Supplementary material for H. Seifi, M. Chun, C. Gallacher, O. Schneider, and K. E. Maclean, "How Do Novice Hapticians Design? A Case Study in Creating Haptic Learning Environments", IEEE Transactions on Haptics (ToH), 2020.

IEEE World Haptics 2017

June 6-9, 2017 | FÃ¼rstenfeldbruck (Munich), Germany

Student Innovation Challenge

The student innovation challenge invites students to use haptic technology in new, creative ways to solve real-world problems. This year, our theme is using haptics to support learning in Science, Technology, Engineering, and Math (STEM):

Teams will develop haptic environments in which learners can explore a STEM concept.

Challenge participants will be given access to open-hardware, low-cost force feedback devices developed to be viable for classroom use, with the option of working with Hapkit (1 degree of freedom), The Haply Dev Kit (2 degrees of freedom), or both. Each uses position sensing and DC motors to render a wide variety of virtual environments. In addition, students will have access to a high-level API to control both devices.

Teams first submit a proposal for their application using Hapkit and/or Haply. Applications should be focused on education. Successful teams (finalists) will receive one Hapkit and one Haply Development Kit, as well as instructions and example programs. Teams will compete for awards, and all finalist teams may keep their devices after the competition.

Important dates:

March 26 – Proposal Submission

March 31 – Challenge Acceptance Notification, kits sent to finalists

April 20 – Early Registration Deadline

June 5 – Final Student Blog Post due

June 6-9 – World Haptics Conference in FÃ¼rstenfeldbruck (Munich), Germany

How to Participate

To participate, a team must submit a two-page proposal (see submission information below) by March 26, 2017. Eight to ten teams will be chosen and notified. One Hapkit and one Haply Dev Kit will be shipped to the selected teams as kits to be assembled by the participants. The selected teams will be given access to supporting documents and application notes, including communication API, development instructions and examples, and detailed construction and design drawings. Teams can also build additional devices or modify the standard devices using instructions available online.

Teams will have approximately eight weeks to create and test their applications before presenting them at World Haptics in FÃ¼rstenfeldbruck (Munich), Germany to conference attendees. A panel of expert judges will evaluate each application at the conference. For each team, one or more team members must attend the full conference to present the teamâ€™s application(s) and will be responsible for applicable conference registration fees. All attending students must register for the conference. We suggest students look early for ways to fund their attendance, such as asking for sponsorship from local research labs, applying for student volunteerships, registering early, and watching out for possible student travel grants.

The Challenge

Participants will create a haptic learning environment in which a user can explore and experiment with specific topic or concept. Learning environments can be about a variety of STEM topics, for example, teaching fundamental mathematical concepts like fractions, or science topics like biodiversity – itâ€™s up to the team!

We encourage teams to structure your environment around active learning: focus on exploration, engagement and intrinsic motivation, and problem solving (as opposed to structured lesson plans which can be de-motivating to students). Â We advise teams to include an education student on their team or draw from learning resources available online.

Haptic interaction using Hapkit or the Haply Dev Kit (or both) must be a significant part of the application, i.e., environments should rely on the haptic feedback, rather than the haptic feedback being added post-hoc or in a nonessential way to an existing graphically-presented lesson. To accomplish this, teams may alter the devices to fit their applications. For example, teams might redesign the handles, use both devices

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World Haptics 2017
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A great #WHC2017 #Worldhaptics has come to an end. We hope you enjoyed it as much as we did. Travel safe.

Jun 9, 2017

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Congratulations to Charles Hudin for the Best Paper Award at #WHC2017 #Worldhaptics

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together, or change the kinematics. Teams can use other modalities, like visual or audio feedback, along with the haptics.

Hapkit and Haply allow for different types of interactions. We encourage teams to at least initially try to design learning environments for both devices, since they present different challenges as well as advantages; for example, Hapkit is more affordable for schools, while Haply offers two degrees of freedom. We also encourage teams to think about the practicality of implementing the environment: e.g., are you designing for it to be deployed in a school, online, or as an app? Hapkit and Haply are both open hardware devices; we encourage participants to use open source software as much as possible.

During the conference, teams will have a dedicated session during demonstration hours to show their lessons to conference participants. During that time, judges will come and interact with the lessons in-person.

Teams will also encapsulate their lesson in an online article or blog post. This documentation will be put into the public domain on the Challenge website, as a resource to the haptics and education communities for others to build upon under Creative Commons Attribution Share-Alike license. Â Judges will use both the live demonstration and online article to make their decision.

Lesson environments will be judged on:

1. **Quality, Effectiveness, and Accessibility of the learning environment** – Will this help learners understand the proposed concept? Are concepts communicated effectively with the modalities in play? Will the learning environment be accessible (affordable, easy to deploy) for schools or distance learners?
2. **Effective use of haptics, and device capabilities –** Does the learning environment take maximal advantage of what the device can do, and gracefully accommodate its limits? Schools have limited resources – we are using low-cost devices for accessibility, imposing tradeoffs. *Judges will highly value solutions* which find clever ways to create compelling experiences at low cost – e.g., using the lower cost (but 1DOF) Hapkit; or leveraging a lower-cost graphic display.
3. **Originality, creativity and engagement** – How innovative, inspiring, original and motivating is the lesson and the teamâ€™s approach?

At the minimum, we will offer an award for best overall lesson and an honorable mention, with the possibility of additional awards based on sponsorship.

TheÂ Hardware

Assembled Hapkit 3.0 devices.

Hapkit

Hapkit (version 3.0) is an open-hardware haptic kit designed to be very low-cost and easy to manufacture and assemble. It is a kinesthetic one-degree-of-freedom haptic

device that uses a capstan drive for transmission. It allows users to input motions and feel programmed forces in one degree of freedom. This enables interactive simulation of virtual environments that represent realistic physics (such as springs and dampers) and creative new touch sensations (like textures and buttons).

The main purpose when creating the Hapkit was to create a simple, robust, one-degree-of-freedom haptic teaching tool. In the student innovation challenge, we are looking for teams who can take advantage of Hapkitâ€™s capabilities to create lessons and learning environments.

For more details, visit http://hapkit.stanford.edu.

Assembled Haply devices. Students can modify existing designs or customize their own.

Haply

The Haply Development Kit is an open-source hardware project that was designed to lower the barrier of entry for students and designers to explore force-feedback haptics. The Haply Dev Board allows for users to design modular haptic systems to explore and test out in their research and design projects.

Within the distributed kit, students can find all the components required to build and assemble a working planar 2 degree-of-freedom force-feedback device. Additional electronic components are also included so that student participants can explore customizing their own haptic robot.

For more details, visit http://www.haply.co.

Hapkit 3.0 (left) and Haply (right) parts. Kits containing both will be sent to finalists to assemble and modify for their lessons.

Creating your Software

In addition, students will have access to a high-level API to ease development for both Hapkit and Haply. Both devices are can be programmed using the Arduino IDE programming environment. There exist online resources such as the Arduino Language Reference to learn the C-like programming language. Students can connect devices to graphical programming frameworks using tools like Processing, Python, Matlab, and Unreal Engine 4.

Submission Requirements

By **March 26, 2017**, students must submit a 2-page proposal document presenting their lesson idea and team information,Â along with a 150-word abstract, 30-word pitch, template, and contact information.Â

Please use the followingÂ link for the submission form:

World Haptics 2017 Student Innovation Challenge Submission Form

Qualifications:

The challenge is open to undergraduate and graduate students. Teams may have between two and four members. Teams can enlist professors, teachers, and professionals as advisors, but the work must be done by the students only, and all team members must be eligible to register for the conference in the student category.

Writing a Good Submission:

Hands-on educational activities help students learn concepts by linking abstract concepts to studentsâ€™ physical experience. Hapkit and Haply allow students to â€œfeelâ€ concepts through forces as a student interacts with the device. There are many different educational concepts that could be translated to haptic virtual environments. A good submission will describe a creative learning environment in which a student will use Hapkit or Haply (or both).

Your two-page proposal should help us understand:

1. The concept you are trying to teach and why it is important and/or difficult to teach using traditional classroom methods
2. What your learning environment will consist of and how students will interact with it
3. Why a force-feedback open-source haptic device is appropriate for your application
4. A roadmap for development and how your teamâ€™s skills can achieve them.

Good design requires iteration, and we donâ€™t expect your final result to be exactly as you describe in your submission, but your concept description should be well thought out, and it should have a plausible chance of working.

You can find examples of successful submissions from the 2015 Student Innovation Challenge here:

- RoughSketch
- HelloHapticWorld
- Remote Texture Exploration

Examples of successful submissions for theÂ 2016 Student Innovation ChallengeÂ are here:

- Intelligent Driver Seat
- Listen To Your Heart
- Tele Teku Teku

Challenge Organization Team:

Organizers: Dr. Oliver Schneider (Postdoctoral Scholar, Hasso Plattner Institute and University of British Columbia), Melisa Orta Martinez (PhD Candidate, Stanford University), Colin Gallacher (Research Associate, University of British Columbia and McGill University) — studentinnovation@worldhaptics2017.org

Mentors: Prof. Karon MacLean (University of British Columbia), Prof. Allison Okamura (Stanford University)

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Tanvas (Student travel grants)

Immersion (Best overall design award)

Disney Research (Runner-up and Peopleâ€™s Choice awards)

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