SensUs

Medal

Submission Document

UppSense

August 1st 2021

uppsala.sensus@gmail.com

https://sensusuppsala.com/

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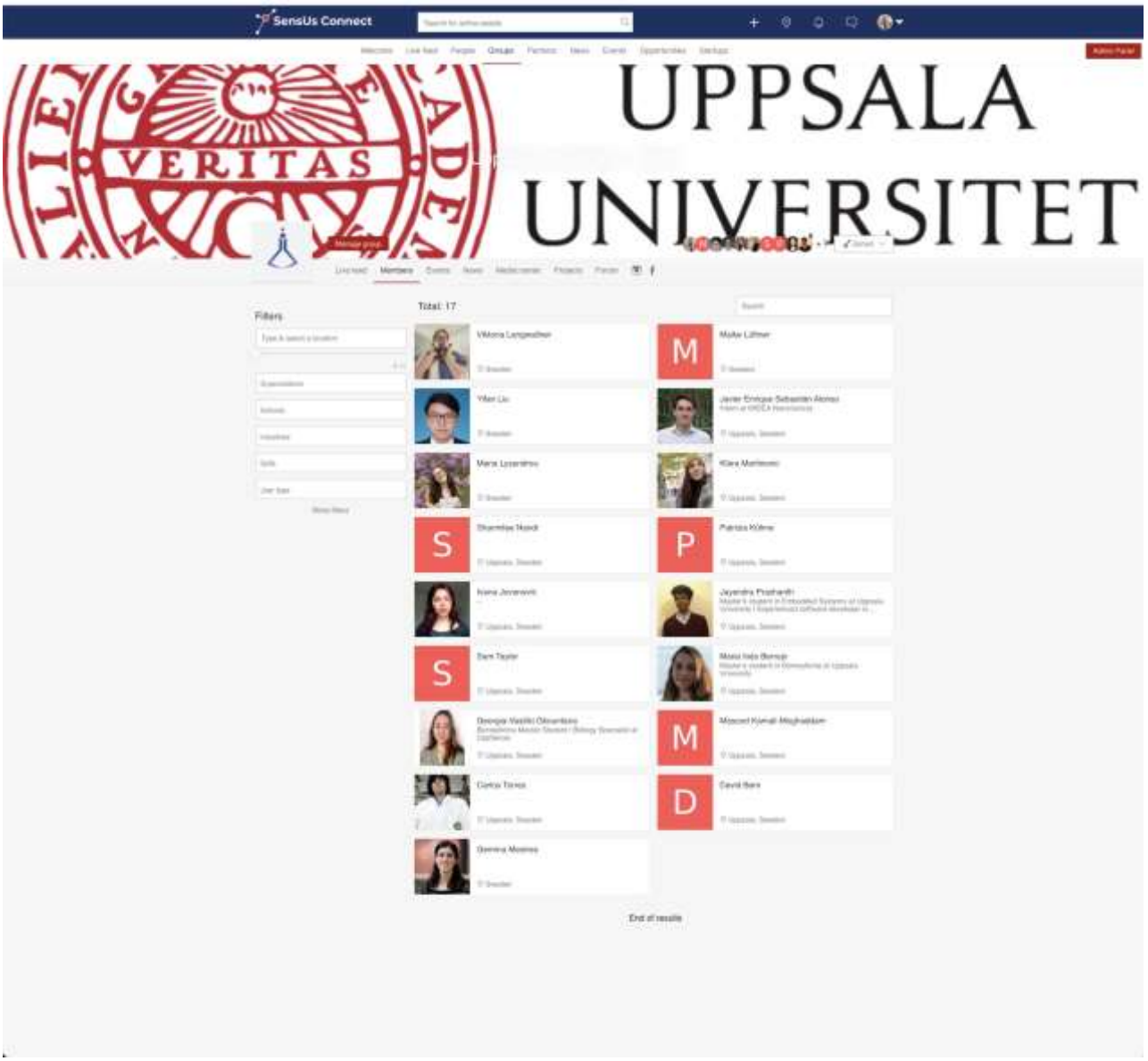
January

1. Bronze

1.1 Register on SensUs Connect;



March

1. Bronze

1.1 Motivation;

UppSense's motivation to take part in SensUs is so that we can come together to build a biosensor, thereby helping to create a better future. We will achieve this as we are a group of 15 individuals of diverse nationalities and backgrounds. This enables us to bring together different ideas and perspectives to problem solving. Lots of passion, enthusiasm, and strong morale, will fuel our battle to detect influenza A.

Our goal is to get out of our comfort zones, learn something new, and develop unique and creative ideas for our biosensor. Through the use of our combined wits, knowledge, and experience within a

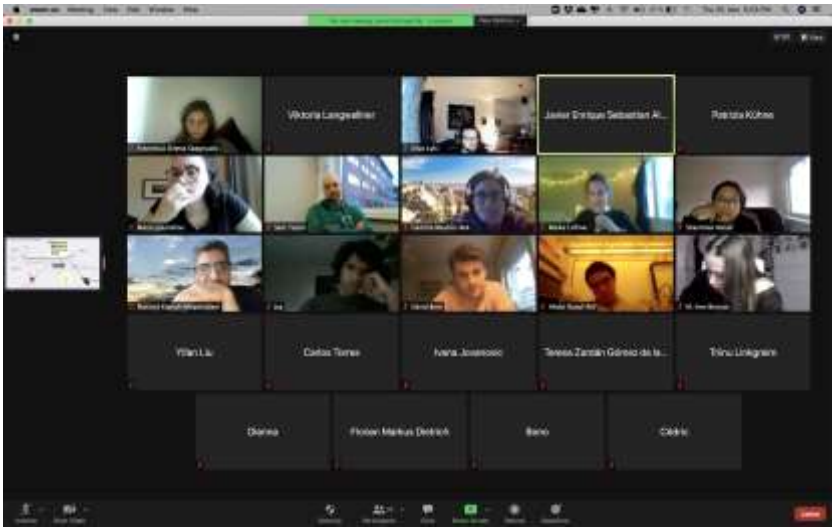
large variety of fields, we hope to build on our research. This experience provides an opportunity to continue to research in our respective fields, and really work on communication skills. We hope to raise awareness that everyone can contribute to their different areas of expertise.

May

1. Silver

1.1 Meet with Alumni;

Attendees (Alumni)	• Triinu Linkgreim - AdUp Sense, 2019 • Dianna Zeleskov - UppSense, 2020 • Cédric de Voghel - UppSense, 2020 • Francesca Diletta Spagnuolo - UppSense, 2020 • Florian Markus Dietrich - UppSense, 2020 • Luis Silva - AdUp Sense, 2019 • Bono Jimmink - UppSense, 2020 • Abdul Raouf Atif - U.V.S., 2018 All are Uppsala University Alumni, team name has changed throughout the years,
Goal of the Meeting	This meeting was targeted to share updates on our biosensor prototypes and get feedback from our mentors (alumni) and supervisors based on their previous experiences. UppSense has been working on two different biosensor models (namely electrochemical and optical) in the previous months. As we will soon start to perform both dry and wet lab experiments, this session was aimed to clarify our doubts on both general and technical aspects. UppSense holds these kinds of meetings (Progress meeting) every four weeks together with alumni from previous years as well as supervisors.
Date	March 25, 2021
Preparation time	2 h
Duration	~ 1,5 h
Summary	First, we started by presenting our project proposals with detailed information (via illustrations and texts) on updated biosensor designs one at a time. Further, we shared our queries concerning each prototype to get a better understanding of the various processes involved, including mixing of sample, separation, and detection of analyte. Lastly, we had a discussion session where our questions were answered, and few suggestions were put forward by mentors and supervisors. Our concerns were mostly around the chip design and measurement processes for the electrochemical biosensor. After the discussion, we finalized to go forward with both Indium tin oxide (ITO) and Boron doped graphene (BDG) for making of the electrodes and testing which one works better using impedance spectrophotometry and cyclic voltammetry separately. Besides this, we also received suggestions on how we could possibly measure the sample concentrations and working-electrode surface area, speed up incubation time, physical properties of the electrode, and many more.

Summary	On the other hand, the optical biosensor prototype received a couple of recommendations on the use of fluorescent beads and use of sialic acid conjugated beads for viral protein detection. It was pointed out that antibodies might react with sialic acid (in addition to hemagglutinin) and would create a false-positive response. Therefore, it would be better to opt for magnetic beads conjugated with antibodies instead. This meeting enabled us to draw necessary conclusions and think about the recommendations before we start developing the different biosensors. The most important take-away message would be that it is important to try different possibilities (or combinations) by ourselves at the laboratories and not depend entirely on preferences based on literature or previous experiments.
Evaluation	The meeting was very informative, and it helped us to move forward with a more filtered idea of how we should plan on working towards constructing a biosensor that fulfills both the competition criteria and can be adapted to detecting the complete Influenza virus.
Pictures	 

June

1. Silver

1.1 Interviews with medical professionals;

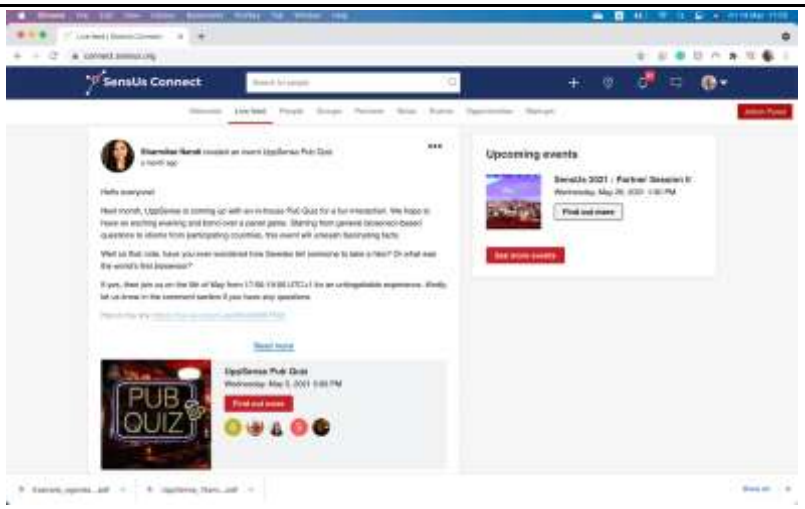
Professional Name	Paula Del Corral
Short description about professional	Paula Del Corral is a nurse currently working at Palma de Mallorca. She has extensive experience working abroad on several projects. Paula went to Cameroon for the project *Madrid Rumbo al Sur* for one summer as a volunteer. Furthermore, she went to South Cambodia as a nurse where she took care of children and seniors. Paula enrolled at a Master program at the Universidad Autónoma de Barcelona and participated in a project at Ecuador with the aim of developing telemedicine in the most remote parts of the country. Her long experience working inside and outside of Europe as a nurse gives her the possibility to visualize and predict the viability of our biosensor at different parts of the globe.
Conducted by	Javier E. Sebastian Alonso
Date	20th June 2021
Preparation time	30 min
Duration	45 min
Summary	Firstly, we began with a short of validation of the business model. With a simple look on the diagram Paula already optimized our approach towards the point of care (POC) application. She highlighted that the chip must present a trustworthy sensitivity in order to track the spread of a virus in a pandemic scenario. Moreover, she explained that a biosensor should work at room temperature if possible because at some locations there won´t be the possibility to keep it in a refrigeration. Furthermore, the chip must be easy to handle as a POC-device so that people could use it independently. By this, nurses and doctors can focus on the real urgencies. Astoundingly, Paula gave us a perspective never received before in other interviews. She considered the mental health of the patient since an early stage. She said that it is very useful that a device can be easy to handle so no specialist is needed, but the results of the test should always be given with the support of a nurse or a doctor because in case of an unpleasant result there is a high risk that the patient enters in a mental breakdown. She defended that technology development should not dehumanize the health care system of any society because above any development we are humans that need company and support. Finally, Paula encouraged us to use the Covid–19 outbreak as an example to develop a technology that can avoid a healthcare system collapse as it has happened all over the globe.
Evaluation	Paula gave us the most humane side of the healthcare system which is rather difficult to consider. Moreover, her international background made it possible to realize how much a biosensor needs to improve. All of these together makes out of this interview a great perspective for the device implementation.

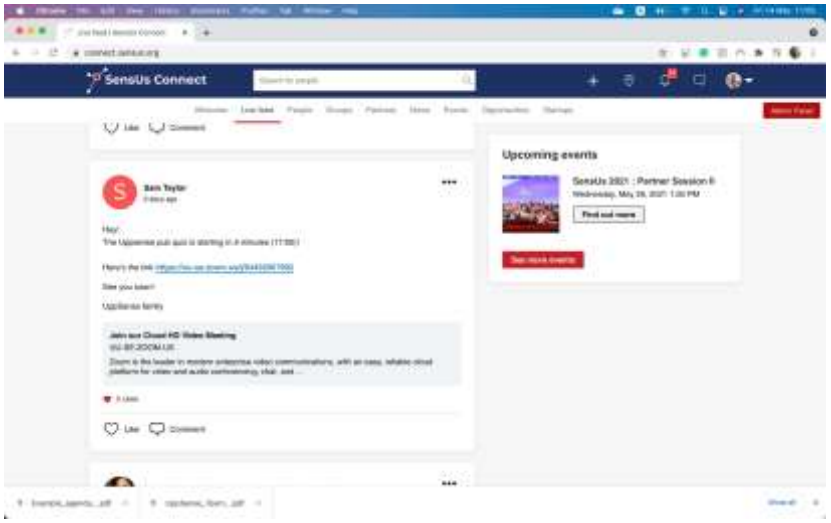
2. Gold

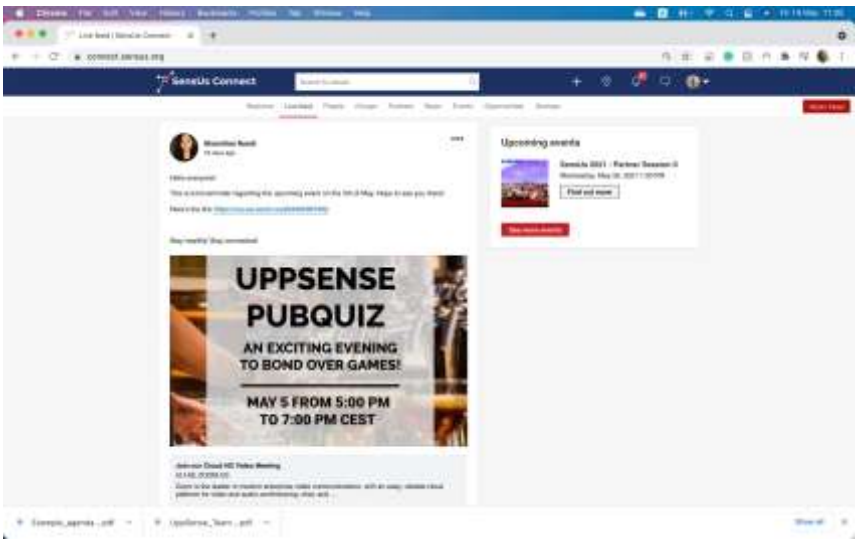
2.1 Organize online Event;

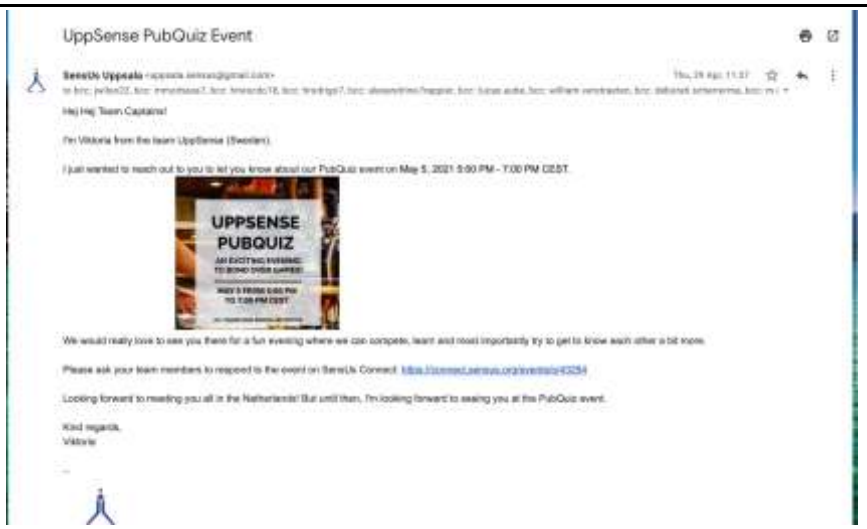
Title of Event	Pub Quiz - UppSense
Date	05/05/2021 - took 120 minutes
Preparation time	15 hours

Type of event	PubQuiz, Networking
Abstract	To connect with each other, to learn more about biosensors, to destress together in a fun and informational manner.
Objective of activity	Get to know each other and have fun through quiz-type questions, provide some information about several systems, whether or not they can be categorized as biosensors and also interesting facts regarding several countries.
Promotion	We used our social media platforms (connect, instagram, facebook). We also got SensUs to post on their instagram story about the event. An email reminder was sent out to all the team captains as well. 


SensUs Connect
Upcoming events
PUB QUIZ

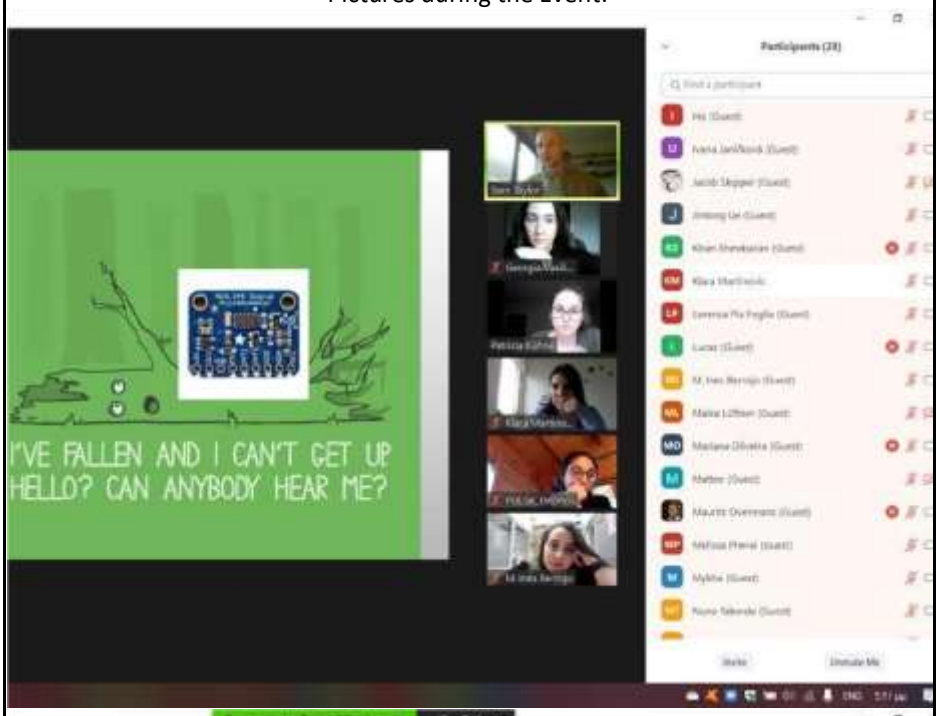
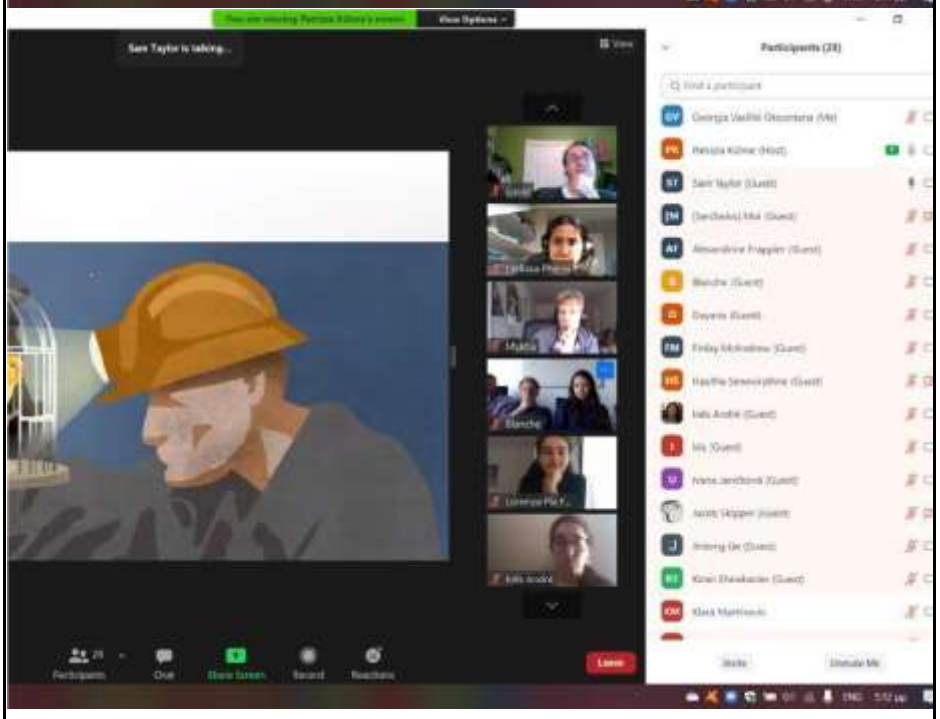

SensUs Connect
Upcoming events


SensUs Connect
Upcoming events
UPPSENSE
PUBQUIZ
AN EXCITING EVENING
TO BOND OVER GAMES!
MAY 5 FROM 5:00 PM
TO 7:00 PM CEST

Partners	UppSense Team
Contact person	Patrizia Kühne (Main) or any other UppSense Member
Evaluation method	We will ask for feedback from the participants. We will use Mentimeter to gather this data.
Evaluation (fill in after the event)	
Number of participants	28 Participants UppSense (Georgia-Vasiliki Gkountana, Patrizia Kühne, Sam Taylor, Ines Berrojo, Maike Lüftner, Klara Martinovic), PULSe (Eleonor, Jintong Ge), BiosensUM (Alexandrine Frappier, Kiran, Lucas Aubé), LxUs (Inês André, Nuno Taborda, Mariana Oliveira), DeTectUs Denmark (Lorenza, Mykhaylo Semenov), SenSwiss (Blanche, William, Eloi< Janette), Influwegians (Finlay McAndrew, Hasitha Senevirathne, Matteo, Jacob skipper), TEST 2021 (Maurits Overmans), SensUs Organization (Iris Schilthuis, Rosan Kolff, Henry)
Lessons learnt	- start early with promotion and preparing the event - was good to set time limits for the different parts
Recommendations	- divide the the preparation within a small group - keep it interactive - when to many participants make smaller groups - practice with your group/friends to get a feeling about the duration, amount of interaction etc.

Picture	Evaluations:

	Pictures during the Event:  

July

1. Silver

1.1 Meetings with a SensUs Partner;

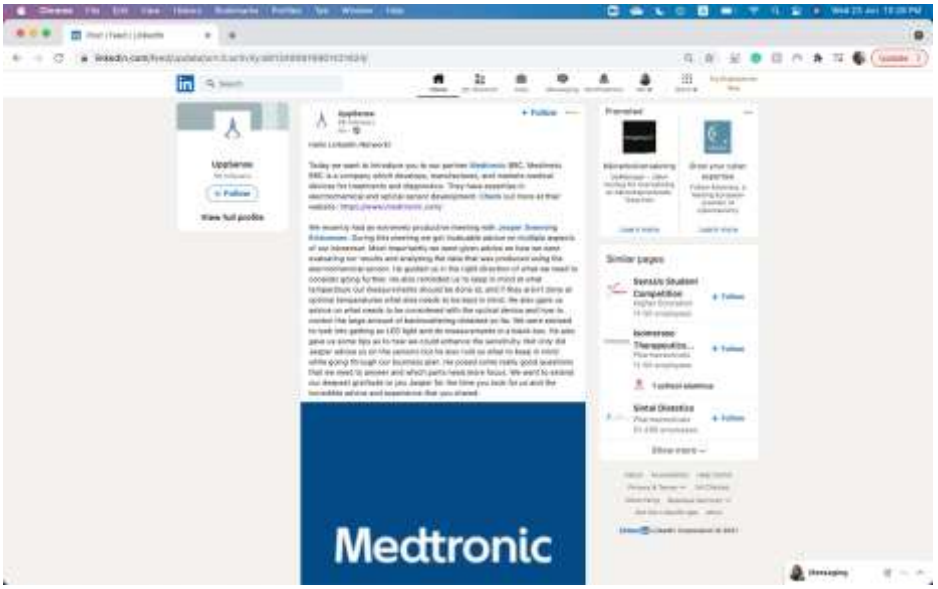
Partner	Medtronic
Attendees	UppSense: Viktoria, Javier, Carlos, Sharmilee, Patrizia Medtronic: Jesper Svenning Kristensen

Goal of the Meeting	The goal of the meeting is to gain some feedback on the progress that's been made. Some of our data was presented and we want feedback on what we see, and what we need to be aware of. We also want some advice to troubleshoot some issues that have arisen in the optical biosensor. Also, we wanted some advice on where to find resources/contacts in the medical industry for the development of our business plan.
Date	11th June 2021
Preparation time	~ 2 hours
Agenda	SensUs *Uppsala University - UppSense | Medtronic* **Present**: Viktoria, Javier, Carlos, Sharmilee, Patrizia 1. **Opening** [1 minute] a. Short Introduction of team b. Introduction of partner members present c. Remarks on the agenda 2. **Electrochemical Approach + Questions** a. Quick recap of our design b. Presentation of our results so far c. Free discussion 3. **Optical Approach + Questions** a. How can we avoid back scattering? b. One of our dyes emits in the 550 nm range. But, our LEDs are all the visible and we can't see the emission. What do you suggest? 4. **Business** [4 minutes] a. Introduce the canvas model and ask for feedback b. Could we have a contact who we could talk to about the market validation in a couple of weeks? 5. **Closing** c. Any other questions that may have arisen
Duration	~ 1 hour

Summary	We had an extremely productive meeting with Jesper Svenning Kristensen. During this meeting we got invaluable advice on multiple aspects of our biosensor. Most importantly we were given advice on how we were **evaluating our results** and **analysing the data** that was produced using the electrochemical sensor. He guided us in the right direction of what we need to consider going further. He also reminded us to keep in mind at what **temperature our measurements should be done at**, and if they aren't done at optimal temperatures what else needs to be kept in mind. He also gave us advice on what needs to be considered with the optical device and how to **control the large amount of backscattering** obtained so far. We were advised to look into getting **an LED light** and do measurements in **a black box**. He also gave us some tips as to how we could enhance the sensitivity. Not only did Jesper advise us on the sensors but he also told us what to keep in mind while going through our business plan. He posed some really good questions that we need to answer and which parts need more focus. The most important parts from the minutes are highlighted in bold in the minutes part below.
Evaluation	Jesper gave us very valuable advice for both our biosensor prototypes as well as our business plan. He highlighted some very important points we have not been considering before and thereby guided us in the right direction. We truly value his insight as he has been handling biosensor development for a while now. Sometimes we forget to consider certain things, and he reminds us of those (for example, the temperature of the testing).

Minutes	**Medtronic-Partner Meeting** **Dated: 11-06-2021** Participants: UppSense-Members: Sharmilee, Carlos, Javier, Viktoria, Patrizia Medtronic contact person: Jesper Svenning Kristensen Agenda: 1) Presentation of the Agenda 2) Update of the electrochemical approach 3) Update of the optical approach 4) Presentation of the Canvas model and demand for a person more related to this part *Electrochemical* ● During optimization, run experiments for shortest time intervals in order to be more precise. For example: In case of AuNP deposition, 1 min and how many seconds gave the highest current signal for CV? ● **Be careful while reading your curve and base your predictions accordingly.** ● Proteins can lose it's binding ability at higher temperatures (>40 °C). Therefore, it would be best to conduct experiments in a cold setup.

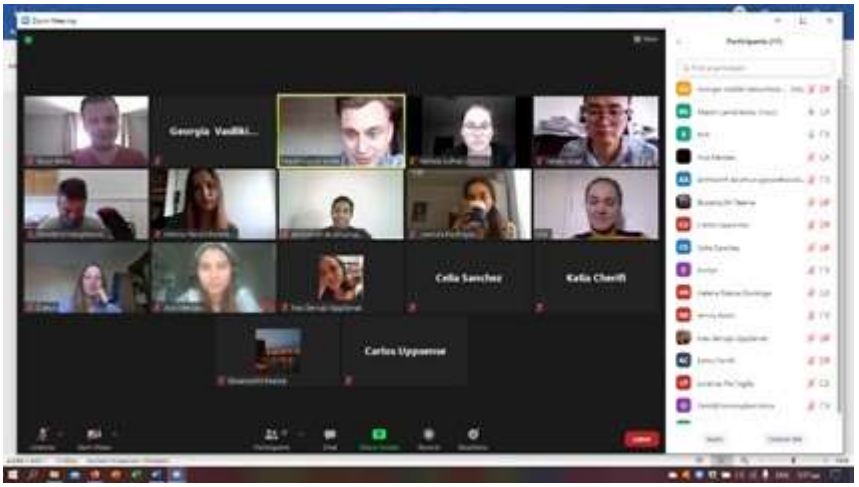
	However, it depends from protein to protein on how long they can survive the room temperature without getting denatured. ● How long would the electrochemical biosensor be able to sit outside in the room temperature? ● **He says that we need to be aware of having good references! ●** Sharp the definition of what to characterize when measuring ● Question he asks us: ○ What are we looking at in the graph? → specify why we have chosen the chosen point. ○ Why does the signal decrease at 3 min → Carlos answer: reaching a limit ○ What is the exact point when you have reached the maximum? → need to know the exact time period at which we will get the best results *Optical* ● **LED experiments should be preferably done in dark places (say a black box or a chamber) to avoid discrepancies.** ● Also, **LED characterization covers a broad spectrum**. Therefore, it is essential to look into it. ● Calculate quantum yield. ● Check the **lipophilicity of the dye** before experimenting as it can lead to protein precipitation at instances. ● **Check absorption**. Might try with simpler equipment like photodiodes or emission filters to determine wavelengths. ● Examine the dynamic range (that corresponds to sensitivity). ● Comparative study to validate the process. ● We should be aware of that the more sensitive a dye is the more dynamic it is *Business* He suggested to be well-versed with: ● What problem will our biosensor solve? ● Our plan for the future. ● Are the target customers willing to use this product? ● What facilities/options would the users want to have? ● Versatility of the device. ● **Add on why the target customers should buy it?** ● **Specify how it would decrease the workload?** ● What need are we meeting with our device? ● How will the product be provided? He doesn't know to whom he could send us, but should contact the SensUs organization to whom they are normally referring with questions like that!

Social Media Post	 https://www.linkedin.com/posts/uppsense_hello-linkedin-network-today-we-want-to-activity-6813490619961421824-DYTX

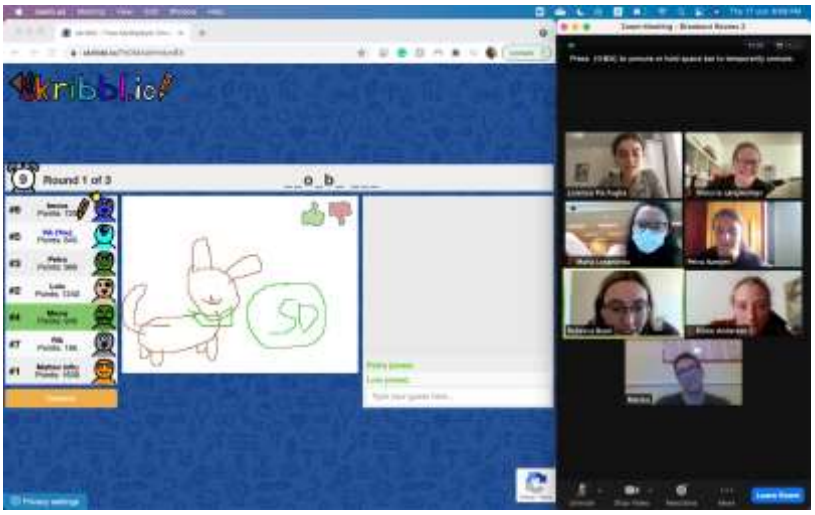
1.2 Be present at two online events;

Title of activity 1	Meet the Teams by PULSe
Organized by	PULSe Team

Date	March 29th 2021
Type of activity	Get-together meeting and quiz time
Abstract	The first point was to introduce members from different teams participating in the competition. After that the PULSe team had a small presentation which was followed by a quiz on the topic of influenza virus and Belgium.
Objective of activity	Socialize with each other.
Lessons learnt	We mostly learned small curiosities about influenza, Belgium and about each other.
Recommendations	If the event was better promoted more people would have joined and it would have been more fun and more interactive.

Screenshot	 

Title of activity 2	Speed Mating Social
Organized by	Influwegians (Glasgow)
Date	17th June 2021
Type of activity	Networking, Socializing, Relaxing
Abstract	We got to take some time to “speed socialize” where we got split into breakout rooms so we could talk to each other and get to know each other better. It was a fun way to get to know other people, and make connections. We also played a version of pictionary to have some competitive fun.
Objective of activity	To get to know each other better. Make connections. Look forward to seeing familiar faces at the innovation days. Also got to test our artistic skills in skribbl.io.
Lessons learnt	We learnt more about each other, but also struggles other teams are facing with regards to covid. We also just learnt some really weird fun facts about each other, and our countries. We also learnt about how artistic we are, and the competitive natures of the people who were in our groups.

Recommendations	Constant advertising and reminders are good to get people to remember and join the event. Seems like the event was mostly very few teams, it would be fun to have a bigger variety, to get to know more people. Time zones are a tricky thing to get further away teams (outside of Europe) to be able to join - try varying the start time from just evenings. Learn the platform being used - there were some struggles with making breakout rooms - maybe just practice it a bit before hand to make things smoother (not a big deal tho since it was a relaxed setting)
Screenshot	 

Team members present in event 1 Ines,
Carlos, Jovanna, Patrizia

Team members present in event 2
Maike, Sam, David, Jay, Maria, Patrizia, Jovanna, Viktoria

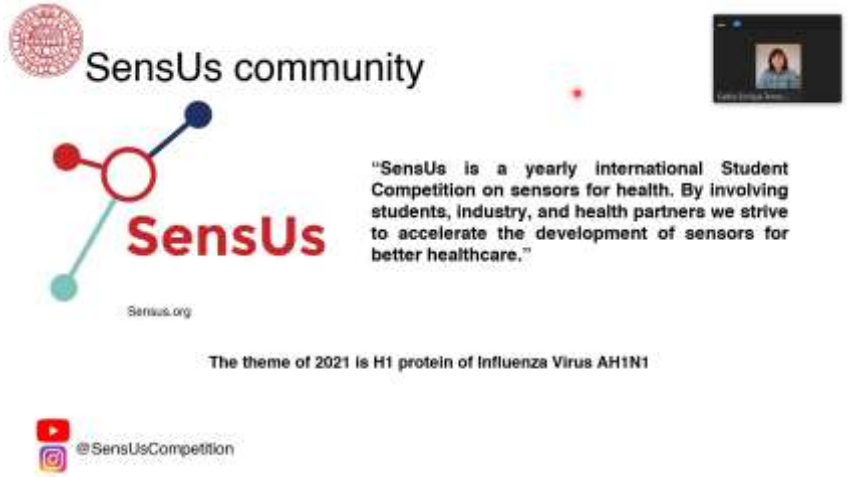
Total number of team members present: 10/15.

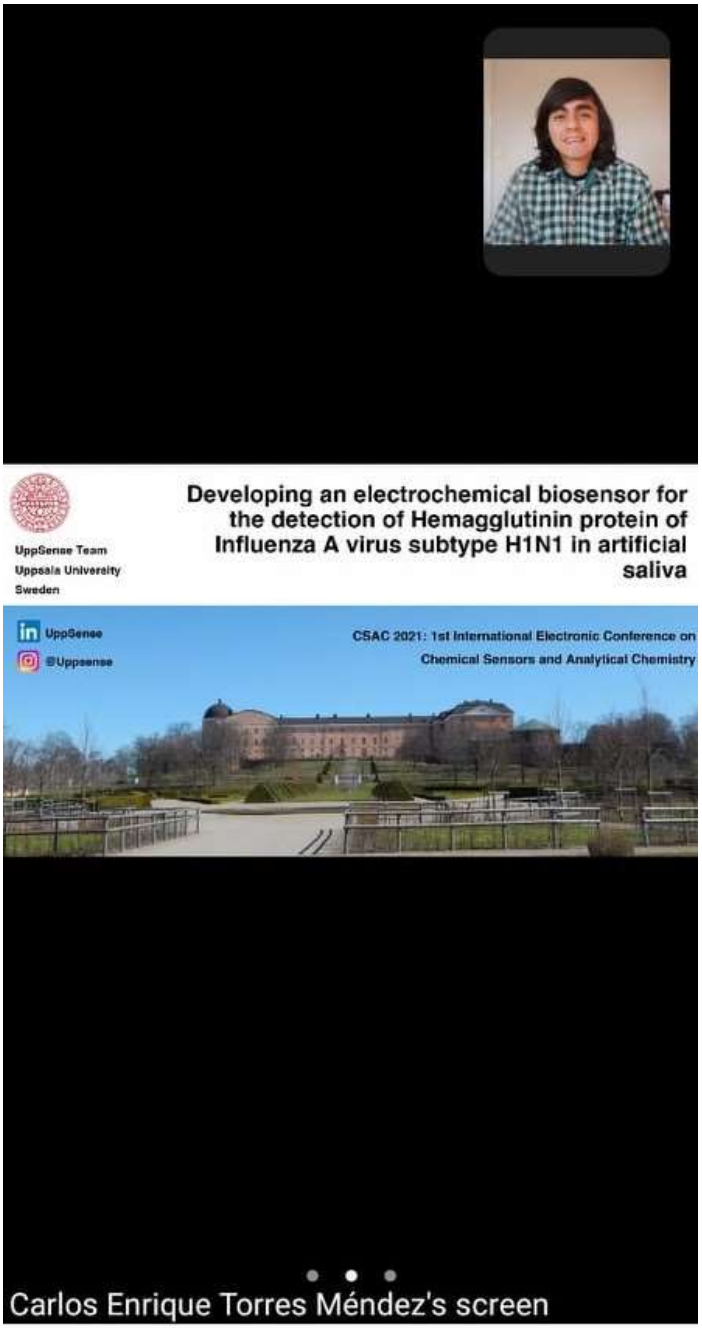
2. Gold

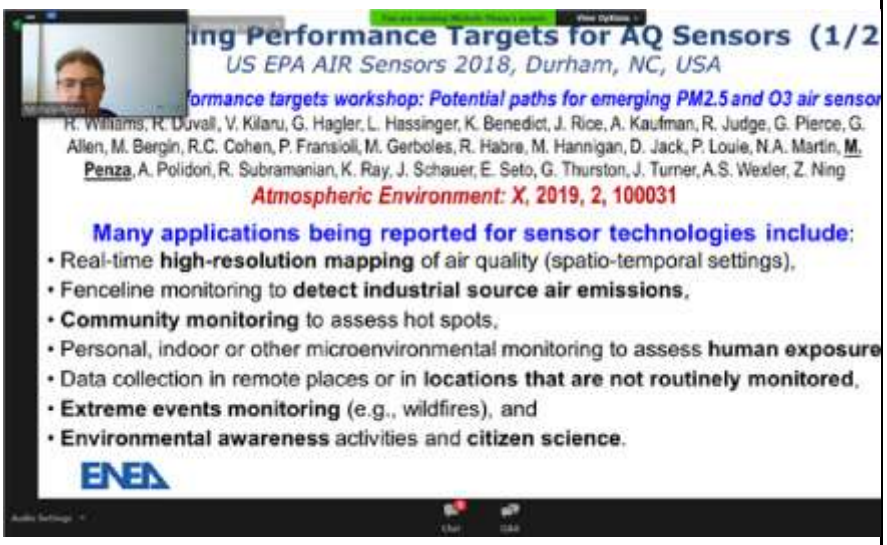
2.1 Present at a professional Event;

Title of event	CSAC2021: 1st International Electronic Conference on Chemical Sensors and Analytical Chemistry
Date	2021-07-01 to 2021-07-15
Preparation time	30 hours

Type of event	Conference (online)
Abstract	CSAC is a virtual conference in which researchers from 27 different countries present current research in Electrochemical and Optical Biosensors, Mass-Sensitive, Chemical and Gas Sensors, Materials, Nanoand Micro-Technologies for Sensing, Chemical Assay and Validation, Analytical Methods, Electronic Noses and Tongues, Microfluidic Devices, Lab-on-a-chip, Single-Molecule Sensing, Medico-Diagnostic Testing.
Objective of event	Get together worldwide well-known experts who are currently working in chemical sensor technologies and to provide an online forum for presenting and discussing new results.
Partners	MDPI/ Chemosensors
Contact person	Carlos Torres
Evaluation method	We evaluated our performance at the conference based on the number of people attending our presentation and with who we had a discussions about our biosensor or electrochemical detection systems in general
Evaluation (fill in after the activity)	
Number of participants	~ 100 during the entire conference
Lessons learnt	1. We found out that biosensors and sensors in general are a much more broad field than what we initially thought, for example uncommon biosensors for diseases in plants and to detect changes in food packaging were presented. 2. From the electrochemical sensors session, we gathered more insights into how the surface of electrodes are functionalized with biorecognition elements and we could compare this data to the results that we have measured in the laboratory. 3. We also gain information on how optimization is carried out for electrochemical techniques such as differential pulse voltammetry.
Recommendations	- plan more time for preparation (both paper submission and presentation) - involve as many team members as possible - plan a get-together to attend the conference in company (if online)

Pictures	  


UppSense Team
Uppsala University
Sweden
Developing an electrochemical biosensor for the detection of Hemagglutinin protein of Influenza A virus subtype H1N1 in artificial saliva
UppSense
@Uppsense
CSAC 2021: 1st International Electronic Conference on Chemical Sensors and Analytical Chemistry
Carlos Enrique Torres Méndez's screen

August

1. Bronze

1.1 Tips for subsequent SensUs Teams

- Tip 1: If the team is split into more subgroups for development (transducer, biology, business) have very regular updates from the different subgroups within the team so that the whole team is on the same page.

- Tip 2: Make use of a bullet board to keep track of progress (future, complete, on going) that way it can be seen visually in one place (Miro can be used for such a purpose online).

- Tip 3: Sometimes even professionals may not agree with your plan, don't get discouraged, seek other opinions too if you believe in your idea. They could be wrong/have a bad day, or even just misunderstood you.

- Tip 4: Talk to healthcare workers early on! They can provide the insight you are missing. This may seem intuitive but was lacking a little for us.

- Tip 5: With being online miscommunications are bound to happen, do not hold grudges and try to work things out sooner than later. Try not to get frustrated that communication is failing.

- Tip 6: Lab access is vital! Try to get in as early as possible. Do as many experiments as you possibly can (within reason of budget). This provides such vital information.

- Tip 7: Be willing to part with ideas. You may get attached to your idea, or your part, but it may not be helpful in the long run. It's okay to not take it to the end, instead focus your energy elsewhere.

Valuable tips in the document:

- Having (regular) progress meetings and getting feedback from mentors, etc.
- Social activities are helpful for bonding with the team members and this is in turn helpful for better communication (especially relevant with online work)
- "Recognize everyone's contribution, accept and respect differences"

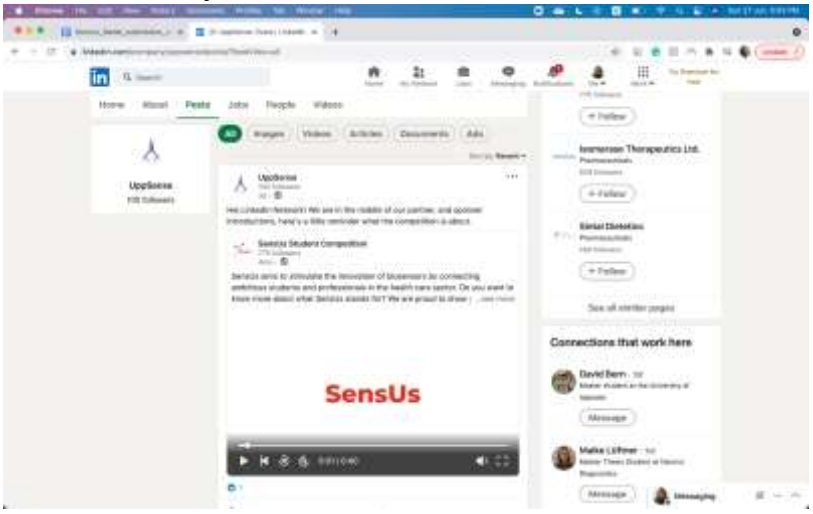
2. Silver

2.1 Reposts on social media;

Post 1: 15th May 2021

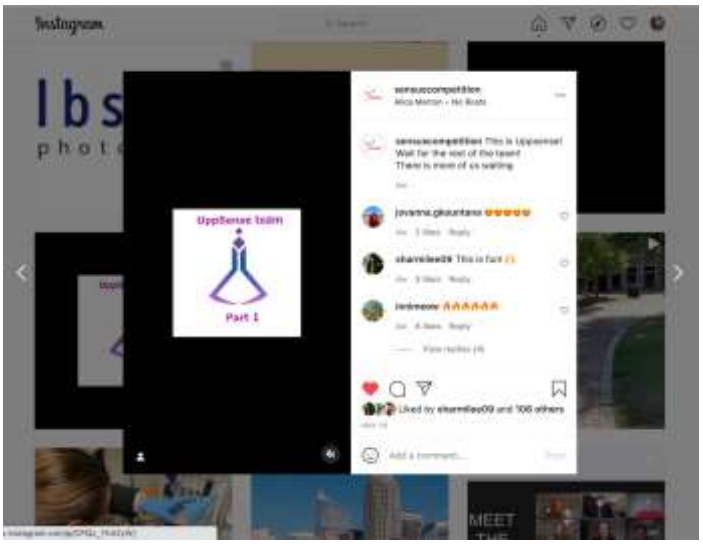
Post 2: 23rd May 2021

Post 3: 24th May 2021

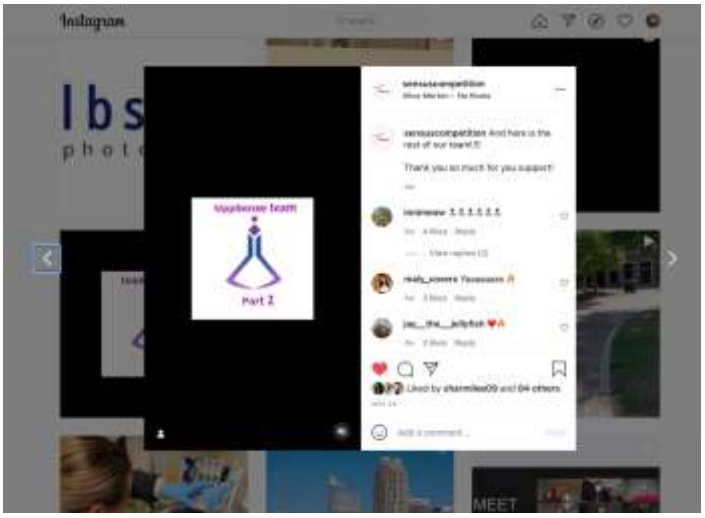


Want to add our instagram takeover medal criteria here too. Our 5 posts with the vlog.
Vlog: https://www.instagram.com/p/CPgVy8-gooj/?utm_source=ig_web_copy_link

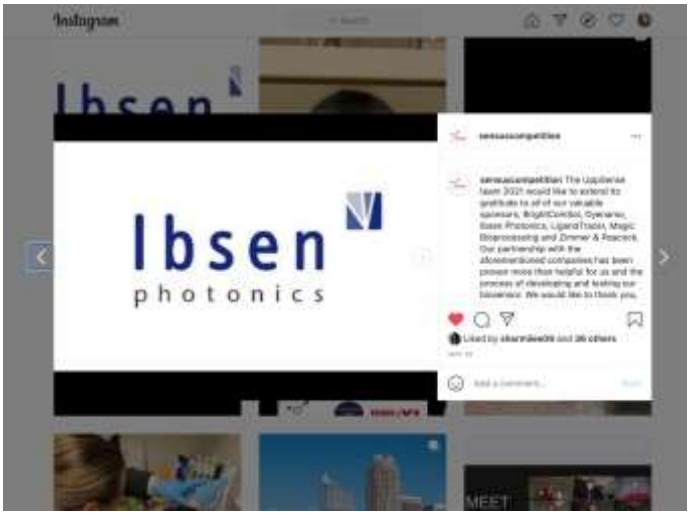
Post 1



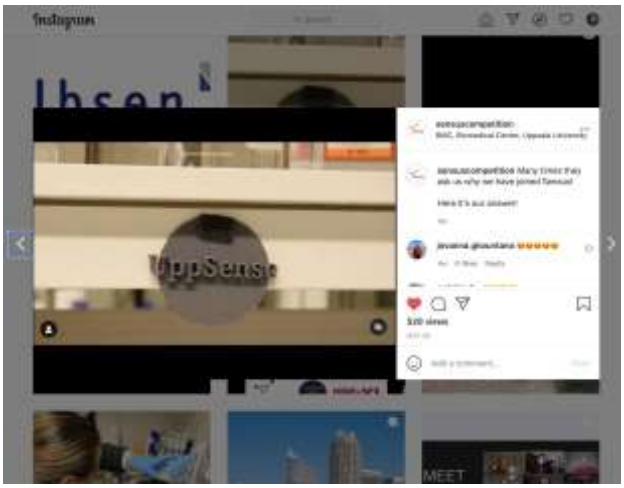
Post 2



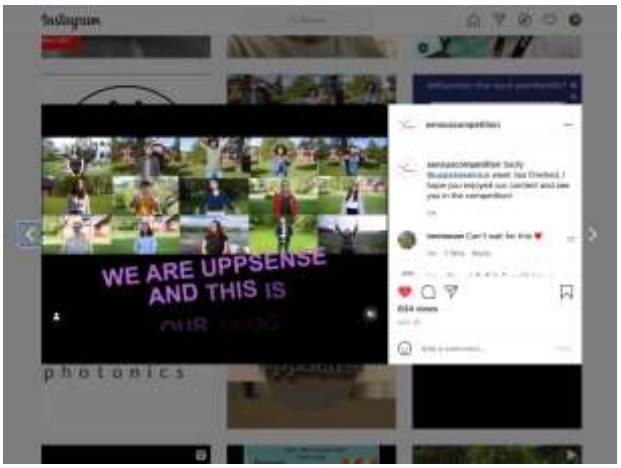
Post 3



Post 4



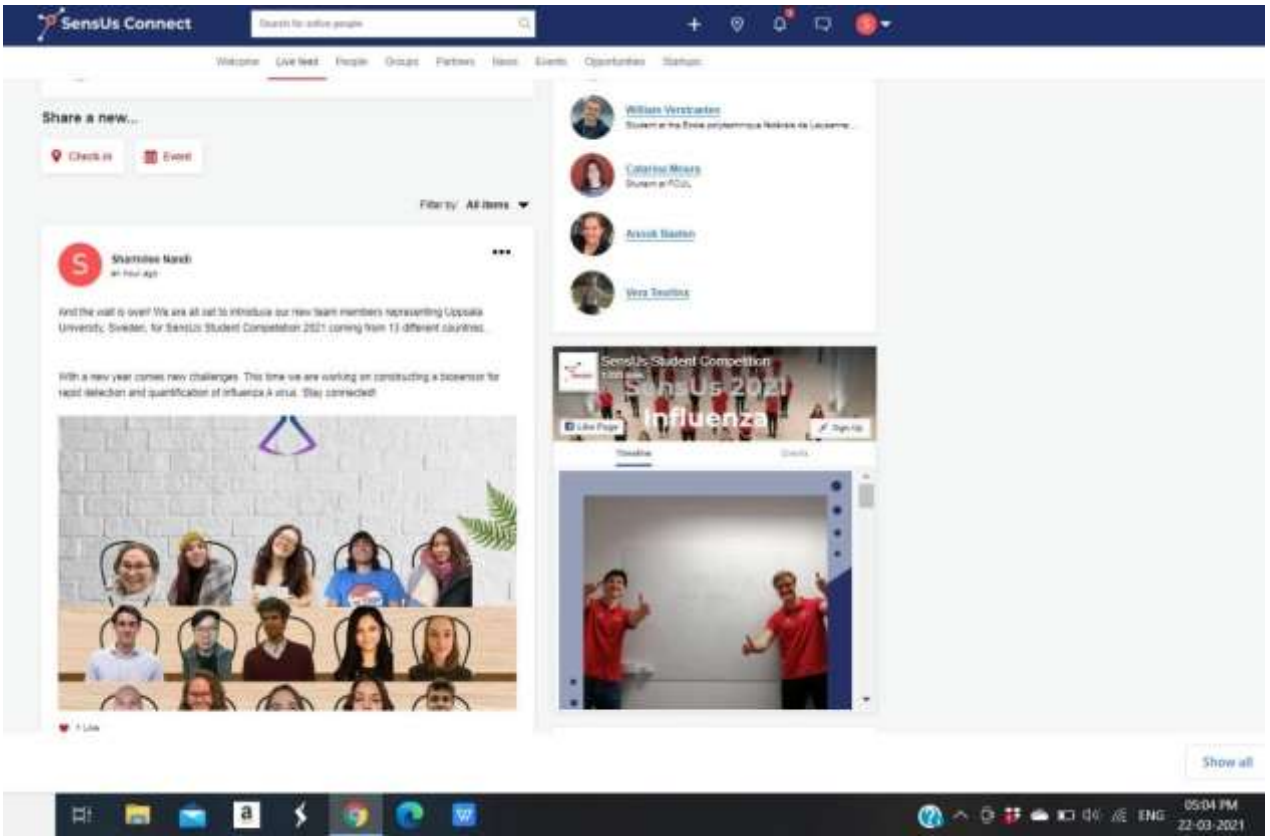
Post 5



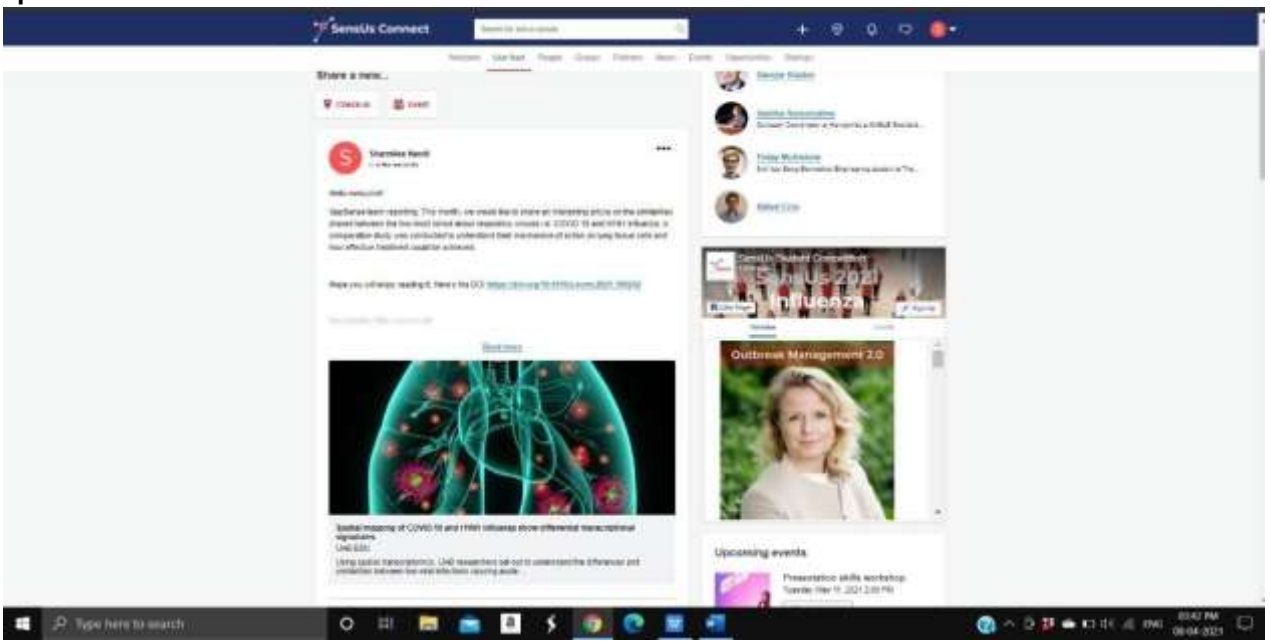
3. Gold

3.1 Post on SensUs Connect every month;

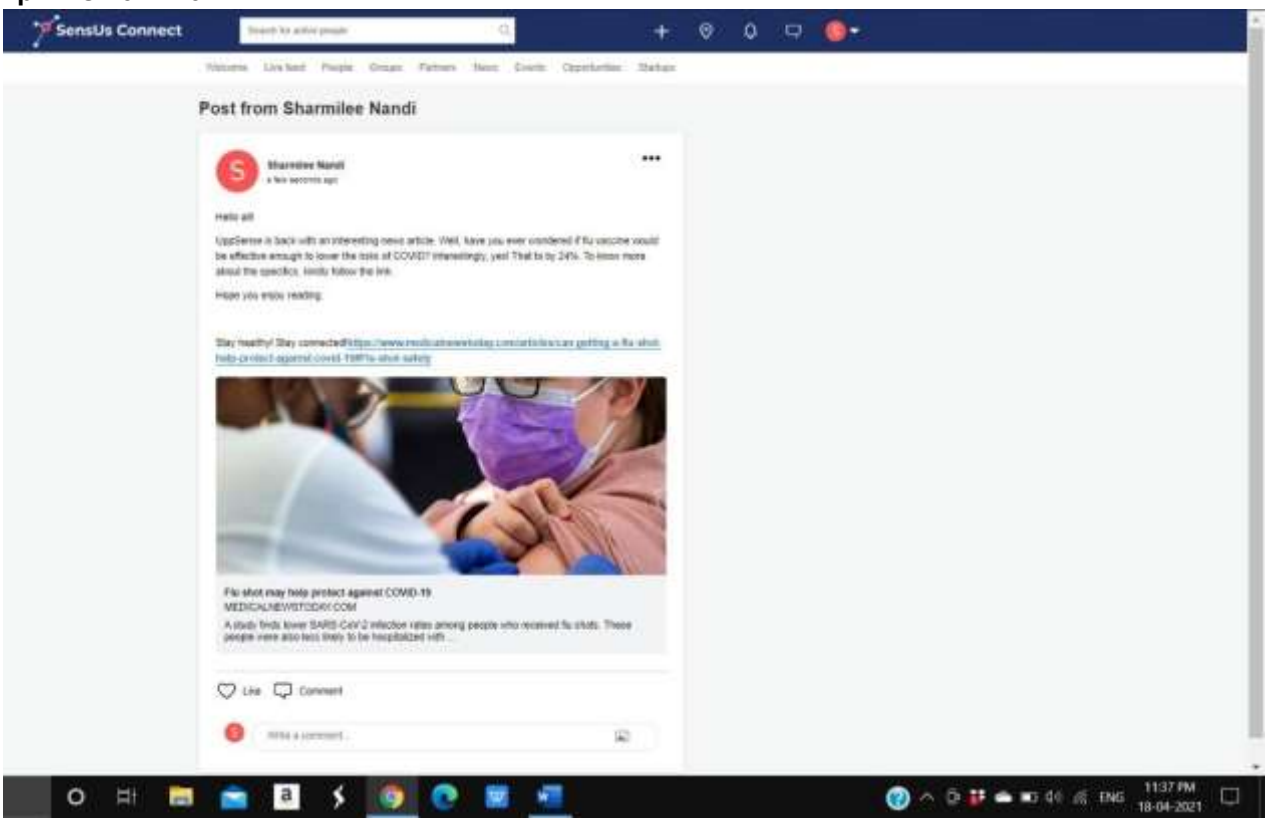
March 22 - 03 - 2021



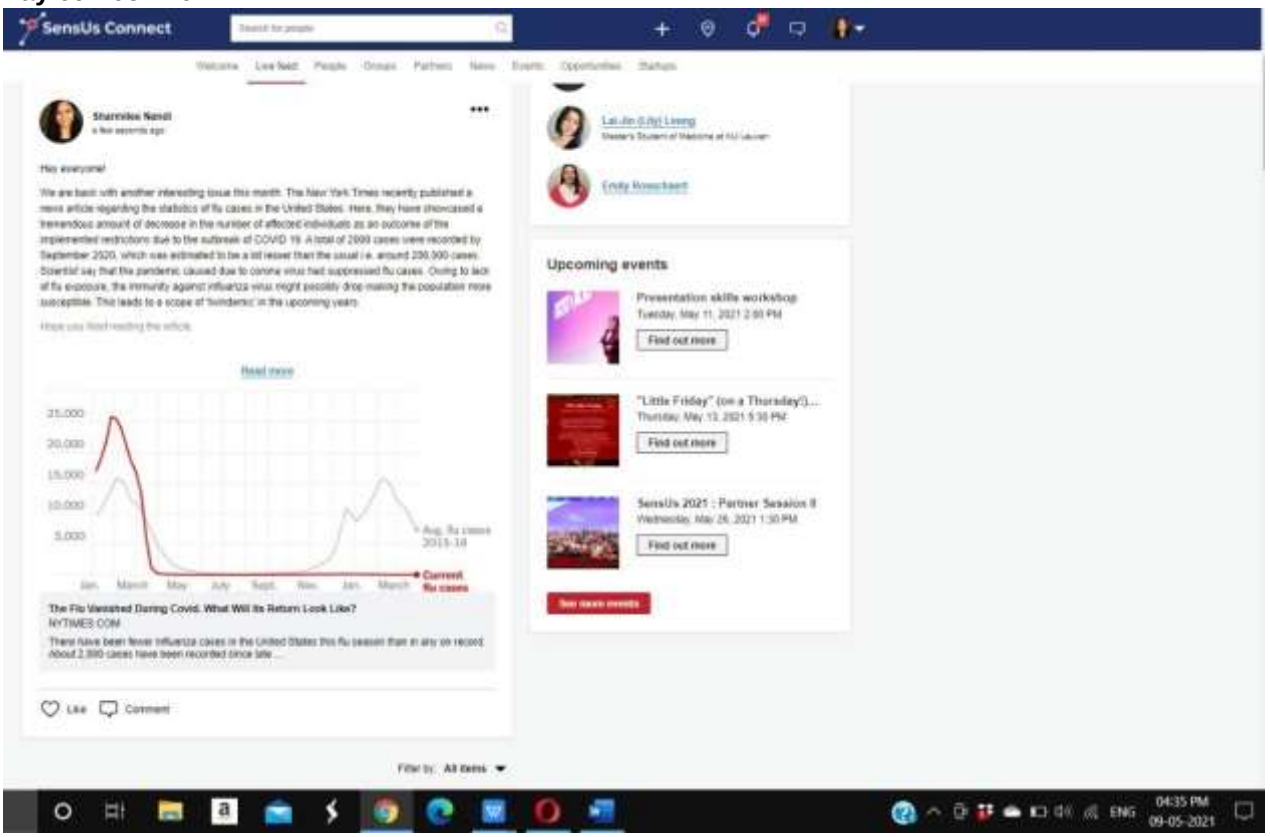
April 08 - 04 - 2021



April 18 - 04 - 2021



May 09 - 05 - 2021



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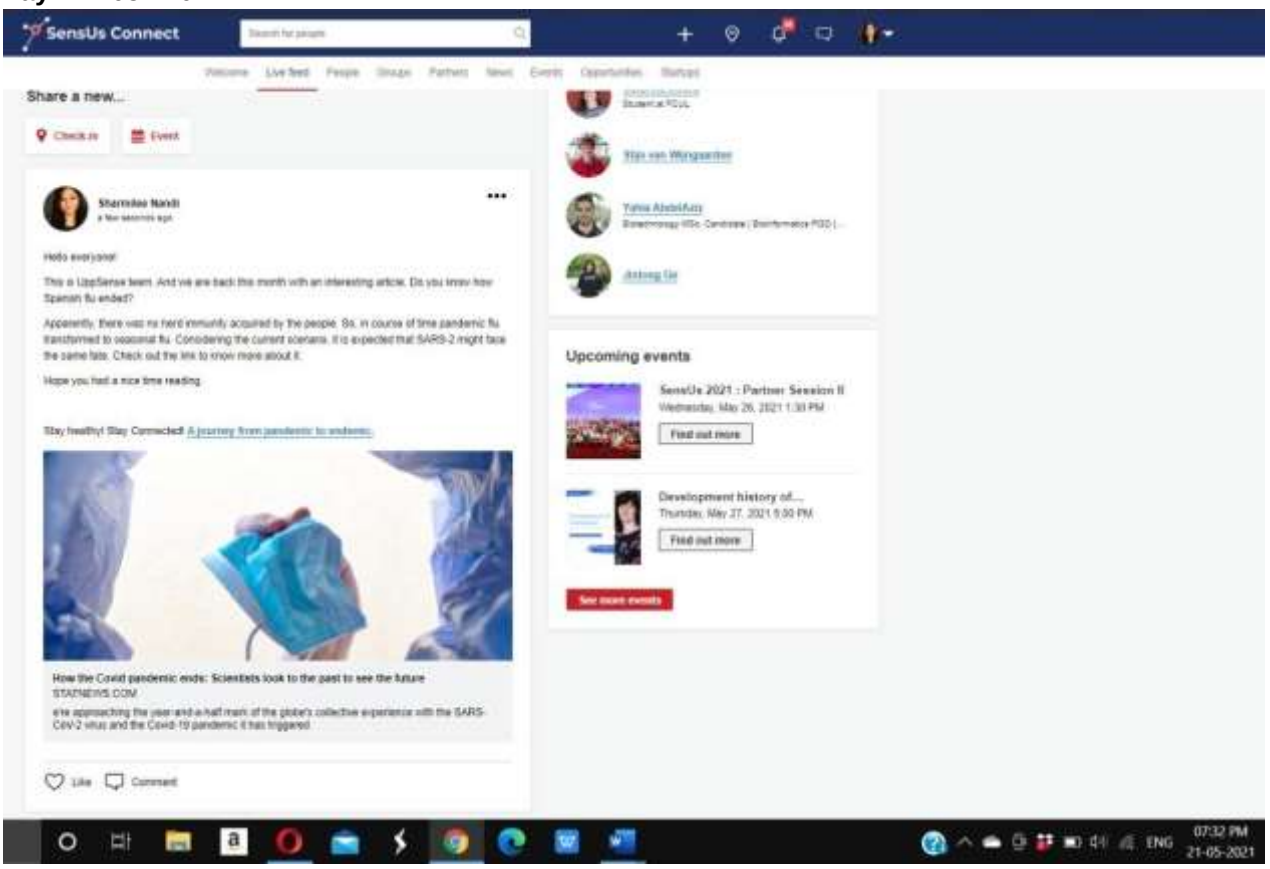

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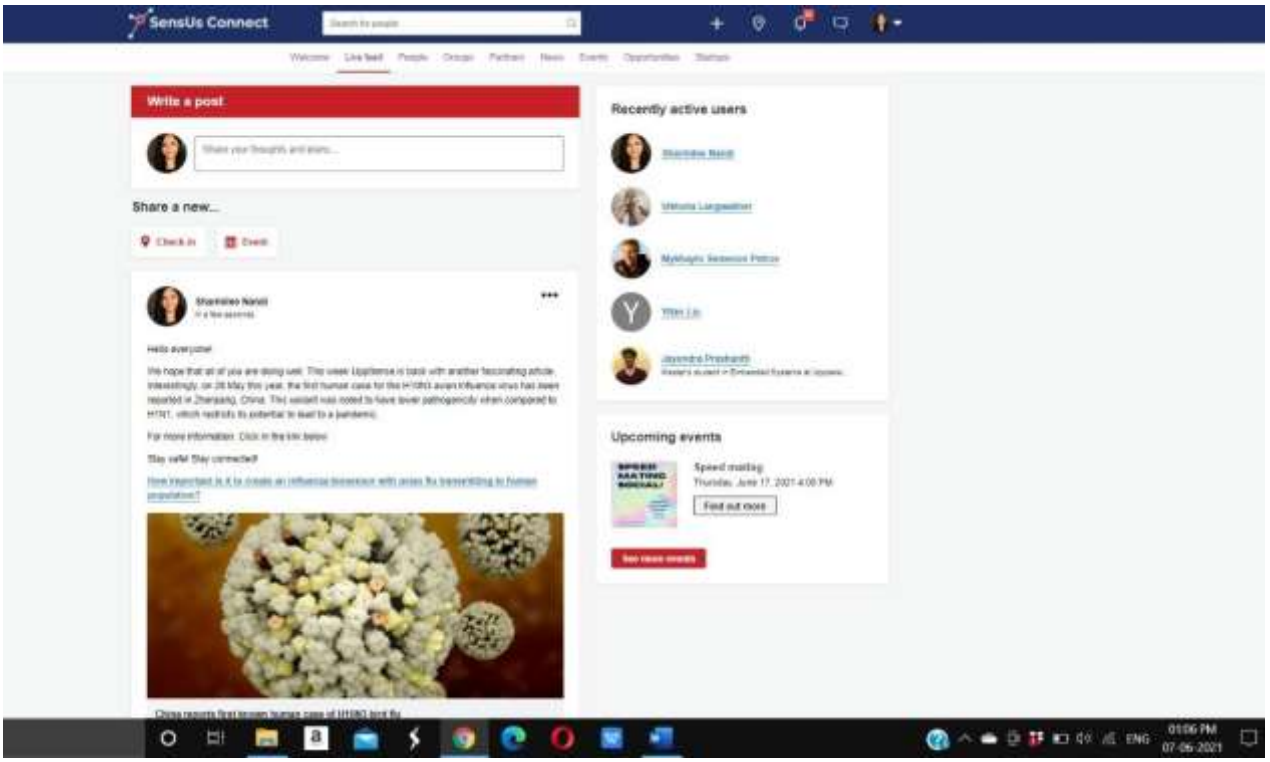

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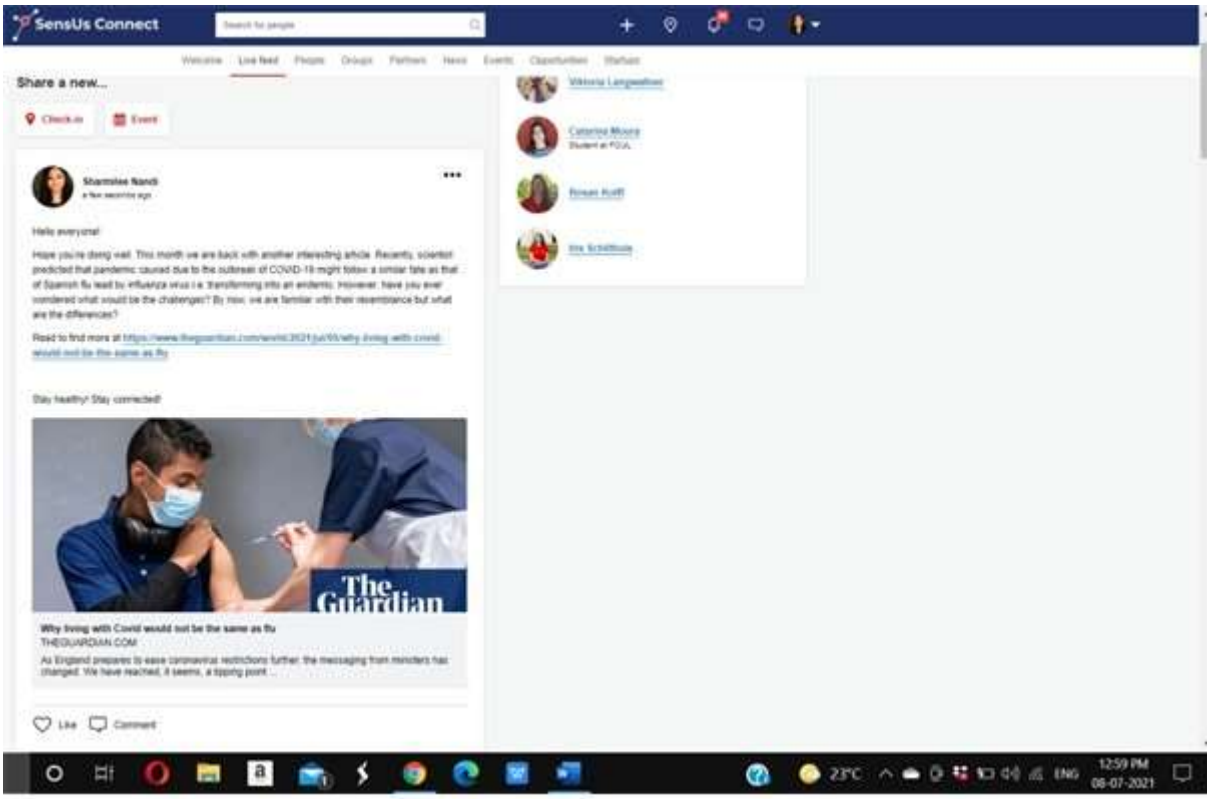
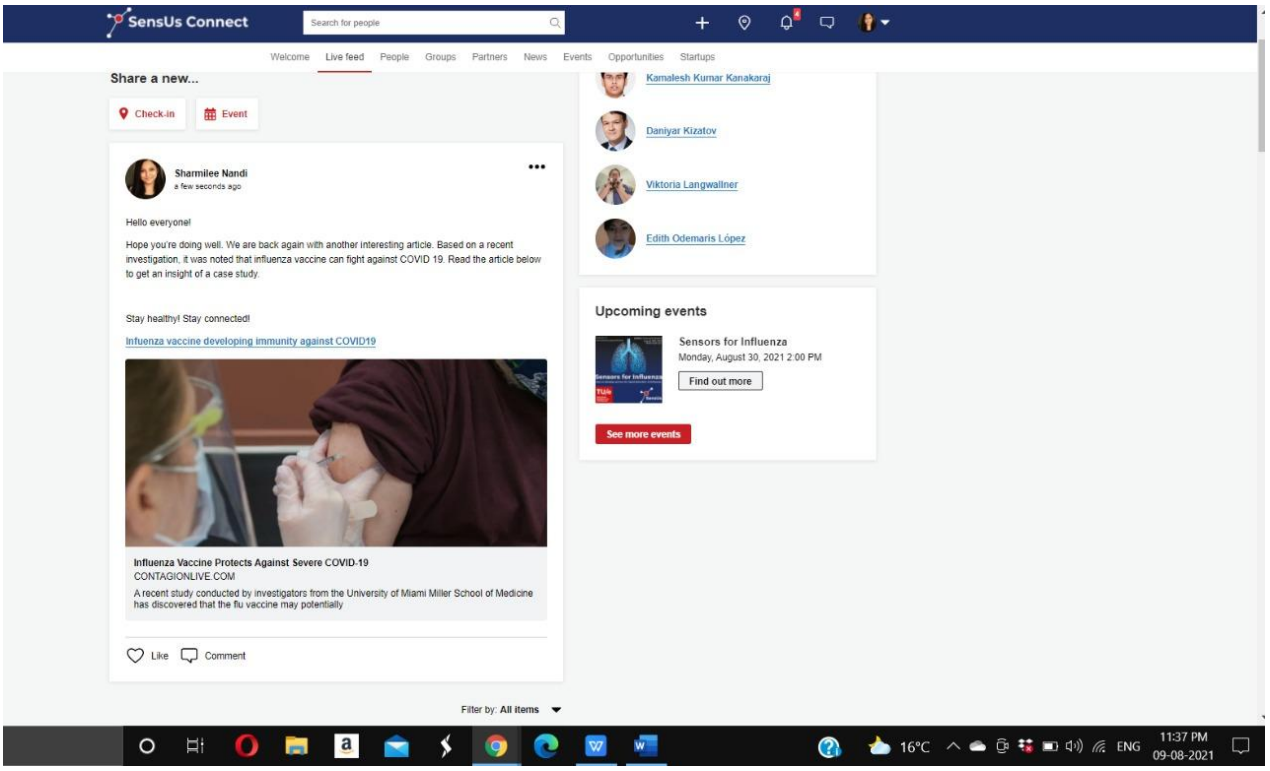


August

9th August 2021



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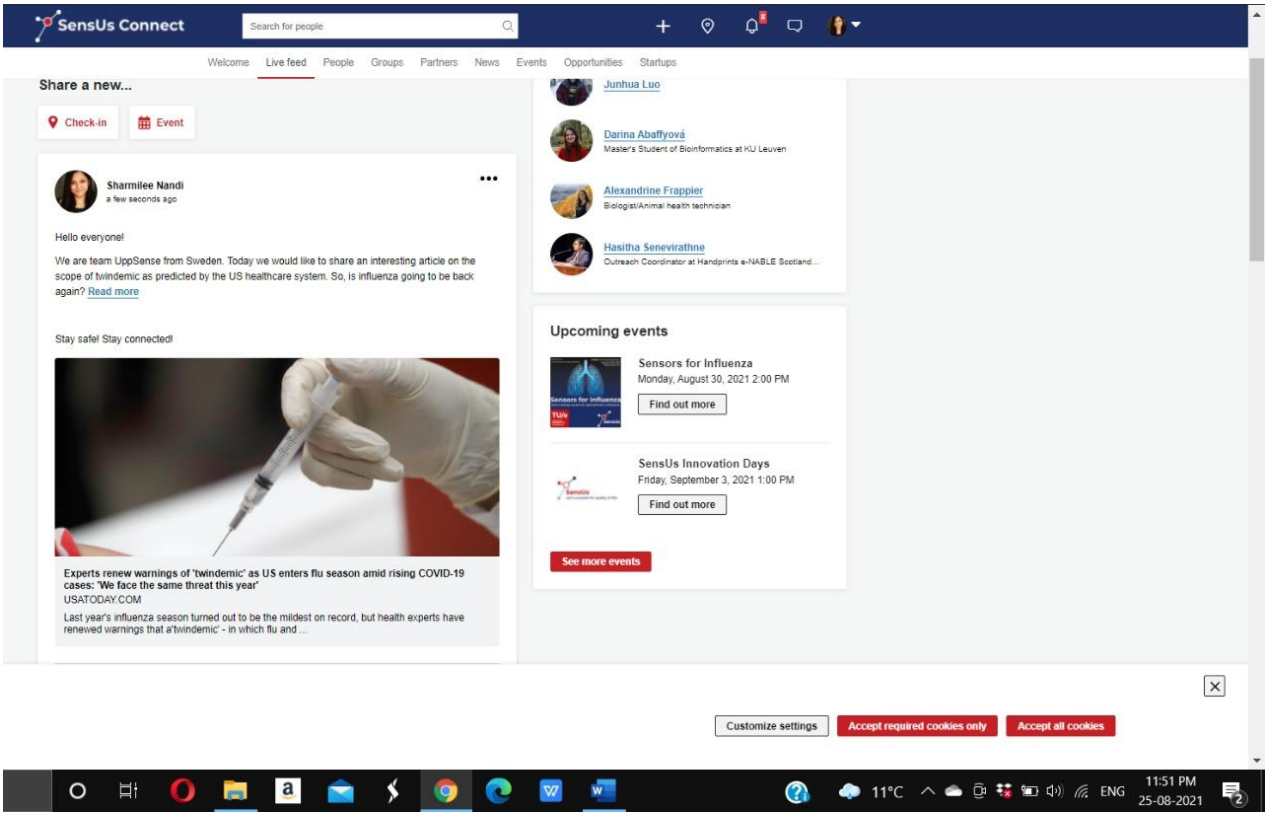

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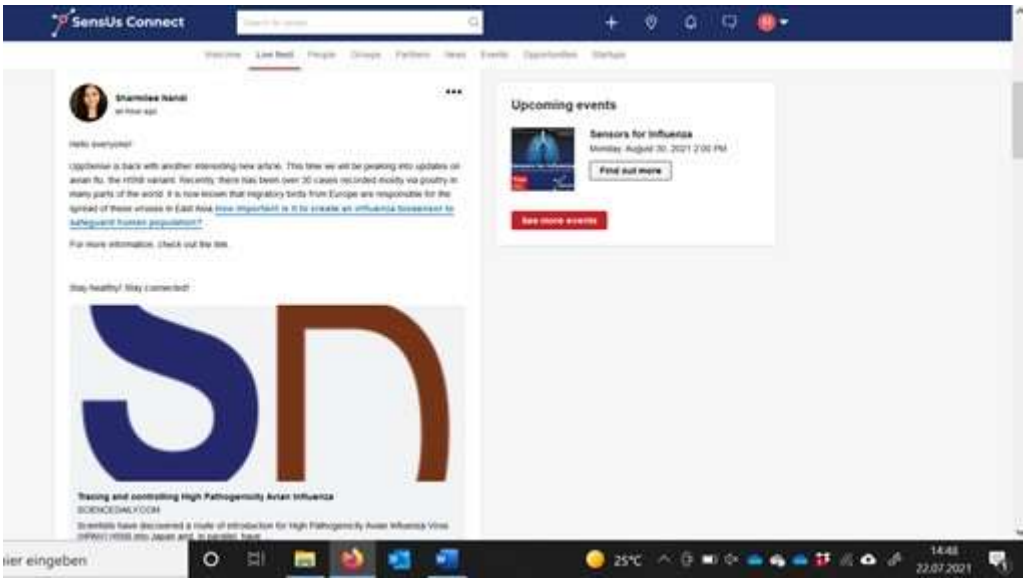

3.2 World-value;

The ongoing Covid-19 pandemic will be remembered by all of us. Everyone was affected by the outbreak of Sars-CoV-2 one way or another. Many people have lost their lives, or the lives of family members to the disease, others lost their livelihood, and most of us spent months and months in isolation. It was, and still is, a time of worry, loss, and waiting. We waited in lines to go to the supermarket, we waited to get tested for the virus and waited to receive the results. We waited for better times. It's been over a year since it all started, and we are still waiting. But, despite it all, this pandemic is also a chance. Since the outbreak in late 2019, new technologies and products for molecular testing have been introduced in record times and we were all witnessing how one vaccine after another got developed and approved for use. Huge investments, both governmental and private, are being made to accelerate the development of innovative tools and medicines [1]. It is still uncertain when and how this pandemic will end. However, what is certain is that there will be other viruses coming along that will not only ruin everyone's vacation plans, but could have more detrimental effects than Covid-19. Influenza viruses and other acute respiratory viruses have led to devastating epidemics and pandemics in the past and are a likely candidate to do so in the future [2]. To prevent another worldwide outbreak, it is of utmost importance to have advanced and reliable technologies at hand that detect the virus reliably and in a short time. All of us in team UppSense recognized the extraordinary significance of the project and decided to join the journey.

While developing our biosensor, we have been making use of experiences made during the Covid-19 pandemic. Conventional virus detection, for example via RT-PCR, takes time, is invasive, and expensive. With this in mind, we were aiming on building a rapid, reliable, resource-efficient, and most of all, affordable biosensor to tackle the next pandemic. Interviews with healthcare professionals and laboratory staff, in- and outside of Sweden, gave us a sense on what is crucial to consider when building an innovative biosensor. We have been receiving great support from many sides and have been reassured that we are on the right track. For us it was important to be able to give peace of mind not only to patients, but also healthcare staff. We wanted to make sure that we could produce a biosensor that is able to take a sample in a way that was not invasive, but still provided highly reliable results, within the shortest time possible.

Our journey is soon coming to an end, and we are excited to not only present our biosensor to the public, but also see what the other teams have accomplished during the past couple of months. In this spirit: "Let's compete for quality of life" [3]!

[1] Bender, R (2021). "BioNTech's Covid-19 Vaccine Success Sparks Investments in German Biotech". *Wall Street Journal,* May 10, 2021. Last accessed on July 28, 2021. Online available at:

https://www.wsj.com/articles/biontechs-covid-19-vaccine-success-sparks-investments-in-germanbiotech-11620644401

[2] Neumann, G., Noda, T., & Kawaoka, Y. (2009). Emergence and pandemic potential of swine-origin H1N1 influenza virus. *Nature*, *459* (7249), 931-939.

[3] https://www.sensus.org/