4.0 Software Development Plan

4.1 Plan Introduction

The project, *Vision Guided Robotic Arm*, is a 3D-printed, servo-driven robotic arm powered by a Raspberry Pi and webcam. It uses computer vision and inverse kinematics to detect, pick up, and manipulate objects. The rationale is to create an affordable, flexible, and educational robotic platform that integrates software and hardware in a single system

Development Activities:
- Hardware assembly and testing (3D printing, servo setup, Raspberry Pi integration)
- Software Development (Python + OpenCV + NumPy for object recognition and inverse kinematics)
- Integration and Testing (combining hardware and software)
- Iterative refinements

Milestones:
- Week 2: Project Proposal Presentations
- Week 5: Requirements + Preliminary Schedule Documents
- Week 8-9: Status Updates SCRUM
- Week 10: Software Design Description Document (Architecture Section)
- Week 12: Software Design Description Document (Detailed Section)
- Week 13-14: ABCDR Project Presentations
- Week 15: Final Presentations

4.1.1 Project Deliverables
- Week 2: Project Proposal Presentations
    - Short presentation introducing our project, goals, and audience
- Week 5: Requirements + Preliminary Schedule Documents
    - Organization of functional, performance, and environment requirements
    - Early milestones and rough schedules
- Week 8-9: Status Updates SCRUM
    - Summarize progress on hardware assembly and initial vision software tests
- Week 10: Software Design Description Document (Architecture Section)
    - Document detailing the high-level architecture of the system
    - Prototype design expected
- Week 12: Software Design Description Document (Detailed Section)
    - Explanation of how kinematics will be implemented and how software modules will communicate
    - Hardware/Software integration should be underway
- Week 13-14: ABCDR Project Presentations
    - Presentation of nearly finished arm
    - Demonstrates vision-guided pick-and-place action with object detection, trajectory planning, and servo actuation.

- Week 15: Final Presentations
    - Full demo of robotic arm and capabilities

4.2 Project Resources

4.2.1 Hardware Resources
- **Execution:**
    - SO-ARM100 – [GitHub - TheRobotStudio/SO-ARM100: Standard Open Arm 100](#)
        - Servos – https://www.walmart.com/ip/seort/16716556565
        - Motor control board – https://www.amazon.com/Waveshare-Integrates-Control-Circuit-Supports/dp/B0CTMM4LWK/
        - Power supply – https://www.amazon.com/Facmogu-Switching-Transformer-Compatible-5-5x2-1mm/dp/B087LY41PV/
        - USB-C cables – https://www.amazon.com/Charging-etguuds-Charger-Braided-Compatible/dp/B0B8NWLLW2/?th=1
    - Webcam
    - Raspberry Pi
    - 3D printer parts
- **Development:**
    - 3D printer
    - Development computers (personal laptops)

4.2.2 Software Resources
- **Source Code:** https://github.com/brukg/SO-100-arm/tree/main/launch
    - Python
    - Opencv
    - Numpy
    - VSCode
    - Github

4.3 Project Organization

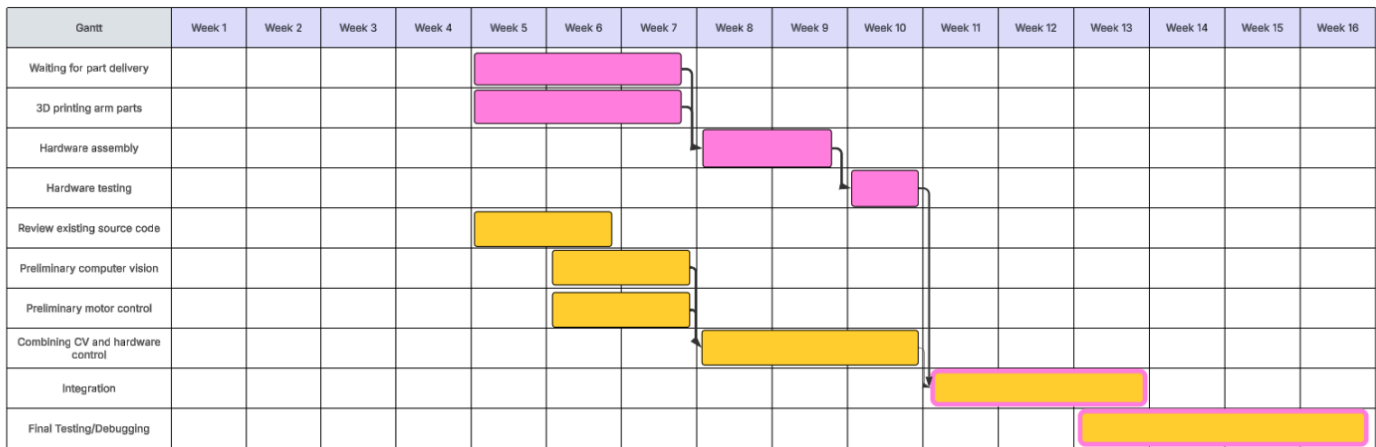| Name	Email	Role
Aidan Hodges	ahodges4@lion.lmu.edu	Currently Undefined
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4.4 Project Schedule

This section provides schedule information for the Robotic Arm= project

4.4.1 PERT / GANTT Chart

Robotic Arm Gantt Chart

Gantt	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	Week 13	Week 14	Week 15	Week 16
Waiting for part delivery					██	██	██									
3D printing arm parts					██	██	██									
Hardware assembly								██	██							
Hardware testing										██						
Review existing source code					██	██										
Preliminary computer vision						██	██									
Preliminary motor control						██	██									
Combining CV and hardware control								██	██	██						
Integration											██	██	██			
Final Testing/Debugging														██	██	██

https://lucid.app/lucidspark/936614d2-6ff0-4eaa-b5a8-3ba914b4f2fa/edit?viewport_loc=2414%2C826%2C4241%2C2404%2CuDe-dlt-NWfS&invitationId=inv_54860a9f-67dd-4b44-893b-698ab2df7bf5

4.4.2 Task / Resource Table

Task	Resource
Waiting for Part Delivery	n/a
3D Printing Arm Parts	3D printer, PLA filament
Hardware Assembly	Raspberry Pi, Servo motors, Motor driver, Power Supply
Hardware Testing	Raspberry Pi, Servos, Webcam
Review Existing Source Code	Laptops
Preliminary Computer Vision	Raspberry Pi, Webcam
Preliminary Motor Control	Raspberry Pi, Servo motors

Combining CV + Motor Control	Raspberry Pi, servos, webcam
Integration	Full robotic arm system
Final Testing/Debugging	Full robotic arm system