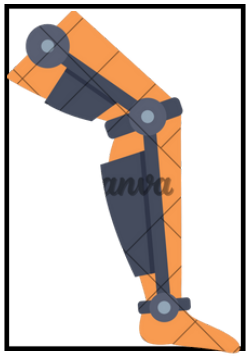
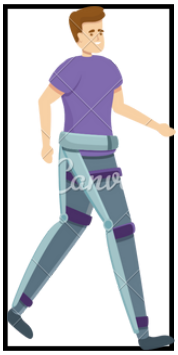
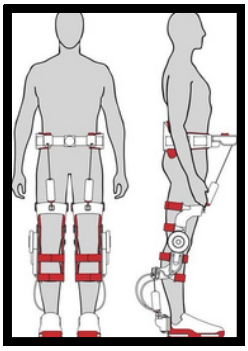
Wearable Robotic Trainer for Gait Rehabilitation in Children with Motor Delays

The aim of this project is to develop a smart assistive exoskeleton for children with motor delays, focusing on lower body support from the feet up to the lower back to help them practice and develop walking skills.

The device will perform three main functions:

1. **Weight Support** It will reduce the load on the child's legs based on their individual strength. The system will allow adjusting the weight to match the severity of the condition.
2. **Active Gait Assistance** The exoskeleton will assist in initiating and guiding the walking motion, especially for children who cannot move their legs independently. As the child improves, the device will reduce its assistance, allowing for more natural movement.
3. **Progress Monitoring** The system will track key data such as how much weight the child is bearing on their own, their ability to initiate movement independently, and overall progress over time. This data will be stored for further evaluation.

System Overview

The wearable exoskeleton will cover the lower body, starting from the feet up to the lower back. It will be lightweight, modular, and adjustable to fit different child sizes. The key components include:

1. **Mechanical Frame :**A lightweight but sturdy exoskeleton structure that wraps around the legs and lower back, providing support and alignment for the child's posture and movement.
2. **Actuators (Motors/Servos):** Placed at key joints like the knees and hips to drive leg movement and simulate a walking pattern. These motors will help initiate steps and control the pace of movement.
3. **Load Sensors / Force Sensors :**Installed under the feet or on leg supports to detect how much weight the child is putting on their legs. This helps monitor progress and adjust the level of assistance.
4. **Control Unit (Microcontroller):** A central unit (e.g., Arduino or similar) that processes sensor data and sends commands to the motors based on the child's needs and therapy goals.

5. **power Supply:** A battery pack safely mounted on the back or waist area, powering the actuators and electronics.

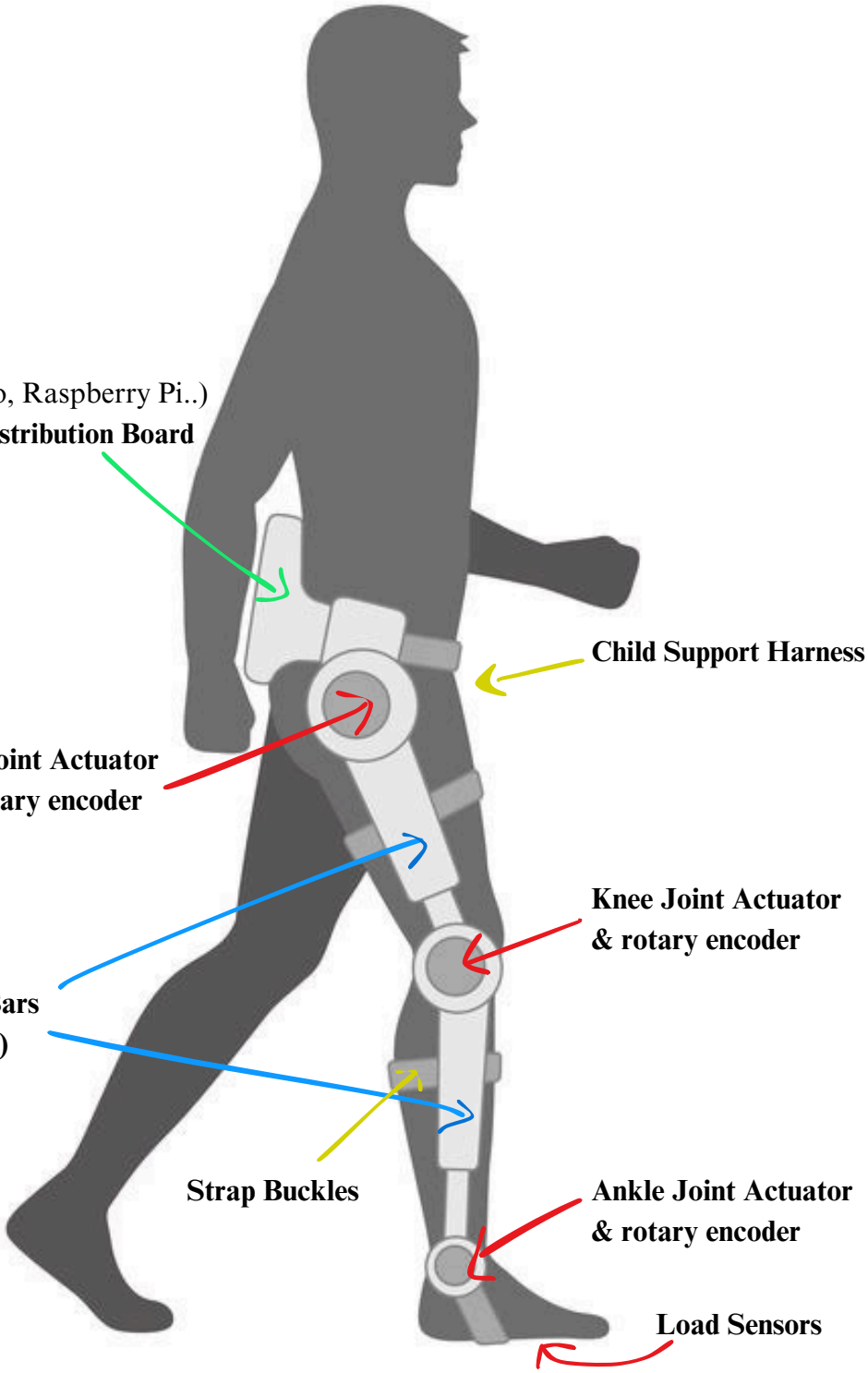
6.**Display Interface:** The laptop will act as the main interface, showing real-time data like

- Supported weight percentage.
- Child's walking mode (assisted or independent).
- Progress logs and improvement tracking.

System Components :

Back-Mounted Components:

1. **Battery Pack**
2. **Main Controller** (Arduino, Raspberry Pi..)
3. **Motor Drivers / Power Distribution Board**
4. IMU sensor



Component Description :

1.Mechanical Frame

The main structure that supports all parts and keeps the device stable.

- Bar: It must be strong enough to support a 2–3-year-old child without bending or breaking.
- Straps: attach the child's body to the device.
- Harness: Soft seat worn by the child.

2**. Load Sensors**

Detect whether the baby's full weight is on the ground or partially supported.

3**. Rotary Actuator**

Used to create precise rotational movement, such as adjusting the child's hip or leg orientation. It allows controlled angular motion, enhancing the device's adaptability and comfort.

4**. Linear Actuators**

Move parts vertically to slightly lift or lower the baby.

5**. Rotary Encoder**

Tracks rotation angle for accurate control of moving parts.

6**. IMU Sensor**

Measures baby's motion and balance (acceleration, tilt, etc.).

7**. Battery**

A compact, rechargeable battery strong enough to power the system for a 2–3-year-old child.

8**. Main Controller**

Brain of the system (like Arduino, ESP32, Raspberry..) that processes sensor data and controls actuators.

9**. Motor Drivers**

Interface between controller and motors; provide enough current and direction control.