Using 3D Hologram to Improve Classroom, Project and Laboratory Demonstration

A proposal for 2017 Innovations in Teaching Using Technology Grant

Courses or curriculum affected

Immediate: Junior/Senior Engineering Clinics session under my supervision
Short-term: Other ME courses, other Engineering Clinics sessions
Long-term: All courses that need classroom demonstrations, project presentations, and experiment demonstrations.

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Objectives of the proposal:

Innovation

In classrooms demonstration is an effective way to attract the attention of students and improve the retention of the knowledge they learned. However, some demonstrations are not very easy to show in the classrooms or labs without major preparation. For example, when a Mechanical Engineering teacher wants to show the internal structure of an internal combustion engine, it is almost impossible to haul the engine to the classroom and lift it up to show the class, not to mention showing the internal structures. Meanwhile, when a Chemistry teacher wants to demonstrate a chemical reaction, it will be dangerous to gather the students around. Even they do, only the students in the inner circle can see clearly what happens in the test tube. We need to find a way to improve how the teachers demonstrate in their classes.

3D hologram is a classic optical illusion with a modern technical twist. It projects images to a set of semi-reflective glass pyramid to provide a 3D floating view. Please see Figure 1 for a commercial product. The technology is currently used mostly by the theatres to generate special effects or by the hobbyists to impress their friends. Some commercial projectors are developed to display products and play video games. Some people also mentioned the possible applications in education. However, most teachers have never heard about the technology.

Figure 1: (Left) A commercial 3D hologram projector made by H+ Technology. (Right) A scenario where two students are studying the movements of the earth and the moon.

In this proposed project, we want to apply 3D hologram to the classroom presentation and laboratory demonstrations. This innovation will transform how the teachers present a scientific object, an engineering design, or a medical anatomy. It will also change how the students present their projects, designs, and creativities.

Scalability

The 3D hologram projector can be easily used in a wide range of classes. It can be easily scaled up so more teachers and students will benefit from it.

In the immediate or a one-year time frame, we will test the concept in Junior/Senior Engineering Clinics and prove its effectiveness. We will take advantage of the hands-on project-based course to set up and configure the system, port the CAD design of a set of mechanical devices and machine components to the 3D hologram display, and then test with student presentations using 3D hologram as a prop to demonstrate their designs and other mechanical components.

In the short term, or within 2~5 years, we will introduce and promote the application of 3D hologram system to the entire department of Mechanical Engineering and to the engineering clinic courses throughout the School of Engineering. The sophomore engineering clinics and junior/senior engineering clinics are both presentation heavy courses. Students are required to give presentations at least twice in these courses. The topics are generally the introduction of a product, an engineering design, or an engineering process. A 360 degree three-dimensional demonstration will hold the attention from the audience and greatly improve the effectiveness of presentation.

In the long term, we will introduce the application of 3D hologram to an even wider audience through papers and demonstrations and by sharing our experiences in discussion groups and seminars. Any course that needs to demonstrate a three dimensional structure or process will benefit from it. For example, in a math class,

the professor can display a complex topological surface. In a physics class, the teacher can demonstrate the collision between two objects while showing their trajectories in space. In a biology or medical class, the anatomy of an animal can be shown layer by layer with the help of a 3D hologram projector.

Adaptability

Although the performance of a 3D hologram projector can be impressive, it is not difficult to use and can be easily adapted by anyone who can proficiently operate a computer and a projector/monitor. The only hurdle is to generate the image source, which requires using video editing software such as Adobe Premiere Element. However, the learning curve of using the software is not as steep as learning a programing language. A teaching assistant or a dedicated student can always help the instructor on the issue.

On the other hand, we hope the wide adaptation of 3D hologram projector will make the publishers be more aware of the technology. Today, many textbooks are equipped with PowerPoint slides and video clips as supplementary teaching materials. They can be easily downloaded from the companion CD or website. If there is enough demand from the teachers, the publishers will port the existing videos and pictures to the 3D format and make it ready to use by the instructors.

Description of the specific innovation

Virtual Reality (VR) is a buzzword for technology today. However, using true VR technology in a classroom to enhance the teaching result is still at its primitive stage. There are some large dedicated devices such as CAVE (like the one used in the South Jersey Technology Park). However, they are generally large and expensive, need a large and dedicated space that is always far from the general-purpose classrooms, and need to have dedicated technicians to maintain and operate it.

On the other side of the spectrum are the VR goggles such as Oculus Rift, HTC Vive, and Google Day Dream View. Their prices are significantly lower compare to the large immersive VR systems such as CAVEs. They can also be paired with existing computers, tablets and phones to save even more. However, when the students are wearing the goggles, it is difficult to know whether they are paying attention to the content or simply taking a quick nap. Meanwhile, many people including teachers and students are sensitive to the perceived fast motion in the VR and will get nausea wearing the goggles.

Therefore, we are turning our eyes to a classical technology with a modern twist, 3D hologram. 3D hologram is not real hologram that using laser induced interfering light beams. Instead, it is an optical illusion to reflect the videos on a semi-

transparent glass that is slanted forty five degrees from the bottom. The viewer will be tricked to think the objects are 3D and floating in the mid-air.

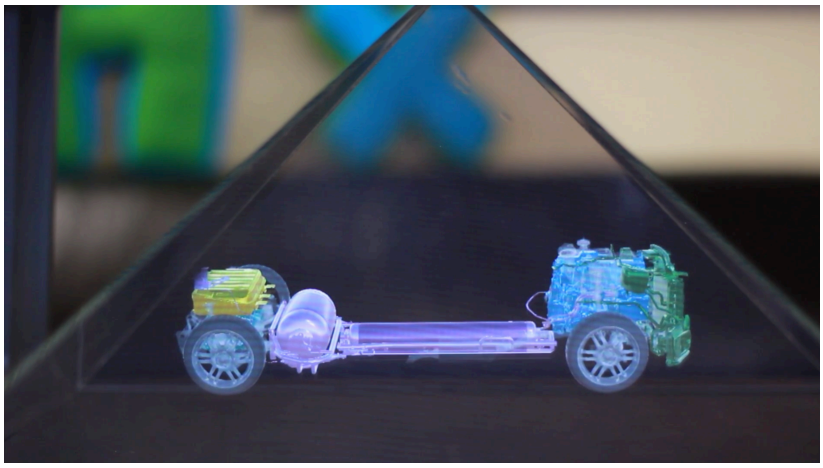

Figure 2: Demonstration of a Marcedes Benz chassis using the 3D hologram projector.

In order to display the pseudo 3D image, the input video needs to be manipulated first. The source of the video can be generated by CAD software such as SolidWorks, which is available to all Rowan faculty members and students via the site license. It can also be obtained by videotaping the target simultaneously from four directions. The video streams will be rotated and combined by a video processing software such as Adobe Element Premier, which is also readily available via Rowan Cloud. When the output video is displayed on the 3D hologram projector, people will be able to view the displayed object from all 4 directions.

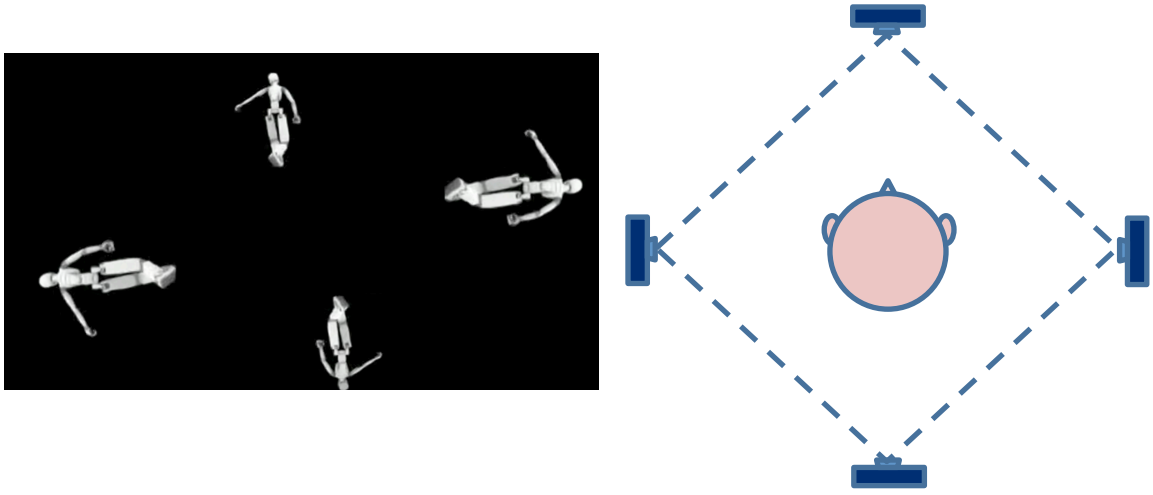

Figure 3: (Left) A screenshot of a typical 3D hologram video. (Right) Set up of cameras to videotape the presenter from all four directions. The four simultaneous streams will be combined by a video processing software such as Adobe Element Premier. The output will be displayed on the 3D hologram projector to provide a 3D view.

Required Academic Technology support

The required academic technology support for this project is minimal. The software (SolidWorks and Adobe Element Premier) can be accessed from all university computers and from home via the Rowan Cloud. The projector itself is an off-the-shelf commercial product. It is plug-and-play when it is connected with an iPad. Although we need to use a computer to record or generate video clips, we can just transfer and play the final video from the connected iPad.

Plans for evaluating and sustaining the innovation

Plans for evaluation

The project will be evaluated using traditional academic assessment techniques in order to demonstrate evidence of student learning. Students will reflect on their student evaluations and reports on how the projector impacted their presentation skills and learning effectiveness. I will also develop feedback forms to the students and other audiences of the presentation and seek their inputs on the effectiveness of using the technology. At the end, when there are enough teaching materials being converted, I will run a comparative demonstration of same teaching material, one using the regular PowerPoint presentation, another using the 3D hologram presentation. I will ask the students to evaluate the two presentations and compare the results.

Sustaining the Innovation:

The innovation will be naturally sustainable due to its visibility and usability in presentations and demonstrations. To further sustain it, I will continuously promote the use of the projector through the Junior/Senior Engineering Clinic. I will be continuously running Junior/Senior Engineering Clinic projects to produce more videos for various courses. More funding will be sought via additional grants, donors, and sponsors. I will also explore the possibility of selling the copyright of the videos to the pushing companies.

Budget. Describe the essential technology and estimated costs. Grant funds are allocated for equipment purchases only.

Technology items required	Cost to implement
Holus Pro 3D hologram projector	$799
Apple iPad Pro	$649
Logitech HD Pro Webcam C920 at $57.47 each, 4pieces	$230
Uline utility cart to push the projector around	$129
Estimated total shipping and handling cost	$100
Total	$1,907