SmartWatch Design Fundamentals

WatchFace Design for Samsung Galaxy SmartWatches

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This Smartwatch Design Fundamentals book is dedicated to everyone in the open-source community who is working so diligently to make professional new media application development software and content development tools freely available to rich application developers to utilize to achieve our creative dreams and our financial goals. Last, but not least, I dedicate this book to my father, Parker Jackson, my family, my lifelong friends, and my Point Concepcion Peninsula production ranch neighbors, for their constant help, assistance, and those stimulating, late night BBQs.

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About the Author

Wallace Jackson has been writing for several leading multimedia publications about groundbreaking multimedia content development industry work since the advent of the *Multimedia Producer* magazine, when he wrote about advanced computer processing architectures, for the issue centerfold (a removable "mini-issue" insert) distributed at one of the first SIGGRAPH trade shows. Since then, Wallace Jackson has written for a large number of popular new media publications, about his work in interactive 3D and new media advertising campaign design. These include *3D Artist* magazine, *Desktop Publishers Journal*, *CrossMedia* magazine, *Kiosk* magazine, *AVvideo/Multimedia Producer* magazine, *Digital Signage* magazine, and many other vanguard publications. Wallace Jackson has authored two dozen Apress books, including several books in the popular Pro Android series, several Java (JavaFX) game development books, digital image compositing books, digital video editing books, digital audio editing books, special effects (VFX) books, and new media content design and production books.

This *Smartwatch Design Fundamentals* book focuses on the new media genres which are supported in Samsung's new Galaxy Watch Designer and the concepts, terminology, work processes, and data footprint optimizations, which will be needed to make great Samsung Galaxy Watch Face multimedia for your Tizen 3.0 and 4.0 smartwatch application designs.

Wallace Jackson is currently the founder and CEO of Mind Taffy Design, a new media content production and digital new media campaign design and development agency which is located in the Northern Santa Barbara County, halfway between their clientele in Silicon Valley to the North and Hollywood, "The OC," West Los Angeles, and San Diego to the South.

ABOUT THE AUTHOR

Mind Taffy Design has created open-source technology-based (HTML5, JavaScript, CSS4, Java, JavaFX, Tizen, and Android) digital new media i3D content deliverables for more than a quarter century (since 1991) for a significant number of major international branded manufacturers, including Sony, Tyco, Samsung, IBM, Dell, Epson, Nokia, TEAC, SGI, KFC, Sun Microsystems, Micron, KDS USA, EIZO, CTX International, Nanao USA, Techmedia, EZC, Adobe, and Mitsubishi.

Wallace Jackson received his undergraduate BA degree in Business Economics from the University of California, Los Angeles (UCLA). He received his graduate degree in MIS Design and Implementation from the University of Southern California (USC), also in Los Angeles. Mr. Jackson received his postgraduate degree in Marketing Strategy from USC, and he also completed the famed USC Graduate Entrepreneurship Program. The two USC degrees were completed while he was at USC's nighttime Marshall School of Business MBA Program, which allowed Mr. Jackson to also work full-time in the day as an RPG-2 and COBOL programmer while he completed his USC graduate and postgraduate MIS business information systems design and marketing degrees at night.

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Fabio Claudio Ferracchiati is a senior consultant and a senior analyst/developer using Microsoft technologies. He works for BluArancio (www.bluarancio.com). He is a Microsoft Certified Solution Developer and Microsoft Certified Application Developer for .NET, a Microsoft Certified Professional, and a prolific author and technical reviewer. Over the past ten years, he's written articles for Italian and international magazines and coauthored more than ten books on a variety of computer topics.

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Finally, I'd like to acknowledge Linus Torvalds and his Tizen 4 team for continuing to enhance Linux and Tizen 4.0 so that these desktop and mobile operating systems will remain the premiere open-source operating systems and so that open-source multimedia content will continue to take this expanding industry to the next level.

Introduction

Smartwatch Design Fundamentals is designed for budding smartwatch designers, programmers, multimedia producers, application designers, Tizen user interface or user experience designers, and anyone interested in developing custom watch faces using new media supported by Tizen 4.0 and Galaxy Watch Designer 1.6.2 or later software.

Chapter 1 covers smartwatch history, terms, fundamentals, and software installation for the tools that we will be learning about and using during the course of this book. We cover many of the Samsung smartwatches which have come out and are supported by the open-source Samsung Galaxy Watch Design (currently Version 1.6.2) software package.

Chapter 2 covers how to acquire free for commercial use or Creative Commons Zero (CC0) assets which we can use to create smartwatch face designs. We look at how to find the popular sites which contain these assets as well as how to download and acquire them.

Chapter 3 covers smartwatch face design types such as analog, digital, and hybrid watch face designs and other considerations regarding the watch faces you will design over the course of this book.

Chapter 4 covers watch face design states such as Active Mode, Low-Bit Color Always-On Mode, and High Color Always-On Mode, as these modes exist across all Samsung Galaxy and Gear Watch models. These different modes exist to allow battery power to be saved by watch face designs, so that models that use Always-On technology to save power allow watch face designers to customize the colors used in their watch faces. When a user rotates their wrist to view the watch face using millions of colors (called Active Mode), when in this mode a smartwatch is using all of the watch's battery power.

Chapter 5 covers the fourth dimension of watch face design, that is, motion-capable or animated watch faces. In this chapter, we show you how to create watch face designs that feature animated elements, as well as how to create the motion assets used in such a design using digital image compositing software such as GIMP 2.10.8.

Chapter 6 takes a look at the various ways to test your watch face design, including the **Run (emulator) Icon** in the Galaxy Watch Designer 1.6.2 software package, the **Samsung Remote Testing Lab** (aka RTL) online in South Korea, the United States, and Poland, and on actual smartwatch devices, such as the Galaxy Watch, Gear Fit, Gear Fit 2, Gear S, Gear S2, Gear S3, or the Gear Sport or Frontier.

Chapter 7 covers how to design watch faces outside of the Galaxy Watch Designer 1.6.2 software package using open-source software packages such as Inkscape and GIMP 2.10.8. It covers the use of layers in GIMP 2.10 to create watch face designs in a way that allows you to export all of the "assets" needed in the Galaxy Watch Designer (GWD) software.

Chapter 8 then shows you how to create an all-original watch face design using the assets which were created in Chapter 7 using GIMP 2.10.8.

Chapter 9 covers Battery Charge Percentage conditional statement implementation, so we can turn the watch face design from a black pinwheel into a red pinwheel as the battery power runs out, giving the user a visual indication of battery power usage.

Chapter 10 covers how to add, design, and modify watch face complications, which are like mini-watch faces within a larger watch face design. These usually show things such as heart rate (beats), steps taken, altitude (floor or story height), battery power used, day of week or month, date, seconds, temperature, humidity, or other chronometer-like indicators you wish to add to your watch face design.

Chapter 11 covers the smartwatch gyroscope sensor, as well as the Gyro Effects section of the Galaxy Watch Designer Properties pane. Almost all of the watch face design properties panes feature the Gyro Effect

section, and we look at how to dissect sample watch face designs that come with the Galaxy Watch Designer in order to learn more about the features.

Chapter 12 covers how to add weather features to the watch face design using the Open Weather API. This chapter covers how to sign up for the Open Weather API, how to get a key, how much the different plans cost, what are the weather watch face limitations, and how to build a weather-capable watch face.

Chapter 13 covers Tag Expressions, which allow developers to add algorithms to their watch face design. This chapter covers which sensors feature Tag Expression keywords and the syntax that is used to develop Tag Expressions which can be used in watch face design.

Chapter 14 finally ends the book covering how to publish your watch face designs in the Samsung Galaxy Watch Store as a Seller, as well as covering Samsung Theme Development which is closely tied to Galaxy Watch Face Design.

This Samsung Galaxy *Smartwatch Design Fundamentals* book is chock-full of tips, tricks, tools, topics, terminology, techniques, and work processes. This watch face design fundamentals book can help you to transition from Tizen smartwatch designer amatuer to a knowledgable professional where your smartwatch design compositing pipeline is concerned, so that you will understand how to incorporate other valuable open-source software packages (Inkscape, GIMP, Blender, Audacity, Fusion, Resolve, etc.) with the Samsung Galaxy Watch Designer software package covered within this book.

CHAPTER 1

Smartwatch Design History, Concepts, Terms, and Installation

In this first chapter of the *Smartwatch Design Fundamentals* book, let's look at the history of some of the popular smartwatches of the past decade, some of the concepts involved with smartwatches, as well as popular terminology used for watch face design components.

First we'll cover some of the popular smartwatches released under the Android (Google) and Tizen (Samsung) operating systems. As part of this, we will cover smartwatch development platforms such as Android WEAR, WEAR2, and Tizen as well as popular terminology. This book covers Samsung's Tizen development platform for Galaxy or Gear, while my previous *Pro Android Wearables* book covered Android WEAR and WEAR2 smartwatch watch face design technologies.

Finally, we'll finish up this first chapter by making sure that you have the design and development software package used for the book properly downloaded and installed on your Windows 10 (or a MacOS) system.

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Since most readers are using the popular Windows Operating System, as hardware systems running that are available at stores such as Walmart and are quite affordable, often costing less than $500 per computer tower. We are using Windows for the screenshots used in the figures utilized throughout this book. The MacOS screens are identical.

The History of the Smartwatch

The first thing we're going to do is look at some of the major smartwatches released nearly a decade ago, starting in 2012. Some watches released before then were electronic, but did not utilize an advanced OS platform like Android or Tizen, so I'm not terming these "smartwatches," but instead "digital watches," and therefore not including watches prior to Sony's Smartwatch in this history section. We'll look at how display resolution and 3G/4G connection capability have evolved over time, as color depth, resolution, and sensors define what the watch face application developer can do using a given smartwatch device.

Sony Smartwatch (2012)

Going back almost a decade, the first popular smartwatch was the Sony Smartwatch, released in 2012, running the Android WEAR API on a 1.3" OLED (Organic Light-Emitting Diode) display. The Sony Smartwatch (V1) has been succeeded by the Sony Smartwatch 2 in 2013 and the Sony Smartwatch 3 released in 2017, which runs the Android WEAR2 API. The Sony Smartwatch 4 is slated for release sometime during 2019. The Sony Smartwatch 4 will finally feature 4G connectivity, so it can be used without "tethering" it to a smartphone using Bluetooth, which the previous three Sony Smartwatches required.

Pebble Smartwatch (2013)

By 2013, in response to the Sony Smartwatch, a start-up company named Pebble had developed a smartwatch in 2012 and released an affordable smartwatch by January of 2013. Pebble smartwatches could be connected to Android or iOS phones and were able to show notifications and messages which came into the smartphone on the smartwatch. Support for Pebble smartwatches stopped in June of 2018.

Samsung Galaxy Gear Smartwatch (2013)

Thanks to Sony and Pebble, 2013 turned out to be a huge year for smartwatches. In September of 2013, another major industry player, Samsung Electronics, released the Galaxy Gear Smartwatch. There was a Galaxy Gear running Android WEAR and another version which ran an open source **Tizen OS** from **the Linux Foundation**. A recent version was recently rebranded as the Samsung Galaxy Watch and is one of the smartwatches we will be developing for throughout this book.

Neptune Pine Smartwatch (2013)

In 2013 Neptune announced the Neptune Pine Smartwatch. The Neptune Pine became available to users in 2014 and ran the full Android OS. I covered the development of the Android WatchFace API in my *Pro Android Wearables* book for Neptune Pine because it did not need to be "tethered" to a smartphone, which is far more common these days. The Pine is still under development in 2018 for the Android OS.

Samsung Gear Fit Smartwatch (2014)

In April of 2014, Samsung released the Gear Fit Smartwatch, which had a slim, curved OLED screen and fitness tracking sensors, which are a popular smartwatch feature for users who like to track their fitness. Features include a Heart Rate sensor, Pedometer, Exercise Modes for Running and Walking, Companion Modes for Cycling and Hiking, and Sleep sensor. Samsung Gear Fit features a slim 1.84" curved Super AMOLED touch display with 432 x 128 pixel resolution. A 210 mAh battery gives users 3–5 days of usage before recharging. The watch body measures 23.4 mm x 57.4 mm x 11.95 mm (0.92 in x 2.26 in x 0.47 in), has replaceable watch bands, and weighs only 27 g (less than 1 ounce).

LG "G" and "R" Smartwatches (2014)

The LG G Watch (model W100, also code named Dory) is an Android WEAR-based smartwatch announced and released by LG and Google on June 25, 2014. It is compatible with smartphones running Android 4.3 or later that support Bluetooth LE. The G Watch "R" version features a round face using an OLED. These smartwatches used a Qualcomm Snapdragon 400 quad-core 1.2 GHz CPU and 512 MB of system memory with 4 GB of solid-state (Flash memory) storage. The display was a 1.65 in (42 mm) LCD with a RGB matrix using a lower screen resolution of 280 by 280 pixels. The smartphone connectivity was accomplished using Bluetooth LE, and the battery power was 400 mAh.

Samsung Gear S Smartwatch (2014)

Samsung released the Gear S in August of 2014, this smartwatch is untethered from the smartphone using 3G connectivity and has increased display quality using a 2 inch curved Super AMOLED display, with a 360 by 480 resolution. The Gear S is powered by a dual-core Snapdragon 400

processor from Qualcomm and has half a gigabyte of system memory (512 MB) and 4 GB of SSD (Solid-State Data) storage (equivalent to a high-speed hard disk drive, or HDD). The display is a large 2-inch (51 mm, for those who prefer larger, 46–56 mm, watches) curved Super AMOLED with RGB matrix technology using 172,800 pixels (360 x 480 pixels at a 3:4 aspect ratio). Display input is accomplished via a capacitive multitouch screen, and features include an Accelerometer, a Gyroscope, a Compass, a Heart Rate Monitor (HRM), an Ambient Light sensor, a UV sensor (the Gear S is the only smartwatch which features one of these), and a Barometer. This smartwatch is a pretty amazing value for a couple hundred bucks, being the only smartwatch with a UV sensor on the market, and it is also still available half a decade later, in 2019! For these reasons, this is one of the smartwatches supported by the GWD software that we will be covering in this book.

Samsung Gear S2 Smartwatch (2015)

Samsung released the Gear S2 in 2015, which can be untethered from the smartphone using optional 3G connectivity and has increased display quality using a 1.2” 302 PPI (Pixels Per Inch) Super AMOLED circular display with a 360 by 360 resolution. The display features capacitive touchscreen input, dual microphones, and sensors for a Pedometer (9-axis sensor), PPG heart rate monitor, and ambient light sensor. The non-3G model can connect with Wi-Fi (802.11 b/g/n) or Bluetooth LE. The Gear S2 also has a Speaker (available on the 3G version only). This watch features a rotating bezel user interface (UI) and an IP68 rating for water resistance up to 1.5 meters deep for up to 30 minutes. It is compatible with 20-mm-width watch straps for Men who like larger-sized watches. The processor on the non-3G model is an Exynos 1 GHz dual-core ARM Cortex-A7 CPU, and the processor on the 3G model is a Qualcomm Snapdragon 400 1.2 GHz dual-core ARM Cortex-A7 CPU.

Apple iWatch (2015)

In April of 2015, Apple unveiled the iWatch, with significantly lesser resolution than the 360 x 480 Samsung Gear S, at 340 x 272 pixel and 390 x 312 pixel versions. Apple smartwatches use the WatchOS 2 API to tether to the iPhone, much like early Android WEAR smartwatches tethered to Android smartphones. A second generation was released in 2016, a third generation in 2017, and a fourth generation in 2018. The iWatch uses a 32-bit ARM CPU and system memory ranges from 512 MB for iWatch V1 up to 768 MB in later versions. Since this book focuses on open-source Tizen (Linux Foundation) smartwatch development for Samsung smartwatch models, which sport the most features at the lowest price points, I will focus primarily on those models and specifications throughout this chapter, as we will be developing for them in the rest of this book.

Huawei Watch (2015)

On September of 2015, Huawei released its Android Smartwatch. The Huawei Watch form factor is based on the circular design of traditional watches, like many of Samsung's smartwatches. Huawei Watch supports a 42 mm (1.4 inch) AMOLED display. The screen's resolution is one of the highest (best) at 400 x 400 pixels at more than 285 PPI, although LG now has a model which features 480 by 480 pixels. This first Huawei Watch used a powerful 1.2 GHz Qualcomm Snapdragon 400 processor. All versions of the original Huawei Watch had 512 MB of RAM and 4 GB of internal data storage, along with a gyroscope, accelerometer, vibration motor, and heart rate sensor. It supports Wi-Fi and Bluetooth 4.1 LE, but does not support GPS location. The watch uses a magnetic charging cradle, with a day and a half of battery life at 300 mAh.

The watch face case is impressive, comprised of stainless steel, covered with a sapphire crystal glass on the watch face front, and is available in six custom finishes: Black Leather, Steel Link Bracelet, Stainless Steel Mesh, Black-plated Link Bracelet, Alligator-pressed Brown Leather, and Rose Gold-plated Link Bracelet.

Samsung Gear Fit 2 Smartwatch (2016)

The successor to the Gear Fit came out in June of 2016 and was aptly named the Gear Fit 2. Compared to the Gear Fit of 2014, the Fit 2 has a new wristband and has an updated design, a built-in GPS, and an ability to automatically recognize different fitness activities. The Gear Fit 2 features a Barometer and a Heart Rate Monitor. It is compatible with Android phones running OS 4.4 or later. It uses the Tizen operating system and featured a 1 GHz CPU with a 4 GB SSD. The display is a slim curved AMOLED, at 38 mm (1.5 in) of diagonal size, with 216 x 432 pixel resolution at a 1:2 aspect ratio. It is powered by a 200 mAh lithium-ion battery.

Samsung Gear S3 Smartwatch (2016)

On November 18 of 2016, Samsung unveiled the Gear S3 Smartwatch, with 360 by 360 resolution at 278 PPI (Pixels Per Inch, a pixel density measurement) in a 1.3 inch Super AMOLED (round) screen. Samsung Gear 3 Smartwatches use the Tizen 3.0 OS and feature sensors for an Accelerometer, Gyro, Barometer, Heart Rate Monitor, Ambient light, and Speedometer. The Gear S3 has two models: the Classic and Frontier. The Classic has a silver watch case and black leather band; the Frontier has a black watch case and rubber band. Both are water resistant, rated IP68, and have GPS. One notable feature is that the bezel ring rotates as part of a user interface, although users can also navigate by swiping the screen or using the two buttons on the side. The Gear S3 features advanced 380 mAh wireless charging, using a WPC inductive charger.

Huawei Watch 2 (2017)

By April of 2017, Huawei had released its Android WEAR2 Smartwatch. The Huawei Watch 2 form factor is also based on the circular design of traditional watches, like many of Samsung's smartwatches. Huawei Watch supports a 45 mm (1.2 inch) AMOLED display. The screen's resolution is slightly lower at 390 x 390 pixels at more than 325 PPI. This watch uses a powerful 1.1 GHz Qualcomm Snapdragon 2100 WEAR processor. The Huawei Watch 2 has 768 MB of RAM and 4 GB of internal data storage, along with a gyroscope, accelerometer, vibration motor, and heart rate sensor. It supports Wi-Fi and Bluetooth 4.1 LE, but does not support GPS location. The watch uses a magnetic charging cradle, with a day and a half of battery life at 420 mAh. The Huawei Watch case is impressive, and looks like a conventional analog watch, comprised of stainless steel with Corning Gorilla Glass 3 on the watch face front. It is available in six custom finishes: Black Leather, Steel Link Bracelet, Stainless Steel Mesh, Black-plated Link Bracelet, Alligator-Imprinted Brown Leather, and Rose Gold-plated Link Bracelet.

Samsung Gear Sport Smartwatch (2017)

In 2017 Samsung unveiled the Gear Sport Smartwatch, with 360 by 360 resolution at 302 PPI (Pixels Per Inch) in a 1.2 inch Super AMOLED (round) screen. Samsung Gear Sport Smartwatches feature a simpler and more durable exterior bezel and strap design, which is more optimized for use in sporting scenarios, but use advanced technologies such as the Tizen 3.0 OS and advanced sensors for Accelerometer, Gyro, Barometer, Heart Rate Monitor, and Ambient Light. The Gear Sport also features water resistance to five atmospheres (5 ATM) and weighs only 67 g. It uses the latest Gorilla Glass 3 standard and Bluetooth 4.2, NFC, GPS, and Wi-Fi connectivity. It features 768 MB (3/4 GB) system RAM and sports a 300 mAh battery.

Samsung Galaxy Smartwatch (2018)

The Samsung Galaxy Smartwatch was released on August 9 of 2018. There is a 46 mm Galaxy Watch in Silver and a 42 mm Galaxy Watch in Rose Gold or Midnight Black. The 63g (gram) 46mm model has a 1.3" (33 mm) display, and the 49g 42mm model has a 1.2" (30 mm) display, both with 360 by 360 pixel (round) screen resolution, featuring the latest Corning Gorilla Glass DX+ quality and durability. The Galaxy Watch features the latest Tizen 4.0 OS running on top of an Exynos 9110 1.15 GHz dual-core CPU. Memory is doubled at a whopping 1.5 GB, with the standard 4 GB of SSD Flash Memory for storage (the Bluetooth-only version has 768 MB and 4 GB). All versions can connect with 802.11N Wi-Fi, Bluetooth 4.2, and NFC, and one of the versions also supports 3G LTE. Sensors include advanced A-GPS, GLONASS, MEMS Accelerometer, MEMS Gyroscope, MEMS Barometer, an Electro-optical HRM sensor (for heart rate monitoring), and a Photodetector (for ambient light level sensing). The only thing I would want added to this in the future is another 120 (480x480) to 280 (640x640) pixels of screen resolution for the screen, taking it up to the 480x480 or 640x640 pixel resolution.

Smartwatch Concepts and Terms

The smartwatch has a significant number of concepts and terms which must be understood by the watch face designers so that they may do their jobs effectively, so it's best that I cover these areas in the first chapter so that readers are not surprised when they come across them in the following chapters of the book. We'll take a look at concepts and terms such as Power Consumption (Always-On), Complications, Components, Conditions, Sensors such as the Gyroscope, Tag Expressions, Layers, Resources, Notifications, Widgets, Apps, and Quick Panel.

Power Consumption (Always-On)

Smartwatches only feature a 200–500 mAh battery capacity, as you have seen in the previous section, and this is a specification you should be aware of and consider when purchasing a smartwatch. For this reason, smartwatches are very particular about the amount of resources, such as colors, pixels, animation, features, and the like, that are used and, more importantly, when they are used. For this reason there is an "Always-On" design that is required that only uses 15% or less of these resources. This design will be used as a default when the user is not looking at their watch face, which is why it is termed the Always-On version of the watch face. A more colorful, animated version of the watch face will be used when the watch detects (via gyro sensor) that the user is looking at the watch face and will give them your "sexy" more colorful (High Color or True Color) animated watch face design.

Complications

Complications are non-time features on a watch face that don't show hours and minutes. They allow a watch to do more than tell time. The Galaxy Watch Designer (GWD) allows you to enhance watch face designs by adding a variety of information regarding date, health, weather, fitness, sensors, steps taken, and the like. These custom watch face components are called complications and can be made into UI elements and tapped like buttons to launch other apps, such as a timer.

Components

Watch face design is comprised of building the watch face using various components that tell the user about the date and time, battery level, the weather, fitness activity, health monitoring, and similar features offered by the smartwatch sensors. If you design a custom complication, that, for

instance, would be a component of your watch face design. Watch face components have a Preview section as well as a Properties section in the GWD software to control how they look.

Conditions

Using the Timeline area at the bottom of the Galaxy Watch Designer software, which we will install and take a look at briefly in the next section of this chapter, watch faces can be designed to change their appearance based on certain conditions, such as the time, step count, gyro data, or the date, using various "conditional lines" in the Timeline pane. This is an extremely powerful feature that allows watch face designers to differentiate their watch faces based upon what the smartwatch user is doing or upon what is happening around them or both. This includes time of day or time of year as well as watch orientation, steps taken (for the fitness models), or even the weather.

Expressions (Tag Expressions)

To add the element of programming code to your watch face design, you can develop (code) "expressions" that contain "tags" that reference watch face design elements as part of the expression. These are aptly named "Tag Expressions" in the Galaxy Watch Designer (GWD) software and add an advanced capability to watch face design similar to what you can achieve by coding in complicated environments like Android WEAR2. Note that tag expressions are only supported in GWD versions after 1.6.0 (GWD was just upgraded to 1.6.1 while I was writing this chapter).

Resources and Layers

Your watch face design can use "Resources" (I like to call these watch face design assets) developed outside of the GWD software using open-source new media content (asset) development software, which I am

going to be making you aware of in the final sections of this chapter. Different design elements can be placed onto different "Layers" using the area at the left side of the Timeline pane (shown in the next section of this chapter, on installing and exploring the Galaxy Watch Designer, or GWD, software). Resources supported by the GWD include PNG (Portable Network Graphics), JPEG (Joint Photographic Experts Group), and GIF (CompuServe Graphics Information Format) file formats, such as you would create in GIMP 2.10, and vector font formats for SVG spline data, such as you would create using Inkscape.

We will be taking a look at how you can get these resources for free using the **Creative Commons Zero (CC0)** licensing model, in the next chapter of this book, so that we have some really cool watch face assets to use throughout this Internet of Things (IoT) development book. At the same time, we'll discuss the basics of each new media asset type when we look at assets of that type, including digital imagery (rasters, pixels, resolution, aspect ratio, color depth, alpha channel, etc.), vector splines (vectors, lines, vertices, splines, curves, fills, patterns, etc.), and digital audio.

Sensors

Different smartwatch models feature different sensor hardware, which is passed through to the Tizen software used to run your watch face design. This is why I covered sensor hardware in the history section of this chapter on a model-by-model basis. There are many different types of sensor hardware, all of which provide really cool feedback on things such as Watch Rotation (Gyroscope), Acceleration (Accelerometer), Altitude (Altimeter), Cardio Health (Heart Rate Monitor or HRM), Fitness (Steps), Sun Exposure (UV Monitor), Ambient Light (Photodetector), Barometric Pressure (Barometer), Geolocation (GPS), Pedometer, and Speedometer. It is amazing how these hardware components can turn the physics reflecting the world around us into usable data for the watch face designer to use to create amazing watch face user experiences.