INTERACTIVE OUTREACH IN VIRTUAL SETTINGS: MODELING FINGER MOTION USING HOUSEHOLD ITEMS

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Introduction

Outreach and education are central to the dissemination of research and a critical part of the graduate student experience. However, outreach activities and presentations have needed to evolve in the face of the pandemic and remote learning. In response to these continued changes, our community can develop lesson plans built around interactive presentations for remote audiences, embedding hands-on activities requiring only household and everyday items. The motivation to create these accessible, tactile activities is to encourage student engagement during virtual outreach lessons.

We demonstrate this idea with our lesson titled "Modeling Human Joint Motion Through Robotics." Developing virtual lessons with hands-on activities increases the scope of our outreach and makes exploring engineering more accessible to all students. Well-constructed and interactive lesson plans can be used long term for both in-person and virtual outreach events.

Lesson Plan

- Pulleys and Levers are Simple Motion Machines
  - Student Discussion: What are some pulleys and levers you've seen before?
- Human Motion is Driven by Pulleys and Levers
  - Student Discussion: Identify the anatomy of the knee and elbow joints in terms of pulleys and levers.

Scan for Slide Deck

Hands on Activity: Build a Finger Model (figure 1)

Scan to Participate in Student Discussion

- Anatomic Models have Limitations
  - Student Discussion: What are some of the limitations of the model you just built?
- There is a Need to Model More Complex Joints
  - Video: Custom Built Robot Modeling Human Shoulder Motion Using Pulleys and Levers.
  - Student Discussion: How does using this robot address the limitations we listed?
- It is Important to Accurately Model Human Joint Motion
  - Student Discussion: What is the purpose of modeling human joint motion? Who will use this information?

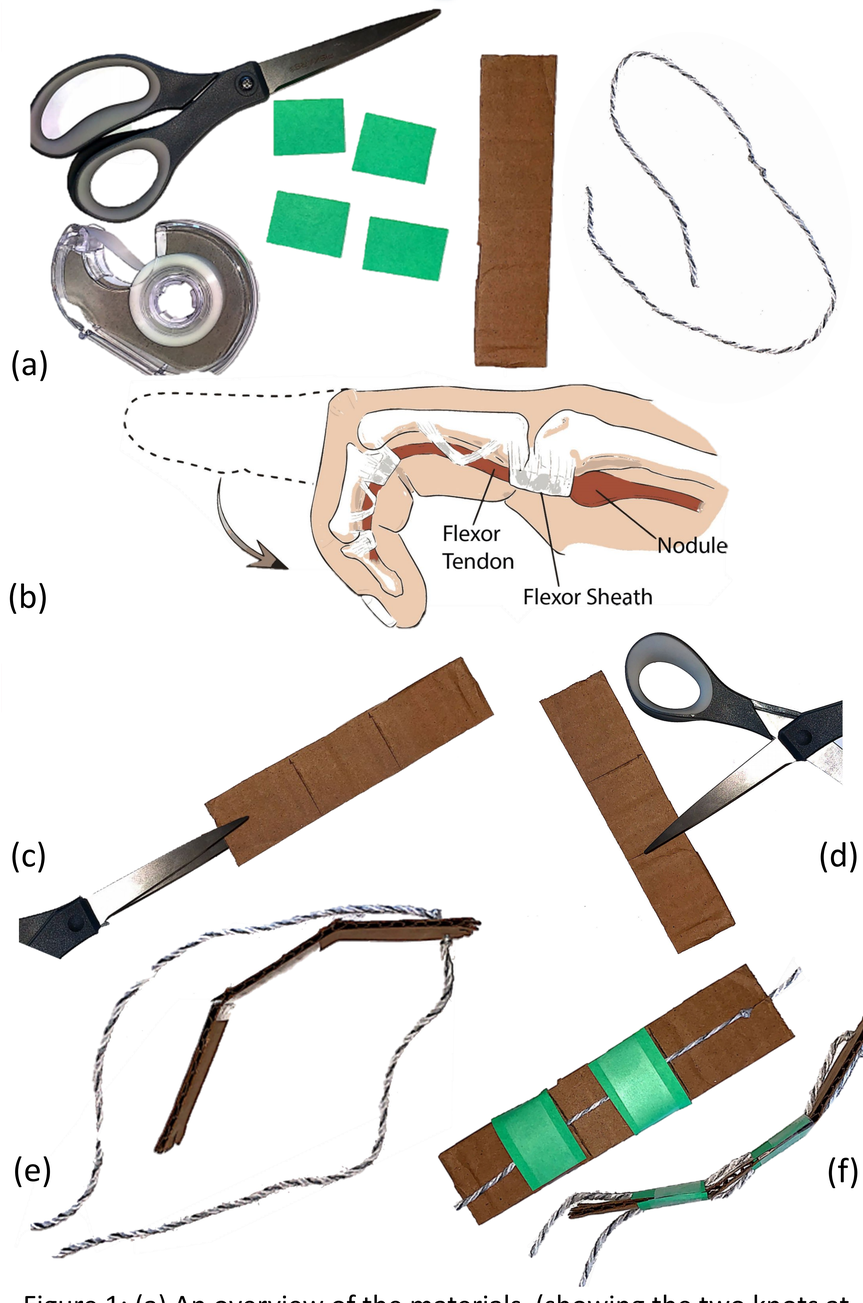

Figure 1: (a) An overview of the materials (showing the two knots at the center of the string), (b) illustration of the anatomy being modeled, and steps to build a model finger: (c) cut a notch in the cardboard for the string to attach, (d) score the cardboard twice to make joints, (e) insert the string between the knots into the notch, (f) make flexor sheaths on each side of the cardboard. Students are instructed to gather their materials ahead of time and reminded at the start of the presentation.

Student Engagement

- Over the past year, we have presented this lesson to high school students through two different career exploration programs on four separate occasions.
- Relating complex concepts in biomechanics and scientific research to everyday objects and high school level physics enables students to engage in the lesson confidently.
- Students can choose how to participate in the lesson during these presentations by building their own model or answering questions during the guided conversations.
- To improve participation in the virtual format, students are encouraged to shout out answers or type them in the chat, rather than wait to be called on.
  - We prompt students to share their ideas as needed by providing examples of answers during discussions.
- Throughout this lesson, students practice critical thinking skills related to biomechanics and research. The hands-on activity allows students to practice tactile learning directly related to the concepts in the lesson and participate regardless of their comfort speaking up during the discussions.

Rationale

Studies focused on learning success during virtual learning have found that students learn best when physically engaged. However, many programs have struggled to adapt in-person lessons to virtual workshops with accessible tactile learning activities [1]. The lesson plan presented here is an example of incorporating an accessible tactile activity into a virtual lesson to encourage student engagement. We can use well-constructed and interactive lesson plans for both in-person and virtual outreach events in the future.

References

1. Hodge-Zickerman, A., E. Stade, and C. S. York, L.N. Margaret and G.-W. Henry, Editors. 2021, IGI Global: Hershey, PA, USA. p. 278-296.

Acknowledgements

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