Gas Leak Localization Using.pdf

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Gas Leak Localization Using Mobile Sensor Networks

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Abstract. A swarm robotics localization strategy based on deliberates fuzzy and swarm behavior is proposed in this paper. Localization is the process of determining the positions of robots or targets in whole swarms environment. To localize the target in real environment, experiment is conducted utilize three identical robots with different color as mobile sensor node. Fuzzy logic and swarm behavior are keeping the swarm robots position and direction with a certain distance to the target position.

INTRODUCTION

Swarm robotic system first introduced in [1]. This is a novel approach for coordination of large numbers of robots. It is inspired from the observation of social insects such as ants, termites, wasps and bees, which stand as fascinating examples of how a large number of simple individuals can interact to create collectively intelligent systems [2-4].

Swarm robotics system need a coordination of large numbers of relatively simple robots. Basically, these systems try to employ a large number of simpler agents to perform different types of tasks to reach the target. In this situation, swarm robot localization should be conducted to support efficient goal directed performance. It can facilitate navigation between points of interest without having to introduce additional nodes.

The concept of swarm behavior is based on local sensing of neighborhood. They emerges in the system even if no group leadership, hierarchical control and global information are present [5-7]. Single operation of intelligent robot commonly used expensive autonomous mobile robots [8]. On the other hand, swarm robots consists of a large number of homogenous autonomous relatively incapable or inefficient robots [9]. The swarm shares information about the environment and individual members interact with each other, therefore a distinction between the sensing and the communication network is made. The main advantages of swarm robotics are robustness, flexibility and scalability of the system [10].

This system can be applied in unknown environment, where the use of a single robot is insufficient. The specific applications can be search and rescue operations, dangerous environment exploration or surveillance. For instance, during a search and rescue operation the robotic swarm is deployed in the target environment.

Localization is the process of determining the positions of robots or targets in models of the environment and aids in the navigation of both individual robots and whole swarms [11]. However, a difficulty associated with conducting localization processes with swarm robots systems is that these systems usually are highly decentralized which makes it hard to synthesize and access global maps, which in turn decreases its flexibility. Unless some centralized mechanisms also are integrated into the system [12].

Some localization technique using vision based self-localization technique that can be used by individual robots in swarm robots systems is described in [13], include the particle swarm optimization (PSO) based techniques that are presented in [14], and neural network [15]. However, this approach does not ensure efficient goal directed behavior. Centralized mechanism must be use to synthesize and access global map to support goal directed navigation. To overcome that drawback, in this paper fuzzy behavior navigation strategies deliberates with swarm behavior. It's facilitate the centralized mechanisms that are necessary for conducting flexible localization tasks to ensure that swarm robotic system is robust towards failure of any one individual.

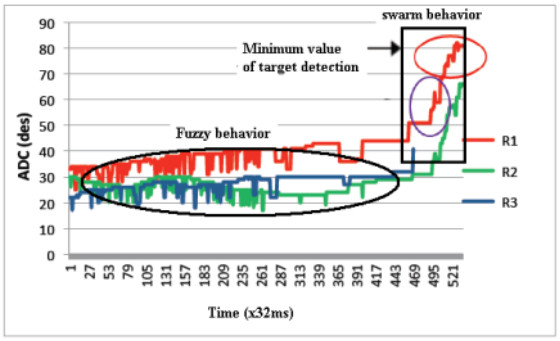
The proposed algorithm deliberates the fuzzy control from low-level navigation tasks such as formation keeping, obstacle avoidance and reaching the target. At the same time the swarm

behavior is covering a large area of the searched environment, thus leading to a faster localization of possible target. The controller works as an adaptive intelligent mechanism and improves the maneuvering performance of the swarm robots.

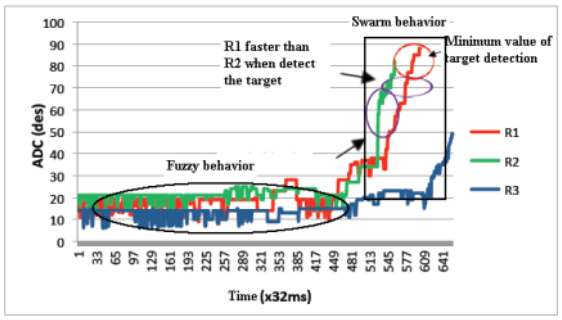
Fuzzy systems are known the popular linguistic rules based knowledge acquisition machine, it is highly desirable to represent the human thinking to utilize the domain knowledge to create autonomous strategies for controlling the mobile robot plan. By using fuzzy logic, each sensor provides some input about the world around the robot; that input being incorporated into a membership functions (MFs). From this MFs, appropriate rules about output actions taken in response to input are generated. These rules allow the robot, to interact with its surroundings in a way that hopefully achieves some goal.

CURRENT RESEARCH

In this research swarm robots design with deliberates fuzzy and swarm behavior for target localization. The experiments are conducted in our robotic laboratory with five identical robots to find target position. The target position is gas source from artificial source in the environment. The swarm robot trajectory produce after the target is achieved.



(a) Target localization in experiment 1



(b) Target localization in experiment 2

Fig 1. Target Localization

In Figs. 1 (a) and (b) respectivelly, shows experimental results of swarm robots motion in two environment with obstacle and without obstacle. In such environment the swarm robots are keeping the position and direction with a certain distance to the target position. In this work deliberate centralize control with swarm behavior and fuzzy behavior, it means the swarm behavior active if one robot detects a target, then the control system will send a signal in the form of color and positions of robot. When the target source not in range swarm robots move with fuzzy behavior. From the result, the target localization using fuzzy-swarm behavior algorithms generate a satisfactory performance, the swarm robots move in the group without collision, keeping safe distance each other and the pathways taken to convergen at the target locations.

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