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VERIFICATION OF CORRECTNESS PROPERTIES FOR AGGREGATION BEHAVIOR OF SWARM ROBOTICS SYSTEM USING SPIN MODEL CHECKER

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Abstract

Swarm robotics is a new approach to the coordination of multi-robot systems which consist of large numbers of relatively simple robots (typically homogenous) which takes its inspiration from social insects. Referring previous research, the algorithm only focus on communication instead of rigorous checking. This research work focused on a developed swarm algorithm aimed at swarm aggregation. The main goal of this research is to verify the correctness properties of an existing model of aggregation behavior of swarm robotics. From the previous researcher, the aggregation algorithm based on the Probabilistic Finite State Automata (PFSA) is derived from the study of cockroach behavior. This algorithm is based on PFSA only relies on local interactions between individuals, the extensibility of the algorithm is very weak. In this research, we take inspiration from natural swarm and then transform to FSM. From FSM aggregation behavior algorithms is built for robot swarms. Model checking is a technique that was originally developed for verifying that finite state of the concurrent systems that implement specifications expressed in temporal logic. PROMELA language and verifying the proposed aggregation algorithm using the SPIN model checker. According to the result present in this research work, it has been proved that SPIN is capable to analyze the swarm robotic system using correctness properties. By verifying rigorously checking with SPIN model checker, the aggregation algorithm has been verified with no counter example and trustworthy.

TABLE OF CONTENT

CHAPTER 1

INTRODUCTION

1.0   Introduction

This chapter explains the overview of the research work starting from the research background. Next is the problem statement which will be focusing and discussing according on the problem that related to this research work. Then scope and limitation and also significance of this research work will be explained.

1.1.1   Background of study

A Swarm Robotics System is a special type of wide area and large-scale distributed system, which focuses on a group of robots cooperating to achieve the same goal as inspired by Swarm Intelligence. Swarm Robotics Systems are a kind of multi-robot systems which consist of many homogeneous autonomous robots without a global controller (T. Yasuda, N. Wada, K. Ohkura, and Y. Matsumura, 2013). Swarm Algorithm mostly inspired social behavior of insects and other animals. This is the concept of simple physical coordination allows the robot to cooperate to perform the duties.

Nature has solved this problem many times over. Schools of fish swim in unison, and are able to execute large scale collective manoeuvres to avoid a predator. Aggregation is a basic and most fundamental behavior for swarm robots because it enables robots to get closer and communicate to each other. By implementing it, the robots are able to perform other type of behaviors such as pattern formation, 'task allocation', 'collective transport' or 'collective mapping'.

Termite colonies build large and very complex nests (complete with thermal regulation (Nicholas R, 2010). Ants collectively search a very large area and are capable of returning food to the nest. In each of these examples, there was no central leader with all the information making decisions for each individual. The origin of swarm robotics