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Intelligent Mobile Robot

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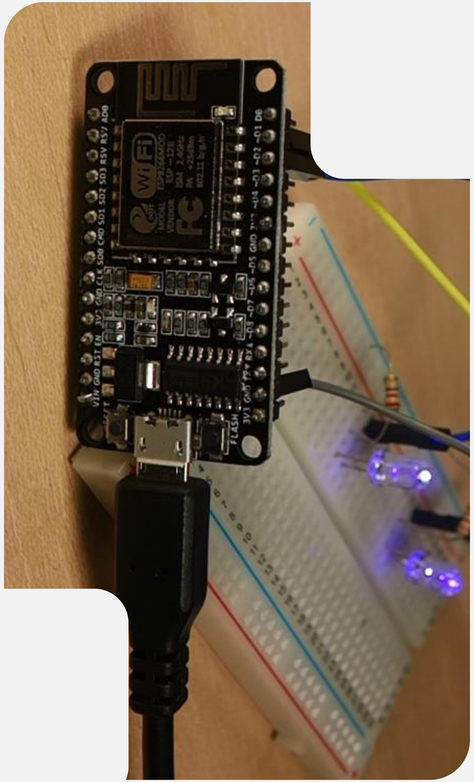
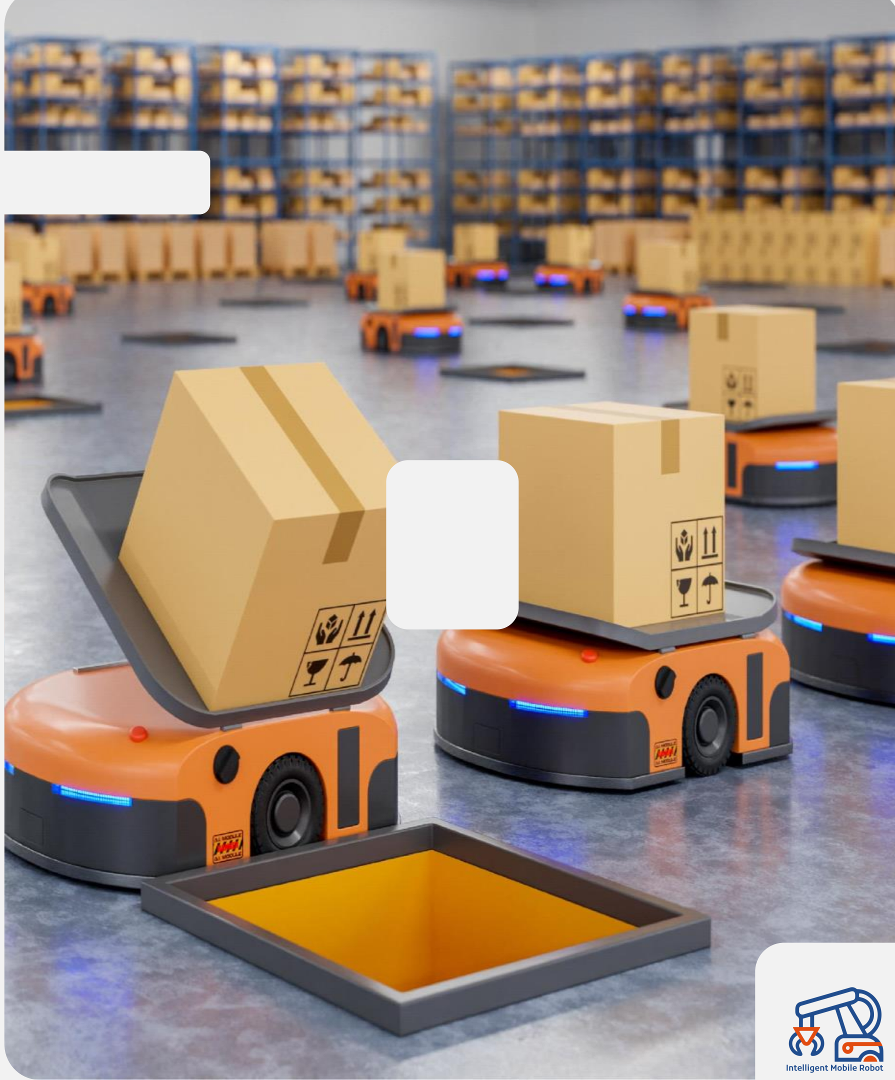


01

Introduction

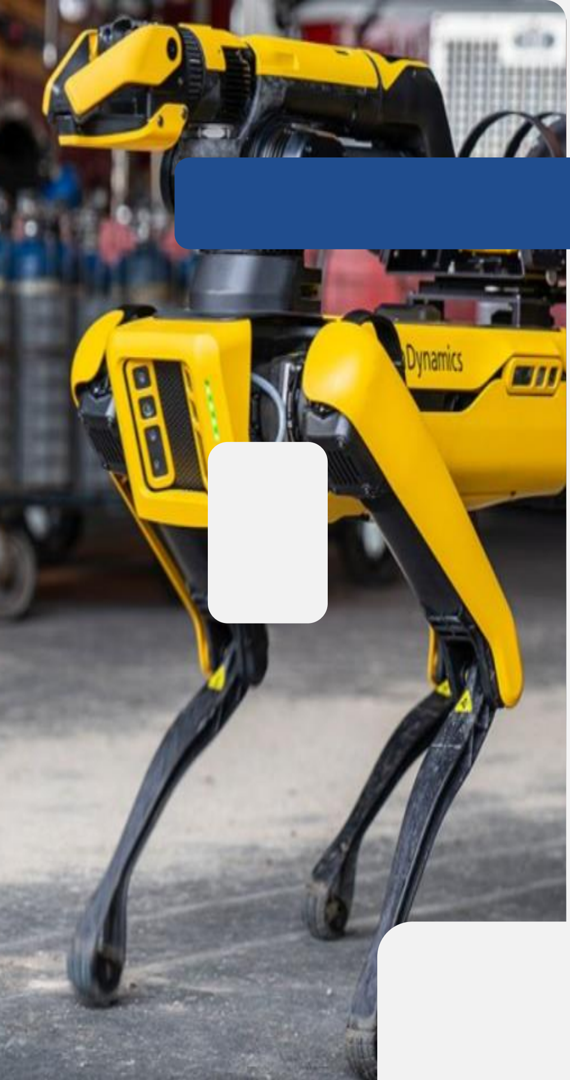
Intro about mobile robot field



Introduction

A robot is a device that performs tasks autonomously or semi-autonomously. It interacts with its environment, senses its surroundings, and carries out programmed actions. Robots can be physical machines, serving various purposes in fields such as manufacturing, exploration, healthcare, and more.

Intelligent Mobile Robot

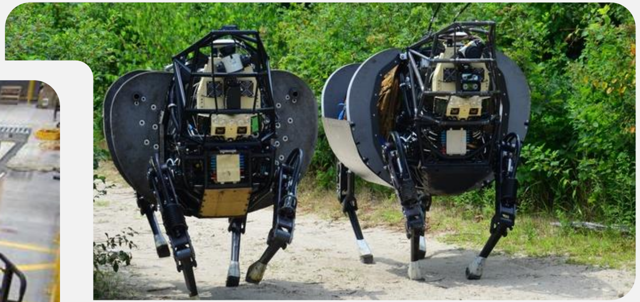


Intelligent Mobile Robot

What are Intelligent Mobile Robots?

Intelligent mobile robots are autonomous robots that are capable of navigating and performing tasks in dynamic environments. They are equipped with sensors, processors, and actuators that enable them to interact with their environment and make decisions based on the data they receive. Intelligent mobile robots have been used in a variety of applications such as industrial automation, search and rescue operations, military operations, and medical care.

Types of Intelligent Mobile Robots



Flying Robots

Flying robots use wings or rotors to fly through the air and can be used for surveillance or search-and-rescue operations

Wheeled Robots

Wheeled Robots Are typically used for navigation in indoor environments where obstacles are present. They use a combination of sensors to detect obstacles and plan paths around them.

Legged Robots

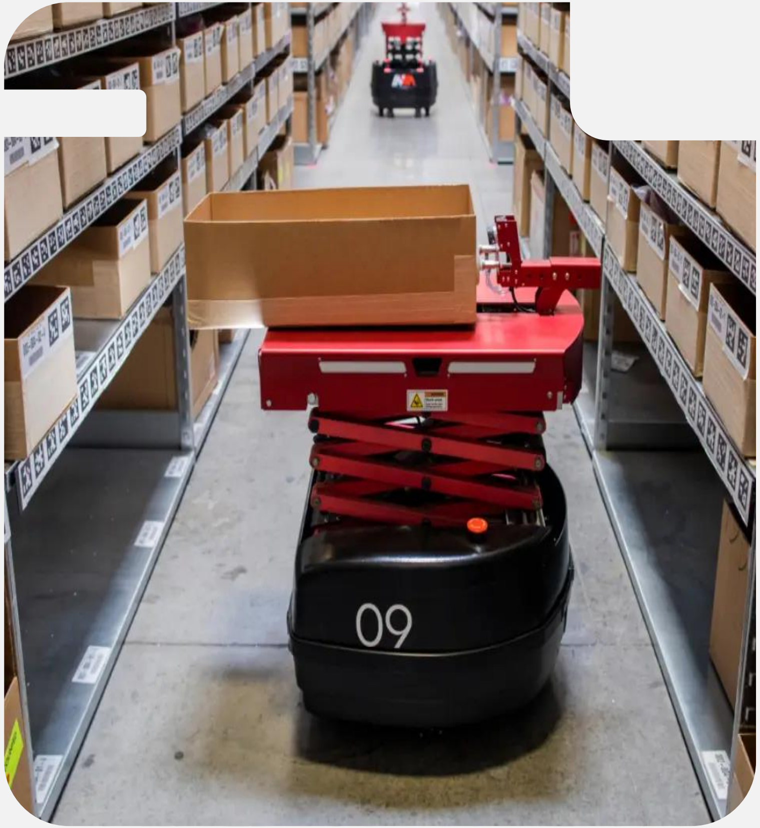
Legged Robots Are designed for outdoor navigation where terrain is uneven or unpredictable. They use legs to move over obstacles or climb stairs.

AGVs Vs AMRs

Automated Guided Vehicles (AGVs) are electric vehicles that move objects around an area. They move on fixed paths or routes, requiring infrastructure, and rely on pre-programmed software for instructions, as they depend on certain paths.AGVs are a form of automation, but they are not intelligent machines.

On the contrary autonomous mobile robots(AMRs) use perception and navigation algorithms to navigate paths inside facilities and move objects from one place to the next, as they are not limited to a specific route.
AMR can navigate without external guidance. In other words, the AMR can navigate freely and decision-making. An autonomous mobile robot is not simply a programmed machine. The AMR is one that, in addition to the initial programming, has a certain Ai algorithm that gives it the degree of independence to make decisions in the middle of the work environment, without the need for human intervention.

AVGs Vs AMRs



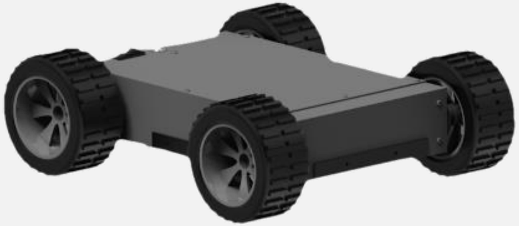
02

IMR Requirements

Project’s requirements needed

Design Requirements

Mobile Robot



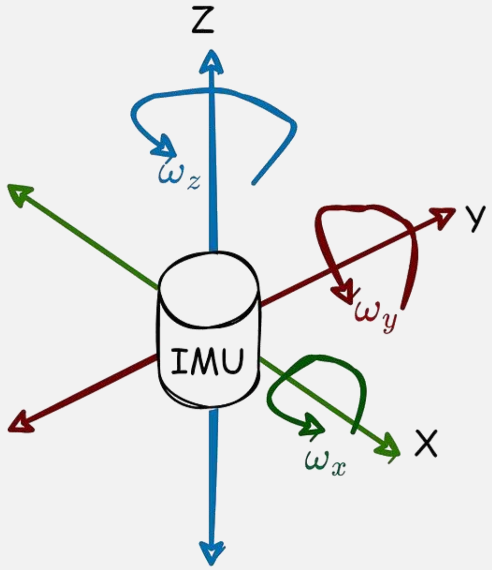
Robot Arm

Hardware Requirements

Processing Units

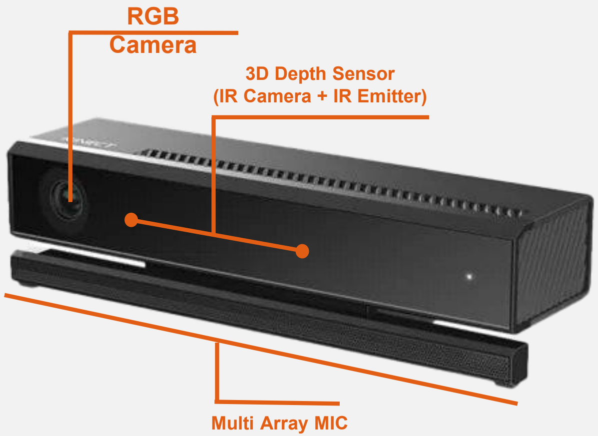
Hardware Requirements

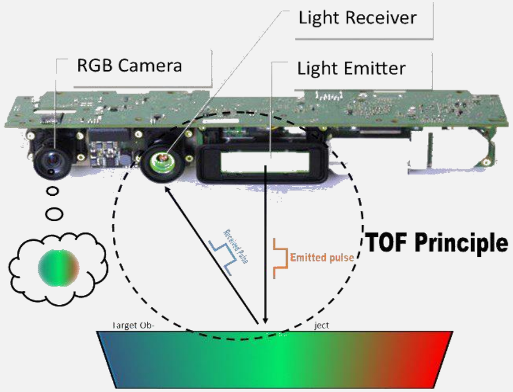
Sensors



Hardware Requirements

Sensors



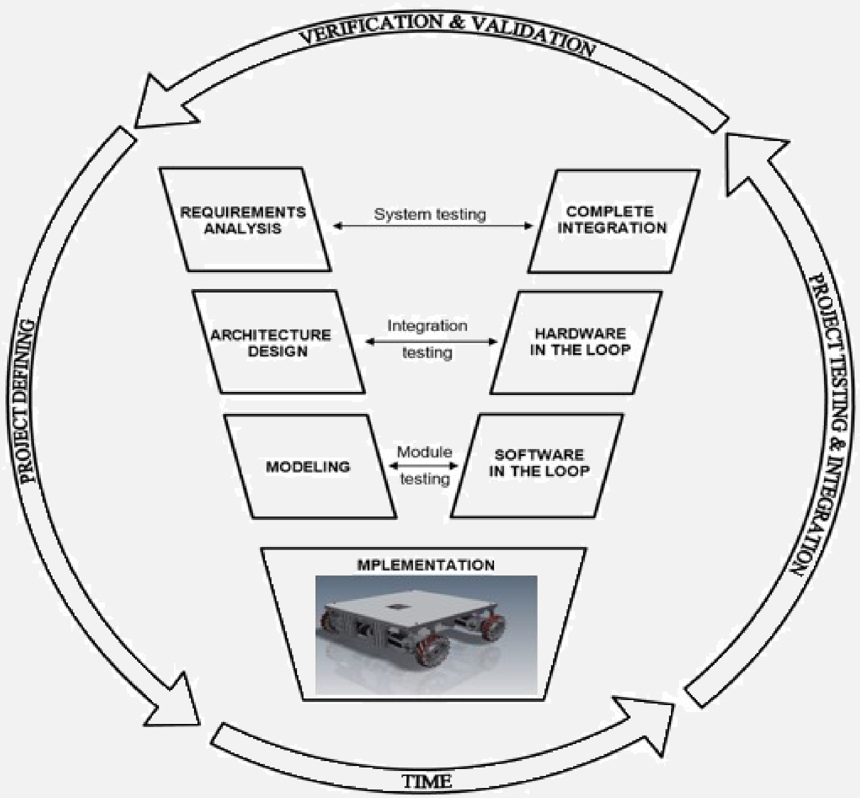


Hardware Requirements

Motors

Software Requirements

V Model Design Procedure



Intelligent Mobile Robot

03

IMR Theories

Introduction to IMR theories

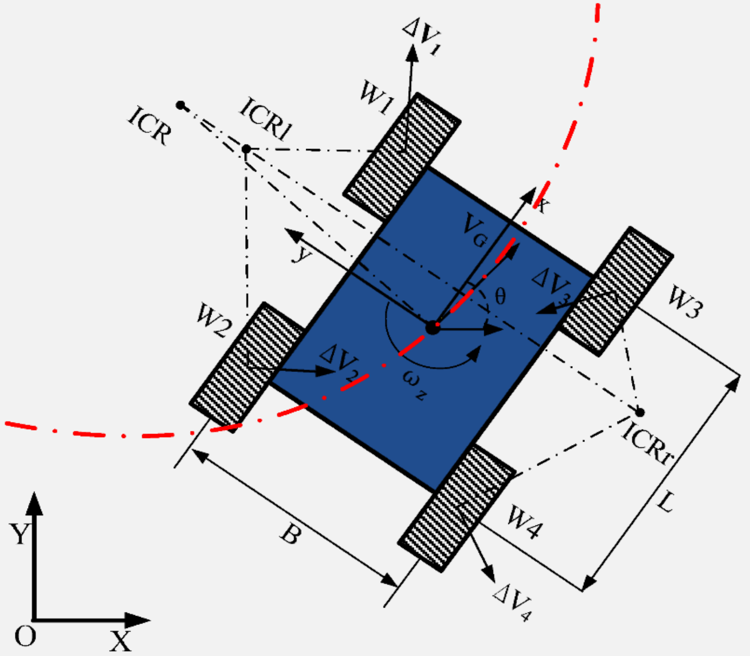
Kinematics

Kinematics is study (the mathematics) of motion without considering the forces/efforts that effect the motion.

Need of Kinematics:

- To understand the behaviour of the system and design system.
- To design suitable controllers , to control the robot efficiently.
- To predict or estimate the system parameters, to illustrate or simulate the real system, etc.

Mobile Robot Kinematics



Degree of maneuverability

- it is the sum of degree of mobility and steerability.
- It includes both the degree of freedom that the robot manipulates directly through wheel velocity and the degree of freedom that it indirectly manipulates by changing the steering configuration and moving.
- Degree of manoeuvrability depends on the kinematics configuration and actuator arrangement of the mobile robot.

- **Degree of manoeuvrability = Degree of mobility + Degree of steerability**
- $\boldsymbol{\delta_M = \delta_m + \delta_s}$

Mobile Arm Kinematics

Degree of freedom:

Our robot arm is considered to be 5 degree of freedom refers to robotic system or manipulator that has five independent parameters or variables that define its configuration or motion.

Robot ARM 3D Model:

Fig 2.2: 3D model of our

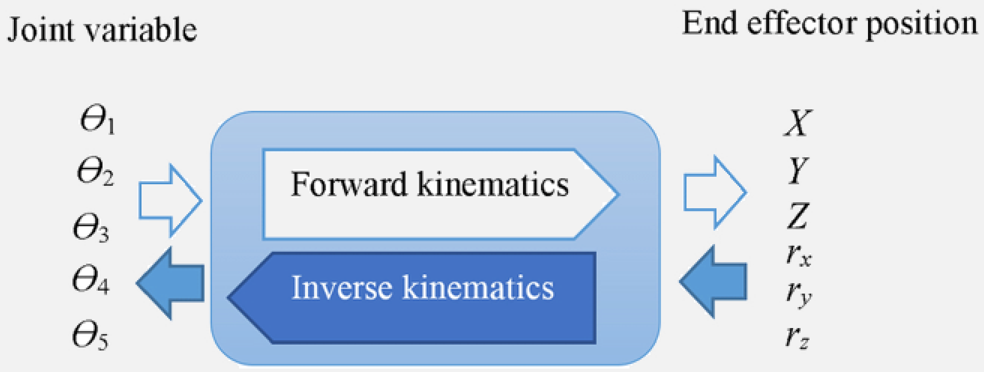
Mobile Arm Kinematics

Joint configuration:

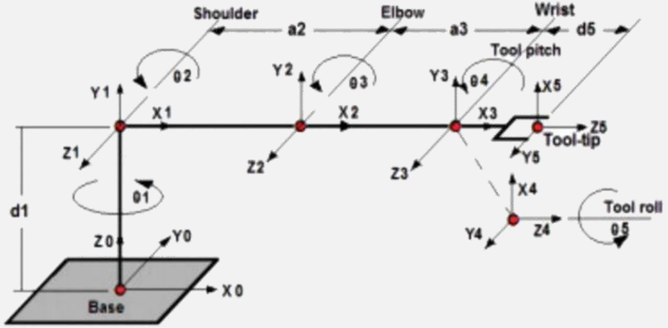
The specific configuration of the 5 joints can very depending on the robot design , but here's our configuration:

- Base Rotation
- shoulder joint
- Elbow joint
- wrist pitch
- Gripper

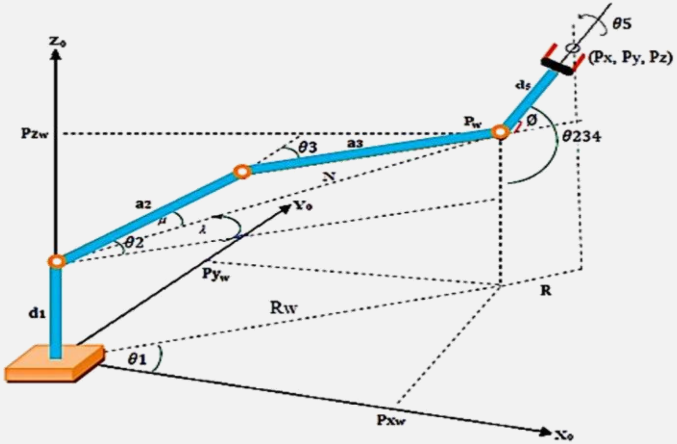
Forward and Inverse Kinematics



Forward and Inverse Kinematics



Forward
kinematic



Inverse
kinematic

Robot motion

What is Robot Motion ?

Robot motion refers to the movement. It involves controlling the robot's actuators, such as motors or pneumatic systems, to achieve desired movements and perform specific tasks. Robot motion can range from simple movements like linear motion (forward, backward) and rotational motion (turning) to more complex motions involving multiple degrees of freedom, such as picking and placing objects, navigating through obstacles, or performing intricate manoeuvres.

Robot motion

Types of planning:

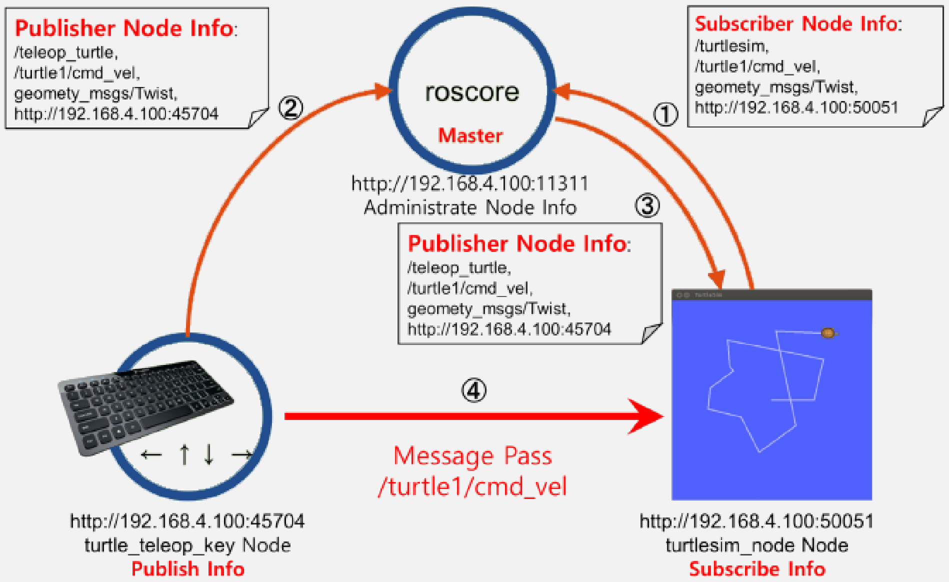
- Path Planning - Generating a feasible path from a start point to a goal point. A path usually consists of a set of connected waypoints
- Motion planning-establishes the exact actions a robot must execute to follow a predetermined path and reach its goal
- Trajectory planning - Generating a time schedule for how to follow a path given constraints such as position, velocity, and acceleration

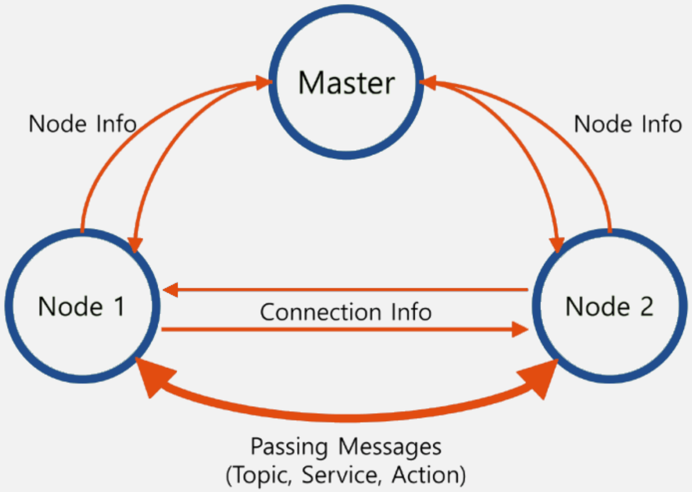
03

ROS

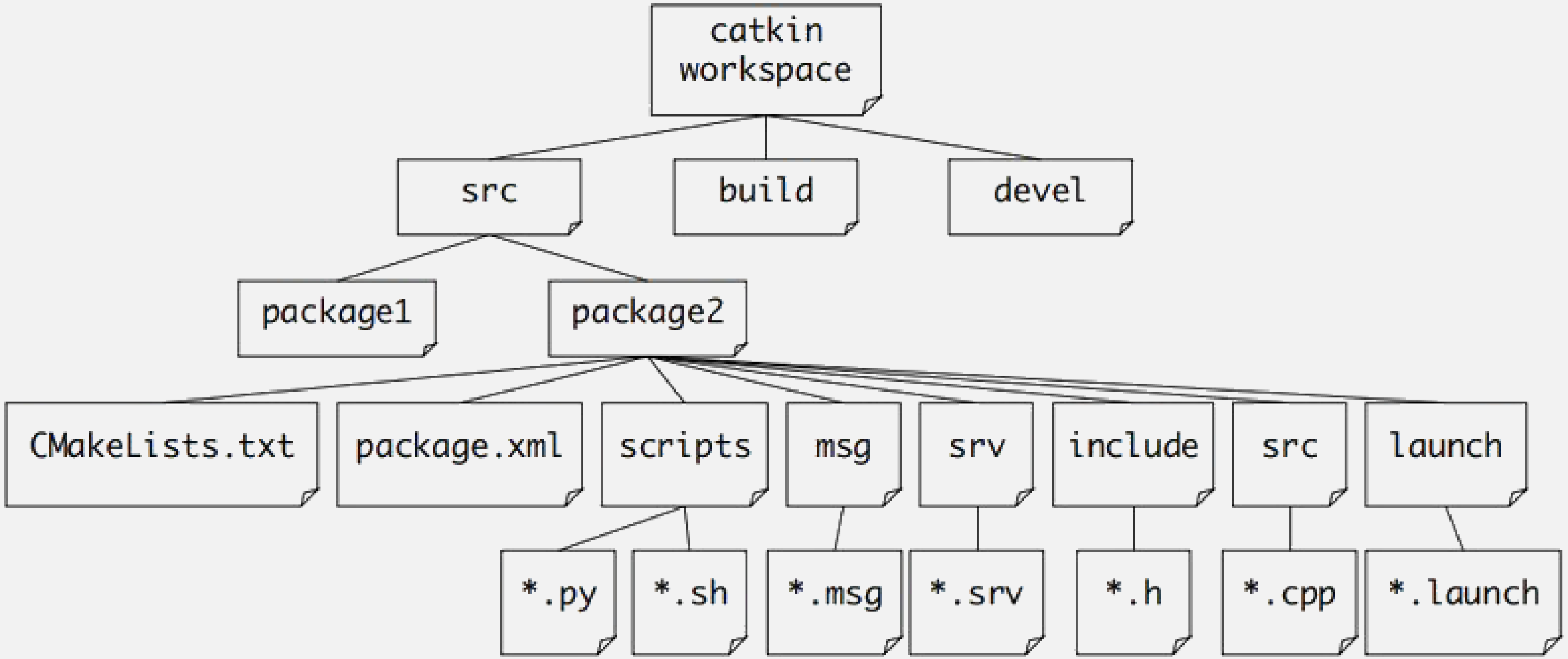
Robot Operating System

Ros Introduction





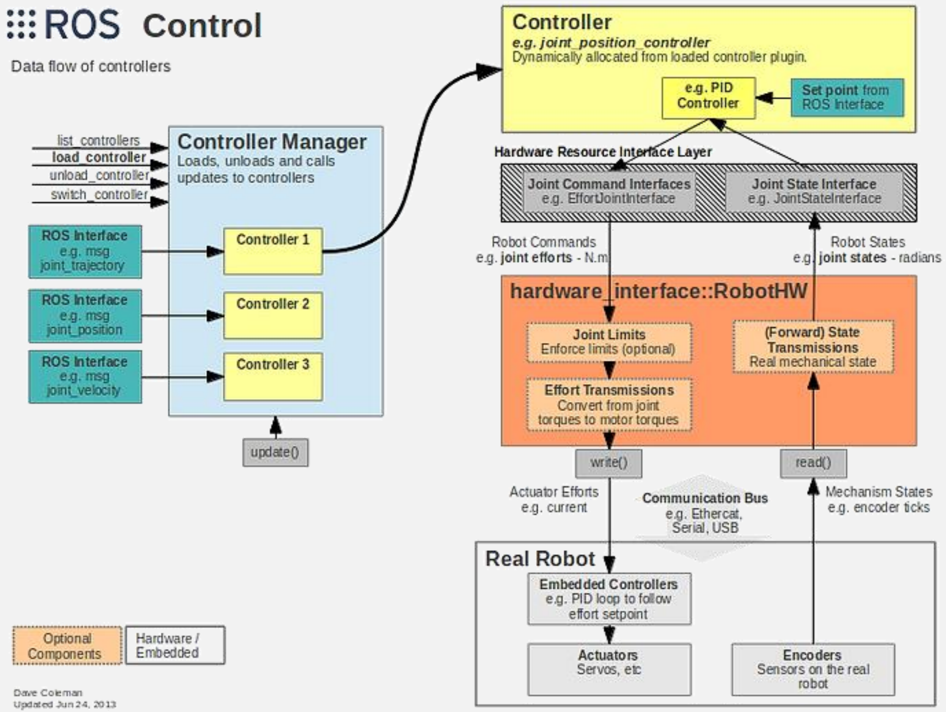
Ros Introduction



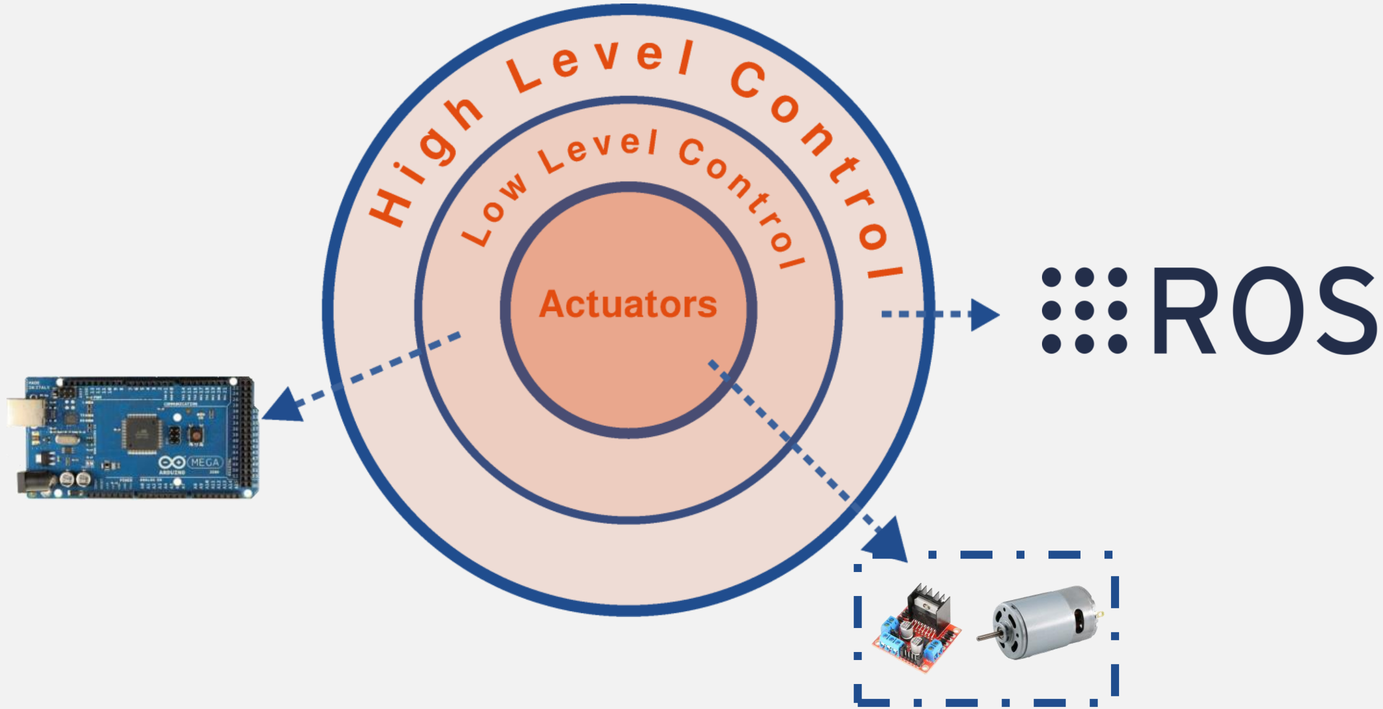
Ros Controller

Control In Ros:

The ros_control packages takes as input the joint state data from your robot's actuator's encoders and an input set point. It uses a generic control loop feedback mechanism, typically a PID controller, to control the output.



Ros Introduction



03

IMR Implementation

How We Implemented our IMR

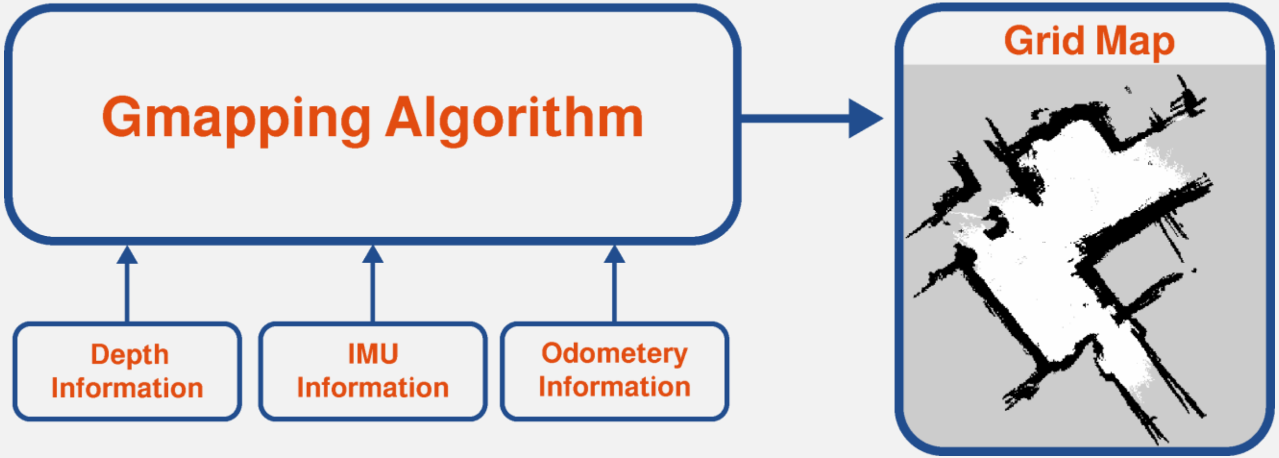
Simultaneous Localization And Mapping

The full name of SLAM is Simultaneous Localization And Mapping, which translates to instant localization and map construction. There are two key words here: localization and map construction, which means that the robot will determine its position in an unknown environment while building a map, and finally output a map like this. In short, the process of SLAM map construction is to measure the distance information between the robot and the surrounding environment with depth sensors, so as to complete the map construction of the surrounding environment. At the same time, the robot will check the consistency of the environment and detect whether it moves to the place where the map has been constructed, and finally complete the map closed loop to finish the whole ma

Gmapping

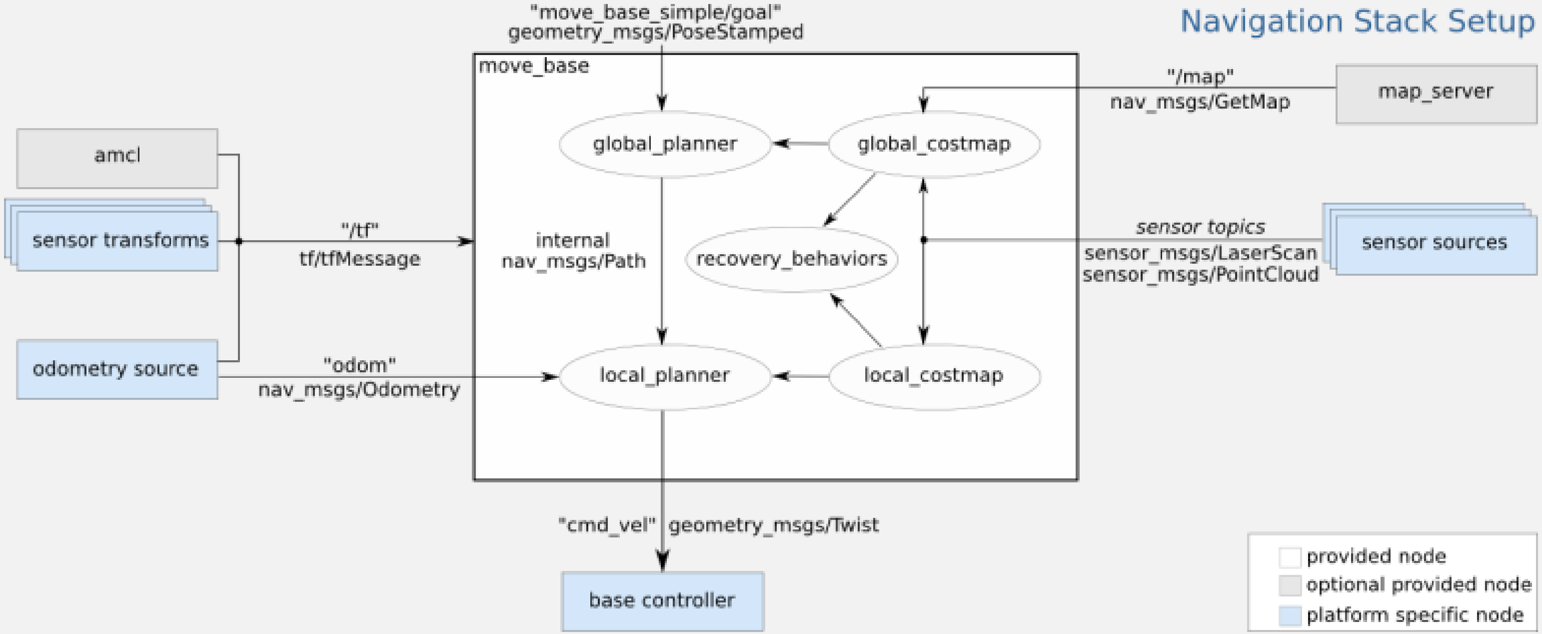
Gmapping:

The most commonly used SLAM algorithm in ROS is Gmapping, a common open source SLAM algorithm based on the filtered SLAM framework,i.e., the localization and map building processes are separated, and the localization is performed first and then the map is built

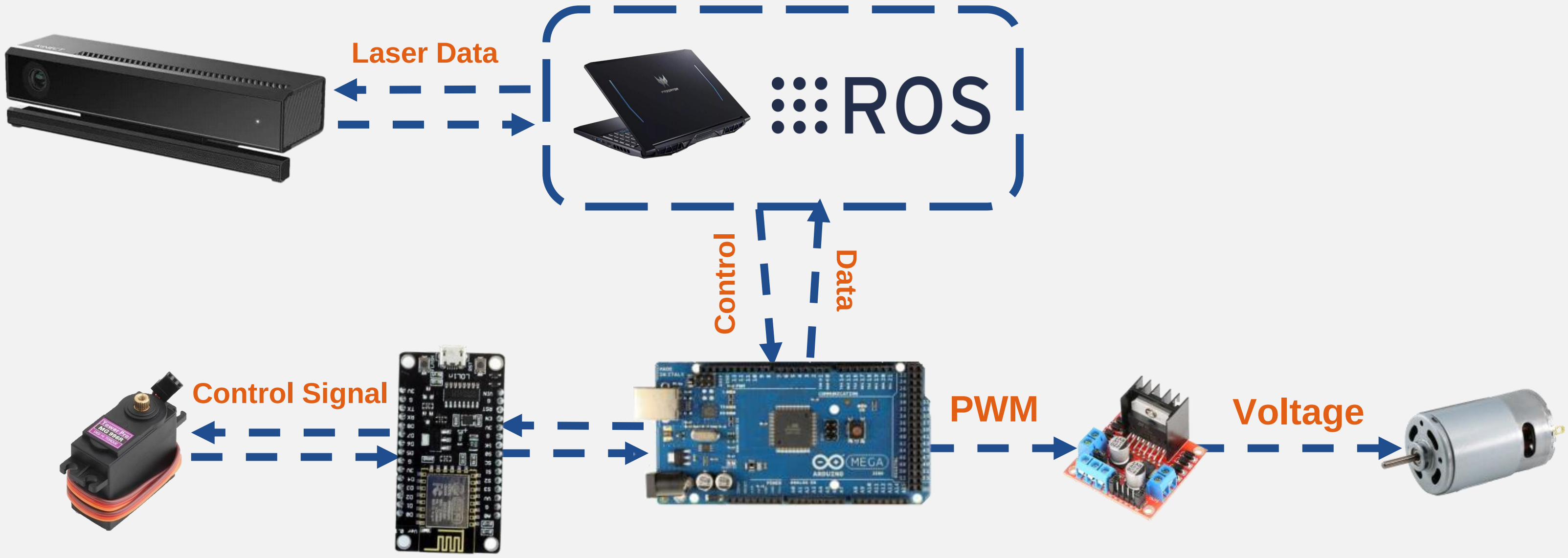


Navigation Stack

The navigation stack assumes that the robot is configured in a particular manner in order to run. The diagram above shows an overview of this configuration. The white components are required components that are already implemented, the gray components are optional components that are already implemented, and the blue components must be created for each robot platform.



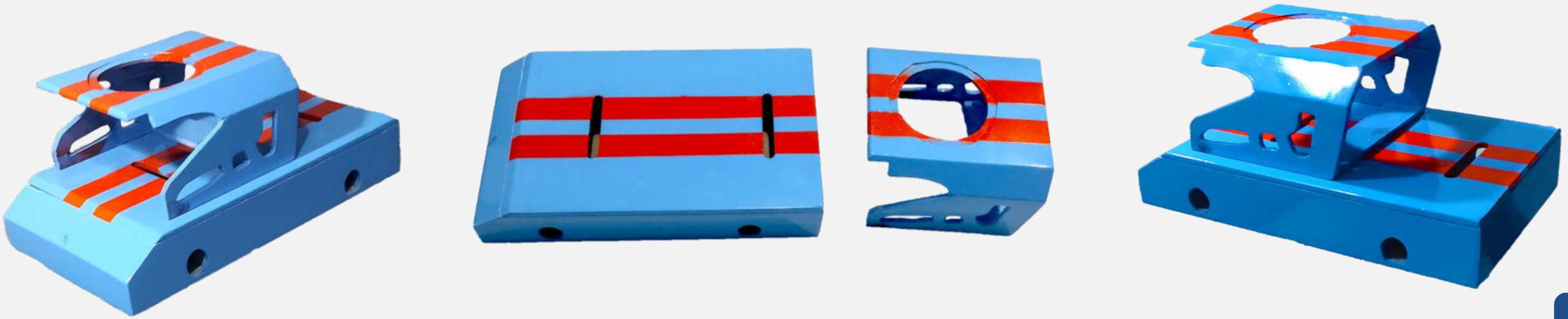
System Diagram



IMR Implementation

Mechanical design:

- Mobile Robot

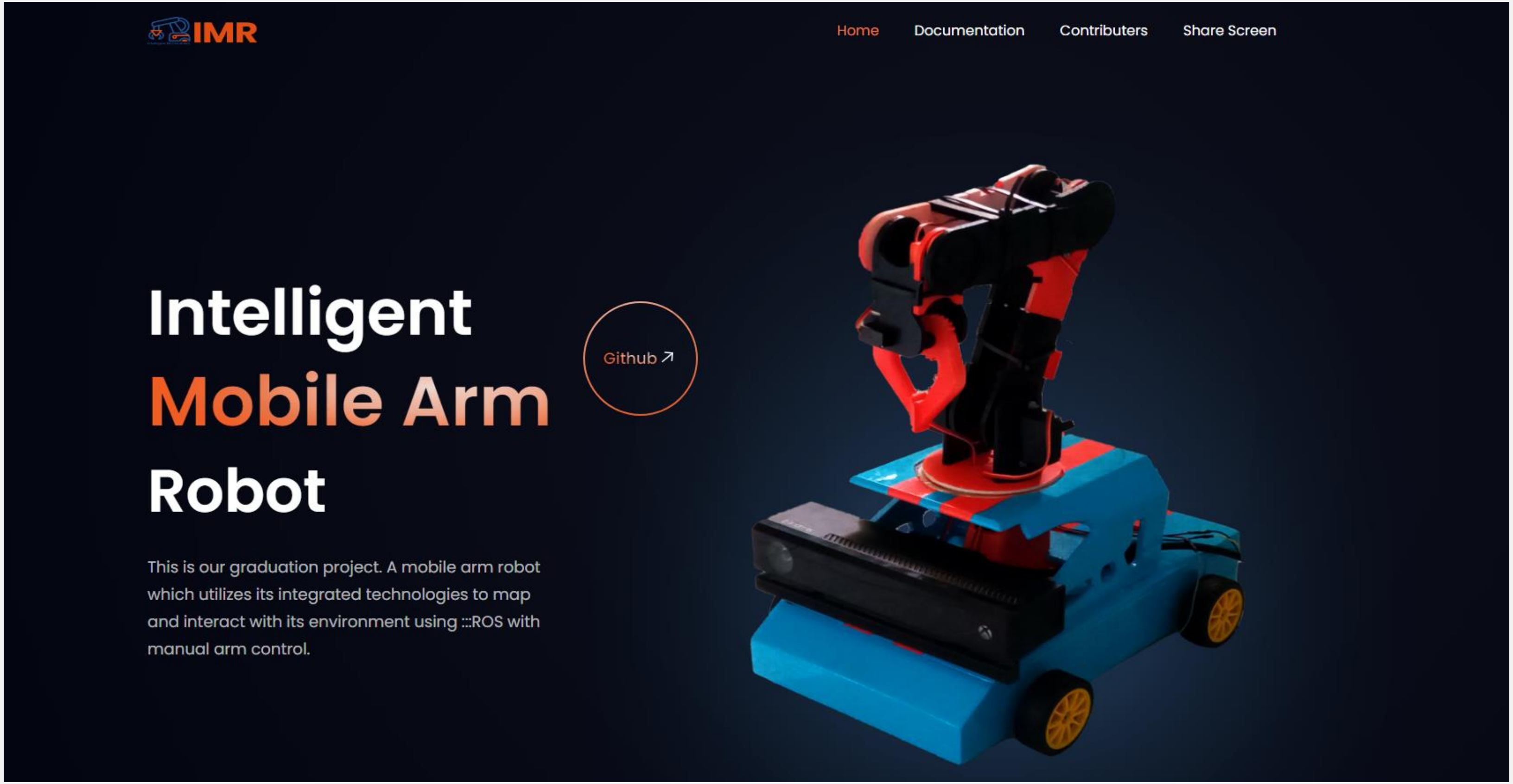


IMR Implementation

Mechanical design:

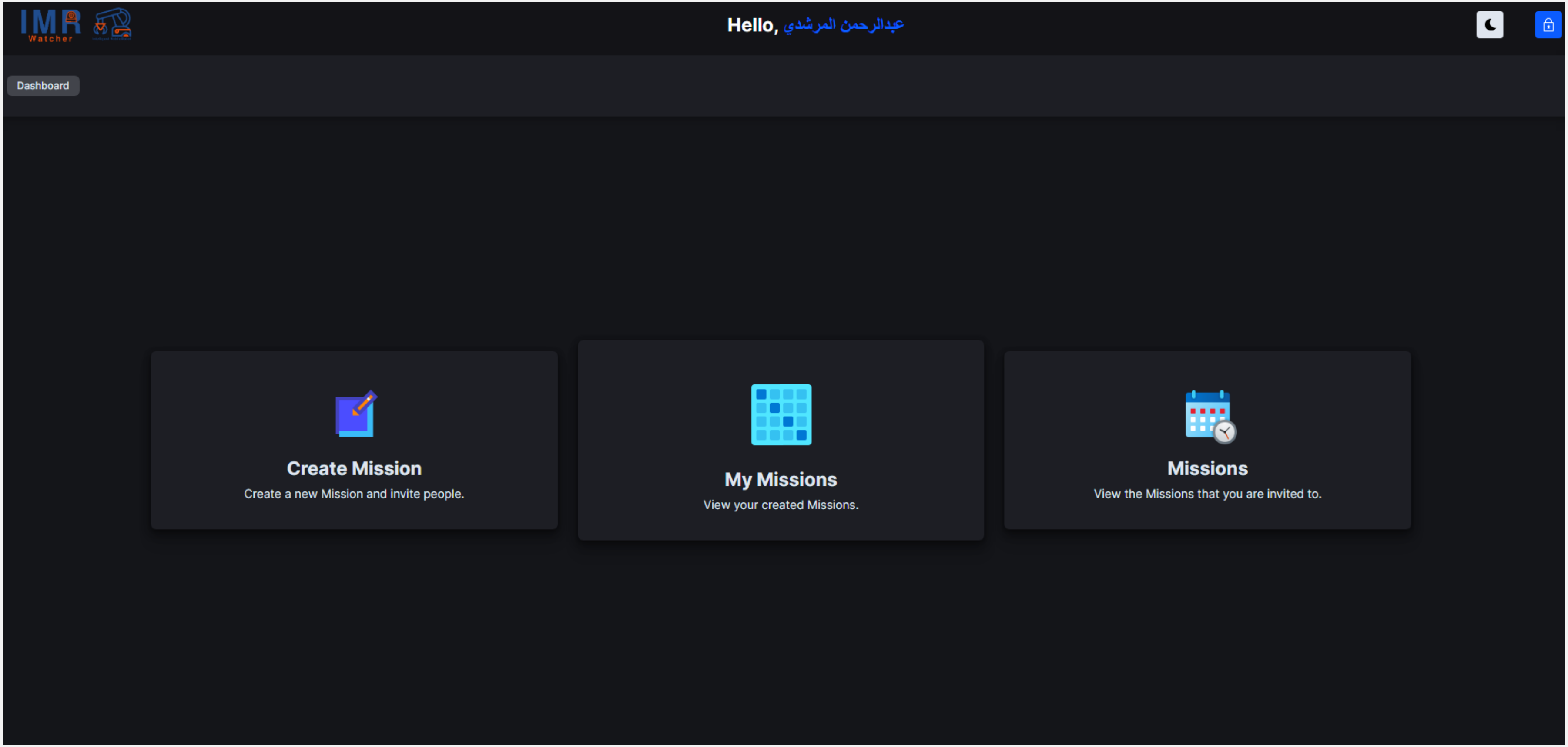
- Robot Arm

IMR Website


IMR
Home
Documentation
Contributers
Share Screen
Intelligent
Mobile Arm
Robot
Github ↗
This is our graduation project. A mobile arm robot which utilizes its integrated technologies to map and interact with its environment using :::ROS with manual arm control.

IMR Watcher

IMR Watcher



Hello, عبدالرحمن المرشدي
Dashboard
Create Mission
Create a new Mission and invite people.
My Missions
View your created Missions.
Missions
View the Missions that you are invited to.

Thanks!

We hope that you enjoyed our project

Intelligent Mobile Robot