Project Details

Introduction:

The aim of our project, Intelligent Driving system (IDRIS) is to develop assistive robot technology for personal domestic applications and make a working prototype. Focus of this project lies on the following domains: Human-Robot Interaction and Cooperation, Navigation and Mapping in dynamic environments, Computer Vision and Object Recognition under natural light conditions, Object Manipulation, Adaptive Behaviours, Behaviour Integration, Ambient Intelligence, Standardization and System Integration

We've gone through the RoboCup@Home theme and based on that divided everything into modules on which we plan to work. Following is a brief description of the contest and our implementation plan.

Module 1- SLAM:

The main focus of the competition is on the robots ability to navigate in a dynamic environment. Task in last year's competition based on this were:

Navigation

The robot must visit a set of waypoints while avoiding obstacles on its path and follow a person outside the arena.

This test focuses on:

- Path Planning
- Obstacle Interaction
- Tracking and following a person

Following & Guiding

The robot must follow a person out of the arena and through unknown, dynamic, and crowded regions of the venue

After reaching the destination, the robot must guide the person back to the arena.

Our plan:

We did some research on visual slam algorithms and according to pros and cons of each algorithm the most suitable for our requirement is ***ORB-SLAM***. It is a real-time SLAM library for Monocular, Stereo and RGB-D cameras that computes the camera trajectory and a sparse 3D reconstruction. It is able to detect loops and re localize the camera in real time. It's an efficient technique and the main advantage is the backup plan.

For the implementation we plan on using ***Xbox Kinect*** connected to the turtlebot.

System Overview

- Feature Choice -> ORB features
- Three Threads: Tracking, Local Mapping and Loop Closing -> Run in parallel
- Map Points, Key Frames and their Selection
  Stores world coordinate system, viewing system, representative ORB descriptor; camera pose, camera intrinsics like focal length and principal point
- Co-visibility Graph and Essential Graph

Each node is a key frame and an edge between two key frames exists if they share observations of the same map points

- Bags of Words Place Recognition -> To perform loop detection and re-localization
  Visual vocabulary is created offline with the ORB descriptors extracted from a large set of images

Module 2- Voice based modules:

Another important theme of RoboCup@Home is for the robot to be of domestic use and be able to do Human Robot Interaction. For that, voice interaction is the biggest bridge between human and robot. Task in last year's competition based on this were:

Speech Recognition & Audio Detection Test

Direct speech recognition

The robot must answer a set of questions to an operator at the first attempt without asking for confirmation

Indirect speech recognition

Carry out Sound Source Localization (SSL) and Automatic Speech Recognition (ASR) at the same time. Volunteers will stand around the robot and a randomly chosen volunteer will ask a question. The robot is expected to turn towards that volunteer and answer the question

Our plan:

We have divided the voice related modules into three parts:
- Voice Recognition
- Voice Synthesis
- Natural Language Classifying for a close to human conversation (cognitive type work)

We plan to implement HARK algorithm as it seems the best in regards with all the present Algorithms on voice recognition – It has in built voice recognition package and it works with ROS pretty smoothly. Also, the vocabulary bank is vast and it does not need WiFi to operate.

Module 3 – Face Recognition:

The task in previous year's theme focuses on people detection and recognition; as well as pose recognition and human robot interaction with unknown people. The task was as follows:

Person Recognition

- A person is introduced to the robot, the robot needs to learn what the person looks like.
- Once the robot has gathered enough information, the person mixes within a crowd
- The robot needs to find the person
- Once the robot has found the person, it must state some information about the person and the crowd, such as genders

Our Plan:

We plan on using the Haar Based Cascade classifier for face detection then using the Principle Component analysis for recognition. In addition we were planning on integrating Intels real sense camera for face and object detection.

In addition to the above mentioned modules we plan on implementing object detection and manipulation using a 5 DOF robotic manipulator attached to the robot

Robot Description:

We have applied for the Toyota HSR platform but for now we'll be working on a turtlebot with a create base