# SLAM based Turtlebot with manipulator arm for elderly assistance

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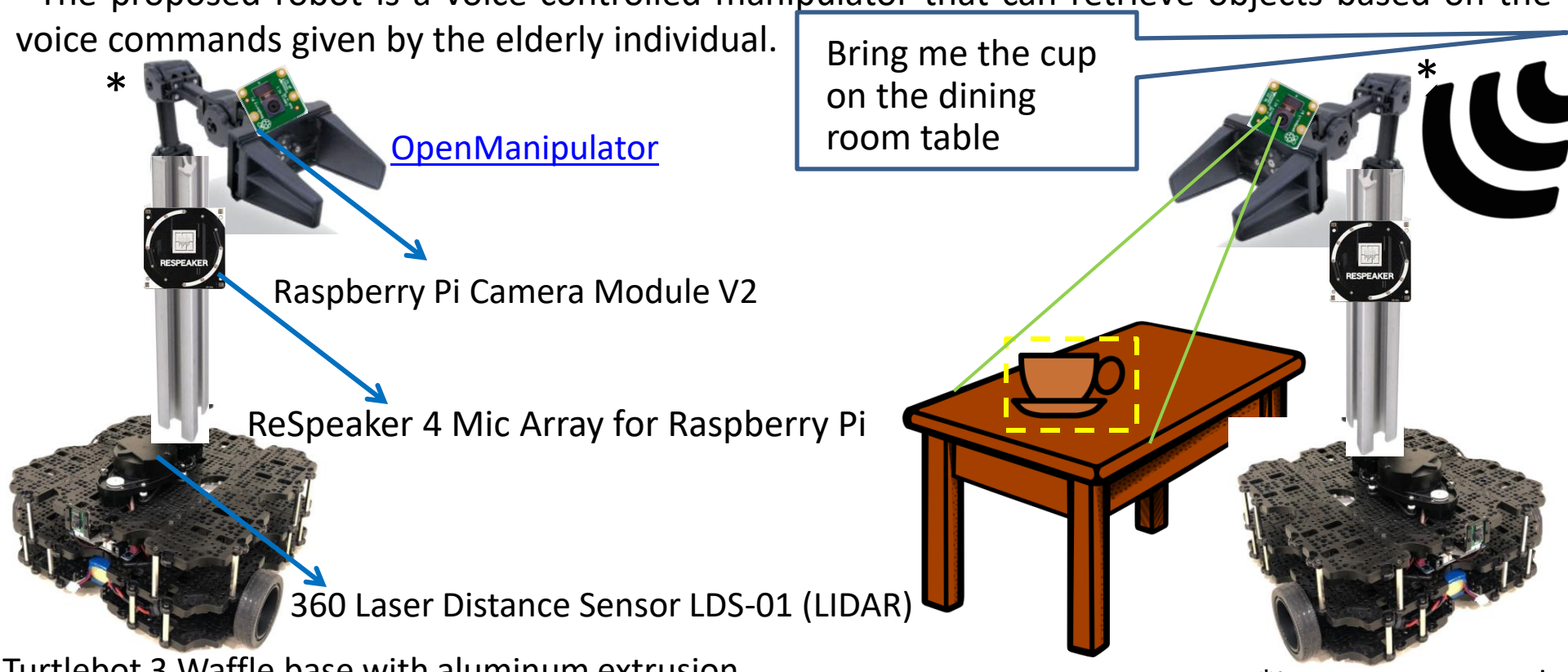
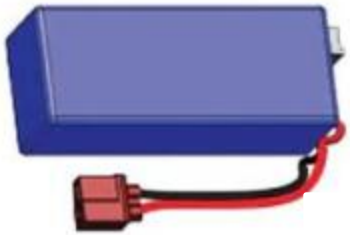
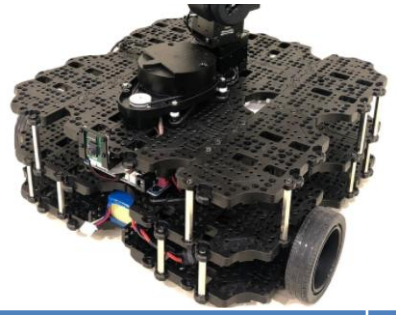
- A 2022 study by the National Center for Biotechnology Information(NCBI), Maryland defines several “activities of daily living” for the elderly(above 50 years of age) such as grasping household objects, working around the house etc. Further, studies prove household activity disability is the most common disability which prevents manipulation tasks around the house.
- The proposed robot is a voice-controlled manipulator that can retrieve objects based on the voice commands given by the elderly individual.



# Power Specifications



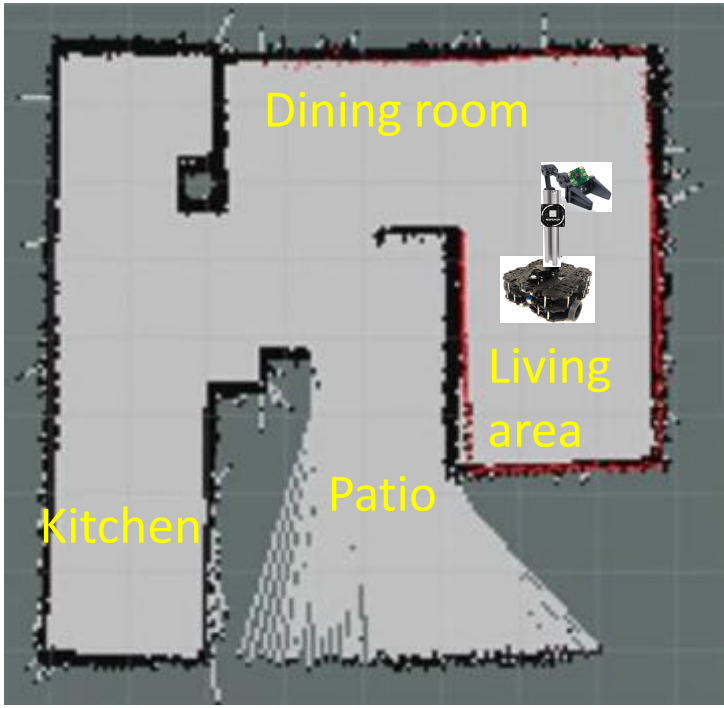



| | LiPo battery 11.1V, 1800mAh | Turtlebot 3 with Raspberry pi 4 | ReSpeaker 4-Mic Array | OpenManipulator | Raspberry Pi Camera Module V2 |
|---|---|---|---|---|---|
| Energy spec. | ~200 W | 36W(x2 Dynamixel motors)+3W(Rpi4) =75W | ~1W | 60 W | ~1.4 W |

| | 360 Laser Distance Sensor LDS-01 (LIDAR) |
|---|---|
| Energy spec. | ~2 W |

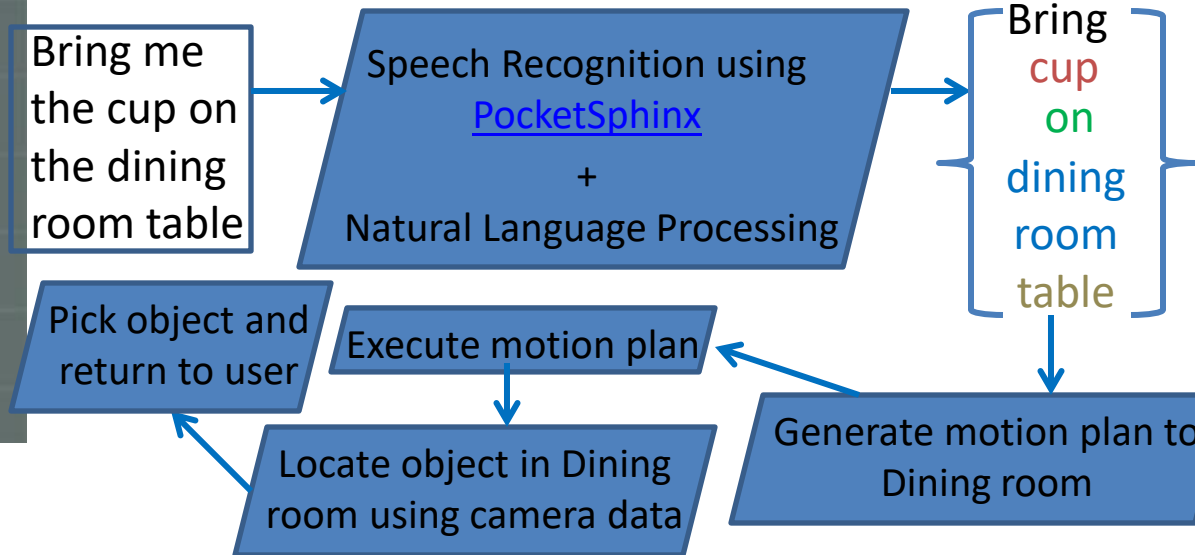
# Navigation

- The 360 Laser Distance Sensor LDS-01 (LIDAR) is first allowed to create a LiDAR SLAM based map of the indoor environment with each section of the indoor setting labelled as kitchen, dining room etc.
- Further, the robot is trained with visual data of everyday objects found in the house such as cups etc. in addition to the location of certain furniture such as table, sofa etc.





Process Flow:



# Sensing

| Sensor Specification | Data collection | Data Flow |
|---|---|---|
| 360 Laser Distance Sensor LDS-01 (LIDAR)  | Generates a LiDAR SLAM map of the surroundings at a 1.8 kHz Sampling Rate upto 3.5 metres | |
| ReSpeaker 4-Mic Array   | A Raspberry Pi expansion board with a 4 Mic array to get audio data for speech recognition based using PocketSphinx | |
| Raspberry Pi Camera Module V2  | Camera module with a Sony IMX219 8-Megapixel sensor to send the camera for image processing using OpenCV on the Raspberry Pi Model 4 | |


LiDAR Data

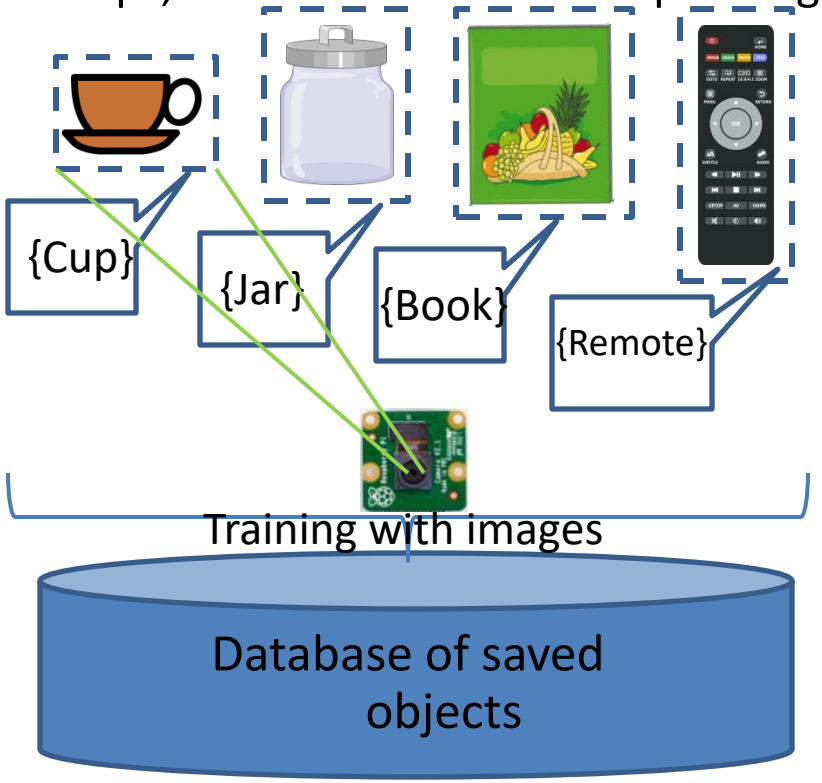
Audio Data

Camera Data

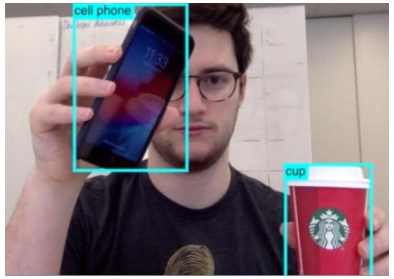
Actuation Signals

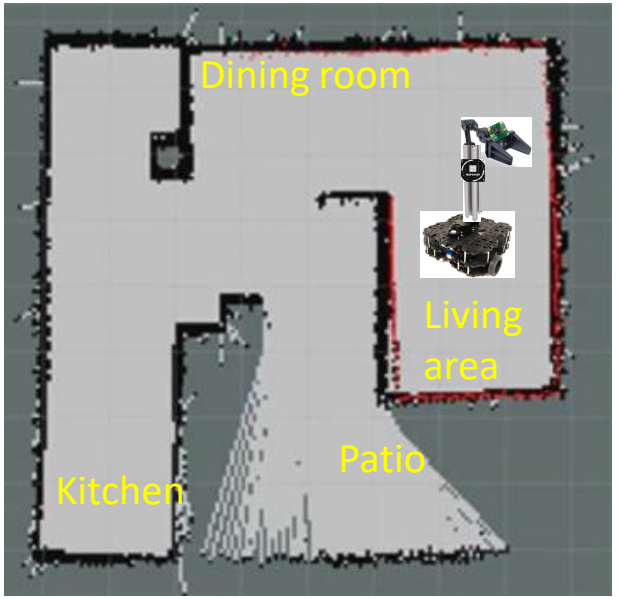
# Computing Platform and Software

- A Raspberry Pi Model 4 is used as the ROS Master communicating with the individual ROS nodes sending LiDAR, Audio and Camera Data.
- Based on the received LiDAR, Audio and Camera Data, the Raspberry Pi sends the actuation signals for the appropriate motion of the turtlebot through the path planned.
- Initially, the robot has to be trained to recognize the essential household items such as cups, medicine boxes etc. depending on the daily needs of the elderly individual.




Training and labeling objects and household areas




- Here, the grasping techniques and problems are not dealt with. Only a limited application design is proposed here