HARDWARE AND SOFTWARE COMPONENTS

1. Hardware components

Component	Type
Control Platform	Nvidia Jetson Nano
Lidar	RP LiDAR
Motor Driver	L298N
Camera	Raspberry Pi V2
Motor	DC Motor
Power Source	Power Bank

- NVIDIA Jetson Nano

  The Nvidia Jetson Nano 2GB module is a very useful utility device that could be employed to leverage the capabilities of spheres like Artificial Intelligence/Robotics. It's a compact robust and very feasible option for developers. This module aids a highly accelerated and efficacious Artificial Intelligence platform, built on NVIDIA's technology stack. This developer kit provides a hands-on approach to the users, by letting them assess their work and collaborate by continual modifications in the real-time. This module consists of the 128-core NVIDIA Maxwell™ for the Graphic Processing Unit segment. The Central Processing Unit is equipped with the Quad-core ARM® A57 @ 1.43 GHz unit. It provides 2GB worth of memory for storage purposes. It also has provisions for wired Ethernet as well as wireless connectivity options for network connections. This way, the NVIDIA Jetson Nano 2GB Developer Kit makes available the exact groundbreaking features as its other counterpart AI products, but in a very economical and reasonable manner.

- RPLiDAR

  SLAMTEC's RPLiDAR A1M8 is a low-cost 360-degree two-dimensional laser scanning (LiDAR) module. Within approximately a 6-meter radius, the device can detect its surroundings with a 360 degrees range. This resulting 2D point cloud data can be utilized for tracing, localization and simulation of surrounding entities and environments. RPLiDAR A1M8 is extremely efficient in evaluating distance based data, measuring it at a frequency of more than 8000 times per second. This makes it the LiDAR device with one of the highest sampling rates in the current versions of feasible LiDAR devices. It has a scalable scanning rate, which can be adjusted from as low as 2Hz to 10Hz. It's plug and play feature makes it an ideal component candidate in the world of robotics and localization-based implementations. The device works smoothly, regardless of the environment being an indoor or outdoor setup.

- L298N Motor Driver

  On its integrated circuit, the L298N Motor Motor Driver module includes an L298 Motor Driver IC, a 78M05 Voltage-Regulator module, resistors, capacitors, a Power LED, and a 5V jumper as its constituent components. Only when the jumper is connected, the 78M05 Voltage-Regulator will be activated. The underlying circuit is powered by the voltage-regulator when the source of power is below or equal to 12V, and the 5V pin can be utilized as an output port to drive the microcontroller system. When the power source is higher than 12V, the jumper must be removed and an additional 5V supply should be provided through the 5V connector to drive the underlying circuit.The L298N is a dual H-Bridge motor driver that enables the simultaneous velocity and position control of two DC motors.

- Raspberry Pi V2 Camera

  Raspberry Pi V2 camera is a specially built add-on module for Raspberry Pi with an 8-megapixel Sony IMX219 image sensor and an auto-focus optical lens. It offers static photos up to 3280 x 2464 pixels and multimedia video options with resolutions as follows - 1080p30 / 720p60/640x480p90. It connects to the Pi module via one of the smaller ports on the module's top surface and employs the unique CSI interface functionality, which was designed primarily for connecting to camera systems. It is a very lightweight module, which weighs just over 3 grams, making it highly portable and easy to use.The current iteration of the Raspbian Operating System supports all of its software requirements.

- DC Gearbox Motor-‘TT Motor’

  A DC motor is an electric device that transforms electrical energy to mechanical energy by employing direct current sources. Magnetic fields created by the electrical activity are used in DC motors to propel the rotation of a rotor mounted inside the driveshaft. The resultant torque and velocity are determined by the input electric signal as well as the motor’s structure. Such TT gearbox Motors have a gear ratio of about 1:48, that includes cables of dimensions around 200 mm and 0.1” male breadboard connectors. It’s ideal for use with a breadboard or terminal modules. It weighs around 30.6 grams, making it very easy to use and integrate into a lightweight robotic system. These motors can be driven with 3VDC, ranging up till 6VDC, with the velocity of the motors increasing incrementally with the rise in the power.

2. Software:
   - OpenCV:

     The code basically uses pre-trained Haar Cascade implementations stored in the OpenCV library. The code uses the GStreamer pipeline to create an interface between the camera and the OS. Each image frame from the camera from the live stream is processed and checks for face detection. The code converts the color image to a grayscale image. Since, the color does not determine the facial features and by doing this it avoids computational overheads and enhances performance. The faces contain a list of coordinates for the rectangular regions where faces were found. We use these coordinates to draw the rectangles in our image.

   - Robert operating system(ROS):

     It is an open-source robotics middleware suite, as it is an collection of software framework for the development of them robot software. The ROS based process represents a graph architecture, the processing of the nodes that receive sensor data, control, planning, state of the robot and the actuator. The Hector SLAM is considered state if the art for particle filter-based mapping. This SLAM algorithm can be used without odometer as well as on platforms that exhibit roll or pitch motion of the sensor.

   - Rapidly-exploring random tree Algorithm:

     The rapidly exploring random tree (RRT) is an algorithm designed to search efficiently non convex, high dimensional space by randomly building a space filling tree. The tree

samples will be drawn randomly from the search space and expands towards large unsearched areas. RRT can also be considered as Monte Carlo method to search in the large voronoi regions of graph. The map of the environment is divided into an obstacle region and obstacle-free region that represents a map as shown above as obstacle region is represented in grey and obstacle-free region is represented in white. The start position of the robot is represented with red dot in the map. The goal region of bot in the environment is represented in green dot. The 'n' number of iterations will be performed by RRT until it reaches the goal. It search patterns are generated based upon extrapolations of these data in order to optimize the probability of containment (POC) and the probability of detection (POD), together they will have equal overall probability of success (POS). So, this serves as a practical application of probability distribution in order to provide the swiftest and most expedient method of rescue, saving both lives and resources.