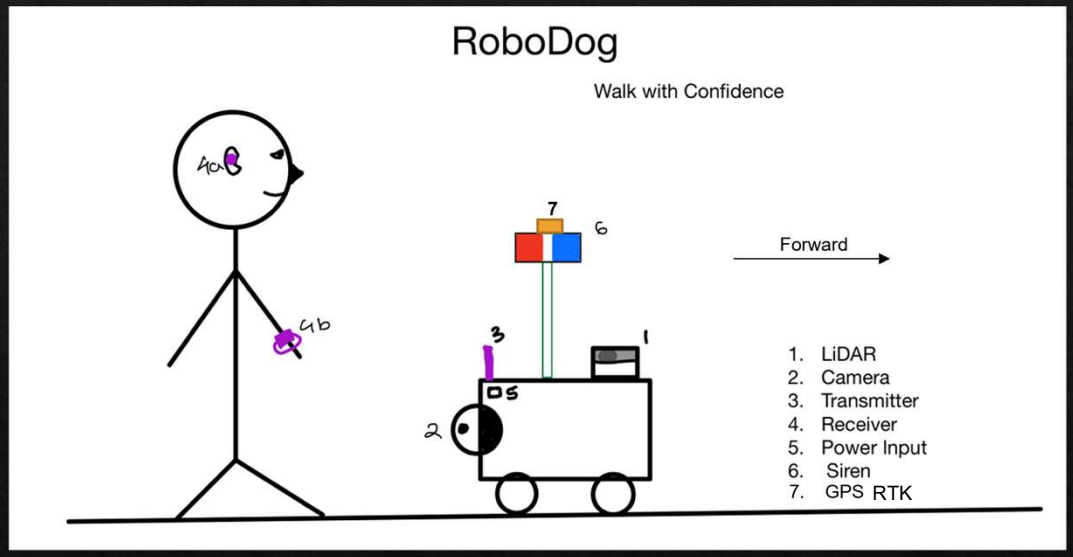
RoboDog for Blind People Navigation



Problem Statement:

Blind people often rely on white cane for navigating. But walking in complex traffic roads, sidewalks would be very difficult and dangerous.

Solution:

RoboDog which helps the blind people by autonomously mapping the surrounding environment, path planning and sending output voice commands to earpiece such “walk straight, left, right or stop” to the person using sensors GPS, LiDAR, Camera

Sensors:

- RTK GPS :

  Robo dog uses 2 RTK processing boards, 2 GNSS antennas, 2 Telemetry radios and outputs latitude and longitude. Input to GPS can be send by voice command to wristwatch which then send to raspberrypi via Bluetooth on robodog. Base GPS is with the person. Rover GPS on the robodog. This gives better positional accuracy than normal GPS.

- LiDAR:

  360 Laser Distance Sensor LDS-01 is a 2D laser scanner capable of sensing 360 degrees that collects a set of data around the robot to use for SLAM and Navigation

- Camera:

  The Raspberry Pi Camera Module v2 Camera Module has a Sony IMX219 8-megapixel sensor . The Camera Module can be used to take high-definition video, as well as stills photographs. Camera is should for tracking the blind person pose and movements. Camera also tracks obstacles from behind.

- IMU:

  The VN-100 is a miniature, high-performance Inertial Measurement Unit and Attitude Heading Reference. Combining 3-axis accelerometers, gyros, and magnetometers. It provides calibrated IMU data.

Navigation:

- The Navigation enables a robot to move from the current pose to the designated goal pose on the map by using the map, robot's encoder, IMU sensor.
- Since the robot must autonomously navigate it has map and localize in the environment at the same time which can be done using SLAM
- Global Path planning can be done using google maps by which starting and ending locations, and local navigation can be done using SLAM.
- SLAM ROS packages such as Gmapping , Cartographer can be used for mapping and localization in environment.
- Low level GPS waypoint navigation path planning can be done using Artificial Potential fields, A*, RRT algorithms.

Power:

Component	Voltage	Current	Power
GPS	5 V	0.45 A	2.25 W
LiDAR	5 V	0.4 A	2 W
Camera	3.3 V	0.45 A	1.5 W
IMU	5 V	0.04 A	0.2 W
Motors- (2)	25 V	1 A	25+25 W
Pi	5 V	1.1 A	5.5 W
Communication	2.5 V	0.5 A	1.25 W
Battery	25 V	1.1 A	~

Assuming the robodog to be operated for one hour, the energy required to generate by battery is 62.7Whr. Keeping the efficiency of 80 percentage. We can keep the energy requirement to 80 Whr. For battery operating at 25 V will have specification of 3200 mAh.

Computation and Software

- Robodog has Raspberrypi as main computer which has ubuntu 20 installed. The system uses ROS for SLAM, Path Planning and Motor Control
- SLAM – Gmapping / Cartographer
- Navigation – Artificial Potential Field
- Camera – Pose tracking of person