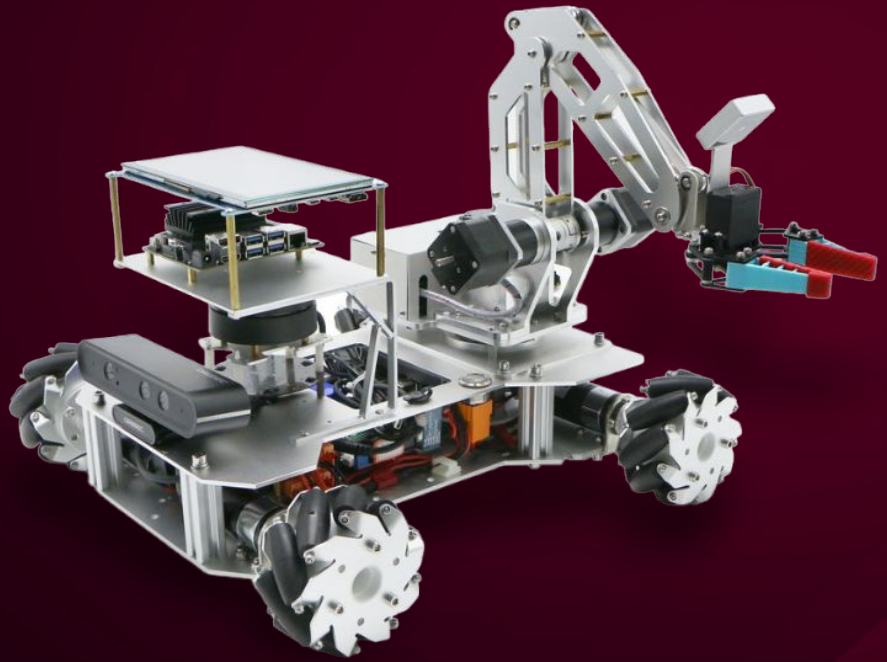
Dwight Look College of ENGINEERING
TEXAS A&M UNIVERSITY

Team 5: Autonomous Object Picking Robot

Bi-Weekly Update 4



Christoffer Cox
James Dickson
Kathy Vo
Sponsor: Swarnabha Roy
TA:Niloofar Borzooei

Executive Summary

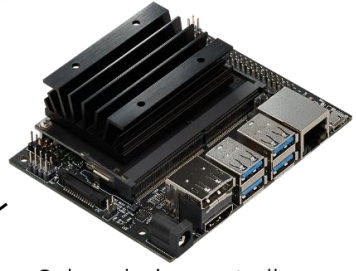
Problem statement:

- With millions of packages processed daily through warehouses, the need for safe and efficient sorting methods is of the utmost importance.
- Workplace injury rates are increasing as the demand grows.

The autonomous object picking robot offers:

- The ability to navigate through indoor environments with no human control
- The ability to differentiate between objects depending on the color
- The ability to grasp and transport designated objects to a given location

Integrated System Diagram



Onboard microcontroller receives request and begins searching for requested block via object detection code

Robot searches location for designed block

When the designed block is located, the robotic arm will pick up the block and bring it to the designated home location

Project Timeline

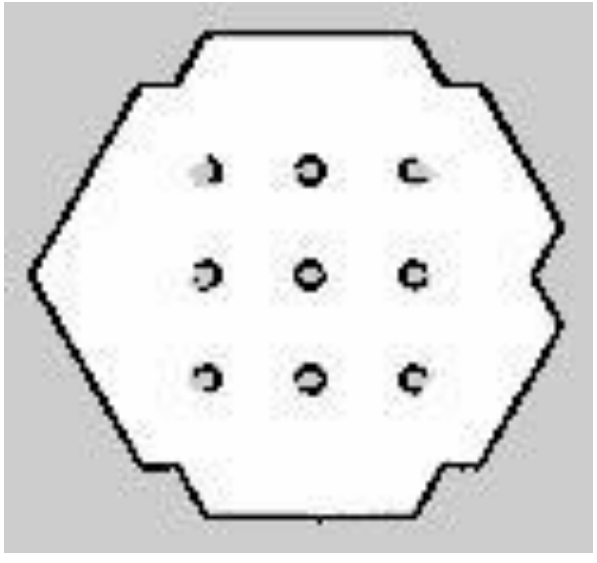
Finalize initial subsystem code (completed 1/20)	Integrate Kinect camera with the Jetson Nano (completed 2/3)	Autonomously move robot and arm using real world detection (to complete by 3/7)	Fully make the robot independent and combine all parts together (to complete by 3/17)	Test system and refine any bugs or issues (to complete by 4/14)	Final Demo and report (to complete by 4/26)

Object Navigation and Object Avoidance

Accomplishments since last update 40 hrs of effort	Ongoing progress/problems and plans until the next presentation
- Continued navigation integration with detection system (90 percent complete) - Continued navigation integration with arm system.	- Fix compatibility issues - Complete integration by next lab

Object Navigation and Avoidance

James Dickson



Object detection and Grasping

Accomplishments since last update 15 hrs of effort	Ongoing progress/problems and plans until the next presentation
- Collaborated with Arm manipulation subsystem to connect the robotic arm to the microcontroller and allow it to move via code - Collaborated with Object navigation subsystem to fix program that extracts block information from object detection code	- Once the block extraction code is fixed, work on program to allow robot to drive through a 3D space to look for the blocks

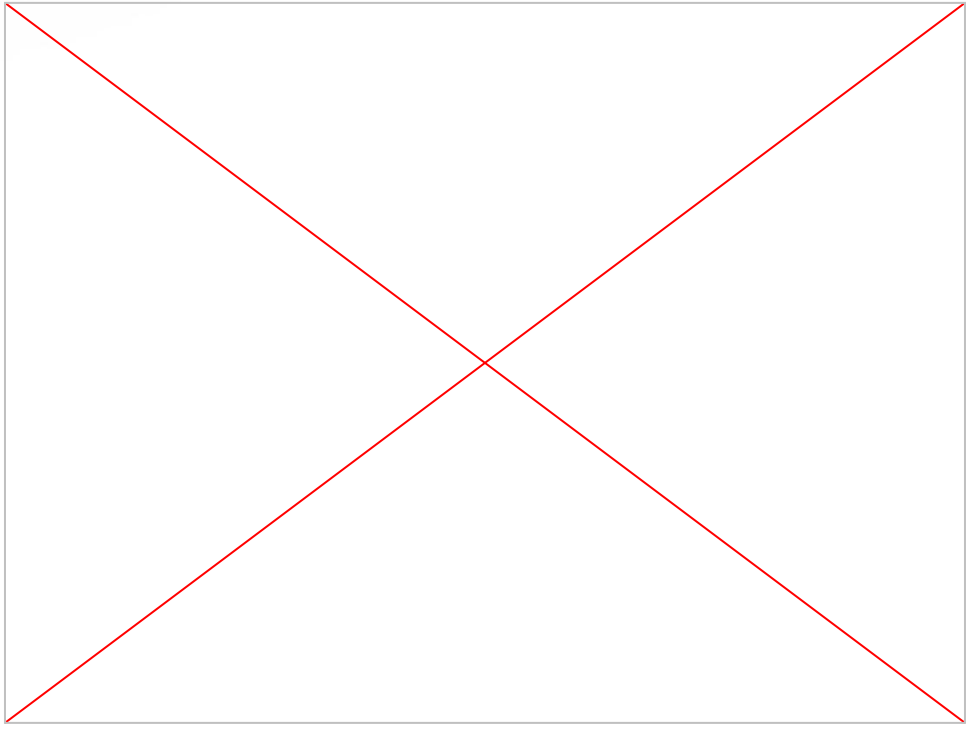
Arm Manipulation

Kathy Vo

Accomplishments since last update 14 hrs of effort	Ongoing progress/problems and plans until the next presentation
- Integrated with the Navigation System to be able to send commands from the Jetson Nano to the MCU	- Continue Integration with the navigation system to move the servo with the Jetson Nano

Arm Manipulation

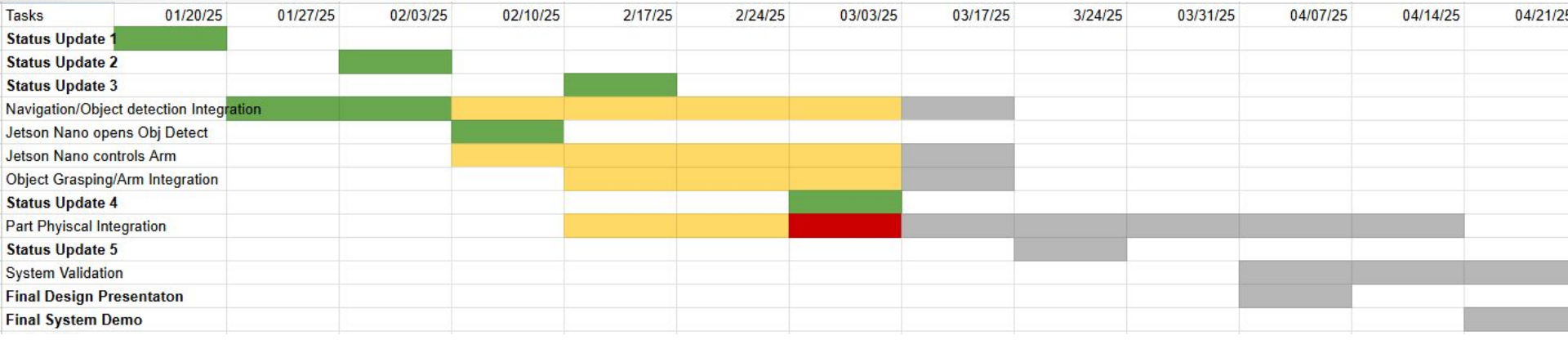
Kathy Vo



Validation Plan

Paragraph #	Test Name	Success Criteria	Methodology	Status	Responsible Eng
3.2.1.1	Object Recognition Time	Detect objects of various colors in a reasonable timeframe	Run multiple tests and see the average time it takes to detect an object	Tested	Chris
3.2.1.2	Object Detection Success Rate	Have a 95% success rate of object detectic	After a series of multiple tests, calculate how often the robot detected an object	Tested	Chris
3.2.1.3	Battery Life	Expected runtime of 2.7 hours with the 36Ah batteries	Allow the robot to run for a certain amount of time then measure the amount of voltage left in the battery	Tested	James
3.2.1.4	Network Requests	Active wifi connection the robot and smartphone	The robot will connecto to the wifi and move	Untested	All
3.2.2.1	Navigation Speed	speed of at least 1.5 meters per second	Use a timer to measure the speed	Tested	James
3.2.2.2	Object Pickup Precision	pick up objects with 90% success rate and error margin of 2 centimeters	Measuring the distance, after a series of tests	Untested	Chris, Kathy
3.2.2.3	Object Placement Accuracy	place objects within a 5 centimeter radius of the designated location	Measuring the distance, after a series of tests	Untested	Chris, Kathy
3.2.3.1.1	Power Consumption	max peak power shall not exceed 432 Watts	Measure the current and voltage of the battery after fully charged	Tested	All
3.2.3.1.2	Input Voltage Level	input voltage level shall be no more than +24V	User multimeter to ensure proper input voltage	Tested	All
3.2.3.1.6	Raw Video Output	create a virtual environment of the robot	Use Gazebo for simulating virtual environment	Tested	James, Kathy

Execution Plan



Guidance on preparing status update 4

- Theme of this presentation is **Requirement Validation (Range) Testing and Error/Exception Testing**. Requirement validation testing shows that your system operates across all the ranges of operation specified in FSR/ICD and continues to function. Error/Exception Testing shows that when operated outside functional range, the system fails in ways that are predictable, safe, recoverable, and non-destructive. In industry this would be included in a System Test Plan Document
- This update should cover what was accomplished in weeks 7 & 8 and what is planned for weeks 9 and 10 **(This period is completion of Integration and mostly System Test)**
- All functional subsystem issues should be resolved by now. Integration planning should be complete. The majority of system integration should be complete. Functional system tests should be underway.
- Additional tests in the test plan for range and error should indicate what FSR/ICD requirements test addresses, whether test can be destructive (result in permanent damage to the system -- these you generally will not conduct in capstone), as well as the date, time, tester, … from the Functional System Tests from last update. **The status update should focus on Final Integration Status, Functional/Range/Error System testing.**
- **You need to be starting system-level validation and planning for all of your Validation Tasks….this update requires you to show your validation plan**

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Team 99: Project Name
Bi-Weekly Update 4

Team members list

Sponsor: Sponsor Name

TA: TA Name

Intro should take 30 seconds

Project Summary (30 seconds)

- What is the problem that we are solving
- High-level summary of what system does to solve the problem

Picture / Diagram here

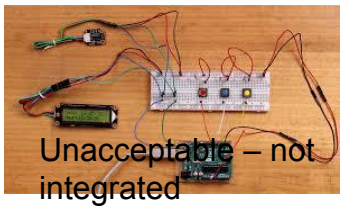
Integrated System Diagram (90 seconds)

NOTE this is not your usual system block diagram

This should show the complete system – with picture of packaged solution or conceptual diagram of packaged solution. Use this to describe how user interacts with system and how system interacts with external environment.

Show how it connects to the outside world (communication, interfaces).
If appropriate show internal breakdown and interfaces.

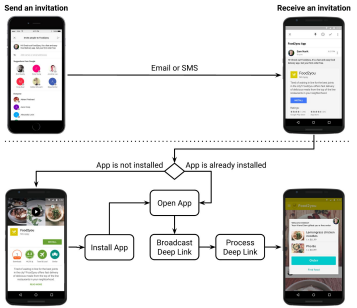
SW projects should show data repository/db; mobile/web app (t end vs backend; and give representative screens users will se look-and-feel



Unacceptable – not integrated

Good – shows enclosure, integrated system. Just label things

Better – Shows packaged amplifier, app for interface, and users headphones



Good – Shows solution with user experience in interacting with SW

Project Timeline (45 seconds)

Target or actual dates within or above boxes –
green done, yellow underway, red deadline or function at risk, white not started

Subsystem Designs and Testing (completed 9/11)	Integration of motor subsystem and MCU (completed 9/17)	Integration of Bluetooth and iPhone App (completed 9/28)	Final Integration (completed 10/15)	System Test (to complete by 11/2)	Validation (to complete by 11/26)	Demo and Report (to complete by 12/5)

-- Just quick overview…do not talk about work completed weeks ago, concentrate on past few weeks and upcoming activity.
-- Save detail for execution plan & validation plan status

You should be putting 7-10 hr/week on capstone!

Team Member 1 (30 seconds)

Accomplishments since last update XX hrs of effort	Ongoing progress/problems and plans until the next presentation
What has been accomplished since last review	What are you going to accomplish in the next 2 weeks

This should not be just subsystem status!
At this point it should be review of the System Integration and Test activities led by Team Member 1

For 4th review Accomplishments should include what integration and functional/range/error system testing completed and planned for next 2 weeks"

"Completed integration of all subsystems"

"Verified sensor data capture and communication through Bluetooth to App"

"Integrated image detection model on Pi-4 on drone, tested detection accuracy"

"Tested app error handling for stuck valve & thermal range exceeded cases"

"ON-GOING automated software testing"

"Range testing of LoRa network from 10m to 5km with 35 points in BCS"

Team Member 1 (45 seconds)

This should all be test results! – show things working, functional test results, error checking, etc

Show test results for integrated systems

Execution Plan (Show for 45 seconds)

- Execution plan
  - Your team planned milestones for completion of any remaining integration, functional, range, and error test, and validation plans should be presented.
  - Milestones should have owners … system tests, and full system integration can be group owned
  - Engineering milestones only [presentation, demo, document due dates are project milestone that do not belong on this chart]
  - Gantt chart.
  - DO NOT try to discuss all milestones in the plan – just high priority present and next engineering milestones

SYSTEM Validation Plan (Show for 1 minute)

- Validation plan
  - This is not a gantt chart.
  - Validation plan is a table showing:
    - Name: descriptive short description of what is being validated,
    - Requirement: Identifer to link to requirement # from conops/fsr/icd
    - Success Criteria for validation – range/lifetime/performance metric/physical limit…that must be met.
    - Methodology – test procedure followed/observations made/simulations completed/.. to satisfy the validation
    - Responsible party

Final slide – thank your audience