A. Task / Problem Definition

1. **Introduce your problem.**
    a. Problem: Hybrid-synchronous learning lacks an interactive, collaborative environment that is present in traditional face-to-face learning. Accommodating both in-person and online students has caused teachers to resort to sharing their screen in the form of a PowerPoint or slideshow and simply talking through the points, rather than explaining examples and working out problems in real time for the students. This way of learning and teaching is monotonous for both students and teachers, and there needs to be some sort of hybrid whiteboard technology that allows for a more engaging learning setting.
    b. Seven Stages of Action
        i. Goal - Teach successfully in a hybrid synchronous environment
        ii. Plan - Use zoom combined with a projector to cater to in person and online students
        iii. Specify - Create a zoom link, share the zoom link with students, plan how you will use the zoom platform to teach synchronously with both types of students
        iv. Perform - Teach an actual class using your own synchronous learning plan
        v. Perceive - Students absorb information and ask questions during class
        vi. Interpret - The success of your teaching method can be perceived by how engaged the students are
        vii. Compare - Are the students performing successfully on assignments and demonstrating a level of understanding of the topic? How do the students' knowledge of the topic compare to those of past students (pre-COVID)?
2. **Identify your potential users.**
    a. Students and professors alike are affected by this issue. Professors struggle with the task of successfully lecturing, which involves engaging the students and being able to explain live examples like they would be able to do on a whiteboard in normal times. A solution would help professors feel more connected to their

students again. Instead of mindlessly flipping through slideshows, with a solution they could draw, elaborate, and explain. Students have the difficult task of learning online. College and graduate levels students spent 20+ years learning in person and asking questions in person, which allowed them to see the subject explained in detail and in steps. Now however, most classes are taught via slideshows to accommodate sharing screens, making the class less engaging and the student less knowledgeable in the subject. A solution would allow students to feel more interested in their studies and progress in learning the information, rather than memorizing it off of a PowerPoint.

B. Analysis of Existing Solutions

1. **Describe existing solutions.**
    a. Some of the existing solutions to whiteboard in Zoom are the annotate feature. This allows users to use a mouse to draw on a shared screen. Similarly, there is an annotate feature on PowerPoint. One pro of these solutions is the ability to add personal notes/examples onto the lecture that students are currently viewing. However, a major con is that in order to use these features the teacher must write using the mouse or the trackpad. This is difficult, delayed, and often leads to writing that is hard to read which contributes to confusing the students more. Because the annotate feature is easy to access on both PowerPoint and Zoom, this is one of the more common “solutions” to the problem.
    b. Another existing solution is the whiteboard feature on Zoom, but it requires a touchscreen device. Additionally, teachers have tried using a second webcam closer to the board and actually writing on a whiteboard in a classroom, but the writing can be difficult to read for students online due to the camera quality and setup. Some of the nicer online whiteboards that allow for collaboration or mobile support are paid services(Miro, Stormboard, and Mural). Another method for writing electronically is by using smart pens like the Livescribe, Neo Smartpen or Moleskine Pen+ which allow the user to write on a special paper and that is then transcribed to a tablet or computer that can then be shared over Zoom. Some of the pros to the use of an annotation tool like a tablet or a smart pen is that it

emulates the “normal” style of writing with pen and paper this allows for cleaner handwriting. A con to this solution is these items tend to be fairly expensive and limited in their applications, especially the smart pens which often only work on special paper.

2. **Describe potential guidelines and solutions.**
    a. Many of the existing free solutions, like the annotation tool on Zoom and PowerPoint, do not allow the user to be in full control. Annotating on Zoom is glitchy. The annotation option is only available when sharing a screen. In order to draw, the user must select “annotate”, “draw”, and then select their desired “pen” to draw with. However, once the user draws on the screen and picks up their finger from the trackpad, the annotation feature seems to be disabled and the screen favors the action of the page (such as typing if you are on a Word document). This sudden change between annotating and typing causes the user to feel frustrated and out of control.
    b. The existing solutions are decent at consistency. Most of the annotation software works in a similar manner. There are pen options, erase options, and highlight options. This is good because users do not need to spend much time learning how to operate the software and can normally jump right in with prior experience.
    c. Reducing short-term memory load needs improvement because when annotating PowerPoint slides the annotations are lost after leaving a slide.
    d. Preventing errors is another principle that could be improved since it is very easy to have a “slip-of-the-hand” with a mouse or stylus which accidentally creates stray lines.
    e. Permit easy reversal of actions needs improvement. With PowerPoint the erase feature deletes all connected lines so if a user creates a stray line through something important the user cannot delete it without deleting the entire annotation. This makes it hard to reverse accidental actions.

C. Proposed Solution

1. **Propose a solution.**

a. Our solution to this problem is the use of a traditional whiteboard marker that has been modified with an infrared light to enable the user to have what is being written to also be captured digitally. Professors will be able to write on the white board in order to cater to in-person students, while at the same time the modified whiteboard marker would transcribe the pen strokes onto the Zoom share screen for the online students to see. Being able to learn in person the traditional way from teachers writing on the whiteboard would encourage more students to go into class if and when they are able, and it would also make learning online more active and engaging and make the online students feel like they are getting more of the benefits of learning in-person.
b. The modified pen would look and feel similar to a traditional whiteboard pen in order to keep the experience of use similar for the professor. Upon contact on the board, the infrared light would automatically come on, allowing the professor to write with the traditional tip of the marker while also digitally displaying the writing for online students. When the marker comes in contact with the board, the infrared light shines red over the felt tip of the marker, signifying that the marker affords the pen strokes to be transcribed onto the Zoom screen. Properties of the modified marker would include having an infrared light that can be seen by an infrared camera which would track pen strokes. This would allow the professor to lecture in front of a whiteboard for in person students while also being able to display writing that online students can easily read.

2. **How will you measure success?**
    a. Success could be measured by a teacher effectively using the technology to teach the class. This would involve the teacher understanding the technologies parts and using it without any errors or difficulties. Furthermore, the solution would be successful if students felt that they were in a more engaged learning environment.
    b. The interactive whiteboard works successfully i.e. the writing on the physical whiteboard gets transferred over onto the Zoom whiteboard with minimal errors.