Zagazig University, Faculty of Engineering,
Computer and Systems Engineering Dept.

ZagHexa
Design, Construction and Control of a Hexapod Walking Robot

a B.Sc. Graduation Project
Submitted by

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to
All, **Whom**, **we**, and **love**.
The best in my life and after ...

Abstract

This report is a documentation of the final year graduation project in electrical engineering at zagazig university. The purpose of this project is to Design, Construction and Control of a six-legged walking robot that is capable of basic mobility tasks such as walking forward, backward, rotating in place and raising or lowering the body height.

The legs are of a modular design that have three degrees of freedom each. This robot will serve as a platform onto which additional sensory components could be added, or which could be programmed to perform increasingly complex tasks.

The components that make up our final design are discussed. Also, we describe the basic robot gaits of locomotion for efficient navigation. This locomotion is tuned to make the robot faster and at same time energy efficient to navigate and negotiate difficult terrain.

The robot is an integrated multi-legged walking robot based on de-facto standard Robotic Operating System (ROS) that employs novel and different walking patterns.

Our robot is teleoperated using hand-held devices such as a smart phone or tablet or a wireless joystick. Furthermore, it has its own navigation system and a camera for instant video recording and streaming.

The power to the entire system is supplied through two 5 volts NiMH batteries. There is an additional power bank to power up the Raspberry Pi and other electronic components. We have an interactive website for robot inspection and online control in addition to leaning materials such as robot building and implementation walkthroughs and as well as step-by-setup tutorials.

Keywords – biologically inspired, legged robot, gait generation, design procedure, simulation

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Key abbreviations

DOF	Degree of freedom
PWM	Pulse Width Modulation
I^2C	Inter-Integrated Circuit
Hexapod	six-leg walking robot
DMP	Digital Motion Processor
LiPo	Lithium Polymer
RPM	Round Per Minute
RPi	Raspberry Pi
GPIO	General-purpose input/output
ADC	Analog-Digital Converter
LPF	Low Path Filter
HPF	High Path Filter
FPS	Frame Per Seconds
GND	Ground

"There is nothing more difficult to take in hand, more perilous to conduct or more uncertain in its success than to take the lead in the introduction of a new order of things."
— Niccolo Machiavelli, (Italian writer and statesman, Florentine patriot, author of 'The Prince', 1469-1527)

1 Introduction

just some text for text

1.1 overview

some data

1.1.1 Flower Power

Figure 1.1: This is a test figure. You can use it as a template for your figures

"It is impossible for us, who live in the latter ages of the world, to make observations in criticism, morality, or in any art or science, which have not been touched upon by others. We have little else left us but to represent the common sense of mankind in more strong, more beautiful, or more uncommon lights."

— Joseph Addison, (English essayist, poet, and politician, 1672–1719), Spectator, No. 253

2 State of the Art

"A computer would deserve to be called intelligent if it could deceive a human into believing that it was human."

— Alan Turing, (British pioneering computer scientist, cryptanalyst,⋯, and philosopher, 1912–1954)

3 Architecture Overview

“Be sure you put your feet in the right place, then stand firm.”

— Abraham Lincoln, (American 16th President, 1809–1865)

4 Robot Foot Ground Contact

“Look up at the stars and not down at your feet. Try to make sense of what you see, and wonder about what makes the universe exist. Be curious.”

— Stephen Hawking, (Brief theoretical physicist, and cosmologist

5 Short–Range Embodied Terrain Classification

"I think setting a goal, getting a visual image of what it is you want. You've got to see what it is you want to achieve before you can pursue it."

— Chuck Norris, (American martial artist, actor, film producer and screenwriter)

6 Long–Range Visual Terrain Classification

"You have brains in your head. You have feet in your shoes. You can steer yourself in any direction you choose. You're on your own, and you know what you know. And you are the guy who'll decide where to go."

— *Dr. Seuss, (American writer and cartoonist, 1904–1991)*

7 Path Planning and Following

"It doesn't matter how beautiful your theory is, it doesn't matter how smart you are. If it doesn't agree with experiment, it's wrong."

— *Richard P. Feynman, (American theoretical physicist, 1918–1988)*

8 Experiments and Results

The true function of philosophy is to educate us in the principles of reasoning and not to put an end to further reasoning by the introduction of fixed conclusions.

— *George Henry Lewes, English philosopher and critic and literature, 1817–1878)*

9 Conclusions and Future Outlook