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PRESS RELEASE
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Mirrorcle Technologies exhibits at CES 2020

Mirrorcle Technologies, the Silicon Valley manufacturer of MEMS-based optical beam-steering products and system solutions, is joining the almost 5000 companies at what is known as globally the largest hands-on consumer technologies gathering: the Consumer Electronics Show 2020 (CES). Mirrorcle's staff is once again joining collaborators at the Microchip Technology booth (South Hall, MP26066) at the Las Vegas Convention Center where Mirrorcle's latest-and-greatest programmable light solutions powered by Microchip's ICs will be on display. Mirrorcle's and Microchip's experts will stand ready to discuss how to incorporate the solutions or subsystems to create smart, connected and secure designs across a variety of markets, including automotive, medical, industrial and others. Specifically, Mirrorcle presents its brand-new MEMS-mirror-based mid-range 3D LiDAR system named "'SyMPL" in Microchip's booth area. Also on display will be a compact full color vector graphics laser projection (VGLP) system, "RGB Playzer", and a 3D Scanning Metrology demonstrator "3DSM" which yields 3D point-cloud information by combining high-resolution laser scans with a fast frame-rate USB 3.0 camera.
"We are excited about the opportunity to present our latest system-level solutions at the Microchip booth here at CES," said Mirrorcle's CEO, Dr. Milanovic. "For the second year in a row, our presence here demonstrates our companies' strong collaboration and we are excited to present our latest customer-driven system solutions powered by Microchip's PIC32MZ MCU and MEMS driver ICs. We appreciate the support and trust that Microchip places in our MEMS mirror technologies and believe that CES 2020 might further aid us in tapping into rapidly growing market segments, such as the fast-growing field of industrial robotics for which our SyMPL LiDAR system is specifically designed."

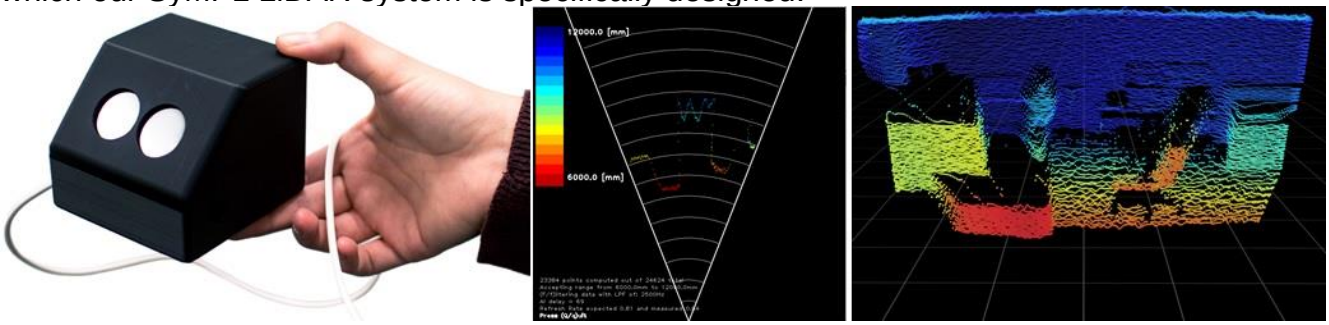

Figure 1. Compact, lightweight Mirrorcle SyMPL 3D LiDAR with sample scans, polar plot and 3D point cloud.

The PIC32MZ MCU is at the heart of Mirrorcle's MEMS Controller boards which enable users to control the company's MEMS mirrors' tip/tilt behavior in precise optical beam-steering applications, and to synchronize with other parts of complex sensor or projection systems. The MCU offers 32-bit performance with up to 252 MHz / 415 DMIPS and up to 2 MB Flash

and 512 KB RAM. Additionally, each system solution also incorporates a number of Microchip’s ICs that cater to the driving needs of electrostatic MEMS mirrors. The key piece here is Microchip’s HV264 Quad High-Voltage Amplifier Array which uniquely matches the driving needs of Mirrorcle’s MEMS Mirrors. It features very low power consumption based on a very low bias current, and it provides adequate bandwidth and voltage range for the most demanding MEMS mirror designs.
“We have worked collaboratively with Mirrorcle since 2014 based on a good match of their electrostatic MEMS mirror products and our high-performance high voltage drivers which are manufactured based on Microchip’s unique process capabilities,” said Donald Humbert, Microchip’s Senior Product Marketing Manager for High Voltage Interface/DMOS/ACDC. “Over time we have been able to increase our support on the digital side as well, with the high-performance 32-bit MCUs and mixed signal ICs. We identified a number of promising trends related to MEMS-mirror based laser beam steering, including opportunities such as fiber-to-fiber optical switching in optical networks, projection displays in automotive, retail and consumer products, AR/VR applications and a variety of use cases for automotive safety driver assist and autonomous vehicle subsystems, including LiDAR and dynamic laser-based headlamps,” Humbert said.

Mirrorcle SyMPL 3D LiDAR System

For the first time ever, the Mirrorcle team presents its new SyMPL 3D LiDAR system in a live and interactive demo. The compact and lightweight plug-and-play solution offers programmable scanning of time-of-flight (ToF) distance measuring beams which yield 3D point-cloud perception sensing data. It may be deployed in a variety of client applications in robotics, UAVs and other industrial use cases. The system works with a low-cost 905nm-based ToF solution, and is capable of sensing objects of varied materials and reflectance out to distances of ~30m with 1cm distance resolution. Users can easily control scanning over more than 10000 discrete angles in both X and Y axes, allowing fast and versatile scans across the full field of regard, enabling full control of aspect ratio, scan speeds, scan rotations, and distance ranges. Based on Mirrorcle’s patented dual-axis solid-state MEMS mirrors, the SyMPL system’s point cloud data is streamed to a display where both a top-down view as well as a color-coded (based on the distance data of each voxel) ‘3D-image’ of the live action in front of the booth is shown.
“This solid-state LiDAR system is a plug-and-play solution that we offer with fully integrated hardware and software applications,” said Sr. Electronics Engineer, Abhishek Kasturi. “This system includes mirrors capable of extremely repeatable 2D scans with hundreds of lines per second, and this high repeatable accuracy enables our Synchronized MEMS Pair LiDAR (“SyMPL”) architecture.” With more sophisticated development kit configurations, Mirrorcle Software Suite SDKs are available for full programmability and product customization as needed. This product mainly targets Robot Vision and similar low-mid range LiDAR applications, including AMR, AGV and drones.

Mirrorcle Playzer / RGB Playzer

Also on display at CES are Mirrorcle’s Vector Graphics Laser Projection (VGLP) systems – specifically the RGB Playzer featuring red, green and blue light sources. This architecture utilizes the company’s fast point-to-point beam steering capabilities in combination with visible lasers to display vector graphics content tailored to convey information and/or to entertain viewers. Mirrorcle’s solutions generally employ the complete system-level stack up

of optical and electronics hardware, firmware, and software. In this case, the proprietary and flexible solution begins at the application software layer where customers can input content in a variety of ways, from images, files, laser-show (ILDA) files, touchscreens etc. Content is processed in the API layers and provided to MEMS and Laser Controller hardware which has been developed for over a decade at Mirrorcle for automotive, biomedical and other customers. Finally, the latest and fastest gimbal-less point-to-point MEMS mirrors do the magic of tracing out the content in bright laser beams so fast and so repeatably that the viewer perceives only the high contrast flicker-less images. The Playzer is known to achieve about 100X higher levels of brightness and contrast compared to other display technologies such as a standard video PicoProjectors, making it suitable for outdoor use, e.g. in automotive display applications.

Figure 2. Mirrorcle Vector Graphics Laser Projectors (VGLP) Playzers (left) and the new RGB Playzer (development kit center and outdoor demonstration right).

The first version of the RGB Playzer was demonstrated at CES 2019 and was received with a lot of interest from automotive and other visitors of the booth. However, that early version relied on fiber-coupled laser sources which were considerably lower in power and could not be packaged very compactly. The new Playzer announced at CES 2020 is based on free-space coupled sources which are typically found in picoprojectors, and has much greater optical power capability, beam quality, and compactness.
“We offer the Playzer systems as part of a development kit for evaluation by any group which might be interested in launching products based on this OEM subsystem,” said Dr. Milanovic, “These kits provide a ready-to-use, simple and playful environment for testing of displaying laser applications. Modules include either single-wavelength laser sources or an RGB laser unit enabling full-color projection.” The target markets for the Playzers include industrial and advertising laser projection, head-up displays (HUD), automotive digital signage and entertainment.

3D Scanning and Metrology Demo (3DSM)

The 3D Scanning and Metrology Demo (3DSM) is designed to demonstrate the capabilities of Mirrorcle’s MEMS mirror and controller with simple Windows based applications to provide Programmable Illumination for 3D Scanning applications. Conventional 3D scanning and metrology tools use a line laser and camera mounted on a stand, and a movable stage for target illumination. The 3DSM is available as a demonstrator kit (“DEMO-06”) and contains a MEMS mirror scan module that can be programmed to perform line scans with variable line time, line density and orientation of lines to image and capture any 3D shape into a point cloud. Users may programmatically steer a laser over a field of regard of ~40° x 40° and more. The Software uses API integrated from Basler’s Pylon platform to capture frame by frame images to extrapolate the 3D point cloud data. “With the extremely repeatable and reliable 2D scanning that our MEMS technologies enable, 3D information can be retrieved

following a number of different strategies,” Dr. Milanovic said. “One can combine our scanners with e.g. a ToF subsystem as we demonstrate in our LiDAR solutions, or with a conventional 2D camera which allows for the generation of 3D point clouds by triangulating the predictable pixel-per-pixel illumination by calculations based on the known distance between illuminating laser scanner and camera.” The 3DSM targets applications that require 3D datasets, e.g. industrial process control and quality assurance, as well as e.g. reverse engineering or other tasks where objects might be recreated with 3D printers.

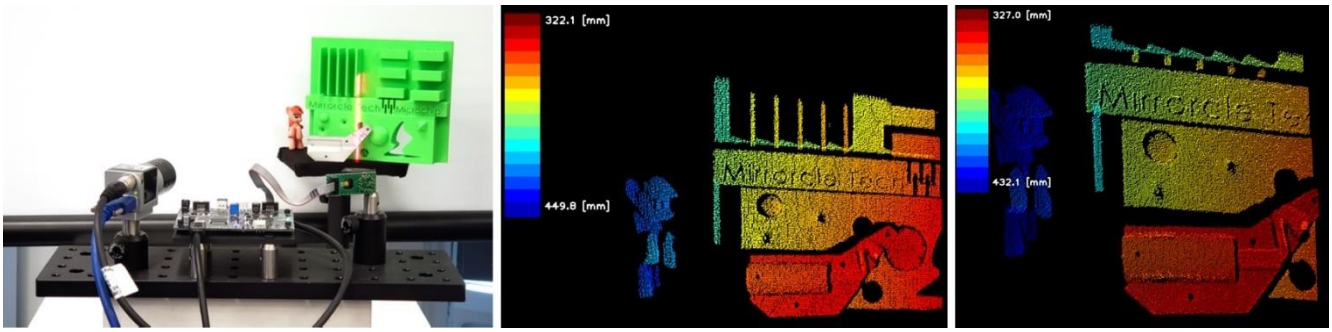

Figure 3. Mirrorcle’s 3D Scanning and Metrology DEMO-06 with sample point cloud data. Larger region of interest scan shows all objects (middle) and same number of lines zoomed onto a smaller region of interest (right).

Additional Mirrorcle-based products on display throughout CES 2020

An additional location at CES where Mirrorcle’s SyMPL 3D LiDAR and RGB Playzer will be on display, is the booth of China’s Great Star (Booth 25661, Great Star Industrial USA, LLC). This is based on the business partnership of Mirrorcle and OLE Systems from Hangzhou, China who are also manufacturers of LiDARs for robotics applications. While the Mirrorcle demo-systems are certainly attracting much attention at Microchip’s CES booth, many additional stationary and/or mobile solutions are also showcased at the event by other companies which are ‘Powered by Mirrorcle’. Many of these solutions are quite new and the sharing of information is restricted, and in many cases the use of MEMS mirrors is not obvious or apparent. “We are excited to see our MEMS mirrors being used in many of our customers’ applications across the show floors,” commented Abhishek Kasturi. “You will understand that we are bound by a number of NDAs which prevent us from divulging more – but visitors can rest assured that more Mirrorcle-made scanners are in use at CES 2020 than one might expect. Our solutions continue to enable many big name-companies at this show. We maintain a relatively low profile but invite any inquiries from interested companies, big or small.” Finally, he added “We are looking forward to presenting additional demos at our booth at the upcoming Photonics West exhibition in San Francisco.” SPIE Photonics West visitors will be welcomed by the friendly staff of Mirrorcle Technologies at booth No. 3081.

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About Mirrorcle Technologies, Inc.

Mirrorcle Technologies, Inc., founded in 2005, is a private corporation that commercially provides products and laser systems based on its proprietary optical microelectromechanical system (MEMS) technology. Since its founding, and supported by its continuous investment in R&D, the company has been offering the world's fastest point-to-point (quasi-static) two-axis

beam-steering MEMS Mirrors, as well as resonant-type micromirror devices with video rates. Mirrorcle is globally the only provider of tip-tilt MEMS actuators in combination with mirrors from submillimeter to several mm in diameter, offering customers a wide selection of specifications to optimize their paths to successful commercialization. Mirrorcle products can be found today in 3D metrology systems, biomedical imaging systems, solid-state LiDARs, AR/VR prototypes, laser projectors, and classrooms. Mirrorcle’s system solutions include the world’s most compact vector graphics laser projectors and 3D LiDARs.
Mirrorcle maintains multiple cleanroom laboratories at its Richmond, California headquarters, and year-round, 24-7 access to a wafer-based CMOS and MEMS fabrication facility. Beyond its own facilities, the company has established high-volume manufacturing with leading MEMS wafer foundries and qualified opto-mechanical assembly houses.

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