National Aeronautics and Space Administration

NASA

TECHNOLOGY SOLUTION

Health, Medicine and Biotechnology

Handheld Space Microscope

Offers submicron resolution in a rugged rechargeable platform

Innovators at NASA Johnson Space Center have developed a handheld digital microscope to fill the critical microscopy needs of human space exploration by providing flight crews in situ hematological diagnostic and tracking ability to assess and monitor crew health in the absence of gravity. Although currently in use aboard the International Space Station (ISS) to work in conjunction with NASA's handheld slide staining system, the microscope may have numerous applications here on Earth.

The microscope is entirely self-contained, and includes optics, illumination, high-resolution imaging hardware, wireless enabled single board computer with scalable power and memory, and rechargeable battery. The microscope also acts as an internet access point and connects via Bluetooth to smart devices for wireless image transfer and remote control.

The microscope is durable enough to support field use while providing submicron imaging that would typically necessitate the use of larger more expensive benchtop microscopes. Cost of manufacturing the microscope may be relatively inexpensive through the utilization of 3D-printed components, and COTS hardware such as interchangeable microscope objectives.

The handheld digital microscope is at technology readiness level (TRL) 8 (actual system completed and "flight qualified" through test and demonstration), and is now available to license. NASA does not manufacture products for commercial sale.

BENEFITS

- High resolution: resolves features to just below one micron
- Portable: rechargeable microscope is palm-sized and lightweight
- Rugged construction: employs 3D-printed polycarbonate exoskeleton; utilizes stainless steel optics cage
- Remote accessible: Bluetooth/WiFi enabled to enhance data sharing for remote analysis
- Convenient data storage: features internal storage with removable SD card
- Low production cost: utilizes COTS hardware and 3D printed components

APPLICATIONS

The technology has several potential applications:

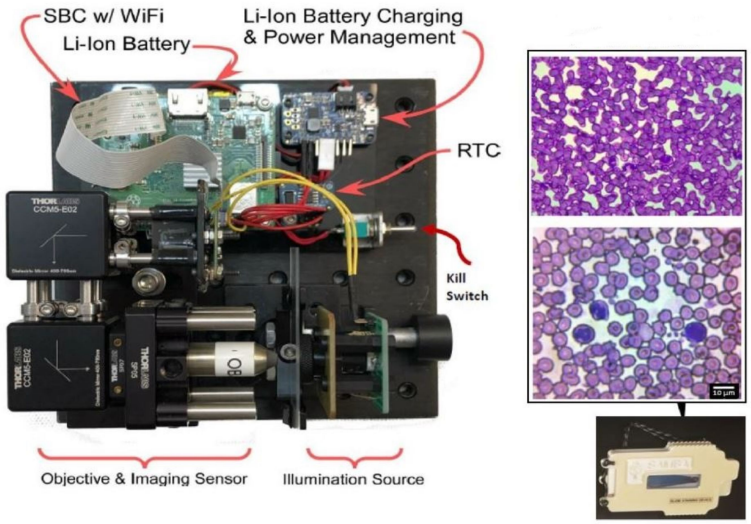
- Academic research
- Disaster areas
- Healthcare
- Military
- Natural sciences
- Other remote research and field work

THE TECHNOLOGY

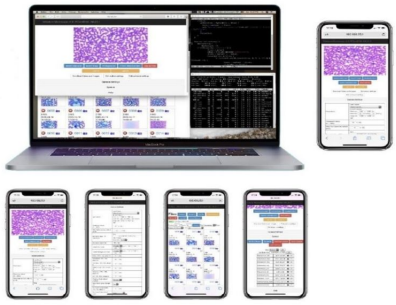
The handheld digital microscope features a 3D-printed chassis to house its hardware, firmware, and rechargeable Li-ion battery with built-in power management. It incorporates an internal stainless-steel cage system to enclose and provide mechanical rigidity for the optics and imaging sensor. To reduce the microscope's size, yet retain high spatial resolution, engineers devised an optical light path that uniquely folds back on itself using high reflectivity mirrors, thus significantly reducing internal volume.

Imaging control and acquisition is performed using a secure web-based graphical user interface accessible via any wireless enabled device. The microscope serves as its own wireless access point thus obviating the need for a pre-existing network. This web interface enables multiple simultaneous connections and facilitates data sharing with clinicians, scientists, or other personnel as needed. Acquired images can be stored locally on the microscope server or on a removable SD card. Data can be securely downloaded to other devices using a range of industry standard protocols.

Although the handheld digital microscope was originally developed for in-flight medical diagnosis in microgravity applications, prototypes were thoroughly ground-tested in a variety of environments to verify the accurate resolve of microbial samples for identification and compositional analysis for terrestrial field use. Owing to its portability, other applications demanding rapid results may include research, education, veterinarian, military, contagion disaster response, telemedicine, and point-of-care medicine.



At left, the scope's single board computer features rechargeable operation and built-in WiFi. On bottom-right, a self-contained slide staining device (by the same inventors) allows quick viewing of biological cells such as this blood smear.



Shown: The handheld microscope features supporting software that allows Bluetooth connectivity with smart devices enabling instant image sharing for telepathology.

PUBLICATIONS

Patent Pending

technology.nasa.gov

NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

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More Information

National Aeronautics and Space Administration

Agency Licensing Concierge

Johnson Space Center

2101 NASA Parkway
Houston, TX 77058
202-358-7432
Agency-Patent-Licensing@mail.nasa.gov

www.nasa.gov

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