Advanced NXT

The Da Vinci Inventions Book

Matthias Paul Scholz

Advanced NXT: The Da Vinci Inventions Book

Copyright © 2007 by Matthias Paul Scholz

All rights reserved. No part of this work may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or by any information storage or retrieval system, without the prior written permission of the copyright owner and the publisher.

ISBN-13 (pbk): 978-1-59059-843-6 ISBN-10 (pbk): 1-59059-843-1

Printed and bound in the United States of America 987654321

Trademarked names may appear in this book. Rather than use a trademark symbol with every occurrence of a trademarked name, we use the names only in an editorial fashion and to the benefit of the trademark owner, with no intention of infringement of the trademark.

LEGO® and MINDSTORMS® are trademarks or registered trademarks of the LEGO Group in the United States and other countries. Apress, Inc., is not affiliated with the LEGO Group, and this book was written without endorsement from the LEGO Group.

Lead Editors: Matthew Moodie, Jim Sumser

Technical Reviewer: Jim Kelly

Editorial Board: Steve Anglin, Ewan Buckingham, Gary Cornell, Jonathan Gennick, Jason Gilmore,

Jonathan Hassell, Chris Mills, Matthew Moodie, Jeffrey Pepper, Ben Renow-Clarke,

Dominic Shakeshaft, Jim Sumser, Matt Wade, Tom Welsh

Project Manager: Kylie Johnston Copy Edit Manager: Nicole Flores Copy Editor: Jennifer Whipple

Assistant Production Director: Kari Brooks-Copony

Production Editor: Laura Cheu Compositor: Susan Glinert Stevens

Proofreader: Lori Bring Indexer: Carol Burbo Artist: April Milne

Cover Designer: Kurt Krames

Manufacturing Director: Tom Debolski

Distributed to the book trade worldwide by Springer-Verlag New York, Inc., 233 Spring Street, 6th Floor, New York, NY 10013. Phone 1-800-SPRINGER, fax 201-348-4505, e-mail orders-ny@springer-sbm.com, or visit http://www.springeronline.com.

For information on translations, please contact Apress directly at 2855 Telegraph Avenue, Suite 600, Berkeley, CA 94705. Phone 510-549-5930, fax 510-549-5939, e-mail info@apress.com, or visit http://www.apress.com.

The information in this book is distributed on an "as is" basis, without warranty. Although every precaution has been taken in the preparation of this work, neither the author(s) nor Apress shall have any liability to any person or entity with respect to any loss or damage caused or alleged to be caused directly or indirectly by the information contained in this work.

The source code for this book is available to readers at http://www.apress.com in the Source Code/Download section.



Contents at a Glance

About the Author .		X
About the Technica	l Reviewer	Χij
Acknowledgments		X۱
Preface)	(Vi
CHAPTER 1	Introduction	. 1
CHAPTER 2	A 3,000-Foot Look at NXT Programming Environments	29
CHAPTER 3	The Armored Car	55
CHAPTER 4	The Catapult1	07
CHAPTER 5	The Revolving Bridge1	67
CHAPTER 6	The Aerial Screw2	27
CHAPTER 7	The Flying Machine 2	77
CHAPTER 8	Outlook: What NXT? 3	31
APPENDIX A	Installation and Configuration of the Programming	
	Environments Used in the Book	
APPENDIX B	Leonardo's Letter of Application to the Duke of Milan 3	57
APPENDIX C	Glossary 3	59
APPENDIX D	Bibliography3	63
INDFX	3	65

Contents

About the Technica	ıl Reviewer	xiii
Acknowledgments		XV
Preface		xvii
CHAPTER 1	Introduction	1
	An Invention-Driven Tour Through the Life of Leonardo da Vinci	2
	Renaissance Man	
	Five Designs	
	The LEGO MINDSTORMS NXT	
	Hardware	16
	Software	
	The NXT Community	25
	The MINDSTORMS Developer's Program	25
	LEGO.com MINDSTORMS Community NXT	25
	MINDSTORMS Education NXT	25
	The NXT STEP	26
	nxtasy.org	26
	mynxt.matthiaspaulscholz.eu	26
	Summary	27
CHAPTER 2	A 3,000-Foot Look at NXT	
	Programming Environments	29
	LEGO MINDSTORMS NXT Software	20
	NXT-G	
	IDE	
	Example Program Snippets	
	RobotC	
	IDE	
	Example Program Snippets	

	NXC	
	IDE Example Program Snippets	
	pbLua	
	Example Program Snippets	
	leJOS NXJ	
	Example Program Snippets	
	Summary	
CHAPTER 3	The Armored Car	55
	Historical Background	55
	Special Challenges	
	Interpreting the Design	
	Building the Gearing Mechanism	
	Building the Armored Car	59
	Programming the Armored Car	97
	LEGO MINDSTORMS NXT Software	98
	RobotC	99
	NXC	100
	pbLua	
	leJOS NXJ	
	Summary	105
CHAPTER 4	The Catapult	107
	Historical Background	107
	Hardware Challenges	109
	The Double Leaf Spring	109
	The Crank Mechanism	109
	Building the Catapult	111
	Programming the Catapult	147
	LEGO MINDSTORMS NXT Software	
	RobotC	
	NXC	
	pbLua	
	LeJOS NXJ	
	Summary	165

CHAPTER 5	The Revolving Bridge167
	Historical Background 167 Hardware Challenges 168 Building the Revolving Bridge 169 Programming the Revolving Bridge 210 LEGO MINDSTORMS NXT Software 211 RobotC 214 NXC 217 pbLua 219 leJOS NXJ 222 Summary 226
CHAPTER 6	The Aerial Screw227
	Historical Background 227 Hardware Challenges 231 Building the Aerial Screw 231 Programming the Aerial Screw 260 LEGO MINDSTORMS NXT Software 262 RobotC 264 NXC 267 leJOS NXJ 268 pbLua 272 Summary 275
CHAPTER 7	The Flying Machine277
	Historical Background

CHAPTER 8	Outlook: What NXT?	. 331
	Enhancing the Five Robots	. 331
	The Armored Car	. 331
	The Catapult	. 332
	The Revolving Bridge	. 332
	The Aerial Screw	. 333
	The Flying Machine	. 333
	Remotely Controlling the Robots	. 333
	Making Other Inventions of Leonardo with LEGO	. 334
	The Theater Stage for Orpheus	. 335
	The Canal Excavation Machine	
	Recommended Web Sites	
	Web Sites on Leonardo da Vinci	
	Sites on LEGO MINDSTORMS NXT	
	Recommended Books	
	LEGO MINDSTORMS NXT: The Mayan Adventure	
	The LEGO MINDSTORMS NXT Idea Book	
	Maximum LEGO NXT: Building Robots with Java Brains	
	Leonardo's Machines: Da Vinci's Inventions Revealed	. 339
APPENDIX A	Installation and Configuration of the Programming	
	Environments Used in the Book	. 341
APPENDIX B	Leonardo's Letter of Application	
APPENDIA D	to the Duke of Milan	057
	to the Duke of Milan	. 357
APPENDIX C	Glossary	. 359
APPENDIX D	Bibliography	. 363
INDEX		. 365