BEHAVIOR BASED MOBILE ROBOT VISION FOR NAVIGATION

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ALKHALIFAH, SAMI SAR. KEJ. (ELEKTRIK - MEKATRONIK & KAWALAN AUTOMATIK) 2012 UTM

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A project report submitted in partial fulfilment of the

requirements for the award of the degree of

Master of Engineering (Electrical – Mechatronics & Automatic Control)

Faculty of Electrical Engineering

Universiti Teknologi Malaysia

JUNE 2012

ABSTRACT

This project focuses on the navigation strategies of multi-robot system. Most work on navigation strategies of multi-robot system has been empirical, with many navigation architectures having been proposed and validated. With the goal of bringing some objective grounding to this important area of research, this project presents a study in i-MARS. A domain-independent taxonomy of i-MARS problems is given. This project demonstrates how such theories can be used for analysis and greater understanding of the problems, and suggests how the same theory can be used in the synthesis of new approaches. Intelligent multi agent robot system (i-MARS) is a set of robots that can communicate between each other to complete certain task. This report presents a project on vision behavior based robot navigation strategy for a single robot that can be used in multi agent robot. The platform is given the name “UTM Multi agent robot’ is designed for research activity purpose and it has a great potential for future development.

ABSTRAK

Projek ini memberi tumpuan kepada strategi navigasi sistem multi-robot. Kerja yang paling atas strategi navigasi sistem multi-robot telah empirikal, dengan banyak seni bina navigasi telah dicadangkan dan disahkan. Dengan matlamat untuk membawa beberapa asas yang objektif ke kawasan ini penting penyelidikan, projek ini membentangkan kajian di i-MARS. Taksonomi domain bebas daripada masalah i-MARS diberikan. Projek ini membuktikan bagaimana teori tersebut boleh digunakan untuk analisa dan pemahaman yang lebih besar daripada masalah dan mencadangkan bagaimana teori yang sama boleh digunakan dalam sintesis pendekatan baru. Pintar pelbagai ejen robot sistem (i-MARS) adalah satu set robot yang boleh berkomunikasi antara satu sama lain untuk menyelesaikan tugas tertentu. Laporan ini memaparkan satu projek ke atas kelakuan wawasan berdasarkan robot navigasi strategi bagi robot satu yang boleh digunakan dalam robot ejen pelbagai. Platform yang diberi nama ''UTM ejen robot Multi 'direka bagi tujuan aktiviti penyelidikan dan ia mempunyai potensi besar untuk pembangunan masa depan.

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LIST OF SYMBOLS

$\dot{\varepsilon}_{\mathrm{r}}$	-	Local or Robot reference frame
$\dot{x}_{\mathrm{r}}$	-	Robot X axis
$\dot{\mathrm{y}}_{\mathrm{r}}$	-	Robot Y axis
$\dot{\theta}_r$	-	Robot angle
r	-	Motor wheel diameter
l	-	Wheel distance from bottom center
$\dot{\varphi}_L$	-	Left wheel spinning speed
$\dot{\varphi}_R$	-	Right wheel spinning speed
$\dot{\varepsilon}_{\mathrm{I}}$	-	Global reference frame (velocity speed)
$\dot{x}$	-	Global X axis
$\dot{\mathrm{y}}$	-	Global Y axis
$\dot{\theta}$	-	Global angle
$\Delta S_{r,l}$	-	Traveled distance for right and left wheels
P_{total}	-	Encoder total pulses per rotation
D	-	Counted pulses from encoder
ΔS	-	Robot traveled distance
$\Delta\theta$	-	Angular error
Δx	-	Traveled distance in X axis
Δy	-	Traveled distance in Y axis

$P = \begin{matrix} X \\ Y \\ \theta \end{matrix}$	-	Robot current position and angle
$P` = \begin{matrix} X` \\ Y` \\ \theta` \end{matrix}$	-	Robot new position and angle
$\Delta P = \begin{matrix} \Delta x \\ \Delta y \\ \Delta\theta \end{matrix}$	-	Robot traveled distance and angular change

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CHAPTER 1

INTRODUCTION

As a design strategy, achieving the behavior of intelligent systems for use in a number of areas, such as military, aerospace, mining, agriculture, factory automation, speed production, services, waste management, health, emergency preparedness and disaster relief at home is most wanted in these days.

Recently, it has aroused great interest in developing and delivering modules set of cooperating robots. The value of collaborative systems most commonly occurs when some tasks are too complex for a single agent, or when there are clear work benefits shows that many robot modules can work better together.

In many applications, the multi-robot system is useful for several reasons. Many cheap robots can work together to replace an expensive robot that makes the cost of a multi-robot system more efficient. Multi-robot systems can perform tasks that individual robots cannot because it is too much for a single robot, regardless of the effect of limited space. Even if a single robot can perform the task, it is always best to use multi-robot system, where costs can be reduced.

1.1 Overview

Knowing what kind of behavior-based robots, it may help to explain what is not. The behavioral treatment is not necessarily intended to provide information or think like a human process. Although these goals are laudable, they can be confusing. The problem is that we are not aware of the various internal processes that actually create our intelligence, but rather the experience of the new phenomenon of "mind". In the mid-eighties, Arkin[1] recognized this fundamental problem and responded to one of the first well-formulated methods of application behavior. His argument was that the underlying factual impossibility of a witness who was inevitably influenced by his / her own perspective on the situation has slipped[1].

Fabrication is completely subjective to the viewer, can not be measured scientifically or models of knowledge. Even researchers who do not believe that the phenomenon of cognition that is wholly illusory, admitted that AI is not to produce it. While many future intelligent systems capable of human behavior so accurately model the expectation is that they require such a high level problem must be the principles of the base can be built up. While some skeptics argue that the strict behavioral therapy can never develop forms of human intelligence, others have argued that bottom-up behavior is the same principle underlying all biological intelligence[1].

For many, this is a theoretical question simply is not the problem. Instead of focusing on the design of systems that can think smart, had changed the focus to the creation of a robot that can act intelligently. From a technical point of view, narrows the design change Robotics, the production of physical robots, the data in the real world, without saying exactly how it would perform.

From a scientific point of view, researchers can now avoid, at a high level of informal discussions about intelligence. Instead, intelligence objectively assessed as a measure of rational behavior for an operation. Since the successful completion of a task is the goal, researchers no longer focus on the design of complex systems for processing and instead tried the link between perception and action as directly as possible. This case is a typical behavior-based robotics.

1.2 Problem Statement

The main topics of research are mobile robot navigation strategy, planning, maneuvering and manipulation [2]. The choice of behavior on a system other than mobility systems for a typical mobile robot platform is based has represented a difficult part of the research component of this project. The control problem for a robot based on the mobile behavior is difficult, mainly because of two facts [3]. First, a system based on a behavioral act in a reactive and deliberative at the same time. Second, his mathematical model is unknown. To control any approach to a dynamic system needs to use some knowledge or model, the apparatus monitored. In the case of a robot consists of the robot and the environment in which it operates. But while a model of the robot on its own rule can be obtained, the situation is different if a robot can be integrated into the real world.

1.3 Purpose of the project

i-MARS (Intelligent Multi-Agent Robot System) are a team of heterogeneous mobile robots. The team can be arranged as two-robot system or three-robot system. The goal of these teams is to carry a large load to a specific location that is difficult for a single robot to accomplish. In order to accomplish the task, the teams used a leader-follower strategy that is more organized to overcome unwanted emergent behaviors that can bring deviations to the team's movement.

The purpose of the project is to design a behavior-based controller (software) for a platform of a single robot to do many tasks. The tasks for this single robot are to navigate, avoid obstacles and stay inside has environment.

1.4 Project questions:

What kind of tasks is the robot doing inside his environment?

- Avoids leaving the environment.

(Keep it from crossing the environment boundary)

- Escapes from the encounter with any obstacle

(When find one, avoid it)

- Searching for an Exit

(When find one, go to it)

1.5 Project scope :

- **One UTM Robot.**
- **UTM robot was equipped with:**

  - A laptop on the robot.

  -Integrated with Interface Free Controller IFC to manage sensors, motors and control outputs.

  -Two rotary encoder for distance measurement ability.

  -Eight Analog distance sensors (IR)located every 45 degree, allow sensing ability between the range of 10cm to 80cm.

  -Eight Ultrasonic ranger finder located every 45 degree, allow sensing ability between the range of 0 to 6.45 m.

  -A SKXBEE (Zigbee module) mounted on the platform as wireless communication device.

  -One pan tilt webcam for vision development purpose.

  -One Hokuyo Laser Range Finder for robot navigation**.**
- **The environment is going to be an aX5)m with yellow boundary.**
- **One exit in the environment.**
- **One obstacle in the environment.**
- **Robot Control Architectures.**
- **Software Programming.**

In recent times there has been little incentive to create and deploy modular cooperating collectives of robots. The interest in this co-action system usually occurs when certain tasks are either too complex to be performed by a single agent or when there are several benefits that will be in collaboration with many simple robotic modules.

In many applications, multi-robot system desirable for many reasons. Many cheap robots that work together to replace an expensive robot, make a multi-robot system is more cost effective. Multi-robot can perform tasks that no separate robot can carry out, since the end of a single robot, however capable, spatially limited. Even if a single robot can do the task, it is better to use the multi-robot system when the cost can be reduced.

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