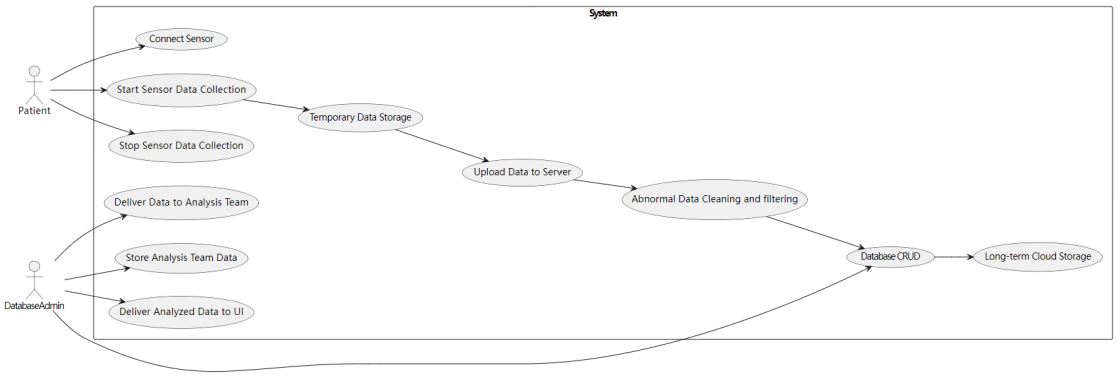
Data module Requirements Specification 1.0

Date	Author	Description
March 28	SmartStride	Data module

This document covers the main needs of patients and database administrators and provides detailed **goals, frequencies, preconditions, postconditions and processes** to ensure that the requirements are clear and implementable.

User case diagram



End User (Patient)

A person using a rehabilitation device is considered an End User.

Power On Device

- **Goal**: To turn on the rehabilitation device and prepare it for data collection.
- **Summary**: The patient powers on the device, which initializes sensors and prepares for motion data collection.
- **Frequency**: Every rehabilitation session.
- **Precondition**: The device is charged and in working condition.
- **Postconditions**: The device is turned on, sensors are initialized, and ready for connection.

Flows

Actor	System
Patient presses power button	Device powers on and initializes sensors

---

Connect Device to Data Management System

- **Goal**: To establish a connection between the rehabilitation device and the cloud-based data management system.
- **Summary**: The patient pairs the device with the system, enabling real-time data transmission and remote monitoring.
- **Frequency**: Every rehabilitation session.
- **Precondition**: The device is powered on, and the system is accessible.
- **Postconditions**: A stable connection is established, allowing data synchronization.

Flows

Actor	System
Patient initiates device pairing	System searches for available devices
Patient selects the correct device	System establishes a secure connection
Patient confirms connection	System displays connection status

---

Start Sensor Data Collection

- **Goal**: To collect motion data from the patient's lower limbs during rehabilitation exercises.
- **Summary**: Once the device is connected, the patient starts the data collection process, and sensor readings are recorded.
- **Frequency**: Multiple times per session.
- **Precondition**: The device is powered on and connected to the system.
- **Postconditions**: Data is continuously recorded and transmitted.

Flows

Actor	System
Patient starts data collection	System begins recording sensor data
Patient performs rehabilitation movements	System captures and processes movement data
Patient stops data collection	System saves the collected data

---

View Rehabilitation Progress

- **Goal**: To allow patients to track their rehabilitation progress.
- **Summary**: The patient accesses the system's interface to review their historical data and progress insights.
- **Frequency**: As needed.
- **Precondition**: Data has been collected and processed.
- **Postconditions**: The patient receives feedback on their rehabilitation progress.

Flows

Actor	System
Patient accesses progress dashboard	System retrieves and displays data insights

---

Enterprise（Database Administrator)

The Enterprise MAY also act as an end user with the cloud platform, accessing data of any device. The Enterprise MAY only access embedded devices if physically present and connected.

Set up Cloud & Configure Device

See Deployment Documentation.

Abnormal Data Cleaning and Filtering

- **Goal**: Ensure the accuracy and continuity of collected data to improve the reliability of rehabilitation training analysis.
- **Summary**:
  - **Abnormal Data Removal**: Set reasonable joint angle thresholds. Data exceeding the range (e.g., knee joint angles should be between 0° and 140°) will be marked as invalid and excluded from analysis.
  - **Data Compensation**: When BLE transmission is interrupted or data is lost, a linear interpolation method is used to repair missing data, ensuring data continuity and completeness.
- **Frequency**: Automatically executed each time data is uploaded to the server or before data analysis.
- **Precondition**: The device has successfully collected raw motion data and uploaded it to the server.
- **Postcondition**: Abnormal data is removed, missing data is compensated, and data integrity is ensured.

Flows

Actor	System
Server receives motion data	Parses data and detects anomalies
System detects abnormal data	Marks invalid data and removes it from the analysis dataset
Server detects missing data	Uses linear interpolation to compensate for missing values
Data processing completes	Stores cleaned data into the database

---

Database CRUD (manage patients' data)

- **Goal**: Manage rehabilitation data in the system, including storing, updating, querying, and deleting records to ensure data integrity and availability.
- **Summary**: The database administrator can perform CRUD operations on patient rehabilitation data to support data maintenance and analysis.
- **Frequency**: Performed periodically or as needed.

- **Precondition**: The system has stored patient rehabilitation data, and the administrator has the necessary access permissions.
- **Postcondition**: Database contents are updated, ensuring data accuracy and consistency.

Flows

Actor	System
Database administrator requests to insert data	System validates the data format and inserts it into the database
Database administrator requests to update data	System updates relevant records in the database
Database administrator requests to query data	System retrieves and returns matching records
Database administrator requests to delete data	System removes specified data from the database

---

Deliver Data to Analysis Team

- **Goal**: To transfer raw rehabilitation data for further analysis.
- **Summary**: The system allows administrators to send collected data to the analysis team for in-depth processing.
- **Frequency**: Periodically, based on analysis requirements.
- **Precondition**: Data collection has been completed.
- **Postconditions**: The analysis team receives structured data.

Flows

Actor	System
Admin selects data batch	System prepares data for export
Admin confirms data transfer	System sends data to analysis team

---

Store Analysis Results

- **Goal**: To securely store analyzed data for future reference and comparisons.
- **Summary**: Once data has been processed, it is stored in the system for medical professionals to review.
- **Frequency**: Ongoing.
- **Precondition**: Data analysis has been completed.
- **Postconditions**: The system securely saves the analyzed data.

Flows

Actor	System
Analysis team submits results	System verifies and stores data

---

Provide Processed Data to UI for Visualization

- **Goal**: To allow medical professionals to visually analyze patient data.
- **Summary**: The system presents processed data in an easy-to-understand format, aiding in decision-making.
- **Frequency**: As needed.
- **Precondition**: Processed data is available.
- **Postconditions**: The user interface displays data insights.

Flows

Actor	System
Admin requests data visualization	System retrieves and displays processed data

---