Self balancing robot

It's a technology to balance two robots individually and cooperativally move and thus dance with eachother. The robots communicate via WiFi and are controlled by one main computer

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Context of use: Education
Level of education: Bachelor

Technology Impact Cycle Tool
Self balancing robot

Impact on society
What impact is expected from your technology?

What is exactly the problem? Is it really a problem? Are you sure?
The project doesn't pose a problem; rather, it serves as a challenging opportunity for Advanced Motion Control students. Its fundamental purpose is to facilitate the practical application of the material learned in class, bridging the gap between theoretical knowledge and real-world practice. This hands-on experience aligns classroom teachings with the practical aspects of the subjects studied in school, fostering a deeper understanding and skill development among students.

Are you sure that this technology is solving the RIGHT problem?
Yes. The robots are a perfect example of control engineering. It is the basis from start to finish of analysing a system and controlling it.

How is this technology going to solve the problem?
It is not going to solve a problem. It is for education purposes.

What negative effects do you expect from this technology?
The robots could be hardcoded. The main idea behind the project is to be creative and program systems that are aware of their environment. This could be bypassed by simply coding each movement, eventually simulating adaptive behaviour of the system. However, this is not considered out of the limits. The client is satisfied with such final design. But the group is advised to use the project in their benefit and try to be innovative by not choosing the easiest path.

In what way is this technology contributing to a world you want to live in?
It does not contribute directly to the world. It is an initial step to go from student engineers to professionals.

Now that you have thought hard about the impact of this technology on society (by filling out the questions above), what improvements would you like to make to the technology? List them below.
A possible improvement would be designing a real system that can be used my humans that works on the same principle. A segway is a perfect example. This could be an outcome of the project, if the project on its own was not repetitive each year.

Hateful and criminal actors
What can bad actors do with your technology?

This category has not been filled yet.

Privacy

Are you considering the privacy & personal data of the users of your technology?

This category has not been filled yet.

Human values

How does the technology affect your human values?

This category has not been filled yet.

Stakeholders
Have you considered all stakeholders?

This category has not been filled yet.

Data
Is data in your technology properly used?

This category is only partial filled.

Are you familiar with the fundamental shortcomings and pitfalls of data and do you take this sufficiently into account in the technology?
The whole purpose of this project is to understand the control technology behind a balancing inverted pendulum. Control engineering is about having an input signal, disturbances and an output signal. By means of a controller you are able to change the input DATA to a signal that is in accordance with the requirements. The input data from the sensors, mathematical theories and hardware guides are the only data inputs that are used in this project. Reports from former groups are handled carefully because we are not sure that they were able to do this project successfully.

So yes, we are familiar with the shortcomings of data, and they are not relevant to this project.

How does the technology organize continuous improvement when it comes to the use of data?
This question has not been answered yet.

How will the technology keep the insights that it identifies with data sustainable over time?
This question has not been answered yet.

In what way do you consider the fact that data is collected from the users?
This question has not been answered yet.

Now that you have thought hard about the impact of data on this technology, what improvements would you like to make? List them below.
This question has not been answered yet.

Inclusivity
Is your technology fair for everyone?

This category has not been filled yet.

Transparency
Are you transparent about how your technology works?

Is it explained to the users/stakeholders how the technology works and how the business model works?
Yes, through a plan of approach, weekly tutor meetings and two reports, all decisions and technology details are thoroughly explained.

If the technology makes an (algorithmic) decision, is it explained to the users/stakeholders how the decision was reached?
Yes, how the robot moves and decides how to interact with its environment is the main part of this project. Complete transparency about how the robot works and why is crucial for the success of the project.

Is it possible to file a complaint or ask questions/get answers about this technology?
It is not something we actively take into account, but if anyone reaches out with a complaint or suggestion, it will be discussed and taken seriously.

Is the technology (company) clear about possible negative consequences or shortcomings of the technology?
Yes, they are aware and want us to make the best out of it despite of it. The shortcomings were taken into account when the requirements were composed.

Now that you have thought hard about the transparency of this technology, what improvements would you like to make? List them below.
There has been made a logbook. We should fill it in so that it is more detailed about what decisions were made and why. So that they can be included in the final report.

Sustainability
Is your technology environmentally sustainable?

In what way is the direct and indirect energy use of this technology taken into account?
The robots are powered with a battery charged by the electrical grid. The electrical grid in the Netherlands consists of 63% of fossil, 33% of renewable and 4 % of nuclear power. The battary is powered by a lithium ion battery which has a round trip efficiency of 78%. Since this project is low powered compared to other mechatronics projects and the round trip efficiancy is quite good this isn't a polluting technology. [source CBS]

Do you think alternative materials could have been considered in the technology?
Alternative materials could be used. The project consists of two robots. One is premade and not much can be done to fix it but the other robot is made of 3d printed material. This casing has broken down multiple times and a redesign could be considerd. The material is made from PLA which is biodigradable and the electronic parts can be handed in at companies like "wecycle" or "E-waste Nederland". To rebuild the robot recycled plastics can be used to print the chassis again. Also a redesign should be considered

Do you think the lifespan of the technology is realistic?
The technology is long published and the biggest factor of breakage is the storing the device, that is physically with the software and the information about the project. The biggest hazard for this technology to "break" is lost documentation. Components are easily swapped and since this project is a demonstration no long continuous loads wil be acting on the system. The 3d printed robot is an example of this. Due to bad documentation the robot is rewired and thus has been broken. Ofcourse the design of the chassis must also improve to make it less likely to break when storing the device.

What is the hidden impact of the technology in the whole chain?
This technology is produced and has no drive to get produced more since this is a demonstration of the capabilities regarding control engineering. The biggest impact is the datacenter hosting the software and documentation. The machine could breakdown but since all components are bolted together these can be replaced by off the shelf components. Only the casing of the second robot should be rebuild when that component breaksdown.

Now that you have thought hard about the sustainability of this technology, what improvements would you like to make? List them

below.

I'm quite pleased with the results of this cycle. The second robot could be improved after the casing breaks down. The casing should get a redesign and be made of recycled materials with the property that is should be biodigradable. It uses an efficient battery technology that does not have to be replaced and the cost of maintaining this robot is minimal due to the fact that it does not need new materials or software to operate

Future

Did you consider future impact?

This category has not been filled yet.