What are the limits of current AI, and what opportunities does this create for Australian research?

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THIS LAST YEAR has seen incredible growth in public awareness of artificial intelligence, but perhaps not as much public understanding. Despite ChatGPT and a raft of other consumer AI software releases, the public perception of AI still hovers excitedly around visions of sentient physical beings: loyal and attentive robots at our side, diligently doing the jobs we humans find so annoying. The truth is far less Hollywood.

While related, AI and robots are not the same thing. The vast majority of what people call "AI" today is machine learning. It's math and computer code. It's software that's able to analyse and interpret vast amounts of information, and make accurate predictions, far more efficiently than any human. And while AI is now driving a technological revolution and powering the world's largest companies, it's not about to cook you dinner and do the dishes.

The capabilities of even the most advanced contemporary robots are far more modest than the public imagines. The truth is the robot vacuum cleaner in your home is one of the smartest pieces of robotic technology you can buy. Most robots deployed in the industry today lack any form of true AI, rendering them essentially elaborate machines for the basic automation of repetitive tasks. They can't deal with complexity, and they stop working if they encounter even the slightest unexpected change in their surrounding environment. They're not intelligent, by the broadest of possible definitions.

This prevailing public misconception tells us a lot about the kinds of opportunities Australian AI research could be well positioned to pursue.

Right now, AI has trouble operating in the real world and interacting with the environment. *Embodied* AI tries to solve that problem.

Embodied AI operates inside smart devices like robots and drones and allows them to perceive, navigate and understand the real world in all its rich complexity. Perhaps the most publicly well-known example of robots with some basic attributes of embodied AI are iRobot's Roomba range of vacuum cleaners; and they can trace part of their origins to Australian robotics and AI research.

Alongside two of his MIT students, Australian roboticist Professor Rodney Brooks founded the iRobot company in 1990. Thirty years and 30 million robot vacuum cleaners later, he's internationally lauded for challenging the traditional AI approaches of the time and pioneering the commercially successful development of behavior-based robots. Modern Roombas are equipped with advanced visual navigation systems so they don't get lost in your living room; and that is a downstream result of landmark research by The University of Adelaide's Professor Ian Reid, who co-invented the computer vision AI technology that effectively transforms an inexpensive digital camera into a powerful geometric sensing and mapping tool.

Embodied AI holds the potential to radically change our economy. Consider Australia's vast landscape: we have plentiful land to cultivate and resources to manage, but manual labor at scale is both inefficient and expensive. Robots guided by advanced machine learning algorithms could potentially be deployed to perform some of these tasks autonomously, capturing significant economic value while doing the jobs Australians don't want to do themselves. This technology could open the door to advanced manufacturing industries previously unviable in Australia due to our high labor costs. Future robots will not be restricted to controlled factory conditions but will operate in open, dynamic environments, executing complex tasks.

The public dream of what AI technology should be—robots that listen to us and carry out our natural-language instructions—has been with us long before *The Jetsons* first appeared on TV screens sixty years ago; and while it's still a way off, recent AI advances are encouraging.

ChatGPT's great mainstream adoption is prompting people to now ask why they can't have similar interactive experiences with other machines. Enter *vision-and-language* AI, a burgeoning field at the intersection of computer vision and natural language processing techniques. It's an area where Australia has a very strong research talent, and an opportunity we should pursue.

The next generation of robots will possess natural language capabilities, allowing for more seamless human-machine interactions, while also interpreting and navigating the physical world in real time. Imagine asking your robot to "clean up that mess in the kitchen," and it not only understands you, but is able to effortlessly avoid obstacles, find the mess in the kitchen and maybe even empty the bin when it's done.

So, what's the broader implication? Australia is well positioned to be at the forefront of AI research in these emerging fields, but it requires investment. While the rest of the world is also accelerating in AI capabilities, Australia has a unique set of assets that make it viable for leadership in AI research.

The gap between current AI capabilities and the public's expectation isn't a drawback, it's an opportunity for Australia to invest in building technology that will significantly alter our economic landscape and daily lives. The question remains: will Australia capitalise on this fertile ground for AI research, or will we let another opportunity slip through our fingers?

PROFESSOR ANTON VAN DEN HENGEL FTSE is a leading researcher in computer vision, the founding director of the Australian Institute for Machine Learning (AIML) and currently director of its Centre for Augmented Reasoning.

His research expertise is in the complex way that information is encoded, especially in images, and methods for recovering it. He is a powerful advocate for the importance of machine learning as a critical technology for Australia's future economic growth and social success.

Essays

For acronyms, abbreviations and endnotes please see the composite document with all the essays.

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Your questions answered

Cover image: An artist's illustration of artificial intelligence (AI). This image represents the boundaries set in place to secure safe, accountable biotechnology. It was created by artist Khyati Trehan as part of the Visualising AI project launched by Google DeepMind. Source: unsplash

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Your questions answered