



Humans-in-the-Loop

Enable Physical AI to Deliver Value Now

AJ Meyer, Founder & CEO of Pickle Robot Company

Introduction

What is Human-in-the-Loop?

Integrating Physical AI with Human Supervision

Pickle Robot: Augmenting, Not Replacing, Humans

Measure, Learn, Integrate

About the Author

Introduction

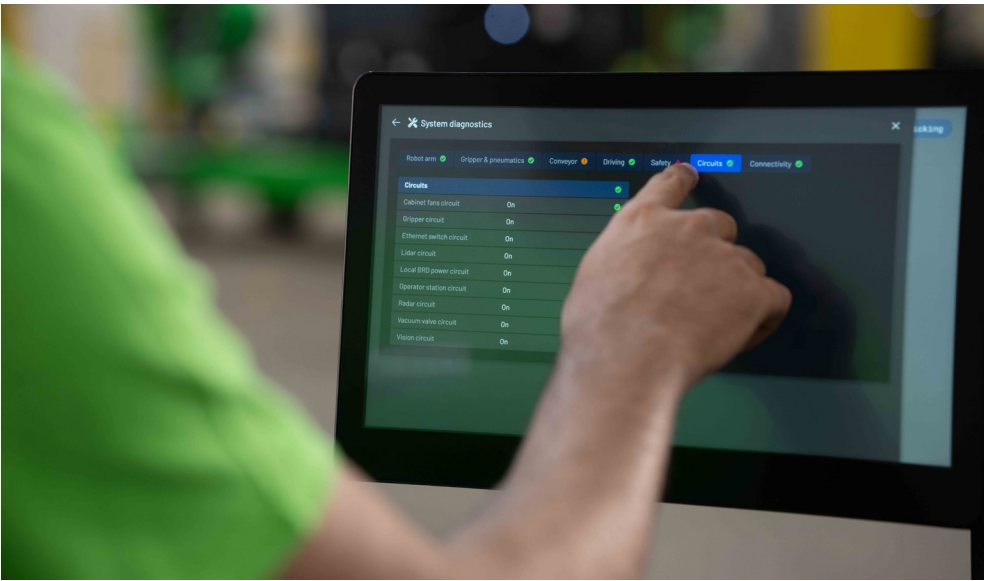
A future where a human workforce co-exists with humanoid robots is still science fiction and often unconnected to actual reality. However, ongoing advances in generative AI, large language models and AI-specific applications are enabling robots and people to work together for greater efficiency in formally manual-only work

Robotic automation and intelligent machines are making their presence known in the logistics sector, and there is an increased awareness that physically demanding and repetitive tasks can be shifted to a non-human worker. The oft-cited concern that a robotic workforce will take the place of human workers is, more often than not, able to be debunked by the common wisdom that machines should not only be an essential part of physical workflows but also developed to augment the workers themselves.

For companies that are investing in cutting-edge technologies such as AI, sensors, data analytics and other enterprise-centric platforms, the future is essentially now. And while gen AI is already a ubiquitous fixture in the digital creative space, there is a consensus that Physical AI has the capacity to both transform human-focused logistics work and remove the pain-points that have been present in the supply chain for decades.

With that in mind, we should think about what Physical AI is, how it can be integrated into logistics and, importantly, why the concept of human-in-the-loop will allow robots to do manual work such as truck unloading at human scale or better now not in the future.

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What is Human-in-the-Loop?

Acknowledging the human-in-the-loop (HITL) in AI and machine learning is a vital part of a collaborative approach that integrates human expertise and input into the lifecycle of these algorithm-based systems.

Numerous academic studies and research papers all cover the same ground, but on a simple level it can be defined as the active participation of humans in the training, evaluation or operation of ML models, with the aim of providing valuable guidance, feedback, and annotations. As a result of this collaboration, the HITL approach enhances the accuracy, reliability and adaptability of the systems themselves, utilizing the capabilities of both humans and machines.

Humans can currently interact with HITL systems in a number of ways, including but not limited to:

- Providing labels for training data
- Evaluating the performance of ML models
- Providing feedback to ML models, either through active learning (the ML model selects the data that its human feedback is based on) or reinforcement learning (the model learns by “trial and error,” which are then subject to a human review)

“ The machine benefits from human expertise in scenarios that require judgement, contextual understanding and the handling of incomplete information.

Given the fact that AI systems (and their presumed impact) seem to be constantly in the news - especially in terms of text prediction and knowledge-based tasks - then it is reasonable to assume that human-machine collaboration is already happening at a rapid rate. On a very basic level, the machine benefits from human expertise in scenarios that require judgement, contextual understanding and the handling of incomplete information. From a purely human perspective, AI and ML systems become a useful tool in a variety of applications.

For context, we should also think about what it means for robotic systems to not have a person involved in the decision-making process - human-out-of-the-loop (HOOTL). This is exactly what it says on the tin; the system operates independently without human intervention, relying on pre-programmed rules and algorithms, and

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Not Replacing, Humans

Measure, Learn, Integrate

About the Author



lacking the adaptability of human input. A fully automated assembly line, for instance, fits into this category and, to the average person, is the traditional view of robotics. However, the winds of change are already blowing in a different direction.

A recent paper published by Metr said that AI’s version of Moore’s Law (the principle that the speed and capability of computers can be expected to double every two years, as a result of increases in the number of transistors contained within a microchip) has “been consistently exponentially increasing over the past 6 years, with a doubling time of around 7 months,” with the researchers noting that the length of time taken by AI agents to complete human tasks (such as coding, for example) is significantly decreasing.

The caveat to this future-ready scenario is that, according to the researchers, the best AI agents are “not currently able to carry out substantive projects by themselves or directly substitute for human labor.” In most cases, the authors of the report said, the “capabilities are increasing very rapidly in some sense, but it’s unclear as to how this corresponds to real-world impact.”

Spoiler alert: real-world impact is exactly the AI focus that Pickle Robot has been working on since we founded the company. To us, it’s Physical AI, and we use it to unload trucks because this application is a terrible experience for people, inefficient for companies, and an operational process that has been crying out for an automated solution for years. Unloading trucks is the first Pickle application to scale and there are plenty of additional supply chain applications that will follow it.

Integrating Physical AI with Human Supervision

Before we start looking at why people remain integral to the logistics process, we need to define what Physical AI is and how it can “satisfactorily” stand-in for a human being, especially in workplaces with physically demanding, dangerous, repetitive and, ultimately, mundane tasks. The use of this word is deliberate: integration should be related more to matching human performance and augmenting the workflows as opposed to replacing the workforce

Physical AI combines techniques and models used by generative AI with sensors and vision systems that capture data in real-time combined with robots to manipulate physical things based on learned



behaviors. For the general public, that likely invokes thoughts of self-driving cars or autonomous vehicles. In other words, machines that can take on various tasks and perform them at a level which is comparable to (or better than) a human.

What is important to note is that a) fully autonomous vehicles are still deemed to be a work-in-progress and b) humans are likely to be “supervising” how the car is behaving. At Pickle Robot, we prefer to use the term as a way to apply AI processes to direct interactions with a physical environment that can solve real-world problems. Unloading a truck, with minimal human interaction, would fall firmly into this scenario.

Integration of a physical robot into a human-centric logistics workspace such as a loading dock or warehousing facility, therefore, needs two factors; collaboration and supervision. In other words, a human worker should be alerted to either monitor the machine’s progress or assist when required. The latter can be classed as intervention, but training workers to be the human supervisor means that the robot can not only complete the assigned task effectively but also with minimal downtime.

A staff-to-supervisor ratio is nothing new. In terms of management efficiency and business optimization strategies, it remains a key

metric. A well-balanced ratio of employees to manager and/or supervisor allows companies to assess the span of control, the cost of supervision and worker morale. Different sectors will always have different supervisory needs, but we all know that manual labor requires a significant level of physical input from its workforce.

For that reason alone, the “heavy lifting” of, say, package picking from a truck or container is more varied than you might expect. Box size and weight, material quality, shifts in weight dispersion, damage during transit, how a box is sealed and final destination within a facility all play a role in how that package is moved. Throw in potentially hazardous elements such as standing water or excessive heat within the enclosed space and it’s not difficult to understand why supervising a machine might be more palatable to the average person than doing the unloading themselves.

If we acknowledge that physical AI can alleviate the pain-points associated with manual truck unloading, it follows that there is considerable scope for integration. Factors such as task alignment, training data, foundational model size and complexity, available ecosystem and, crucially, the ROI of integrating a non-human worker into your workspace all come into play.

The question, however, is what are a) the steps for success and b) how we can foster a culture of collaboration and human supervision or input. The answer - no surprises here - is firmly rooted in both data and acknowledging that Physical AI solves a problem.

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Pickle Robot: Augmenting, Not Replacing, Humans

Measure, Learn, Integrate

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Our approach to AI is designed to not only unlock value today, but also solve ongoing pain points associated with the physical economy, especially in logistics. Integrating Physical AI in the form of an intelligent robot also frees workers from dull, dangerous and repetitive jobs, with the added bonus that it both delivers operational value on an industrial scale and requires minimal supervision.

Pickle’s robots have been designed to learn and do specific physical work at a human scale or better. This comes from a synchronized view of hardware and software, built on a foundation of Generative AI and Machine Vision that falls firmly into the category or definition of Physical AI.

Every data point that our robotic arms gather during the unloading process flows back into the foundational AI model. This means that every installed Pickle Robot will learn its role and, in essence, become more efficient from the data flywheel. By using generative AI to fine-tune the pre-trained model to applications that are specific to the logistics sector, we create customer models for business-specific scenarios that work from day one.

In addition, the hardware also uses machine vision to see and analyze complex scenes through multiple cameras, analog-to-digital conversion and digital signal processing in real time. Already installed in multiple warehouses across the United States, it can cope with the plethora of package scenarios that each unload reveals and fits in the majority of trailer or ocean-delivered containers. And, as an added bonus, Pickle is mobile, setting up in less than 10 minutes when moving from dock to dock ... you just need to press the “Go” button.



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Pickle Robot: Augmenting,
Not Replacing, Humans

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There is an ongoing discussion that AI’s continued integration into both the digital enterprise space and the physical workplace is inevitable.

If that holds true, we need to identify and highlight the jobs or roles that we can shift away from humans and allocate to intelligent machines. In some ways, this is easier said than done. From a logistics perspective, for instance, there is a defined need to augment the available workforce and reduce the physical challenges associated with that sector.

This includes delivering value through physical AI and, ultimately, showing respect to the human workers by letting a machine take on physically demanding tasks. Understanding how best to not only use automated processes but also allow the existing workforce to be part of the integration is a balancing act, but it can be a business optimization strategy that works for all stakeholders.

And while unloading trucks is a career choice that few people choose to follow, it is both a necessary part of the supply chain and a job that needs to be done. Which makes it a perfect fit for the next-generation of intelligent robots that will simplify our lives.

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Integrating Physical AI with Human Supervision

Pickle Robot: Augmenting, Not Replacing, Humans

Measure, Learn, Integrate

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AJ Meyer

AJ is a serial entrepreneur with expertise in Generative AI, robotics control systems, and strong ties to the MIT Engineering community. He founded and continues to run three technology companies – Industry Labs, Leaf Labs, and the Pickle Robot Company. Industry Labs is a tech startup co-working company with several locations in the Boston area. Leaf Labs is an R&D firm that specializes in deep tech software/hardware projects including brain implantable devices and cutting-edge prototypes for clients including Google and Facebook. Pickle Robot is the leader in Physical AI which combines Generative AI and foundation models with vision systems and industrial robotics to create automation products that do physical work at human scale or better. AJ has a BA in electrical engineering and computer science from MIT.

