Delft University of Technology
Master's Thesis in Embedded Systems

A Transiently powered autonomous robot

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Abstract

TODO ABSTRACT

Contents

Chapter 1

Introduction

1.1 Motivation

There is a increasing research interest in small autonomous robots, since they have the potential to By working together the collective, individuals are able to achieve more than on their own. Inspired on nature, small robotic platforms have been developed to mimic swarm behavior of animals.

Gathering information in case of disaster Mobile sensing for hard to reach or inspect places Collaboration increase fault tollerance

Robots needs to explore their surroundings, sense, process and react accordingly.

Small sizes allow robots to work in areas that would otherwise be unreachable. However these applications will require new sensing, control and navigation strategies to make use of the increasingly resource constrained robots.

Currently small robotic platforms still rely on batteries as a source of power, since electric motors consume considerably more energy compared to computation and sensing. Lithium-ion batteries have a high energy density but still limit the operation time of the robot. When the voltage of the battery drops below a certain level, indicating that the battery is almost empty, the robot needs to move to a charging station before it runs out of energy. Replacing the battery with an energy harvesting system would make the robot energy-autonomous.

1.2 Problem statement

Intermittently powered robots, that purely rely on harvested power are currently non existent. The intermittent availability of energy creates new challenges in control, navigation and actuation. This research will explore the feasibility of an autonomous battery-less robot, focusing on the development of such a robot and especially porting a complex task like navigation

to it. Therefore the main question this work will try to answer is:
How to make make a transiently powered robot navigate autonomously?

1.3 System Description

1.4 Contributions

1.5 Outline

What will be discussed in the coming chapters

TODO ORGANISATIONAL DESCRIPTION OF THESIS

Chapter 2

Related Work

2.1 Battery-powered robotic platforms

Hardware modularity is a way to make the robot adapt its resources to different environments and sensing operations. By separating out power, computation, motor control and sensing a verity of capabilities can be tested [**?**, **?**]. Microrobots typically use infrared-based neighbor to neighbor distance sensing and communication [**?**]. While controlling a swarm or collective is mainly accomplished by means of active low power transceivers [**?**, **?**].

Choosing the right locomotion resource can depend on different factors, moving in the most energy efficient way on a particular surface is often the determining factor. On a flat surface, robots commonly use a two-wheeled differential drive design to not only move but allow for steering as well [**?**, **?**]. In other designs overall cost is a decisive factor, Kilobot uses two vibrating motors for locomotion. When the motors are activated the centripetal forces will generate a forward movement [**?**]. The GRITSBot does not use conventional DC motors, requiring encoders to estimate their speed. Instead by using stepper motors the speed can be set by changing the delay between steps. Estimating it's position therefore is reduced to simply counting steps [**?**].

Chapter 3

CHAPTER TITLE

INTRODUCTION TEXT TO THIS CHAPTER IN WHICH ALL SECTIONS ARE DESCRIBED ROUGHLY (1 SENTENCE EACH).

This chapter describes the ... In Section 3.1, examples are given of how to use tables and figures in MSc theses.

3.1 SECTION TITLE

Every caption of a table (or figure) should start with a capital letter, and should end with a period. References to tables are given with a capital letter for table, as in "(see Table 3.1)" or "in Table 3.1, ...".

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Table 3.1: Complete sentence describing the tabular data.

References to figures are given with a capital letter for figure, as in "(see Figure 3.1)" or "in Figure 3.1, ...".

[?] [?]

Figure 3.1: Complete sentence describing the figure thoroughly.

Chapter 4

Conclusions and Future Work

4.1 Conclusions

TODO CONCLUSIONS

4.2 Future Work

TODO FUTURE WORK