Faculty of Computer Science – Bachelor of Computer Science

September 22, 2022

Free University of Bolzano – Bozen

Development of a Sensor-based Portable Data Collection System for Climbers

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unibz

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The Internet of Things

Sports Climbing

Enhance the sportive experience through integrated technological solutions

The Objective

Develop a System to collect Data about Indoor Climbing Activity

The Approach

- Research of Existing Solutions
- Definition of Requirements
- Comparison of Alternatives
- Selection of Technologies

Current Research

Stereo Cameras

Fitness Wearables

Smart Sensors

System Requirements

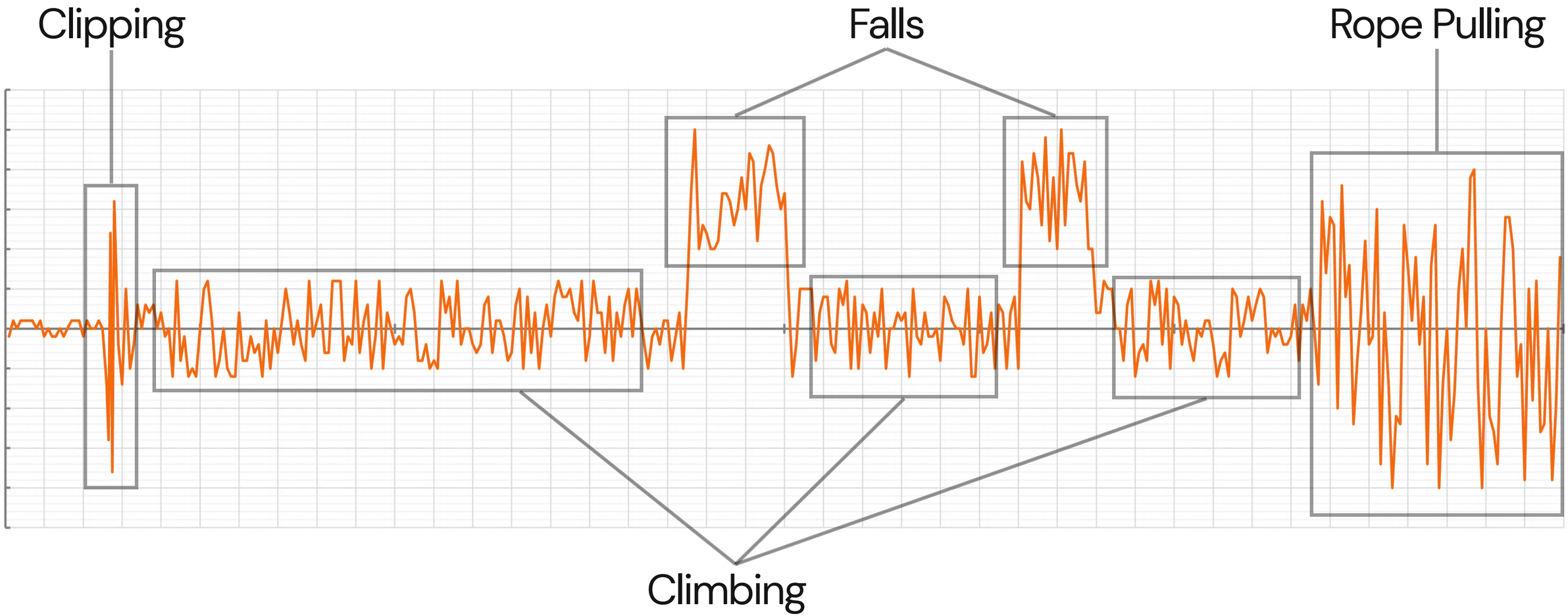
- Non-Intrusiveness
- Accuracy of Data
- Respect for Privacy
- Cost-Effectiveness
- Broad Accessibility
- Universal Applicability
- Low/Zero Maintenance
- For all Climbing Styles

Sensors on Quickdraws

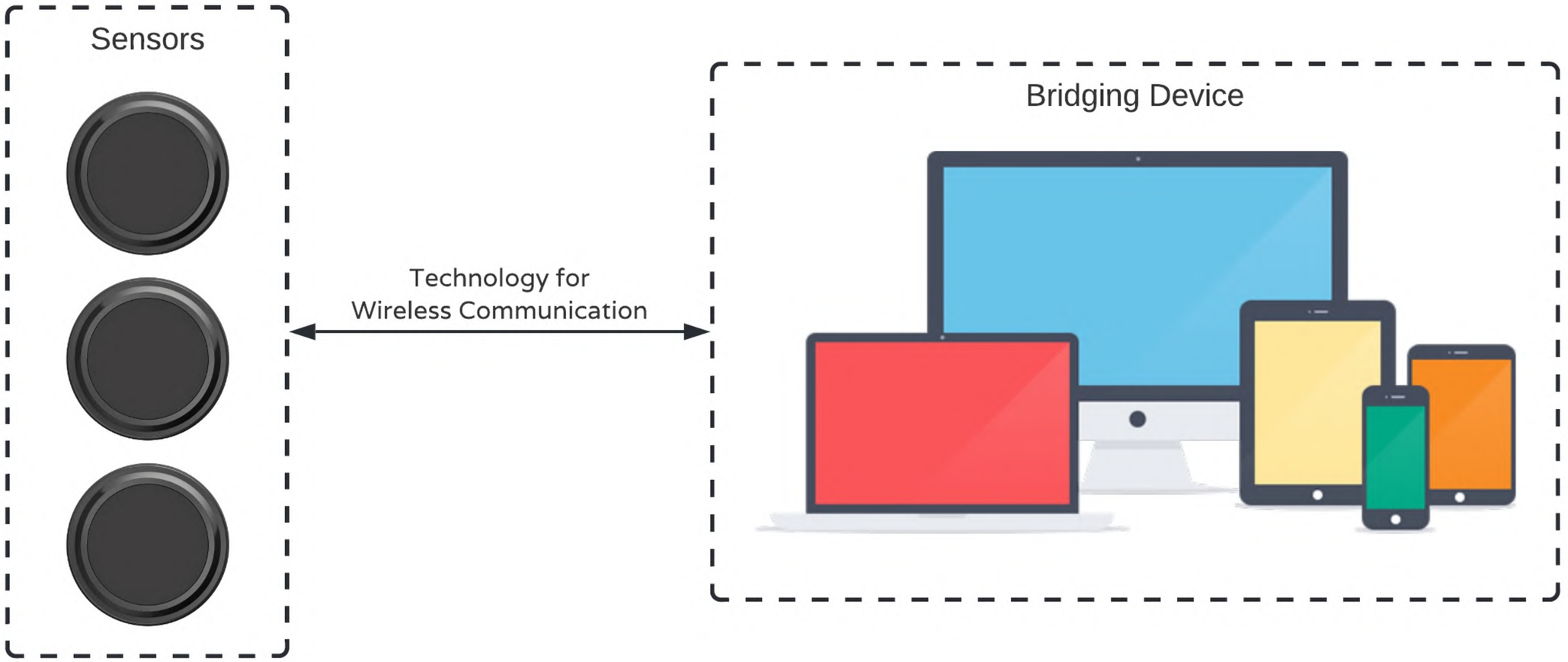
Not for every climbing style
Insuffucient battery life
Stability of connection
Consistency of output

Possible Issues and Downsides

What Data can be collected?



Hardware Components



The Sensors

Several Sensors

Resistant Build Structure

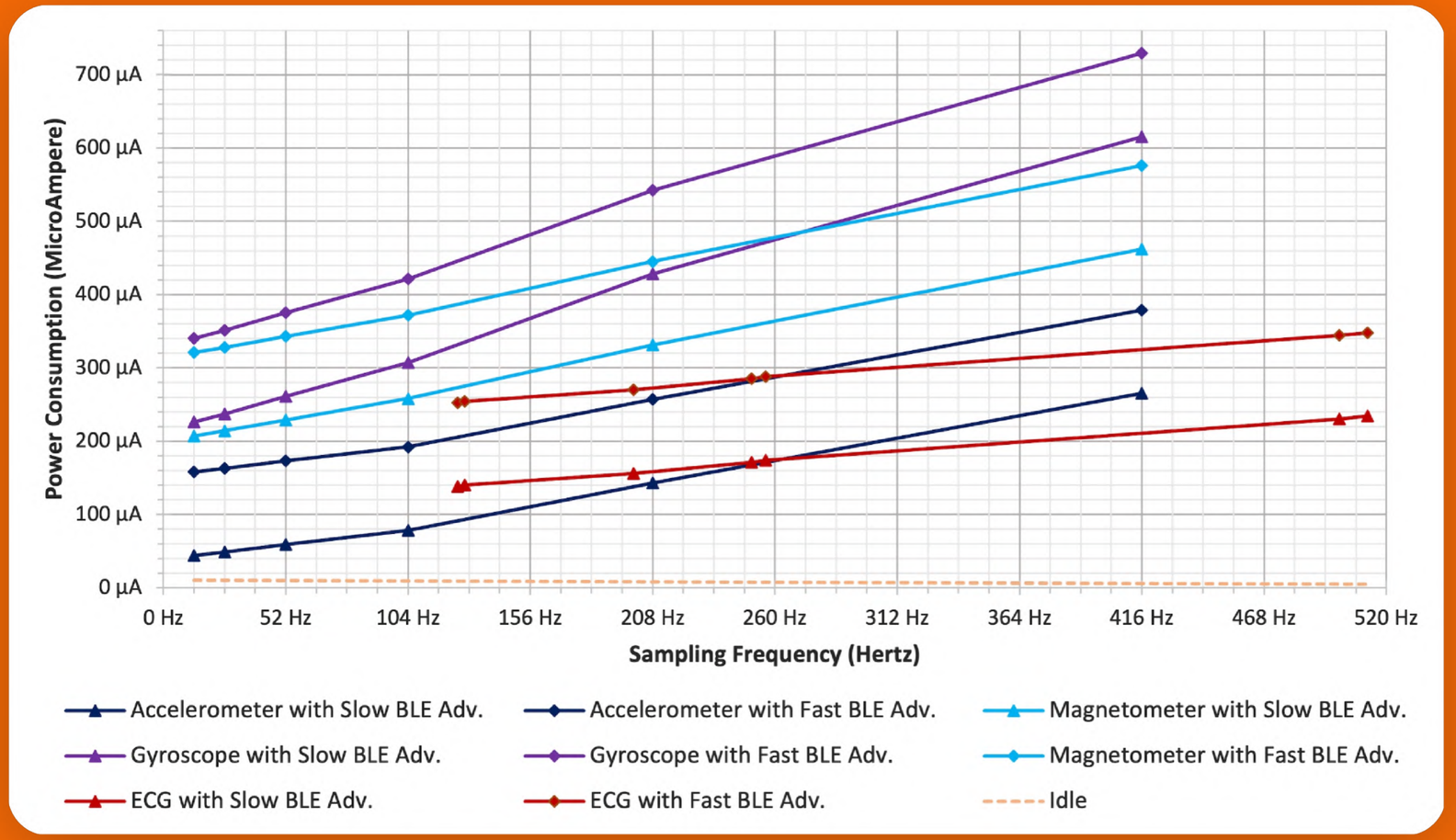
Long Battery Life

Bluetooth Low Energy

Low Power Components

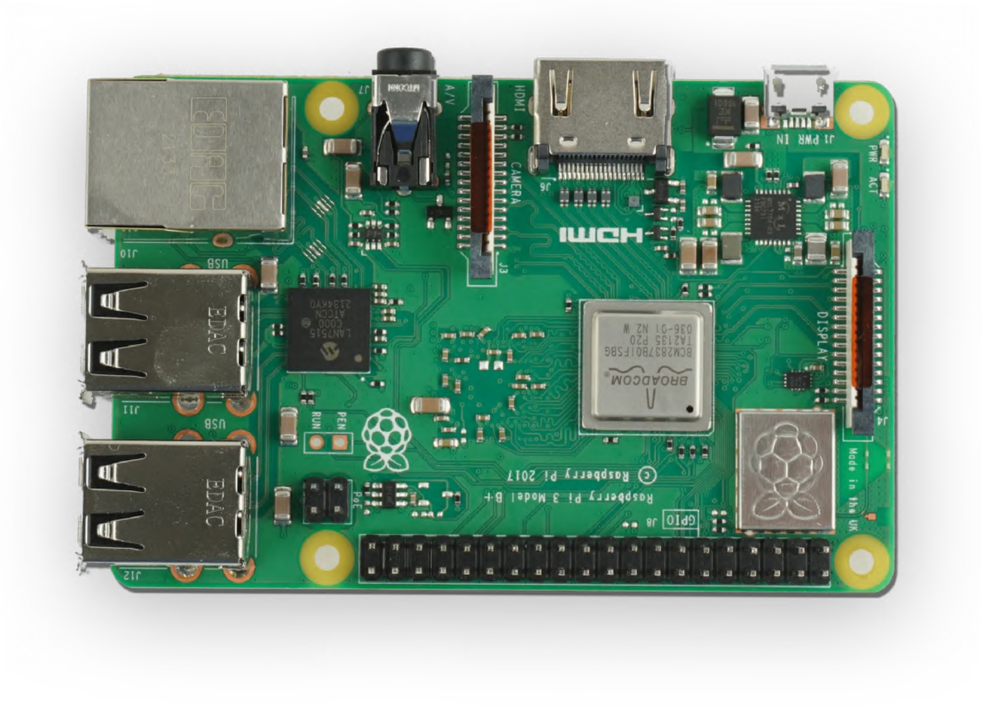
Open Source Software Suite, SDK and API

Lightweight



~ 18 days of estimated battery life

Bridging Device



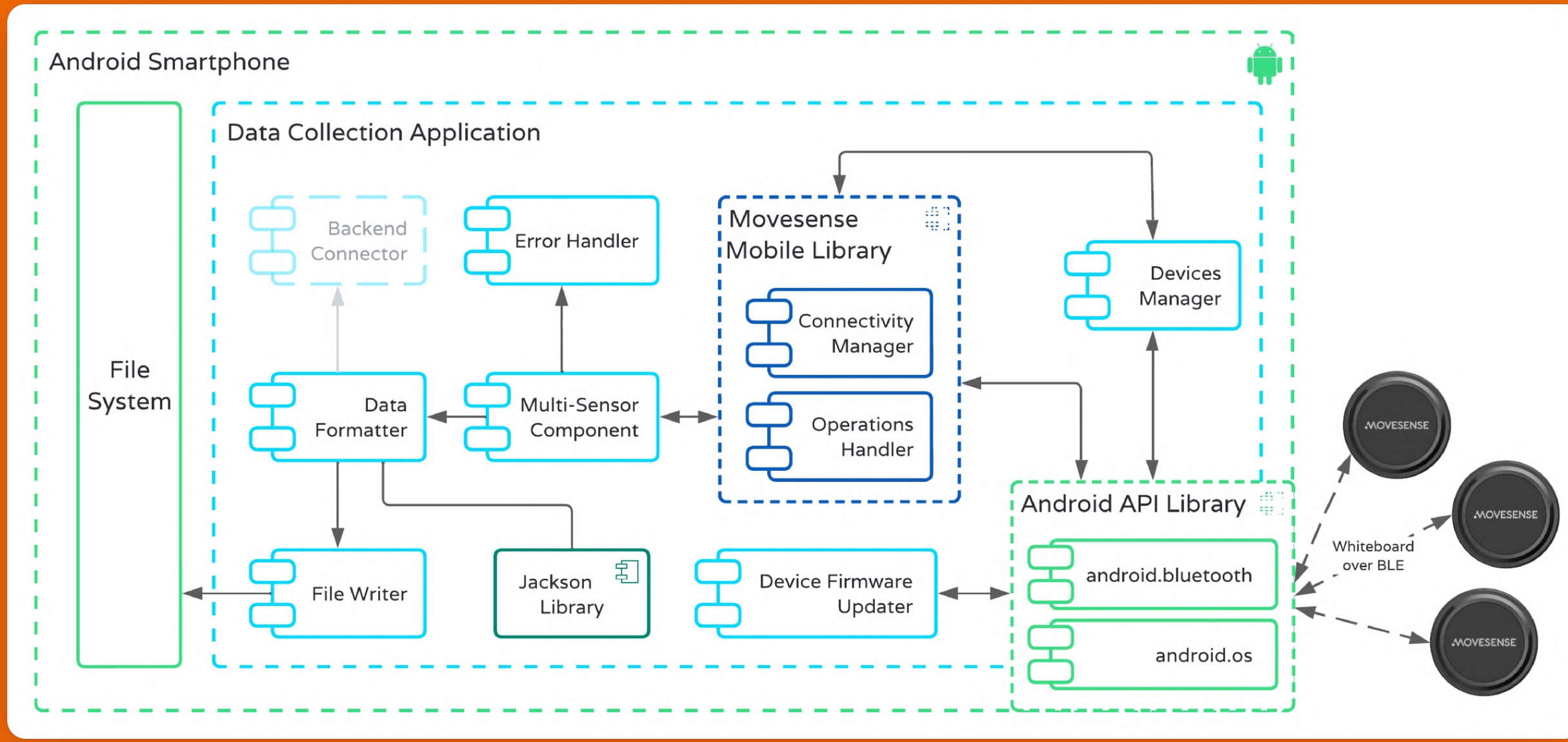
Mobile Library

Integrate Sensors With Third-Party Mobile Apps

Device Library

Develop Custom Firmware for Sensors

Movesense SDK



Architecture of the Data Collection System

The Data Formatter standardizes the output of the application, using JSON

```json
{
    "type": "object",
    "properties": {
        "Timestamp": {"type": "integer"},
        "Sensor": {
            "type": "string",
            "enum": [
                "LinearAcceleration",
                "AngularVelocity",
                "MagneticField",
                "HeartRate",
                "Temperature"
            ]
        },
        "Value": {
            "type": "object",
            "properties": {
                "x": {"type": "number"},
                "y": {"type": "number"},
                "z": {"type": "number"}
            }
        }
    },
    "required": ["Sensor", "Value", "Timestamp"]
}
```

Evaluation of the solution through unit tests

Validate the JSON file with the Schema in 4 edge cases

- Disconnection of Sensor
- Disconnection of Smartphone
- Fatal Error of the Application
- Smartphone Battery Dead

Measure the battery consumption of Accelerometer and Gyroscope

~ 18 days of estimated battery life

~ 17 days of battery life

System to Collect Data about Indoor Climbing Activity

using accelerometers and gyroscopes

applied on climbing quickdraws