NYU TANDON SCHOOL OF ENGINEERING

ME-GY 6933 Advanced Mechatronics

PROJECT-2

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OBJECTIVE

The aim of this stage is to model and develop a system of two robots that localize themselves in a known environment while they cover different regions in the environment, i.e., no overlap in the regions covered. The robot will have a specific task assigned in its own region.

WHAT WE ACHIEVED (Propeller Stage)

- MOTION:
  - *Changed wall tracking (from Project 1) to Wavefront algorithm for better navigation to be used while mapping*

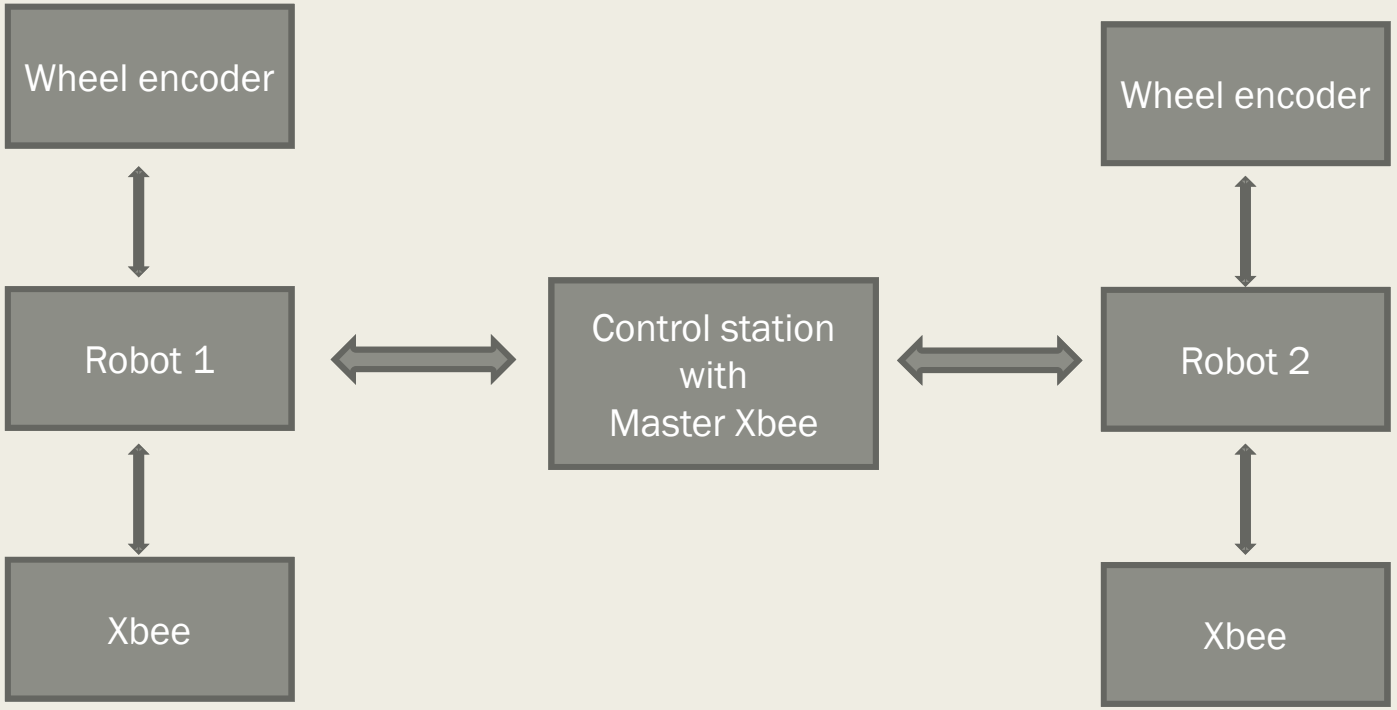
- COMMUNICATIONS:
  - *Point-to-multipoint with Xbee instead of point to point limitations to incorporate use of distributed systems*

- Multiple ROBOTS:
  - *Propeller Robot + Arduino Robot developed to serve the objective*

WHAT WE LEARNT

- Hands-on experience with Propeller Board of Education and its on-board functionalities
- Revision of C, C++ programming concepts with use of Simple IDE
- Research of available recursive algorithms and data structures for robot navigation
- Research over simpletools.h, fdserial.h and simpletext.h libraries
- Configuring Xbee modules to work in a multipoint network, research of its command, API and AT modes and use of Xbee module as a co-ordinator, end device and router
- Experience with and programming of wheel encoders, selecting motor drivers and motors and research of IMU sensors to get feedback from a mobile robot

SYSTEM BLOCK DIAGRAM



SYSTEM PROS

- Algorithm developed is generic enough to be used with different systems with similar development board functionalities
- The code is modular and robust enough to be easily manipulated for hardware connections and additions
- System generates simulation of the robot motion on the serial terminal
- Can broadcast localization information with respect to the map, to any computer or other robot in its network
- Can be queried to autonomously reach a specific location or user defined location

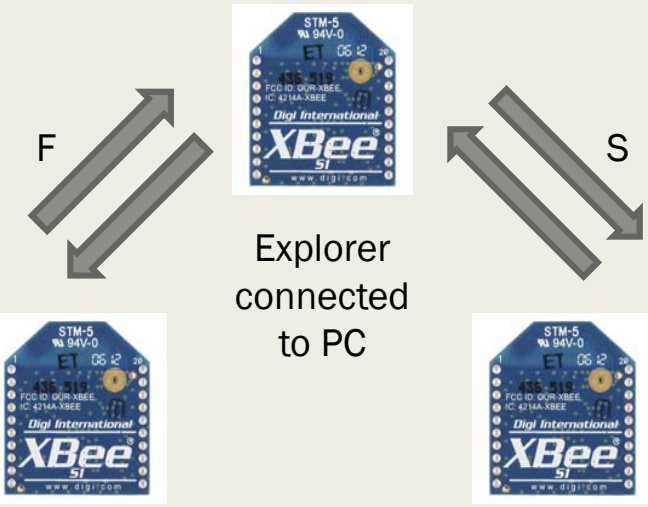
BREADTH-FIRST SEARCH AND WAVEFRONT

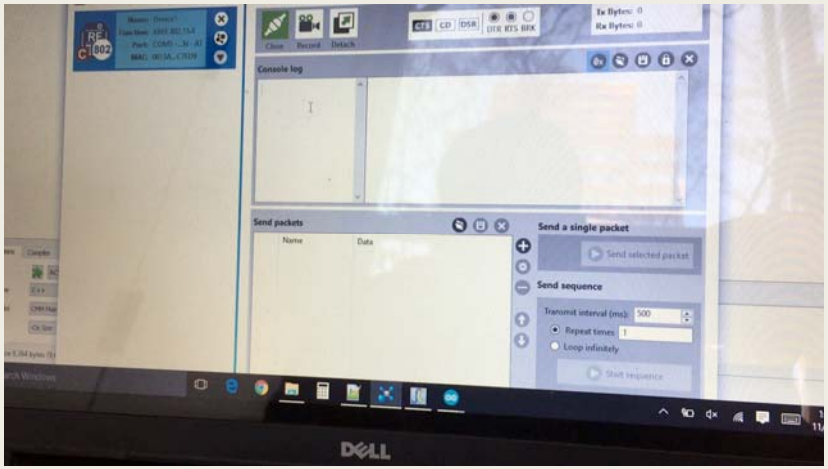
- **Breadth-first search** (**BFS**) is an algorithm for traversing or searching tree or graph data structures. It starts at the tree root (or some arbitrary node of a graph, sometimes referred to as a 'search key') and explores the neighbor nodes first, before moving to the next level neighbors.

ALGORITHM

- Receive input for goal location via Xbee
- Generate grid of known environment
- Assign value to each cell of the grid map using wavefront algorithm
- Find shortest path using breadth-first search (BFS)
- Manipulate robot motion as per the deduced path obtained by BFS
- Using appropriate feedback sensors, track the location of the robot

POINT-TO-MULTIPOINT TOPOLOGY





FUTURE IMPROVEMENTS
(with respect to system limitations)

- Add feedback mechanisms to Arduino robot
- Dynamic mapping
- Localize robots with respect to each other

VIDEO – I ARDUINO

R	9	W	3	2	G
9	8	W	4	3	2
8	7	6	5	4	3
9	8	7	6	5	4
10	9	8	7	6	5
11	10	9	8	7	6

VIDEO – II
PROPELLER

0	0	5	6	7	8
R	W	4	5	6	7
5	W	3	4	5	6
4	W	2	3	4	5
3	2	G	2	3	4
4	3	2	3	4	0

REFERENCES

- http://www.societyofrobots.com/
- CLRS – Introduction to Algorithms
- Class notes on Propeller Intro Lec5 To 8
- http://learn.parallax.com/tutorials/
- https://www.sparkfun.com/datasheets/Wireless/Zigbee/XBee-Datasheet.pdf

THANK YOU