Visualizing Temples through Time

Litian Zhang and Geoffrey M. Draper

The large number of temples dedicated in recent decades has rendered it impossible to draw a linear timeline of all temples on a standard printed page. We propose an interactive timeline that can run on mobile devices. Rather than display the entire timeline at once, our visualization renders a subset of the temples on an interactive spiral and provides controls for the user to navigate forward and backward through time. Below we will present a mobile app prototype of this visualization, called Temples Timeline, and discuss its implementation and reception.

Introduction and Motivation

Since 1836, The Church of Jesus Christ of Latter-day Saints has dedicated more than 160 temples. Let us consider the challenge of effectively visualizing the dates of these dedications on a timeline. The most obvious approach would be to print the timeline on a standard sheet of paper (fig. 1); however, there are simply too many data points.

Clearly, we need more room. If we space the names of the temples 1 inch (2.5 cm) apart, the chart grows to approximately 13 feet long (4 meters), which is too large to conveniently print and display. What if, instead, we saved the chart in an electronic format such as a PDF or an image? This would, naturally, be less expensive than printing it and would permit wider distribution. However, even on a large computer screen, the user would have to scroll around a great deal to find a specific temple. Zooming out would reduce the chart to illegibility. The problem would be exacerbated if the user were viewing the timeline on a small device, such as a tablet or smartphone.

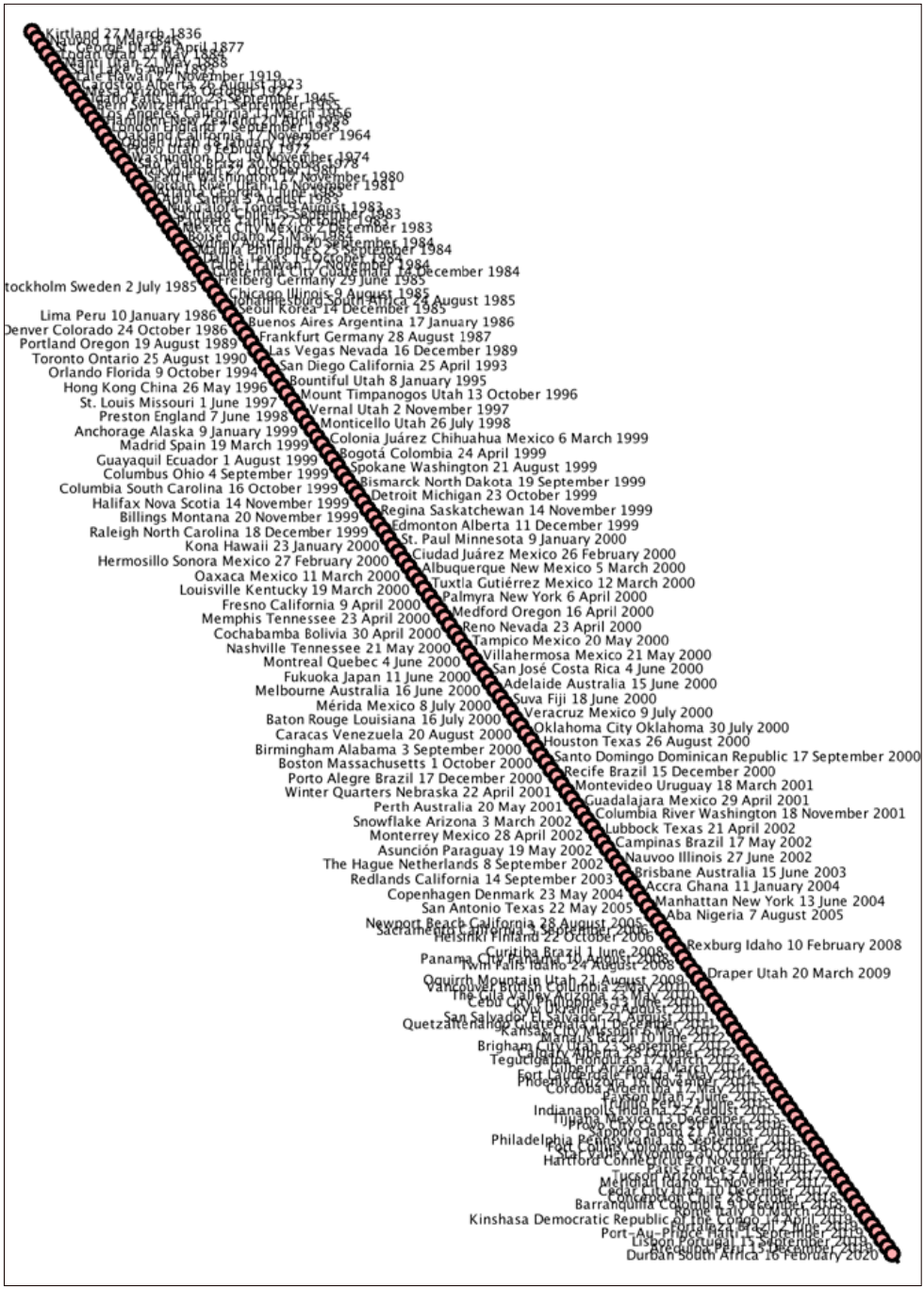

Figure 1. Even if we draw a timeline along the diagonal, there are too many temples to fit on a single page and be readable.

In a previous *BYU Studies Quarterly* article, a computer program for displaying the chronology of apostolic succession in the Church, called Latter-day Apostles, on mobile devices was described. The authors describe the First Presidency and the Twelve mathematically as "*well-ordered sets,*" in other words, a set in which there is a "first" element (the Apostle with the longest tenure), a "second" element (the Apostle with the second-longest tenure), and so on all the way down to the "last" element—the most recently ordained Apostle.[1]

We can describe the set of all current temples the same way. There is a "first" element (Kirtland, Ohio), a "second" element (Nauvoo, Illinois), and so on until the most recently announced temple. The difference is that the set of operating temples is generally always increasing in size, whereas the set of living Apostles is limited to approximately fifteen individuals at a time. Nevertheless, we can adapt some principles from the previously mentioned article to address the problem of visualizing a timeline of temples on a small screen.

Design

The Latter-day Apostles app uses a dual-ring layout, displaying the First Presidency on the inner ring and the Quorum of the Twelve Apostles on the outer ring. This works well for the relatively fixed number of Apostles at any given time.[2] To visualize a timeline of all the temples, we chose a spiral-based visualization.[3] The use of spirals for interactive data visualization was introduced in 1998 by John Carlis and Joseph Konstan. All circles are positioned along a spiral line, with the diameters increasing gradually from the center to the outer end of the spiral.[4] As the user adjusts the date, the positions of the current on-screen temples are updated accordingly. The most recently dedicated temples will be on the outer rim of the spiral, with older temples in the middle, arranged counterclockwise by age. By reducing the size of the interior temples,

1. Meilan Jin, Iliesa S. K. Delai, and Geoffrey M. Draper, "Visualizing Apostolic Succession," *BYU Studies Quarterly* 55, no. 2 (2016): 115–26, quotation on 119, italics in original.

2. Jin, Delai, and Draper, "Visualizing Apostolic Succession," 120.

3. Geoffrey M. Draper, Yarden Livnat, and Richard F. Riesenfeld, "A Survey of Radial Methods for Information Visualization," *IEEE Transactions on Visualization and Computer Graphics* 15, no. 5 (September/October 2009): 759–76, especially 767–68, https://ieeexplore.ieee.org/document/4770098.

4. John V. Carlis and Joseph A. Konstan, "Interactive Visualization of Serial Periodic Data," in *Proceedings of the 11th Annual ACM Symposium on User Interface Software and Technology* (New York: Association for Computing Machinery, November 1998): 29–38, https://doi.org/10.1145/288392.288399.

we increase the total number of temples on the screen. Our assumption is that users will be more likely to interact with icons along the outer periphery of the spiral, so reducing the size of the inner icons is an acceptable compromise (see figs. 2a and 2b).

Prototype

As a proof of concept of our spiral visualization scheme, we have implemented a mobile app called Temples Timeline.[5] It is currently available for free on the Apple App Store, Google Play, and Amazon Appstore. The app is available in both English (fig. 2a) and Mandarin Chinese (fig. 2b).

Figure 2a. *(left)* Using a spiral layout allows us to fit more icons on the screen. The outermost icons are large enough to select, while the inner ones are smaller and provide context. **Figure 2b.** *(right)* Screenshot of the Temples Timeline app in Mandarin (Android version).

5. The app's original working title was Latter-day Temples. Some of the screenshots shown in this paper reflect the old title.

To keep the app running at interactive speeds, we limit the number of temples displayed to about sixty. In other words, the small icons near the center of the spiral do not continue ad infinitum. Once they are too small to see (approximately 1/16-inch diameter), the app no longer renders the image.

Interaction

The screen display is divided into two areas. The largest is the spiral visualization itself. Just below the visualization is a slider, with a knob (called a "thumb") that the user can drag left or right. In order to increase the app's usefulness, we included several options for interacting with the spiral:

- The user can move forward or backward in time by moving the slider thumb, by tapping the left/right arrow buttons, or simply by rotating the spiral itself (see figs. 3, 4, and 5).

Figure 3. By dragging the slider left, the spiral rotates clockwise, bringing older temples to the forefront. By dragging the slider right, the spiral rotates counterclockwise, introducing newer temples into the display.

Figure 4. By tapping the left and right buttons, the user can rotate the spiral one temple at a time.

Figure 5. The user can also rotate the spiral directly by dragging his or her finger in a circular pattern on the screen.

- The user can look up specific temples by name (fig. 6) or by year (figs. 7a and 7b).
- Tapping any temple image in the spiral opens a larger photo of that temple and shows additional information, such as announcement and dedication dates (figs. 8 and 9).

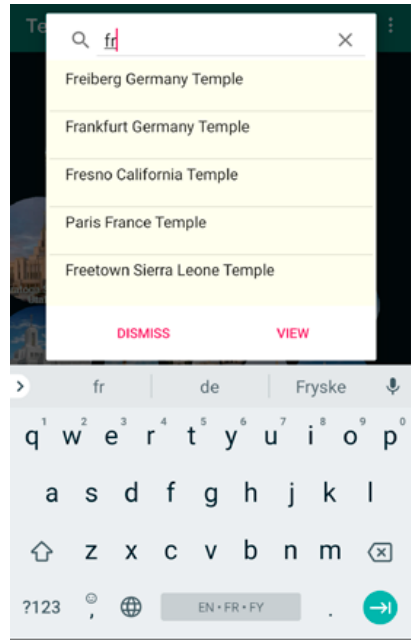

Figure 6. To look up a temple directly, the user can type its name into the search bar. The spiral then rotates to bring the selected temple to the outer arm of the spiral, and highlights its photo.

Future Work

Just as the Latter-day Apostles app's method for visualizing apostolic succession[6] was successfully applied to other domains,[7] we believe the visualization metaphor described in this paper can be readily applied to other forms of data. Possible applications of this visualization could include:

- A history of an organization, such as a business, university, or country.
- A succession of heads of state (for example, kings and presidents) of a country.
- A list of scientific discoveries in a given domain.
- An alternative representation of the periodic table of elements.

6. Jin, Delai, and Draper, "Visualizing Apostolic Succession," 115–26.

7. Iliesa S. K. Delai, Meilan Jin, and Geoffrey M. Draper, "Visualizing Time-Variant Sets on a Handheld Device," in *Proceedings of the 9th International Symposium on Visual Information Communication and Interaction* (New York: Association for Computing Machinery, September 2016): 140–41, https://doi.org/10.1145/2968220.2968231.

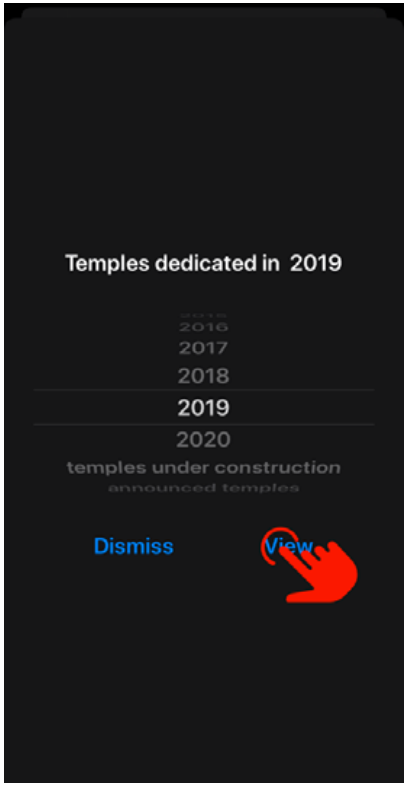

FIGURE 7A. The "year picker" allows the user to highlight temples dedicated in a given year.

FIGURE 7B. Once the year is selected, the temples dedicated during that year are highlighted, and the spiral rotates to bring them into the outermost ring.

Figure 8. Tapping a temple in the spiral brings up a larger photo of that temple along with additional details.

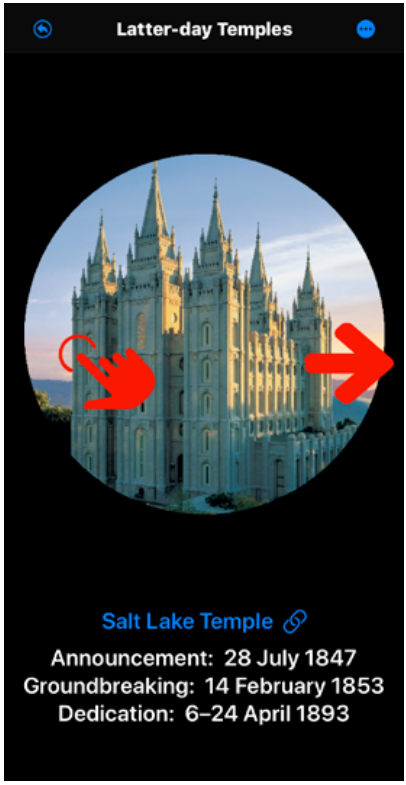

Figure 9. Swiping right or left on the temple photo brings up the previous or next temple, respectively.

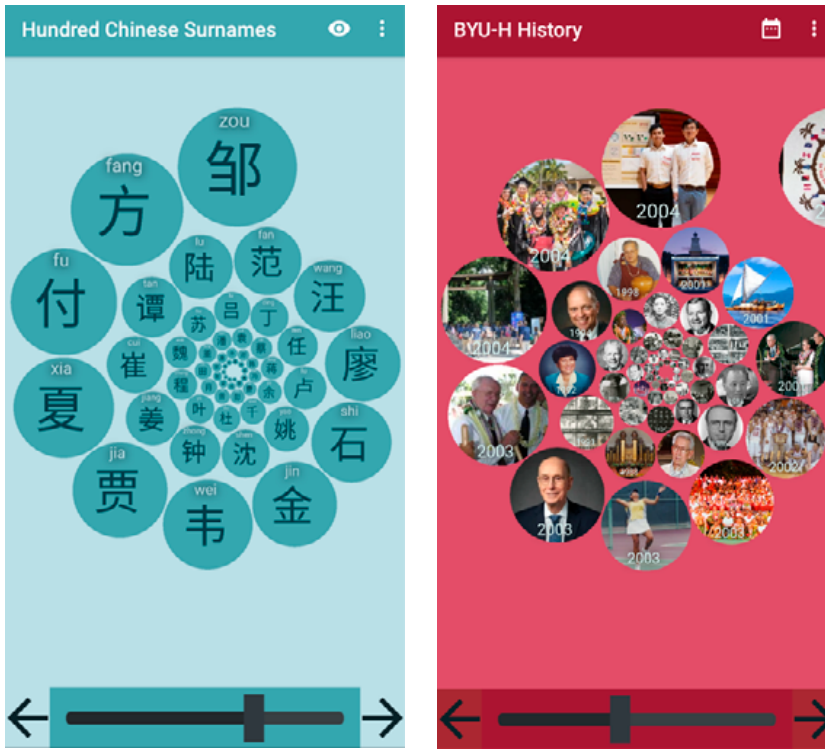

Figure 10a. *(left)* The Hundred Chinese Surnames app (available on Google Play and Amazon Appstore) uses the same visualization style as Temples Timeline, but with an entirely different data set. **Figure 10b.** *(right)* The BYUH History app also uses a spiral layout. (This app is not yet available online.)

As a proof of concept of applying this visualization to alternate data sets, we are developing two additional apps using a similar spiral layout. One focuses on visualizing Chinese surnames and culture,[8] while the other displays the historical milestones of Brigham Young University–Hawaii (figs. 10a and 10b).

Discussion and Conclusion

In this paper, we have presented a technique for visualizing well-ordered sets on a handheld device. In contrast to the prior work of Jin, Delai, and

8. Litian Zhang, Tsz Chin Lam, and Geoffrey M. Draper, "Interactive Spiral: A Radial Visualization for Mobile Devices," in *Proceedings of the 14th IEEE Pacific Visualization Symposium* (April 2021), http://vis.tju.edu.cn/pvis2021/pdf/poster/poster-papers/1019-doc.pdf.

Draper, which was limited to approximately fifteen on-screen icons at a time, our technique can accommodate many times this number.

At the time of this writing, the Temples Timeline app has been downloaded over five hundred times. Initial feedback from users has been overwhelmingly positive, and some features (in particular, the search-by-name feature shown in figure 6) were a direct result of users' suggestions. It is our hope that the Temples Timeline app will give its users a renewed appreciation for the beauty and sanctity of the temples as well as inspire Latter-day Saint software developers to build more apps that celebrate the unique culture and doctrines of the restored Church of Jesus Christ.

Litian Zhang is currently employed as a support engineer for SAP in Shanghai, China. He graduated in 2021 from Brigham Young University–Hawaii with a bachelor's degree in computer science.

Geoffrey M. Draper is a professor of computer science at Brigham Young University–Hawaii. His research interests include information visualization, human-computer interaction, mobile app development, and vintage computing. He received a PhD in computer science in 2009 at the University of Utah.

Funding for this project was provided by the faculty of math and computing at Brigham Young University–Hawaii. We thank Mr. Carl Yamagata of the BYU–Hawaii Office of Information Technology for providing a development workstation for the first author. We are grateful to Tsz Chin Lam and Abigail Smith for their assistance in preparing the other spiral visualization apps mentioned in this article. We also gratefully acknowledge the staff of the Intellectual Property Office of The Church of Jesus Christ of Latter-day Saints for permission to use the Church's official temple photographs in the Temples Timeline app.