THE WALL STREET JOURNAL.

MONDAY, AUGUST 30, 2021

Carnegie Mellon's Cloud Lab to Automate Labor-Intensive Science Experiments

University is partnering with startup Emerald Cloud Lab to build facility that will use robotics and AI to take some of the drudgework out of scientific research

By Sara Castellanos

A digital illustration of the planned Carnegie Mellon University Cloud Lab, which will be built by the university and startup Emerald Cloud Lab. The facility is expected to be ready by summer 2022. PHOTO: EMERALD CLOUD LAB INC.

Carnegie Mellon University is working with startup Emerald Cloud Lab Inc. to build a $40 million science laboratory designed to automate lab experiments with robotics and artificial intelligence.

Construction of the project, which will be funded by the university, is expected to begin this fall and be complete by the summer of 2022, according to Rebecca Doerge, dean of the Mellon College of Science.

The CMU "Cloud Lab" will be the world's first university-owned cloud lab, in which experiments are designed by scientists using software and carried out remotely by about 200 different types of robotic machines, Dr. Doerge said.

The goal is to free up the university's researchers, including chemists, biomedical engineers and biologists, to do more of the creative analysis and strategic thinking related to the development of new materials and drugs, she said. "The benefit comes in accelerating science," said Dr. Doerge, who spearheaded the initiative.

The lab will be constructed at a building owned by the university, near Bakery Square in Pittsburgh, and will encompass about 20,000 square feet. It will be modeled after Emerald Cloud Lab's existing facility in South San Francisco, where the company is based. That lab primarily is used by undisclosed pharmaceutical and biotechnology companies.

CMU researchers will be the first to access the Cloud Lab, but the university will eventually allow other schools and life-sciences startups in Pittsburgh to access the lab remotely, Dr. Doerge said.

Emerald Cloud Lab, a five-year-old company, offers scientists remote access to about 190 different types of scientific instruments at its South San Francisco lab, said Brian Frezza, co-founder and co-chief executive.

Scientists in fields such as chemistry and biology can design experiments from anywhere using its proprietary software that gives instructions to machines over the cloud, he said. The lab runs on cloud infrastructure from Amazon.com Inc.'s Amazon Web Services and the company charges customers on a monthly or yearly subscription basis.

Through CMU's Cloud Lab, university researchers will have remote access to the same kinds

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of automated scientific resources as the lab in South San Francisco. These include instruments that transfer liquid between tubes, sequence DNA and take X-rays of molecular structures.

Typically, biologists and chemists spend significant amounts of time conducting experiments in physical labs, Dr. Doerge said. For lab experiments such as those involving drug discovery, researchers might need to put thousands of different samples in test tubes — a repetitive process that can be handled by robots, Dr. Doerge said.

A graduate student recently reproduced three years' worth of his own scientific research on synthetic biology in about three weeks by running experiments at Emerald Cloud Lab's facility, Dr. Doerge said. The student designed the experiments using Emerald Cloud Lab's proprietary software, and they were carried out by robotic machines.

The two cloud labs are part of a broader push to bring automation, which has transformed industries from retail to logistics, to the practice of science. That field can be highly labor-intensive.

Strateos Inc. offers the use of robotic life-science instruments over the cloud and International Business Machines Corp. has a cloud-based AI service called RoboRXN that allows scientists from anywhere in the world to synthesize, or create, molecules using a robot based in Switzerland.

Most of the instruments at CMU's Cloud Lab will employ machine-learning techniques and a network of sensors.

The sensors will gather data from the instruments and AI algorithms will run analysis, such as figuring out the volume of liquid in a sample, Dr. Frezza said. These technologies also are used at the South San Francisco lab.

Automation is likely to reduce the potential for laboratory mistakes, because tasks are carried out the same way every time and logged into a database, Dr. Frezza said.

A team of Carnegie Mellon University researchers is developing AI systems for the machines that can automatically suggest ways to calibrate the equipment for optimal tests. For example, an AI system could suggest the best way to purify a mixture of compounds, and machines in the lab would carry out those instructions automatically, said Christopher Langmead, associate professor of computational biology at Carnegie Mellon.

A broader cultural shift must occur before automation becomes widely adopted in science, a field that has traditionally relied on manual work, said Satty Chandrashekhar, managing director and partner at Boston Consulting Group's data science and AI division, Gamma.

Automation can speed up research, but there is a learning curve associated with the process. Researchers will need to be retrained to make it work, according to Mr. Chandrashekhar.

"This is not a magic bullet," he said.