

الإهداء

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ABSTRACT

This thesis studies in details the modular architecture to designing autonomous mobile robots which has four different layers: perception, localization, planning and control. This architecture aims to provide a test bed for researchers where they can rapidly prototype the application of new methods without the effort of redesigning the entire infrastructure. The document also contains a background about the relevant topics and related works reviews, a detailed description of the approach taken, tests and the consecutive results. It discusses an implementation of the modular architecture in a quadcopter platform to convert it from an ordinary human-controlled quadcopter to an autonomous quadcopter that can navigate the environment without any human aid. Different algorithms are used on the different layers such as attitude planner and attractive and repulsive algorithm in the planning layer in addition to the cascaded PID regulator in the control layer. A ground station is used to provide the interface between the user and the platform for monitoring purposes. Virtual Robot Experimentation Platform (V-REP) is used to simulate the behavior of the autonomous quadcopter in an indoor environment that contains some obstacles.

المستخلص

تدرس هذه الأطروحة الهيكلية النموذجية لتصميم الروبوتات الذاتية والتي تتكون من أربع طبقات مختلفة: الإدراك، تحديد الموقع، تخطيط المسار و التحكم. هدف هذه الهيكلية هو توفير نموذج اختباري للباحثين يمكنهم من تطوير تطبيقات لطرق جديدة في طبقة بعينها دون الحاجة لإعادة تصميم كامل للنظام. يحتوي البحث أيضا على خلفية عن المواضيع المشابهة التي تم تنفيذها في نفس المجال ووصف مفصل للطريقة التي تم اختيارها والاختبارات والنتائج التي تم الحصول عليها. تناقش الأطروحة تنفيذ الهيكلية النموذجية في طائرة رباعية لتحويلها من طائرة عادية تقاد بواسطة الانسان الى طائرة ذاتية القيادة يمكنها الطيران في اي بيئة من دون اي مساعدة منه. تم استخدام خوارزميات مختلفة في مختلف طبقات النظام مثل خوارزميات مخططة الوجهة للهدف و الانجذاب للهدف والابتعاد عن الاصطدام بالعوائق في طبقة التخطيط للمسار وخوارزمية محكمة الإستقرار ذات الحلقات المتداخلة (خارجية وداخلية). تم استخدام محطة تحكم أرضية لتوفير الربط ما بين الطائرة و المستخدم لأغراض المراقبة. منصة اختبارات الروبوتات الافتراضية (V-REP) استخدمت لمحاكاة سلوك الطائرة الذاتية في بيئة داخل المنزل تحتوي على عدد من العوائق.

TABLE OF CONTENTS

TITLE	PAGE
DEDICATION IN ARABIC	i
ACKNOWLEDGEMENTS IN ARABIC	ii
ABSTRACT	iii
ABSTRACT IN ARABIC	iv
TABLE OF CONTENTS	v
LIST OF TABLES	vii
LIST OF FIGURES	viii
LIST OF ABBREVIATIONS	x
LIST OF APPENDICES	xi
CHAPTER ONE:	
INTRODUCTION	
1.1 Introduction	1
1.2 Problem Statement	1
1.3 Proposed Solution	2
1.4 Methodology	2
1.4.1 Quadcopter Dynamic	2
1.4.2 The Control Architecture	2
1.5 Aim and Objectives	4
1.6 Research Outlines	5
CHAPTER TWO:	
LITERATURE REVIEW	
2.1 Background	6
2.1.1 Autonomous navigating in dynamic environments	6
2.2 Related Works	15
CHAPTER THREE:	
METHODOLOGY	
3.1 The Design of the Autonomous Quadcopter	18
3.2 Software architecture	24
3.2.1 Perception layer	26
3.2.2 Localization/map building layer	27
3.2.3 Cognition/planning layer	27
3.2.4 Motion control layer	30

3.3	Hardware architecture	32
3.3.1	Sensors	32
3.3.2	Actuating system	37
3.3.3	The power system	39
3.3.4	The processing units	40
3.4	The ground station system	41
3.5	The simulation	41
3.5.1	The simulation environment	41
3.5.2	The simulation process	43
3.6	Prototype Implementation	45
3.6.1	Frame design	45
3.6.2	Prototype design phases	46
CHAPTER FOUR:		
RESULTS		
4.1	Results of simulation	49
4.2	Hardware calibration	51
4.3	Prototype testing	53
4.4	The Reliability of components	53
4.4.1	Sensors	53
4.4.2	Actuating system	54
4.4.3	Power system	54
4.4.4	The processing units	55
4.5	The stability of the system	55
4.6	The ground station testing	55
CHAPTER FIVE:		
CONOCLUTION AND RECOMONDITATION		
5.1	Final Remarks	56
5-2	Recommendations	58
References		
Appendix A: The main quadcopter code		60
Appendix B: Arduino code		65
Appendix C: The ground station communication codes		67
Appendix D: The simulation code		70
Appendix E: Simulation and Prototype circuit diagrams		75

LISTOF TABLES

TABLE NO.	TITLE	PAGE
2-1	Sensors classification	8
3-1	Ultrasonic (HC-SR04) distance sensor module pins	33
3-2	Pin configuration of Barometer(BMP180)	34
3-3	IMU (MPU-9250) pin layout	36
3-4	GPS (NEO-6) pin layout	37
3-5	Illustrates the simulation environment parameters	42
3-6	The specifications of the Quadcopter components	45
3-7	Dimensions of the Quadcopter components	46
4-1	Motor calibration	51
4-2	Compass calibration	52
4-3	Accelerometer calibration	52
5-1	Different remarks about the project	57

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE
2-1	Conceptual architecture block diagram	6
3-1	Plus quadcopter schematic	19
3-2	X quadcopter schematic	20
3-3	Illustration of the forces on a beam	21
3-4	The center of the gravity of a spoon	22
3-5	Illustration of the rotation momentum	23
3-6	Main software algorithm	25
3-7	Ultrasonic algorithm	26
3-8	Calculating the quarter	27
3-9	Attitude algorithm	28
3-10	Obstacle avoidance algorithm	29
3-11	Attitude and altitude controller algorithm	31
3-12	Interfacing Raspberry Pi with Ultrasonic(HC-SR04)	33
3-13	Pin out Diagram for IMU (MPU-9250)	35
3-14	Typical Electronic Speed Controller	38
3-15	The communication architecture between the ground station and the quadcopter	41
3-16	The autonomous quadcopter simulation	43
3-17	Detection of an obstacle shown in the five views	44
3-18	Drilling the layers	47
3-19	Connecting everything together	47

3-20	Testing the different components	48
4-1	Show the quadcopter in the designed indoor environment	49
4-2	The quadcopter succeeded to adjust its path in a turn	50
4-3	The quadcopter successful to read and avoid obstacle	51
4-4	The quadcopter test bed	53

LIST OF ABBREVIATIONS

3D	Three Dimensions
ADC	Analog-to-Digital converter
AMR	Autonomous Mobile Robot
CPU	Central Processing Unit
DC	Direct Current
DDC	Display Data Channel
DOF	Degree Of Freedom
EEPROM	Electrical Erasable Programmable read only Memory
ESC	Electronic Speed Controller
FMA	Flying Machine Arena
GPIO	General Purpose Input Output
GPS	Global Position System
I2C	Inter-integrated Circuit
IDE	Integrated Development Environment
ILC	Iterative Learning Control
IMU	Inertial Measurement Unit
INS	Inertial Navigation System
KV	Kilo Revolution Per Minute per Volt
La	Latitude
Lo	Longitude
LQG	Linear Quadratic Gaussian
LSD	Large Scale Direct
RC	Radio Controller
PRM	Probabilistic Roadmap
RRT	Rapidly exploring Random Tree
SLAM	Simultaneous Localization and Mapping
TCP	Transmission Control Protocol/Internet Protocol
UAV	Unmanned Arial Vehicle
USAR	Urban Search and Rescue
USB	Universal Serial Bus
V-REP	Virtual Robot Experimentation Platform
PID	Proportional Integral Derivative
PWM	Pulse Width Modulation

LIST OF APPENDICES

APPENDIX	TITLE	PAGE
A	The main quadcopter code	60
B	Arduino code	61
C	The ground station communication codes	62
D	The simulation code	63
E	Simulation and Prototype circuit diagrams	75