

Press Release

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Mirrorcle Technologies' MEMS mirrors scan full hemisphere

Mirrorcle Technologies, Inc. (MTI), a California-based manufacturer of patented, gimbal-less MEMS micromirror devices announces that it has successfully designed and delivered a battery-powered laser beam scanning system for outdoor use, with the ability to scan multiple laser beams over an entire hemisphere. A customer approached MTI seeking a solution to address various points in a 3D volume (2π steradian solid angle) with powerful visible laser beams for a special application. The unit was to be realized with a relatively small volume, mass, and power consumption, to allow mobile outdoor use over extended periods.

Seven of MTI's MEMS devices and proprietary control electronics were integrated in a prototype system, named Hemiscan (later dubbed "R2" due to its obvious resemblance of the famed movie robot R2-D2). Together the MEMS devices and associated optics provide a scan of 360° in azimuth, and 90° in elevation, in other words covering a full hemisphere. In a compact, light weight, and low power unit, the mirrors provide the customer with the ability to address any point in 3D space above the system's 'horizon' with a powerful laser beam.

To achieve this, MTI performed an extensive optical design, electronic design and realization of MEMS and laser driver boards and other circuits, complete software development, and subcontracted AdvancedMEMS in Berkeley, CA for the mechanical design of various subsystem and system mounts. After demonstrating the main function and completing indoor tests the customer further ruggedized the unit and integrated thermal control to protect the device from outdoor temperature extremes and moisture condensation.



Figure 1. Mirrorcle Hemiscan - Mobile, robust, extreme wide-angle laser scanning system designed for indoor and outdoor use.

Hemiscan system features high-power green lasers, whose beams are steered by Mirrorcle Technologies' MEMS devices. Six of these mirrors are arranged in a circular pattern in a plane, and a seventh points upwards, covering the space around the vertical axis of the scanning system. As each of these subunits provides beam steering in $>60^\circ$ field of view, the overall combined effect is 7 beams in a hemisphere space above the device. The 60° FoV of each subunit is enabled by custom optics that help expand addressable angles of the individual mirrors (typically 20° FoV without optical enhancement). With a battery pack and its compact design, this system is highly mobile and can be used anywhere for off-line operation. The housing is designed to withstand harsh environmental conditions, including precipitation, wind and vibrations, and was made for years of outdoors use. Seven integrated, credit-card sized PCBs contain firmware and control electronics for precise mirror movement and synchronized laser control. One of the benefits of MTI's MEMS mirrors is their extremely low power requirement, maximizing the operation time when fully standalone on battery power. The overall power consumption of the prototype demonstration is typically about 30W during continuous operation, including a temperature control unit, which allows long term car-battery run operation.

Full-immersion video gaming environments feasible

"We are very happy to see a multitude of our MEMS devices work in unison," said Dr. Veljko Milanović, CEO of Mirrorcle Technologies, Inc. "So far, we have successfully demonstrated systems using one or two devices, such as for projection and 3D tracking applications. Having 7 of our MEMS mirrors integrated in one comprehensive system we built from scratch is very exciting, and opens the doors for many new applications." Novel display solutions for the entertainment industry come to mind, because MTI's MEMS technology is fully capable of focus-free image projection, including real-color HD video display. With the new setup, any darkened room could become a 3-D video-gaming environment, further improving player immersion and gaming experience. Similarly, this setup could be used in a planetarium or in other entertainment-related applications.



Figure 2. Mirrorcle Hemiscan is photographed in its outdoor tests, fully stand alone and battery powered. To the right is an indoor lab test at Mirrorcle Technologies showing the opened unit and seven laser beams simultaneously scanning above the engineers' heads.

There are possible uses in Air Traffic Management (ATM) or for enemy detection in defense applications. The mirrors could be used to precisely track objects in 3D space. With ever more busy air traffic, it is paramount to supplement conventional radar data with additional detection- and communication solutions. Air Traffic Control (ATC) of the future could use hemispheric laser-based aircraft detection, monitoring and projecting likely trajectories to help avoid collisions. Comprehensive, hemispheric scans of the sky could also be used for defense applications, such as for monitoring air- or submarine environments. The specific benefit of the "R2" prototype that has been developed at Mirrorcle Technologies' Richmond facility is its mobility, robustness and track record of long-term continuous use without failure.

Endless application possibilities with hemispheric scanning capability

"In reality, the range of applications of this novel arrangement of MEMS mirrors is endless," Dr. Milanović concluded. "Apart from its entertainment potential, from laser shows to surround projection, the technology can become beneficial in such varied applications as city planning, tunnel measurement, architectural modeling, archeological documentation, underground mine measurement, submarine mapping and so forth. We simply want people to know of this capability because it is their ideas that can truly make amazing things happen from this."

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About Mirrorcle Technologies, Inc.

Mirrorcle Technologies, Inc. (MTI), founded in 2005, is a California corporation that commercially provides products and services based on its proprietary optical microelectromechanical system (MEMS) technology. Since its founding, and supported by its continuous investment in R&D, MTI has offered the world's fastest point-to-point two-axis beam-steering mirrors, as well as resonating-type micromirror devices with rates up to HD video. MTI is globally the only provider of tip-tilt MEMS actuators in combination with mirrors from 0.8mm to several mm in diameter, offering customers a wide selection of specifications to optimize their paths to successful commercialization. In addition to a variety of existing designs and in-stock products, MTI also contracts to create specialty designs and fabricate custom units for its customers.

In addition to the laboratory at its headquarters, MTI has year-round, 24-7 access to wafer-based CMOS and MEMS fabrication facilities. Micromirror fabrication and wafer-level testing are performed in a clean-room environment. In 2010, MTI established a manufacturing service cooperation with a leading MEMS wafer foundry, allowing the company to ramp up volume-production while maintaining highest quality standards.

As a privately held company, MTI is able to act efficiently, offering creative and highly responsive service to its customers. The motivated staff is dedicated to provide highest-quality products and support to facilitate customers' product development and successful commercialization. It draws on several decades of staff's combined experience in MEMS design, fabrication, and testing.