

SCIENCE ON THE MOVE 2021

SMART SYSTEMS

Task



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Smart Systems

What is it all about?



Corona viruses were unknown or of no interest to most of us – until we realized that a tiny RNA-virus, surrounded by thousands of other viruses coexisting with humans, changed our life, in no time, on the whole planet. Nobody could imagine that Europe, China, Russia and the USA would be paralyzed almost simultaneously, that an emergency shutdown would change our daily routines radically.

We were all forced to interrupt our traditions and to think about alternatives. Smart alternatives. All of a sudden, we realized how vulnerable structures are, which we trusted to be strong and stable. Until they collapsed. Crises force us to search for alternatives. Crises can be an eye-opener, making it obvious that we cannot postpone tasks indefinitely.

For about 50 years the awareness has been increasing that resources on our planet are limited and that we have to invent and establish sustainable systems which will allow further generations to live in peace and prosperity.

This year's SOTM is going beyond. Beyond solving a task, investigating a phenomenon, building a model – this year, the task will be to develop or at least think about a smart system which is convincing in many dimensions. A system which will contribute to making a change for the benefit of all of us. We are interested in smart ideas which are fun, helpful, changing maybe a habit or a procedure, a product or a system as a whole.

Fruitful ideas are often born in silence. First as a dream, emerging step by step to a vision, finally evolving to a functioning element in our society. Great ideas can become game changers in the field of communication, technical inventions, scientific achievements or social interactions.

Can you, as a class, contribute to solving a problem encountered by our society by designing your own smart system? The field is huge. Think about energy, climate, waste recycling, water and air quality, food and health, economy, education, social security or social interactions. Examine a process you'd like to improve, analyze the different players or components and their interactions, and come up with ideas and alternative approaches to turn this process into a system with "smart" properties. The solution should make you smile – why? It's simply clever! It benefits all participants, for example by saving time and nonrenewable resources and minimizing negative output such as waste or pollution, and thereby leads to a win-win situation on all levels.

To contribute to our society by a smart system – as described – is definitely a tough challenge. As an alternative we offer you to investigate a system of your choice in the field of physics, mathematics, biology or chemistry. Working in the field of science you will contribute by an experimental approach, investigating and describing a system of your choice in basic science or applied science. Nevertheless, you must discuss ideas on how your system might contribute to solving a problem of our society.

Please read on to find examples of smart systems and our judging criteria.

Examples

A smart system does not have to be invented from scratch. Maybe you have a new idea, maybe you take an already existing idea and develop it further. Get inspired by the following ideas and research more on your own.

Home solar power plants:



People in Switzerland have been able to invest in solar power plants for a while, not only to produce electricity for their private household but in addition to provide electricity to people living in the same house or in the neighborhood. This is facilitated by simple and very accurate tools that measure electricity consumption. Low interest rates on the market make it interesting to invest in this smart system. But how could people be encouraged to consider such an investment? Your task could be

to analyze the actual situation in different Cantons in Switzerland and to deliver a marketing strategy to promote the investment in home solar power plants. How can you convince people of this win-win situation?

More examples:

1. **Drip irrigation:** 40 years ago, fields used to be watered with the aid of water-sprinklers. In arid regions this led to water evaporation and soil salinization. Somebody had a very simple, brilliant idea: Why not water plants through tubes with tiny little holes? Drip irrigation was born, a very smart system! The idea is simple, the costs low and the effect huge.
2. **Rainwater in toilets:**
Toilets are normally flushed with high-quality tap water. By creating a tank for collecting rainwater we could run our toilets and washing machines or water our gardens without wasting high-quality tap water.
3. **Swiss Shrimps:**
Producing shrimps using waste heat and saltwater of a nearby salt refinery factory is a classical win-win situation.
4. **Sustainable energy supply:**
Some villages in the alps use water coming from a source high up in the mountains as tap water and to run a turbine and produce electricity in a generator simultaneously.
Or: Through the use of a heat pump that draws thermal energy from a nearby lake, houses can be heated, and cold-loving fish are happy. While heating houses by a heat-pump, the water-temperature of the nearby lake decreases. Fish are happy.
5. **Social investment in the future:**
Besides technical inventions there are social systems which might emerge during a crisis. Musicians start giving concerts in the neighborhood as a gift. Young people help elderly people to get the shopping done. Elderly people who are still fit support even older people with a handicap, earning points they can use when they themselves get older and find themselves in a needy situation.
6. **Prepaid littering:**
We invented a system which ensures that waste removal is paid in advance, included in the price of a product. Littering is less of a problem than it was before.
7. **CO₂-balance 2050:**
Can we establish a system that helps people to follow the progress of their community in achieving the defined goal of a CO₂-balanced situation until 2050? What do we have to do to break it down from a political decision to a story that involves us all and to which we can contribute?

8. From organic garbage to organic fuel:

Why not giving up a composting-plant square in a community in favor of delivering the green waste to a factory using highly sophisticated methods to produce gas for cars out of degradable organic waste (Kompogas)?

9. Aquaponics:

Aquaponics is a system combining a fish- or shrimp-tank with hors-sol cultivation of crops. Instead of adding fertilizer to grow the plants, wastewater of the shrimp- or fish-tank is used to fertilize them. Plants clean the water by removing minerals from it, so the animals likewise benefit from the system. A classical win-win situation.

10. Sun-powered desalination:

Solar powered systems to desalinate seawater would be very helpful to ensure enough water to use in agricultural regions near the sea. Wastewater of settlements around the fields can be sterilized and used as a fertilizer added to the gained sweet water.

11. News or fake news?

Establishing a system to distinguish news from fake news, easy to use, fast, credible.

12. Recycling car batteries by a smart system

The rising market of electrical cars calls for smart systems that use old batteries for alternative tasks or recycle them in a smart way.

The Task – Overview

Your task consists of three subtasks:

1. **The Paper:** Describe your topic and your system precisely, emphasize what is known already and what's your contribution to the improvement of our daily life.
2. **The Visualization:** Clean and scientific description of the system. The choice is yours: a poster, computer animation, non-digital 3D model, slide presentation, ...
3. **The Video Clip:** Imagine you would like to merchandize the product. Make a short video clip (max. 2 minutes) that presents the idea in a convincing, persuasive way to attract investors.

Please read all instructions until the very end! It is crucial for you to know what will be judged and how many points you may get for each subtask! See also page 12.



The Paper

What you have to do...

Write a paper with the following structure, **including tables and graphics**:

1. Introduction (max. 1 A4 page)

Your Topic. Analysis of the situation. Vision.

Your introduction should give an overview of the topic and your project, an analysis of the current situation incorporating your topic. What is the problem (describe it qualitatively and quantitatively including numbers), what does already exist and how would you like to contribute to improving our daily life with your smart system?

2. Detailed description of the system you have chosen (max. 4 A4 pages)

Make it happen!

Give us a precise and detailed description of your system and explain how it is supposed to work. What are the different elements of the system? How do they interact with each other? How can your goal be achieved? Show the planned implementation steps in detail. How and where should your idea be turned into reality? Are collaborations possible/necessary?

3. Budget, Marketing (max. 2 A4 pages)

Numbers and estimations.

We do not ask you to establish a professional business plan, but you should be able to deliver a strategy of how your basic idea could finally become a successful project in reality. Please provide a budget and a timeline. Also think about marketing: How shall people know about your project (e.g. social media, online shop, newspaper)?

4. Analysis (max. 1 A4 page)

Expert assessment and self-criticism.

One expert (politician, scientist, entrepreneur, ...) must deliver a short statement/comment that you should take into consideration while elaborating your system. Plan to search and contact the expert early enough! Make clear what the expert's suggestions were. How and to what extent did you incorporate them into your project?

Discuss the problems you encountered in the implementation phase and make suggestions on how the whole system and idea could be improved. How big might the impact of the suggested smart system be on improving an existing situation?

5. Progress Report (max. 1 A4 page)

You are expected to describe and explain precisely your process of choosing a system. **What happened between your team's initial discussions and the system of your choice?** Track your first ideas and discussions as you go along.

Mention **three suggestions** that were made and give a short **explanation** why you decided to choose the particular topic. Give arguments for and against choosing a certain topic including the one you finally selected as the most promising one.

Hint: Get inspired by talking with different teachers, friends, scientists or entrepreneurs about your project. It is not forbidden to ask for hints or inspiration. Check carefully the criteria we use to assess the system you have chosen.

Please note: As soon as you start to elaborate the idea of the system you selected, your teacher is only allowed to act as a coach in the background.

6. Activity List (max. 1 A4 page)

Each class needs to report which member was or is responsible for which portion or aspect of the work. Each person in the class must have participated at least once during the task (no matter what kind of work she/he did). Take one picture showing the class involvement. Place it next to the activity list.

7. Reference List (max. 1 A4 page)

Please use in-text citations and insert a bibliography (reference list) at the end of the document.

Please note! If the progress report, the activity list and the reference list are not provided, points will be deducted from your score!

For judging your paper, the following aspects will be taken into consideration:



A. Introduction and description of the smart system

- Is the topic sufficiently covered?
- Is the chosen system correctly, coherently, clearly described?
- Are the expected interactions in the chosen system carefully analyzed?
- Were collaborations considered?
- Are the possible implementation steps described?
- How big would the impact on the improvement of our daily life be?

B. Budget / Marketing

- How could your idea generate profits?
- What is the ratio of investment and return? (small intervention, big effect)
- How good are the chances to find an investor?
- How can you promote the suggested smart system?
- How can you convince people to invest?

C. Analysis

- Is the possible impact of the suggested smart system on an existing situation described?
- How thorough is the critical analysis of the suggested smart system?
- Are problems and suggested solutions discussed?
- Was the expert's feedback carefully considered and integrated?

D. Creativity and Practicability

- Is the idea/approach new, unexpected, fascinating, unprecedented?
- How likely is it that the idea can be realized? (political, financial, social aspects)
- To what extent does the proposal lead to a win-win situation? To what extent is the system self-reinforcing (positive feedback)?

Expected documentation

0. Cover page (name of school, name of class, project title)
1. Introduction (max. 1 A4 page)
2. Detailed description of the system you have chosen (max. 4 A4 pages)
3. Budget, Marketing (max. 2 A4 pages)
4. Analysis (max. 1 A4 page)
5. Progress Report (max. 1 A4 page)
6. Activity List (max. 1 A4 page)
7. Reference List (max. 1 A4 page)

Combine all pages in 1 PDF file (**max. 11 A4 pages plus cover**) and name it, strictly following these conventions:

- ▶ Name of School
- ▶ Name of Class (same as on application form or on simplyscience.ch)
- ▶ Project title
- ▶ Date (year/month/day)
- **Please use underlines instead of spaces!**

Here is an example:

Gymnasium_Muster_Class3b_SwissShrimps_20210401.pdf



The Visualization

What you have to do...

Imagine you have to present your idea to a broad audience. How can you visualize the basic aspects of your idea so that your audience understands it? You are free to choose the method (poster, computer animation, non-digital 3D model, slide presentation, ...). Explain what you expect from your system, how the different variables interact with each other and of course why your system is smart. The focus should be on visual material, not on written text, but the visualization should be self-explanatory even if someone has not read your paper. Make your visualization visually appealing and memorable.

For judging your visualization, the following aspects will be taken into consideration:

Comprehensibility

Does the visualization clearly convey how the system functions?
Is the visualization helpful to understand the concept, the involved interacting parameters?

Creativity, imagination

How creative is the visualization?
How attractive is it and does it invite people to read the paper?
Is the visualization inspiring, innovative?



Expected documentation

Depending on the chosen technique, the file types will vary. Please make sure you send us only one file (e.g. combine several pictures in one PDF document). Please send us videos as .mp4. Keep in mind that we must be able to open the file, so please use common file types.

Name your file strictly following these conventions:

- ▶ Name of School
 - ▶ Name of Class (same as on application form or on simplyscience.ch)
 - ▶ Name of file (Visualization)
 - ▶ Date (year/month/day)
- **Please use underlines instead of spaces!**

Here is an example:

Gymnasium_Muster_Class3b_Visualization_20210401.xyz



The Video Clip

What you have to do...

Imagine you have created a website for your company. On the homepage you would place a strong video to attract the interest of possible investors.

This 2-minute video clip should above all present and explain your system in an enjoyable and meaningful way. You may use elements of the "visualization".

Please check the aspects which we will judge to find the best way to present your smart system by the video clip.

For judging your video clip, we will take into consideration:



Script

Is there a structure, a well-thought-out start and end of the clip?
How well does the video clip explain the system in its full complexity and the basic idea behind it?
Does the video clip convince people of the importance of the presented smart system?

Technical skills

How sophisticated are the technical skills? Camera work, sound quality, editing?

Creativity, attractivity

Does the clip invite people to go deeper into the topic, read the paper and have a look at the visualization?
Is the clip enjoyable, inspiring, is there a desire to review it instantly?
Is the viewer captivated? Does the clip evoke a smile on the lips?

The filename extension should be .mp4. If your original file has a different extension, you can use freeware such as VLC (<http://www.videolan.org/vlc/>) to convert your video.

The size of the file must not exceed 100 MB and it must not be longer than 2 minutes.



Name the video file strictly following these conventions:


- ▶ Name of School
 - ▶ Name of Class (same as on application form or on simplyscience.ch)
 - ▶ Name of file (VideoClip)
 - ▶ Date (year/month/day)
- **Please use underlines instead of spaces!**

Here is an example:

Gymnasium_Muster_Class3b_VideoClip_20210401.mp4

Scoring List

Subtask	Judging criterion	Score (P)
Paper		30
 1	Introduction and description of the smart system Is the topic sufficiently covered? Is the chosen system correctly, coherently, clearly described? Are the expected interactions in the chosen system carefully analyzed? Were collaborations considered? Are the possible implementation steps described? How big would the impact on the improvement of our daily life be?	15
	2 Budget / Marketing How could your idea generate profits? What is the ratio of investment and return? (small intervention, big effect) How good are the chances to find an investor? How can you promote the suggested smart system? How can you convince people to invest?	5
	3 Analysis Is the possible impact of the suggested smart system on an existing situation described? How thorough is the critical analysis of the suggested smart system? Are problems and suggested solutions discussed? Was the expert's feedback carefully considered and integrated?	5
	4 Creativity and Practicability Is the idea/approach new, unexpected, fascinating, unprecedented? How likely is it that the idea can be realized? (political, financial, social aspects) To what extent does the proposal lead to a win-win situation? To what extent is the system self-reinforcing (positive feedback)?	5
Visualization		10
 1	Comprehensibility Does the visualization clearly convey how the system functions? Is the visualization helpful to understand the concept, the involved interacting parameters?	5
	2 Creativity, imagination How creative is the visualization? How attractive is it and does it invite people to read the paper? Is the visualization inspiring, innovative?	5

Video clip		10
	1 Script Is there a structure, a well-thought-out start and end of the clip? How well does the video clip explain the system in its full complexity and the basic idea behind it? Does the video clip convince people of the importance of the presented smart system?	2.5
	2 Technical skills How sophisticated are the technical skills? Camera work, sound quality, editing?	2.5
	3 Creativity, attractivity Does the clip invite people to go deeper into the topic, read the paper and have a look at the visualization? Is the clip enjoyable, inspiring, is there a desire to review it instantly? Is the viewer captivated? Does the clip evoke a smile on the lips?	5
Total		50

To submit

1. Paper: .pdf, max. 6 MB
2. Visualization: depends on the chosen technique
3. Video clip: .mp4, max. 2 minutes, max. 100 MB

Hint: If you need to compress your file you can use online tools such as <https://pdfcompressor.com/de/>.

Send all 3 files together
via **WeTransfer** (<https://wetransfer.com>) to:

scienceonthemove@simplyscience.ch

Don't forget to add the name of your school and class
in the message field!

Closing Date of the task:

Thursday, 01.04.2021, 13:00

Questions?

E-Mail: scienceonthemove@simplyscience.ch

Contacts

Sarah Menzi (Project Manager)

+41 (0) 44 368 17 48

Thomas Flüeler (Managing Director)

+41 (0) 44 368 17 46