Advancements in Microscopic Observation Technology for Space Bio-Experiments

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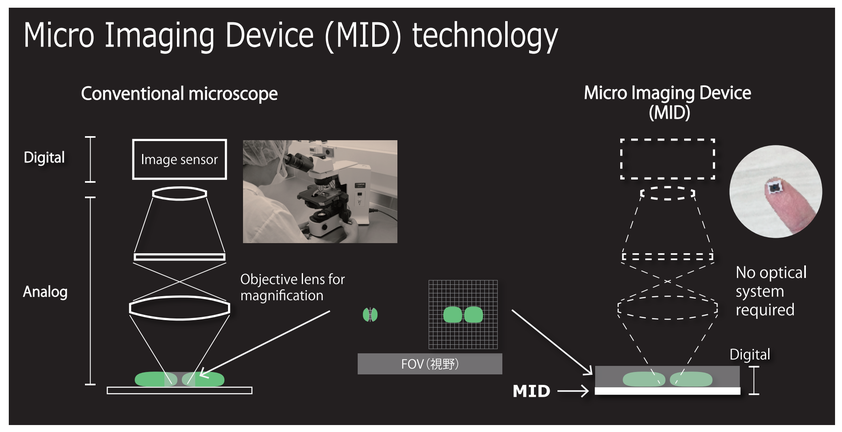
Introduction

We are developing a unique one-chip microscopic observation device called Micro Imaging Device (MID) using semiconductor technology. MID does not require optical lenses, and directly detects the object of observation placed on a semiconductor sensor chip with densely arranged photodiodes. MID is a lightweight and compact digital control device, and has a high availability with lab automation for research that requires microscopic observation. This time, we have developed a Raspberry Pi-driven MID board specialized for use in lab automation. Raspberry Pi is a single-board computer used in not only electronics but also space missions, and the MID board we developed functions as a camera module for Raspberry Pi, making it possible to capture still images, videos, and time lapse according to user's needs. Furthermore, by using these as a core unit to control various electronic devices, it has become possible to build a compact automated experimental unit. Currently, we are working on commercializing a space bio experiment service (Micro Bio Space LAB, MBS-LAB) to be installed on a satellite payload.



Current MID products and specifications

iVesa

Bright field/self-luminous
Dark box housing
MID cartridge-type
IF: USB3.0 type-A

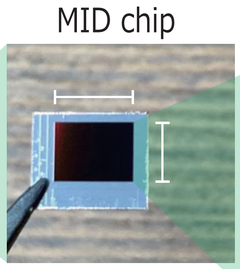
Cellany

Bright field
For cell observation
MID cartridge-type
IF: USB3.0 type-C

AminoME

Bright field
B to C model
USB stick-type
IF: USB3.0 type-A

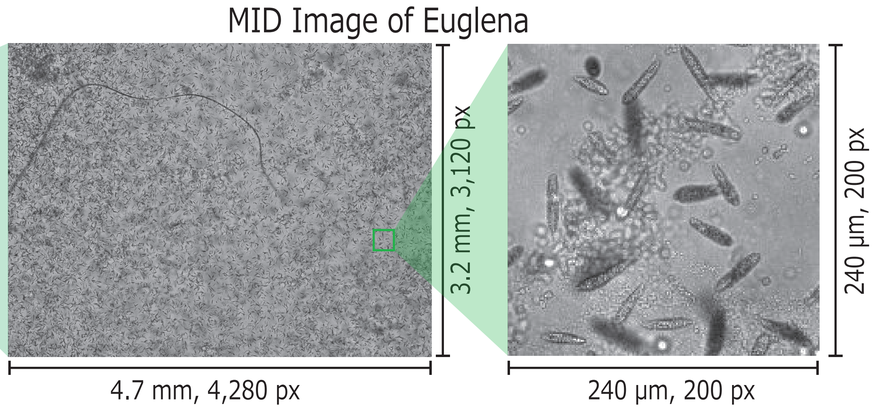
MID chip



Field of view	4.7 x 3.2 mm
Depth of field	0 to 50 µm
Resolution	1.2 µm
Data format	4,208 x 3,120 px, 10 bit, 30 FPS

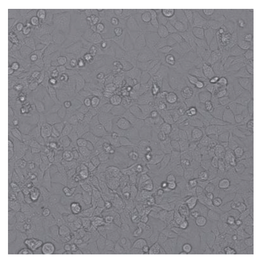
In order to popularize MID technology in microscopic observation processes in various research fields and industries, we have commercialized demonstration machines and have responded to customization according to needs.

MID Image of Euglena

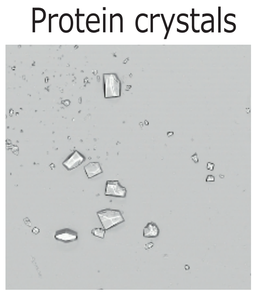


Just place the sample on MID to obtain a monochrome bright field image. No focusing is required.

Cultured calls

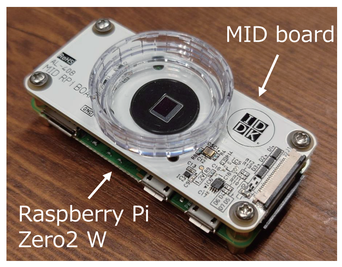


Protein crystals



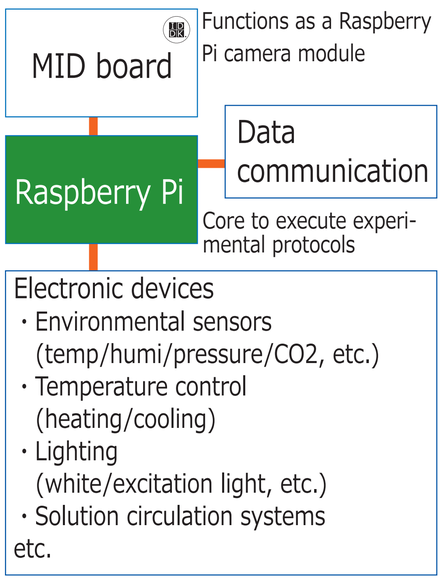
MID has the characteristic that transparent samples such as cells and protein crystals in solution can be imaged with clear contours without polarization processing such as phase contrast.

Development of Raspberry Pi-driven MID board



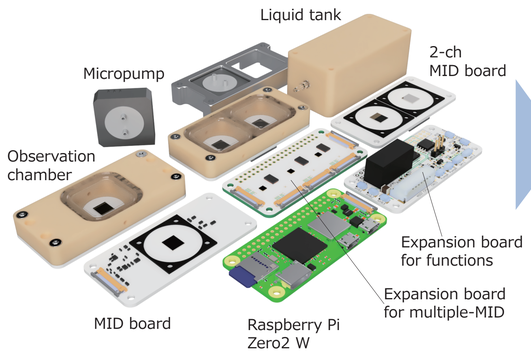
Size: 65 x 30 x 3 mm
IF: MIPI CSI-2
Power: 504 mW (Active)
29 mW (Stanby)

The MID board functions as a camera module for the single-board computer Raspberry Pi (Linux OS). By controlling various electronic devices from this core unit, it has become possible to realize a compact experimental unit. This led to the idea of Micro Bio Space LAB (MBS-LAB), a space bio experiment unit for artificial satellites, where weight is directly linked to cost, and automation is inevitable.

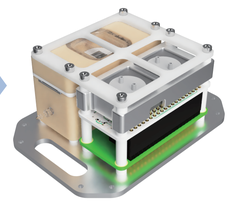


MBS-LAB experimental unit

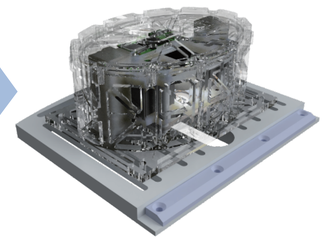
Option parts lineup



Assembly example (1-unit)

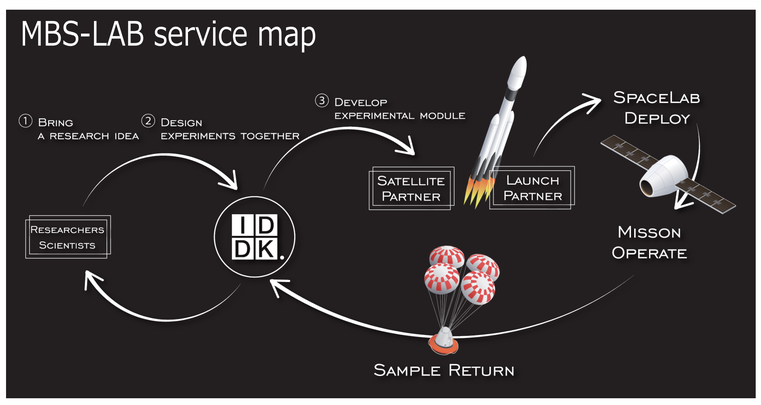


pressurized housing

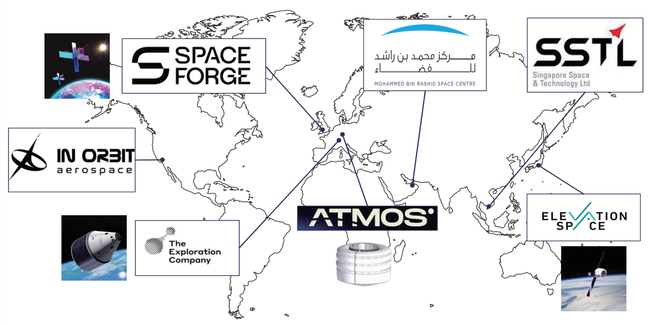


We have developed options to meet user needs and expanded our lineup. These expansions will enable the configuration of experimental units compatible with any biological sample.

Micro Bio Space LAB (MBS-LAB) platform



IDDK's partners



A private-sector-led one-stop shop service by IDDK. By partnering with multiple domestic and international satellite payload companies, we will create many launch opportunities and provide diverse operation periods and experiment environments. Demonstration to begin in 2024, service to begin in 2025.

Conclusion

MBS-LAB aims to play a part in the next-generation experimental platform in anticipation of the retirement of the International Space Station (ISS) in 2030. MBS-LAB aims to open the door to space experiments, which have been narrow until now, by creating launch opportunities with many partners and providing low costs and an overwhelming number of experiments.

Furthermore, the next generation developments are progressing, such as a color-chip (with R/B/G filterss), multiple fluorescence observation, extend the working distance (in millimeters), and increase resolution, to satisfy all life science needs.

This system can also be installed on a clinostat (microgravity simulator) and can be used for various research on the ground.

IDDK Co., Ltd.
Contribute to a better future for humanity through our microscopic technology.
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