

WM-3 — Intelligent Robot Arm

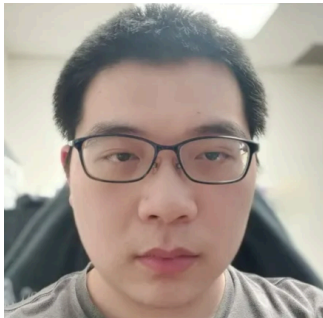
Project Plan

CS 4850 – Section 03

Fall 2024

Professor Perry

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Team Leader



Ellie Ireland
Developer

Team Members:

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Revision History

Name	Date	Reason For Changes	Version
Zhiwen Zheng	08/30/2024	First draft	v0

1.0 Project Overview

This senior project involves designing and building a robot arm using a professional simulation environment. The goal is to develop a robot arm that can perform basic grasping and manipulation tasks. After designing the arm in the simulation, we'll build it using the provided hardware and test its ability to pick up and handle objects.

2.0 Project website

GitHub: <https://github.com/WM-3-Inreelligent-Robot-Arm>

Deliverables - Specific to Your Project

- o Team/Project Selection document (Individual Assignment)
- o Weekly Activity Reports (WARs – Individual Assignment)
- o Team Status Report (TSR – Group Assignment)
- o Peer Reviews (Individual Assignment)
- o Project Plan (Group Assignment)
- o SRS, SDD, STP & Dev Doc (Group Assignment)
- o Present Prototype for Peer Review (Group Assignment)
- o Final Report Package (Group Assignment)
 - o Final Report (Group Assignment)
 - o Source Code (Group Assignment)
 - o Website (Group Assignment)
 - o Video Demo (Group Assignment)
- o C-Day Application/Submission

Milestone Events

#1 By 9/9/2024

- Be Familiar with the robotic information and learn how to use the software we will use in setting the Manipulator and Waffle Pi Robot

#2 By 10/13/2024

- Starting coding the prototype and running the codes on simulator to make sure it works before the hardware arrive, and prepare for prototype presentation

#3 By 11/4/2024

- After the hardware arrive, transferring the prototype into Manipulator and Waffle Pi Robot to make them works.

Meeting Schedule Date/Time

The meeting will be mainly in person meeting, and members are Professor Waqas Majeed, Ellie Ireland, and Zhiwen Zheng. It will start at 11 am in Atrium Building J122 room in Marietta Campus.

Collaboration and Communication Plan

The meeting will be set up on Discord, members are Ellie Ireland, and Zhiwen Zheng. The meeting time will be on 11 am on Thursday every week.

Project Schedule and Task Planning

- Meeting with Prof. Majeed
- Decide software and requirements.
- Review requirements with Prof. Majeed
- Get sign off on requirements
- Define tech required *
- Database design
- X design
- Y design
- Develop working prototype
- Test prototype
- Review prototype design
- Apply to hardware and check
- Document updated design
- Test product
- Presentation preparation
- Poster preparation
- Final report submission to D2L and project owner

Risk Assessment

1. Risk Identification

1.1 Physical Risks

- **Collision with Objects or People:**
 - o **Likelihood:** Medium
 - o **Impact:** High
 - o **Description:** The TurtleBot3 Waffle Pi is a mobile robot that could collide with objects, equipment, or people if it deviates from its intended path. Similarly, the OpenMANIPULATOR-X robotic arm might accidentally strike someone or something during operation.

- o **Mitigation:** Define clear boundaries for robot operation, use obstacle detection algorithms, and ensure a safe distance between the robot and people.
- **Injury from Moving Parts:**
 - o **Likelihood:** Medium
 - o **Impact:** High
 - o **Description:** The OpenMANIPULATOR-X robotic arm has moving joints that can cause pinching or crushing injuries if a person's hand or finger gets caught during operation.
 - o **Mitigation:** Implement emergency stop buttons, conduct thorough safety briefings, and ensure operators are trained in safe handling of the robot.

1.2 Electrical Risks

- **Short Circuits or Electrical Malfunctions:**
 - o **Likelihood:** Low
 - o **Impact:** High
 - o **Description:** Both robots are powered by electrical components, and there is a risk of short circuits or electrical malfunctions, which could result in equipment damage or fire hazards.
 - o **Mitigation:** Regularly inspect and maintain the robots' electrical systems, ensure proper insulation and grounding, and avoid overloading circuits.

1.3 Software Risks

- **Software Bugs Leading to Unintended Behavior:**
 - o **Likelihood:** Medium
 - o **Impact:** Medium
 - o **Description:** Software bugs or errors in the control algorithms might cause the robots to behave unpredictably, potentially leading to collisions or equipment damage.
 - o **Mitigation:** Conduct thorough testing in a controlled environment before running experiments, implement failsafe mechanisms, and have a supervisor present during all tests.

1.4 Environmental Risks

- **Slips, Trips, and Falls:**
 - o **Likelihood:** Medium

- o **Impact:** Medium
- o **Description:** Cables, equipment, or robot parts lying on the floor could create tripping hazards in the lab environment.
- o **Mitigation:** Keep the workspace organized, secure loose cables, and ensure clear pathways are maintained.
- **Environmental Conditions (Temperature, Humidity):**
 - o **Likelihood:** Low
 - o **Impact:** Medium
 - o **Description:** The lab environment may have varying temperatures and humidity levels, which could affect the performance of the robots' electronic components.
 - o **Mitigation:** Ensure that the lab environment is climate-controlled, and monitor the temperature and humidity regularly.

1.5 Operational Risks

- **Loss of Control or Communication:**
 - o **Likelihood:** Medium
 - o **Impact:** High
 - o **Description:** Wireless communication between the robot and the control system may be lost or disrupted, leading to loss of control over the robot.
 - o **Mitigation:** Use reliable communication protocols, have a backup control system, and ensure a fail-safe mode is active to stop the robot if communication is lost.

2. Risk Evaluation

- **Overall Risk Level:** Medium
- **Highest Risk:** Physical injury due to collisions or moving parts.

3. Risk Mitigation Strategies

- **Training:** All team members must undergo training on robot operation, safety procedures, and emergency protocols.
- **Safety Measures:** Establish physical boundaries, use safety signs, and install emergency stop buttons.
- **Testing Protocols:** Conduct initial tests in a simulated environment and gradually introduce real-world conditions.
- **Monitoring:** Use sensors and cameras to monitor the robots' operations in real-time.

- **Regular Maintenance:** Schedule regular maintenance checks for both robots, focusing on mechanical and electrical components.
- **Emergency Response Plan:** Develop a detailed emergency response plan, including steps for handling collisions, electrical malfunctions, or loss of control.

4. Review and Revision

- **Review Frequency:** After any incident.
- **Responsible Parties:** Project owner, and team members.
- **Documentation:** Keep detailed records of all incidents, maintenance, and safety checks.