

# TANVI MANKU

Impact-Driven Explorer and Engineering Student

## **ENGINEERING DESIGN PORTFOLIO**

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# TABLE OF CONTENTS

- ① About Me
- ② Autonomous Mail Delivery Robot
- ③ Adjustable DC Power Supply
- ④ Automated Waste Collection and Storage: Eco-Sort Compressor



# ABOUT ME

I'm **Tanvi**, an **explorer** of all sorts!

I'm a third-year Engineering Science student at the University of Toronto (UofT), majoring in **Robotics Engineering** and minoring in **AI**.

I'm also a research student in UofT's Department of Electrical and Computer Engineering, currently developing tools to build better **brain-computer interfaces**.

I am always seeking opportunities to leverage my interests in **software** and **embedded systems** to make a positive impact on the world.

I'm looking to embark on my next adventure and use my skills to make meaningful contributions!

# AUTONOMOUS MAIL DELIVERY ROBOT

## MOTIVATION

Design a robot to simulate mail delivery on a topological map, where colored paper represents offices.

## KEY OBJECTIVES

- Follow the line, stop at each office to mimic a delivery, and traverse the full route
- Successfully localize the robot, given a random map and starting point

## SOLUTION

TurtleBot3 Waffle Pi. Applied:

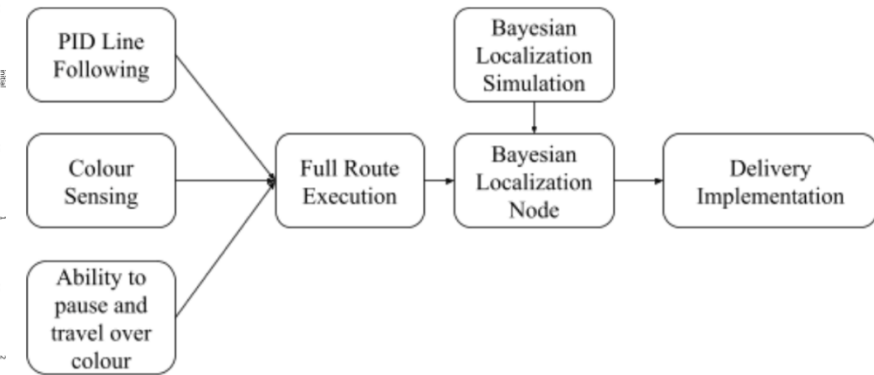
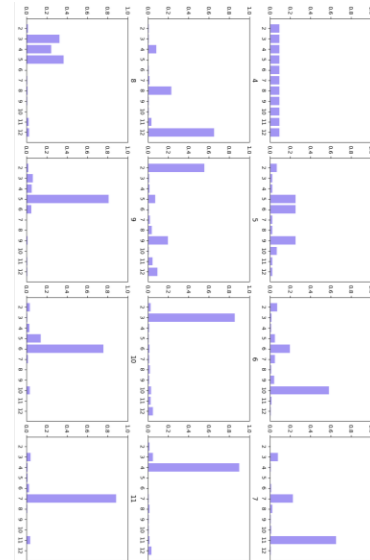
- Color sensing and line detection on camera input
- Bayesian localization
- PID control-based navigation

## RESULTS

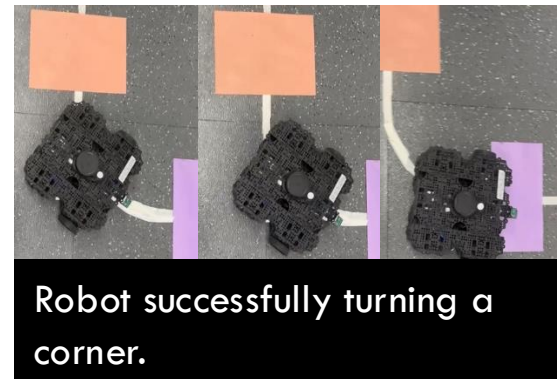
- 100% accuracy in localization
- Navigated full course
- Detected and stopped at each 'office'

## TECHNICAL DETAILS

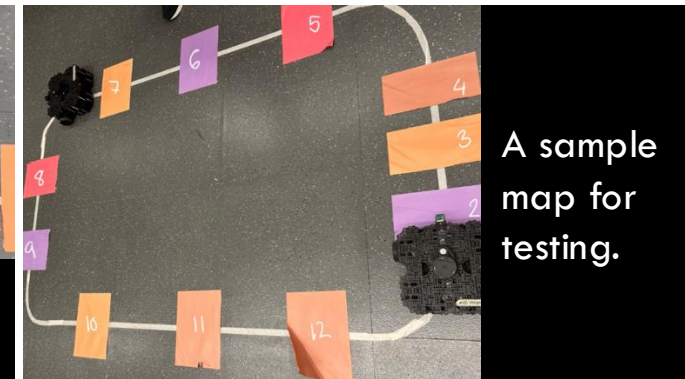
- Python: ROS, OOP
- State estimation with Bayesian localization
- Visual odometry
- PID control
- Trajectory planning and navigation



**Left:** Output of an initial generic state estimation model (Bayesian localization).  
**Top:** Flow chart of solution strategy.



Robot successfully turning a corner.



A sample map for testing.

Code available [here](#).

# ADJUSTABLE DC POWER SUPPLY

## MOTIVATION

Build low-cost power supply for common circuit loads.

## KEY OBJECTIVES

- 19 V, 3.42 A input
- 0 – 15 V, 0 – 3 A output
- $\leq 250$  mV of noise

## SOLUTION

Circuit contains:

- Non-inverting summing amplifier to scale input as per user-set target
- Buffer amplifier to reduce interstage loading
- Low-pass filter to reduce high-frequency noise

Target output adjusted with custom firmware loaded onto a microcontroller.

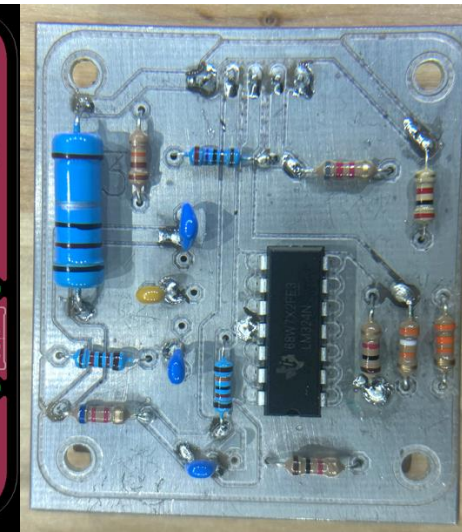
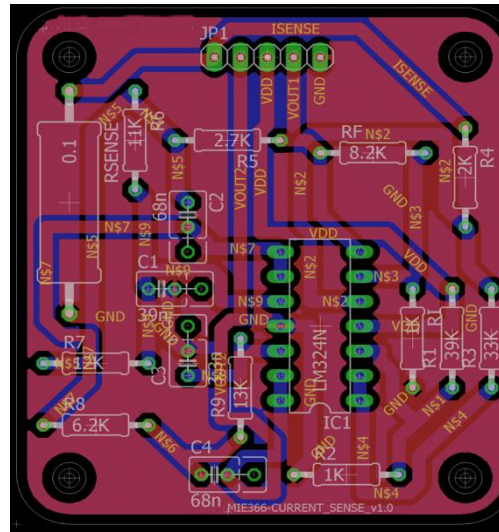
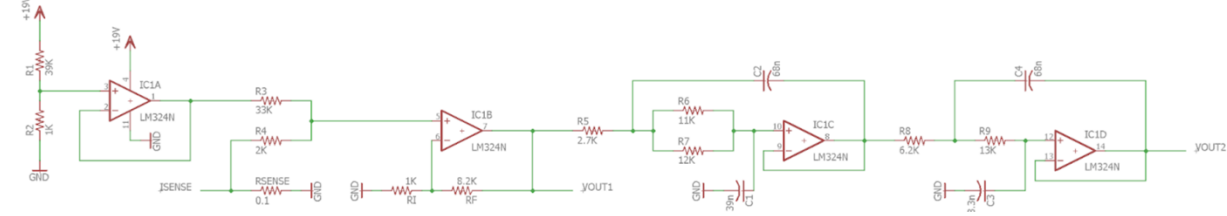
## RESULTS

- Output voltage deviates by  $\leq 100$  mV from target
- Output current deviates by  $\leq 20$  mA from target

## TECHNICAL DETAILS

- Circuit design
- EAGLE: PCB fabrication
- SuperSpice: circuit simulation
- Soldering
- Electronic testing (oscilloscope, multimeter, etc.)

Schematic of circuit with buffer, scaling, and filter stages.



Left: Trace of solder + component layers.

Right: Assembled and soldered PCB.

Testing accuracy of user-set target to measured output of completed power supply.





# AUTOMATED WASTE COLLECTION AND STORAGE: ECO-SORT COMPRESSOR

## MOTIVATION

Increase efficiency in waste segregation and storage.

## KEY OBJECTIVES

*Rapid prototyping (two months) with six-person team:*

- $\geq 85\%$  waste classification accuracy
- Intake waste  $\leq$  average soda can's size & weight

## SOLUTION

Automated waste collection system. Uses computer vision (CV) to sort into appropriate bins. Maximizes storage through compression.

## KEY CONTRIBUTIONS

- Designed embedded systems to facilitate communication between components

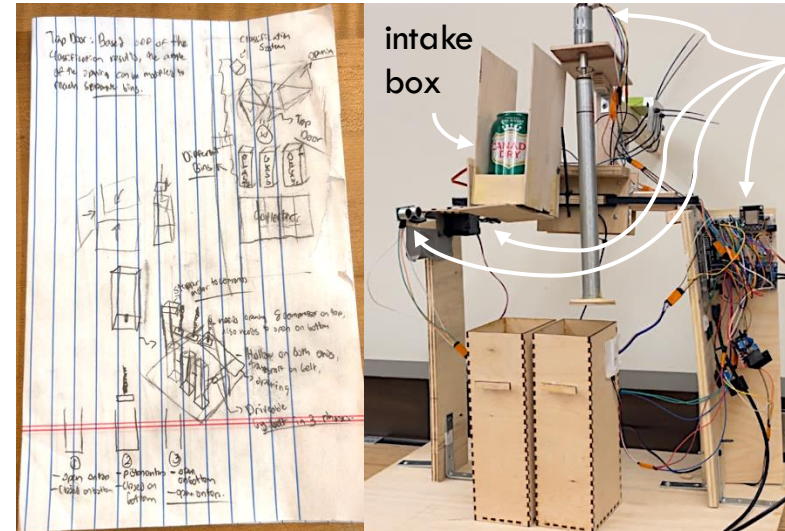
- Built intake box with automated opening and depositing mechanism

## RESULTS

- CV algorithm classified waste with 77% accuracy
- Deposited waste landed in bin 80% of the time
- Embedded system enabled CV algorithm to run without Internet connectivity

## TECHNICAL DETAILS

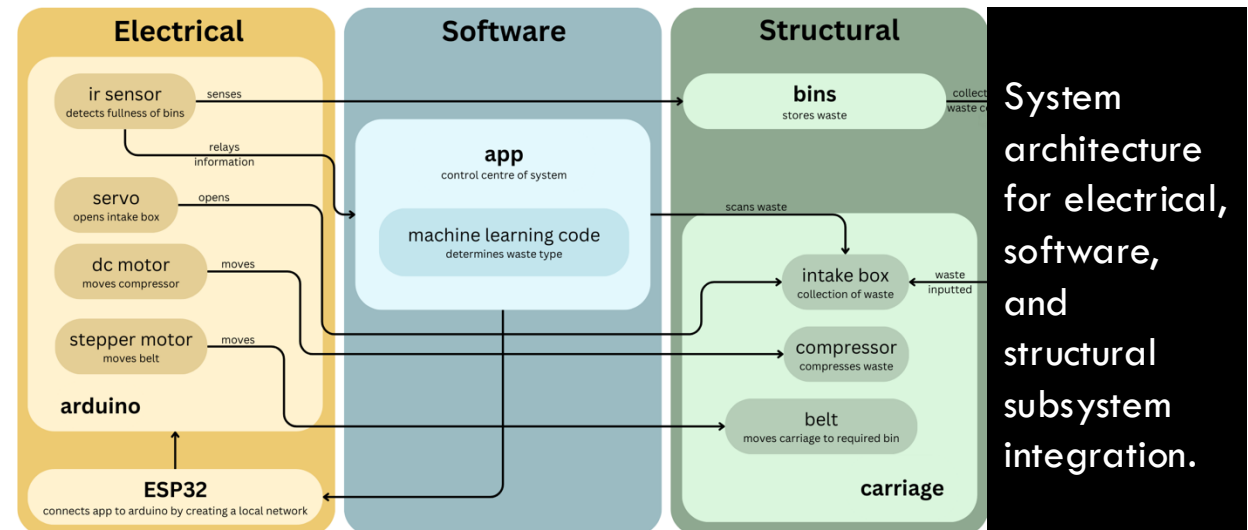
- Python, C
- Mechanical fabrication & assembly (power & hand tools)



embedded systems components

**Left:** Initial sketch of prototype design.

**Right:** Finished prototype.



**System architecture for electrical, software, and structural subsystem integration.**

# THANK YOU!

Please feel free to reach out!

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