
Preface

Overview

Sensing and planning are at the core of robot motion. Traditionally, mobile robots have been used for performing various tasks with a general-purpose processor on-board. This book grew out of our research enquiry into alternate architectures for sensor-based robot motion. It describes our research starting early 2002 with the objectives of obtaining a time, space and energy-efficient solution for processing sensor data for various robotic tasks.

New algorithms and architectures have been developed for exploration and other aspects of robot motion. The research has also resulted in design and fabrication of an FPGA-based mobile robot equipped with ultrasonic sensors. Numerous experiments with the FPGA-based mobile robot have also been performed and they confirm the efficacy of the alternate architecture.

Organization and Features

Chapter 1 presents the motivation for the work described in this book. Chapter 2 surveys prior work on sensors and processors on mobile robots. Prior work on exploration and navigation algorithms is also described and the algorithms are examined from a VLSI point of view. Chapter 3 presents the details of design and fabrication of the FPGA-based mobile robot used for experiments reported in this book. Chapter 4 presents a hardware-efficient grid-based exploration strategy for dynamic planar environments. Chapter 5 studies the problem of constructing landmarks, in a hardware-efficient manner, using data gathered by the mobile

robot during exploration. Chapter 6 presents a summary of the work described in this book and discusses extensions.

Programs have been developed in Verilog for exploration and other tasks. To give the reader a better feel for the approach, central modules in the Verilog code for exploration have been included in this book as an appendix. A list of suggested mini-projects is included as another appendix.

Audience

This book presents material that is appropriate for courses at the senior undergraduate level and graduate level in the areas of robotics and embedded systems. It is also suitable for researchers in the areas of VLSI-efficient algorithms and architectures. Practising engineers in the area of FPGA-based system design would also find the book to be immensely useful.

Basic familiarity with logic design and hardware description languages would be adequate to follow the material presented in this book.

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