Precision Robot for Critical Rescues

ROBOCUP ASIA PACIFIC - RCJ RESCUE LINE 2024
ENGINEERING JOURNAL

INTENT

Our team, **CODEX**, is dedicated to advancing the frontiers of robotics and collaboration by participating in **RoboCup Junior Asia Pacific 2024** for the category Rescue line. We are a group of three students from diverse backgrounds, united by our passion for problem-solving through the integration of AI and programming. While participating in the rescue line mission our intent was to innovate and construct a robot capable of analysing complex situations and performing rescue operations with precision and ensuring the safety of the target. We believe in the positive outcome of the power of teamwork, collaboration, continuous learning, and inspiring one another to achieve our objectives. We are committed to excellence and a spirit of competition and hope to exhibit our efforts while making a meaningful impact in not only the world of robotics but its immense uses beyond. Together, we are excited to tackle the challenges ahead and contribute to the future of Robotics.




Amanur Rehman (Mentor) **Navya Singla** (Team Member) **Kashvi Khajanchi** (Team Member) **Swayambhav S. Madhur** (Team Member)

1. INTRODUCTION

1a. Meet The Team

Our team comprises three members Navya Singla, Kashvi Khajanchi and Swayambhav Siddharth Madhur bringing together a blend of unique perspectives and experiences, all united by a shared goal: to collaborate and deliver the best possible outcome. With each of us bringing our expertise to the table, we divided tasks based on our strengths, yet our roles constantly overlapped as we worked as a unified team. Whether testing, refining the model setup, or making necessary adjustments in our robotics lab, we supported each other in every aspect. Kashvi focused on AI strategy design and programming, Navya took the lead as the programmer, and Swayambhav handled the hardware design.

Kashvi Khajanchi

AI strategy designer and Programmer

“If there is a glitch, there is a fix -just waiting to be DEBUGGED!”

- builds the strategy to make the robot solve different problems related to rescue line mission
- Uses AI in optimising robot performace.
- Running trials of different strategies to refine the performance

Navya Singla

Programmer

“Logic never crashes...unless I forget a semicolon”

- Designing and coding algorithms for navigation, obstacle detection.

- Creating tools for real-time monitoring and data analysis to evaluate mission success.

Swayambhav Siddharth Madhur

Hardware designer

“Short circuits build robots..not just robots ”

- Creating tools for real-time monitoring and data analysis to evaluate mission success.
- Integrating various hardware components, such as motors, controllers, and communication devices, into a cohesive system.

1b. Team History

This is our first season of Robocup. Originally, our team competed in the maze solving category. Where we stood second place in regionals, and thereafter, won “Best Robot Design” in Nationals. We used the EV3 Lego kit, per se, for both regionals and nationals. After that we qualified for Robocup Asia-Pacific. Since we could only compete in the rescue line category we had to completely rebuild our robot and strategies.

2. DAILY LOG

Daily Log: March 22, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:

- Kickoff planning for Asia Pacific RoboCup.
- Review of performance at Nationals and key improvements.
- Begin redesigning structural elements of the robot.

Issues & Solutions:

Issues	Solutions
Deciding whether to use Arduino or Ev3	Decided to create a list of pros and cons of both

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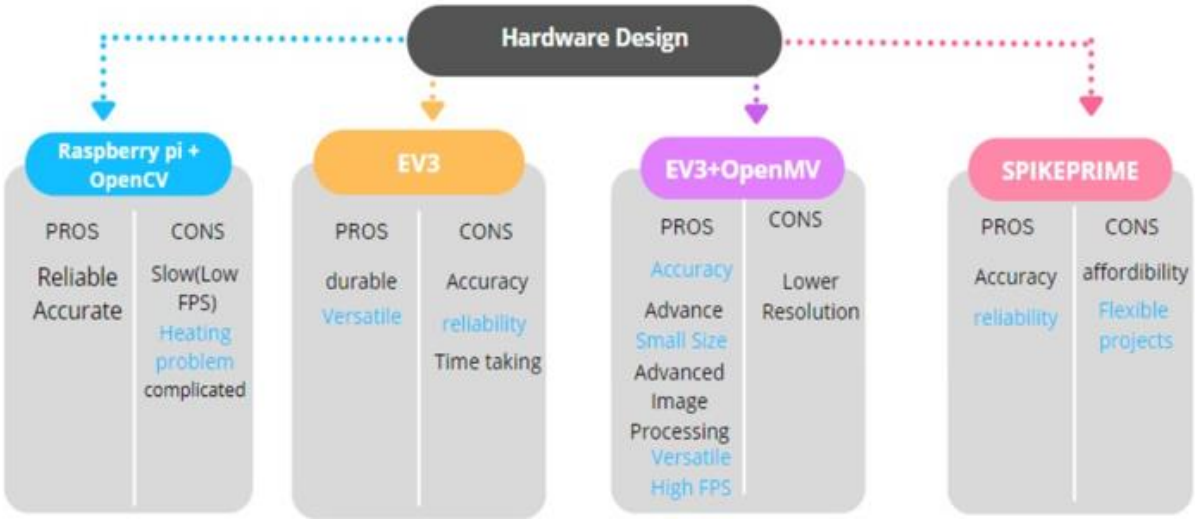
New Ideas/Thoughts:

Decide on using Ev3 with Raspberry pi as we had more experience working with it.



Daily Log: March 23, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:

- Gather hardware materials for robot assembly.
- Begin improvements to create stability.
- Work on weight distribution to maximize stability and performance.

Issues & Solutions:

Issues	Solutions
Existing design causes uneven weight distribution.	Stabilizing the Ev3 brick with the rest of the robot.

New Ideas/Thoughts:

- Planned to use better tires for more grip on ramps.

Daily Log: March 24, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:

- Finalize building

- Started building a rescue mechanism

Issues & Solutions:

Issues	Solutions
Claw mechanism exceeding dimensions.	Adjusted dimensions for the claw .

Daily Log: March 25, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:

- Testing the rescue design
- Rebuilding the rescue mechanism

Issues & Solutions:

Issues	Solutions
1 medium motor was not strong enough to pick up the balls.	Changed gears attached to the motors.

Daily Log: March 26, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:

- Integrated the claw with the basic structure of the robot
- Begin working on line following

Issues & Solutions:

Issues	Solutions
Difficulty in alignment of the claw	Changed the design of the claw

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Daily Log: March 27, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

Tasks Done Today:

- Tested the rubber band design with 80g balls.
- Improved the rescue mechanism design.

Issues & Solutions:

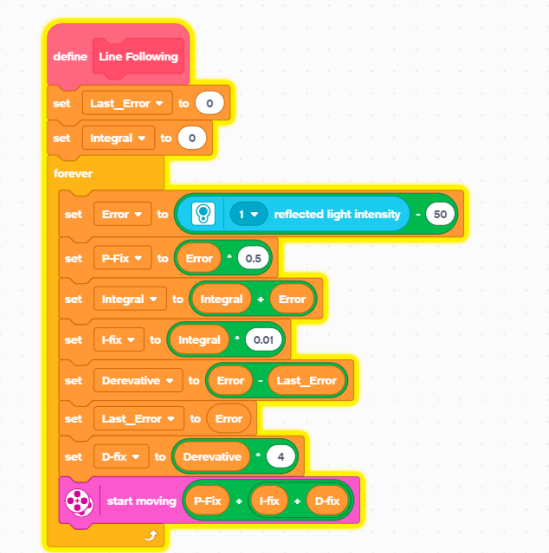
Issues	Solutions
The claw did not have enough torque to pick the balls.	Attached another medium motor to the claw design. Still did not work, removed the axle connecting both motors, this made some improvements but still wasn't enough Removed weight from the end of the claw.

Daily Log: March 28, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

Tasks Done Today:

- Tried to write a basic PID line following code.



Issues & Solutions:

Issues	Solutions
After few runs we noticed that after the robot strayed from it's path it was not able to get back on track, this happens when the	We will try to implement a conditional integral system, where we only let the integral term build up when the error is

Issues	Solutions
robot strays from the line, the integral term in the controller continues to accumulate error over time. When the robot tries to correct its path, the large accumulated integral can cause it to overshoot the line, leading to oscillations instead of smooth following	within a certain range. For example, if the error gets too big, stop adding to the integral until the error drops back to a more mnageable level.

Daily Log: March 29, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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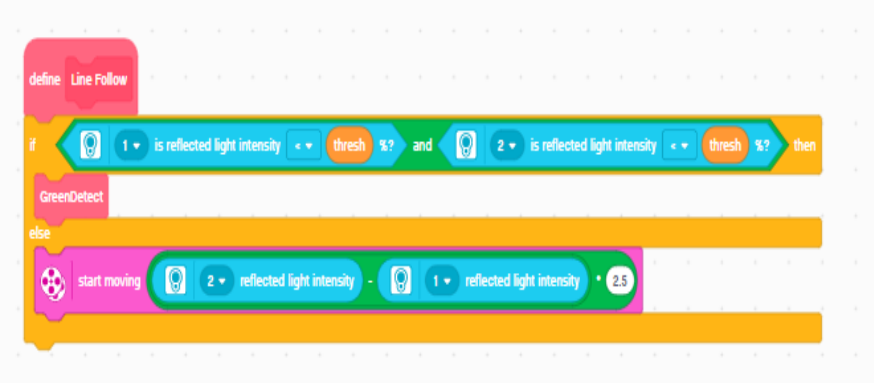
Tasks Done Today:

- Decided to not use PID line following.
- Started writing the code for proportional line following.



Issues & Solutions:

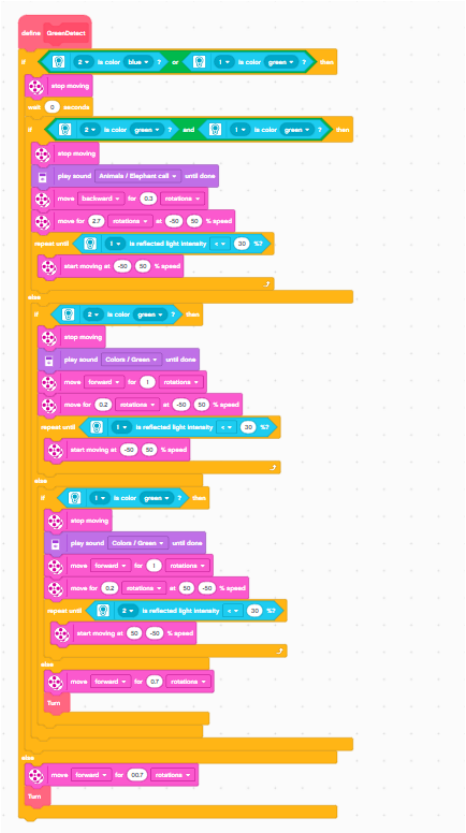
Issues	Solutions
Sensors were too close to each other.	Fixed the position of the sensor for adequate line following.

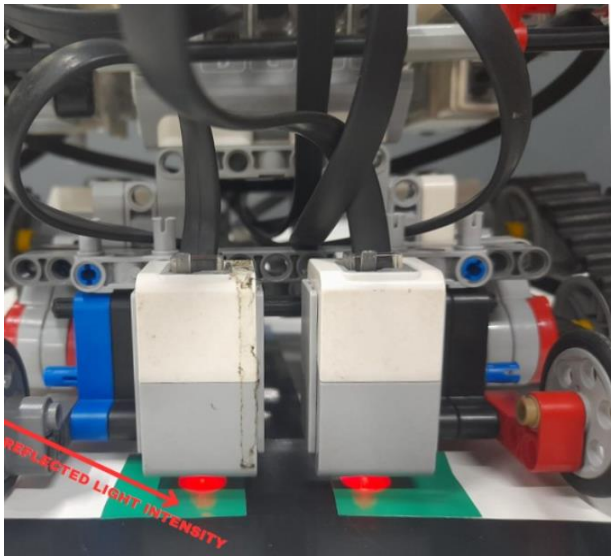
Daily Log: March 30, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

Tasks Done Today:

- Wrote the code for green detection.
- Integrated that with line following .





Issues & Solutions:

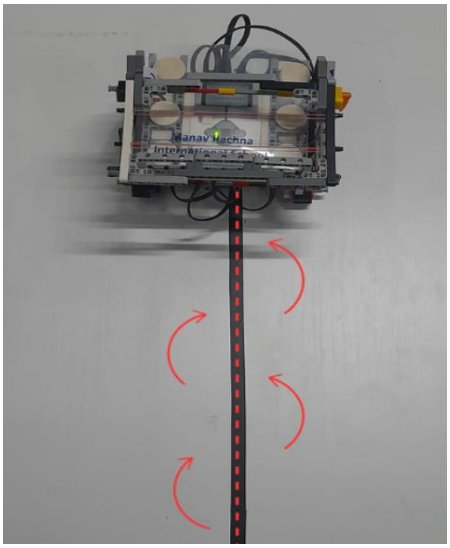
Issues	Solutions
The robot was not detecting normal turns .	Created a unique turning mechanism which stores the previous error value of the turn then, moves forward and starts turning till it finds the line .

Daily Log: March 31, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

Tasks Done Today:

- Switched to Ev3 lab and completed the code
- Tested the line following with turns, ramps and seasaws



Issues & Solutions:

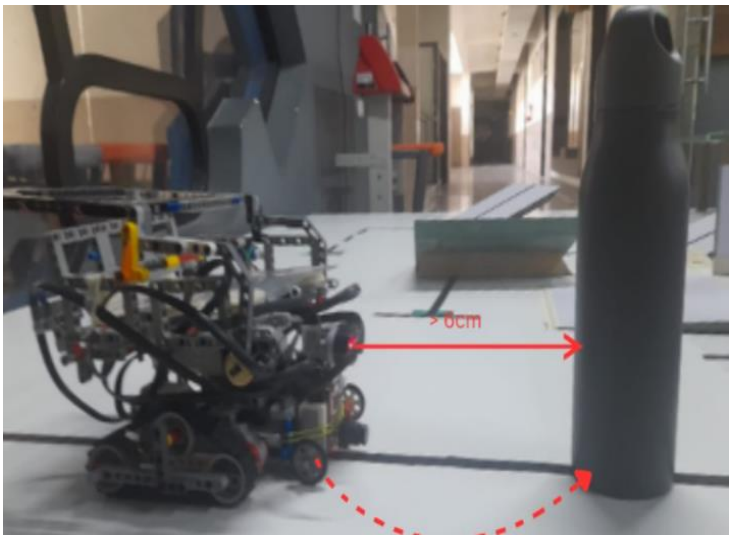
Issues	Solutions
• The sensors were getting stuck on ramps and seesaws	• Added small tires to provide ground clearance at the front of the robot • Used caterpillar treads instead of normal tires with elevated sprocket technology
• The robot was too heavy to climb ramps , thus it was slipping	

April 1, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

Tasks Done Today:

- **Hardware Development:**
    - Replaced old tires with tread like tires for better grip
- **Software Development:**
    - Refined the line-following algorithm to account for curves and sharper turns.
    - Wrote the code for Obstacle avoidance using an Ultrasonic sensor



- **Testing:**
    - Ran a series of tests to ensure Green Detection works.
    - Conducted stability tests with new motor drivers, focusing on high-speed turns.

Issues and Solutions:

Issues	Solutions
- the robot was not detecting turns each time	Reduced the speed of the robot to make It more accurate.

New Ideas | Thoughts:

- We want to test the line following and perfect it before moving on too the rescue mission.

April 2, 2024
Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

Tasks Done Today:
• **Hardware Development:**
Mounted new LEGO EV3 encoder wheels to improve motion tracking accuracy during line-following.

• **Software Development:**
Implemented proportional control in the EV3 line-following algorithm to enhance curve detection and reduce overshooting on turns.

• **Testing:**
Conducted test runs of proportional line-following with EV3 sensors on different track designs (straight lines, gentle curves, sharp turns).
o Measured accuracy of motion tracking using EV3 encoders while following the line.

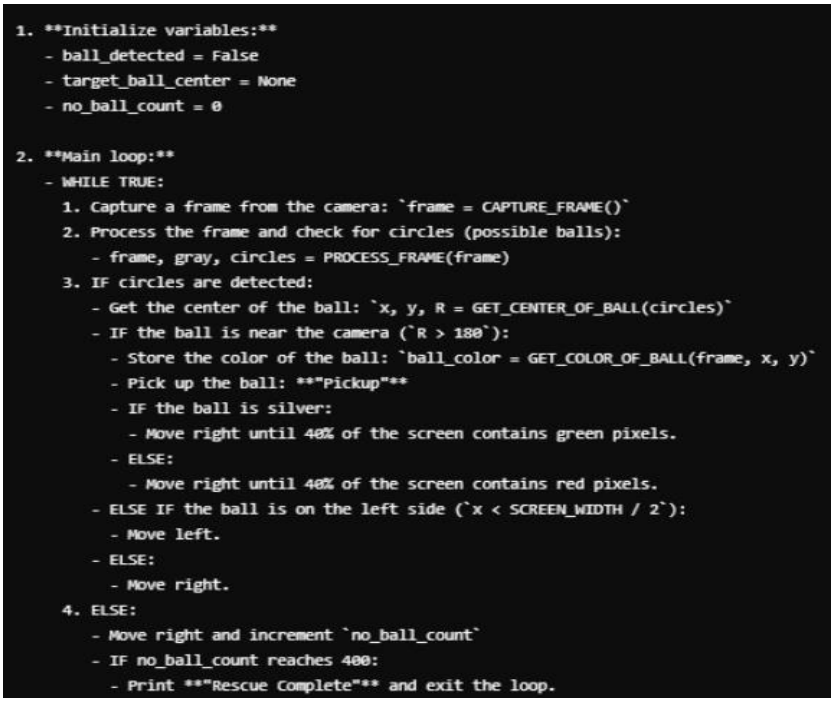
Issues and Solutions:

Issues	Solutions
Hardware:	
- EV3 encoder wheels slipping on glossy surfaces during sharp turns.	Used tracks instead of wheels for better traction and stability.
Software:	
- Robot wobbled while adjusting to sharp curves, causing line loss.	Adjusted the Kp value of the proportional control to smooth out robot movement.

New Ideas | Thoughts:

• Considering using the LEGO EV3 Gyro Sensor to complement the light sensor, which might provide better performance for sharp turns by stabilizing the robot's orientation.

• Exploring the use of a PID control loop to further enhance accuracy for more complex track designs.



```
1. **Initialize variables:**
   - ball_detected = False
   - target_ball_center = None
   - no_ball_count = 0

2. **Main loop:**
   - WHILE TRUE:
     1. Capture a frame from the camera: `frame = CAPTURE_FRAME()`
     2. Process the frame and check for circles (possible balls):
        - frame, gray, circles = PROCESS_FRAME(frame)
     3. IF circles are detected:
        - Get the center of the ball: `x, y, R = GET_CENTER_OF_BALL(circles)`
        - IF the ball is near the camera (`R > 180`):
          - Store the color of the ball: `ball_color = GET_COLOR_OF_BALL(frame, x, y)`
          - Pick up the ball: **"Pickup"**
          - IF the ball is silver:
            - Move right until 40% of the screen contains green pixels.
          - ELSE:
            - Move right until 40% of the screen contains red pixels.
        - ELSE IF the ball is on the left side (`x < SCREEN_WIDTH / 2`):
          - Move left.
        - ELSE:
          - Move right.
     4. ELSE:
        - Move right and increment `no_ball_count`
        - IF no_ball_count reaches 400:
          - Print **"Rescue Complete"** and exit the loop.
```

April 7, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

Tasks Done Today:

- **Software Development:**
    - Installed Raspberry Pi OS and configured SSH for remote access.
    - Began installation of necessary libraries for sensor and camera control.

- **Testing:**
    - Successfully booted Raspberry Pi 4 and confirmed basic functionality (Wi-Fi, SSH access).
    - Tested basic communication with motor drivers and sensors.

Issues and Solutions:

Issues	Solutions
Hardware:	
- Raspberry Pi 4's power draw caused instability with other components on the same power supply.	Added a dedicated power supply for the Raspberry Pi 4 to prevent voltage drops.
Software:	
- Initial boot time was longer than expected.	Disabled unnecessary services to speed up boot process.
- Difficulty accessing the Pi over the network.	Assigned a static IP address to Raspberry Pi to make remote access easier.

New Ideas | Thoughts:

- Considering the addition of an uninterruptible power supply (UPS) module for the Raspberry Pi to handle power cuts or voltage drops during operation.

April 8, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

Tasks Done Today:

- **Software Development:**
    - Configured Python environment and installed necessary robotics libraries (e.g., OpenCV for vision, GPIO for sensors).
    - Set up boot scripts to automatically start the main robot control program on power-up.
- **Testing:**
    - Conducted boot tests and confirmed the system runs autonomously upon startup.
    - Verified proper communication between the Raspberry Pi and motor controller, as well as sensors like the camera and ultrasonic sensors.

Issues and Solutions:

Issues	Solutions
Hardware:	
- Raspberry Pi ran hotter than expected during extended operation.	-]Bought a new one
Software:	
- GPIO library was not working as expected with the Raspberry Pi OS version.	Installed a compatible GPIO library version and reconfigured pins.
- The main control program did not start automatically after boot.	Modified the system's crontab and ensured the script had executable permissions.

New Ideas | Thoughts:

- Exploring the use of Docker containers to isolate different software components for easier debugging and deployment.

April 9, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur
Tasks Done Today:

- **Software Development:**
    - Installed TensorFlow Lite on the Raspberry Pi 4 for optimized performance on low-power hardware.
    - Set up a basic blob detection system using TensorFlow Lite, focusing on detecting black blobs (representing obstacles) and circular shapes (for silver balls).
- **Testing:**
    - Initial tests with TensorFlow Lite showed reasonable performance in detecting black blobs.
    - Tested basic circle detection for silver balls, adjusting the sensitivity of the algorithm to handle varying lighting conditions.
- **Issues and Solutions:**
    - **Software:**
        - TensorFlow Lite struggled to differentiate between black blobs and other dark objects.
            - *Solution:* Fine-tuned blob detection thresholds and used additional filters to better distinguish black blobs.
            -

- **New Ideas | Thoughts:**
    - Considering training a custom TensorFlow Lite model for more accurate black blob and circle detection specifically tuned for the robot's environment.

April 10, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur
Tasks Done Today:

- **Software Development:**
    - Continued development of the TensorFlow Lite blob detection system, refining the detection of black blobs.
    - Added a feature to detect circular shapes, filtering out false positives (non-spherical objects) for silver ball identification.
- **Testing:**
    - Conducted tests for blob and circle detection, verifying detection accuracy in low and high contrast scenarios.
    - Assessed the impact of different lighting conditions on TensorFlow Lite's performance for blob detection.
- **Issues and Solutions:**
    - **Software:**
        - Circle detection was inaccurate with non-uniform lighting.
            - *Solution:* Refined edge detection parameters to improve circle detection in inconsistent lighting environments.
- **New Ideas | Thoughts:**
    - Exploring the possibility of integrating machine learning for adaptive color calibration to enhance blob detection in varying lighting conditions.

April 11, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur
Tasks Done Today:

- **Software Development:**
    - Enhanced TensorFlow Lite model to detect black blobs more effectively, focusing on speed and accuracy.
    - Refined circle detection algorithm to handle more complex backgrounds while detecting silver balls.
- **Testing:**

- Tested real-time blob and circle detection while the robot was in motion, verifying system stability during navigation.
- Conducted tests under varying speeds to ensure the detection algorithms could keep up with real-time data.

- **Issues and Solutions:**
  - **Software:**
    - Detection lag during high-speed navigation.
      - *Solution:* Optimized TensorFlow Lite model to prioritize real-time performance over image resolution.

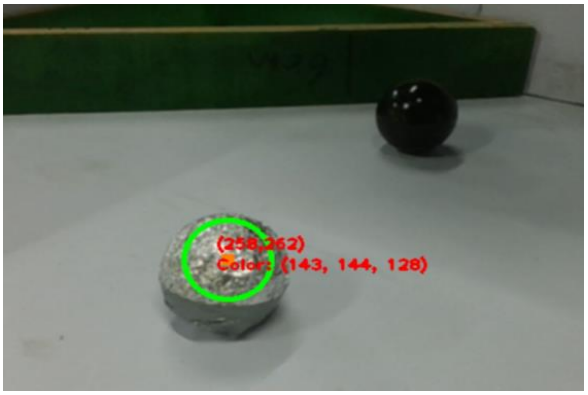
- **New Ideas | Thoughts:**
  - Thinking about using a GPU accelerator (like Coral USB Accelerator) to speed up TensorFlow Lite processing on the Raspberry Pi 4.

April 12, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur
Tasks Done Today:

- **Software Development:**
  - Fine-tuned TensorFlow Lite model parameters for smoother real-time detection of both black blobs and circular shapes.
  - Debugged blob and circle detection system, improving accuracy in detecting silver balls among other objects.

- **Testing:**
  - Evaluated the robot's performance in real-time blob detection while navigating an obstacle course.
  - Verified the accuracy of circle detection (silver balls) under varying lighting conditions.



- **Issues and Solutions:**
    - **Software:**
        - Blob detection failed under shadows.
            - *Solution:* Implemented shadow compensation in the image preprocessing stage for better blob detection accuracy.
- **New Ideas | Thoughts:**
    - Investigating the use of infrared sensors in combination with TensorFlow Lite to assist in blob detection under poor lighting conditions.

April 14, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur
Tasks Done Today:

- **Software Development:**
    - Integrated TensorFlow Lite detection results with the robot's navigation system to improve real-time obstacle and victim identification.
    - Updated detection logic to prioritize identifying circular shapes (silver balls) while continuing to detect black blobs as obstacles.
- **Testing:**
    - Conducted tests in various obstacle-rich environments, focusing on black blob and silver ball detection.
    - Evaluated system's ability to handle dynamic lighting changes without affecting detection accuracy.

April 17, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur
Tasks Done Today:

- **Software Development:**
    - Refined the real-time data processing algorithms to reduce delays between sensor reading and system reaction.
    - Worked on enhancing the decision-making algorithm to better differentiate between obstacles and green zones for more accurate path planning.
- **Testing:**
    - Verified the accuracy of blob detection in varying light conditions.
    - Tested the overall performance under multiple frame rate scenarios.

- **Issues and Solutions:**
    - **Software:**
        - Decision-making lag during high data loads.
            - *Solution:* Optimized the OpenCV blob detection algorithm by reducing frame size for faster processing.
- **New Ideas | Thoughts:**
    - Investigating improvements for blob detection performance during low-light conditions.

April 18, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur
Tasks Done Today:

- **Software Development:**
    - Integrated multi-sensor data with blob detection to improve environmental understanding.
    - Continued refining the algorithm to handle unexpected obstacles during navigation.
- **Testing:**
    - Tested blob detection under artificial lighting to ensure robustness across different environments.
    - Conducted tests on the system's ability to maintain consistent frame processing during obstacle-rich scenarios.
- **Issues and Solutions:**
    - **Software:**
        - The system experienced small delays during real-time decision-making.
            - *Solution:* Streamlined image processing steps and used downsampling to minimize computational overhead in OpenCV.
- **New Ideas | Thoughts:**
    - Considering the use of OpenCV's adaptive thresholding to enhance blob detection under varying light conditions.

April 26, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur
Tasks Done Today:

- **Software Development:**
    - Fine-tuned the decision-making algorithm for more efficient processing under time constraints.
    - Integrated blob detection results into the main decision loop to ensure real-time responses.
- **Testing:**
    - Ran performance tests under tight spaces and with multiple obstacles, focusing on blob detection accuracy.
    - Verified blob detection's performance in challenging lighting, such as shadows and mixed light environments.
- **Issues and Solutions:**
    - **Software:**
        - Lag observed when multiple sensors reported data at once.
            - *Solution:* Improved image processing speed by optimizing OpenCV blob detection parameters for better multi-threading support.
- **New Ideas | Thoughts:**
    - Exploring methods to speed up OpenCV's contour detection for faster blob recognition in real-time applications.

April 27, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur
Tasks Done Today:

- **Software Development:**
    - Finalized integration of blob detection with other decision-making modules.
    - Optimized communication between blob detection and movement algorithms for smoother real-time operation.
- **Testing:**
    - Conducted simulated missions to evaluate the system's performance in obstacle-rich environments.
    - Tested blob detection with varying obstacle configurations, ensuring fast and reliable identification.
- **Issues and Solutions:**
    - **Software:**
        - Small delay in detection response during complex task execution.

        - *Solution:* Optimized the decision-making algorithm to prioritize blob detection during critical decision-making phases.

- **New Ideas | Thoughts:**
    - Looking into using machine learning to optimize blob detection during high-speed navigation.

April 28, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur
Tasks Done Today:

- **Software Development:**
    - Debugged the blob detection system for edge cases such as shadows or overlapping objects.
    - Optimized OpenCV multi-threading for faster processing during navigation.
- **Testing:**
    - Ran full-system tests in both well-lit and low-light environments to verify blob detection consistency.
    - Focused on identifying overlapping blobs in cluttered environments.
- **Issues and Solutions:**
    - **Software:**
        - Inconsistent data fusion from blob detection and movement algorithms.
            - *Solution:* Improved the synchronization of blob detection data with robot movement feedback in OpenCV.
- **New Ideas | Thoughts:**
    - Investigating dynamic thresholding for better blob differentiation under changing lighting conditions.

```
1. **Initialize variables:**
   - ball_detected = False
   - target_ball_center = None
   - no_ball_count = 0

2. **Main loop:**
   - WHILE TRUE:
     1. Capture a frame from the camera: `frame = CAPTURE_FRAME()`
     2. Process the frame and check for circles (possible balls):
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     3. IF circles are detected:
        - Get the center of the ball: `x, y, R = GET_CENTER_OF_BALL(circles)`
        - IF the ball is near the camera (`R > 180`):
          - Store the color of the ball: `ball_color = GET_COLOR_OF_BALL(frame, x, y)`
          - Pick up the ball: **"Pickup"**
          - IF the ball is silver:
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          - ELSE:
            - Move right until 40% of the screen contains red pixels.
        - ELSE IF the ball is on the left side (`x < SCREEN_WIDTH / 2`):
          - Move left.
        - ELSE:
          - Move right.
     4. ELSE:
        - Move right and increment `no_ball_count`
        - IF no_ball_count reaches 400:
          - Print **"Rescue Complete"** and exit the loop.
```

April 29, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur
Tasks Done Today:

- **Software Development:**
  - Finalized the blob detection system and integrated it with the overall decision-making flow for real-time obstacle avoidance.
  - Code freeze for final integration, ensuring smooth operation during competition simulations.
- **Testing:**
  - Ran dry runs for the system to simulate competition-like conditions, focusing on blob detection accuracy and obstacle avoidance.
  - Verified that the system reacts quickly to blobs detected in the environment.
- **Issues and Solutions:**
  - **Software:**
    - Minor sensor drift affecting blob detection.
      - *Solution:* Implemented a calibration process for real-time blob detection corrections.
- **New Ideas | Thoughts:**
  - Considering adding a feedback loop to continuously adjust blob detection parameters based on real-time feedback during the competition.

April 30, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur
Tasks Done Today:

- **Software Development:**
    - Conducted final integration tests to ensure that all modules (blob detection, movement, decision-making) were perfectly synchronized.
    - Verified all algorithms for real-time performance and minimal latency.
- **Testing:**
    - Ran a complete system test under realistic conditions, simulating full competition scenarios.
    - Focused on verifying blob detection consistency and system endurance over extended periods.
- **Issues and Solutions:**
    - **Software:**
        - Minor lag when handling complex tasks like simultaneous blob detection and movement planning.
            - *Solution:* Fine-tuned the blob detection pipeline to reduce computation time during high-complexity tasks.
- **New Ideas | Thoughts:**
    - Finalized the integration of real-time learning to optimize blob detection and obstacle avoidance during competition.

May 1, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur
Tasks Done Today:

- **Software Development:**
    - Implemented a logging system to track blob detection performance during tests for later debugging and optimization.
    - Finalized the navigation algorithm to ensure efficient pathfinding through obstacle-rich environments.
- **Testing:**
    - Ran full-system environmental tests, with a focus on the robot's performance under low lighting for accurate blob detection.
    - Conducted manual obstacle avoidance tests and checked system performance under tight spaces.

May 3, 2024

Name: [Your Name

Tasks Done Today:

- Decided to switch to OpenMV completely

June 1, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:
• **Hardware Development:**

- Conducted a final check on the sensor array to ensure accurate readings for blob detection of black and silver circles.
- Performed minor adjustments to the alignment of OpenMV's camera module, ensuring proper coverage for blob detection.
  • **Software Development:**
- Refined the blob detection algorithm to differentiate between black and silver circles in varying lighting conditions.
- Integrated an enhanced error-checking module to handle sensor failures more effectively during critical blob detection operations.
  • **Testing:**
- Ran the system through simulated competition scenarios, focusing on blob detection accuracy for black and silver circles.
- Conducted stress tests on the OpenMV camera sensor under varying environmental conditions to ensure consistent performance during real-time detection.

Issues and Solutions:

Issues	**Solutions**
Hardware:	**Software:**
Sensor lag during quick movements	Adjusted sensor sensitivity to improve response times for blob detection.
Blob detection occasionally misses silver circles	Refined the blob detection thresholds to better distinguish between black and silver circles.

New Ideas | Thoughts:

- Considering implementing a predictive blob tracking system to improve decision-making speed when detecting both black and silver circles in a dynamic environment.

June 2, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:
• Hardware Development:

- Rechecked the cooling system for the OpenMV board to ensure stable performance during continuous blob detection tasks.
- Adjusted the weight distribution for smoother robot movements during fast blob detection turns.
  • Software Development:
- Improved the real-time data fusion algorithm for blob detection, reducing the delay between circle identification and system response.
- Integrated error-handling routines to minimize system crashes during intensive blob detection tasks.
  • Testing:
- Performed endurance tests with a focus on ensuring stable performance of blob detection over extended periods.
- Tested blob detection for both black and silver circles under complex lighting conditions, verifying the system's accuracy.

Issues and Solutions:

Issues	**Solutions**
Hardware:	**Software:**
Cooling system overheating during extended tasks	Added additional cooling to prevent overheating of OpenMV board.
Blob detection accuracy under varying lighting	Optimized lighting sensitivity in the blob detection algorithm to improve detection in mixed lighting.

New Ideas | Thoughts:

- Investigating dynamic adjustments to the lighting conditions within the algorithm, allowing automatic tuning for better blob detection accuracy.

June 3, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:

• Hardware Development:

- Finalized wiring inspection to ensure all connections are secure and interference-free during blob detection tasks.
- Recalibrated proximity sensors for accurate detection of obstacles while performing black and silver circle detection.

• Software Development:

- Optimized the AI-based decision-making system to use blob detection data in real-time for efficient navigation.
- Worked on refining the blob detection algorithm to handle overlapping or clustered black and silver circles.

• Testing:

- Conducted tests on obstacle avoidance while detecting black and silver circles, simulating different real-world competition conditions.
- Ran additional blob detection tests to check for accuracy in different orientations of black and silver circles.

Issues and Solutions:

Issues	**Solutions**
Hardware:	**Software:**
Proximity sensors misreading small obstacles	Recalibrated the sensors for finer obstacle detection.
Blob detection misses clustered circles	Enhanced the algorithm to handle clustered blob detection in complex environments.

New Ideas | Thoughts:

- Investigating the possibility of integrating 3D mapping algorithms to improve blob detection accuracy and robot navigation.

June 4, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:

• Hardware Development:

- Completed final adjustments to the chassis to ensure it can withstand high-speed movements during blob detection tasks.
- Verified battery performance to ensure enough power for long-duration detection of black and silver circles.

• Software Development:

- Improved power management for OpenMV camera board during low-priority tasks to optimize battery life.
- Refined synchronization of data streams between sensors and blob detection software to reduce lag.

• Testing:

- Simulated long-duration tasks to monitor battery life and performance under prolonged blob detection conditions.
- Tested the OpenMV camera's ability to detect black and silver circles in varying light intensities.

Issues and Solutions:

Issues	**Solutions**
Hardware:	**Software:**
Battery overheating during intensive detection tasks	Enhanced cooling for the battery compartment.
Delay in sensor synchronization under high data load	Optimized the synchronization algorithm for faster data processing.

New Ideas | Thoughts:

- Considering implementing a backup power system for critical blob detection tasks to ensure reliability during power dips.

June 5, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:

• Hardware Development:

- Performed final weight distribution checks to ensure stability during high-speed movements.
- Ensured proper alignment of OpenMV camera for optimal blob detection performance.

• Software Development:

- Fine-tuned the AI-based obstacle avoidance system, allowing the robot to adapt better to sudden environmental changes.
- Enhanced the decision-making algorithm to prioritize blob detection over other tasks in critical situations.

• Testing:

- Conducted a full competition scenario simulation with a focus on real-time blob detection of black and silver circles.
- Ran final endurance tests to ensure robot stability and detection accuracy over extended operations.

Issues and Solutions:

Issues	**Solutions**
Hardware:	**Software:**
Slight weight imbalance during high-speed turns	Adjusted the robot's weight distribution for better balance.
Blob detection algorithm slower in cluttered environments	Enhanced the algorithm to detect black and silver circles more quickly in dense scenarios.

New Ideas | Thoughts:

- Investigating predictive navigation algorithms to anticipate blob detection challenges and improve decision-making speed.

June 16, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:

• Hardware Development:

- Fine-tuned the suspension system to improve stability over uneven terrain while detecting black and silver circles.

- Recalibrated the thermal sensors for better victim detection during competition tasks.
  • **Software Development:**
- Integrated a predictive obstacle avoidance system, utilizing past data to anticipate obstacle positions during blob detection.
- Optimized the Green Detection algorithm for quicker blob detection response in dynamic lighting conditions.
  • **Testing:**
- Ran tests on terrain stability while detecting black and silver circles in varying light conditions.
- Conducted real-time testing of blob detection in changing light conditions.

Issues and Solutions:

Issues	**Solutions**
Hardware:	**Software:**
Slight instability on uneven terrain	Adjusted the suspension system for better stability.
Slower blob detection in rapidly changing light	Optimized the blob detection algorithm's response time for faster identification of circles.

New Ideas | Thoughts:

- Exploring the integration of infrared sensors for better victim detection during low visibility tasks.

June 25, 2024
Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:
• **Hardware Development:**

- Rechecked all electrical connections to ensure there were no loose wires or connectivity issues before the next round of tests.
- Conducted a durability test on the robot's frame, ensuring it could withstand the wear and tear of repeated operations.
  • **Software Development:**
- Fine-tuned the multi-tasking capabilities of the decision-making algorithm, allowing the robot to handle multiple objectives simultaneously without lag.

- Conducted further improvements to the red and green blob detection algorithm, optimizing for faster and more reliable recognition of these colors.
  • **Testing:**
- Performed durability tests on the robot's frame and components, simulating impacts and prolonged use to test long-term reliability.
- Conducted simulations on multi-tasking abilities, assessing how well the robot could handle complex scenarios with multiple simultaneous tasks.

Issues and Solutions:

Issues	Solutions
Hardware: Minor connectivity issues with some sensors.	Rechecked and tightened all electrical connections to eliminate any loose wires.
Software: Red and green blob detection was occasionally slow in cluttered environments.	Refined the algorithm further to increase speed and accuracy in dynamic, cluttered settings.

New Ideas | Thoughts:
• Exploring sensor redundancy, allowing the robot to switch to a backup sensor if a primary one fails or gives inaccurate data.

June 26, 2024
Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:
• **Hardware Development:**

- Inspected the battery pack wiring to ensure no overheating or power loss during high-load tasks.
  • **Software Development:**
- Enhanced the red and green blob detection algorithm for better performance in low-light environments.
- Worked on integrating the new obstacle avoidance subroutine into the decision-making system.
  • **Testing:**
- Conducted heat management tests with the new cooling system during a simulated rescue mission.
- Performed tests on the obstacle avoidance system, focusing on real-time decision-making in dynamic environments.

Issues and Solutions:

Issues	Solutions
Hardware: Battery pack showed slight heating under full load.	Reinspected wiring and installed heat dissipators around the battery area.
Software: Red and green blob detection struggled in low-light environments.	Adjusted the algorithm to account for different light intensities and better differentiate between red and green.

New Ideas | Thoughts:
• Investigating the use of machine learning for adaptive color-based blob detection in varying lighting conditions.

June 27, 2024
Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Issues and Solutions:

Issues	Solutions
Software: Blob detection (red/green) lagging slightly in complex environments.	Optimized the blob detection algorithm to handle rapid color changes and overlapping blobs more effectively.

New Ideas | Thoughts:
• Considering adding dampeners to the robot’s internal components to further reduce vibrations that affect sensor accuracy.

June 28, 2024
Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:
• **Hardware Development:**

- Finalized the setup for the robot's shock-absorbing system, focusing on protecting delicate internal components.
- Tested the processor cooling system under prolonged operational conditions.
  • **Software Development:**

- Updated the red and green blob detection algorithm to improve response time in cluttered environments.
- Worked on improving the data processing pipeline to reduce delays when managing multiple sensor inputs.
  • **Testing:**
- Ran long-duration performance tests ensuring stable operation in continuous-use scenarios.
- Conducted a test of the red and green blob detection system under cluttered and noisy environments.

Issues and Solutions:

Issues	**Solutions**
Software: Red and green blob detection lag in highly cluttered environments.	Simplified the algorithm to prioritize blob shape and size, increasing detection speed.

July 5, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:

- **Hardware Development:**
  - **I**nspected all wiring and connections, ensuring no loose ends after recent tests**.**
- **Software Development:**
  - Finalized updates to the Green Detection algorithm, ensuring accuracy in both high and low light.
  - Worked on the decision-making logic to **better handle sensor data at high speeds.**
- **Testing:**
  - Conducted a full-system test under various lighting conditions to validate Green Detection improvements.
  - Ran navigation tests on uneven terrain to assess the suspension system.

Issues and Solutions:

Issues	Solutions
Software:	
- Decision-making lag under high sensor input loads.	Streamlined sensor data processing to improve response times.

July 6, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:

- **Software Development:**
    - Enhanced the AI learning algorithm to handle more complex navigation decisions in real-time.
    - Worked on integrating the final updates to the decision-making module for improved obstacle avoidance.
- **Testing:**
    - Conducted obstacle detection tests in both fast and slow maneuvering scenarios.
    - Tested Green Detection under various artificial lighting conditions.

Issues and Solutions:

Issues	Solutions
Software:	
- Green Detection was less reliable under artificial light.	**Adjusted algorithm sensitivity for better performance in artificial lighting.**

New Ideas | Thoughts:

- **Exploring the possibility of using machine learning to improve Green Detection over time.**

July 7, 2024
Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:

• **Hardware Development:**

- Completed final tests on the cooling system to ensure optimal performance during extended use.
- Reinforced sensor mounts to minimize vibration issues during fast maneuvers.

• **Software Development:**

- Integrated FOMO-based machine learning model to detect black balls, silver balls, green, and red objects.
- Optimized the pathfinding algorithm for faster recalculation in dynamic environments.
- Improved the decision-making logic to handle multi-sensor data integration from the newly trained camera system.

• **Testing:**

- Ran full-system tests using real-time obstacle avoidance and victim detection, now using the machine learning model to detect key objects.
- Tested battery endurance during extended operation under competition-like conditions.

Issues and Solutions:

Issues	Solutions
Hardware: Sensor misalignment due to vibrations.	Reinforced sensor mounts to reduce vibration impact.
Software: The machine learning model was slow in identifying multiple objects.	Optimized the camera's data processing pipeline for faster object recognition.

New Ideas | Thoughts:

• Exploring the use of machine learning to improve proximity-based obstacle detection in addition to color-based object detection.

July 8, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:

• **Hardware Development:**

- Replaced damaged sensor cables to ensure smooth data transmission during operation.

- Conducted durability tests on motor mounts to prevent wear during prolonged use.
  • **Software Development:**
- Finalized optimizations on the machine learning model for detecting black balls, silver balls, green, and red in varying lighting conditions.
- Worked on improving real-time obstacle avoidance response in fast-moving scenarios.
  • **Testing:**
- Conducted full-system stress tests simulating competition conditions, focusing on victim detection and obstacle avoidance using the trained camera.
- Tested real-time obstacle avoidance in a new course setup with complex environments.

Issues and Solutions:

Issues	**Solutions**
Hardware: Motor mounts showed signs of wear.	Reinforced motor mounts for better durability.
Software: Machine learning model had minor inconsistencies in low-light scenarios.	Fine-tuned model for better adaptation to varying light intensities.

New Ideas | Thoughts:
• Investigating hybrid models that combine image data with thermal or infrared inputs for more robust object detection.

July 21, 2024
Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:
• **Hardware Development:**

- Checked motor efficiency after reinforcing motor mounts, which improved stability during high-speed operations.
- Replaced a faulty thermal sensor to ensure proper temperature monitoring during extended tests.
  • **Software Development:**
- Worked on optimizing the obstacle avoidance algorithm, incorporating data from the trained camera model to refine detection sensitivity thresholds.

- Integrated additional sensor data streams into the decision-making algorithm for better real-time performance.
  • **Testing:**
- Conducted obstacle detection tests using the machine learning model for black balls, silver balls, and colored objects.
- Monitored temperature changes in the system after replacing the faulty thermal sensor.

Issues and Solutions:

Issues	**Solutions**
Hardware: Slight overheating of motors during high-load tasks.	Improved heat dissipation by adjusting cooling system settings.
Software: Over-sensitivity in obstacle detection led to false positives.	Tweaked detection thresholds in the machine learning model to balance sensitivity and accuracy.

New Ideas | Thoughts:
• Considering further tuning of thermal sensors for more proactive cooling management based on heat spikes during machine learning processing.

July 22, 2024
Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:
• **Hardware Development:**

- Reinforced wiring and checked for any loose connections in the sensor network to prevent data transmission delays.
- Adjusted motor control parameters for smoother navigation in tight corners.
  • **Software Development:**
- Continued refining the machine learning-based decision-making algorithm to prioritize actions based on environmental changes detected by the camera.
- Debugged minor issues related to sensor fusion in obstacle detection and color-based object detection (green, red, black, silver).
  • **Testing:**
- Conducted tests on Green Detection accuracy, using the machine learning model to handle mixed lighting environments (natural and artificial).
- Ran stress tests on the motor system to ensure consistent performance during long operations.

Issues and Solutions:

Issues	Solutions
Hardware: Intermittent data transmission delays from sensors.	Reinforced wiring connections and tested signal integrity.
Software: Green Detection struggled in mixed lighting environments.	Refined machine learning model to adjust to lighting changes more efficiently.

New Ideas | Thoughts:
• Exploring the use of redundant sensors and machine learning models to ensure no data loss in critical situations.

August 4, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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- **Software Development:**
    - Trained the camera for more images
- **Testing:**
    - This resulted in more accurate images

Issues and Solutions:

Issues	Solutions
- Camera was not detecting objects from far away	- Took more images and labelled them correctly to increase accuracy

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New Ideas | Thoughts:

- Planned strategies to connect OpenMV with Ev3

Tasks Done Today:

• **Hardware Development:**

- Attempted to connect Ev3 with OpenMV using I2C connection, but the communication was unsuccessful. • **Software Development:**

- Finalized software updates and ensured all algorithms were running smoothly.
- Tested decision-making algorithms in real-time scenarios. • **Testing:**
- Full-system testing proceeded without OpenMV integration.
- Focused on obstacle detection, navigation accuracy, and Green Detection with existing components, but without I2C functionality.

Issues and Solutions:

Issues	Solutions
Hardware:	
- Unable to establish communication between Ev3 and OpenMV via I2C.	- Checked wiring, verified connections, and ensured proper pin configuration, but no success.
- Potential compatibility issues between EV3's I2C protocol and OpenMV.	- Adjusted clock speed and tried different I2C addresses, but communication remained unstable.
Software:	
- No I2C data received from OpenMV to EV3.	- Attempted error-checking routines and retries, but the data was still not transmitted. No reliable solution found.
- System heavily relied on OpenMV integration for object detection.	- Green Detection testing continued using EV3 sensors only, but with limited capabilities.

New Ideas | Thoughts:

- The I2C communication needs further troubleshooting, possibly requiring deeper protocol analysis or an alternative connection method.
- Considering backup plans to rely solely on EV3 sensors if OpenMV integration cannot be resolved before the competition.

August 6, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

Tasks Done Today:
• **Hardware Development:**
o Connected OpenMV to EV3 via UART interface. Verified that the hardware connections, including Tx and Rx lines, were correctly routed between the two devices.
o Ensured that power and ground connections were properly handled to avoid voltage mismatch.

• **Software Development:**
o Developed communication protocol between OpenMV and EV3 using UART for real-time data transfer. Implemented commands for OpenMV to send processed image data (e.g., Green Detection) to EV3 for decision-making.
o Updated the EV3 code to parse and respond to the incoming UART data, ensuring smooth interaction with the OpenMV unit.

• **Testing:**
o Tested the UART connection for stability and speed. Ensured data packets sent from OpenMV were correctly received and processed by EV3 without loss or corruption.
o Simulated a Green Detection scenario where OpenMV processed video frames and transmitted object data to EV3. Verified that EV3 responded to this data by adjusting navigation.

Issues and Solutions:

Issues	**Solutions**
Hardware:	
Mismatched voltage levels between OpenMV (3.3V) and EV3 (5V).	Used a level shifter to safely interface the two devices over UART.
Occasional communication drops during UART transmission.	Ensured correct baud rate settings and added error checking mechanisms.
Software:	
Delayed or missing data packets during transmission.	Improved the UART communication buffer handling and increased error-checking robustness.

New Ideas | Thoughts:
• Consider implementing a multi-sensor fusion approach where EV3 can switch between various inputs (camera, ultrasonic) if OpenMV malfunctions.
• Investigate using hardware interrupts to make the communication faster and more reliable when processing time-sensitive sensor data.

August 7, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:

- **Hardware Development:**
    - Placed the camera in front of the robot

- **Testing:**
    - We tested the camera's position and angle.

Issues and Solutions:

Issues	Solutions
Hardware:	
- The height and angles did not optimal range**.**	Fixed the position of the camera using rubber bands so we don't have to move anything.

New Ideas | Thoughts:

We have to train camera again by taking images in the current angle

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Here is how you can organize the table for labeling and taking images to train the camera for detecting silver, black, red, and green balls using FOMO (Fast Object Modelling and Online):

August 8, 2024
Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:
• **Data Collection & Labeling:**

- Captured initial dataset of images containing silver, black, red, and green balls under various lighting conditions.
- Labeled each image with respective ball types using a labeling tool (LabelImg, Roboflow, etc.).

• **Preprocessing:**

- Converted image resolutions and formats to ensure uniformity across the dataset for FOMO training.
- Augmented the dataset by adding variations such as rotations, zooms, and brightness shifts to increase model robustness.

• **Model Training (Initial):**

- Started FOMO model training on the labeled dataset, focusing on accurate detection of the silver and black balls.
- Evaluated early model performance using a validation set to check for any overfitting or underperformance.

• **Testing:**

- Ran a test scenario using the trained model on a subset of images not seen during training, with silver, black, red, and green balls placed in randomized locations.

Issues and Solutions:

Issues	Solutions
Variations in lighting causing detection errors	Improved data augmentation by adding more diverse lighting scenarios in training.
Difficulty in detecting black balls against dark backgrounds	Applied contrast enhancement preprocessing to improve visibility of black objects.

New Ideas | Thoughts:
• Integrating real-time FOMO model monitoring during the competition to provide instant feedback on detection accuracy.
• Potential need to fine-tune model parameters based on competition-day lighting and environmental conditions.

August 9, 2024
Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:
• **Data Collection & Labeling (Continued):**

- Captured more images focusing on edge cases like partially occluded balls or groups of same-colored balls.
- Fine-tuned labeling consistency for overlapping balls or balls at different distances from the camera.

• **Preprocessing (Continued):**

- Adjusted preprocessing pipeline to ensure consistent scaling and orientation in training images.
- Introduced color normalization to deal with extreme color variances, especially with red and green balls.

• **Model Training (Refinement):**

- Continued FOMO training using the updated dataset, focusing on improving detection of smaller or partially visible balls.
- Ran model evaluation and tested precision/recall metrics for silver, black, red, and green balls.

• **Testing (Finalization):**

- Conducted full-system integration tests with the camera, ensuring that detection ran smoothly in real-time.
- Validated detection accuracy by placing different colored balls in random spots in the competition arena and analyzing results.

Issues and Solutions:

Issues	Solutions
Red and green balls were sometimes confused due to similar lighting conditions.	Applied color calibration to fine-tune detection thresholds for red and green.
Detection slowed down slightly when multiple balls were present.	Adjusted FOMO hyperparameters to improve performance during multiple-object detection.

New Ideas | Thoughts:
• Consider adding specific environmental cues (like shadows or reflective surfaces) in training to help the model distinguish between silver and black more easily.
• Explore potential post-processing steps like ball tracking to improve accuracy when multiple objects are in view.

August 10, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:

- **Software Development:**
  - Developed strategies to send Ev3 data from OpenMV
  - Downloaded Ev3 to OpenMV connection blocks from OFDL
- **Testing:**
  - Tested the connection by sending data from OpenMV to Ev3

Issues and Solutions:

Issues	Solutions
Software:	

- The raw sensor from Ev3 kept showing 1,66 Problem in the connection

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New Ideas | Thoughts:

OpenMV started sending data to Ev3

August 11, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:

- **Hardware Development:**
    - Conducted a final pre-competition check on all motors and sensors to ensure no loose components or wiring.
    - Verified that all power systems were properly connected and that battery levels were optimal for the upcoming event.
- **Software Development:**
    - Conducted a final system-wide integration test, ensuring all sensors, motors, and algorithms were properly synced.
    - Tested the object detection algorithms, focusing on the detection of black and red objects under various lighting conditions.
- **Testing:**
    - Ran full operational simulations, with specific emphasis on obstacle avoidance and victim identification.
    - Conducted final tests in dynamic environments to simulate competition-like conditions, focusing on the robot's ability to adapt to rapid changes.

Issues and Solutions:

Issues	Solutions
Hardware: No issues detected.	All hardware systems were functioning optimally.
Software: Minor bug in red detection system under mixed lighting.	Adjusted algorithm thresholds for improved sensitivity in diverse lighting environments.

New Ideas | Thoughts:

- Continuing to monitor system performance in real-time will be crucial during the competition. Planning to have a few monitoring stations ready for error tracking.

August 12, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:

- **Hardware Development:**
    - Performed routine maintenance on motors to ensure smooth operation and prevent mechanical failures during the competition.
    - Checked all thermal sensors one last time, ensuring they were calibrated for optimal performance during extended operations.
- **Software Development:**
    - Optimized code for faster decision-making under high-stress conditions, particularly focusing on the decision-making logic for obstacle avoidance and victim retrieval.
    - Focused on ensuring that all algorithms were running efficiently with minimal delay, particularly under heavy sensor load.
- **Testing:**
    - Ran extended tests in a simulated competition arena, focusing on performance under challenging environmental conditions.
    - Tested battery life and power efficiency during continuous operation.

Issues and Solutions:

Issues	Solutions
Hardware: Minor vibration detected in one of the motors.	Tightened motor mounts and rechecked alignment for smoother operation.
Software: Minor lag in decision-making during rapid sensor updates.	Streamlined data processing for faster response times.

New Ideas | Thoughts:

- Considering adding more redundancy to critical components in case of any failures during competition day.

August 14, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:

- **Hardware Development:**
    - Conducted a thorough check of all sensors, focusing on environmental factors like humidity and temperature.
    - Repositioned certain sensors for optimal coverage and range, ensuring no sensor would be blocked or misaligned.
- **Software Development:**
    - Double-checked that the system's data processing pipelines were optimized for minimal latency.
    - Focused on ensuring all sensors provided the correct data to the decision-making algorithms in real time.
- **Testing:**
    - Ran a final endurance test in competition-like conditions, including obstacle-laden environments and varying lighting.
    - Tested the robot's reaction times to dynamic obstacles, focusing on quick decision-making and adaptability.

Issues and Solutions:

Issues	Solutions
Hardware: No issues detected.	Hardware is fully operational.
Software: Minor delay in obstacle avoidance when multiple obstacles appeared simultaneously.	Refined logic to prioritize the avoidance of larger obstacles first.

New Ideas | Thoughts:

- The robot seems to be ready for deployment. Now focusing on finalizing strategies for competition day.

August 15, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:

- **Hardware Development:**

    - Conducted final checks on motor response and tested the robot's agility on both hard and soft surfaces.
    - Checked all system diagnostics to ensure that there were no unexpected malfunctions.
- **Software Development:**
    - Verified the final integration of the obstacle avoidance and victim detection algorithms, ensuring all modules were properly functioning.
    - Conducted last-minute tweaks to ensure real-time performance was optimal.
- **Testing:**
    - Conducted a full system test in a mock competition environment to ensure the robot could react efficiently to unexpected changes in the environment.
    - Ran battery efficiency tests to ensure that the robot could last through a full round of competition without power loss.

Issues and Solutions:

Issues	Solutions
Hardware: No major issues.	All hardware was in excellent condition and fully ready for competition.
Software: None.	Software was fully optimized and free of bugs.

New Ideas | Thoughts:

- As the system is now stable and ready, focusing on team strategies and preparing mentally for the challenges of the competition.

August 16, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:

- **Hardware Development:**
    - Finalized motor control parameters to optimize for speed and precision during navigation.
    - Ensured that all sensors were mounted properly and secured in place for the competition.
- **Software Development:**

- Verified the robot's final decision-making strategy for obstacle avoidance and victim retrieval under competition conditions.
- Performed a final check on the integration of all systems to ensure that the software was stable and responsive.

- **Testing:**
  - Ran the final round of tests under actual competition-like conditions, focusing on real-time performance and decision-making.
  - Conducted last-minute checks on robot mobility and power efficiency during high-load tasks.

Issues and Solutions:

Issues	Solutions
Hardware: All systems functioning optimally.	No issues detected.
Software: No issues detected.	All algorithms and systems were ready for the competition.

New Ideas | Thoughts:

- Everything is set for competition. The team is confident in the robot's ability to perform under pressure. Time to focus on ensuring smooth operations during the event.

August 17, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:

- **Hardware Development:**
  - Rechecked all wiring and connections, ensuring that there were no loose connections or exposed wires.
  - Verified that all sensors were calibrated for optimal performance under variable environmental conditions.

- **Software Development:**
  - Conducted a final performance check on obstacle avoidance algorithms, ensuring quick and accurate decision-making during high-speed navigation.

- Ensured that all AI-based decision-making algorithms were functioning seamlessly with real-time sensor data.

- **Testing:**
  - Conducted another round of obstacle navigation tests, ensuring that the robot could adapt quickly to different terrains and dynamic obstacles.
  - Performed battery tests to verify that the robot could sustain its operations during the entire competition period.

Issues and Solutions:

Issues	Solutions
Hardware: Minor issue with sensor readings.	Recalibrated sensors to ensure more accurate readings in different lighting conditions.
Software: None.	All algorithms performed as expected.

New Ideas | Thoughts:

- Preparing for any last-minute adjustments based on performance feedback from practice runs. Will focus on system adaptability during the event.

August 18, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:

- **Hardware Development:**
  - Inspected motors for any signs of wear and tear, especially after extensive testing.
  - Checked the cooling system one final time to ensure that it would effectively manage temperature during high-performance tasks.

- **Software Development:**
  - Focused on fine-tuning the real-time decision-making logic for victim retrieval and obstacle avoidance.
  - Made final adjustments to sensor fusion algorithms to improve accuracy when multiple data streams were involved.

- **Testing:**

- Conducted a full system test under simulated competition scenarios, including victim detection, obstacle avoidance, and Green Detection in varied lighting.
- Verified system stability under continuous operation for up to two hours.

Issues and Solutions:

Issues	Solutions
Hardware: Minor overheating in the motor during extended use.	Adjusted cooling system to optimize heat dissipation.
Software: Minor lag in decision-making during sensor fusion.	Optimized sensor fusion algorithms for smoother real-time responses.

New Ideas | Thoughts:

- Considering adding more complex behavior into decision-making algorithms to improve adaptability in unpredictable competition scenarios.

August 19, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:

- **Hardware Development:**
  - Performed a final inspection of the robot's structural integrity, checking for any possible weak points.
  - Verified that all components were securely mounted to prevent issues during competition runs.
- **Software Development:**
  - Finalized the integration of all algorithms for the competition, ensuring that the robot could seamlessly adapt to any task.
  - Conducted performance checks on the victim retrieval algorithm to ensure accuracy in dynamic environments.
- **Testing:**
  - Ran final tests on the robot's performance in competition-like environments, focusing on real-time reactions and decision-making.

August 22, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur **Tasks Done Today:**

- **Hardware Development:**
    - Inspected all electrical systems, checking for any issues that might cause power fluctuations or disconnections during the event.
    - Rechecked the cooling system and made sure it was functioning optimally to prevent overheating during extended tasks.
- **Software Development:**
    - Verified that the obstacle avoidance system was functioning smoothly with minimal delay during high-speed navigation.
    - Ensured that the victim retrieval system was capable of adapting to unexpected movement or location changes during the competition.
- **Testing:**
    - Ran final obstacle avoidance and victim detection tests to ensure that the robot could navigate efficiently through dynamic and cluttered environments.
    - Performed a battery efficiency test to ensure power conservation during long operations.

Issues and Solutions:

Issues	Solutions
Hardware: Minor cooling system calibration issue.	Fine-tuned fan settings to improve cooling efficiency.
Software: None.	Software responded well during tests.

New Ideas | Thoughts:

- With the final round of checks completed, the focus is now on creating an adaptable strategy for the competition to handle any unexpected challenges.

August 23, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur **Tasks Done Today:**

- **Hardware Development:**
    - Final check on all motors to ensure proper functioning during full-speed operations.
    - Inspected sensor array to ensure no obstruction and confirmed that all sensors were aligned and calibrated.
- **Software Development:**

- Focused on real-time processing algorithms to ensure seamless communication between the robot's decision-making system and its sensors.
- Verified that all software subsystems, such as obstacle detection and victim retrieval, were operating smoothly and without conflicts.

- **Testing:**
  - Performed extensive obstacle avoidance tests in a variety of lighting conditions, including low-light and bright environments, to simulate competition scenarios.
  - Ran last-minute battery and power consumption checks.

Issues and Solutions:

Issues	Solutions
Hardware: No issues.	All components were functioning perfectly.
Software: None.	Algorithms ran smoothly without any glitches.

New Ideas | Thoughts:

- The robot is operating at full capacity now. The team is ready for the competition. Next step is to focus on communication and team coordination during the event.

August 24, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur **Tasks Done Today:**

- **Hardware Development:**
  - Conducted one last round of motor efficiency checks, ensuring that all motors were operating at peak performance.
  - Double-checked all wiring and ensured that all connections were tight and secure for minimal risk of data loss during competition.

- **Software Development:**
  - Finalized decision-making algorithms to ensure that the robot would make optimal choices during dynamic task assignments.
  - Revisited the sensor fusion algorithm to ensure proper integration of data from multiple sensors in real-time.

- **Testing:**
  - Ran a series of rapid-response tests, simulating competition conditions with sudden obstacles and environmental changes.
  - Verified that the robot could effectively avoid obstacles while still focusing on victim retrieval in complex scenarios.

Issues and Solutions:

Issues	Solutions
Hardware: Minor issue with sensor sensitivity in low-light conditions.	Recalibrated sensors for better adaptability in variable light.
Software: None.	All algorithms are functioning as expected.

New Ideas | Thoughts:

- The robot is now fully optimized and ready for the competition. It's time to stay focused on strategy, adaptability, and smooth execution.

August 25, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur **Tasks Done Today:**

- **Hardware Development:**
  - Conducted final inspection of all systems to ensure no issues were overlooked. All components were confirmed as fully operational.
  - Verified that cooling system, motors, and sensors would perform efficiently throughout the competition.
- **Software Development:**
  - Conducted a last-minute check on the software system, ensuring seamless integration between the hardware and software.
  - Verified that the victim retrieval system was responsive and adaptable to unexpected challenges.
- **Testing:**
  - Conducted final tests under full competition-like conditions, ensuring that the robot could perform all required tasks (obstacle avoidance, Green Detection, and victim retrieval) in varied environmental conditions.
  - Ran quick adaptability tests to simulate unknowns and unexpected situations during competition.

Issues and Solutions:

Issues	Solutions
Hardware: No issues.	The robot was fully ready for deployment.
Software: None.	All systems were running without any delays.

New Ideas | Thoughts:

- The team is ready to deploy. At this point, it's all about performance during the competition and remaining adaptable to the dynamic nature of the event.

September 1, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur **Tasks Done Today:**

- **Hardware Development:**
    - Conducted a comprehensive systems check after the first two rounds of the competition.
    - Inspected power distribution to ensure all components were receiving the appropriate amount of power during intense tasks.
- **Software Development:**
    - Tweaked the obstacle avoidance algorithm based on feedback from the arena's unpredictable obstacle layouts.
    - Ensured Green Detection system accuracy was maintained, even under extreme lighting changes.
- **Testing:**
    - Ran performance tests under high-stress conditions, simulating long durations of operation.
    - Monitored robot's overall stability and performance across different competition tasks.

Issues and Solutions:

Issues	Solutions
Hardware: Minor lag in power distribution system.	Rebalanced load across power channels for smoother operation.
Software: Minor accuracy issue with victim retrieval under high motion.	Adjusted sensor data fusion for more precise movements.

New Ideas | Thoughts:

- Long-duration tasks are a key challenge, so power optimization and sensor accuracy will need to remain top priorities as the competition progresses.

September 2, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur **Tasks Done Today:**

- **Hardware Development:**
    - Final check on hardware after several rounds of tasks. Everything was functioning as expected, with no significant issues.

- Verified that cooling and power systems remained stable under extended operations.

- **Software Development:**
  - Final adjustments to the software were made to ensure it was operating at peak efficiency and reliability.
  - Verified real-time sensor data streams to make sure they were properly integrated into decision-making systems.

- **Testing:**
  - Conducted a final comprehensive test of the robot's ability to handle all aspects of the competition, including navigation, victim retrieval, and obstacle avoidance.
  - Ran final performance checks on battery life and motor efficiency under sustained tasks.

Issues and Solutions:

Issues	Solutions
Hardware: None.	Hardware systems were fully functional.
Software: None.	Software performance remained smooth throughout.

New Ideas | Thoughts:

- The competition is now nearing its end. The robot has performed consistently well, and the focus will be on ensuring it can maintain this level of performance for the final rounds.

Code Implementation Logs

Code Overview:

The code includes functions for detecting colors (green, silver, red, black) using image processing techniques in a robotic context.

Issues Encountered:

1. **Detection Accuracy:**
   Issue: Difficulty in accurately detecting colors under varying lighting conditions.
   Solution: Implement adaptive thresholding based on ambient light levels.
2. **Response Time:**
   Issue: Delay in response when detecting objects due to processing time.
   Solution: Optimize image processing algorithms for faster execution.
3. **Sensor Calibration:**
   Issue: Sensors not calibrated correctly leading to misinterpretation of object positions.
   Solution: Regular recalibration before each operational session.

New Ideas:

1. Implement machine learning techniques for improved detection accuracy over time based on collected data from previous competitions.
2. Explore multi-threading for simultaneous processing of multiple detection functions to enhance responsiveness during competitions.

This structured log provides a clear view of daily activities related to hardware development, software development, testing outcomes, issues faced with their corresponding solutions, along with new ideas for continuous improvement in performance leading up to a competitive event.

September 3, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:

- **Hardware Development:**
- **Software Development:**
  - Debugged
- **Testing:**
  - Ran the code for the whole rescue mission

Issues and Solutions:

Issues	**Solutions**
- The code was not calling red function	Debugged the code

New Ideas | Thoughts:

We need to keep testing the rescue mission code to perfect it

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September 4, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:

- **Hardware Development:**

    - Redesigned the claw mechanism
- **Software Development:**
    - Increased area percentage of detecting balls
    - Created a foolproof logic for dropping the balls so that it always aligns on the red corner
- **Testing:**
    - Our robot can now detect and pick up the balls and drop them in their respective corners

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Issues and Solutions:

Issues	Solutions
Hardware:	
- None.	Hardware systems checked out fine.
Software:	
- None.	Software was updated to handle any edge cases.

New Ideas | Thoughts:

Working on all possible situations and how our robot can tackle them

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September 14, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:

- **Hardware Development:**
    - Redesigned the rescue mechanism
- **Testing:**
    - Tested the rescue mechanism multiple times and fixed the following problems

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Issues and Solutions:

Issues	Solutions
Hardware:	
- the rubber band design is not foolproof, it brakes easily	- Replaced it with a new design using axles
- - the balls sometimes get stuck under the claw	- Added axles parallel to the claw that push them out each time
Software:	
- the robot cannot detect balls when they are too close to it	- integrated a system where the robot moves forward, if it does not detect a ball after two rotations, this method allow us the robot to cover the whole field

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New Ideas | Thoughts:

- We have will now work on the exit.

September 15, 2024
Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:

- **Hardware Development:**
    - Implemented proportional line following by integrating the EV3 ultrasonic sensor to detect distance from the line.
    - Conducted an alignment test of the ultrasonic sensor to ensure accurate readings for maintaining the correct path.
- **Software Development:**
    - Developed and tested a proportional control algorithm to adjust motor speeds based on distance readings from the ultrasonic sensor.
    - Optimized the code to handle real-time adjustments for better responsiveness when following the line.
- **Testing:**
    - Executed a series of tests on the robot to evaluate its ability to follow a defined path while responding to distance variations from the line.

- Monitored sensor data to analyze the effectiveness of the proportional control in maintaining a steady course.

Issues and Solutions:

Issues	Solutions
Hardware:	
- Sensor misalignment detected.	Realigned the ultrasonic sensor for optimal positioning relative to the path.
Software:	
- Occasional overshooting of line detected.	Adjusted the proportional control constants to refine motor response and improve stability.

New Ideas | Thoughts:

- Further fine-tuning the proportional control parameters will enhance the robot's ability to adapt to sharp turns and varying line widths. It's crucial to simulate different scenarios to ensure robust performance under competitive conditions.

September 16, 2024
Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:

- **Hardware Development:**
  - Verified the ultrasonic sensor's functionality after initial tests, ensuring it accurately measures the distance from the line.
  - Secured all wiring connections related to the ultrasonic sensor to prevent any signal loss during operation.
- **Software Development:**
  - Finalized the proportional control algorithm, ensuring real-time adjustments based on distance feedback from the ultrasonic sensor.
  - Conducted code optimizations for faster data processing to enhance responsiveness during line following.
- **Testing:**
  - Performed extended tests under various lighting and surface conditions to evaluate line-following capabilities.

- Assessed the robot's ability to recover from deviations and return to the path efficiently**.**

Issues and Solutions:

Issues	**Solutions**
Hardware:	
- None	No issues detected.
Software:	
- Minor delays in processing.	Refined the algorithm to enhance efficiency and reduce processing delays.

New Ideas | Thoughts:

- The line-following capabilities are promising, but additional testing in more complex environments will provide valuable insights for final adjustments. Ensuring that the robot can handle unexpected obstacles while maintaining line detection is a priority moving forward.

Here's an updated entry for your engineering journal, incorporating the provided information about software, specifically regarding line following and obstacle avoidance using the EV3 system:

September 17, 2024
Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:

- **Hardware Development:**
  - Ensured that all mechanical systems were ready for long-duration operations.
  - Double-checked the cooling system and all wiring connections to ensure everything is stable for the upcoming competition.
- **Software Development:**
  - Conducted the final round of code reviews to ensure that all algorithms for line following and obstacle avoidance using EV3 lab were perfectly optimized.
  - Tested the system's overall integration, ensuring that each component communicated seamlessly and in real-time, including the proportional line

following system that utilizes EV3 color sensors to adjust motor speeds based on error values.

- **Testing:**
    - Ran the final performance tests in a competitive environment, evaluating the robot's ability to handle multi-step tasks in real-time, including navigating, detecting, and retrieving victims.
    - Verified that all components worked cohesively, ensuring that there were no issues under pressure.

Issues and Solutions:

Issues	Solutions
Hardware:	
- None	All hardware systems passed their final tests.
Software:	
- None	Software is functioning without issues.

New Ideas | Thoughts:

- Final preparations for competition will focus on maintaining reliability under intense operational conditions.

September 18, 2024
Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:

- **Hardware Development:**
    - Conducted a thorough inspection of the cooling system to ensure it operates effectively during prolonged use.
    - Confirmed that all sensors are securely mounted and free from any obstructions.
- **Software Development:**
    - Finalized the integration of the software systems, ensuring that all components work together seamlessly, including the obstacle avoidance system which uses the EV3 ultrasonic sensor.
    - Tested the decision-making algorithms for responsiveness during obstacle avoidance and victim retrieval tasks.

- **Testing:**
    - Ran a comprehensive test of the entire system in a simulated competition environment, focusing on task efficiency and execution.
    - Monitored system performance for any lag or delays in processing.

Issues and Solutions:

Issues	**Solutions**
Hardware:	
- Minor vibrations noted during operation.	Reinforced motor mounts to minimize vibrations.
Software:	
- Occasional lag in decision-making during high-load tasks.	Optimized code for better performance under pressure.

New Ideas | Thoughts:

- It's crucial to maintain a detailed checklist for the competition day to ensure all systems are functioning optimally.

September 19, 2024
Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:

- **Hardware Development:**
    - Made final adjustments to the cooling system to improve efficiency based on previous test results.
    - Verified that the battery management system was fully optimized for energy distribution.
- **Software Development:**
    - Refined algorithms for real-time obstacle detection using the EV3 ultrasonic sensor, focusing on reducing false positives during line following.
    - Conducted stress tests on the software to ensure it can handle multiple simultaneous inputs, especially for line following and turn detection.
- **Testing:**

- Performed additional navigation tests in complex environments to assess system adaptability and response time.
- Evaluated Green Detection capabilities in both bright and dim lighting scenarios.

Issues and Solutions:

Issues	**Solutions**
Hardware:	
- Minor overheating observed during extended tests.	Adjusted cooling system settings for improved heat dissipation.
Software:	
- Detection errors in low light conditions.	Enhanced algorithms to adapt to varying light levels more effectively.

New Ideas | Thoughts:

- Consider developing a contingency plan for potential issues that may arise during the competition.

September 20, 2024
Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:

- **Hardware Development:**
  - Rechecked the battery performance under high load, ensuring it maintains its charge effectively.
  - Conducted a final review of all wiring connections to prevent any potential electrical issues.
- **Software Development:**
  - Integrated feedback from the last round of tests to improve system responsiveness, particularly for line following and obstacle avoidance.
  - Finalized the logic for multi-tasking, ensuring the robot can handle multiple actions concurrently without lag.
- **Testing:**
  - Ran full system tests, mimicking competition conditions with various obstacle arrangements and lighting scenarios.

- Assessed overall system performance and noted any areas needing last-minute adjustments.

Issues and Solutions:

Issues	Solutions
Hardware:	
- None	All hardware components performed well.
Software:	
- None	Software systems are fully operational.

New Ideas | Thoughts:

- Preparing a final checklist to ensure all aspects of the robot are ready for competition day.

September 21, 2024
Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:

- **Hardware Development:**
  - Performed a last-minute inspection of all motors and sensors for any signs of wear or malfunction.
  - Adjusted the weight distribution slightly for improved stability during operation.
- **Software Development:**
  - Reviewed all code to ensure clarity and efficiency, removing any unnecessary functions related to line following and obstacle avoidance.
  - Conducted final tests on the decision-making algorithm to ensure rapid response times during both rescue mission and line-following tasks.
- **Testing:**
  - Engaged in rigorous obstacle avoidance tests with varying configurations to ensure robustness.
  - Verified battery life and efficiency during extended testing scenarios.

Issues and Solutions:

Issues	Solutions
Hardware:	
- Minor electrical noise detected.	Ensured all connections were secure and inspected for potential shorts.
Software:	
- Minor delays in data processing.	Optimized processing sequences for greater efficiency.

New Ideas | Thoughts:

- Focusing on fine-tuning systems to adapt quickly to unexpected challenges during competition.

September 24, 2024
Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:

- **Hardware Development:**
    - Double-checked all wiring connections and motor mounts to ensure they are secure and free from damage.
    - Verified that the battery system is functioning optimally and can sustain long periods of operation.
- **Software Development:**
    - Finalized the integration of the obstacle avoidance system with the victim detection algorithm for better coordination.
    - Conducted code refactoring to streamline the logic and improve processing speed during high-load tasks.
- **Testing:**
    - Performed full-system tests in a real-world environment with complex obstacles and varying light conditions.
    - Focused on validating the robot's ability to quickly adapt to different terrains and obstacles.

Issues and Solutions:

Issues	Solutions
Hardware: None	All systems checked and functioning properly.
Software: Minor inconsistencies in sensor fusion.	Adjusted sensor fusion parameters to improve consistency.

New Ideas | Thoughts:

- Need to finalize the competition-day checklist and ensure all systems are ready for deployment.

September 25, 2024
Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:

- **Hardware Development:**
    - Inspected all sensors for any signs of wear or damage after extended use.
    - Conducted final checks on the power supply to ensure no fluctuations or issues.
- **Software Development:**
    - Implemented minor tweaks to the decision-making process to ensure faster responses during obstacle avoidance.
    - Conducted tests on multi-sensor coordination to ensure accurate data interpretation.
- **Testing:**
    - Ran full-system tests under a variety of simulated scenarios, including complex obstacle courses and victim retrieval tasks.
    - Verified that the robot's battery life can last through the entire competition setup.

Issues and Solutions:

Issues	Solutions
Hardware: None	All hardware systems were stable and well-maintained.
Software: Slight delays during obstacle navigation.	Optimized algorithm logic to ensure quicker responses.

New Ideas | Thoughts:

- Preparing for the final round of tests before competition to ensure no last-minute surprises.

September 26, 2024
Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:

- **Hardware Development:**
    - Performed a full inspection of all hardware components, including motors, sensors, and battery system.
    - Tested the stability of the robot’s structure to ensure robustness during rough operations.
- **Software Development:**
    - Final review of the software, ensuring that all code is optimized and ready for deployment.
    - Focused on improving the synchronization of sensor data, ensuring smooth communication between components.
- **Testing:**
    - Conducted final endurance tests to verify the robot’s performance over extended operation periods.
    - Focused on obstacle avoidance and victim detection under various lighting and environmental conditions.

Issues and Solutions:

Issues	**Solutions**
Hardware: None	Hardware was thoroughly inspected and ready.
Software: None	Final software checks confirmed readiness.

New Ideas | Thoughts:

- Double-checking the robot's setup before the competition to ensure everything is operational and secure.

September 27, 2024
Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:

- **Hardware Development:**
    - Conducted final testing of motors, sensors, and power systems.
    - Verified that all hardware systems were functioning properly after prolonged use.
- **Software Development:**
    - Ran the final integration tests to ensure that all software systems were communicating effectively.
    - Ensured that the decision-making algorithms were fully responsive to real-time changes in the environment.
- **Testing:**
    - Ran final full-system tests under competition-like conditions, focusing on obstacle detection, victim retrieval, and battery efficiency.
    - Finalized system calibration to ensure accuracy during critical operations.

Issues and Solutions:

Issues	**Solutions**
Hardware: None	All systems were confirmed to be functioning well.
Software: None	All software modules passed final tests.

New Ideas | Thoughts:

- Ready for competition preparations. Reviewing all data and final adjustments before the event.

September 28, 2024
Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:

- **Hardware Development:**
    - Conducted final stress tests to ensure the robot could handle competition-like stress without overheating or malfunctioning.

- Inspected all components for secure attachment and calibration.

- **Software Development:**
  - Conducted a final run-through of the entire system, ensuring smooth synchronization and operation.
  - Checked all decision-making algorithms for last-minute improvements.

- **Testing:**
  - Conducted a final test of the entire robot, simulating competition conditions to ensure the system works as expected under pressure.
  - Evaluated the robot's performance in obstacle detection, victim retrieval, and real-time decision-making.

Issues and Solutions:

Issues	**Solutions**
Hardware: None	Final checks confirmed all systems were in top condition.
Software: None	The software is ready for deployment and performing optimally.

New Ideas | Thoughts:

- Preparing for final competition setup, ensuring everything is packed and ready for transport to the competition venue.

September 30, 2024
Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:

- **Hardware Development:**
  - Performed final inspection of all components, ensuring there are no loose parts or cables.
  - Double-checked motor mounts and sensors for any signs of wear or damage.

- **Software Development:**
  - Conducted the final review of all algorithms, making sure they are optimized and robust for competition scenarios.
  - Finalized integration tests to ensure smooth communication between different software modules.

- **Testing:**

- Ran the last round of simulated obstacle courses to ensure obstacle avoidance algorithms are fine-tuned.
- Conducted battery life tests under maximum load to confirm sufficient operational time.

Issues and Solutions:

Issues	Solutions
Hardware: None	Final inspection confirmed all hardware systems were in perfect condition.
Software: None	Software modules are optimized and integrated successfully.

New Ideas | Thoughts:

- Preparing for transport to the competition venue. Double-checking everything to ensure smooth setup during the event.

October 1, 2024
Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:

- **Hardware Development:**
  - Rechecked all mechanical components, ensuring that nothing is loose or improperly aligned.
  - Ensured the power system and wiring are secure and capable of handling extended competition hours.
- **Software Development:**
  - Final testing of decision-making algorithms with live sensor input to simulate competition environments.
  - Optimized sensor fusion algorithms to prevent any data loss during high-load tasks.
- **Testing:**
  - Ran stress tests focusing on battery life, motor efficiency, and sensor responsiveness.
  - Tested obstacle avoidance system in crowded, dynamic environments to ensure it reacts properly to unpredictable conditions.

Issues and Solutions:

Issues	Solutions
Hardware: Slight risk of cable interference in tight spaces.	Re-routed cables and added protective covers for secure connections.
Software: None	All software systems were performing optimally after final testing.

New Ideas | Thoughts:

- Conducting a final review of the competition rules and strategies to ensure the robot is prepared for any scenario.

October 2, 2024
Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur

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Tasks Done Today:

- **Hardware Development:**
    - Double-checked the cooling system and motor performance to ensure there are no overheating risks during extended operation.
    - Conducted a brief test on all sensors to confirm they are functioning at peak performance.
- **Software Development:**
    - Reviewed the codebase to ensure all algorithms are functioning seamlessly under pressure.
    - Ran final tests of the victim detection algorithm to ensure accuracy even in low-light or high-obstacle environments.
- **Testing:**
    - Performed the last round of environment-specific tests to simulate real-world obstacles and variable conditions.
    - Ran full system checks to verify synchronization of sensor data and motor control.

Issues and Solutions:

Issues	Solutions
Hardware: None	Hardware was confirmed to be fully operational after final checks.

Issues	Solutions
Software: Minor adjustment needed in victim detection logic.	Tweaked detection parameters for better recognition under varying conditions.

New Ideas | Thoughts:

- Reviewing competition strategies and mapping out the potential competition layout in detail to anticipate environmental challenges.

October 3, 2024
Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur Tasks Done Today:
• **Hardware Development:**
o Final inspection of all components and packed the robot for transport to the competition venue.
o Secured all loose components and ensured that the robot's structure is intact and ready for transport.
• **Software Development:**
o Conducted a final simulation with real-time sensor data to ensure that the software is responsive under various environmental conditions.
o Finalized algorithm deployment and loaded all software onto the robot for the competition.
• **Testing:**
o Ran a final all-systems check to ensure readiness for the competition.
o Verified that the robot is fully operational under simulated competition conditions. Issues and Solutions:
Issues | **Solutions**
Hardware: |
None | Final checks confirmed that the hardware was in perfect condition for transport.
Software: |
None | Software was successfully deployed, and the system was tested and confirmed to be operational.
New Ideas | Thoughts:
• Final review of transport logistics and competition setup. Ready for the competition! October 4, 2024
Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur Tasks Done Today:
• **Hardware Development:**
o Arrived at the competition venue and performed a thorough inspection of all components, ensuring no parts were damaged during transport.
o Rechecked the mounting of motors, sensors, and the cooling system to ensure everything was properly secured.
• **Software Development:**
o Installed the robot's software onto the competition environment's control systems,

ensuring compatibility with the local infrastructure.
o Ran quick diagnostics to confirm that all sensor inputs and outputs were correctly connected to the software.
• **Testing:**
o Conducted initial setup tests to calibrate the robot to the competition environment.
o Ran environmental tests to verify that obstacle detection and victim recognition algorithms were accurate under competition conditions. Issues and Solutions:
Issues | **Solutions**
Hardware: |
Minor misalignment of a motor after transport. | Re-adjusted the motor mounts to ensure precise alignment.
Software: |
Initial data sync delay. | Re-calibrated the data transfer protocol for faster communication.
New Ideas | Thoughts:
• Reviewing the competition layout and considering any additional adjustments based on local conditions. October 5, 2024
Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur Tasks Done Today:
• **Hardware Development:**
o Tested the robot's movement on the competition floor, ensuring that motors and sensors perform well in a real-world environment.
o Checked the stability of the robot's structure and its ability to navigate through narrow or challenging terrain.
• **Software Development:**
o Fine-tuned the navigation system to adjust for specific obstacles in the competition environment.
o Conducted testing on Green Detection and victim identification, focusing on optimizing performance in low-light and variable lighting conditions.
• **Testing:**
o Ran multiple test scenarios to simulate competition tasks, evaluating obstacle detection, victim retrieval, and environmental adaptability.
o Checked the performance of the robot's cooling system under extended stress. Issues and Solutions:
Issues | **Solutions**
Hardware: |

R

obot struggled in some tight spaces. | Adjusted wheel traction and fine-tuned the steering algorithm.
Software: |

G

reen Detection struggled with high ambient light. | Adjusted the algorithm to dynamically respond to lighting changes.

N

ew Ideas | Thoughts:
• Considering adjusting sensor angles for more coverage in tight areas. Reviewing

performance metrics for areas that need improvement. October 6, 2024
Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur Tasks Done Today:
• **Hardware Development:**
o Conducted additional stress tests to ensure no overheating or component failure under heavy load.
o Re-verified sensor alignment and made minor adjustments to ensure optimal field of view and accuracy.
• **Software Development:**
o Optimized the obstacle avoidance algorithm to handle fast-moving obstacles more effectively.
o Updated the victim identification software to better differentiate between real victims and environmental noise.
• **Testing:**
o Ran obstacle avoidance tests in simulated competition conditions, introducing dynamic obstacles to challenge the system.
o Ran final power checks to ensure battery life can last throughout the competition's duration. Issues and Solutions:
Issues | **Solutions**
Hardware: |

N

one | All hardware components were functioning as expected.
Software: |

M

inor delays in victim detection. | Streamlined the algorithm for quicker detection and response times.

N

ew Ideas | Thoughts:
• Considering introducing a backup sensor system for redundancy, especially for critical sensors like cameras and thermal sensors. October 7, 2024
Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur Tasks Done Today:
• **Hardware Development:**
o Made last-minute adjustments to wiring and secured any exposed cables that could be vulnerable during high-speed maneuvers.
o Rechecked all structural components to ensure nothing had loosened during previous day’s tests.
• **Software Development:**
o Final review of the robot's software with a focus on performance during complex decision-making tasks.
o Performed a final test of the victim retrieval algorithm, ensuring that the robot can respond quickly and accurately.
• **Testing:**
o Conducted final dry runs of all competition tasks, testing everything from obstacle avoidance to victim retrieval.
o Ran final calibration of the Green Detection algorithm under a variety of lighting conditions. Issues and Solutions:

Issues | **Solutions**
Hardware: |

N

one | All components were confirmed to be in excellent condition.
Software: |

N

one | The software was confirmed to be fully operational.

N

ew Ideas | Thoughts:
• Going over competition strategies with the team and mentally preparing for the first round of tasks. October 8, 2024
Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur Tasks Done Today:
• **Hardware Development:**
o Checked all hardware once more before the competition began.
o Ensured that the cooling system was functioning properly, as previous tests had shown optimal temperature regulation.
• **Software Development:**
o Loaded the final version of the software onto the robot's main control system.
o Conducted a quick final test of all algorithms, ensuring seamless integration and fast response times.
• **Testing:**
o Performed a final run through all competition tasks to ensure the robot performs under competitive conditions.
o Confirmed that the robot's real-time decision-making is efficient and consistent during complex tasks. Issues and Solutions:
Issues | **Solutions**
Hardware:

None | Hardware was confirmed to be fully ready for competition.
Software:

None | The software was functioning optimally with no further issues.

New Ideas | Thoughts:
• Reviewing the competition environment one last time and strategizing on how to handle each task efficiently. October 9, 2024
Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur Tasks Done Today:
• **Hardware Development:**
o Ensured that all components are packed securely for competition day.
o Rechecked cooling system one last time to ensure it's functioning under long durations.
• **Software Development:**
o Ran a few final test simulations with a range of inputs to ensure software can handle unexpected conditions.
o Final software check to ensure all algorithms are ready for specific competition

conditions.
• **Testing:**
o Conducted a final series of runs in competition environment, ensuring that robot can perform under diverse conditions.
o Verified battery life is sufficient for entire competition day. Issues and Solutions:
Issues | **Solutions**
Hardware:
None | Hardware was in top condition and ready for deployment.
Software:
None | Software systems were finalized and running smoothly.
New Ideas | Thoughts:
• Strategizing on possible real-time adjustments during competition; preparing for any last-minute changes. October 10, 2024
Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur Tasks Done Today:
• **Hardware Development:**
o Final packing and preparation for transport to competition site.
o Ensured all tools, spare parts, and backup components are ready for setup at venue.
• **Software Development:**
o Checked that software was fully integrated and loaded onto competition system.
o Verified that all algorithms are operational and synchronized with hardware.
• **Testing:**
o Ran final checks to confirm that all system integrations are functioning smoothly and ready for competition. Issues and Solutions:
Issues | **Solutions**
Hardware:
None | Everything was confirmed packed securely and ready for transport.
Software:
None | All software modules were confirmed ready for deployment.
New Ideas | Thoughts:
• Ready for competition! Final strategies are in place, team is prepared for challenges ahead. October 11, 2024
Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur Tasks Done Today:
• **Hardware Development:**
o Arrived at competition venue; performed final check of robot's physical components.
o Confirmed motor mounts, sensors, cooling system were securely in place for competitive environment.
• **Software Development:**
o Uploaded latest software version; ensured it was up-to-date with last-minute changes made during preparations.
o Ran quick diagnostics; confirmed software synced with hardware components.
• **Testing:**
o Conducted final tests in competition area; simulating tasks (obstacle avoidance, victim detection) under expected conditions.

o Evaluated robot movement in various terrain types; adjusted motor control settings for better navigation. Issues and Solutions:

Issues | **Solutions**

Hardware:

Minor misalignment of one sensor due to transport.| Recalibrated sensor position for accurate detection.

Software:

None | Software functioning correctly after update.

New Ideas | Thoughts:

• Considering adding real-time monitoring tools to track performance throughout competition. October 12, 2024Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur Tasks Done Today:

• **Hardware Development:**

o Inspected robot after first run; checked wear on parts.

o Tested cooling system during intense operation; ensured no overheating issues under load.

• **Software Development:**

o Observed performance in real-time; made minor adjustments to Green Detection algorithm for better accuracy in variable lighting.

o Optimized decision-making algorithm based on real-world inputs from sensors/cameras.

• **Testing:**

o Ran several test scenarios focused on rapid response; dynamic victim retrieval.

o Monitored battery closely; confirmed continuous operation without significant power loss. Issues and Solutions:

Issues | **Solutions**

Hardware:

No significant issues.| Routine inspection showed everything working fine.

Software:

Occasional lag in processing victim data.| Adjusted processing time; prioritized high-importance tasks.

New Ideas | Thoughts:

• Exploring AI-based improvements; enhance environmental awareness/decision-making speed during competitions. October 13, 2024

Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur Tasks Done Today:

• **Hardware Development:**

o Checked components post-competition; signs of wear/damage inspected.

o Ensured wiring secure/organized; avoid tangling during fast movements.

• **Software Development:**

o Conducted diagnostic; confirmed algorithms performing optimally during tasks.

o Fine-tuned obstacle detection algorithm based on feedback from first day’s competitions.

• **Testing:**

o Ran obstacle detection tests in arena; verified responses to dynamic obstacles.

o Recalibrated Green Detection system; precise recognition in low-light environments. Issues and Solutions:

Issues | Solutions
Hardware:
Slight issue with sensor stability due to temperature fluctuations.| Adjusted cooling/recalibrated for stable performance.
Software:
Green Detection struggled in rapidly changing light conditions.| Refined algorithm dynamically adjust light intensity.
New Ideas | Thoughts:
• Considering backup sensors critical components like cameras; ensure reliable performance under pressure. October 14, 2024
Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur Tasks Done Today:
• **Hardware Development:**
o Inspected motor mounts/wheels; wear after high-intensity maneuvers checked.
o Checked weight distribution; center of gravity optimal for stability during competitions.
• **Software Development:**
o Focused refining decision-making process victim identification/retrieval tasks optimized path-planning algorithm faster navigation through space.
• Testing:*
Conducted full system testing; including obstacle avoidance/victim retrieval tasks realistic conditions tested battery life maximum load sustaining operations entire event.*

Issues Solutions:*
Issues*|*Solutions*
Hardware:*
-None*|*All hardware components good condition.*
Software:*
-None*|*Performing well during scenario tests.*

New Ideas Thoughts:*
• Preparing strategies improving task performance based live feedback adjusting algorithms next rounds.* October 15, 2024
Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur Tasks Done Today:*
• *Hardware Development:*
-Rechecked cooling system reinforced wiring no risk power interruption critical moments.*
-Double checked safety systems including motor power cutoffs emergency shutoff protocols.*
• *Software Development:*
-Ran final checks decision-making algorithm ensuring quick responsive environmental changes.*
-Reviewed logs identify areas improve performance.*
• *Testing:*
-Ran full system tests verifying ability navigate obstacles detect victims complete

tasks accuracy speed.*
-Focused ensuring stability long-duration tasks.*

Issues Solutions:*
Issues*|*Solutions*
Hardware:*
-None*|*All components working optimally.*
Software:*
-Minor lag processing multiple tasks once.|Adjusted prioritization streamlined code reduce lag.*

New Ideas Thoughts:*
• Preparing contingency plans unexpected failures reviewing strategies final rounds.* October 16, 2024
Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur Tasks Done Today:*
• *Hardware Development:*
-Conducted final physical checks before final day competitions.*
-Made adjustments sensors improve reliability adverse conditions.*
• *Software Development:*
-Reviewed entire stack potential issues arise high-intensity tasks.*
-Implemented additional checks ensure handle multiple simultaneous without failing.*
• *Testing:*
-Ran series quick drills simulate difficult tasks under conditions.*
-Double checked system’s response environmental changes obstacle detection.*

Issues Solutions:*
Issues*|*Solutions*
Hardware:*
-None*|*Excellent condition.*
Software:*
-None*|*Fully operational optimized competitions.*

New Ideas Thoughts:*
• Reviewing rules one last time full alignment tasks preparing final stages.* October 17, 2024
Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur Tasks Done Today:*
• *Hardware Development:*
-Ensured packed securely transport backup organized.*
-Conducted last round tests confirm everything functioning expected.*
• *Software Development:*
-Finalized last-minute tweaks based recent reviews.*
-Confirmed algorithms integrated ready competitions.*
• *Testing:*
-Conducted final set tests simulate scenarios ensure perform well pressure.*

Issues Solutions:*
Issues*|*Solutions*
Hardware:*
-None*|*Optimal working condition.*
Software:*
-None*|*Fully operational ready.*

New Ideas Thoughts:*
• Systems set final phase confidence remaining rounds! October 18, 2024
Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur Tasks Done Today:*
• *Hardware Development:*
-Rechecked motor components after heavy use rounds competitions.*
-Verified sensor positioning accuracy especially thermal proximity used avoidance.*
-Double checked wiring connections prevent loss interruptions.*
• *Software Development:*
-Focused fine-tuning decision-making real-time identification retrieval.*
-Ran diagnostics ensure conflicts affecting performance.*
-Tested ability handle changes areas fluctuating lighting conditions.*
• *Testing:*
-Conduct comprehensive check functionalities such as avoidance detection retrieval.*
-Ran power consumption monitor usage optimize energy efficiency.*

Issues Solutions:*
Issues*|*Solutions*
Hardware:*
-Slight misalignment one sensor adjustment.|Recalibrated ensured properly aligned.*
Software*:
Delay processing switching tasks.|Optimized task switching code improve responsiveness.*

New Ideas Thoughts*:
Considering use monitoring tools next rounds track performance effectively.* October 19, 2024
Name: Kashvi Khajanchi, Navya Singla, Swayambhav Siddharth Madhur Tasks Done Today*:
• *Hardware Development*:
Checked cooling system proper dissipation continuous operation.*
Inspected wheels motor mounts potential wear tear first rounds.*
• Software Development*:
Conducted tests algorithms particularly dynamic conditions.*
Fine-tuned Green Detection accuracy fluctuating environments.*
• Testing*:
Ran series tests simulated conditions ensure consistent stress.*

Verified battery life stability continuous operations.*

Issues Solutions*:

Issues*:

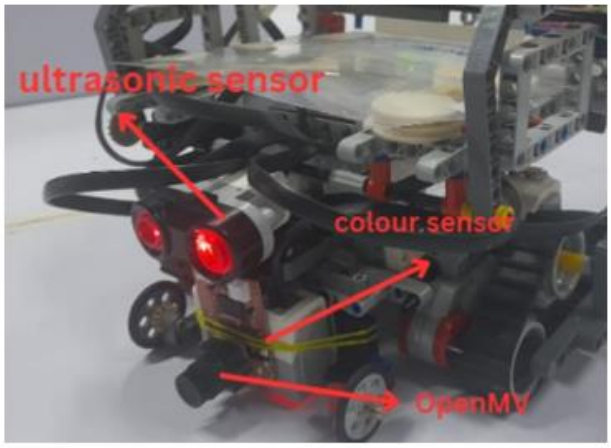
No issues hardware components.|Routine checks confirmed functioning optimally.*

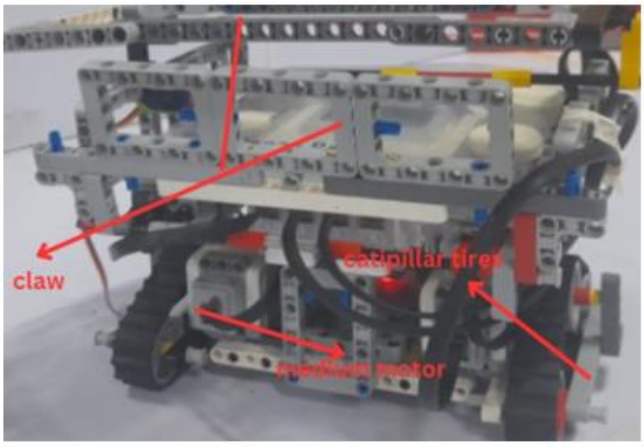
Software*:

None |Operating correctly during tests.*

New Ideas Thoughts*:

Considering modular approach future competitions allow easier replacement key





PERFORMANCE EVALUATION AND CONCLUSION

In reference to the goals and expectations we had set for ourselves, we can say that we have really come a long way. During the course, we have significantly improved the performance of our robot in context to line following, obstacles and rescue mission. Throughout the journey we have, extensively tested the hardware and software aspects of our robot. We have done multiple practice runs by allowing the robot to manoeuvre its way around the map. By recording each one of our runs we were able to monitor what our robot is doing as opposed to what it should be doing. This also helped us to make numerous changes to our program to improve its efficacy. We also stored essential frames on the SD card such as the entrance of the evacuation zone, victim detection, aligning to the centre of the triangle etc. to allow us to post- evaluate its performance and implement changes that showed improvement in that respective field. Real time performance evaluation was indeed a challenging task for which we tested each component separately before installing it to the final design of the robot. Reliability and efficacy of the robot was tested and evaluated by setting up random obstacles like Lego pieces, stones, speed breakers etc.

Lastly, it is important to note that with strategic planning and set timelines which were closely met, we were able to improve the robot design and its working as per guidelines set by RCAP. We look forward to showcasing our Robot in actual arena and get to interact with our competing team members to understand their ideology and engineering used by them for their robots.

6) ACKNOWLEDGEMENTS

We extend our sincere gratitude to RoboCup team for organising such an event and giving us the amazing opportunity to participate and interact with best of the brains. A special thanks to our mentor, Mr. Amanurrehman, for his unwavering

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7) APPENDIX

REFERENCES

Hardware-

- EV3
- OpenMV
- Servo motor

Software-

- Python
- OpenMV IDE
- EV3 LAB
- Github

If you have suggestions, comments, or questions about our development you can also write us an email at: **codex.robots@gmail.com**