PETRAS

LANDSCAPE BRIEFING

07 JULY 2020

COVID-19: The Internet of Things and Agritech

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The COVID-19 pandemic has inspired a range of Internet of Things (IoT) innovations to help stop the spread of the virus. This is an Agritech sector-specific edition of COVID-19: IoT and Cybersecurity looking at the use of automation in agriculture to help address challenges posed by the COVID-19 pandemic.

Past editions are found on the PETRAS website.

Overview

- COVID-19 has brought severe labour shortages to the agriculture sector; automation has been indicated as a possible solution to the current, and similar future, labour shortages
- Recent automation innovations in agriculture include drones, picking and harvesting robots, autonomous tractors, weeding robots, robotic milking, and shepherding and herding robots
- Although promising, automation in agriculture is still very expensive for most farmers even in developed countries
- A webinar with UK industry representatives, conducted in April 2020, identified main opportunities for automation in agriculture, as well as limiting factors and potential solutions

The World Bank warned in a May 2020 brief that the current pandemic is posing threats to food security[1]. Among the challenges agriculture faces during the pandemic, labour shortages have been indicated as prominent, with one possible solution gaining interest being automation[2]. Automation, sometimes associated with 'smart farming',' is 'technology that makes farms more efficient and automates the crop or livestock production cycle' by utilising technologies like 'drones, autonomous tractors, robotic harvesters, automatic watering, and seeding robots'[3].

Notable examples of recent automation innovations in agriculture include:

Drones

In June 2020, the Indian Ministry of Agriculture used drones to spray insecticides, in a bid to protect their crops from locust swarms. Although deployed in a small number, the drones offer an advantage compared to traditional methods for managing locusts by reaching inaccessible areas, like the top of trees. The Ministry is currently looking at drones that can remain airborne for an extended period of time and can fly at night.[4]

Pakistan also saw drones used against locusts in 2019. The small crop spray initiative could replace 3 helicopters and 32 spraying vehicles. The researcher who launched the initiative said that drones have 'higher work efficiency, lower operator exposure and improved ability to spray chemicals in a timely and highly spatially-resolved manner'[5].

UK fruit growers Wilkin & Sons have joined forces with academic experts at the University of Essex in a Knowledge Transfer Partnership to monitor and prevent disease of their strawberry crop using drones and IoT with latest computer vision techniques with the aim of reducing inputs and improving yield[6].

Drones as airborne fruit pickers are being developed by Israeli based Tevel. The company announced in 2020 that next year will be conducting

pilots on its apple picking drones in Spain, USA, and Italy[7].

Belgian remote sensing company Vito in collaboration with Katholieke Universiteit Leuven have announced the development of a flower counting drone to be used in orchards[8]. This is usually done by workers in the field, but the drone can increase the efficiency of the process (time, objectiveness, etc.).

Picking and harvesting robots

In the US, Root AI has developed the robot Virgo, that can mimic human harvesters and gently pick bruisable fruits and vegetables. In May 2020 the robot started its R&D trial runs in greenhouses[9].

In the UK, Cambridge based Dogtooth Technologies developed a prototype strawberry harvester. Final trials to prove commercial viability took place in June 2020. The robot works by using cameras on robot arms which scan the fruit, estimate its 3D location and assess whether the strawberry is ready to be picked. In terms of work capacity, twelve machines, each working at half the speed of a human being, need to be supervised by a person. Experts believe that these types of robots will be 'plugging a shortage, rather than taking jobs'[10].

Other strawberry picking robots, that could be adapted to other soft fruits, were developed by the US based Harvest CROO Robotics and Spanish start-up Agrobot[11]. The robots are working at a speed slower than a human, but they compensate by using more robotic hands. Both companies are expected to develop a commercial version soon[12][13].

Autonomous Tractors

In the UK, the Hands Free Farm (HFF) team was the first in the world to plant, tend and harvest a crop with a fully autonomous vehicle. The project, run by Harper Adams University, Precision Decisions, Farmscan AG and Agri-EPI Centre, aims to develop a fleet of autonomous machines that could be remotely controlled. This year, they successfully drilled a cover crop (planted to cover the soils rather than for harvesting) while working from home and respecting social distancing measures[14].

Weeding robots

The US based Blue River Technology, acquired in 2017 by John Deere, is currently deploying commercially See & Spray machines in weeding for cotton and soybeans. The AI enabled machines identify weeds and then spray them with herbicides, reducing thus the amount of herbicides used and preventing the development of superweeds. [15]

Another US based robotics company, Greenfield Robotics, was reported in July 2020 to be in field trials for its fully autonomous weeding robots. The 'broadleaf weeding bot' is a small mower that uses machine vision to 'see' the rows, and has a sensor to sense depth. It combines these sensors with GPS data, so that the robot can be controlled remotely on a pre-programmed course. The robot mows the weeds that grow in between crops, helping farmers who do not want to use pesticides or prefer a no-till farming (a technique for growing crops or pasture without disturbing the soil through tillage) [16].

The Small Robot Company, a UK-based agricultural robotic start-up has developed an autonomous non-chemical weeding solution. Named 'Dick', the robot identifies weed seedlings and kills them with an electric 'zap'. The field trials are undergoing and the company expects to produce a commercial version in 2021. The robotic solution works in conjunction with a (near) autonomous mapping and monitoring scanning robot, and an AI[17].

Robotic milking

The Swedish milking equipment company DeLaval launched its new robotic milking system the new DeLaval V310 in November 2019. It allows cows to decide when and how often they want to be milked, and the robots have inbuilt detection of health problems and pregnancy[18]. The system learns and adapts to each udder, and uses 3D cameras to guide the milking process. Benefits of the automation include more time to focus on herd growth and cow welfare. During the pandemic, some farmers were asked to reduce milk output. The insights on welfare and its impact on milk yield is therefore important information and allows the farmer to adjust to the pandemic conditions and prevent waste[19].

PETRAS is funded by the UKRI via the Security of Digital Technologies at the Periphery (SDTaP) programme.

Shepherding and Herding

Spot, the 4-legged robot of the American company Boston Dynamics, was being tested in May 2020 in New Zealand for its potential use in shepherding[20]. Yet local farmers expressed doubts robots could replace sheepdogs in the near future, as the works the dogs do require advanced motor skills, intelligence and a connection with the sheep[21].

Vertical farms

Vertical farming is the practice of growing crops inside in vertically stacked layers. They are usually fully automated, recycling water and nutrients and resulting in higher productivity, lower water usage (up to 95% less), and shorter growing times[22].

A number of startups have been working on the development of vertical farms for the past few years. One such UK based startup, LettUs Grow, has been reported in January 2020 to be expanding its operations by, among other, building a new research centre and scaling existing technology[23].

Automation in agriculture: prospects

For all its promises, automation in agriculture is still very expensive for most farmers even in developed countries, said Vikram Adve, co-director of the US based University of Illinois–Urbana-Champaign's Center for Digital Agriculture[24].

Yet the challenges posed by COVID-19, in particular labor shortages and supply-chain management issues, are driving a need for automation in agriculture. A webinar with industry participants organized by the University of Lincoln (UK) on 9th April 2020[25], sought to present different perspectives on challenges and potential solutions for UK agriculture post-COVID-19 and post Brexit. Participants in the webinar included growers and producers of fresh produce, SMEs developing automation devices, and companies that are already using robots. See Box 1 for outcomes of the webinar.

Box 1: The webinar identified:

- Main opportunities for automation in UK agriculture:
    - Assess the availability of 'off-the-shelf' equipment
    - Repurpose devices that have been developed for a different purpose
    - Invest in emerging agritech promising solutions
- Limiting factors and potential solutions:
    - Funding – enabling fast-track funding for vulnerable SMEs currently working in agritech robotics
    - Lack of engineers and skills – although robotics is a new technology in agriculture, other industries have trained engineers with skills transferable to agriculture
    - Lack of evaluation sites – COVID-19 led to severe labour shortages, further leading to produce being discarded, as it could not be harvested, creating an opportunity for testing technology at low risk to the producers
    - Lack of capital to scale –anecdotal evidence suggests that some venture capitalists and banks do view robotics companies in agriculture as a potential 'quick win'
    - Delay in IP (Intellectual Property) protection –IP protection is making collaboration between robotics SME difficult. However, some IP attorneys are investigating a possible fast-track response.

Endnotes

1 https://www.worldbank.org/en/topic/agriculture/brief/food-security-and-covid-19
2 https://www.agri-tech-e.co.uk/uncertainty-in-food-supply-drives-interest-in-fast-tracking-automation/
3 https://www.plugandplaytechcenter.com/resources/how-automation-transforming-farming-industry/
4 https://economictimes.indiatimes.com/news/economy/agriculture/agriculture-ministry-eyes-drones-for-night-duty-in-locust-fight/articleshow/76681161.cms
5 https://dronelife.com/2019/12/03/crop-spraying-drones-tackle-locust-swarms-in-pakistan/
6 https://www.essex.ac.uk/news/2020/06/10/wilkin-,-a-,-sons-and-essex-take-flight-in-new-collaboration-to-boost-strawberry-crop
7 https://www.tevel-tech.com
8 https://blog.vito.be/remotesensing/flower-count-fruit-orchards
9 https://builtin.com/robotics/harvesting-robots-agriculture-root-ai
10 https://www.ft.com/content/eaaf12e8-907a-11ea-bc44-dbf6756c871a
11 http://www.fruitnet.com/fpj/article/181389/robocrop
12 https://southeastproduceweekly.com/2019/04/16/robotic-strawberry-harvester-one-step-closer-to-reality-in-florida-fields/
13 http://www.fruitnet.com/fpj/article/181389/robocrop
14 https://www.agriland.co.uk/farming-news/hands-free-farm-completes-first-major-operation-despite-covid-delays/
15 http://www.bluerivertechnology.com/
16 https://onezero.medium.com/tiny-weed-killing-robots-could-make-pesticides-obsolete-99b3a6359c39
17 https://www.smallrobotcompany.com/meet-the-robots#weed-killing
18 https://www.thescottishfarmer.co.uk/livestock/dairy/18069236.delavals-robot-milker-detects-heats-pregnancy/
19 https://www.thescottishfarmer.co.uk/features/18550813.better-welfare-yield-following-robot-installation/
20 https://blog.rocos.io/rocos-partners-with-boston-dynamics
21 https://www.theverge.com/2020/5/22/21267379/robot-dog-rocos-boston-dynamics-video-spot-shepherd-reaction
22 https://www.weforum.org/agenda/2019/09/vertical-farming-agriculture-aerofarms/
23 https://siliconcanals.com/crowdfunding/agritech-startup-lettus-grow-bags-e27-6m-to-develop-new-future-for-farming/
24 https://builtin.com/robotics/harvesting-robots-agriculture-root-ai
25 https://www.agri-tech-e.co.uk/uncertainty-in-food-supply-drives-interest-in-fast-tracking-automation/