Weather Data and Representations: A Survey of Wear OS Apps

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Abstract

In this poster, we inspect common weather applications developed for Android Wear OS Smartwatches. Our goal is to learn (1) which type of weather data is commonly depicted in weather applications, (2) how this data is represented, and (3) how smartwatch wearers can interact with these applications. Based on this survey, we plan to develop glanceable weather visualizations that contain appropriate interactions. The current state of weather applications depicts a large number (15) of different weather data types; however, few use visual representations like bar charts (1), radial bar charts (2), or maps (4).

CCS Concepts

• ***Human-centered computing*** → ***Empirical studies in visualization; Ubiquitous and mobile devices;***

1. Introduction and Related Work

Weather data is one of the most depicted information on smartwatch faces [IBL*20] and smartwatches nowadays have separate applications to inspect the current weather and future weather trends. However, a detailed analysis of how this type of data is represented in these applications is missing to inspect if there is potential for redesigning them using visualizations. In a recent survey, Islam et al. [IBL*20] inspected how and which types of data (health&fitness, weather&planetary, and device data) are commonly shown on smartwatch faces. However, the survey did not focus on dedicated weather applications.

In general, micro visualizations [Ise21]—small visualizations depicted on a smartwatch, which can be read at a glance—are a common way to visualize data on smartwatches. Recent studies have inspected how quickly such micro visualizations can be read [BBB*19, BBB*23, GB23, IAB*22] and many works exist that use and create micro visualizations for smartwatches [Che17, NSLM*19, NAR*21, SKK*20, Suc18]. However, these works mainly focus on heart rate data [GB23, NSLM*19, NAR*21], sleep data [IAB*22], back pain data [Suc18], stock prices [Che17], as well as heel strikes and forefoot strikes while running [SKK*20].

In this poster, we present the results of an analysis of weather applications found on the Google Play Store for smartwatches. We inspected (1) which types of weather data are commonly depicted in weather applications, (2) how this data is represented, and (3) how smartwatch wearers can interact with these applications. The current state of weather applications depicts a large number of different weather data types; however, few use visual representations like (radial) bar charts, line charts, or maps.

2. Smartwatch Weather Applications

We inspect common weather applications developed for Android smartwatches (Wear OS) to understand which types of weather data are commonly shown and how they are represented in addition to looking at the interactions these applications use.

2.1. Methodology

We analyzed a total of 11 weather applications for smartwatches using Wear OS that are available for free on the Google Play Store. We searched for the keyword "weather" and installed the applications on a Fossil Gen 6 smartwatch using Wear OS by Google Version 2.30. The search was carried out in February 2024 and resulted in 10 applications. Additionally, we included the already installed Google Weather application. The applications we found are: *Accu Weather*, *Google Weather*, *MyRadar*, *Rain Alarm*, *Simple Weather*, *Weather for Wear OS*, *Weather Forecast (Gidra Weather)*, *Weather XL*, *Weather XS*, *Windy*, *YR*.

2.2. Results

In the following, we summarize the results of our analysis of smartwatch weather applications.

Data Types. In total, we found 15 different data types: Precipitation (18×), Weather Conditions (15×), Temperature (11×), Minimum and Maximum Temperature (11×), Wind Information (speed and direction mainly, 10×), Humidity (5×), Temperature felt (4×), Ultraviolet (UV) Index (3×), Air Pressure (3 ×), Cloud Coverage (3×), Sun Information (sunrise and sunset, 3×), Moon Information (2×), Air Quality (1×), Sight (1×), and Allergy Information (1×), see also Table 1. Some of these are represented multiple

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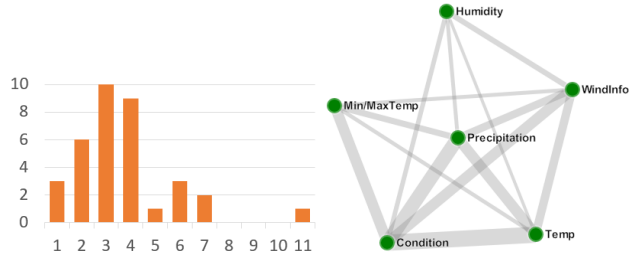

Figure 1: *Left: Number of data types shown together in a view. Right: Co-occurrence of weather data types with at least five occurrences. Line width depicts the number of occurrences.*

times in an application, for example, current weather conditions and weather conditions in the forecast. We only counted duplicates if the representation was different, for example, once using text and once using a chart to understand how the data is commonly represented. Figure 1 (left) shows how many data types are presented together in one view. The average number is 3.2 (min: 1, max: 11). If there was only one data type represented by itself, it was always precipitation shown on a map. Figure 1 (right) shows the co-occurrence of weather data types with at least five occurrences. Line width depicts the number of occurrences showing that weather conditions and temperature appear often with the other data types shown in the graph.

Representations. Overall, the main representation type was a combination of Text+Icon (38×), followed by just Text (34×), and just Icon (12×). Charts/Maps (7×) were used seldom. Maps were only used to show precipitation (rain radar). See Table 1 for details. The types of visualizations we found were bar charts (1×), radial bar charts (2×), and maps (4×). One bar chart and one radial bar chart depicted the minimum and maximum temperatures. Another radial bar chart was used to show the amount of rain (light versus heavy) for the next hours. For representing different data types within the weather forecast (hourly and daily) mostly list views (12×) and tables (8×) were used. Only one application used dedicated pages for representing the forecast.

Interactions. For navigating within the app, the most common interaction is to scroll vertically using one finger (11×) or the control wheel (9×). Some applications allow showing more detailed data by tapping (4×), or other data using a swipe (2×) or tapping (2×). For zooming the map, the applications either use one finger (1×), two fingers (1×), or a tap + button interaction (1×). If the map can be panned usually one finger is used (2×). Playing an animation of the rain radar used tap (1×) or buttons (2×) to start and pause it.

3. Discussion and Conclusion

Islam et al. [IBL*20] found that survey participants depicted the temperature (158×) and weather condition (143×) the most as weather data on their smartwatch face. This is in accordance with our results. However, they also saw, as the third and fourth most used weather data, sunset/sunrise (57×) information and the moon phase (32×). The weather applications we inspected often did not show this information at all (only 3 applications for sunset/sunrise and 2 applications for moon phase).

Table 1: *Weather data types and their representation.*

Data Type	Text	Text+Icon	Icon	Chart/Map	Total
Precipitation	6	6	1	5	18
Condition		5	10		15
Temperature	11				11
Min/Max Temp	5	4		2	11
Wind Info	3	6	1		10
Humidity	1	4			5
Felt Temp.	2	2			4
UV Index	2	1			3
Pressure	2	1			3
Cloud Cover		3			3
Sun Info		3			3
Moon Info	1	1			2
Air Quality		1			1
Sight		1			1
Allergy Info	1				1
Total	34	38	12	7	91

The results we obtained for the type of representation are similar to the results of the survey by Islam et al. [IBL*20] on smartwatch faces. The weather condition was mostly depicted using icon or text+icon, temperature using text or text+icon (we only found text representations), wind information using text and text+icon, moon information using icon or text+icon (we found text or text+icon), humidity using text or text+icon, and sunset/sunrise information using text+icon or text (we found only text+icon).

Overall, similar to the survey by Islam et al. [IBL*20], we also found that charts or maps as visual representations were used the least frequently. We only found 3 (radial) bar charts and 4 uses of maps. This leaves room for improvement, however, the number of weather applications we inspected was quite low. One application we found on the Google Play Store but could not install called *How is the weather* [Soy] and also the Apple Watch weather application [Inc24] (we looked at images online) use graphs and charts more frequently. For example, *How is the weather* uses a line chart for the hourly weather forecast, as well as radial bar charts for air quality, humidity, and cloud coverage. The Apple Watch weather application also uses radial bar charts to depict the number of sun hours, the humidity, and the air quality, as well as bar charts to depict the minimum and maximum temperature, precipitation, number of sun hours, and humidity.

To conclude, the number of visualizations used to depict weather information on smartwatches is still sparse even though related work [BBB*19, BBB*23, IAB*22] showed that micro visualizations can be read quickly on smartwatches. There is a huge gap to be filled with visualization techniques to depict weather information. One option is to use line charts to show daily and hourly forecasts (as only seen by the weather application *How is the weather*).

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