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Cyclical Data Presentation with A Helical Display

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Abstract:

Techniques are described that enable cyclical data presentation with a helical display. A helix, which is a particular form of a spiral, is generally not used for conventional data presentations because it can be difficult to understand in two-dimensional (2D) presentations. In a three-dimensional (3D) presentation, however, such as in a VR environment, helices, curls, and spirals are well-known forms and can be used for data presentation. In particular, cyclical information can be presented in embedded helices in which the helical shape is used to display cycles within cycles continuing in one or more directions. For example, a 3D helical calendar can allow a user to zoom into and out of the helix to view the cycle of hours within the cycle of days, within the cycle of months, within the cycle of a year or multiple years.

Keywords:

Virtual reality, user interface, helical user interface, infographic, pattern repetition, helical scrolling, virtual reality controls

Background:

Virtual reality (VR) environments rely on display, tracking, and VR-content systems. Through these systems, realistic images, sounds, and sometimes other sensations simulate a user's physical presence in an artificial environment. Each of these three systems are illustrated below in Fig. 1.

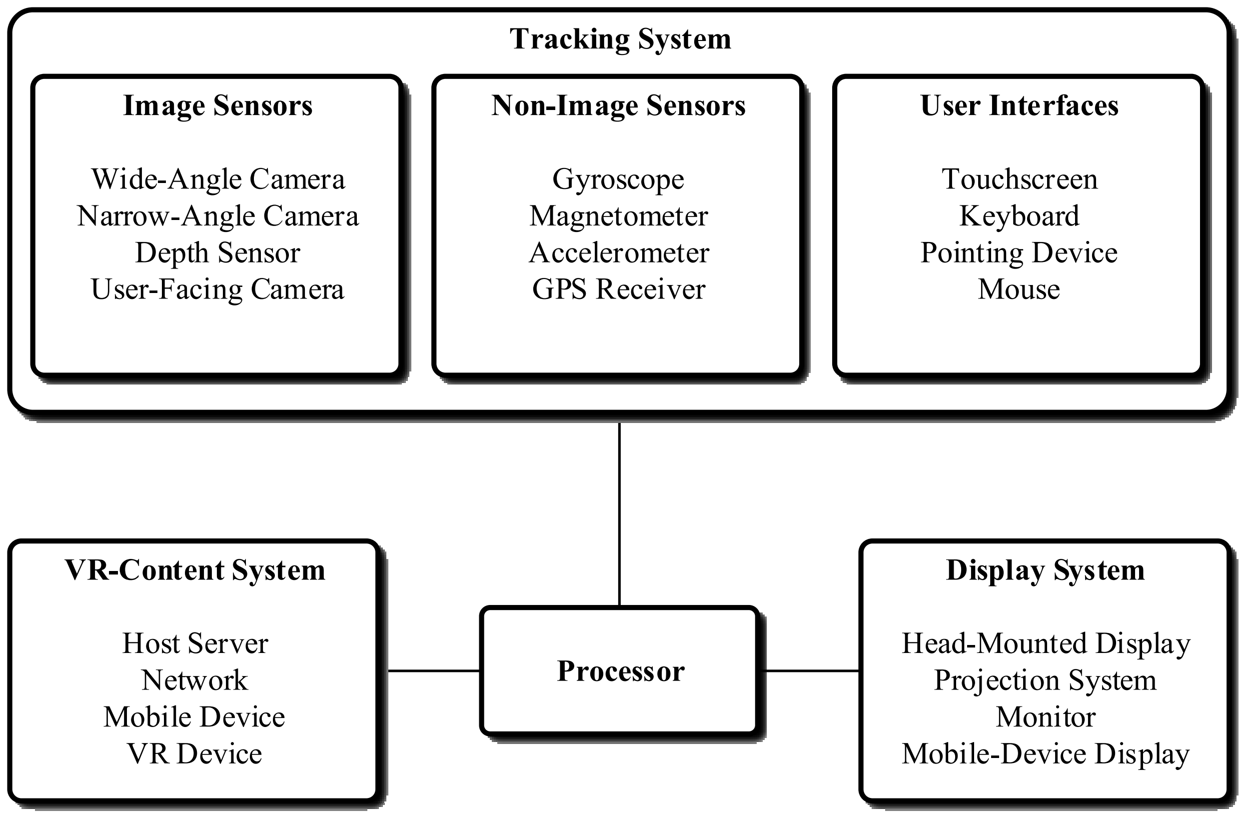


Fig. 1

The systems described in Fig. 1 may be implemented in one or more of various computing devices that can support VR applications, such as servers, desktop computers, VR goggles, computing spectacles, laptops, or mobile devices. These devices include a processor that can manage, control, and coordinate operations of the display, tracking, and VR-content systems. The devices also include memory and interfaces. These interfaces connect the memory with the systems using various buses and other connection methods as appropriate.

The display system enables a user to “look around” within the virtual world. The display system can include a head-mounted display, a projection system within a virtual-reality room, a monitor, or a mobile device’s display, either held by a user or placed in a head-mounted device.

The VR-content system provides content that defines the VR environment, such as images and sounds. The VR-content system provides the content using a host server, a network-based device, a mobile device, or a dedicated virtual reality device, to name a few.

The tracking system enables the user to interact with and navigate through the VR environment, using sensors and user interfaces. The sensors may include image sensors such as a wide-angle camera, a narrow-angle camera, a user-facing camera, and a depth sensor. Non-image sensors may also be used, including gyroscopes, magnetometers, accelerometers, GPS sensors, retina/pupil detectors, pressure sensors, biometric sensors, temperature sensors, humidity sensors, optical or radio-frequency sensors that track the user's location or movement (*e.g.*, user's fingers, arms, or body), and ambient light sensors. The sensors can be used to create and maintain virtual environments, integrate "real world" features into the virtual environment, properly orient virtual objects (including those that represent real objects, such as a mouse or pointing device) in the virtual environment, and account for the user's body position and motion.

The user interfaces may be integrated with or connected to the computing device and enable the user to interact with the VR environment. The user interfaces may include a touchscreen, a keyboard, a pointing device, a mouse or trackball device, a joystick or other game controller, a camera, a microphone, or an audio device with user controls. The user interfaces allow a user to interact with the virtual environment by performing an action, which causes a corresponding action in the VR environment (*e.g.,* raising an arm, walking, or speaking).

The tracking system may also include output devices that provide visual, audio, or tactile feedback to the user (*e.g.*, vibration motors or coils, piezoelectric devices, electrostatic devices, LEDs, strobes, and speakers). For example, output devices may provide feedback in the form of blinking and/or flashing lights or strobes, audible alarms or other sounds, songs or other audio files, increased or decreased resistance of a control on a user interface device, or vibration of a physical component, such as a head-mounted display, a pointing device, or another user interface device.

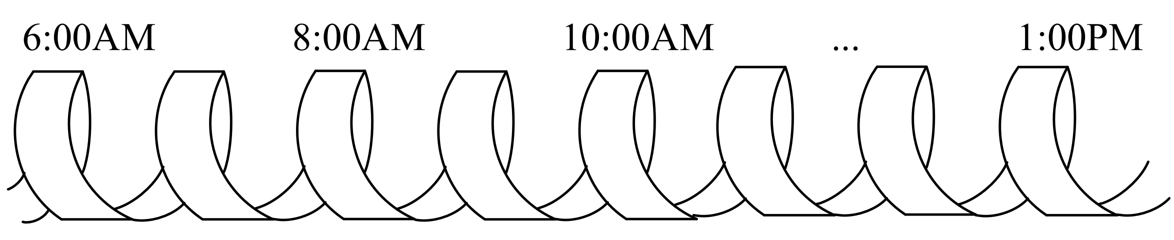
Fig. 1 illustrates the display, tracking, and VR-content systems as disparate entities in part to show the communications between them, though they may be integrated, *e.g.*, a smartphone mounted in VR goggles, or operate separately in communication with other systems. These communications can be internal, wireless, or wired. Through these illustrated systems, a user can be immersed in a VR environment. While these illustrated systems are described in the VR context, they can be used, in whole or in part, to augment the physical world. This augmentation, called "augmented reality" or AR, includes audio, video, or images that overlay or are presented in combination with the real world or images of the real world. Examples include visual or audio overlays to computing spectacles (*e.g.,* some real world-VR world video games or information overlays to a real-time image on a mobile device) or an automobile's windshield (*e.g.,* a heads-up display) to name just a few possibilities.

A particular configuration of the systems of Fig. 1 enables the user to display and view data in a helical format. As VR technology evolves, the ability to present data in various three-dimensional (3D) formats presents an opportunity to improve information transfer. For instance, two-dimensional (2D) data presentations for cyclical data (data that repeats regularly), such as timelines and calendars, can become large after only a few cycles. Further, an important aspect of data presentation is the ability to display patterns in the data. Many 2D representation of data are limited in the patterns that are revealed, especially when the time frame is long. In contrast, there are ways to represent information in a 3D space (such as a VR environment), that can allow a user to see more information in less space and make patterns more visible. As data-driven research and analysis becomes more common and users become more familiar with 3D environments, the lack of effective data presentations presents a problem for business, academic, and scientific users.

Description:

To address these problems, techniques are described that enable cyclical data presentation with a helical display. A helix, which is a particular form of a spiral, is generally not used for conventional data presentations because it can be difficult to understand in two-dimensional (2D) presentations. In a three-dimensional (3D) presentation, however, such as in a VR environment, helices, curls, and spirals are well-known forms and can be used for data presentation. In particular, cyclical information can be presented in embedded helices in which the helical shape is used to display cycles within cycles continuing in one or more directions. For example, a 3D helical calendar can allow a user to zoom into and out of the helix to view the cycle of hours within the cycle of days, within the cycle of months, within the cycle of a year or multiple years.

Fig. 2 illustrates two views of an example helical display, a side view and a view looking down the central axis of the helix. In the example of Fig. 2, each loop of the helix represents a particular point in a cyclical data stream (*e.g.*, as shown in the side view, each loop may represent an hour of the day).



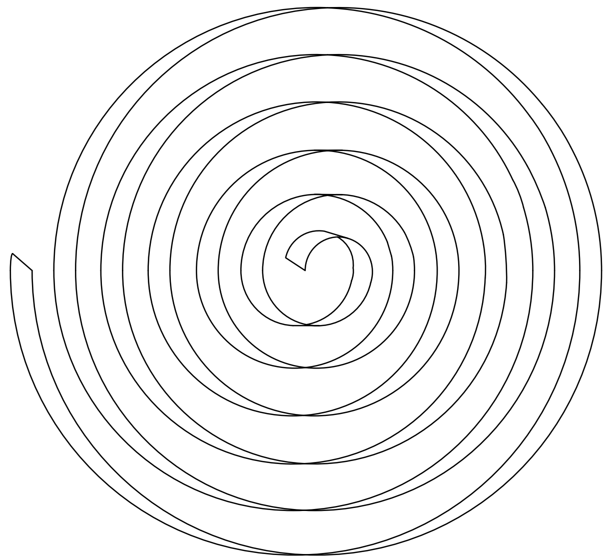


Fig. 2

Additionally, this helix can be used to make another helix that represents days of the month. In turn, the second helix can be used to make a helix that represents the months of the year. In this way, various layers of data can be represented not only in a single helix, but the user can zoom in to a helix to see finer details, or zoom out to see coarser data. Fig. 3 below illustrates this concept using the example of a calendar.

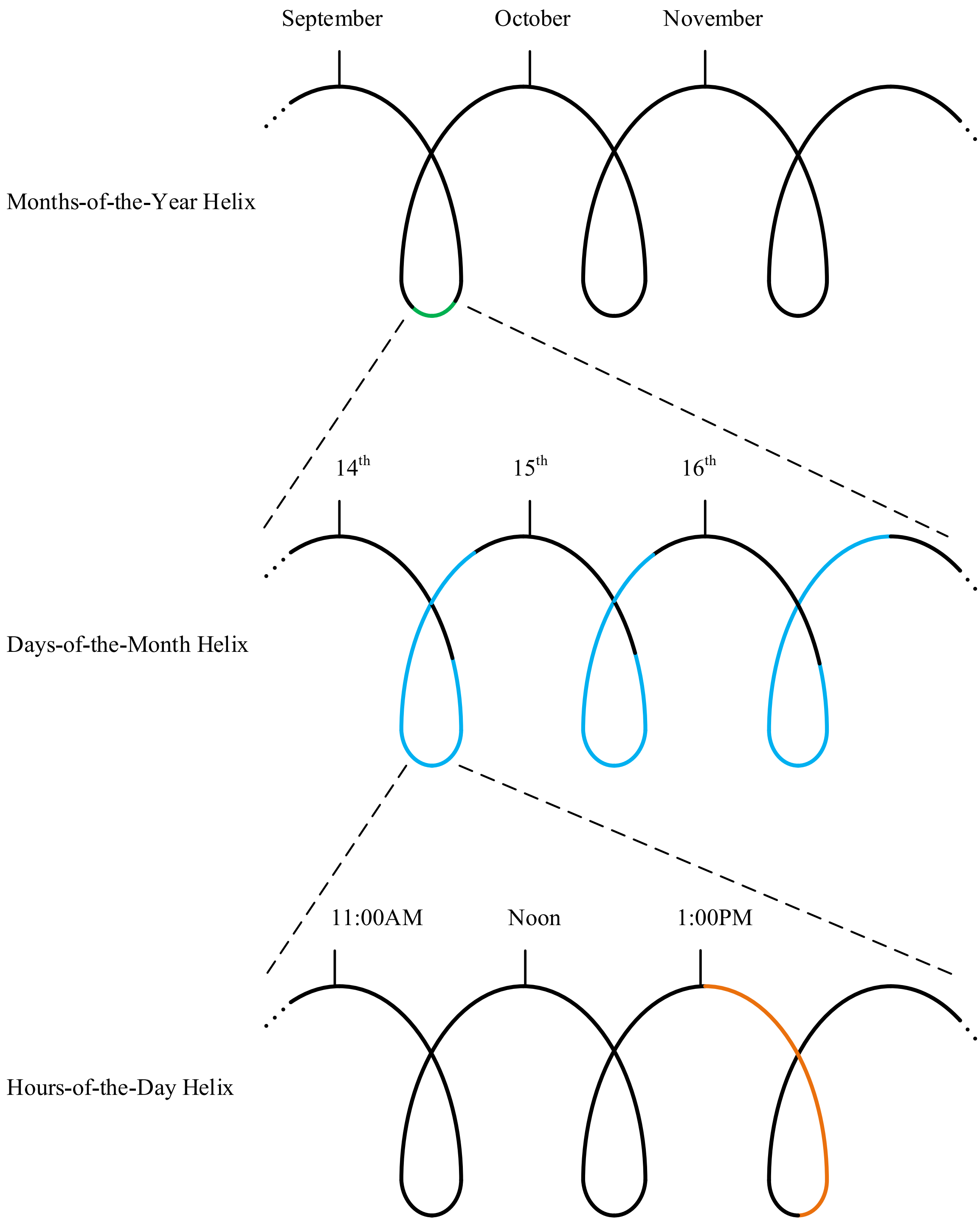

September
October
November
Months-of-the-Year Helix
14th
15th
16th
Days-of-the-Month Helix
11:00AM
Noon
1:00PM
Hours-of-the-Day Helix

Fig. 3

Fig. 3 above illustrates an example of a helical shape in which each loop of a helix is made from another helix that represents another layer of data in the main helix. In Fig. 3, the displayed portion of the top helix (the Months-of-the-Year Helix) has loops that represent September, October, and November. The user can zoom into the loop that represents September to see details of, for example, a three-day time period (represented in green). The displayed portion of the middle helix (the Days-of-the-Month Helix) shows the three days as the 14th, 15th, and 16th. To view even finer details, the user can zoom into the loop that represent a particular time during a day. The loops of the displayed portion of the lower helix (the Hours-of-the-Day Helix) show times from 11:00AM to 1:00PM.

Additionally, various events, activities, or statuses can be displayed on certain points of the calendar and then viewed from various perspectives. For example, in the middle helix, times when the user is asleep are shown in black and times when the user is awake are shown in blue. Additionally, in the lower helix, a meeting scheduled from 1:00PM to 1:30PM is shown in orange.

As noted, cyclical data presentation with a helical display allows a user to view the same data from different perspectives. Consider Fig. 4 through Fig. 6, which illustrate this feature. Fig. 4 illustrates an example of a helical shape in which each loops represents a month. In the example of Fig. 4, the data inside each loop is temperature data. One side of the loop that represents the month of June is colored blue, and a black dot on the loop represents the day with the highest average temperature.

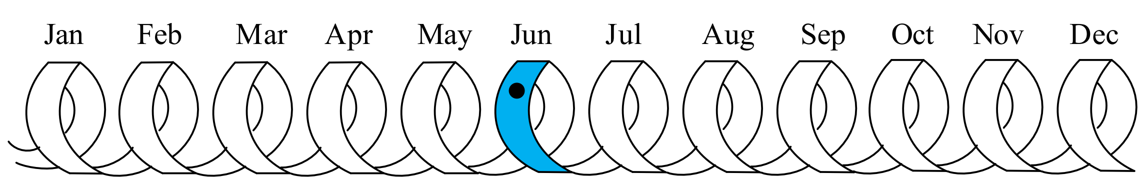


Fig. 4

If the data presentation shown in Fig. 4 is extended over several years, the position of the black dot shows the variation in the day with highest average temperature. Fig. 5 illustrates the pattern by displaying six years' worth of the data. As shown in Fig. 5, the date with the highest temperature fluctuates over the years, with the earliest date being shown in year Y4 and the latest date being shown in year Y6.

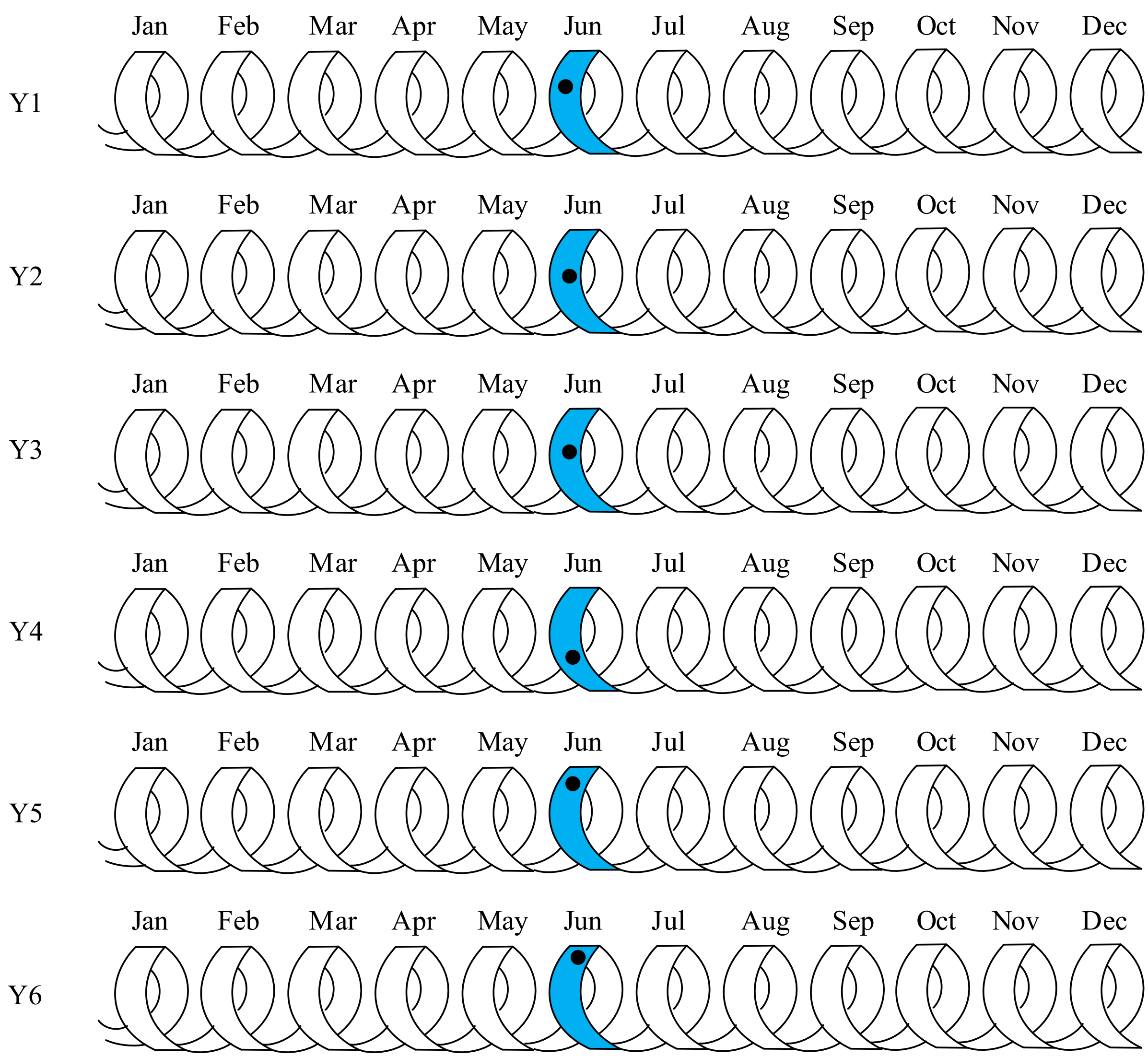


Fig. 5

The three-dimensional helical shape also allows the data to be viewed from different angles. For example, Fig. 6 illustrates another view of the data shown in Fig. 5, but looking at the helix along its central axis. In this view, each loop represents a year.

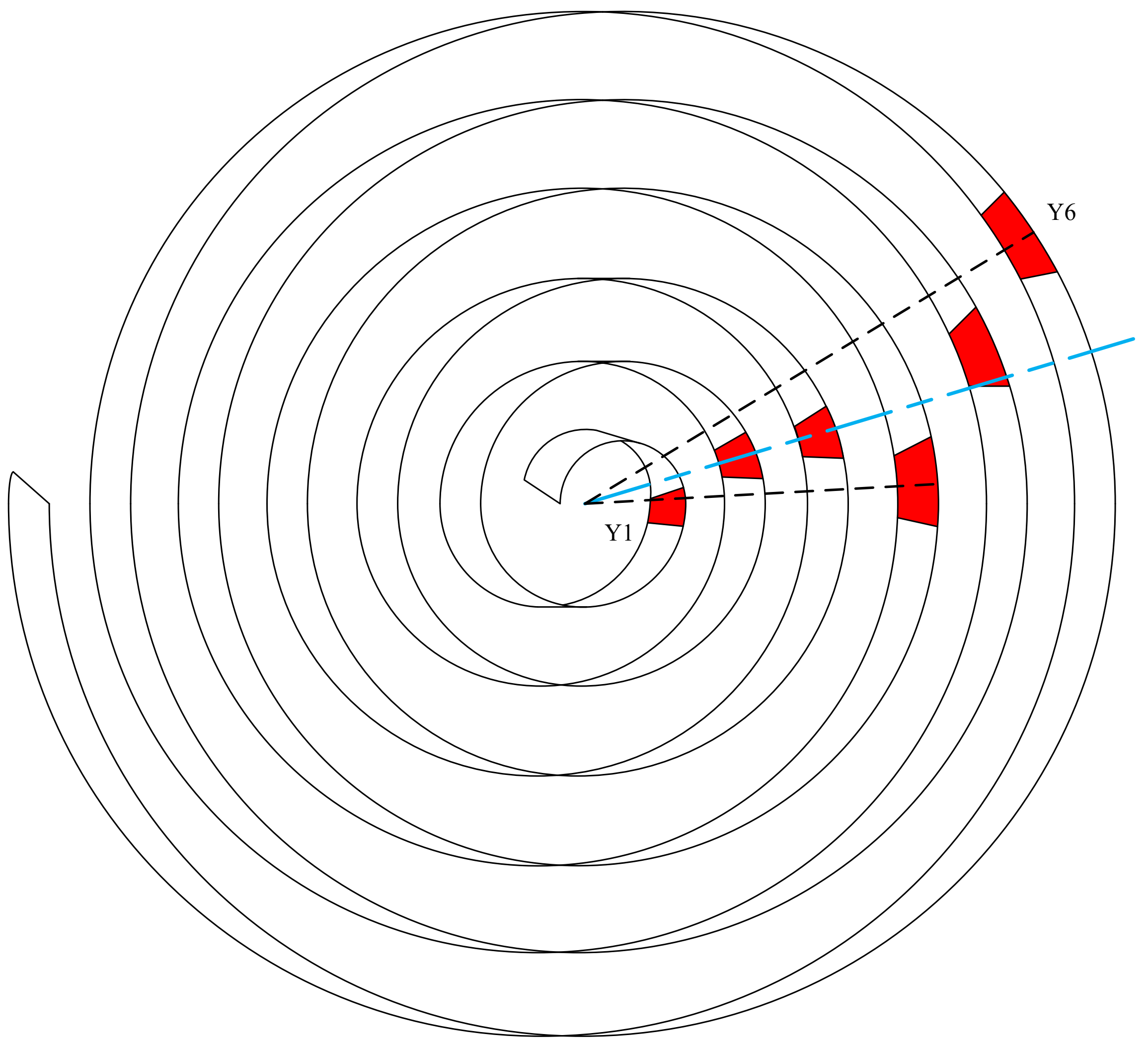


Fig. 6

As shown, the inner loop is year Y1 and the outer loop is year Y6. The day with the highest average temperature is shown as a red segment of the loop. The six-year average is shown with a dashed blue line, and the Y4 and Y6 dates are shown with dashed black lines. Once again, the pattern shows that the date with the highest temperature fluctuates over the years, with the earliest date being shown in year Y4 and the latest date being shown in year Y6. As with the example illustrated in Fig. 3, the user may zoom in to see additional details or zoom out to get a broader picture of the data and any patterns that are visible.

While not shown in Fig. 2 through Fig. 6, other implementations of cyclical data presentation with a helical display may also include additional features to augment the display. For example, statistical markers may be included, such as marks or colors that can show the margin of error for some kinds of experimental data or polling data. Likewise, multiple measurements of the same data from different sensors may be displayed with different line colors or a different line thickness.