Turtlebot assembly:

1. Introduction:

* Robots with sensory and navigation capabilities
  + Humans and animals interact with external environment using sensory systems – including visual, auditory, olfactory, gustatory, tactile, etc. These systems help animals sense and interpret the environment and perform activities like foraging, mating, evading predators, etc. for survival. These sensory systems are also used by robots for sensing and acting in given environment. A robot equipped with visual sensor (camera), olfactory sensor (e.g., chemical sensor), tactile sensor (e.g., touch sensor, airflow detection sensor), etc.
* Importance of olfaction in robotics.
  + These sensory systems can allow robots to perform tasks such as detecting and navigating towards a target odor source in an unknown environment. The technology used in robotics to find odor sources is known as odor source localization (reference 1). OSL has increasingly important applications including fire source finding, air pollution monitoring, detecting chemical gas leaks, marine surveys, etc.
* Challenges of odor source localization: odor plume detection, airflow detection.
  + Development of a robotics system that can
* Moth-inspired algorithm

1. Related works:

* Multi-sensor robot platform development.

1. Methodology:

* Platform development:
  + Turtlebot3 Waffle-Pi:
    - Platform: Turtlebot3 is a popular mobile robot system for research and education. It is highly modular and customizable.
    - ROS: Turtlebot3 uses Robot Operating System (ROS) as it’s operating system.
    - Raspberry pi
    - OPENCR
    - Given sensors: Turtlebot3 includes Raspberry Pi Camera, 360-degree LiDAR sensor, 3-axis gyroscope, 3-axis accelerometer, 3-axis magnetometer. These sensors help Turtlebot3 to measure 9-axis inertia.
    - Capabilities: Turtlebot3 has can perform SLAM (simultaneous localization and mapping), Navigation and manipulation tasks with the given sensors and DYNAMIXEL diver. It can be paired with additional sensors for increasing its functionalities.
  + Physical assembly of turtlebot3
  + System setup
    - Remote PC – description and role
      * A remote PC can be used to run custom programs for controlling the Turtlebot3. Turtlebot3 runs on ROS. Both Python and C++ is supported in this platform.
    - SBC, OPENCR – description and role
    - Included sensors: laser, odometry, camera – sensor description and assembly
    - Networking
  + Additional sensor assembly – highlight of the paper:
    - Sensor connection: for odor source localization, additional chemical sensor, airflow speed, wind direction sensors were needed.
      * Chemical sensor –introduction, how it works, connection type, connecting to OPENCR:
        + Introduction: MQ3 sensor is a widely used Metal Oxide Semiconductor (MOS) sensor. It operates on 5V DC and consumes about 800mW. It can detect alcohol concentrations ranging from 25 to 500 ppm.
        + Connecting to OPENCR: its VCC pin connects to 5V output (ping number ? of OpenCR). Its GND connects to pin number ? of OpenCR. Digital/analog pin connection.
      * Airflow and windspeed sensor:
        + Introduction
        + Connecting to OPENCR:
    - Sensor code: Turtlebot3 OPENCR firmware supports additional two touch detecting Bumper sensors, cliff detecting IR sensor, ultrasonic sensor, illumination detecting LDR sensor, etc. However, adding different sensors than the ones listed above require changing the OpenCR firmware code.
      * Chemical sensor edit:
      * Windspeed sensor edit:
      * Wind direction sensor edit:

Uploading changed OPENCR firmware:

* Odor source localization
  + Bio inspired method: moth-inspired model

1. Experiments
   1. Experiment design – search area, odor source, airflow:
   2. Robot system:
      1. Mapping the experiment area
      2. Sensory input
      3. Navigation method
      4. Moth-inspired algorithm
   3. Experiment: different robot initial position, different odor source position
2. Conclusion and future works

* Sensor update
* ML based methods

References