

Pro Android Augmented Reality



Raghav Sood

Apress®

Pro Android Augmented Reality

Copyright © 2012 by Raghav Sood

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed. Exempted from this legal reservation are brief excerpts in connection with reviews or scholarly analysis or material supplied specifically for the purpose of being entered and executed on a computer system, for exclusive use by the purchaser of the work. Duplication of this publication or parts thereof is permitted only under the provisions of the Copyright Law of the Publisher's location, in its current version, and permission for use must always be obtained from Springer. Permissions for use may be obtained through RightsLink at the Copyright Clearance Center. Violations are liable to prosecution under the respective Copyright Law.

ISBN 978-1-4302-3945-1

ISBN 978-1-4302-3946-8 (eBook)

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

The images of the Android Robot (01 / Android Robot) are reproduced from work created and shared by Google and used according to terms described in the Creative Commons 3.0 Attribution License. Android and all Android and Google-based marks are trademarks or registered trademarks of Google, Inc., in the U.S. and other countries. Apress Media, L.L.C. is not affiliated with Google, Inc., and this book was written without endorsement from Google, Inc.

The use in this publication of trade names, trademarks, service marks, and similar terms, even if they are not identified as such, is not to be taken as an expression of opinion as to whether or not they are subject to proprietary rights.

While the advice and information in this book are believed to be true and accurate at the date of publication, neither the authors nor the editors nor the publisher can accept any legal responsibility for any errors or omissions that may be made. The publisher makes no warranty, express or implied, with respect to the material contained herein.

President and Publisher: Paul Manning

Lead Editor: Steve Anglin

Technical Reviewers: Yosun Chang, Chád Darby

Editorial Board: Steve Anglin, Ewan Buckingham, Gary Cornell, Louise Corrigan, Morgan Ertel, Jonathan Gennick, Jonathan Hassell, Robert Hutchinson, Michelle Lowman, James Markham, Matthew Moodie, Jeff Olson, Jeffrey Pepper, Douglas Pundick, Ben Renow-Clarke, Dominic Shakeshaft, Gwenan Spearing, Matt Wade, Tom Welsh

Coordinating Editors: Corbin Collins, Christine Ricketts

Copy Editors: Vanessa Moore; Nancy Sixsmith, ConText Editorial Services

Compositor: Bytheway Publishing Services

Indexer: SPi Global

Artist: SPi Global

Cover Designer: Anna Ishchenko

Distributed to the book trade worldwide by Springer Science+Business Media New York, 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 www.springeronline.com.

For information on translations, please e-mail rights@apress.com, or visit www.apress.com.

Apress and friends of ED books may be purchased in bulk for academic, corporate, or promotional use. eBook versions and licenses are also available for most titles. For more information, reference our Special Bulk Sales—eBook Licensing web page at www.apress.com/bulk-sales.

Any source code or other supplementary materials referenced by the author in this text is available to readers at www.apress.com. For detailed information about how to locate your book's source code, go to www.apress.com/source-code.

To my family and friends

-Raghav Sood

Contents at a Glance

■ About the Author	xi
■ About the Technical Reviewers	xii
■ Acknowledgments	xiii
■ Introduction	xiv
■ Chapter 1: Applications of Augmented Reality	1
■ Chapter 2: Basics of Augmented Reality on the Android Platform	13
■ Chapter 3: Adding Overlays	41
■ Chapter 4: Artificial Horizons.....	65
■ Chapter 5: Common and Uncommon Errors and Problems	95
■ Chapter 6: A Simple Location-Based App Using Augmented Reality... ..	107
■ Chapter 7: A Basic Navigational App Using Augmented Reality... ..	141
■ Chapter 8: A 3D Augmented Reality Model Viewer	159
■ Chapter 9: An Augmented Reality Browser.....	221
■ Index	319



Contents

- About the Author..... xi
- About the Technical Reviewers xii
- Acknowledgments xiii
- Introduction xiv
- Chapter 1: Applications of Augmented Reality 1
- Augmented Reality vs. Virtual Reality 1
- Current Uses 1
 - Casual Users.....2
 - Military and Law Enforcement.....4
 - Vehicles4
 - Medical5
 - Trial Rooms.....6
 - Tourism.....6
 - Architecture.....6
 - Assembly Lines.....7
 - Cinema/Performance.....7
 - Entertainment.....7
 - Education.....8
 - Art.....8
 - Translation.....8
 - Weather Forecasting9
 - Television9
 - Astronomy9
 - Other.....9
- Future Uses 10
 - Virtual Experiences.....10
 - Impossible Simulations10

Holograms	11
Video Conferencing.....	11
Movies	11
Gesture Control.....	12
Summary.....	12
■ Chapter 2: Basics of Augmented Reality on the Android Platform	13
Basics of Augmented Reality on the Android Platform.....	13
Creating the App	13
Camera.....	14
Orientation Sensor	21
Accelerometer.....	24
Global Positioning System (GPS)	28
Latitude and Longitude)	29
ProAndroidAR2Activity.java.....	32
AndroidManifest.xml.....	36
main.xml	37
Sample LogCat Output	37
Summary	38
■ Chapter 3: Adding Overlays	41
Adding Overlays.....	41
Widget Overlays	41
Layout Options.....	43
Updating main.xml with a RelativeLayout	45
TextView Variable Declarations.....	49
Updated onCreate	49
Displaying the Sensors' Data.....	49
Updated AndroidManifest.xml	52
Testing the App	53
Markers.....	54
Activity.java.....	54
CustomObject Overlays	56
CustomRenderer	60
AndroidManifest	62
Summary	63
■ Chapter 4: Artificial Horizons.....	65
A Non-AR Demo App	65
The XML.....	66

The Java	67
The Android Manifest.....	77
Testing the Completed App.....	78
An AR Demo App	80
Setting Up the Project.....	81
Updating the XML	82
Updating the Java Files	86
Testing the Completed AR app.....	92
Summary.....	93
■ Chapter 5: Common and Uncommon Errors and Problems	95
Layout Errors	95
UI Alignment Issues	95
ClassCastException	96
Camera Errors.....	97
Failed to Connect to Camera Service	97
Camera.setParameters() failed	98
Exception in setPreviewDisplay().....	99
AndroidManifest Errors.....	100
Security Exceptions	100
<uses-library>	101
<uses-feature>	101
Errors Related to Maps	102
The Keys.....	102
Not Extending MapActivity.....	102
Debugging the App.....	103
LogCat	103
Black and White Squares When Using the Camera	104
Miscellaneous	105
Not Getting a Location Fix from the GPS	105
Compass Not Working	105
Summary.....	106
■ Chapter 6: A Simple Location-Based App Using Augmented Reality... ..	107
A Simple Location-Based App Using Augmented Reality and the Maps API .	107
Editing the XML.....	109
Creating Menu Resources	111
Layout Files	112
Getting API Keys	117
Getting the MD5 of Your Keys.....	118

Java Code	118
Main Activity	119
FlatBack.java	128
FixLocation.java	132
Running the App	135
Common errors	138
Summary.....	139
■ Chapter 7: A Basic Navigational App Using Augmented Reality... ..	141
The New App	141
Updated XML files.....	142
Updated Java files	145
Updated AndroidManifest	155
The Completed App	155
■ Chapter 8: A 3D Augmented Reality Model Viewer	159
Key Features of this App.....	160
The Manifest	162
Java Files.....	163
Main Activity	163
AssetsFileUtility.java.....	168
BaseFileUtil.java	169
CheckFileManagerActivity.java.....	170
Configuration File	175
Working with Numbers	175
Group.java	178
Instructions.java	180
Working with Light	181
Creating a Material	183
MemUtil.java.....	186
Model.java	187
Model3D.java.....	189
Viewing the Model.....	191
Parsing .mtl files.....	199
Parsing the .obj files.....	203
ParseException.....	207
Rendering	207
SDCardFileUtil.java	209
SimpleTokenizer.java	210
Util.java.....	211
3D Vectors	213
XML Files.....	214

Strings.xml	214
Layout for the Rows.....	215
instructions_layout.xml	215
List Header	216
main.xml	216
HTML Help File	217
Completed App.....	219
Summary	220
■ Chapter 9: An Augmented Reality Browser.....	221
The XML	222
strings.xml	222
menu.xml	222
The Java Code.....	223
The Activities and AugmentedView	223
Getting the Data	242
DataSource	242
LocalDataSource.....	242
NetworkDataSource	243
TwitterDataSource.....	246
WikipediaDataSource	250
Positioning Classes.....	252
ScreenPositionUtility	254
The UI Works	255
PaintableObject	255
PaintableBox	258
PaintableBoxedText	260
PaintableCircle.....	263
PaintableGps.....	264
PaintableIcon	265
PaintableLine	266
PaintablePoint.....	267
PaintablePosition.....	268
PaintableRadarPoints	270
PaintableText.....	271
Utility Classes	273
Vector	273
Utilities.....	277
PitchAzimuthCalculator	277
LowPassFilter	278
Matrix	280

Components 285

 Radar 285

 Marker 289

 IconMarker.java 302

Customized Widget 303

 VerticalSeekBar.java 304

Controlling the Camera 305

 CameraSurface.java 305

 CameraCompatibility 309

 CameraModel 310

The Global Class..... 311

 ARData.java 311

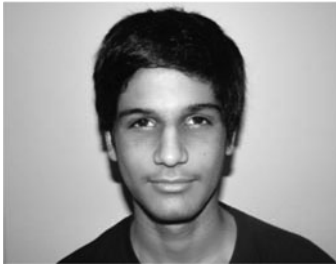
 AndroidManifest.xml..... 316

 Running the App 317

Summary..... 318

■ **Index 319**

About the Author



■ **Raghav Sood**, born on April 16, 1997, is a young Android developer. He started seriously working with computers after learning HTML, CSS, and JavaScript while making a website at the age of nine. Over the next three years, Raghav developed several websites and quite a few desktop applications. He has learned several programming languages, including PHP, Java, x86 assembly, PERL, and Python. In February 2011, Raghav received his first Android device, an LG Optimus One running Froyo. The next day, he began work on his first Android app. He is currently the owner of an Android tutorial site, an author on

the Android Activist site and the developer of 12 Android apps. Raghav regularly takes part in the android-developers Google Group, trying to help whomever he can. Raghav also enjoys reading, photography and robotics. He currently resides in New Delhi, India. This is his first book.

About the Technical Reviewers

■ **Yosun Chang** has been creating apps for iOS and Android since early 2009, and is currently working on a next generation 3D and augmented reality mobile games startup called nusoy. Prior to that, since 1999 she did web development on the LAMP stack and Flash. She has also spoken at several virtual world, theater, and augmented reality conferences under her artist name of Ina Centaur. She has a graduate level background in physics and philosophy from UC San Diego and UC Berkeley. An avid reader who learned much of her coding chops from technical books like the current volume, she has taken care to read every single word of the chapters she reviewed — and vet the source. Contact her @yosunchang on Twitter.

■ **Chád Darby** is an author, instructor, and speaker in the Java development world. As a recognized authority on Java applications and architectures, he has presented technical sessions at software development conferences worldwide. In his 15 years as a professional software architect, Chád has had the opportunity to work for Blue Cross/Blue Shield, Merck, Boeing, Northrop Grumman, and a handful of startup companies.

Chád is a contributing author to several Java books, including *Professional Java E-Commerce* (Wrox Press), *Beginning Java Networking* (Wrox Press), and *XML and Web Services Unleashed* (Sams Publishing). Chád has Java certifications from Sun Microsystems and IBM. He holds a B.S. in Computer Science from Carnegie Mellon University.

You can read Chád's blog at www.luv2code.com and follow him on Twitter @darbyluvs2code.



Acknowledgments

Writing a book is a huge task. It's not the same as writing a blog or a review. It requires a lot of commitment right until the end. The difference in the time zones in which the team and I are located made it a little harder to communicate, but we managed quite well.

I was helped by several people in this project and would like to take the opportunity to thank them here.

First, I would like to thank Steve Anglin for having faith in me when he decided to sign me up for this book. I hope you feel that this faith was well placed. I would also like to thank Corbin Collins, Christine Ricketts, and Kate Blackham for putting up with the delays and giving me a gentle nudge to meet the deadlines, as well as their amazing work on this book.

On the more technical side, I would like to thank my tech reviewers Chád Darby and Yosun Chang for their invaluable input. I would also like to thank Tobias Domhan for writing the excellent AndAR library, the development of which will be continued by both of us from now on.

Finally, I would like to thank my family for their support, particularly for patience while I ignored them while working on this book.

Without all of these people, you would not be reading this book today.

–Raghav Sood

Introduction

Augmented reality is relatively recent development in the field of mobile computing. Despite its young age, it is already one of the fastest growing areas in this industry. Companies are investing lots of money in developing products that use augmented reality, the most notable of which is Google's Project Glass. Most people perceive augmented reality as hard to implement. That's a misconception. Like with any good app, good augmented reality apps will take some amount of effort to write. All you need to do is keep an open mind before diving in.

Who This Book Is For

This book is aimed at people who want to write apps employing augmented reality for the Android platform by Google. The book expects familiarity with the Java language and knowledge of the very basics of Android. However, an effort has been made to ensure that even people without such experience can understand the content and code. Hopefully, by the time you're done with this book, you'll know how to write amazing and rich Android apps that use the power of augmented reality.

How This Book Is Structured

This book is divided into nine chapters. We start with a basic introduction to augmented reality and move up through more and more complex features as we go. In Chapter 5, we take a look at dealing with the common errors that can happen in an augmented reality app. After that, we have four example apps that show use how to make increasingly complex augmented reality applications. A more detailed structure is given here:

- **Chapter 1:** This chapter gives you an idea of what augmented reality really is. It has several examples of how augmented reality has been used throughout the world, along with a short list of potential future applications.
- **Chapter 2:** This chapter guides you through writing a simple augmented reality app that consists of the four main features an augmented reality app usually uses. By the end of this chapter, you will have a skeleton structure that can be extended into any augmented reality application.

- **Chapter 3:** In this chapter, you are introduced to some of augmented reality's most important features: overlays and markers. In the span of two example apps, we cover using standard Android widgets as overlays as well as using the open source AndAR library to add marker recognition to our app.
- **Chapter 4:** The fourth chapter introduces the concept of artificial horizons by using a nonaugmented reality app. Then a second app is written that utilizes artificial horizons in an augmented reality app.
- **Chapter 5:** This chapter talks about the most common errors found while making an augmented reality app and also provides solutions for them. In addition to the errors, it also talks about other problems that don't result in an error, but still manage to stop your app from functioning as intended.
- **Chapter 6:** In this chapter, we write the first of our four example apps. It is an extremely simple AR app that provides basic information about the user's current location as well as plotting it on a map.
- **Chapter 7:** This chapter shows you how to extend the example app from Chapter 6 into a proper app that can be used to allow the user to navigate from his/her current location to one set on the map by the user.
- **Chapter 8:** This chapter shows you how to write an augmented reality model viewer using the AndAR library that allows you to display 3D models on a marker.
- **Chapter 9:** The last chapter of this book demonstrates how to write the most complex app of all: an augmented reality world browser that shows data from Wikipedia and Twitter all around you.

Prerequisites

This book contains some fairly advanced code, and it is assumed that you are familiar with the following:

- Java programming language
- Basic object-oriented concepts
- Android platform (moderate knowledge)
- Eclipse IDE basics

While it is not an absolute requirement to have all these prerequisites, it is highly recommended. You will absolutely need an Android device to test your apps on because many of the features used in the apps are not available on the Android emulator.

Downloading the Code

The code for the examples shown in this book is available on the Apress web site, www.apress.com/9781430239451. A link can be found on the book's information page under the Source Code/Downloads tab. This tab is located underneath the Related Titles section of the page.

You can also get the source code from this book's GitHub repository at <http://github.com/RaghavSood/ProAndroidAugmentedReality>.

In case you find a bug in our code, please file an issue for it at the GitHub repository, or directly contact the author via the means given below.

Contacting the Author

In case you have any questions, comments, or suggestions, or even find an error in this book, feel free to contact the author at raghavsood@appaholics.in via e-mail or via Twitter at [@Appaholics16](https://twitter.com/Appaholics16).