

## ENPM-808X Final Project – Phase 0 Proposal: Group 3

### 1. Abstract:

For the 808X Final Project, Team#3 has selected the following project, for Acme Robotics, as part of their five-year product development roadmap.

It is proposed to develop an autonomous robot in the given category of 'Multi-Robot/Swarm Actions'.

As part of this project, multi-agent, or swarm algorithms on 20 or more robots are implemented simultaneously, to achieve a desired action from the swarm of robots. The product will be developed by following the high-quality software engineering practices and agile development to build a simulated robotic system and demo using ROS and Gazebo

Swarm algorithms that is currently proposed is the pattern formation in an environment. The patterns are geometric patterns such as circle, square, line, star, lattice, etc. to accomplish a desired action with the group of robots. Pattern formation is beneficial for preserving communication range and overcoming environmental constraints (e.g., forming a chain to pass a narrow passage) or relocation of a desired object.

### 2. Project Code: TS-3000

### 3. Team Members:

- Dhinesh Rajasekaran – 119400241 (Driver)
- Arshad Shaik – 118438832 (Navigator)

### 4. Platform:

The TurtleBot will be considered as the platform to execute the swarm action algorithms. However, the platform may be changed during the course of execution of the project, subject to the better alignment of project needs.

### 5. Development Methodology:

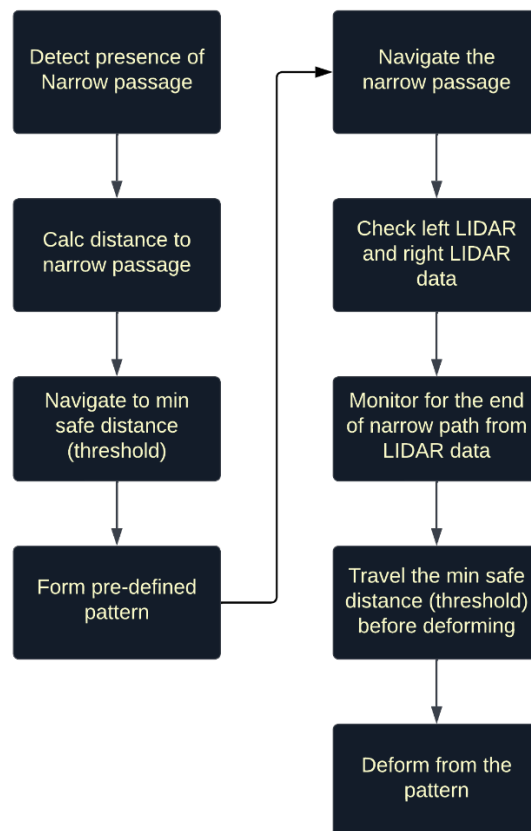
The product will be developed as per below outlined process, to ensure high quality.

- High quality software engineering practices - Agile Iterative Development, Process, Test Driven Development
- Google C++ Style guide, Doxygen for code documentation, CI
- Test Driven Development
- Programming language: C++
- IDE: VS Code
- ROS Version: ROS2
- OS: Ubuntu 20.04
- License: MIT License

### 6. Operating environment:

Gazebo will be used to simulate the physics of the robots and their swarm actions. The more intricacies of the gazebo world will be created as the development process progress.

## 7. Swarm Action Block Diagram:



## 8. Technical Risks/Project Management Risks/ Unknown:

- Using Ros2 for the implementation of this project.

Currently, there is a familiarity of developing this kind of product using ROS1, however, using ROS2 is new to the team. To mitigate this, we may use ROS1 instead of ROS2 as a fall-back option.

- Level of autonomy:

The demo of this project will be a swarm of robots forming a geometric shape, changing their group shape when come across a narrow passage during their navigation and finally get back to their original formation, after crossing it.

In this application, the levels of autonomy will include auto detecting the narrow passage, length of the passage, shape of the passage, adapting the velocity and shape of the TurtleBots accordingly to these parameters etc.

In situations, where the desired level of autonomy is challenging, within the bounds of the project, a suitable level of autonomy will be selected, for the timely delivery of the project.

## 9. Deliverables:

The following are the deliverables from this project:

- Professional-level source code
- Documentation
- A functional user-runnable demo,
- A 5-minute technical presentation
- Demo will show a group of 20 swarm robots form a pattern of rectangle and navigate through a narrow passage by transforming into a line formation and return to their original group shape after crossing the passage.