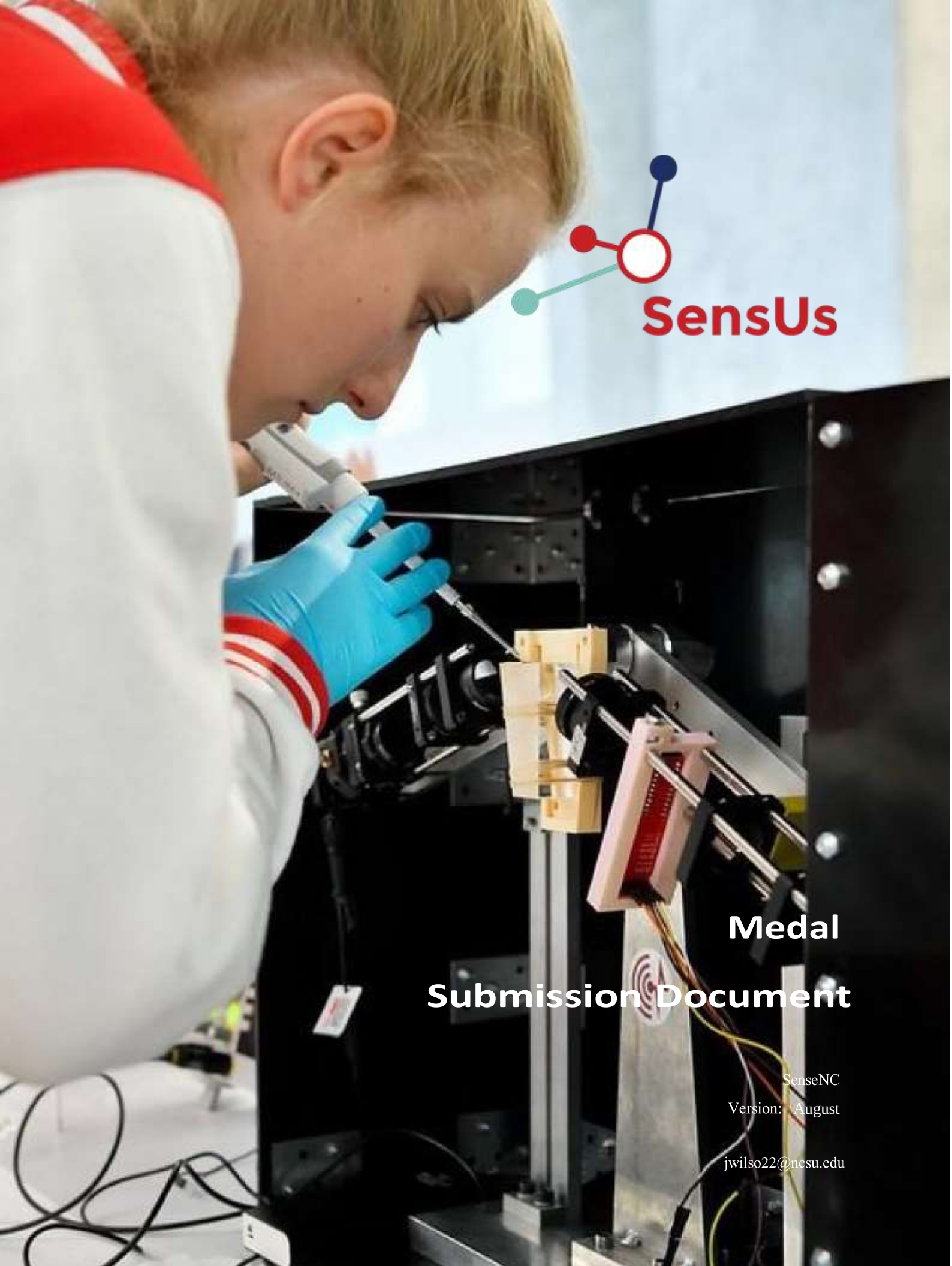

SensUs

Medal Submission Document

SenseNC

Version: August

jwilso22@ncsu.edu

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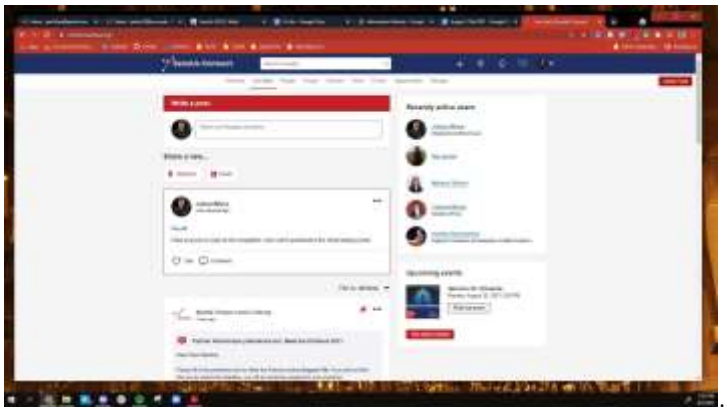
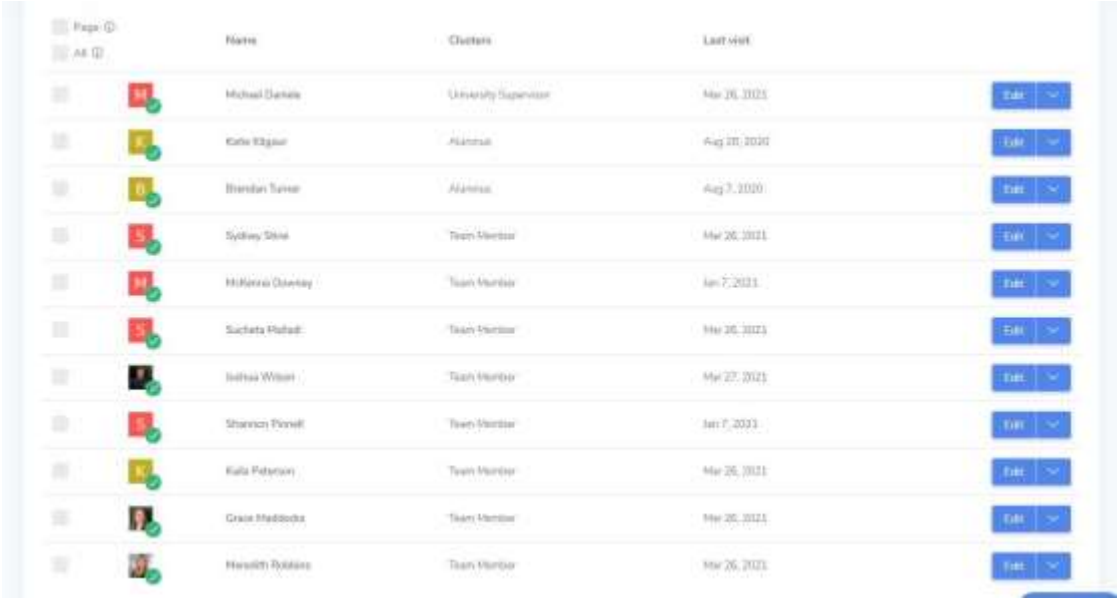


January

1. Bronze

1.1 Register on SensUs Connect;



March

1. Bronze

1.1 Motivation;

SenseNC combines a team of engineers to develop an innovative biosensor. The team is composed of eight students enrolled at North Carolina State University across the disciplines of Chemical Engineering, Electrical & Computer Engineering, and Biomedical Engineering. Through teamwork and mentorship from our team's supervisor, Dr. Michael Daniele, SenseNC will contribute ground-breaking advancement of modern medical technology.

Our goal is to accurately detect H1N1 in a saliva sample while producing a positive user experience. H1N1 is a bio-marker, commonly known as swine flu, and is aerially transmitted through coughing/sneezing. Thanks to the SensUs 2021 competition we will be provided the opportunity to safely research, develop, and test a device that will be able to determine the concentration of H1N1 in human saliva. This challenge will allow each team member to advance professional skills that will be used in their future careers. The SenseNC team is excited to participate in this international competition while contributing to the improvement of biosensors.

May

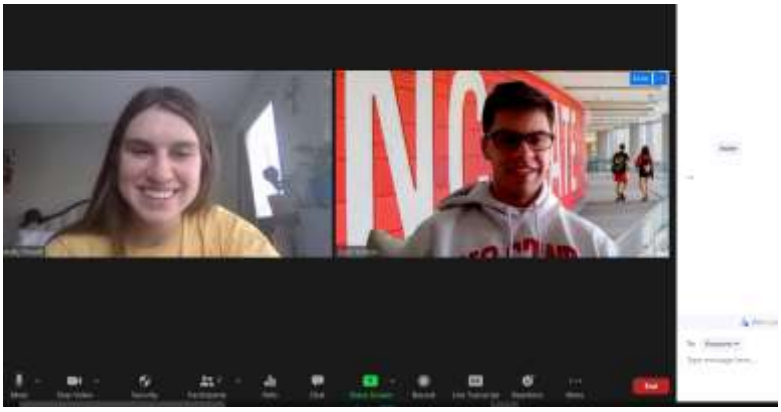
1. Silver

1.1 Meet with Alumni;

Attendees	Molly Powell and Joshua Wilson.
Goal of the Meeting	The purpose of this meeting is to receive critical feedback on business proposals and on chemistry design. This Alumni was a valuable member of the team and their feedback is greatly appreciated. We will present to them what our purpose is this year and how all three subteams (electrical, chemistry, and business) will work toward this goal. They will then provide any feedback they can think of and it will be recorded. We will then show them the relevant technical information and they will provide specific technical details. This will give them time to provide specific technical feedback.
Date	05/25/2021

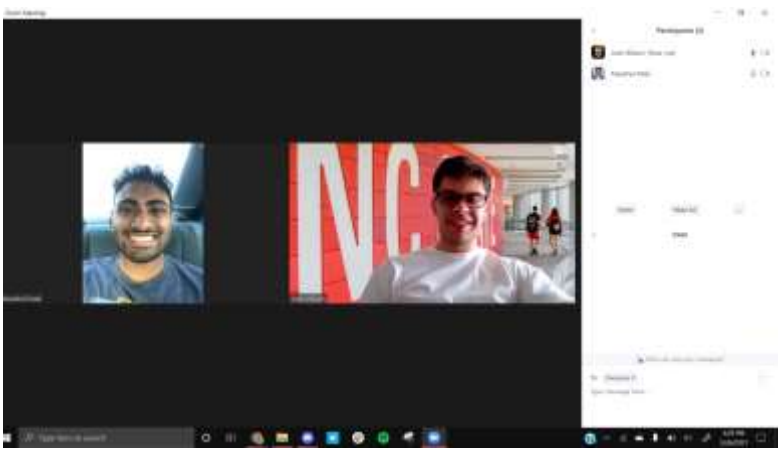
Preparation Time	1 hour.
Duration	30 minutes.
Summary	She believes it seems to be a complete system. She likes that we are reusing hardware - to shorten the learning curve. Likes where we are heading for steps on how to improve on what we know. She wants us to always keep in mind on how patients/users will be able to interact with the sensor. Reflect the design process from that. Grant proposal comments were extremely valuable, without these comments we could not have further developed the effectiveness of the proposal. We had a good introduction, it introduces the topic very well and tells the reader an excellent summary of what will be presented. Proposals should focus on what we are researching & skills gained. The people granting the money mostly care about the undergraduate students that are developing skills. When filling out an application describe what skills (business, presentation, research, etc.) all student growth! OUR for funding is a great resource, we should use this resource to apply our proposal to. Saying that research on H1N1 is relevant for other infectious diseases (such as COVID). Not a direct comparison. If Meredith has any other questions ask Molly!!! Molly's information is found on the contact information google sheet near the business team members.
Evaluation	I have evaluated the effectiveness based on how critical the feedback was. Molly provided valuable feedback and will lead to changes to the specified documents/designs. Very

	valuable meeting!

Picture	

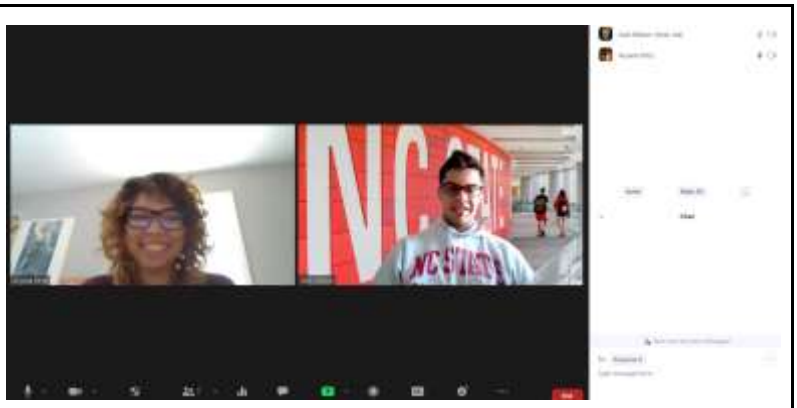
Attendees	Meekhel Patel and Joshua Wilson.
Goal of the Meeting	The purpose of this meeting is to receive critical feedback on electrical design. This Alumni was a valuable member of the team and their feedback is greatly appreciated. We will present to them what our purpose is this year and how all three subteams (electrical, chemistry, and business) will work toward this goal. They will then provide any feedback they can think of and it will be recorded. We will then show them the relevant technical information and they will provide specific technical details. This will give them time to provide specific technical feedback.
Date	05/26/2021
Preparation Time	1 hour.
Duration	30 minutes.

Summary	Meekhel was extremely supportive of how we decided to move toward our final sensor design. He believes that the progress we made toward the final design is very great! Once I showed him the specific measurements we were making he had some helpful comments. We had some trouble trying to produce accurate data from a cyclic voltammetry measurement with a glucose strip. To help reduce the noisiness of the signal we should increase the wait time between samples. This will help make our measurements more accurate and will allow us to create accurate data measurements. There could be alot of fluctuations between current and voltage samples, which could mean that we are not measuring all the important data points. Increase sampling time (sample in smaller steps) and wait certain times to get outputs from any inputs. This could allow us to ensure that we can find all important data points. Meekhel then had some important points on how we could develop our presentation skills. For our presentations we should use block diagrams to show how everything works together. Make sure pictures included in the presentation are relevant to the presentation. Make sure you reference the pictures during the presentation to ensure that the viewers are acknowledging the purpose of it.
Evaluation	I have evaluated the effectiveness based on how critical the feedback was. Meekhel provided valuable feedback and will lead to changes to the specified documents/designs.

	Very valuable meeting!
Picture	

Attendees	Aryana Ortiz and Joshua Wilson.
Goal of the Meeting	The purpose of this meeting is to receive critical feedback on chemistry design. This Alumni was a valuable member of the team and their feedback is greatly appreciated. We will present to them what our purpose is this year and how all three subteams (electrical, chemistry, and business) will work toward this goal. They will then provide any feedback they can think of and it will be recorded. We will then show them the relevant technical information and they will provide specific technical details. This will give them time to provide specific technical feedback.
Date	05/28/2021
Preparation Time	1 hour.
Duration	30 minutes.
Summary	Aryana had extremely valuable feedback that we will implement in our team structure and design. Aryana mentioned that we should try harder recruiting on the business team. She mentioned that it was difficult splitting time between the business team and the chemistry team. She wants us to ensure that we have enough team members to develop great products without over committing our time to different teams. She believes that it is great that we can do lab work this year. Aryana mentioned that COVID-19 did not allow us to perform important tests and our access to the lab this year will allow us to produce accurate tests. We can produce real results and develop a physical sensor. Aryana is jealous that we can go to the Netherlands this year. She was unable to go to the Netherlands last year due to the COVID-19 pandemic. Aryana is excited for our team and believes that we have an excellent biosensor design. She mentioned that allowing us to develop the sensor in the lab is a great opportunity. Aryana wants us to keep her updated on our progress and send her photos/videos of our participation in the SensUs competition. She wants to thank SensUs for allowing her to participate in this exciting competition.

Evaluation	I have evaluated the effectiveness based on how critical the feedback was. Aryana provided valuable feedback and will lead to changes to the specified documents/designs. Very valuable meeting!

Picture	

June

1. Silver

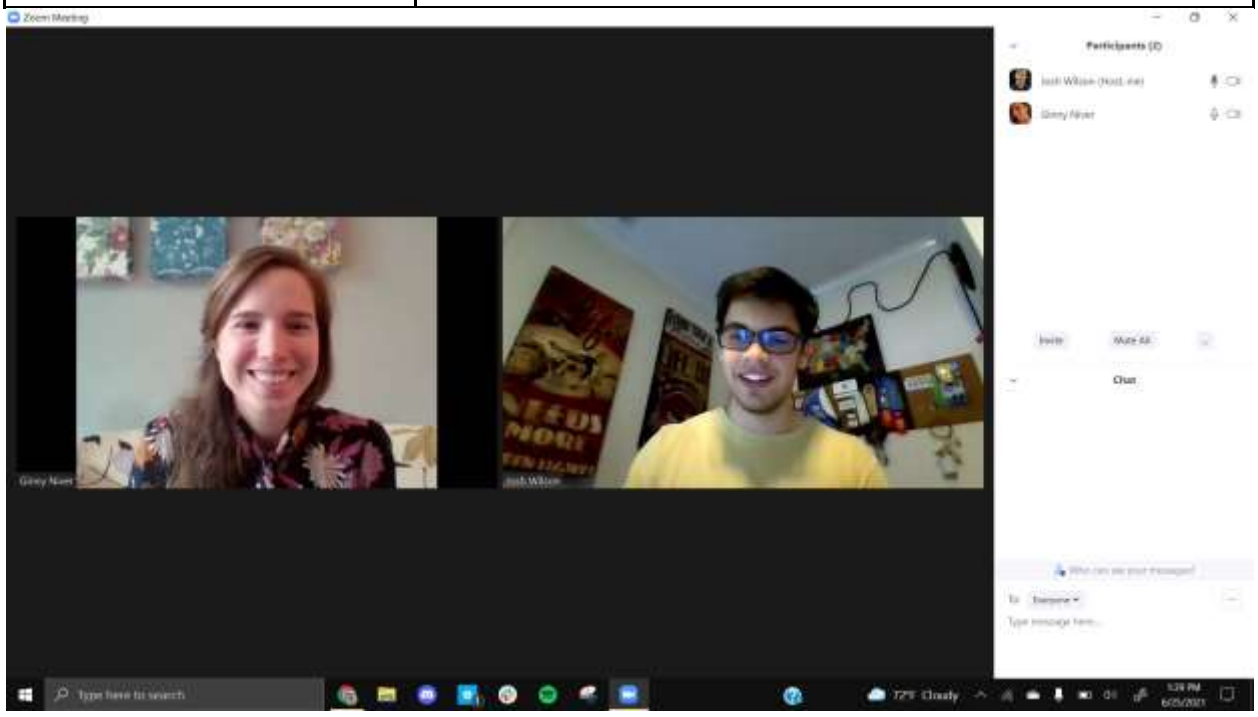
1.1 Interviews with medical professionals;

2.1 Organize online Event;

Professional Name	Gin Niver
Short Description About Professional	This meeting was organized to gain more insight on how we should market our device in the medical community. Gin is a student in the ELP program at Wake Forest, working on a masters in studies in law then starting PA school next year. They work in the OR as an anesthesia tech (well that will be over soon) and have insight into the hospital setting. Gin was taking courses at NC State and completed a few in the physiology program. Now they are focusing on the PA program. Gin has given us much to ponder. Such as other medical fields that are moving into remote health care.
Conducted By	Joshua Wilson

Date	June 25th, 2021
Preparation	90 minutes
Duration	45 minutes
Summary	We first began with an introduction to the SensUs competition. Next we followed with an introduction to SenseNC. Gin's experience with biosensors was the next topic of discussion. She worked with 2 biosensors in the past. She works in an OR. One biosensor she has experience with is a Glucometer, when she was a technician. Providers would also use this device. Gin has also worked with an ACT machine. This device measures the patients in surgery - slows blood clotting vascular surgeries. Do them immediately on the spot. Needs to be done not to kill patients. Tell them how fast blood is clotting. She had to help QC one. Had a couple COVID exposures. Those tests are done in a separate lab. In primary care they have some sensors, not used much. COVID RAPID TEST should be an interest investigated by the SenseNC team. These tests are usually done separately in a lab. COVID has some rapid tests you can take home. Diabetics - you used to monitor. Could do tests and physicians determine results remotely. Patients can not validate their results. Look into remote health care regulations. She likes that a lot of people have encouraged remote health care. She believes that a lot of people benefit with remote health care. Being able to resolve things on the phone is very helpful. Signal-soft is a company that should be investigated by the SenseNC team. It is cheaper to do remote health care. Mental health care. Remote monitoring for jerry actricks. When doing tests remotely, it is

	less disruptive to their day. Less exposure. How well Gin believes that our product could translate into the medical field. Minute clinic, urgent care, look where they are doing certain types of flu testing. With COVID, a lot of people need to stay home. How can we deliver to people at home quickly and cost effectively? Where is rapid testing for COVID. Don't think it will be functional unless we can run multiple tests at once. Batch testing? Test group then individual. What is the best way to market our product? Are these devices common in Gin's field of work? Try to reach out to a primary caregiver - drug reps. Talk to a pharmacist. Rapid influenza tests - CDC website. Think about the function of tests - non-invasive tests.
Evaluation	We evaluated the quality of our interview based on how well the topics we wanted to cover were addressed. These topics were covered very well. She was extremely insightful into the operation and use of biosensors in the medical field. She gave us new insights into how we should market our device.



Title of Event	SenseNC Presentation
Date	June 22nd 2021
Preparation Time	72 hours.
Type of Event	Professional Presentation
Abstract	SenseNC is a team of undergraduate and graduate students motivated to engineer an innovative biosensor and present their results in an international conference held at Eindhoven University of Technology. The team's challenge is to detect the concentration of H1N1, an extremely infectious aerially transmitted disease, in a saliva sample. Please join us June 22nd, as Eight students present their current progress while they race toward delivering their final product.
Objective of Activity	To promote our team's research, receive valuable feedback, a great opportunity for the team to practice their professional presentation skills.
Promotion	We promoted this event on the SensUs connect page, on the SenseNC instagram page, and through emails sent out by the ASSIST organization. We did this through a creative flyer. 

SenseNC ▶ Session 2021 ×

ASSIST Center

to group-assist-grads, group-assist-ncsu-undergrads, group-assist-undergrads, group-assist-ncsu-grads

You've just received an invitation to attend the SenseNC presentation (on Zoom) set for June 22 from 4-5 p.m.

We hope you'll be able to participate!

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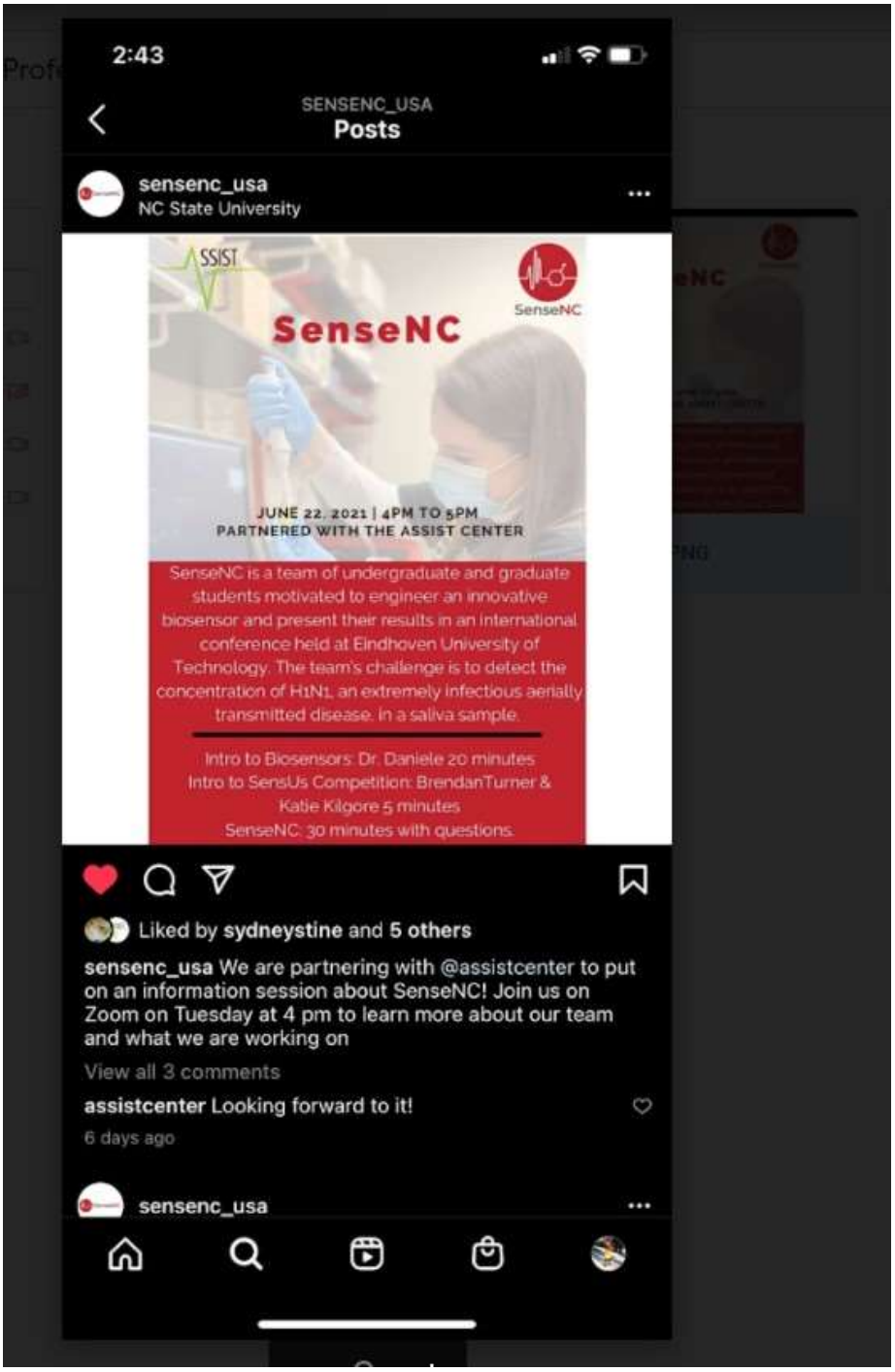
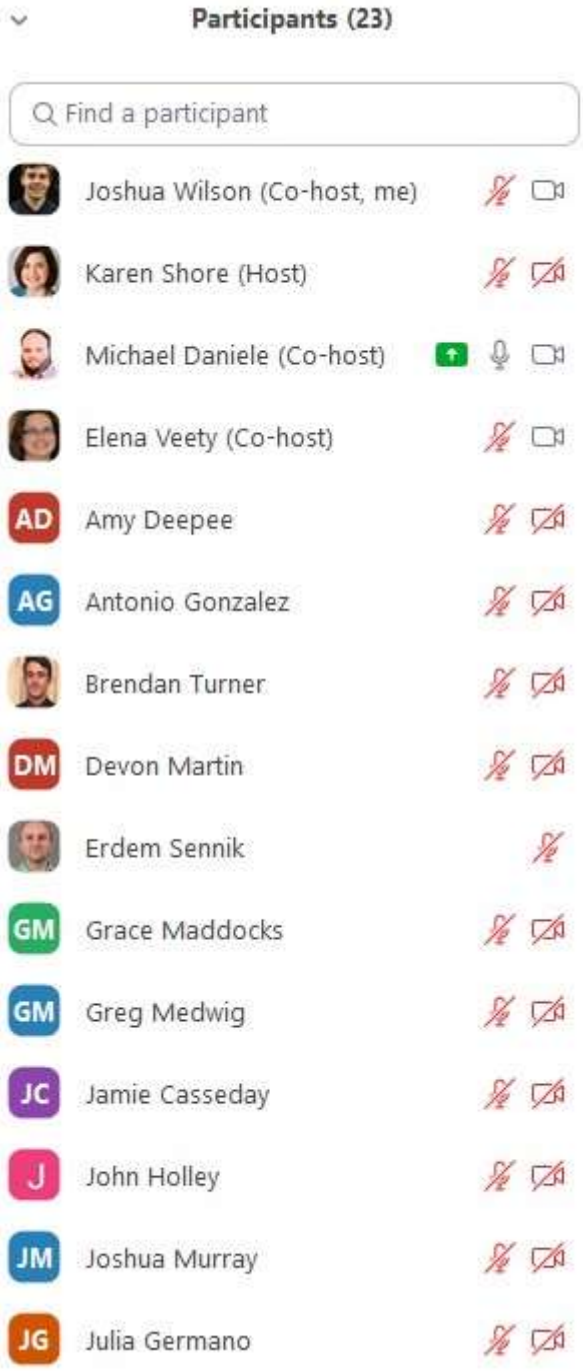
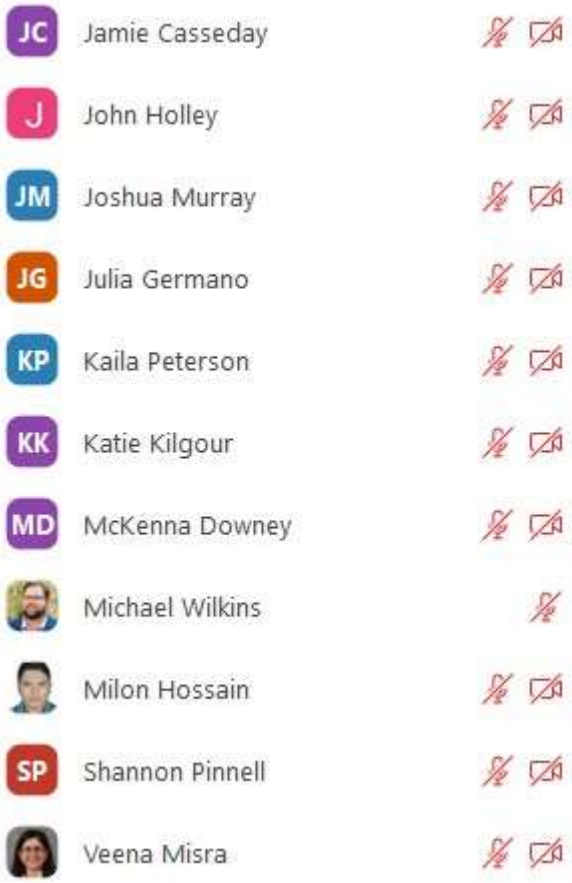
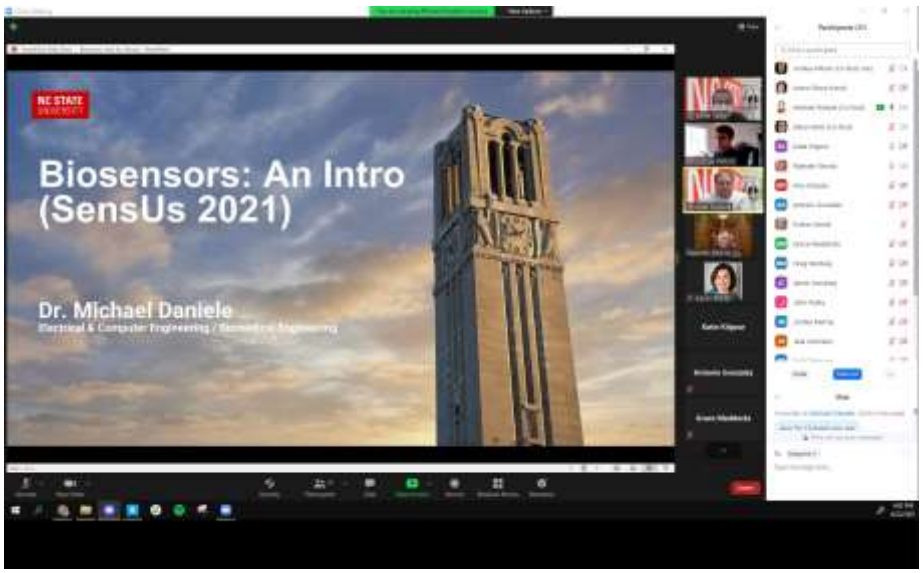
NSF ASSIST Center
Monteith Engineering Research Center

	
Partners	ASSIST Center & BioInterface lab.
Contact Person	Dr. Micheal Daniele (mdaniel6@ncsu.edu).
Evaluation Method	We evaluated the effectiveness of this meeting based on our feedback/questions from the audience.

Evaluation	We performed well but there alot of questions based on the premise of our research, as well as the ability of our sensor to detect other diseases.

Number of Participants	23 including 8 SenseNC team members. This makes the total number of participants that are team members 15. 

	
Lessons Learnt	We learned that we need to take more time introducing the problems before detailing the technical approaches our team is using. It is important to summarize our goals as well as our methods.
Recommendations	Know who your audience is, and tailor your message to them.

Picture	

July

1. Silver

1.1 Meetings with a SensUs Partner;

Title of activity 1	SenseNC Presentation
Organized by	SenseNC
1.2 Be present at two online events; **Date**	June 22nd 2021

Type of activity	Professional Presentation
Abstract	SenseNC is a team of undergraduate and graduate students motivated to engineer a biosensor and present their results in aninternational conference held at Eindhoven Technology. The team's challenge is to detect the concentration of H1N1, an extreme aerially transmitted disease, in a saliva sample.Please join us June 22nd, as Eight stud their currentprogress while they race toward delivering their final product.
Objective of activity	To promote our team's research, receive valuable feedback, a great opportunity for the team to practice their professional presentation skills.
Lessons learnt	We learned that we need to take more time introducing the problems before detailing the technical approaches our team is using. It is important to summarize our goals as well as our methods.
Recommendations	Know who your audience is, and tailor your message to them.
Screenshot	
Title of activity 2	Interesting Botany
Organized by	TruSense2021
Date	July 24 2021
Type of activity	Networking and fun.
Abstract	Hi, everybody. I believe everyone is seriously developing biosensors at the moment, and the process is very rewarding but also a little boring.So let's relax with some interesting botanic information, feel the magic of nature, and taste the vitality of the world in the beautiful summer! Welcome our keynote speakers.@ Zhijian Yan @ Beini Chen
Objective of activity	Connecting with students.
Lessons learnt	We learned that we are very similar in interests across the world.
Recommendations	Take part in more team interactions during the competition.

Screenshot	

2. Gold

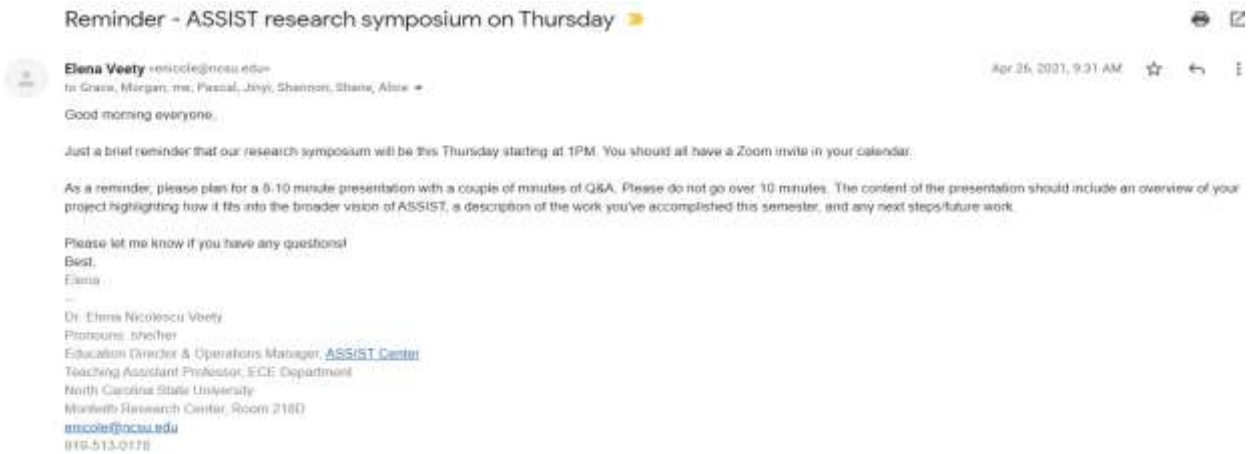
2.1 Present at a professional Event;

Title of event	Spring 2021 ASSIST Symposium
Date	April 29th 2021
Preparation time	12 hours
Type of event	Symposium.
Abstract	Plan for a 8-10 minute presentation with a couple of minutes of Q&A. Please do not g over 10 minutes. The content of the presentation should include an overview of your project highlighting how it fits into the broader vision of ASSIST, a description of the w you've accomplished this semester, and any next steps/future work.
Objective of event	Present research.
Partners	ASSIST Center
Contact person	Dr. Micheal Daniele (mdaniel6@ncsu.edu).
Evaluation method	How well we addressed ASSIST vision
Evaluation (fill in after the activity)	
Number of participants	30-40
Lessons learnt	We need to address what the purpose of the event we are presenting at ties into our research.
Recommendations	Present at more symposiums before the innovation days.
Picture	

August

1. Bronze

1.1 Tips for subsequent SensUs Teams



Reminder - ASSIST research symposium on Thursday

Elena Veety <emcole@ncsu.edu>
to Grace, Morgan, me, Pascal, Jinyi, Shannon, Shane, Alice

Apr 26, 2021, 9:31 AM

Good morning everyone,

Just a brief reminder that our research symposium will be this Thursday starting at 1PM. You should all have a Zoom invite in your calendar.

As a reminder, please plan for a 8-10 minute presentation with a couple of minutes of Q&A. Please do not go over 10 minutes. The content of the presentation should include an overview of your project highlighting how it fits into the broader vision of ASSIST, a description of the work you've accomplished this semester, and any next steps/future work.

Please let me know if you have any questions!
Best,
Elena

--
Dr. Elena Nicolescu Veety
Pronouns: she/her
Education Director & Operations Manager, ASSIST Center
Teaching Assistant Professor, ECE Department
North Carolina State University
Monteith Research Center, Room 218D
emcole@ncsu.edu
919.513.0178

- Tip 1: Schedule recurring team meetings.

- Tip 2: Have sub-teams develop timeline for deliverables.

- Tip 3: Have sub-teams take plenty of photos and videos during work events.

Valuable tips in the document:

- Using a Trello.

2. Silver

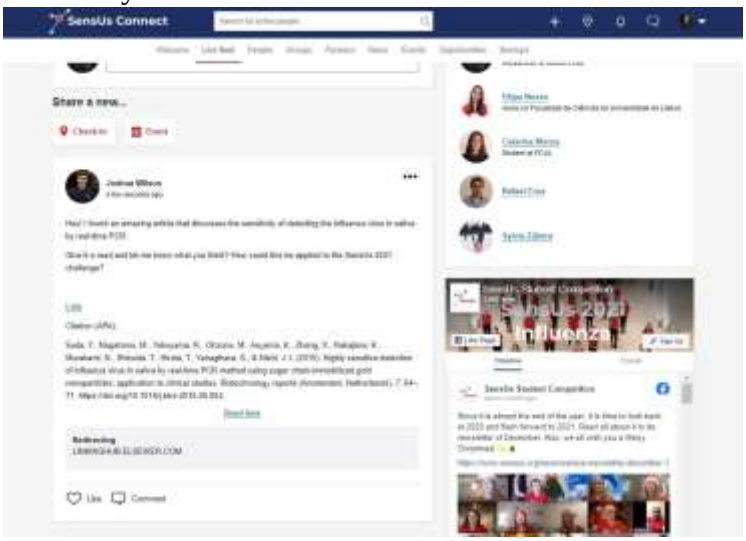
2.1 Reposts on social media;

3. Gold

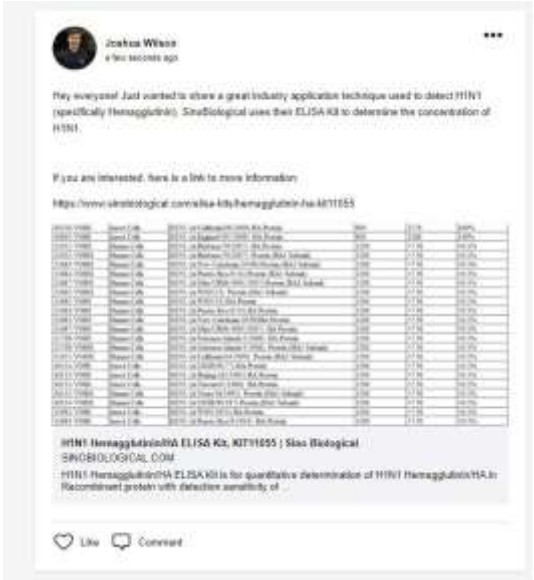
3.1 Post on SensUs Connect every month;

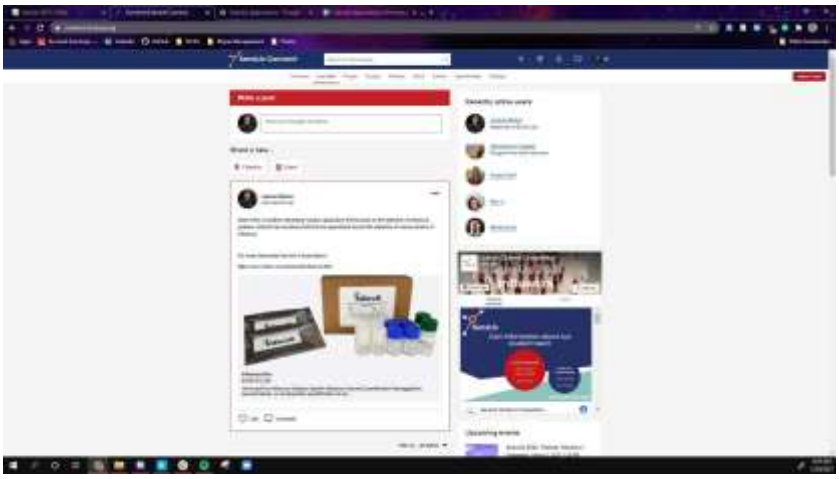
Reposts on Social Media (3):

January Posts:

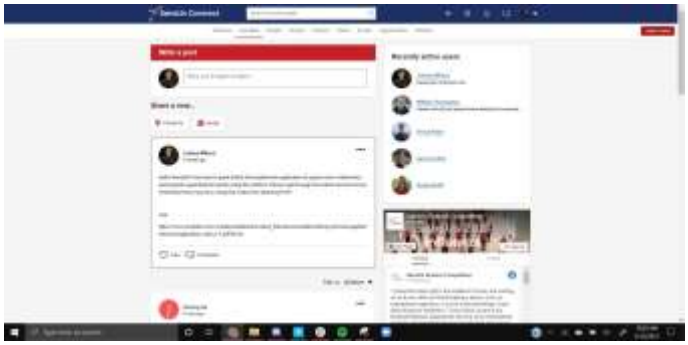


February Posts:



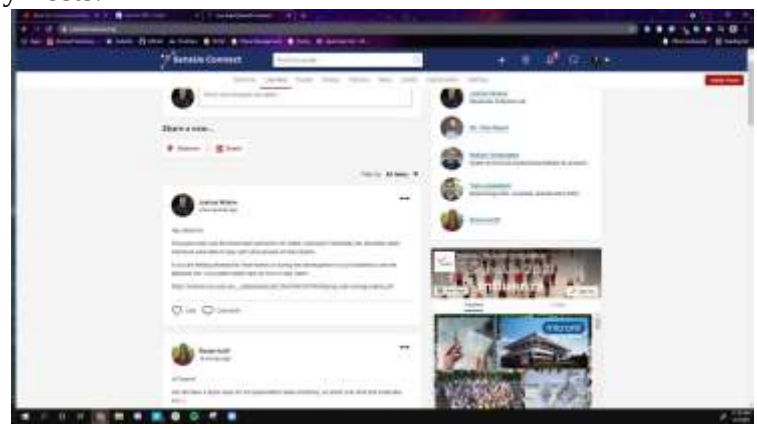


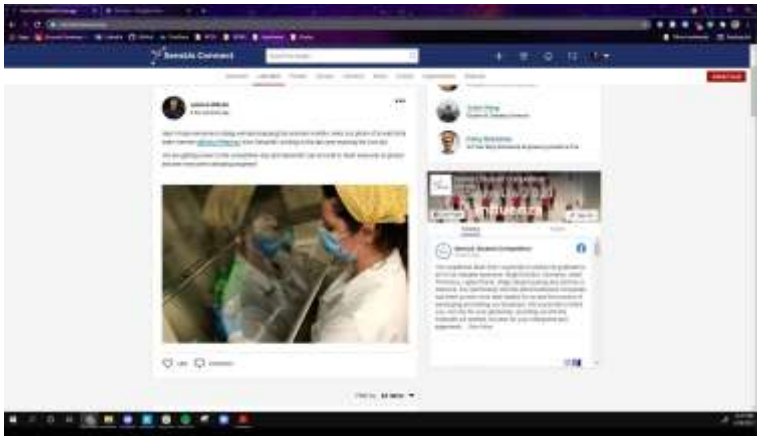
March Posts:



April Posts:

May Posts:

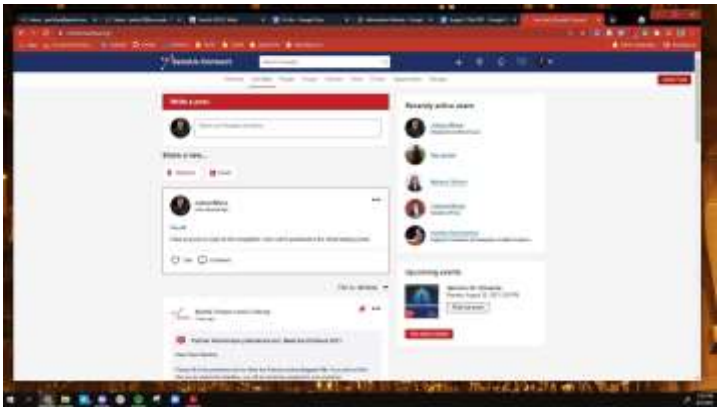




June Posts:

July Posts:

August Posts:



3.2 World-value;

H1N1, commonly known as Swine Flu, is an influenza type A virus characterized by rapid airborne transmission and high rates of infection. This high infection rate increases the need for efficient testing methods. Current solutions for detection are limited in their ability to provide at-home rapid testing.

Our work aims to create a novel biosensor system that detects the presence of H1N1 in a saliva sample via a Hemagglutinin aptasensor. Within the physical structure of a given H1N1 particulate, Hemagglutinin (HA) is the most abundant protein antigen; resultantly, the use of HA in a biosensor enables significantly higher accuracy for detecting H1N1. The presented biosensor utilizes a redox modified aptamer and custom electrochemical instrumentation. The RHA0006 DNA aptamer was used as a template for modifications upon which both thiol and methylene blue attachments were added. This aptamer was previously reported to exhibit provide high sensitivity and specificity to HA. The custom electrochemical instrumentation was designed and engineered to provide benchtop, portable interrogation of the aptasensor. Quantification of HA, within the estimated range of 10 -10 virus particles/mL was evaluated by square wave voltammetry. Simulated saliva and interferents were evaluated. Operation of the aptasensor with commercial potentiostats and the custom electrochemical instrumentation was compared. This research was conducted as part of the extracurricular SensUs Competition for student led research in the areas of biosensors and biotechnologies.