Project Deliverable Contract
MECHTRON 4TB6

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Table 1: Revision History

Date	**Developer(s)**	**Change**
2023-11-25	Lisa Ji, Haoyu Lin Yuntian Wang, Zichun Yan	Revision 0

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1 Naming Conventions and Terminology

symbol		description
CTRL	=	The main embedded system controller. It receives command from MiniPC to control the fundamental actuator system. Overall, it control the WBR posture and movement.
DJI	=	SZ DJI Technology Co., Ltd.
IMU	=	Inertial Measurement Unit
Jump Mode	=	A controller mode make the robot to jump over obstacles or gaps.
LiDAR	=	Light Detection and Ranging
MacRM	=	MacRobomaster Club
MiniPC	=	A mini computer that receives user input, handles image processing and SLAM, to make decisions and send the decisions to CTRL
RMUL	=	RoboMaster University League
SLAM	=	Simultaneous Localization and Mapping. A technique that allows the robot to create a map of its surroundings and estimate its own position within the map
SRS	=	System Requirements Specification
UI	=	User Interface. A software program that allows the user to interact with the robot and the delivery system.
WBR	=	Wheeled Bipedal Robot

2 Introduction

2.1 Document Purpose

This document provides deliverable contract for the UWheeledChair project of Group 1. It outlines the essential deliverable for the project, and will serve as a basis for evaluating the completion of the project. The whole documentation is divided into three parts: Delivery Control Deliverables, Robot Control Deliverables and Evaluation Criteria.

2.2 Project Purpose

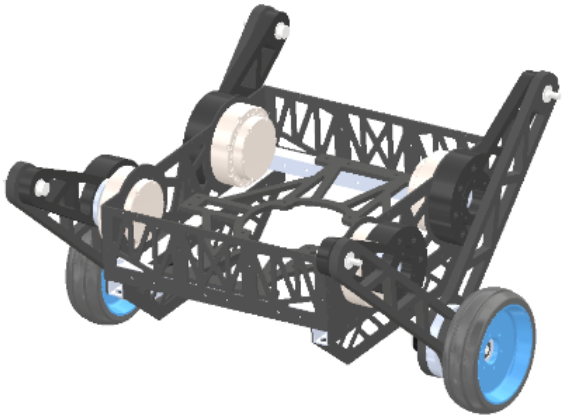

Figure 1: WBR Mechanical Platform

This project is to develop the software and control system for a fully-autonomous delivery robot, based on the existing assembly of a Wheeled Bipedal Robot (WBR) provided by the MacRobomaster Club (MacRM), as shown in Figure 1. The project will be referred to as the WBR project in the following documents.

For MacRM, WBR was constructed following the constraints defined in the rules, Committee (2023), of the 2024 RoboMaster University League (RMUL) Competition, whose host is SZ DJI Technology Co., Ltd. (DJI). Details of the constraints is shown in section Design Constraints of another document, the System Requirements Specification (SRS).

Since the mechanical and electronic hardware are fixed constraints, the WBR project mainly focuses on the software and control system, while the MacRM is responsible for the mechanical design, provision, and maintenance.

3 Delivery Control Criteria

The delivery control system as operated by MiniPC is responsible for the high level decision-making functionality of the robot, whose overall goal to deliver parcels from a delivery station to a destination.

3.1 SLAM

- Able to read and process information from sensors (such as cameras, LiDAR, IMU, etc.) in at least 10 Hz frequency.
- Able to accurately locate robot itself in a given environment with less than 0.1 m error compared to ground truth after running at least 20 minutes.
- Able to detect unexpected local obstacles at least 3 meters ahead.

3.2 Path Tracking and Finding

- Able to find a suitable path from the delivery station to the destination using a pre-defined map or a SLAM-generated map
- Able to return to the delivery station after the parcel is being picked up.
- Able to constantly gather information from SLAM and update paths related to unexpected local obstacles.
- Able to restrict the robot to stay in designated areas.

3.3 User Communication

- Able to allow the sender to schedule delivery tasks and assign destinations using a UI.
- Able to notify the sender and the receiver when the robot arrives at the destination.

3.4 Parcel Handling

- Able to allow sender to load parcel and receiver to take parcel out only with given credentials.

- (Optional Criterion) Parcel Status Monitoring: able to monitor and display the status of the parcel, such as weight, temperature, humidity, etc. The box should be able to notify the sender and the receiver if the parcel status exceeds the acceptable range.

4 Robot Control Criteria

The control criteria system is responsible for the stability and agility of the robot, which are essential for the delivery performance.

4.1 Posture Control

- Able to respond to user commands quickly, including roll, pitch, and yaw angle adjustment of the package platform.
- Able to maintain the body posture stably upright.
- Able to recover the body posture after external disturbance, for example, a slight kick by a human.

4.2 Motion Control

- Able to move at constant speeds, the maximum speed should be at least 1 m/s.
- Able to rotate at constant speeds, the maximum speed should be at least 30 rpm.
- Able to do a sharp turn, the minimum turning radius should be at most as wide as two robot bodies at the moving speed of 1 m/s.

4.3 Jump Control

- Able to jump high enough that the robot can stay floating in air for at least 0.4 seconds.
- Able to launch jump from an asymmetric terrain, where the initial state of the robot chassis platform is not possible to be horizontal.
- Able to jump across a 0.25 m wide chasm.
- Able to jump consecutively at least twice while moving or rotating the robot body

5 Evaluation Criteria

The completion of the project will be evaluated based on the successful implementation and functioning of the above-listed deliverables. Each deliverable must meet its described criteria to be considered complete. The evaluation will be conducted by testing the robot in a simulated or real environment, and measuring its performance using various metrics such as accuracy, speed, reliability, etc.

6 Appendix A - Table of Units

Throughout this document SI (Système International d'Unités) is employed as the unit system. In addition to the basic units, several derived units are used as described below. For each unit, the symbol is given followed by a description of the unit and the SI name.

symbol	**unit**	**SI**
m	length	metre
kg	mass	kilogram
s	time	second
min	time	minute
m/s	speed	meter/second
m/s^2	acceleration	meter per second square
rpm	angular speed	round per minute
Hz	frequency	times per second

References

RoboMaster Organizing Committee. *RoboMaster 2024 University Series Robot Building Specifications Manual V1.0*. RoboMaster Organizing Committee, Shenzhen, China, 1st edition, October 2023. Available at https://terra-1-g.djicdn.com/b2a076471c6c4b72b574a977334d3e05/RM2024/RoboMaster%202024%20University%20Series%20Robot%20Building%20Specifications%20Manual%20V1.0%20(20231031).pdf.