Development of a Robotic System for Efficient Item Delivery in Healthcare

Group 6

Introduction

01 - Current Demand

Increasing need for efficient processes in delivering medications, medical instruments, and essential items within healthcare facilities

02 - Objective

This project specifically aims to address robot navigation inside a hospital simulation environment for taking medicines from one place to another.

03 - Goal

We aim to solve is to develop a robotic system capable of sliding and taking up items from a designated location and delivering them to patients in a controlled and safe manner.

04 - Benefits

This project is an intersection of the growing demands within healthcare facilities and the advancements in robotics, aiming to bridge the gap between these needs and capabilities.

Tools and Technologies

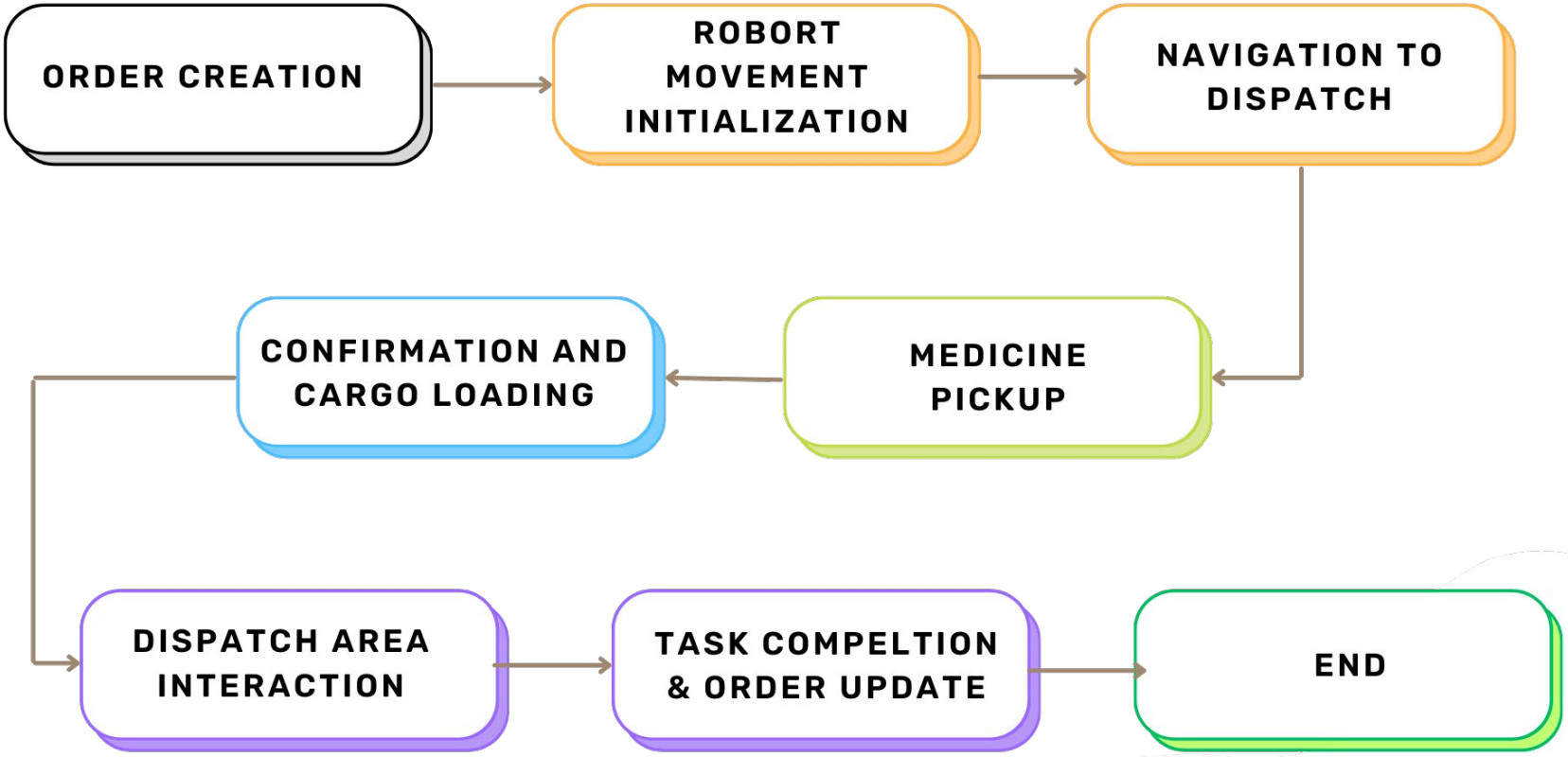
ROS Melodic

Gazebo

C++

RVIZ

Robot Task


ORDER CREATION
ROBORT MOVEMENT INITIALIZATION
NAVIGATION TO DISPATCH
MEDICINE PICKUP
CONFIRMATION AND CARGO LOADING
DISPATCH AREA INTERACTION
TASK COMPELTION & ORDER UPDATE
END

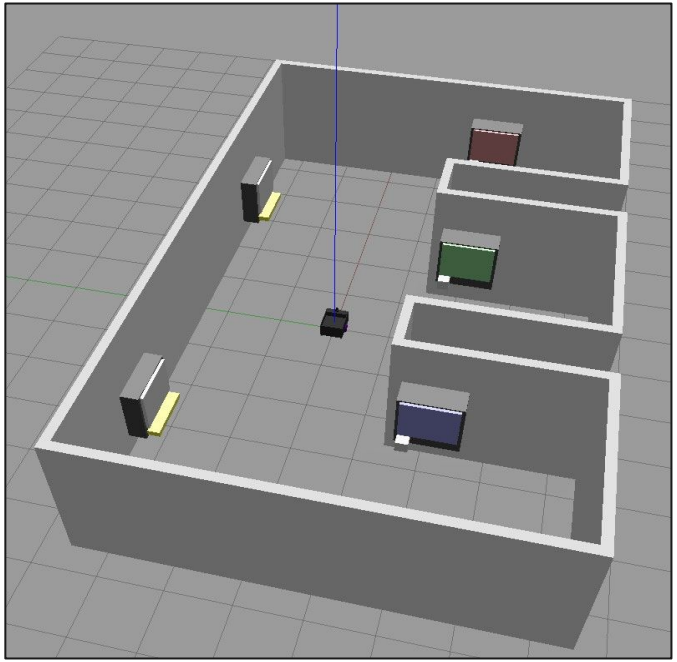
Environment : Hospital World

Hospital Layout:

- Medicine storage unit on the right.
- **Dispatch area** on the left.
- There will be Bed arrangement for **patients** in between.

Robot Task:

- **Navigates** in between corridor to reach medicine storage unit for pick up.
- Collects items (**Medicines**).
- **Delivers** medicine to patient bed.



URDF Robot Design

Robot Design:

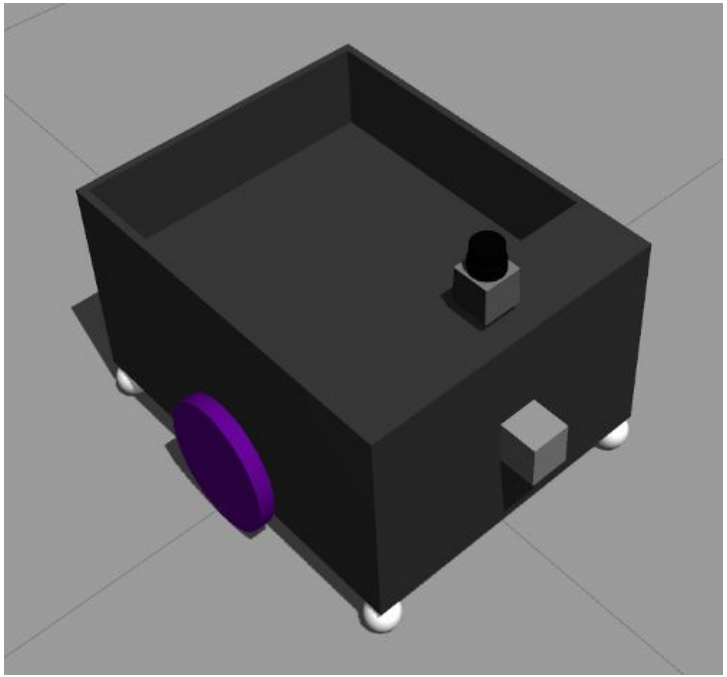
- Two **main wheels** for locomotion.
- Ball caster wheels on the sides for **stability**.
- Flat surface at the back designed for carrying items.

Sensors for Navigation:

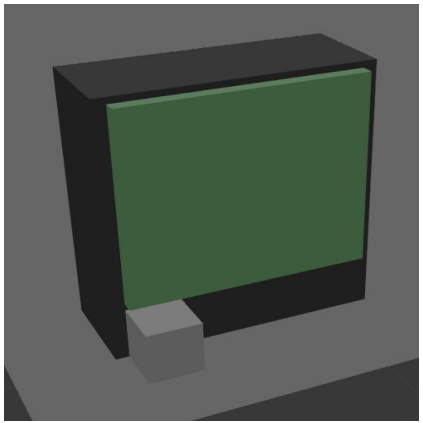
- Equipped with a **camera** for visual perception.
- Features **Lidar** for **mapping** and determining its **location**.

Technical Specifications:

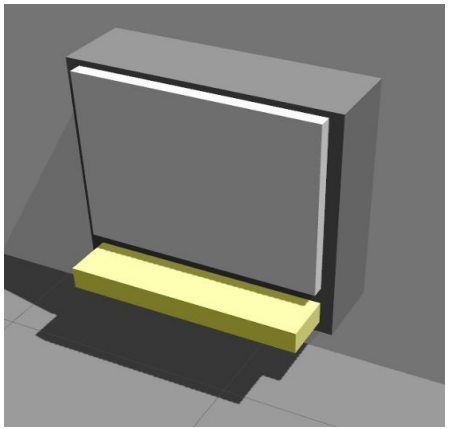
- Developed using URDF format.
- Utilizes .xacro files for configuration.
- Capable of turning towards different locations.



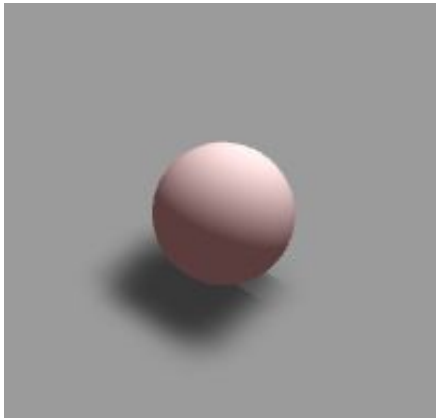
Other Components



Medicine Storage Room

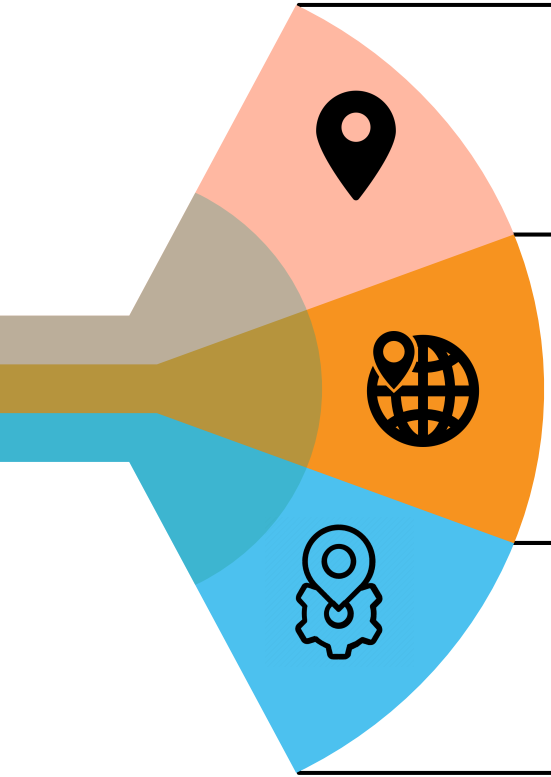


Dispatch (Patient's Bed)



Product (Medicine)

Mapping & Navigation



Mapping Process

- Utilizes **SLAM** (Simultaneous Localization and Mapping) **technique**.
- SLAM package is used for **mapping** the hospital layout.

Localization Setup

- **AMCL (**Adaptive Monte Carlo Localization) utilized for **localization**.
- Precise **positioning of the robot** within the hospital environment.

Navigation Configuration

- **move_base** package for navigation.
- Inflation radius adjusted for **safe corner navigation**.

SLAM Package

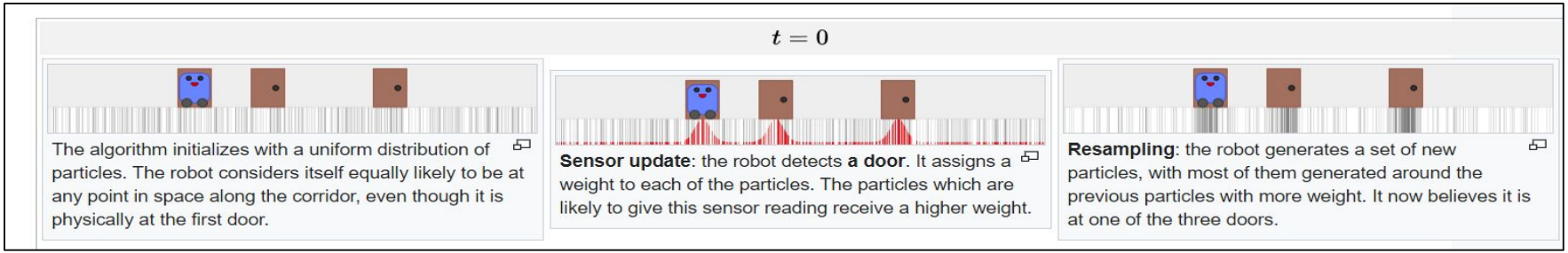
- **SLAM (Simultaneous Localization and Mapping)**: Constructs an **environment map** while tracking the **robot's location**.
- **Algorithm:** It uses a probabilistic approach. The grid-based representation allows the creation of a map with cells that can be marked as **occupied**, **free**, or **unknown**.

Integration :

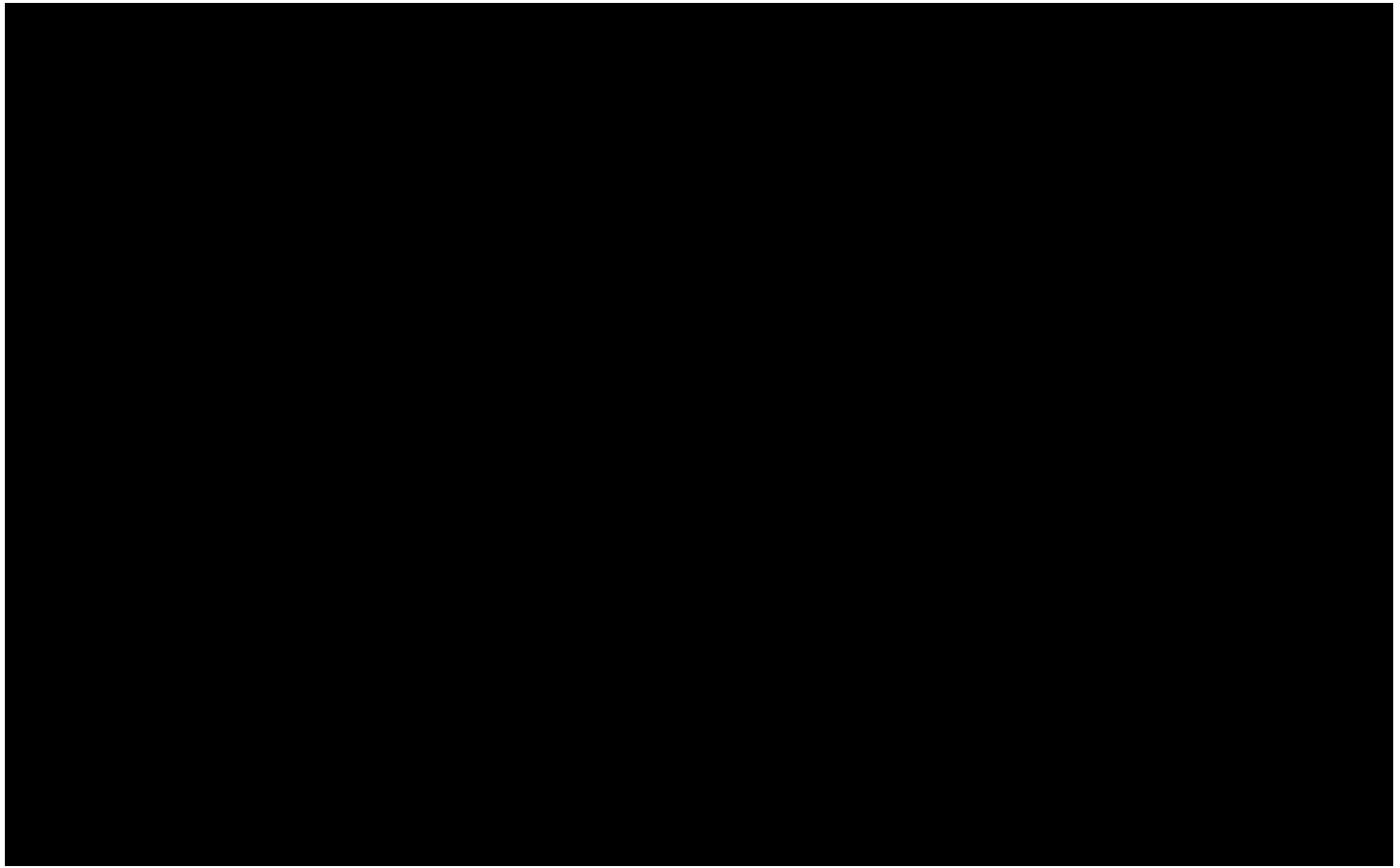
- **ROS Integration:** Works seamlessly with ROS, serving as a node that takes sensor data (typically laser range finders) to generate an **occupancy grid** map for navigation.
- **Laser Scan Input:** Relies on laser scan data to update the map and accurately determine the robot's pose within the environment.

AMCL

- **AMCL (Adaptive Monte Carlo Localization):** Uses probabilistic methods and **particle filtering** for medicine delivery as it calculates precise robot positioning in hospitals, aiding accurate medication delivery.
- **Utilizes Continuous updation of Model:** Constantly updates robot position using sensor data, ensuring adaptability in hospital environments.
- **AMCL for Hospital Navigation:** Adapts localization for hospitals, adjusting to layout changes for accurate navigation and medication delivery.



Demo



Future Directions

03

Adaptable Grasping Module

Introducing adjustable grippers for different medicine packages, ensuring accurate handling.

02

UI Dashboard for Control

Providing Dashboard for better task view and control, making medicine delivery smoother and easily used by hospital employees.

01

Real-time Obstacle Detection

Using advanced sensors and navigation algorithms to detect and avoid moving objects or obstacles.

Conclusion

- Demonstrates comprehensive understanding and application of ROS, **Gazebo**, and C++ for robotics and techniques like **MCL**.
- Gained Knowledge for **environment** and **robot creation**.
- Provides a **foundation** for scaling **automation** in logistics and Hospital management.

THANK YOU