




**NAME:** HIL (hardware in the loop) 

**DATE:** May 15, 2026 2:29 PM


**DESCRIPTION OF TECHNOLOGY**  
 The technology consists of an electric kart test bench where a Siemens motor is used to simulate real-life driving resistance. Control inputs are generated using Simulink and Amesim models, which are executed in real time through the Speedgoat system. This allows accurate simulation and testing of vehicle behavior without the need for on-road testing.

**HUMAN VALUES** 


This technology brings students together to work on a project. Students can learn how a real-life electric kart reacts in different scenarios and understand the electronics and software of this setup.

**TRANSPARENCY** 


Yes, there are weekly meetings held with the stakeholders and specialists to better understand the current status of the testbench and where to go from here.

**IMPACT ON SOCIETY** 


The test bench is not a reliable setup and the setup is not very clear for students. Also, the Matlab program is not always working reliably. If these problems are solved, the test bench can be used in a school project, which will be very interesting for these students.

**STAKEHOLDERS** 


- Bas Geleijns
- Paul Versteegen
- Stefan van den Biggelaar
- Alexander Germeau
- project group
- second year students
- next project groups

**SUSTAINABILITY** 


By performing tests in a controlled lab environment instead of real road tests, overall energy use can be reduced. Indirectly, the use of a simulation-based HIL setup lowers the need for repeated physical prototyping and on-road testing, which would otherwise require additional energy and resources.

**HATEFUL AND CRIMINAL ACTORS** 


This technology can hurt someone, it is a fast-spinning machine. Also it works on big electric power which can be dangerous. The kart can also be used off the test bench; it can drive on its own. This can cause accidents and if you use it on the road, it is against the law.

**DATA** 


The HIL setup depends heavily on sensor data and communication signals. These can be affected by noise, delays, or calibration errors. The accuracy of the simulation results depends on the quality of the input data. To address this, we plan to verify and calibrate sensors, clean up the wiring to minimize interference, and cross-check logged data with expected model outputs.

**FUTURE** 

In the future, many students can learn a great deal from this technology. They can learn about electronic systems, hardware, software and electronic safety. This project can really contribute to the automotive education.

**PRIVACY** 

No, not personal data. It does use data to run the test bench.


**INCLUSIVITY** 

Yes, this technology has a built-in bias. The HIL system relies on MATLAB/Simulink and Speedgoat, which means it only works optimally with specific software and hardware versions. New MATLAB updates are compatible with Speedgoat, but not with older hardware such as PC104. This creates a bias toward using Speedgoat and newer software, limiting flexibility and making it harder to use alternative systems or older components.

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**HUMAN VALUES** 

**How is the identity of the (intended) users affected by the technology?**

To help you answer this question think about sub questions like:

- If two friends use your product, how could it enhance or detract from their relationship?
- Does your product create new ways for people to interact?...

**TRANSPARENCY** 

**Is it explained to the users/stakeholders how the technology works and how the business model works?**

- Is it easy for users to find out how the technology works?
- Can a user understand or find out why your technology behaves in a certain way?
- Are the goals explained?
- Is the idea of the technology explained?
- Is the technology company transparent about the way their...

**IMPACT ON SOCIETY** 

**What is exactly the problem? Is it really a problem? Are you sure?**

Can you exactly define what the challenge is? What problem (what 'pain') does this technology want to solve? Can you make a clear definition of the problem? What 'pain' does this technology want to ease? Whose pain? Is it really a problem? For who? Will solving the problem make the world better? Are you sure? The problem definition will help you to determine...

**STAKEHOLDERS** 

**Who are the main users/targetgroups/stakeholders for this technology? Think about the intended context by...**

When thinking about the stakeholders, the most obvious one are of course the intended users, so start there. Next, list the stakeholders that are directly affected. Listing the users and directly affected stakeholders also gives an impression of the intended context of the technology.

...

**SUSTAINABILITY** 

**In what way is the direct and indirect energy use of this technology taken into account?**

One of the most prominent impacts on sustainability is energy efficiency. Consider what service you want this technology to provide and how this could be achieved with a minimal use of energy. Are improvements possible?

**HATEFUL AND CRIMINAL ACTORS** 

**In which way can the technology be used to break the law or avoid the consequences of breaking the law?**

Can you imagine ways that the technology can or will be used to break the law? Think about invading someone's privacy. Spying. Hurting people. Harassment. Steal things. Fraud/identity theft and so on. Or will people use the technology to avoid facing the consequences of breaking the law (using trackers to evade speed radars or using bitcoins to launder...)

**DATA** 

**Are you familiar with the fundamental shortcomings and pitfalls of data and do you take this sufficiently into...**

There are fundamental issues with data. For example:

- Data is always subjective;
- Data collections are never complete;
- Correlation and causation are tricky concepts;
- Data collections are often biased;...

**FUTURE** 

**What could possibly happen with this technology in the future?**

Discuss this quickly and note your first thoughts here. Think about what happens when 100 million people use your product. How could communities, habits and norms change?

**PRIVACY** 

**Does the technology register personal data? If yes, what personal data?**

If this technology registers personal data you have to be aware of privacy legislation and the concept of privacy. Think hard about this question. Remember: personal data can be interpreted in a broad way. Maybe this technology does not collect personal data, but can be used to assemble personal data. If the technology collects special personal data (like...

**INCLUSIVITY** 

**Does this technology have a built-in bias?**

Do a brainstorm. Can you find a built-in bias in this technology? Maybe because of the way the data was collected, either by personal bias, historical bias, political bias or a lack of diversity in the people responsible for the design of the technology? How do you know this is not the case? Be critical. Be aware of your own biases....

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