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Midpoint Demo - Team 5: Cart-i B

Demoing
- Cart-i B following human as human walks forward and backward
- Incorporation of pivot turns

Issues that Arose
- Roomba cannot make sweeping turns → modify our algorithm so it doesn't always preference either turns or moving straight
- Wire to the roomba easily pops out causing it to go out of control → safety mode used
- Camera stick bows and moves too much → moved camera lower and plan to use wires/fishing line to keep it in place

Where We Are
- Milestones:
    - Test separate components (X)
    - Move forward/backward (X)
    - Pivot turns (X)
    - Incorporate sensors + Path Planning
    - Cart to wait when picking up from aisle
    - Incorporate logic for sharp turns (out of aisles)
    - Setup Final Demo Components → jacket, obstacles, etc
- Stretch Goals:
    - Incorporate Roomba sensors
    - Have an "on/off" button

Plan to Complete Rest of Our Features
- Incorporate sensors + Path Planning
    - Pallavi has already wired up sensors
    - Need to build platform for sensors/arduino
    - Plan for path algorithm
        - General idea: Always see in which direction the robot should be moving and pivot robot accordingly → check sensor values → if possible with total clearance = proceed → if obstacle collision possible = pivot accordingly and then repeat
        - (Pseudo) Code Plan:

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```
                    if (shouldMove and MoveZ < 0):   //moving forward
                        if (interrupt):
                                Sensors = get_serial()
                                Obs1 = sensors & 0x1
                                Obs2 = sensors & 0x10
                                Obs3 = sensors & 0x100
                                Obs4 = sensors & 0x1000
                                if (Obs1 and Obs2 and Obs3 and Obs4):
                                        stop
                                Elif if (Obs 2 or Obs3 ):
                                    If (Obs2 && Obs1):
                                        turn_right(15)
                                    Elif (Obs2):
                                        turn_right(30)
                                    If (Obs3 && Obs4):
                                        turn_left(15)
                                    Elif (Obs3):
                                        turn_leftt(30)
                    If (shouldMove and MoveZ >  0):   //moving backward
                            if (interrupt):
                                Sensors = get_serial()
                                Obs5 = sensors & 0x10000
                                If (Obs5):
                                    stop()
```

- Cart to wait when picking up from aisle
  - In addition to green circle on back, add red circles to sides of arms
  - If red circle detected (by similar means as current image processing algorithm) & isn't changing past a threshold in MoveX (left-right movement) → stop cart
- Incorporate logic for sharp turns (out of aisles)
  - Original plan → array of circles and base off of their angles
    - No longer going with this → roomba cannot move forward and turn at the same time
  - New Plan → use red circles
    - When a person turns sharply (90 degrees), the red circles on the arm will be seen
    - Based on the side in which the red circle leaves the frame, program can tell which way human turned

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- Cart-i B continues to where human was last seen & start taking a 360 in the direction in which the human is predicted to be until it finds the green circle again
- (Pseudo) Code Plan:

```
If (red):
    If (section2): // red circle is in center  of red of frame
        stop()
    If (red and section1 or section3): //red center in right/left of frame
        move_forward(thresh/redArea)
        If (section 1):
            turn_and_search_left()
        Else:
            turn_and_search_right()
```

Initial Project Proposal Schedule:

Milestone	9/16-9/22	9/23-9/29	9/30 -10/6	10/7 -10/13	10/14 -10/20	10/21 -10/27	10/28 -11/3	11/4 -11/10	11/11 -11/17	11/18 -11/24
OpenCV Tagged Object Recognition	▓	▓								
Develop Object Detection Algorithm	▓	▓	▓							
Set Up Cart & Motors	▓	▓								
Implement Object Detection Algorithm on Pi				▓	▓					
UART on FPGA side				▓	▓	▓				
UART on Pi side				▓	▓	▓				
Port Object Detection Algorithm to FPGA						▓	▓			
Testing & Iterating on Design								▓	▓	▓

Design Doc Schedule:

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Task	9/16-9/22	9/23-9/29	9/30-10/6	10/7-10/13	10/14-10/20	10/21-10/27	10/28-11/3	11/4-11/10	11/11-11/17	11/18-11/24	11/25-12/1	12/2-12/8
Open CV track marker	Arushi											
Component Research + Order Parts	Shreyas / Pallavi											
Motor Set Up		Shreyas	Shreyas									
Develop and Code		Arushi	Arushi									
Obstacle Detection Alg		Pallavi	Pallavi									
Set Up Communication Interfaces (Pi to Motor)			Shreyas / Arushi	Shreyas / Arushi								
Set Up Custom Cart				Pallavi	Pallavi							
Test Basic Straight Line Following					Pallavi	Pallavi	Pallavi					
Integrate Obstacle Detection and Open CV Tracking Algorithms					Arushi	Arushi	Arushi					
Set Up Communication Interfaces (Ultrasonic to Pi)					Shreyas	Shreyas	Shreyas					
Test Straight Line Following With Obstacles							Everyone	Everyone				
Develop Turning + Relocation Alg							Arushi / Pallavi	Arushi / Pallavi				
Test Turning + Relocation with Obstacle Avoidance									Everyone	Everyone	Everyone	
Further Testing + Adding Stretch Goals											Everyone	Everyone

Legend:
- Everyone (yellow)
- Shreyas (blue)
- Pallavi (red)
- Arushi (green)

Revised Post-Midpoint Schedule:

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Shreyas Gatuku
Arushi Patel

	11/4-11/7	11/8-11/10	11/11-11/14	11/15-11/18	11/19-11/22	11/23-11/26	11/29-12/1	12/2-12/5	12/6-12/7	
Stabilize camera using fish hooks and add platform for arduino	▉ (Everyone)									
Calibrate ultrasonic sensor range and orientation	▉ (Shreyas & Pallavi)									
Finish up ultrasonic sensor arduino code to incorporate new interrupt protocol	▉ (Pallavi)									
Add in identification for red circle for turns	▉ (Arushi)									
Write out obstacle detection path planning and calibrate angles		▉ (Shreyas & Pallavi)								
Test different obstacle scenarios			▉ (Everyone)	▉	▉					
Implement scenario where customer is picking up object from shelf				▉ (Arushi)	▉					
Solder ultrasonic sensors into place				▉ (Shreyas & Arushi)						
Implement turning into aisle algorithm using red circle targets						▉ (Everyone)	▉			
Test different scenarios and calibrate move forward distance for turns										
Create jacket for final demo with both green circles and red circles								▉ (Everyone)	▉	
Preparing final demo setup with mock grocery store environment										
Stretch Goals:										
Incorporating iRoomba floor sensor to detect smaller obstacles						▉ (Shreyas & Pallavi)	▉			
Have button to turn on/off auto-pilot shopping cart						▉ (Arushi)	▉			

Legend:

▉ (yellow)	Everyone
▉ (blue)	Shreyas
▉ (red)	Pallavi
▉ (green)	Arushi
▉ (orange)	Shreyas & Pallavi
▉ (purple)	Shreyas & Arushi

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Path Planning Diagram: