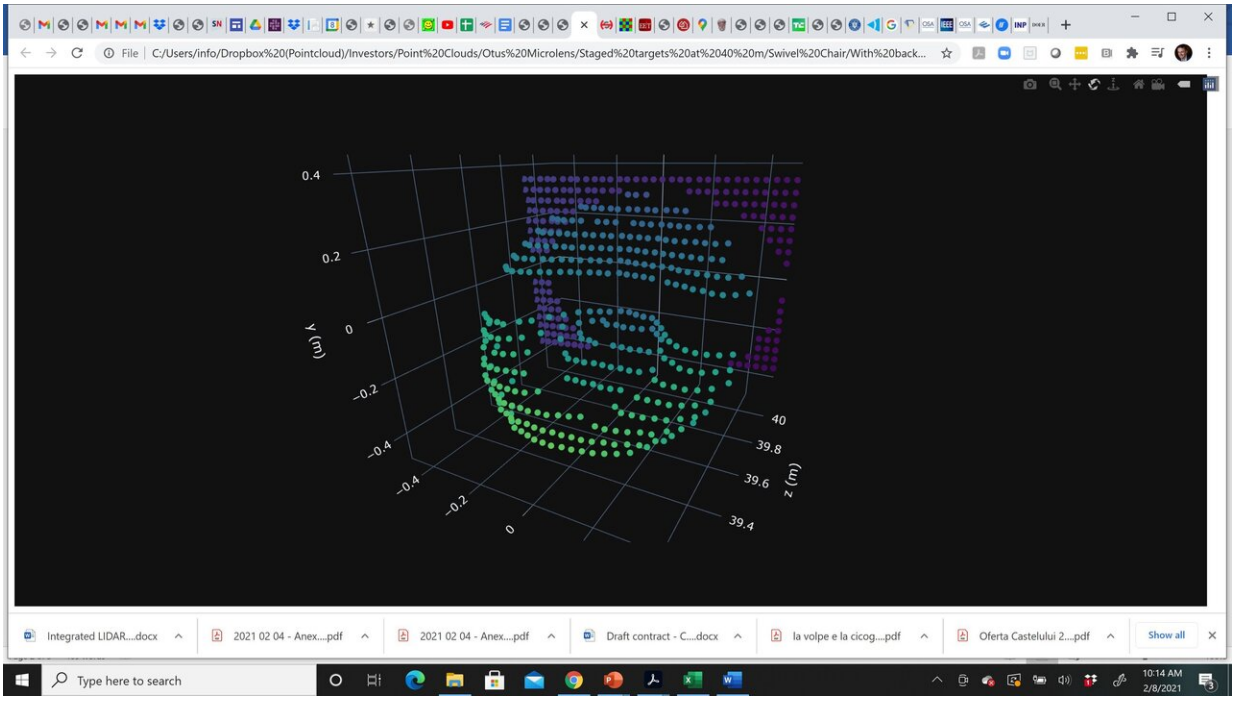
Silicon chip provides low cost solution to help machines see the world clearly

February 10 2021



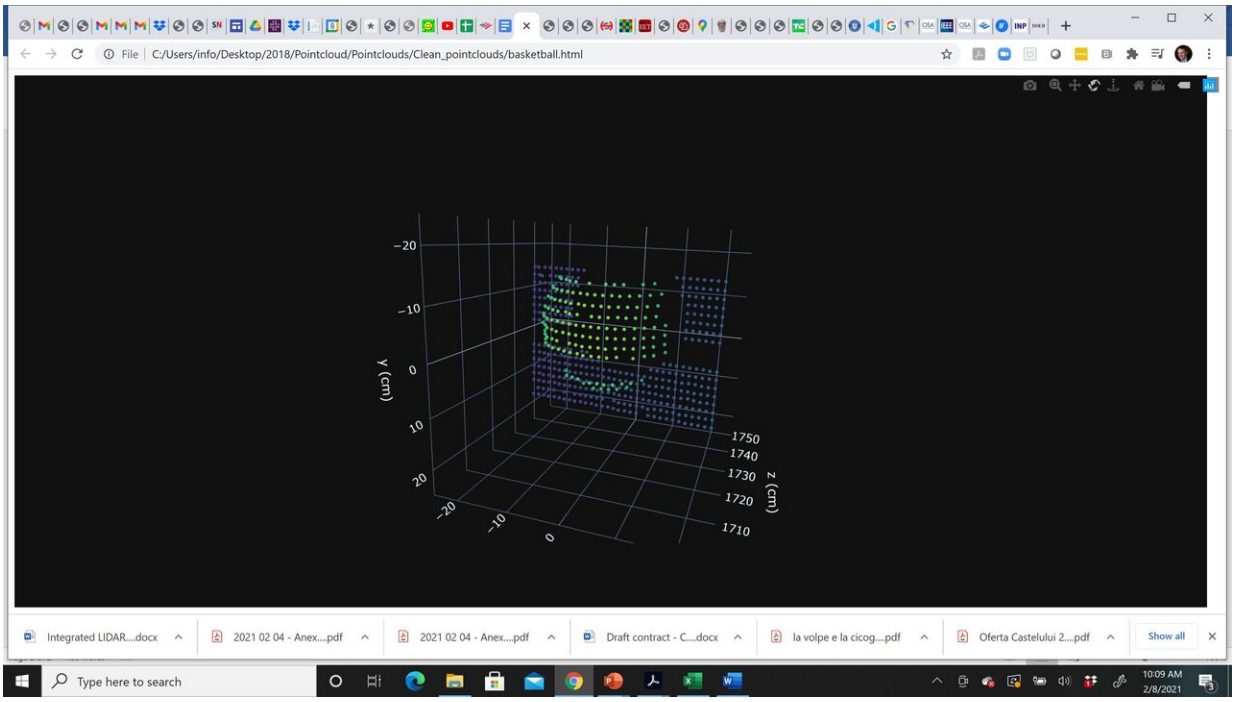
Swivel chair and screen at 40 m -- picture taken using a 32x16 pixel sensor (2mmx2.5mm sensor size). Credit: Pointcloud Inc

Researchers in Southampton and San Francisco have developed the first compact 3-D LiDAR imaging system that can match and exceed the performance and accuracy of most advanced, mechanical systems currently used.

3-D LiDAR can provide accurate imaging and mapping for many applications; it is the "eyes" for autonomous cars and is used in facial recognition software and by autonomous robots and drones. Accurate imaging is essential for machines to map and interact with the physical world but the size and costs of the technology currently needed has limited LIDAR's use in commercial applications.

Now a team of researchers from Pointcloud Inc in San Francisco and the University of Southampton's Optoelectronic Research Centre (ORC) have developed a new, integrated system, which uses silicon photonic components and CMOS electronic circuits in the same microchip. The prototype they have developed would be a low-cost solution and could pave the way to large volume production of low-cost, compact and high-performance 3-D imaging cameras for use in robotics, autonomous navigation systems, mapping of building sites to increase safety and in healthcare.

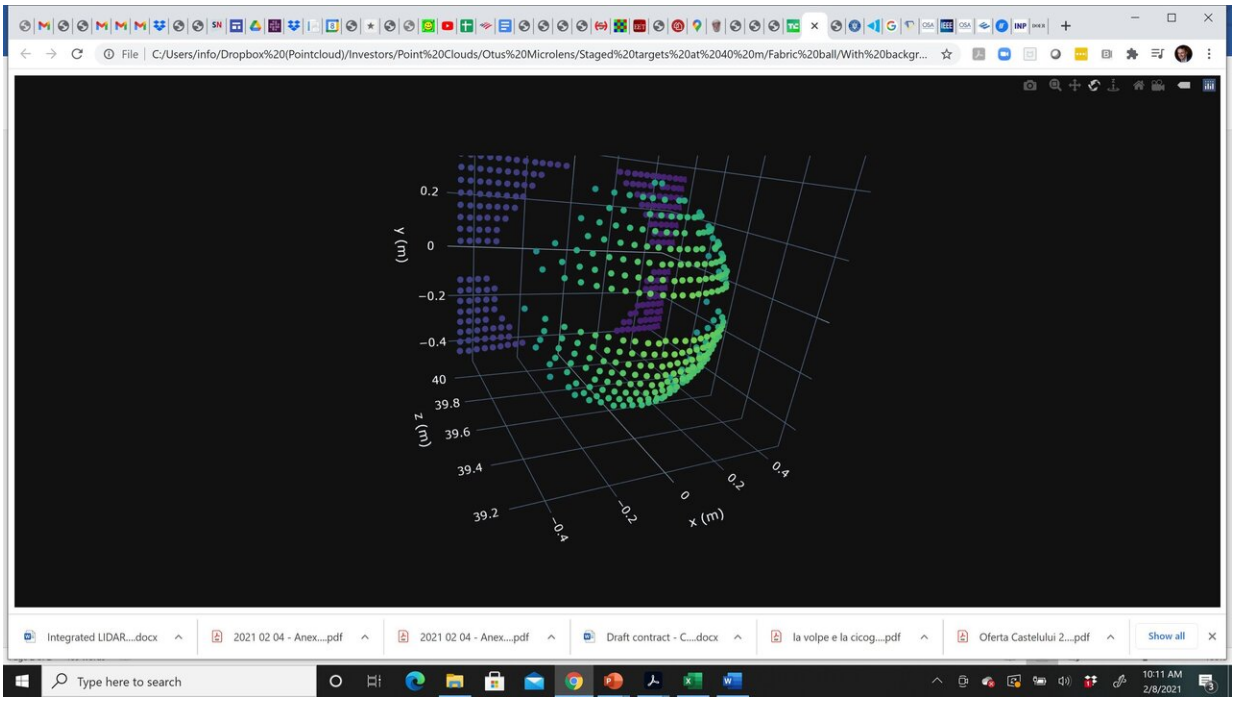
Graham Reed, Professor of Silicon Photonics within the ORC said, "LIDAR has been promising a lot but has not always delivered on its potential in recent years because, although experts have recognized that integrated versions can scale down costs, the necessary performance has not been there. Until now.



Basketball and screen at 17 m -- picture taken using a 32x16 pixel sensor (2mmx2.5mm sensor size). Credit: Pointcloud Inc

"The silicon photonics system we have developed provides much higher accuracy at distance compared to other chip-based LIDAR systems to date, and most mechanical versions, showing that the much sought-after integrated system for LIDAR is viable."

Remus Nicolaescu, CEO of Pointcloud Inc added, "The combination of high performance and low cost manufacturing, will accelerate existing applications in autonomy and augmented reality, as well as open new directions, such as industrial and consumer digital twin applications requiring high depth accuracy, or preventive healthcare through remote behavioral and vital signs monitoring requiring high velocity accuracy.



Exercise ball and screen at 40 m -- picture taken using a 32x16 pixel sensor (2mmx2.5mm sensor size). Credit: Pointcloud

"The collaboration with the world class team at the ORC has been instrumental, and greatly accelerated the technology development."

The latest tests of the prototype, published in the journal *Nature*, show that it has an accuracy of 3.1 millimeters at a distance of 75 meters.

Amongst the problems faced by previous integrated systems are the difficulties in providing a dense array of pixels that can be easily addressed; this has restricted them to fewer than 20 pixels whereas this new system is the first large-scale 2-D coherent detector array consisting of 512 pixels. The research teams are now working to extend the pixels arrays and the beam steering technology to make the system even better suited to real-world applications and further improve performance.

More information: A universal 3D imaging sensor on a silicon photonics platform, *Nature* (2021). DOI: 10.1038/s41586-021-03259-y , www.nature.com/articles/s41586-021-03259-y

Provided by University of Southampton