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"AUTONOMOUS RESCUE VEHICLE"

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Abstract : The development of an Autonomous Rescue Vehicle represents a groundbreaking fusion of precision navigation and artificial intelligence technologies. This innovative vehicle is designed to revolutionize rescue operations by minimizing human risk through autonomous operation. Leveraging advanced GPS technology and machine learning algorithms for precise navigation and obstacle detection, the system not only enhances safety but also automates tasks, reduces operational costs, and streamlines the rescue process. The primary objective of this project is to significantly improve the efficiency and effectiveness of emergency response operations while safeguarding the well-being of human rescuers.

By autonomously navigating disaster-stricken areas, identifying hazards, and providing timely assistance, the vehicle aims to reduce response times, increase the likelihood of saving lives, and enhance the overall coordination of rescue efforts during natural disasters, accidents, or other emergency situations. Equipped with advanced sensors, robust communication systems, and intelligent decision-making algorithms, this autonomous rescue vehicle promises to be a vital asset in protecting communities and mitigating the impact of unforeseen crises. This technology not only represents a significant leap forward in rescue operations but also sets the stage for a future marked by innovation and efficiency in disaster response.

Index Terms - Nvidia jetson Nano, RP lidar, Arduino mega atmega2560, L298n motor driver module, dc motor 6812, Servo motor, Lithium-ion battery, 5MP Raspberry Pi Camera Module, RF (Radio Frequency) remote control, Connecting wires, BNC connector, Fiber sheet

I. INTRODUCTION

In the face of ever-increasing natural disasters, accidents, and emergency situations, the need for efficient and effective rescue operations has become paramount. In response to this challenge, the development of the autonomous rescue vehicle stands as a beacon of hope and innovation. By harnessing the power of precision navigation and artificial intelligence, this cutting-edge vehicle represents a paradigm shift in the field of emergency response.

At its core, the autonomous rescue vehicle integrates advanced GPS technology and sophisticated machine learning algorithms to ensure precise navigation while detecting obstacles in real-time. This technological marvel not only enhances safety for both rescuers and victims but also transforms the traditional landscape of rescue missions. By minimising human risk through its autonomous operation, the vehicle streamlines the entire rescue process, automating tasks, reducing operational costs, and bolstering the efficiency of emergency response efforts.

The primary objective driving the creation of this vehicle is to revolutionise the way we approach emergency response operations. By autonomously navigating through disaster-stricken areas, identifying hazards, and providing timely assistance, the vehicle significantly reduces response times, thereby increasing the chances of saving lives. Moreover, the integration of advanced sensors, robust communication systems, and intelligent decision-making algorithms equips the autonomous rescue vehicle to serve as a crucial asset in safeguarding communities and mitigating the impact of unforeseen crises.

II. PROPOSED SYSTEM

1. Block diagram

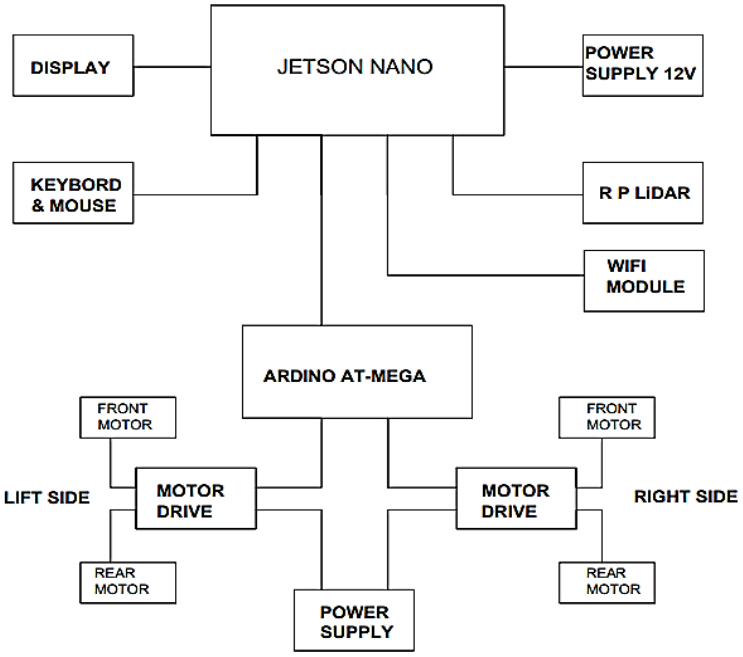

Figure 2.1: block diagram

The autonomous rescue vehicle combines advanced hardware components like Lidar, Nvidia Jetson Nano, and Arduino for autonomous operation. It uses AI to navigate disaster areas, identify hazards, and assist in rescue efforts, reducing human risk and improving response times. It can operate autonomously or be manually controlled when necessary, making it a valuable asset in emergency situations.

2. The chassis:

To create the chassis, first create a rectangular block of dimensions (110*56*62 cm). Then sketch two offset rectangles on the two adjacent faces of the Use the "Rectangle" command to draw a rectangular block with the dimensions 110 cm in length, 56 cm in width, and 62 cm in height. Specify the first corner point and then input the dimensions to create the rectangle.

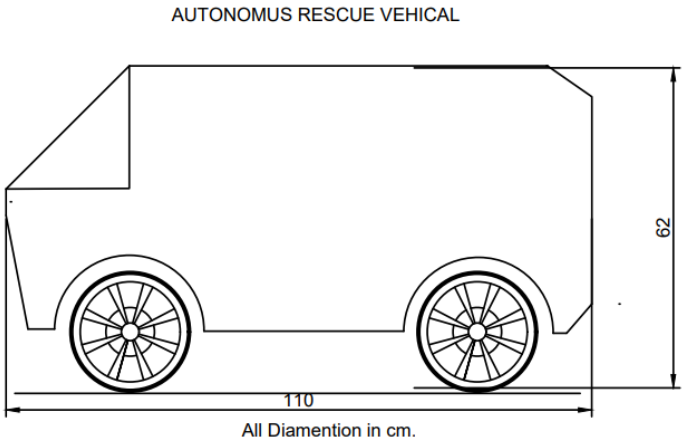

Figure 2.2: Chassis with dimensions

Extrude two flat rods from the bottom rectangular frame which divide the frame into 3 equal parts as shown in the figure. This is done to give a support to the base

III. HARDWARE DETAIL

1. Nvidia jetson Nano

Figure 3.1: Nvida jetson Nano

The Jetson Nano, with its quad-core ARM Cortex-A57 processor and 128-core Maxwell GPU, serves as the central processing unit in the autonomous rescue vehicle project. It powers real-time decision-making, object recognition, and obstacle detection crucial for safe navigation through disaster areas. Its energy-efficient design ensures prolonged operation while handling sensor data fusion and communication tasks effectively. Integrated with sensors like cameras and lidar, the Jetson Nano enables precise mapping, hazard identification, and localization. Its AI capabilities empower the vehicle to autonomously navigate and respond to emergency situations, making it a pivotal component in revolutionizing rescue operations with innovation and efficiency.

2. RP Lidar

Figure 3.2: RP Lidar

The RP Lidar sensor is essential for obstacle identification and environmental awareness in the autonomous rescue vehicle project. With the aid of laser scanning technology, the RP Lidar generates 360-degree, three-dimensional maps of the area around the vehicle, making it possible to estimate distances accurately and identify impediments instantly. With these capabilities, the vehicle can drive through disaster regions safely and on its own, which improves its effectiveness and efficiency during rescue missions. The RP Lidar sensor, taken as a whole, helps the car recognize dangers and find its way across difficult terrain, which helps it react to emergencies quickly and effectively.

3. Arduino Mega ATmega2560

Figure 3.3 :Arduino Mega ATmega2560

In the autonomous rescue vehicle project, the Arduino Mega serves as the control center for motor operations, sensor integration, data processing, and communication. It coordinates the movement of DC motors via motor driver modules, integrates sensors like the RP Lidar for environmental perception, and facilitates data exchange with the Jetson Nano and other peripherals. Handling lower-level processing tasks ensures seamless operation, system monitoring, and responsiveness to external commands. As a central hub, the Arduino Mega plays a pivotal role in orchestrating the vehicle's functions, contributing to its autonomy, efficiency, and effectiveness in navigating disaster areas and executing rescue operations.

4. Motor Driver Module

Figure 3.4: motor driver module

The L298N motor driver module is employed in the autonomous rescue vehicle project to control the movement of DC motors used for locomotion or other mechanical functions. It features a dual H-bridge design, enabling independent control of two motors. The module precisely regulates speed and direction using pulse-width modulation (PWM) signals from the Arduino Mega or similar microcontrollers. By interfacing with the Arduino Mega, the L298N facilitates seamless motor control, allowing the vehicle to navigate through disaster areas, avoid obstacles, and execute precise manoeuvres. Overall, the L298N motor driver module ensures efficient and responsive motor operation, critical for the vehicle's autonomy and functionality.

5. Dc Gear Motor

Figure 3.5: DC Gear Motor

The 12V DC gear motor is a fundamental component in the autonomous rescue vehicle, providing controlled and slow-speed rotation with increased torque. Integrated into the vehicle's propulsion system, these motors enable precise movement and navigation through disaster-stricken areas. Their gearboxes reduce motor speed while enhancing torque, which is essential for manoeuvring in challenging terrain. This motor type is instrumental in achieving the vehicle's responsiveness, allowing it to navigate obstacles, execute precise movements, and contribute to the overall efficiency and effectiveness of the autonomous rescue vehicle during emergency response operations.

6. Servo Motor

Figure 3.6 : servo motor

In the autonomous rescue vehicle project, the servo motor plays an essential role in controlling mechanical components requiring precise angular positioning. Its rotary actuator enables controlled movement within a specific range, crucial for functions like steering mechanisms, camera orientation, or robotic arm operations. With feedback mechanisms ensuring accurate positioning, servo motors enhance the vehicle's agility, responsiveness, and versatility in navigating challenging terrain, avoiding obstacles, and executing rescue tasks. By providing precise motion control, the servo motor contributes significantly to the vehicle's ability to adapt to dynamic environments, ultimately improving its effectiveness in emergency response operations.

7. Lithium-Ion Battery

Figure 3.7: Lithium ion battery

In the autonomous rescue vehicle project, the lithium-ion battery serves as the primary power source, providing reliable and portable energy to drive the vehicle's operations. With a capacity of 12 volts and 12 ampere-hours, it delivers sustained power for extended periods, essential for prolonged rescue missions. Its high energy density and lightweight design make it ideal for powering various components, including motors, sensors, and communication systems. The lithium-ion battery enables the vehicle to operate autonomously, navigate disaster areas, and execute rescue tasks efficiently, ensuring uninterrupted performance and contributing to the vehicle's overall reliability and effectiveness in emergency response scenarios.

8. Raspberry Pi Camera Module

Figure 3.8: Raspberry Pi Camera Module

The Raspberry Pi Camera Module is utilized in the autonomous rescue vehicle project for visual perception and situational awareness. It captures high-definition images and video, enabling the vehicle to analyze its surroundings, detect obstacles, and assist in navigation. Integrated with the Raspberry Pi single-board computer, the camera module provides real-time visual data crucial for making informed decisions during rescue missions. Its compact design and compatibility with Raspberry Pi systems make it an ideal choice for applications requiring imaging capabilities, including robotics, surveillance, and remote monitoring. Overall, the Raspberry Pi Camera Module enhances the vehicle's perception abilities, contributing to its autonomy and effectiveness in rescue operations.

IV. CONCLUSION

The autonomous rescue vehicle is an innovative combination of humanitarian relief and state-of-the-art technology. It is a shining example of innovation in disaster response thanks to its integration of cutting-edge GPS, machine learning, and a variety of sensors, including LiDAR and environmental sensors. This intelligent vehicle maximizes efficiency in manoeuvring through hazardous and dynamic areas while simultaneously guaranteeing the safety of responders. Furthermore, its smooth communication with emergency services and rescue teams provides a level of coordination and situational awareness that is essential for efficient response operations. It enables well-informed decision-making and maximizes resource allocation during emergencies by transmitting vital information in real-time, such as survivor positions and infrastructure status. This vehicle represents a major advancement in using technology to save lives and improve disaster response efforts.

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