

contents in detail

acknowledgments	xix
introduction	xxi
who this book is for	xxi
prerequisites	xxi
what to expect from this book	xxi
how best to use this book	xxiii
1	
LEGO and robots: a great combination	1
LEGO MINDSTORMS NXT	1
the NXT online community	2
the LEGO MINDSTORMS NXT kit.....	2
NXT versions	3
MINDSTORMS software versions	3
art and engineering	4
qualities of a good program	4
software, firmware, and hardware.....	5
NXT-G.....	5
what you'll learn from this book.....	6
what's next?	6
2	
the NXT-G programming environment	7
a tour through the MINDSTORMS environment.....	7
a: work area	8
b: programming palettes	8
c: robo center.....	8
d: my portal window	8
e: configuration panel.....	9
f: help panel.....	9
g: navigation panel	9
h: controller.....	9
writing an NXT-G program.....	9
your first program.....	10
saving your work	10
running your program.....	11
your second program	11
debugging	12
reproduce the bug.....	12
simplify the program	12

look at the parts of the program.....	12
fix the bug.....	12
the edit-compile-test cycle.....	13
comments.....	13
adding comments.....	14
rules for working with comments.....	15
the configuration panel.....	15
general layout.....	15
changing panels.....	15
disabled items.....	16
a block's configuration icons.....	16
conclusion.....	16

3 **the test robot..... 17**

right-side motor.....	19
left-side motor.....	21
chassis.....	23
caster wheel.....	25
caster wheel for the NXT 2.0 retail kit.....	25
caster wheel for the original NXT retail kit and education set.....	27
attach the caster wheel.....	29
add the NXT.....	31
touch sensor bumper.....	33
attach the bumper to the chassis.....	36
ultrasonic sensor.....	37
sound sensor.....	38
color sensor or light sensor.....	39
attach the wires.....	41
the final beam.....	42
alternate placement for the color sensor.....	42
alternate placement for the ultrasonic sensor.....	43
conclusion.....	44

4 **motion..... 45**

the NXT motor.....	45
the move block.....	46
the move block's configuration panel.....	46
the feedback boxes.....	48
the NXT intelligent brick view menu.....	48
there and back.....	49
moving forward.....	49
turning around.....	49
testing a single block.....	50
moving back to the start.....	50
around the block.....	50
the first side and corner.....	50

the other three sides and corners	51
testing the program.....	52
the motor block.....	52
brake, coast, and the reset motor block.....	53
the CoastTest program.....	53
a problem with coasting	54
the reset motor block.....	55
the record/play block.....	55
configuration panel	55
the remote control tool.....	56
conclusion.....	56

5

sensors.....	57
using the sensors	57
the touch sensor.....	58
configuration panel	58
feedback box	58
the NXT's view menu	59
the BumperBot program.....	59
detecting an obstacle.....	60
backing up and turning around	60
testing.....	61
the sound sensor.....	61
configuration panel	61
setting the trigger value	61
BumperBot with sound.....	62
the light and color sensors.....	63
light sensor configuration panel.....	63
using the color sensor as a light sensor	64
the RedOrBlue program	64
determining red and blue values.....	64
the switch block	64
improving the program.....	66
using color sensor mode.....	67
the ultrasonic sensor.....	68
configuration panel	68
door chime.....	68
detecting a person	69
playing a chime	69
stopping the chime.....	69
the rotation sensor.....	70
configuration panel	70
the rotation sensor block.....	70
the BumperBot2 program.....	71
conclusion.....	72

6		
program flow	73	
the sequence beam	73	
the switch block	73	
configuration panel	74	
the LineFollower program	75	
more than two choices	76	
using tabbed view	78	
comments and tabbed view	78	
the loop block	79	
the keep alive block	79	
the stop block	80	
BumperBot3	80	
conclusion	82	
7		
the WallFollower program: navigating a maze	83	
pseudocode	83	
solving a maze	86	
program requirements	86	
assumptions	88	
initial design	88	
following a straight wall	89	
writing the code	89	
testing	90	
turning a corner	91	
writing the code	91	
testing	92	
going through an opening	93	
writing the code	94	
using sound blocks for debugging	95	
testing	95	
final test	96	
conclusion	96	
8		
data wires	97	
what is a data wire?	97	
the GentleStop program	97	
tips for drawing data wires	101	
the SoundMachine program	101	
controlling the volume	102	
using the math block	103	
adding tone control to the SoundMachine program	103	
understanding data types	104	
using the number to text block	105	
displaying the tone frequency	105	
using the text block	107	

adding labels to the displayed values.....	108
dealing with broken wires	109
conclusion.....	110

9	
data wires and the switch block.....	111
the switch block's value option	111
rewriting the GentleStop program	112
advantages of using a sensor block.....	113
passing data into a switch block.....	113
passing data out of a switch block.....	113
matching more than two values.....	116
adding and removing conditions.....	117
the default condition.....	117
using numbers with the NXT-G 2.0 switch block.....	117
fixing the SoundMachine program's volume display.....	117
calculating the input value using NXT-G 1.1	118
calculating the input value using NXT-G 2.0	118
modifying the program.....	118
conclusion.....	121

10	
data wires and the loop block	123
the loop count.....	123
creating the LoopCountTest program.....	123
restarting a loop.....	124
setting the final loop count value.....	124
setting the loop condition.....	125
timers	125
the timer block.....	125
a programmable timer, version 1	126
the compare block.....	127
a programmable timer, version 2	127
a programmable timer, version 3	129
conclusion.....	129

11	
variables	131
a place for your data.....	131
managing variables.....	131
the variable block	132
the RedOrBlueCount program.....	133
creating the variables.....	133
initializing the variables	134
initializing the display	135
displaying the initial values.....	135
counting the red objects.....	135
counting the blue objects.....	137

grouping common settings.....	138
replacing long data wires with variables.....	138
the LightPointer program	138
defining the variables.....	139
finding the light source	140
initializing the values	140
the LightPointer program, part 1	141
the LightPointer program, part 2	143
constants	144
managing constants.....	145
the constant block.....	145
conclusion.....	146

12

the NXT buttons and the display block..... 147

the NXT buttons	147
the NXT button block.....	148
the PowerSetting program.....	148
defining the variable.....	148
the initial value and the loop.....	149
displaying the current value	149
adjusting the power value.....	150
testing the program.....	151
making the program faster.....	151
the display block.....	152
displaying an image.....	152
power setting with images.....	153
drawing on the screen	155
the NXTSketch program.....	155
defining the variables.....	156
initialization	156
drawing the line	156
saving the new location	158
testing the program.....	158
conclusion.....	159

13

my blocks 161

building bigger blocks.....	161
creating a my block.....	161
the custom palette.....	163
editing a my block	163
configuring a my block.....	164
changing the name of a configuration item	165
the DisplayNumber block	166
configuration items	166
controlling the line setting using a data wire	166

building the DisplayNumber block.....	167
testing.....	170
creating the DisplayNumber block.....	170
changing the names of the configuration items.....	171
using the DisplayNumber block.....	173
managing the custom palette.....	174
sharing programs with my blocks.....	175
copying files.....	175
create pack and go.....	175
advanced my block topics.....	175
variables and my blocks.....	176
nesting my blocks.....	176
broken my blocks.....	176
adding a data plug.....	177
conclusion.....	177

14

math and logic.....	179
computer math.....	179
integer math.....	179
range of values.....	179
division.....	180
odometer.....	181
floating-point math.....	183
range.....	183
precision.....	183
the number to text block.....	183
the random block.....	184
adding a random turn to BumperBot.....	184
the logic block.....	185
adding some logic to BumperBot.....	186
the range block.....	189
improving RedOrBlue.....	189
improving RedOrBlueColorMode.....	192
conclusion.....	194

15

files.....	195
using files.....	195
the file access block.....	195
the filename.....	196
the action setting.....	196
the type setting.....	196
saving the RedOrBlueCount data.....	197
checking for errors.....	199
the FileReader program.....	200
restoring the RedOrBlueCount data.....	201

managing memory.....	207
deleting files.....	207
transferring files.....	208
common problems.....	208
conclusion.....	208

16

data logging.....	209
data collection and the NXT.....	209
the VerifyLightPointer program.....	209
collecting the brightness data.....	210
running the program.....	211
analyzing the data.....	212
adding rotation sensor data and a timestamp.....	212
gaps in the data.....	214
setting the initial file size.....	215
controlling the amount of data.....	216
data logging using the LEGO MINDSTORMS education NXT software 2.0.....	217
the data-logging blocks.....	217
the VerifyLightPointer2 program.....	218
the NXT data logging application.....	219
conclusion.....	220

17

using multiple sequence beams.....	221
multitasking.....	221
adding a second sequence beam.....	221
avoiding a busy loop.....	223
adding a sequence beam to a loop block.....	223
the crowbar and pin technique.....	224
adding the sequence beam.....	225
expanding the loop block.....	226
making the light flash.....	227
understanding program flow rules.....	229
starting blocks and data wires.....	229
starting a loop or switch block.....	229
using values from a loop or switch block.....	229
using my blocks.....	230
synchronizing two sequence beams.....	230
the AroundTheBlock program.....	230
the DoorChime program.....	230
keeping out of trouble.....	232
conclusion.....	232

18		
the LineFollower program		233
following a line		233
requirements		233
assumptions		233
the starting point		234
selecting the sensor trigger values		234
building the LineFollowerConfig program		235
testing the LineFollowerConfig program		237
changing the LineFollower program		238
improving the control algorithm		243
how far from the edge?		244
controlling the motors		248
setting the power values		248
testing the program		251
conclusion		251
A		
NXT websites		253
B		
moving from NXT-G 1.0/1.1 to NXT-G 2.0		255
numbers		255
block changes		255
using old programs		256
side-by-side installation		256
index		257