Computer vision

AI-Assisted Visual Inspection PoC for PCUs

This technology is a proof-of-concept computer vision system designed to support visual inspection of PCUs on the manufacturing shop floor. A fixed camera captures an image of each PCU under defined conditions. The image is analysed by an anomaly-detection model that has learned the visual appearance of normal reference PCUs. The system produces an anomaly score and a localised heatmap to indicate image regions that differ from the normal-reference data.

The intended purpose is to help operators identify visually observable deviations earlier and direct their attention to areas that may require closer inspection. The system may support more consistent visual inspection and provide additional visual evidence for quality review. It is not designed to identify the root cause of a deviation, classify a specific defect type, or autonomously decide whether a PCU should be accepted, reworked, or rejected. The final quality decision remains the responsibility of the operator and authorised quality personnel.

The technology addresses the limitation of manual visual inspection, where

small or subtle deviations may be difficult to notice consistently and inspection outcomes can depend on individual experience, workload, and environmental conditions. By comparing a captured image with normal-reference images, the system can highlight visual differences that could otherwise receive less attention.

However, the expected benefits remain conditional. The PoC was evaluated only under defined test conditions, including a fixed camera configuration, controlled lighting, a limited set of normal PCUs, and selected introduced visual deviations. The results show that the system can generate anomaly scores and heatmaps for these cases. They do not yet demonstrate reliable performance across all PCU variants, real production defects, environmental variation, or long-term shop-floor use. A larger validation study with representative production data and continued human oversight would be required before operational deployment.

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Context of use: Work
Level of education: Master

Impact on society

What impact is expected from your technology?

This category is only partial filled.

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

Manual inspection of PCUs can be inconsistent because it depends on operator attention, experience, workload, and visual conditions. As a result, small or subtle visual deviations may be overlooked or identified late.

This is a relevant quality-control problem because visible non-conformities may require rework, investigation, or rejection. However, the problem should not be overstated: not every visual difference is a defect, and not every defect is visible to the camera.

The PoC therefore does not aim to replace operators or guarantee defect detection. It investigates whether anomaly detection can support operators by highlighting visual differences that require closer review. The controlled PoC tests provide initial evidence that this is technically feasible, but broader validation is required before production use.

Are you sure that this technology is solving the RIGHT problem?

This question has not been answered yet.

How is this technology going to solve the problem?

This question has not been answered yet.

What negative effects do you expect from this technology?

This question has not been answered yet.

In what way is this technology contributing to a world you want to live in?

This question has not been answered yet.

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.

This question has not been answered yet.

Hateful and criminal actors

What can bad actors do with your technology?

This category is only partial filled.

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

> The technology could be misused if inspection results, images, or system settings were intentionally altered to conceal a non-conforming PCU or to avoid responsibility for a quality failure. For example, an unauthorised user could remove inspection records, modify normal-reference images, or change the anomaly threshold so that deviations are less likely to be flagged.
>
> These risks should be mitigated through role-based access control, protected audit logs, version control for reference data and model settings, and documented approval for changes. The system should support traceability and investigation, not enable users to bypass quality procedures.

Can fakers, thieves or scammers abuse the technology?

This question has not been answered yet.

Can the technology be used against certain (ethnic) groups or (social) classes?

This question has not been answered yet.

In which way can bad actors use this technology to pit certain groups against each other? These groups can be, but are not constrained to, ethnic, social, political or religious groups.

This question has not been answered yet.

How could bad actors use this technology to subvert or attack the truth?

This question has not been answered yet.

Now that you have thought hard about how bad actors can impact this technology, what improvements would you like to make? List them below.

This question has not been answered yet.

Privacy

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

This category is only partial filled.

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

> The PoC is designed to process images of PCUs rather than personal data. However, inspection records may contain indirectly identifiable information, such as timestamps, workstation identifiers, user login details, or operator decisions if these are recorded.
>
> Therefore, any operator-related data should be minimised, protected through role-based access, and used only for quality assurance, traceability, or approved system maintenancenot for routine employee monitoring or performance evaluation.

Do you think the technology invades the privacy of the stakeholders? If yes, in what way?

This question has not been answered yet.

Is the technology is compliant with prevailing privacy and data protection law? Can you indicate why?

This question has not been answered yet.

Does the technology mitigate privacy and data protection risks/ concerns (privacy by design)? Please indicate how.

This question has not been answered yet.

In which way can you imagine a future impact of the collection of personal data?

This question has not been answered yet.

Now that you have thought hard about privacy and data protection, what improvements would you like to make? List them below.

This question has not been answered yet.

Human values

How does the technology affect your human values?

This category is only partial filled.

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

The technology may affect operators professional identity because it introduces AI-generated anomaly outputs into a task that relies on visual experience and quality judgement. If the system is perceived as replacing or overruling expertise, operators may feel reduced from skilled inspectors to users who merely follow machine recommendations.

The PoC should therefore be presented as an advisory tool that supports attention and evidence gathering. Operators retain responsibility for interpreting the output and making or escalating the final quality decision, preserving their role as skilled quality professionals.

How does the technology influence the users' autonomy?

This question has not been answered yet.

What is the effect of the technology on the health and/or well-being of users?

This question has not been answered yet.

Now that you have thought hard about the impact of your technology on human values, what improvements would you like to make to the technology? List them below.

This question has not been answered yet.

Stakeholders

Have you considered all stakeholders?

This category is only partial filled.

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

Name of the stakeholder
Assembly operator

How is this stakeholder affected?
-

Did you consult the stakeholder?
No

Are you going to take this stakeholder into account?
No

Did you consider all stakeholders, even the ones that might not be a user or target group, but still might be of interest?

-

Now that you have thought hard about all stakeholders, what improvements would you like to make? List them below.

This question has not been answered 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?

> Yes. The main data limitation is that the anomaly-detection model learns only from the normal-reference images provided to it. If these images do not represent acceptable variation in PCUs, lighting, camera position, or assembly conditions, the system may generate false positives or fail to detect relevant deviations.
>
> This is addressed by using controlled image capture, documenting the reference dataset, restricting changes to data and model settings, and requiring revalidation when products, cameras, lighting, or reference images change. However, the current PoC has only been tested on limited data, so broader production validation is still required.

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 is only partial filled.

Will everyone have access to the technology?

This question has not been answered yet.

Does this technology have a built-in bias?

The system does not make decisions about people, so it is not expected to create demographic bias. However, it can contain technical bias if the normal-reference dataset does not represent legitimate variation in PCUs, camera positioning, lighting, or assembly conditions.

In that case, the model may incorrectly flag certain acceptable PCUs as anomalous or fail to identify deviations that are not represented in the test data. This risk is reduced through representative reference data, controlled imaging conditions, and revalidation after relevant process changes.

Does this technology make automatic decisions and how do you account for them?

This question has not been answered yet.

Is everyone benefitting from the technology or only a a small group? Do you see this as a problem? Why/why not?

This question has not been answered yet.

Does the team that creates the technology represent the diversity of our society?

This question has not been answered yet.

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

This question has not been answered yet.

Transparency

Are you transparent about how your technology works?

This category is only partial filled.

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

The intended operation of the PoC should be explained clearly to operators and other stakeholders. They should understand that the system compares PCU images with normal-reference images and produces an anomaly score and heatmap to highlight visual differences. It does not confirm a defect, identify its root cause, or make autonomous quality decisions.

As this is an internal proof of concept, there is no external commercial business model. The intended value is to support visual inspection and quality assurance, not to replace operators or evaluate their performance.

If the technology makes an (algorithmic) decision, is it explained to the users/stakeholders how the decision was reached?

This question has not been answered yet.

Is it possible to file a complaint or ask questions/get answers about this technology?

This question has not been answered yet.

Is the technology (company) clear about possible negative consequences or shortcomings of the technology?

This question has not been answered yet.

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

This question has not been answered yet.

Sustainability

Is your technology environmentally sustainable?

This category is only partial filled.

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

> The current PoC uses limited energy through the fixed camera, local computing device, image storage, and anomaly-detection inference. Its energy demand is expected to be low at PoC scale because images are processed intermittently during inspection rather than through continuous large-scale model training.
>
> Nevertheless, energy use should be considered before scale-up. Training or retraining, increased inspection volume, cloud processing, data storage, and replacement of hardware would increase both direct electricity use and indirect environmental impact. The system should therefore use efficient hardware, avoid unnecessary image retention and retraining, process data locally where feasible, and measure energy use during a production pilot. AI-related energy use includes both model training and ongoing inference, as well as the supporting computing and cooling infrastructure.

Do you think alternative materials could have been considered in the technology?

This question has not been answered yet.

Do you think the lifespan of the technology is realistic?

This question has not been answered yet.

What is the hidden impact of the technology in the whole chain?

This question has not been answered yet.

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

This question has not been answered yet.

Future

Did you consider future impact?

This category is only partial filled.

What could possibly happen with this technology in the future?
In the future, the technology could support more consistent visual inspection, earlier attention to observable deviations, and improved traceability of recurring quality issues. If validated with representative production data, it could be extended to additional PCU variants or inspection stations.

However, wider use could also create over-reliance on AI outputs, reduced independent inspection skills, or pressure to use the system for productivity monitoring rather than quality support. Future deployment should therefore remain gradual, include continuous performance monitoring and operator training, and require review before expanding the systems purpose or data use.

Sketch a or some future scenario (s) (20-50 years up front) regarding the technology with the help of storytelling. Start with at least one utopian scenario.
This question has not been answered yet.

Sketch a or some future scenario (s) (20-50 years up front) regarding the technology with the help of storytelling. Start with at least one dystopian scenario.
This question has not been answered yet.

Would you like to live in one of this scenario's? Why? Why not?
This question has not been answered yet.

What happens if the technology (which you have thought of as ethically well-considered) is bought or taken over by another party?
This question has not been answered yet.

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