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VALE

Meet VALE

VALE is an indoor guide robot, designed to help ease day to day life for those with disabilities or cognitive issues that might result in brain fog or a loss of spatial awareness. Our robot acts as the bridge between giving those communities more independence and offering a modern solution. First and foremost VALE is a guide robot that can lead a user anywhere they want to go to on one level of a building with an easy room input system travel is a breeze.

1. Hardware

A basic functional block diagram for our system can be seen in Figure 1. At the center of our project is our microcontroller, the Beaglebone Blue. This system is set up on the MXET departments SCUTTLE robot that can be seen in Figure 2. This is an easy to use mobile robot platform that can be easily adapted to different scenarios.

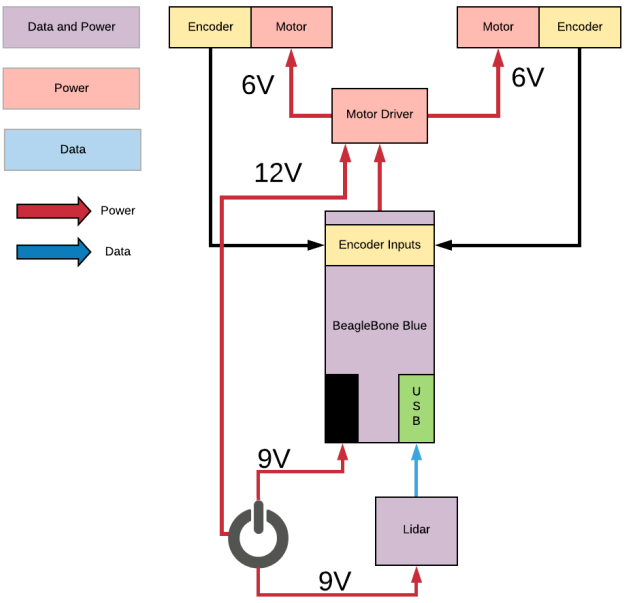

Figure 1. Functional Block Diagram

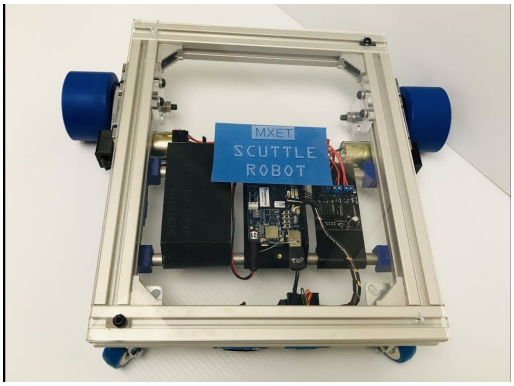

Figure 2. SCUTTLE Robot

2.Software

VALE works by scanning the environment and storing that data in the form of a 'map'. 'Destinations' are extracted from these maps and VALE travels to the destination.

To start off, the lidar scans the room and converts these points to local values and from there to global. Next using odometry, VALE's position is updated in the memory. The offset in position is used for future scans. 27 data points are used in each scan, but by taking a new scan every 67ms, a very detailed map can be created. Once the map is created, the points for a room are extracted and set as possible 'destinations'.

VALE then asks the user for a destination via the terminal. The user can then type in their destination. At this point, VALE will activate the motors and drive to the destination. When the recorded position of the robot is close to the destination points, the motors are deactivated and VALE stops.

3. Equations

$$x_{p2} = d * sin(\theta)$$
$$y_{p2} = d * cos(\theta)$$

Equations 1 - Finds Local

$$xp2' = cos(\theta') * xp2 - yp2sin(\theta') + x'$$
$$yp2' = sin(\theta') * xp2 + yp2sin(\theta') + y'$$

Equations 2 - Finds Global

$$Change\ on\ each\ wheel = .029 * (Degree_{T2} - Degree_{T1})$$
$$Distance\ traveled\ on\ each\ wheel = 2 * Pi * r * \frac{Change\ on\ each\ wheel}{Divisions\ per\ Rotation}$$
$$Distance\ traveled\ by\ center = \frac{Distance\ traveled\ on\ left\ wheel + Distance\ traveled\ on\ right\ wheel}{2}$$
$$Change\ in\ theta = \frac{wheel\ radius * (Distance\ traveled\ on\ right\ wheel - distance\ traveled\ on\ left\ wheel)}{2 * length}$$

Equations 3 - Odometry

$$NewX = oldX + Distance\ traveled\ by\ center * cos(old\ Theta)$$
$$NewY = oldY + Distance\ traveled\ by\ center * sin(old\ Theta)$$
$$New\ Theta = old\ Theta + Change\ in\ Theta$$

Equations 4 - Update position

4. Conclusion

In conclusion, this robot has the potential to help reduce the stress of navigation inside buildings as well as being able to be commercialized on a larger scale. It can be used in large buildings as well as at peoples homes. Designed with the disability and elderly communities in mind first, VALE exists to offer some independence back to those communities in the form of a friendly guide robot.