AI in Focus - Robotics

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The next application of Artificial Intelligence (AI) to be examined in our *AI in Focus* series is in the area of robotics. The 2019 WIPO report on AI[i] reports: "Those AI functional applications with the highest growth rates in patent filings in the period 2013 to 2016 were AI for robotics and control methods, which both grew on average by 55 percent a year."[ii]

Many large companies are working in the robotics space. The companies include Siemens and Toshiba, which have significant presences in Ontario[iii] (with Siemens Canada headquartered in Oakville and Toshiba Canada headquartered in Markham), as well as Alphabet (the parent company of Google Canada, which plans on setting up its headquarters in "Sidewalk Toronto").[iv] In 2018, Siemens was ranked 4th in the list of top applicants by AI functional application in robotics, while Alphabet was ranked 7th, and Toshiba was ranked 10th.[v] There are also a number of homegrown companies investing in the future of AI in robotics, such as Kitchener-based Clearpath Robotics. Regardless of their size, companies developing robotics pursue a variety of strategies to protect their intellectual property namely seeking protection under patent, trade secret, copyright and trademark law.

Not only are robotics companies investing in AI, but so too is academia. "Despite the dominance of companies in AI, universities and public research organizations play a leading role in inventions in selected AI fields such as distributed AI, some machine learning techniques and neuroscience/neurorobotics."[vi] For example, The Canadian Centre for Field Robotics at York University has created a field robotics laboratory[vii] to test robotic vehicles capable of operating on land, under water, or in the air at low altitudes (e.g., indoor quadrotors).[viii]

Back in the corporate world, certain trends have been seen with regards to the association of certain functional applications with specific application fields. One expected example is the association of the application of natural language processing with the field of personal devices. In the field of robotics and control methods, however, they have been particularly associated with transportation applications.[ix]

A recent example of the application of AI in robotics can be seen in a published Siemens patent application for "Optimizing an Automated Process to Select and Grip an Object Via a Robot."[x] This published application describes an artificial neural network (ANN) that is used as an automated learning algorithm to optimize the entire packaging system in terms of energy consumption. The ANN is trained to optimize energy consumption during a learning phase during which output data is generated from the input data of a camera image. The input data is the objects with their positions. The output data indicates an assignment to one of the robot gripper arms for each object, as well as a prioritization that must be adhered to by the assigned robot.

It is not surprising that ANNs are being used as the AI method of choice in robotics, as they have been found to be successful in the case of convolutional neural networks in recognizing images and patterns, as well as in the case of recurrent neural networks in recognizing and predicting sequences.

Another recent example of the application of AI in robotics is the TossingBot, a picking robot developed at Robotics by Google. The TossingBot is a picking robot that "learns to grasp and throw objects into selected boxes outside its natural range."[xi] TossingBot uses a convolutional neural network to learn both grasping and throwing.[xii] "Using overhead cameras to track where objects land, TossingBot improves itself over time through self-supervision."[xiii] A recent New York Times article suggested that such a robot could be useful in warehouses and distribution centers where humans sort through the items going in and out.[xiv] It remains to be seen whether Google will pursue a patent to protect its TossingBot.

Since patents covering technologies at the intersection of robotics and AI are relatively new, there has not been any litigation testing the validity of such patents or their effectiveness at preventing infringement. However, if the experience of iRobot, the company behind the Roomba cleaning robot, is any indication of things to come, patent protection may indeed be effective. In 2017, iRobot asserted patents that it had filed between 2002 and 2015 covering its robotic vacuum products, with some success. Granted, these patents describe only limited AI – one of them describes learning programs that "allow a mobile robotic device to map out a room and remember where the objects in the room are placed".[xvi]

However, iRobot plans to bolster its patent portfolio with robotics inventions that use more advanced forms of AI. This is evident in a published patent application iRobot filed in June 2018 for a "Mobile floor-cleaning robot with floor-type detection".[xvii] The published application describes a machine-learning approach for implementing floor-type detection. It will have to be seen whether the published application will be allowed and issue to a granted patent and then whether iRobot will choose to enforce their patent rights.

This has been the third article in our *AI in Focus* series. You can read the first two articles here:

- AI in Focus – Autonomous Vehicles
- AI in Focus – Fundamental Artificial Intelligence and Video Games

If you have any ideas for other topics that you would like us to cover in our next article in this series, please email Isi Caulder, Co-Leader of the Artificial Intelligence (AI) practice group at Bereskin & Parr LLP.

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[i] WIPO (2019). *WIPO Technology Trends 2019: Artificial Intelligence*. Geneva: World Intellectual Property Organization, available at https://www.wipo.int/tech_trends/en/artificial_intelligence/.

[ii] *Ibid*, p. 14.

[iii] Invest in Ontario, "Industrial Automation and Robotics", retrieved on April 7, 2019.

[iv] Alex Bozikovic,"Google's Sidewalk Labs signs deal for 'smart city' makeover of Toronto's waterfront", The Globe and Mail, June 12, 2018, retrieved from https://www.theglobeandmail.com/news/toronto/google-sidewalk-toronto-waterfront/article36612387/.

[v] WIPO (2019), *supra*, p. 72.

[vi] *Ibid*, p. 16.

[vii] Invest in Ontario, *supra*.

[viii] Canada Foundation for Innovation, "Canadian Centre for Field Robotics", retrieved on April 7, 2019.

[ix] *Ibid*, p. 55.

[x] U.S. Patent Publication No. 2019/0084153, available at https://patents.google.com/patent/US20190084153A1.

[xi] Andy Zeng, "Unifying Physics and Deep Learning with TossingBot", Google AI Blog, March 26, 2019, retrieved from https://ai.googleblog.com/2019/03/unifying-physics-and-deep-learning-with.html.

[xii] Andy Zeng et al., "TossingBot: Learning to Throw Arbitrary Objects with Residual Physics", arXiv:1903.11239 [cs.RO], March 27, 2019, retrieved from https://arxiv.org/abs/1903.11239.

[xiii] Zeng, "Unifying Physics and Deep Learning with TossingBot", *supra*.

[xiv] Cade Metz, "Inside Google's Rebooted Robotics Program", The New York Times, March 26, 2019, retrieved from

https://www.nytimes.com/2019/03/26/technology/google-robotics-lab.html.

[xv] Dani Kass, "ITC Order Recommends Banning Roomba Rivals' Imports", Law360, July 26, 2018, retrieved from https://www.law360.com/articles/1066940/itc-order-recommends-banning-roomba-rivals-imports.

[xvi] U.S. Patent No. 9,486,924, available at https://patents.google.com/patent/US9486924B2.

[xvii] U.S. Patent Publication No. 2018/0289231, available at https://patents.google.com/patent/US20180289231A1.