RCJ 2024 Eindhoven Rescue Line

RL25 TEAM U.S.A.

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RCJ USA 2024 #1
RCJ USA 2023 #1
RCJ Asia Pacific 2023 #3

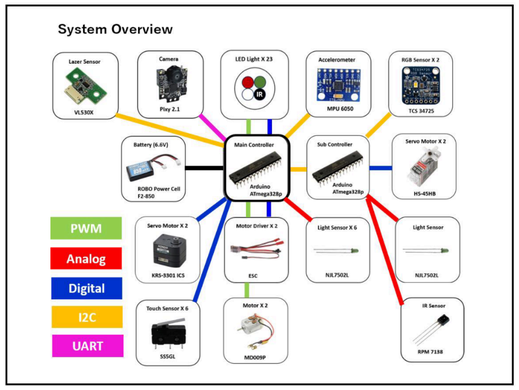
2024 2023 2023

Bard College at Simon's Rock Robotics Club

Kyle Lockwood
Hardware/Strategist/Researcher
Conduct research and develop design ideas & make over all strategies.

Kent Nakai
Software/Hardware/Electronics
Make overall decisions from the hardware designs to the programming.

- **Arduino ATmega328p X2** — To control robot
- **ROBO Power Cell F2-850 Type (Li-fe)** — To provide a stable power supply
- **Motor MD0009P X2** — To move the wheels
- **Servo Motor KRS-3301 ICS X2** — To lift robot arm
- **Servo Motor HS-45-HB X2** — To grab victims
- **RGB Sensor X2 TCS 34725** — Identify colors (Red& Green)
- **Accelerometer MPU 6050** — Detect slopes and for turns
- **Lazer Sensor VL530X** — Detects distance to walls and obstacles
- **Pixy 2.1 Camera** — Detect victims
- **Touch Sensor X6 SS5GL** — Recognize walls and obstacles
- **LED light X 23** — To see various sensors
- **Light Sensor NJL7502L X5** — Measure the amount of light reflecting
- **IR Sensor RPM 7138** — Identify existence of the ball
- **Motor Driver ESC X2** — Controlling motor output



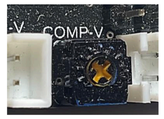
Electronic Innovative Solution

17 Levels of Volume

By adding volume to the circuit board, it is possible to run multiple programs. This makes it easier to adjust the robot's bending angle.

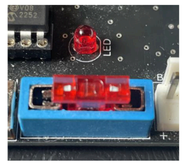
Interruptions

By incorporating an interrupt function into the circuit instead of programming, it is possible to force a reset when a certain condition is met.



Protection Circuit

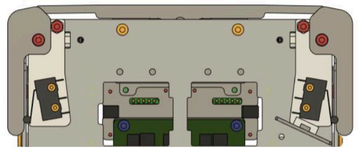
To protect the circuit board and safely use the Li-Fe battery, which is prone to damage if misused, we implemented a protection circuit. Protection circuits include a circuits that limit the voltage can pass and the circuits with LED that notifies us the timing to chage the battery.



Hardware Innovative Solution

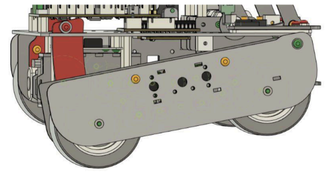
Obstacle and Wall Avoidance

By strategically using touch sensors, the robot can detect walls from any direction: front, left, or right



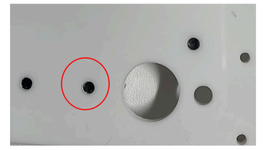
Suspension

The suspension system ensures that all four wheels remain in contact with the ground, providing stable power output.



Nut Less Mechanism

The design does not use a nut by cutting a tap to avoid breakdowns and disassembly during competition and to reduce the number of parts



Switching LED lights

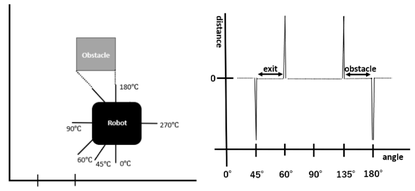
By using red LEDs, green and black can be recognized as the same color. Then, in order to distinguish between green and black, white and black can be distinguished by emitting white light

Detection System (IR Camera)

By using infrared light, it is possible to consistently distinguish between spherical and flat surfaces.

Exit Discovery

The robot rotates in the evacuation zone, collecting data using lasers to find the exit. A set of down and up spikes of the graph shows the exit or the entrance.



Line Trace

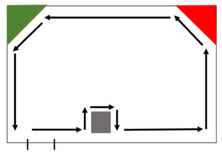
PD control is designed to enable the smoothest and most stable line tracing.

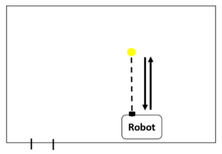
Line Trace for Slopes

The PD gain of the robot is programmed to change according to the angle from the horizontal axis of the robot, so that the line tracing can be adjusted to the slope.

Efficient Rescue Methods

Speed and accuracy are achieved through a combination of conventional evacuation zone patrolling and ball detection by camera.





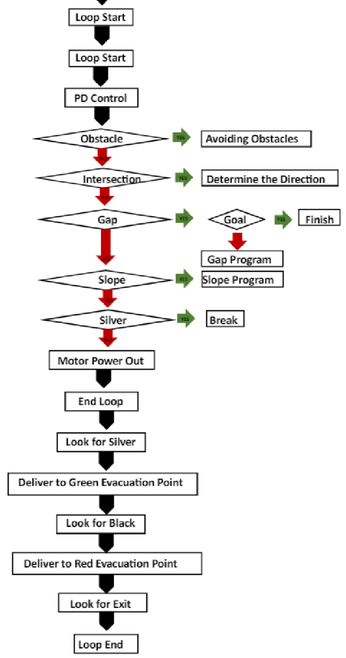
Possible Question from Audience

Why not include "I" for PD control?

Answer

I (integral component) can turn too much when approaching a gap and lose the line.

Main Program

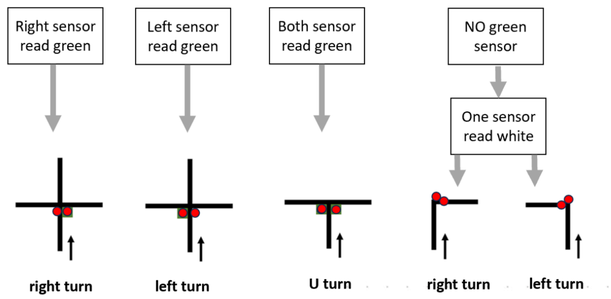


Software Innovative Solution

Intersection

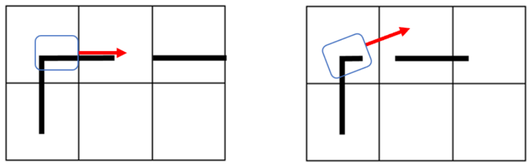
An intersection is detected when both edge light sensors see black (or green). Using RGB sensors, the robot can navigate through the intersection.

If both two light sensors judge the line to be black (green), the robot will check two RGB sensors.



Gap Correction

If the robot is not parallel to the line when it reaches a gap, the angle of the robot is corrected based on the value of the previous line trace.



GOAL **Create a robot that can achieve 100% accuracy with simple calibration in any situation, and demonstrate its ability with stable performance.By participating in Rescue Line and creating Rescue Robots, we hope to acquire skills and knowledge that can be applied to various robots in the future.**

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