

The Cultural Touch

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ABSTRACT

The Cultural Touch is an interactive tool designed for educational purposes that produces information about specific countries when physically touched by the user(s). The object of our system is to create a fun, intuitive learning opportunity to promote knowledge of the world we live in and its history. Through a projection based, tunable capacitive sensor platform, users' touch on a particular region of an interactive globe causes information for that region to be displayed on a digital screen. Under the current format, the cultural information displayed is related to the year the globe is in, which can be changed by spinning the globe. A spin interaction will send the user back and forth in time. In this paper we describe our engaging, tangible, and transformative globe.

General terms

Experimentation, Performance, Design, Human Factors

Author Keywords

Tangible; educational; world; touch; cultural; student; informative; fun; historical.

INTRODUCTION

Several world globes have previously been developed to improve user interaction and engagement while exploring our planet, expanding traditional 2D methods such as Google Earth [6] on a flat screen, or the classic 3D desktop globe. In this paper we introduce our novel Tangible User Interface globe as an enhancement of previous iterations of tangible globes (e.g. Globe4D [3], Intelliglobe [7], V-Tech Fly and Learn [13], Globus Multi-touch Solution [5], and The Darwin Project [12]), which further embodies physical interactions on the globe.

Previous tangible globes are limited because they do not allow for spontaneity and they permit only limited simultaneous interaction on the globe.

All of the existing globes use tokens, such as pens or magnifying glasses to handle user input as compared to our model, which is

purely hand driven. Moreover, the previous globes do not support single user multi-touch or users' collaboration. Globe4D [3], developed by Companje et al. (2006), is a globe that could send the user back in time by rotating a ring surrounding the spherical surface. A map of the world is projected from above showing continental shifts of the earth. The *Cultural Touch* is most similar to their implementation of a fourth dimension of time. However, the *Cultural Touch* will show the map as it was known by the world in a given year, while Globe4D lets the user explore continental shifts, earthquakes, and other natural processes that occurred over time. In addition, this implementation does not support a touch interaction to gather information about the continent or region. Google Earth [6] has a similar implementation by providing Historical Imagery, which allows users to explore how certain cities have evolved over the past 50 years. Other implementations such as the multi-touch solution named Globus [5] support familiar multi-touch interactions, such as zooming by squeezing or spreading two fingers, dragging the map, or rotating the map by circulating two fingers close to each other. All of these interactions were already explored in tangible user interfaces by Fitzmaurice et al. (1995) [4]. Moreover, although the implementation of Globus supports multi-touch, it is not suitable for collaborative interactions. Furthermore, the actual spherical surface of Globus is stationary so it offers a different user experience than the traditional globe that users are familiar with. Lastly, we explored multiple embodiments in which education and a fun experience were combined with novel interactions, such as V-Tech's Fly and Learn [13]. V-Tech's solution is a globe designed for children, that lets the user 'fly' to a certain location by using a joystick to move an airplane with a magnifying glass attached to it. The joystick is also used to rotate the globe. The magnifying glass solution was also implemented in The Darwin Project [12], which was exhibited during the Exploratorium in San Francisco, California (2013). The Darwin Project showed users information about microscopic sea life.

THE CULTURAL TOUCH

The *Cultural Touch* is an educational tool that has been designed to create an engaging learning experience for elementary school students. The globe enables spontaneity by letting the users spin the globe and unexpectedly landing them in a time period, thus providing a surprise element. Users can explore the globe by

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making a controlled rotational movement to travel to other places of the earth. When the users touch a country, information is presented on a screen. For example, when one user touches the globe, information about the selected country is displayed. However, when a second country is selected, the users are presented with side-by-side information relative to the countries. This system supports an intrinsically defined learning approach where users are free to form their own interpretations and opinions through the presentation of non-deterministic information. Furthermore, the Cultural Touch creates a novel teaching experience by allowing kids to probe historical information during specific time periods.

IMPLEMENTATION

The *Cultural Touch* globe consists of a white inflatable ball with a diameter of 24 inches on which the world map is projected. By default, the world map, as it is known today, is projected using a small projector located approximately 4 feet away. When the user turns the globe the map shifts following the rotation, with a precision of 120 degrees. This results in 3 different “frames” of the world. For each frame users can touch capacitive regions on the ball and select up to 4 countries. The capacitive regions are built with stripped wires that are wrapped around the blank ball. When users touch the wires, a change in capacitance can be measured resulting in a higher capacitance value. If this value exceeds a given background threshold, information about the touched region is shown on the LCD screen. The LCD screen used to present information about the countries has a resolution of 800 x 480 pixels and presents information of up to two countries at a time. The rotation of the globe is measured with photocells, so that for each frame of 120 degrees we use one photocell. Upon rotation of the globe, photocells are exposed to the higher intensity light projected by the projector and will correspondingly measure a higher analog value. The map will then, as described earlier, update to a different frame of the world map.

When a threshold difference in light measurements between any of the three photocells is registered and the time difference between those inputs is smaller than 0.25 seconds, the globe will detect a spinning event instead of a controlled rotation. This event will send the user back in time, embodied by projecting an older map of the world. The year in which the user is currently in, is displayed on the middle of the map. The current setup embodies the years 2013 and 1473. To compliment the projected map change representative of different time periods, information about the countries shown on the LCD screen is defined by the year the globe is presenting. We use an Arduino Uno in order to measure input light through the photocells and touch through the capacitive sensors accordingly, while a Java application handles the output by updating the map and the information on the LCD screen based on the Arduino input. An elliptical image of the world is projected on the spherical surface. Unfortunately, the old world map had not, at that time, been presented in an elliptical format, which resulted in a small mis-map between the map of 2013 compared to the map of 1473. This manifests in a small difference in alignment between capacitive sensors for the different time periods.

SETUP

The *Cultural Touch* system is comprised of

- A white sphere on a spinning stand
- A projector located adjacent 4 feet to the system oriented at the white sphere
- An LCD screen
- A slide bar is shown in this figure for reference but is actually embodied on the globe itself



Figure 1: Set-up of the *Cultural Touch*.

INTERACTION SCENARIOS

The *Cultural Touch* offers a variety of interactions. One or multiple people can interact with the globe at the same time. The main user interaction scenarios are explained below:

Obtaining country information

A user walks up to the globe; he/she wants to see information about the United States of America. He/she turns the globe around using both hands making a controlled, precise rotation. The user finds USA on the globe and touches it. The globe responds by sending information about the USA to the LCD screen. The information displayed on the screen is related to the culture and language of the selected region.

Changing time in history

The user wants to see information about the USA both in current day and in the 19th century. He/she turns the globe around using both hands for controlled, precise rotations. When he/she sees the USA he/she touches it. The globe shows information related to culture and language of the USA currently. The user now spins the globe rapidly to “travel back” in time to 1473. The map changes and shows the world how it was known in 1830. In addition, the screen produces information related to the USA in 1473.

Comparing countries and regions

The first user walks up to the globe, he/she wants to see information regarding the USA. He/she turns the globe using both hands for controlled, precise rotations. When he/she sees the USA he/she touches it. The globe responds by presenting information about the USA currently. While the first user is interpreting this information a second user approaches the globe and touches

Russia. The globe responds by producing side-by-side cultural information about both selected countries. Finally, the first user stops touching the USA to “turn off” the selection and the globe now presents information solely about Russia. This interaction can be expanded to accommodate up to 4 countries with a larger LCD display (Figure 2).

Country relationships in different historical times

Two users walk up to the globe; they want to see information regarding the USA and Russia at a random point in history. They rapidly spin the globe. The globe responds by selecting a random point in history (just 1473 with the current prototype) with both “USA” and “Russia” selected when the users touch those regions on the new globe. The information now presented is about the cultural characteristics of the two countries at the historical time. So that the users are aware of what time period the globe randomly lands in, the date projected in the center of the globe (Figure 3).

CURRENT WORK

Currently the *Cultural Touch* has been presented with some of the above interactions integrated. The main functionalities of the current work are the historical spin and the regional information for a country.



Figure 2: Touching two countries simultaneously

The historic spin is currently programmed to demonstrate the current year and a year in the 15th century for proof of concept purposes.

Using a combination of photocells that are calibrated to the projector, the program is able to detect a faster, uncontrolled spin as opposed to a slower, controlled rotation and responds by switching the time period. A slider rule representing time period has not yet been implemented and currently the time period is superimposed onto the map so that the user understands what year the map is showing (Figures 2 and 3).

Regional touch works for both embodied time periods and is currently programmed to allow for up to 2 country selections simultaneously. Further, as proof of concept, the globe was split into 3 frames with 4 countries each. Therefore, the user can currently choose only 12 countries in each time period, using wire oriented on latitudinal lines for the capacitive touch system.



Figure 3: Moving back in time

FUTURE DIRECTIONS

The current implementation of the *Cultural Touch* only supports three different frames of the earth with an angle of 120 degrees each with up to four countries per frame. Countries are thus divided over a wire that is wrapped around the globe, resulting in a

touchable area beyond the boundaries of a country. Thus, it does not matter where the user touches the globe along the wire for each given frame.

In a future implementation we would like to make the entire globe touchable and shift the projection of the map with respect to the actual rotation (not strictly 120 degree increments). In order to implement this, more expensive and advanced technology is necessary. Furthermore, the precision of the current prototype is insufficient to support a reliable demo of the *Cultural Touch*. Factors such as light in the room, air humidity, and the room layout influence the behavior of the *Cultural Touch* prototype.

Some of these factors change over time and this results in the need to continuously calibrate the globe. This problem can be solved if the map is projected from the inside of the globe with a range of 360 degrees. Comanje et al. (2006) also suggested this solution in their paper on Globe4D [3]. The projector could then rotate along with the spherical surface, thus giving us the possibility to implement precise touchable regions on the globe for each country or region and eliminating the reliance on light sensors thereby enhancing the robustness of our system.

In a future version of the *Cultural Touch* we would also like to support considerably more years for users to ‘travel’ to. However, for every year input a different map should be projected on the globe. Therefore, in order to implement this functionality, we need to develop an automated function to map 2D images of the world into elliptical images for proper 3D projection on the spherical surface.

CONCLUSION

The *Cultural Touch* is an interactive prototype designed for educational purposes that presents cultural information about specific countries in different time periods when physically touched by the users. The goal of the system is to prove its concept as an entertaining educational platform that promotes intuitive learning about the world we live in and its history. Through a projection of the globe on a tunable capacitive sensor platform, user’s touch on a specific region causes information related to that region to be displayed on a digital screen. Time and budget constraints limited the functionalities of this prototype. Nevertheless, the validity of the concept has been established and a future commercial product can be easily foreseen.

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