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## Problem Description

The project addresses the physical strain of manually transporting tools and equipment in harsh work environments where affordable and accessible transport systems are lacking. The goal is to develop a mobile robotic assistant that can detect a worker, map a route, and follow them to carry tools safely and cost-effectively.

## Problem Background

Most workers who work in demanding or harsh environments, i.e. construction, industry, factory or maintenance workers, often must carry heavy tools on their person. This becomes an issue especially in industrial environments where operators cannot afford to have excess weight on them, causing safety hazards.

Solutions to this problem already exist. Workers often rely on push carts, dollies, hand trolleys, rolling toolboxes to move heavy equipment. These require constant pushing or pulling and can be difficult to maneuver on uneven surfaces or in tight spaces. Other solutions include using a portable tool belt or backpacks. These keep tools within reach but place the full weight directly on the worker's body, increasing fatigue and risk of injury over long shifts.

This forms a need to make a mobile, autonomous, and tool-carrying system that can follow a worker, transport equipment safely, and reduce physical strain without requiring continuous manual operation.

## Scope

The project will demonstrate a working proof-of-concept of a mobile tool assistant. The team will design, build, and test a small-scale robotic platform that can autonomously follow a single worker and carry a modest payload of tools across a flat or moderately uneven indoor surface. The work will involve selecting and assembling appropriate hardware such as motors, sensors, a supporting frame, and a battery to create a safe and stable prototype. On the software side, the team will implement core functions such as person-tracking, obstacle avoidance, and return-to-base behavior so that the robot can reliably follow a worker in a controlled environment. A controller edge node will also be developed to allow a worker to start, stop, or summon the robot without requiring constant supervision.

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## Objectives

The project team shall:

1. Develop and deliver a mobile prototype of a compact, and safe robot capable of transporting small to medium tool loads in an indoor industrial environment.
2. Implement a reliable person-following capability that allows the robot to detect and follow a designated worker after activation.
3. Integrate obstacle detection and avoidance to minimize collision risk in a dynamic workspace.
4. Provide an automatic “return to base” function so the robot returns to its charging station when idle or when the battery is low.
5. Demonstrate usability and safety by producing a working prototype within one academic year and within the approved budget.

## Constraint

The design and implementation shall be limited by the following constraints:

1. Single-Floor Navigation: The system shall be restricted to operation on flat, single-level surfaces. The design shall not support stair climbing or traversal of steep inclines.

2. Indoor Use: The system shall be designed for operation in indoor environments only. Outdoor operation is excluded due to environmental complexity and weatherproofing requirements.

3. Payload Capacity: The system shall be capable of carrying a moderate tool payload only, as limited by motor performance, chassis strength, and available project resources.

4. Timeframe: The project shall be executed within the academic year, which constrains scope to the development of core functionalities rather than advanced features.

5. Team Size: The project shall be executed by a team of four members. The limited manpower constrains the project scope, task allocation, and development capacity within the given timeframe.

6. Budget: The project shall operate under limited financial resources, restricting the use of high-cost sensors, materials, and hardware.

## Key Considerations

The robotic assistant shall operate in a safe and non-distracting manner, maintaining appropriate distance from workers and functioning predictably so as not to interfere with normal workflows. The design shall incorporate reliable load management, robust battery management, and durable, energy-efficient components to meet safety and operational requirements. The project shall also emphasize positive social impact by reducing physical strain on workers, ensuring ease of use and accessibility, and reinforcing the role of the robot as an assistant that supports productivity rather than replacing human labor.