloud-based analytics, closing the loop back to the user.



FINAL LIST OF HARDWARE COMPONENTS (5 pts)

(Write the final list and quantity of the components you have included in your system)

Component/part	Quantity
ESP32 Microcontroller (with Wi-Fi support)	1
Push Button Switch	1
OLED Display	1
SparkFun 6 Degrees of Freedom Breakout - LSM6DSO (Qwiic)	1
Breadboard (for prototyping)	1

Jumper Wires	10+
Resistors (for button circuit)	1
USB Cable (for power and programming)	1

PROJECT IMPLEMENTATION (30 PTS)

Tasks/Milestones Completed (15 pts)

(Describe the main tasks that you have completed in this project. Max 250 words).

Task Completed	**Team Member**
Button Circuitry Code for reading and recording different types of button presses Code adjusting for recording Accelerometer input	Teddy Barker
Cloud server interaction between ESP32 and AWS server Front end visualization of recorded data on server Circuitry for Accelerometer	Henry Barker

Challenges/Roadblocks (5 pts)

(Describe the challenges that you have faced and how you solved them if that is the case. Max 300 words).

One of the main challenges was achieving reliable gesture detection with the MPU6050 accelerometer. Initially, the raw sensor data was noisy and inconsistent, leading to false positives or missed habit tracking events. To address this, we fine-tuned the gesture detection logic by applying threshold filtering and adding a small cooldown period between valid detections. This significantly improved accuracy and user experience.

Additionally, we faced challenges with button input reliability. Our initial design used double presses to trigger habit tracking, but this proved unreliable due to debouncing issues and the precise timing required from the user. The ESP32's detection of quick consecutive presses was inconsistent, leading to frustration during testing. To solve this, we redesigned the input method to differentiate between a short press and a long press instead. This approach was much more stable, as it relies on timing the duration of a single press rather than detecting rapid sequential presses. It also simplified the code and made the device easier and more intuitive for users to operate.

Overcoming these roadblocks helped me deliver a more stable, accurate, and user-friendly habit tracking solution.

Tasks Not Completed (5 pts)

(Describe the tasks that you originally planned to complete but were not completed. If all tasks were completed, state so. Max 250 words).

Task	**Reason**
Double tap button presses implementation	Debouncing and timing proved difficult, switched to long press vs short press.

Time spent per week graph	Very hard to debug and test, switched to time spent per hour in the current day graph.

WEAK POINTS / FUTURE WORK (15 pts)

(Mention at least two points of your project that have room for improvement. These points can be additions to the existing project setup (components) or improvement of the current implementation. Max 200 words).

While the project successfully demonstrates a working prototype, there are a few areas with clear room for improvement. First, the battery life of the wearable is limited. Currently, the device uses Wi-Fi for communication, which consumes significant power. Switching to Bluetooth Low Energy would greatly improve efficiency and extend battery life, making the wearable more practical for daily use.

Second, while the system supports basic habit tracking, the user interface for reviewing progress is minimal. In future work, I would develop a more feature-rich mobile app or web dashboard that presents detailed insights, trend graphs, and personalized feedback. This would make the system more engaging and useful in helping users maintain long-term habits.

Other potential improvements include adding additional sensors, like accelerometers or heart rate monitors, to enable context-aware tracking and refining the physical design for greater comfort and aesthetics.

SOURCE CODE (25 pts)

Please include a link to the source code of your project. A link to a repository (like GitHub) is preferred.

https://github.com/henry27barker/HabiTrack
Demo Video