IndHist: Tangible Approach To Learn Indian History

Himanshu Bansal, Varun Nagpal, Ranju Ravindran, Keyur Sorathia
Indian Institute of Technology Guwahati, India
(h.bansal, v.nagpal, ranju, keyur)@iitg.ernet.in

ABSTRACT
Previous studies show that history is considered to be less engaging due to the non-participatory learning experience it offers. This paper presents IndHist, a novel approach of multimedia enabled instructional design technique supported through tangible user interfaces to teach historical events of India with an aim to enhance participatory and constructive learning Historical events (e.g. the salt march, the revolt of 1857) are presented through multiple tokens placed on interactive tabletop. These tokens are manipulated to demonstrate information through an audio-visual interface. Fiducial markers are used to track the presence and positioning of each token. Usability evaluation with twenty participants produced motivating qualitative and descriptive quantitative results along with few system interface design suggestions which could be helpful for those who want to work further in this direction.

Keywords
Tangible User Interfaces; Indian History; Usability Evaluation;

1. INTRODUCTION

Educators have treated learning history as a singular pre-defined process where students begin as open thinkers and slowly learn facts in order to grasp the correct narrative [5]. Seixas [17] believes that what is passed on as history: the mere cramming of a set of facts, causal explanations – might better be taught with reference to their present day culture, societal beliefs and heritage. It is a pre-conceived notion among majority of students that history does not include any social context as it is the meaningless remembering of names, dates, and facts. To design learning solutions which addresses these issues is presently a major topic of research among learning scientists [1].

Previous explorations in tangible interfaces have suggested that they might be particularly suitable for children in interactive and playful learning [11]. The connections between physical inputs and digital feedback may lead to an increase in involvement and levels of learning [16]. As interaction with tangible interfaces is safely assumed to be more intuitive or familiar than with other type of interfaces [4, 9], they tend to be more accessible to children, people with learning disabilities or novices [20], thereby increasing the net participation [9].

Researchers have suggested the use of new technologies in museum installations due to lack of digital interactivity and involvement in traditional exhibition installments [10, 15]. In [10] Hornecker observed that tangible interactive installations are more engaging, accessible and more popular than traditional installations in her evaluation of case-study of medien.welten exhibition.

On the basis of our findings from the literature, we decided to explore tangible interfaces to make the experience of learning Indian history more engaging, natural and constructive.

In the next section, similar works are discussed in which researchers have used tangible interfaces for improving the interactive experience of history. After that, concept of our proposed system IndHist is described followed by the explanation of prototyping process. Usability tests were conducted with participants to evaluate the prototype. Results of the qualitative and descriptive quantitative analysis of the data are presented before concluding with the discussion about the results and future works.

2. RELATED WORKS

Often tangible interfaces have been used to facilitate learning are about topics as diverse as programming [7] and molecular biology [8] but tangible approach to aid history learning and exhibit Indian History has not been explored much yet. The Eternal Gandhi Multimedia Museum (digital multimedia museum) [6] located at Gandhi Smriti, New Delhi has a number of tangible interface installations presenting historical records of Gandhi's life, and aims to revive and redefine the values by which India obtained freedom. 'Reenactment: The Salt Satyagraha Online' [13] by Joseph DeLappe is another project in which he walked on a treadmill for 22 days and 240 miles to control his Gandhi avatar on a virtual screen walking across Second life.

3. PROPOSED CONCEPT

"The Salt March" and "The Revolt of 1857" are two very important events of the Indian history. We chose them as our case study events because they can be represented in more than one sub-events. Two tokens (objects carrying information) of Mahatma Gandhi and Mangal Pandey (Indian freedom fighters) were made so that they could be related to real life iconic figures of Indian history.

Mahatma Gandhi's token is used for depicting The Salt March and Mangal Pandey for The Revolt of 1857. As soon

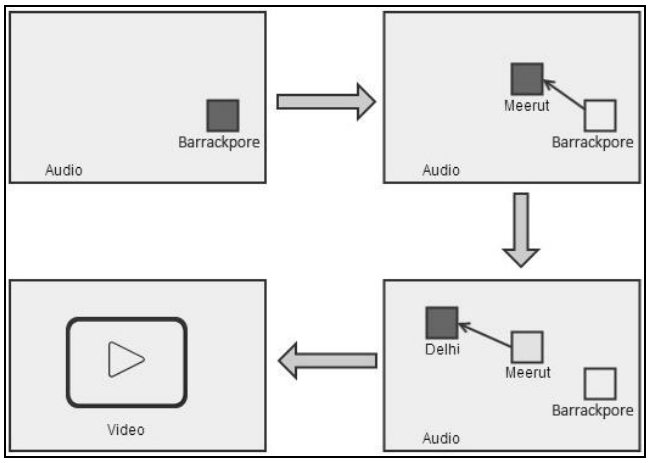

Figure 1: GUI and Task flow for one particular event

as any of the above two tokens is placed on the table, system detects the event corresponding to that particular token and starting point of that event (small box) is displayed on screen with event's name on top right of the interface, direction sense in bottom left. When the token is moved to the location where starting point is displayed, system detects the token and audio containing information corresponding to this particular location is played and also next location (in chronological order) of the event becomes visible. All the locations in system map were approximated as per their actual geographical location. After listening to audio content of each sub-event token should be moved to next appearing location and similar pattern is observed.

It goes on till the event reaches the last location where as soon as the audio is finished a short video is displayed showing summary of the entire event. Similar to this, other token and corresponding event is also laid out.

Pictures of Mahatma Gandhi and Mangal Pandey were engraved on their respective token so that users can easily relate to particular iconic figure of the Indian history. Thus, offering affordance and enhancing the recall factor from the physical appearances [19]. The events in the map were laid out in chronological order and relative location on system map is approximated as per the actual geography of the respective locations. Thus, the learning of event flow and their respective locations with positive recall is enhanced. Information to the users is delivered in audio-visual format because there is a greater improvement in recall as compared to the equivalent text [2].

4. SYSTEM PROTOTYPING

In order to test the concept with users, we prepared a prototype of the system.

4.1 Prototyping tools used

- *Processing*: Processing [12] is a programming language which is mostly used for quick prototyping of computer-graphics and computer vision projects.
- *Fiducial Markers*: These markers are tagged with objects for easy and precise tracking by the camera.
- *ReacTIVision*: ReacTIVision [14] is an open source, cross-platform computer vision framework for the fast and robust tracking of fiducial markers attached onto physical objects. TUIO protocol is used to connect reacTIVision with the processing code [18].
- Table with frost screen on its top, Projector and External Webcam
- Physical Tokens: Two 3d physical objects of size which can easily fit into a hand.

4.2 Prototyping Procedure

The physical 3D models (tokens) of Mahatma Gandhi and Mangal Pandey were created to represent "The Salt March" and "The Revolt of 1857" respectively. The corresponding fiducial markers I0 and I1 (fiducial ids) were tagged beneath the tokens. These tokens were placed on a table top with a frost screen as its upper surface. A portable webcam connected to a laptop computer along with a projector was placed beneath the table surface. The webcam was used to capture and track the movement of fiducials. Logical algorithm was developed and integrated within the system using Processing IDE as programming end to work along with the fiducial markers. Projector was used to display the processing output screen on the table surface.

The final prototype was created using frost screen, webcam, projector which in turn was connected to a laptop computer that runs the code on Processing. The program analyzes the camera tracked fiducials and the projector displays the paths on to the frost screen according to the marker which was initially detected. Audio tracks were played to deliver the information about the events which took place at the current location of token. Once the user reaches the last location of that event, (s)he can view the final video on screen after removing the marker from the screen. As soon as the user puts on another marker on the screen the respective historical event begins.

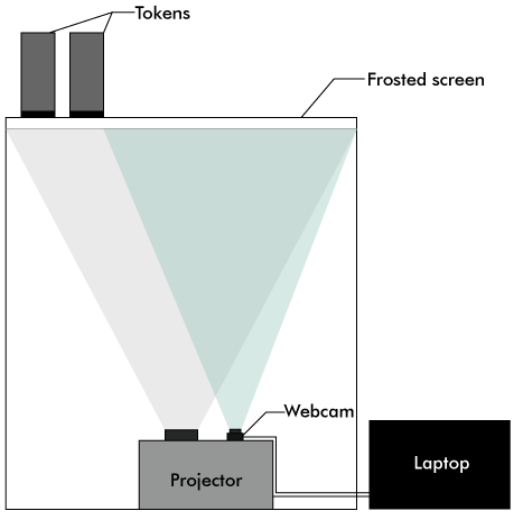

Figure 2: System's equipment schematic arrangement

5. EXPERIMENTS

Usability evaluation of the system was conducted in a lab. This was done to evaluate the system's usability and also to get qualitative responses from participants in order to identify functional and interface issues in the system.

Experiments were conducted with 20 participants out of which 10 were 7-10 grade students and rest 10 participants were of age more than 20 years including college students, professors and staff considering interactive museum case. System Usability Scale (SUS) [3] was used for quantitative usability testing of the prototype. SUS was chosen to measure user perceived system effectiveness, learnability, ease of uses and also due its popularity in research community. Out of these 10 likert items present in SUS, 2 were changed according to our context (inquiry about system's effectiveness in teaching Indian History). One of such example item was: "I liked the way in which information of historical events was provided" and participant was asked to fill his agreement to it on the scale of 5. It has both positive and negative statements in the questionnaire to address users' biasness.

5.1 Procedure Followed

Each participant was first briefed about the project and the aim of the usability testing. It was made clear to them that it was voluntary for them and they were free to withdraw any time in-between the study. After that, participants were told to complete all the four steps for each of the two events by placing tokens in appropriate square. Lastly, their responses were taken by asking them to fill the questionnaire. Participants were told to fill the 10 statements in the questionnaire on the extent to which they agree on a 5 point likert scale. Qualitative feedback given by the users was also noted down in a notebook.

6. RESULTS

6.1 Descriptive Quantitative Results

Data gathered from twenty participants was compiled. From the sheet a frequency distribution table was prepared consisting of frequency of each level 1 to 5 for all the ten items. Modes and standard deviations (SD) for all the ten items were also included in this table as mode is a better way to determine central tendency of likert scale as level of measurement or data type for likert scale is ordinal.

Items	Strongly Disagree (1)	2	3	4	Strongly Agree (5)	Mode	Std. Dev.
Q1	0	2	3	9	6	4	0.94
Q2	4	12	2	2	0	2	0.85
Q3	0	0	0	4	16	5	0.41
Q4	17	2	1	0	0	1	0.52
Q5	0	1	6	12	1	4	0.67
Q6	0	0	2	11	7	4	0.64
Q7	3	2	1	8	6	4	1.43
Q8	11	6	3	0	0	1	0.75
Q9	0	1	1	11	7	4	0.77
Q10	15	4	1	0	0	1	0.57

Table 1: Descriptive Quantitative Results

Standard deviation included here, was calculated participant-wise not aggregated response levels wise. It gives the information about how much participants' responses to a particular question are differing among themselves. Lower standard deviation value signifies credibility of question and its responses.

Following inferences were made out from quantitative analysis:

- From mode, it was clear that responses for all the statements/ques. are on positive side i.e. 4 or 5 for positive statements and 1 or 2 for negative statements.
- For ques. no. 3, 4, 5, 6 and 10, SD is relatively low (<0.7). Therefore it can be inferred that they perceived:
    1. System is easy to use (ques. 3 and 4)
    2. Usage of system is easy to learn (ques. 10)
    3. Various functions are well integrated (ques. 5)
    4. They liked the way information of history events was provided (ques. 6)

6.2 Qualitative Results

Qualitative user feedback was also noted down. They faced problems while using the table and gave following suggestions:

- Participants suggested that there should be an actual colored map in place of the self-designed maps which would make this system visually and analytically more rich. This could not be achieved at the moment due to technical constraints.
- Participants felt that surface should be inclined at an angle rather than horizontal such that its surface is facing towards user. They felt that horizontal surface would make it difficult for kids to access complete table using tokens.

7. DISCUSSIONS AND CONCLUSION

The major factor contributing to boring and uninteresting history learning experience is the method in which information is delivered to students. Similarly, installations in museums are unable to capture and retain visitor's attention due to little or no interactivity at all and thus they fail to deliver the content as intended.

IndHist serves as a platform to teach and learn all the events based history topics in a storytelling format to address above mentioned issues. Information to a user is delivered in audio-visual format rather than the conventional textual format which in turn has lower remembrance.

System is designed and prototyped using fiducial marker tracking technology and all the interactions are performed on a table top horizontal surface. Case study topics chosen from Indian history are "The Salt March" (Mahatma Gandhi, 1930) and "The Revolt of 1857" (Mangal Pandey).

Iconic tangible approach is used so that students can easily relate to the events and iconic figures of Indian history.

Despite not using inferential statistics, descriptive quantitative analysis shows us possibility of future research in using tangible interfaces to learn about history topics. As can be seen from table 1, modes of all the 10 items are in the positive side of the neutral (neither agree nor disagree). Also standard deviation is less than one for nine out of ten items which shows that responses of the participants are near the central tendency.

From qualitative analysis, we got useful insights. Participants liked the idea of using audio-video format of delivering information. Few issues in the interface were also pointed out by them e.g. use of actual map for the background and inclining the surface at an angle facing towards user. Overall, user feedback is positive and helpful for researchers who wish to extend this work further.

8. FUTURE WORKS

First, we will refine the current prototype based on the recorded feedback of the participants to be followed by empirical study with larger participant sample size. Also, we are intending to test the system's effectiveness in improving the students' motivation in studying History after using the system.

Acknowledgements

We would like to express our gratitude to EI Lab, IIT Guwahati for providing us with equipment and programming support during prototyping.

References

1. Barnett, M. Barab, S.A., Schatz, S., Warren, S. Designing a Community of Inquiry in an Undergraduate History Course: A Clash of Cultures. Paper presented at the 2000 Annual Meeting of the American Educational Research Association, New Orleans, LA. (2000).
2. Balslev, T., De Grave, W. S., Muijtjens, A. M. M. and Scherpbier, A. J. J. A. Comparison of text and video cases in a postgraduate problem-based learning format. Medical Education, 39, 1086–1092 (2005).
3. Brooke, J. SUS-A quick and dirty usability scale. Usability evaluation in industry, 189-194 (1996).
4. Dourish, P. Where the action is: the foundations of embodied interaction. MIT Press (2001).
5. Downey M. T. & Levstick, L. S. Teaching and learning history. In Shaver, J. P., (Ed). Handbook of research on social studies teaching and learning. New York: Macmillan, pp. 400-410 (1991).
6. Eternal Gandhi Multimedia Museum, Sacred World; http://www.sacredworld.info/gandhi.htm
7. Fernaeus, Y. and Tholander, J., Finding design qualities in a tangible programming space. In Proc. of CHI '06, 447-456
8. Gillet, Alexandre, et al. "Tangible interfaces for structural molecular biology." Structure 13.3, pp. 483-491 (2005).
9. Hornecker, E. and Buur, J., Getting a grip on tangible interaction: a framework on physical space and social interaction. In Proc. of CHI '06, ACM Press, 437-446.
10. Hornecker, E., & Stifter, M., Learning from interactive museum installations about interaction design for public settings. In Proceedings of the 18th Australia conference on Computer-Human Interaction: Design: Activities, Artefacts and Environments, ACM. 135-142 (2006).
11. Price, S., Rogers, Y., Scaife, M., Stanton, D. and Neale H. Using 'tangibles' to promote novel forms of playful learning. Interacting with Computers, 15 (2) pp. 169-185.
12. Processing 2 official website, http://processing.org/
13. Reenactment: The Salt Satyagraha Online, http://saltmarchsecondlife.wordpress.com/tag/salt-march/
14. ReacTIVision framework webpage, http://reactivision.sourceforge.net/
15. Reading, A., Digital interactivity in public memory institutions: the uses of new technologies in Holocaust museums. Media, Culture & Society, 25(1), pp. 67-85 (2003).
16. Rogers, Y., Scaife, M., Gabrielli, S., Smith, H. and Harris, E. A Conceptual Framework for Mixed Reality Environments: Designing Novel Learning Activities for Young Children. .. Presence: Teleoperators & Virtual Environments, 11 (6), 677-686.
17. Seixas, P., Schweigen! die Kinder! or, Does postmodern history have a place in the schools? In Stearns, P.N. Seixas, P., & Wineburg, S. (Eds.), Knowing teaching & learning history: National and international Perspectives. New York: New York University Press, (2000).
18. TUIO processing webpage, http://www.tuio.org/?processing
19. Ullmer, B., & Ishii, H. Emerging frameworks for tangible user interfaces. IBM systems journal, 39, 3.4, pp. 915-931 (2000).
20. Zuckerman, O., Arida, S. and Resnick, M., Extending tangible interfaces for education: digital montessori-inspired manipulatives. In Proc. of CHI '05, ACM Press, 859-868