Sudan University of Science and Technology

College of Engineering

Electronics Engineering School

Prototype Design of Autonomous Mobile Agents for Environment Monitoring

A Research Submitted In Partial Fulfillment for the Requirements of the Degree of B.Sc (Honors) in Electronics Engineering

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الآية

قال تعالى:

﴿وَقُلِ اعْمَلُوا فَسَيَرَى اللَّهُ عَمَلَكُمْ وَرَسُولُهُ وَالْمُؤْمِنُونَ ۖ وَسَتُرَدُّونَ إِلَىٰ عَالِمِ الْغَيْبِ وَالشَّهَادَةِ فَيُنَبِّئُكُم بِمَا كُنتُمْ تَعْمَلُونَ﴾

سورة التوبة(١٠٥)

DEDICATION

To Our Mother's A strong and gentle soul who taught us to trust in ALLAH, believe in hard work and that so much could be done with little.

To Our Father's For earning an honest living for us and for supporting and encouraging us to believe in our self

To Mr. Khalifa Eltayeb Khalifa Our great supervisor who spent a lot of time to help us in preparation of this project

To Our Brothers and Friends For being our guardian during our educational career

We extend our pleasures to the staff of **Sudan University of Science and Technology** and to all those who take our hands and helped us in the preparation of this project.

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First and foremost all praises are due to ALLAH, for all physical and mental support throughout our life and during this project phases, and his peace and blessing be on the prophet.

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ABSTRACT

In recent years, remote environment monitoring has been significantly improved with wireless sensor networking technology. This improvement helps the human being to avoid access to hazard areas.

This research concerned with design and implement of an autonomous mobile robot agent that can access to hazard areas. This mobile robot will have the ability to move forward, backward, turn left and right, with characteristic of object detection and avoidance. The agent also has the capability to sense the environmental parameters of the region, and send that data to the remote monitoring terminal using wireless communication.

المستخلص

في السنوات الأخيرة حدث تطور كبير في كيفية مراقبة و رصد العوامل البيئية عن (مثل درجة الحرارة والرطوبه) نسبةً بعد لإستخدام تكنولوجيا شبكات الإستشعار اللاسلكية. هذا التطور أسهم في مساعدة الإنسان ليستطيع تجنب الوصول إلى هذه المناطق الخطره.

هذا البحث يهتم بتصميم وتنفيذ روبوت ذاتي الحركة الذي بدوره يستطيع الوصول والعمل في هذه المناطق الخطره. هذا الروبوت لديه القدرة على التحرك في جميع الإتجاهات بالاضافة لذلك فإنه يستطيع الكشف عن المعوقات التي تواجهه و تجنبها , كما لديه القدرة على إستشعار التغيرات في عوامل البيئة المختلفة, و إرسال تلك البيانات الي المركز المسؤول عن المراقبة عن طريق إستخدام شبكة للاتصالات اللاسلكية.

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Abbreviations

A

AC	Alternative Current
ADC	Analog to Digital Converter

C

CCD	Charge Coupled Device
CISC	Complex Instruction Set Computing

D

DC	Direct Current
DVMT	Distributed Vehicle Monitoring Test bed

E

E-step	Expectation Step

G

GHz	Gega Hertz

H

HB	Hybrid

I

IEEE	Institute of Electrical and Electronic Engineering
IR	Infrared

K

Kbps	Kilo Bit Per Second

L

LCD	Liquid Crystal Display
LED	Light Emitting Diodes

M

MANETs	Mobile Ad hoc Networks
Mbps	Mega Bit per Second
MHz	Mega Hertz
Msec	Milli Second
MWSN	Mobile Wireless Sensor Network
M-step	Maximization Step

P

PAN	Personal Area Network
PC	Personal Computer

PM	Permanent Magnet
PPM	Part Per Million
PSD	Position Sensitive Device
PUMA	Programmable Universal Machine for Assembly

R

RF	Radio Frequency
RH	Relative Humidity
RISC	Reduced Instruction Set Computing
R.U.R	Rossum's Universal Robots

T

T	Time

V

VR	Variable Reluctance

W

WSN	Wireless Sensor Network
WPANs	Wireless Personal Area Networks

Chapter One

Introduction

Chapter One

Introduction

1.1Preface:

In this project a mobile robot designed to access hazardous areas that cannot be accessed by humans for the reason of collecting information through sensors.

A Mobile robot equipped with sensors is used to monitor the environment and gathered information to be capable to predict the environmental disasters before it begun and react accordingly, or just to collect information about any area that is dangerous to be accessed by human because it`s hazards.

This is done by sent information about what happened in this environment to the control station by Bluetooth, Zigbee or any other transmission circuit, so the users have the ability to avoid any undesirable action.

The robot has the possibility to work independently by sense the environment and avoid any obstacles in its way without user controlled with the help of necessary navigation sensors, this self control feature added to the design make it an autonomous mobile robot.

By added the mobility feature, large space can be covered by less number of agents rather than use of more number of wireless sensors network fixed nodes to cover the same area.

1.2Problem Statement:

In wireless sensors network fixed nodes distributed in the environment that need to be monitored. So large number of nodes must be used and this required high cost. Also sometimes environment that must be monitored with the help of wireless sensors network nodes is dangerous places that cannot be accessed by human because of any risk factors such as Chemical contamination, Toxic gas, lack of O2 or any other factor.

1.3Proposed Solution:

Design and implementation of autonomous mobile robot equipped with the necessary sensors for self navigation and information gathering. It acts as Mobile Wireless Sensors Network agent (MWSN).

1.4 Research Objective:

1. Simulation of mobile robot and the physical phenomenon that should be measured.

2. Design of an autonomous mobile agent prototype can move (forward, backward, turn left, turn right), collect information, detect and avoid objects.

1.5Methodology:

- In general all the needed Background about Wireless Sensors Network, Mobile robot and know the advantages, disadvantages and application of it.

- Determine the problem statement, proposed solution and objectives of using the mobile agent.
- Write Literature review about Mobile Robot, Wireless Sensors Network (WSN) and the previous related works.
- Draw the block diagram of robot prototype circuit and determine the components.
- Building the necessary simulation knowledge about the microcontroller.
- Simulation of mobile agent and sensing circuit.
- Evaluation of the mobile agent system performance.
- Hardware design is integrated with the software after developing it.
- Testing the mobile agent working.
- Show the results of the mobile robot and discuss this.
- Write recommendations deduced from this project.
- Write the final report about monitoring environment using Mobile Wireless Sensors Network (MWSN).

1.6Research Outline:

- Chapter one include preface, problem statement, proposed solution, research objective and methodology.
- Chapter two includes definitions related to mobile robot, background, robot component, and literature review.

- Chapter three include block diagram, system component and flow chart.
- Chapter four include software and hardware design.
- Chapter five include conclusion and recommendation.