Synchrum: A Tangible Interface for Rhythmic Collaboration

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ABSTRACT
Synchrum is a tangible interface, inspired by the Tibetan prayer wheel, for audience participation and collaboration during digital performance. It engages audience members in effortful interaction, where they have to rotate the device in accord with a given rotation speed. We used synchrum in a video installation and report our observations.

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INTRODUCTION
Traditional cultural artifacts hold great potential as sources of inspiration for the design of novel digital interfaces. While travelling in India and China, the first author observed the use of a fascinating cultural object, the Tibetan prayer wheel. This object exists in different sizes and colors and its use is prevalent among Tibetan populations in the aforementioned countries. The Tibetan prayer wheel consists of a circular cylinder, mounted on top of a graspable handle that can be used to rotate the cylinder rhythmically. A written prayer roll is inserted in the cylinder and the traditional belief is that each turn of the cylinder corresponds to a recitation of the prayer.

This idea inspired the development of a computational object, synchrum, for use by members of the audience in a digital performance. Synchrum is shown in Figure 1 (Left). The interface was designed to afford collaboration and its use would require physical activity and effort.

The importance of the development of mechanisms that enable audience engagement and participation in performance has been recognized before and various tools have been used for their facilitation. The clapometer or applause meter is a device, usually consisting of a microphone and a monitor, used to determine the sound level of applause during a game show or performance. It has been used to tailor video narratives in response to audience input [2, 5]. In Terminal Time, the audience was asked a number of questions prior to the screening of a documentary film and their responses were recorded and input to an algorithm that selected the format and content of the film based on their perceived biases and opinions. The designers considered using buttons but preferred the applause meter because it made the act of voting public, adding performative, collaborative and competitive aspects to the interaction [2].

Other approaches allowed audience members to use means other than noise to participate in shared games. The Cinematrix Interactive Entertainment System employed reflective paddles and computer vision to create a wireless “mouse for the masses” that gives large audiences real-time control over onscreen computer games [1]. This project inspired the development of three other large audience computer interaction mechanisms where members of the audience either leaned left and right in their seats, used laser pointers on a common screen or batted a ball whose shadow controlled the on-screen interface [3].

While these methods proved engaging, they have several shortcomings: the system was unable to accurately track each and every participant’s activity, where the participants were located (i.e., their proximity to the screen) limited their affected their interaction and, perhaps most important, their free movement with respect to the screen was not supported.

SYNCHRUM: AN INTERFACE FOR RHYTHMIC COLLABORATION
Synchrum, shown in Figure 1 (Left), is a tangible computational object designed for rhythmic collaboration. It consists of a wireless physical interface in the form of a cylinder mounted on top of a graspable handle and embedded with sensors and a microcontroller. The cylinder houses a rotating weight that blocks an embedded led light in each rotation, making it possible to detect the frequency with which rotations are made. A light at the top of the unit, the synch indicator, lights up when the unit is in synch with a given rotation speed.

The performance designer can monitor the current rotation speed of each synchrum in real time. For each synchrum, a target rotation speed, in rotations per minute, can be specified which expresses how fast the unit has to be rotated to be in synch. An error threshold value indicates how close the user’s average speed has to be to the target speed for the unit to be in synch. This value, in effect, reflects system tolerance for movement inconsistency and can be used to
tweak the difficulty of the interaction (i.e., the lower the threshold, the harder it is to be in synch). Both error threshold and target rotation speed can be changed during interaction. During a performance, information received from synchrum units can be used, by a live performance designer or a computer program, to determine what the next sequence of actions (e.g., with respect to the narrative or ambience factors such as light or music), should be.

Several design goals were central to synchrum’s design. First, the interaction was to involve physical effort, an important method for inducing pleasure and engagement is recognized [4]. Second, the physicality of interacting with synchrum, that involved non-trivial hand and wrist movements, was important since it both added a performative aspect to the interaction and encouraged cooperation and coordination. A third design goal was for the interface to support varying and easily adjusted degrees of difficulty. In addition to the presence of the error threshold value mentioned before, the speed of rotation was another factor that affected the effort needed during interaction. This characteristic makes the interface accessible to more users and allows the performance designer to tweak the difficulty based on the user population (e.g., adult vs. children) in real time.

We used synchrum in an interactive installation, entitled Liberation, that was demoed at the ACM TEI’06 conference. The installation consisted of a seated actor on whom a video of chains was projected. Each chain was associated with a rotating wheel, each with a different speed. At any given time, one rotating wheel was active. Participants could collaborate with each other to remove the chains by rotating synchrum units in synch with each other and the highlighted chain. Figure 1 (Right), shows the installation. Due to space restriction at the conference, it was not feasible to have the live actor and a video of him was used for the installation. In this particular setup, only two synchrum units were used. However, the interface is easily scalable and can accommodate large audiences, where each audience member has a unit whose rotation pattern can be monitored by the system.

We made the following observations. The participants found the physical feedback from the weight, as well as, the synch indicator light from the weight helped with adjusting their movements. Many participants looked at their partner’s movements and tried to imitate them. This collaboration often resulted in conversation and verbal communication that was often humorous. Overall, the participants found the interaction interesting and enjoyable. Many encouraged their friends to try it.

**Figure 1: Synchrum (Left) and the Liberation installation (Right)**

**CONCLUSION**

Synchrum is a tangible interface, inspired by the Tibetan prayer wheel, for audience engagement and collaboration during digital performance. Synchrum uses effortful interaction and requires the physical rotation of a wheel in synch with a specified speed. The performance designer can monitor and tweak the interaction difficulty in real time.

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**REFERENCES**


