

MANDEYE DEV/PRO manual

May 8, 2024

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Chapter 1

Introduction

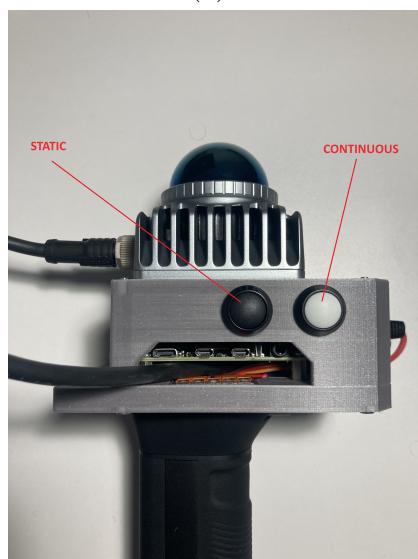
Figure 1.1 shows MANDEYE DEV and PRO portable mobile mapping systems. MANDEYE DEV is manufactured using 3D printing technology. MANDEYE PRO is manufactured using aluminum chassis. The functionality is the same for both devices.

MANDEYE DEV is 3D LiDAR (Light Detection and Ranging) data recorder introduced in ENRICH 2023 (<https://enrich.european-robotics.eu/>). "ENRICH is the world's first and only robotics trial that gives you pure and unspoiled real world scenarios for testing." It can be mounted on any vehicle having 1kg payload or being hand held. MANDEYE DEV was integrated with small 4x4 autonomous mobile robot ClearPath Jackal. It received 3D mapping award after it delivers 3D map of the scenario in fully automatic way. It is robust, reliable, accurate, precise and 10x more affordable than competitive 3D mapping systems. It can collect 3D data more than 4 hours in continuous mode. The 3D map is processed off-line using open source software available in <https://github.com/MapsHD/HDMapping/>. Data can be also converted to ROS rosbags (please send me email: januszbedkowski@gmail.com), so You can test it with plenty of LiDAR mapping open-source software. It is designed for:

- collecting 3D data for INDOOR and OUTDOOR scenes,
- providing ground-truth trajectory,
- enhance autonomous navigation and mapping of Your mobile robot,
- improve the robotic system deployment,
- professional applications,
- having fun from 3D mapping.



(a) Left: MANDEYE DEV, right: MANDEYE PRO



(b) MANDEYE DEV



(c) MANDEYE PRO

Figure 1.1: MANDEYE DEV and PRO. MANDEYE DEV is manufactured using 3D printing technology. MANDEYE PRO is manufactured using aluminum chassis. The functionality is the same for both devices.

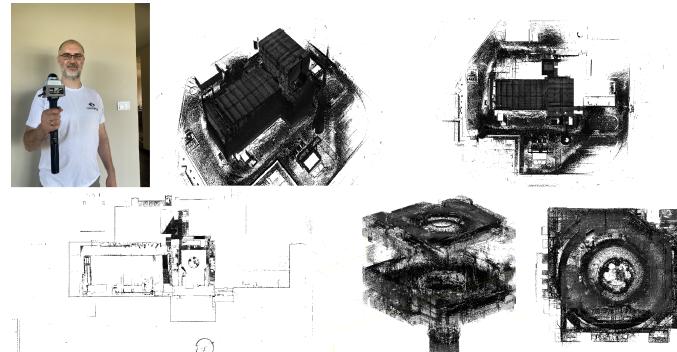
Following photos will show MANDEYE DEV and what it can do.



(a) MANDEYE DEV with 3D mapping award.

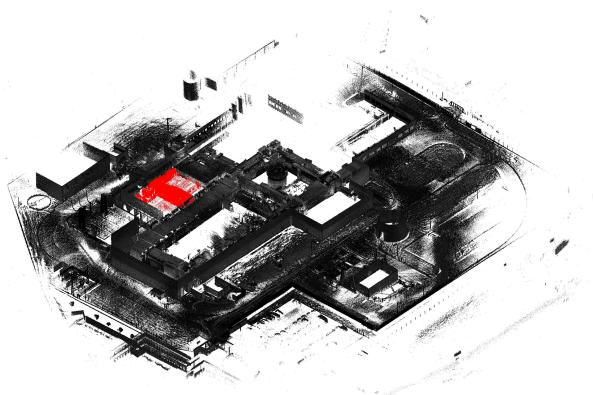


(b) MANDEYE DEV integrated with 4x4 Jackal robot.



**MANDEYE - REVOLUTION IN AFFORDABLE 3D MAPPING
TESTED IN ENRICH2023 - NUCLEAR POWER PLANT FACILITY
1kg, 4 hours work, accurate, precise, affordable (1999EUR)**

(c) 3D map of entire Nuclear Plant acquired with hand-held MANDEYE DEV.

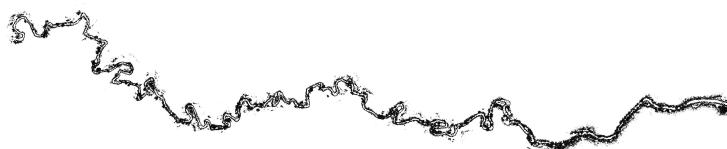


(d) Red color: 3D map delivered by autonomous 4x4 Jackal equipped with MANDEYE DEV. Gray scale: 3D map of ground floor of Nuclear Plant acquired with hand-held MANDEYE DEV.

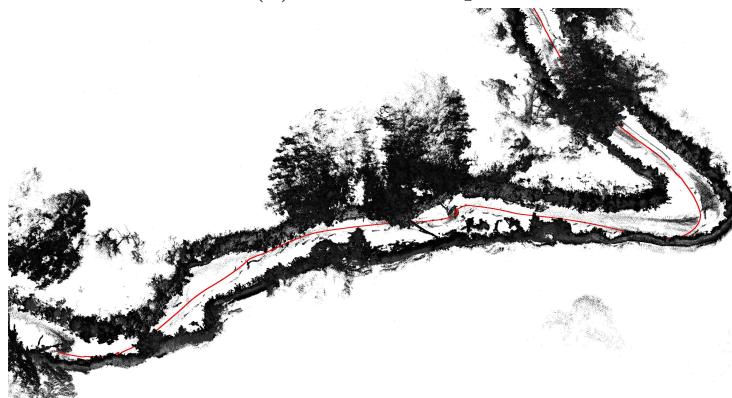
Figure 1.2: MANDEYE DEV for professional use in action during ENRICH 2023 <https://enrich.european-robotics.eu/>.



(a) MANDEYE DEV mounted onto water vessel.



(b) 3km river trip.



(c) Red line: ground truth trajectory of water vessels.
Gray scale: 3D map.

Figure 1.3: MANDEYE DEV for having fun with 3D mapping.

Chapter 2

Hardware description

MANDEYE DEV is composed of (figure 2.1a):

- MANDEYE DEV main unit.
- RONIN grip which is also a battery for MANDEYE DEV/PRO. It must be attached to the main unit. To install it first unscrew safety screws, attach RONIN grip and tighten the safety screws back. From below RONIN grip has a thread to attach a tripod.
- Tripod, screwed from below of the RONIN grip.
- Tool for nuts.
- Charger, to charge battery (which is inside the RONIN grip) separate RONIN grip from MANDEYE DEV main unit and connect it with the charger, then connect the charger to power source.

MANDEYE DEV is stored in a suitcase for secure transport (figure 2.1b).



(a) MANDEYE DEV all components - 1: MANDEYE DEV main unit, 2: Handle (attached to main unit), 3: Tripod (attached to handle), 4: Tool for nuts, 5: Charger.



(b) Suitcase with MANDEYE DEV for secure transport.

Figure 2.1: MANDEYE DEV parts.

MANDEYE PRO is composed of (figure 2.2a):

- MANDEYE PRO main unit.
- RONIN grip which is also a battery for MANDEYE DEV/PRO. It must be attached to the main unit.
- Tripod, screwed from below of the RONIN grip.
- Charger, to charge battery (which is inside the RONIN grip) separate RONIN grip from MANDEYE PRO main unit and connect it with the charger, then connect the charger to power source.

MANDEYE PRO is stored in a suitcase for secure transport (figure 2.2b).



(a) MANDEYE PRO all components - 1: MANDEYE PRO main unit, 2: Handle (attached to main unit), 3: Tripod (on the right), 4: Charger.



(b) Suitcase with MANDEYE PRO for secure transport.

Figure 2.2: MANDEYE PRO parts.

2.1 Turn on device (MANDEYE DEV/PRO)

Please click button on the bottom of the RONIN grip (figure 2.3a). Green square lights on RONIN grip should be visible. In short time blue light on MANDEYE DEV should be visible indicating that the device is on (figure 2.3b). Wait around 30 seconds till all other lights on MANDEYE DEV (green, red and yellow) blink one after another - this indicates that the device is ready for action. Now proceed to Section 2.2 Turn on continuous scanning or to Section 2.4 Turn on stop scan. Otherwise please check error section 2.5.



(a) RONIN grip is turned on, green square lights are visible.



(b) MANDEYE DEV is turned on, blue light can be seen.

Figure 2.3: MANDEYE DEV turned on.

2.2 Turn on continuous scanning (MANDEYE DEV/PRO)

If everything from section 2.1 is done and no errors where indicated (otherwise check error section 2.5) the procedure for running continuous data collection is as follows:

- 1: Place MANDEYE DEV steady on the ground using attached tripod.

- 2:



Push white button, after doing so green light should turn on (figure 2.4a).

- 3: Gently take MANDEYE DEV to hand and go around your scanning area.
- 4: Go back to starting point (if possible) and gently place MANDEYE DEV on the ground.
- 5: To turn off continuous scanning push white button while red light (figure 2.4b) is not indicating the fact that device is copying data from local memory to USB drive. After that green light should turn off leaving only the blue light on. MANDEYE DEV is again in the ready for action state (blue light is on and scanning can be started).

2.2. TURN ON CONTINUOUS SCANNING (MANDEYE DEV/PRO) 13



(a) MANDEYE DEV is showing by green light that 3D continuous scanning data are recorded in local memory.



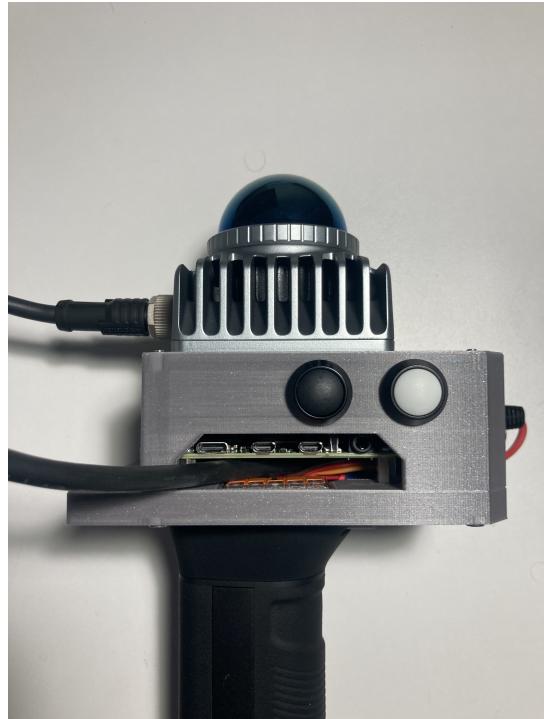
(b) MANDEYE DEV is showing by green and red light that it copies continuous scanning data from local memory to USB stick.

Figure 2.4: MANDEYE DEV during continuous scanning.

2.3 Turn on stop scan (MANDEYE DEV/PRO)

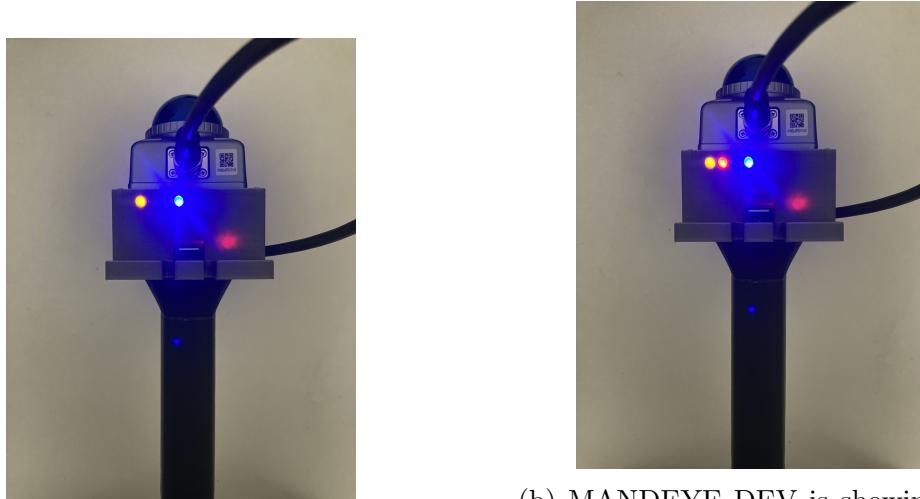
If everything from section 2.1 is done and no errors where indicated (otherwise check error section 2.5) the procedure for using stop scan is as follows:

- 1a: Place MANDEYE DEV steady on the ground.
- 2a:



Push black button and wait till yellow and red lights (figure 2.5b) will turn off.

- 1b: Place MANDEYE DEV steady on the ground in second location.
- 2b: Push black button and wait till yellow and red lights will turn off.
- 1c: Place MANDEYE DEV steady on the ground in third location.
- 2c: Push black button and wait till yellow and red lights will turn off.
- 1d: ...
- 2d: ...
- 1N: Place MANDEYE DEV steady on the ground in N-th location.
- 2N: Push black button and wait till yellow and red lights will turn off.



(a) MANDEYE DEV is showing by yellow light that 3D data are recorded in local memory.

(b) MANDEYE DEV is showing by yellow and red light that it copies data from local memory to USB stick.

Figure 2.5: MANDEYE DEV during stop/scan scanning.

2.4 Turn off device (MANDEYE DEV/PRO)

After being finished using MANDEYE DEV make sure that no process is active (only blue light is on - figure 2.3b). To turn the device off, press shortly RONIN grip button and then press longer RONIN grip button. All green lights on RONIN grip and blue light on MANDEYE main unit should turn off.



Figure 2.6: MANDEYE completely turned off. All RONIN lights are off.

2.5 Error indicators (MANDEYE DEV/PRO)

MANDEYE DEV is capable of indicating two errors:

- 1: "No USB drive", red light is blinking (figure 2.7a),
- 2: "No communication with LiDAR", yellow and green lights are blinking (figure 2.7b).

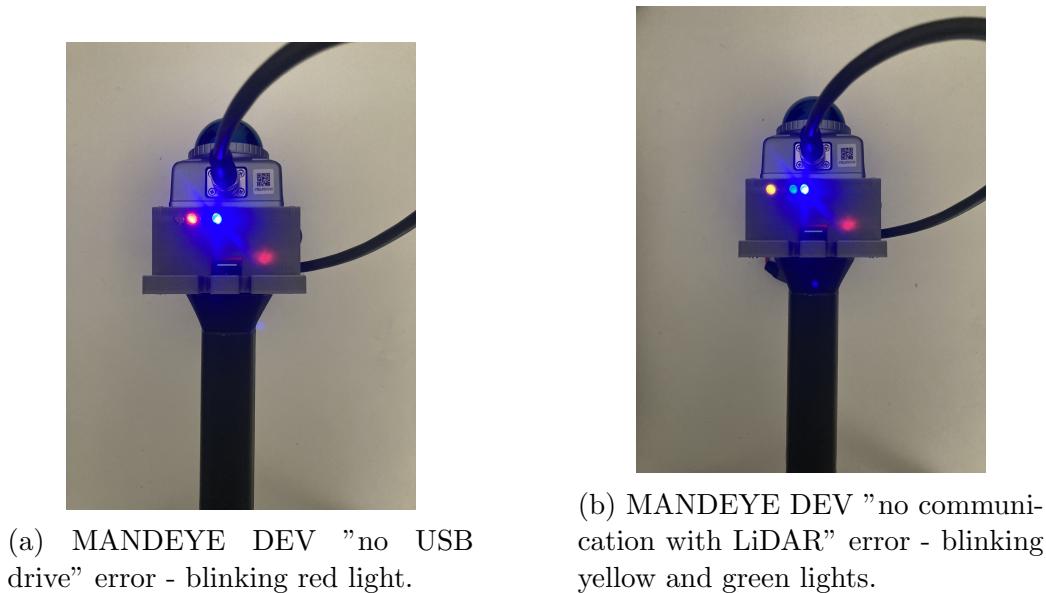


Figure 2.7: MANDEYE DEV error indicators.

2.6 Data structure on USB drive (MANDEYE DEV/PRO)

MANDEYE DEV starts with empty USB drive that has to be formatted as FAT, otherwise error "No USB drive" can appear. Once MANDEYE DEV will be turned on it will create following data on USB drive:

- *continuousScanning_0000* (this is folder for continuous scanning data)
- *stopScans_0000* (this is folder for stop scan scanning data)
- *mandala_manifest.txt* (this is MANDEYE DEV internal file)
- *version.txt* (this file contains firmware version, so please check the title of this documentation if it is the same as on USB drive).

The more you operate with MANDEYE DEV the more *continuousScanning_0000*, *stopScans_0000* will appear. New folders are creating for each turn on of the MANDEYE DEV, so sometimes they can be empty. Once you approach full USB drive, please remove all files from it.

2.7 Online documentation and software (MANDEYE DEV/PRO)

This manual is available at:

https://github.com/JanuszBedkowski/mandeye_controller

Compatible software for 3D data registration is available at:

<https://github.com/MapsHD/HDMapping>

2.8 Support (MANDEYE DEV/PRO)

In case of any issue/question contact januszbedkowski@gmail.com