

UAS Research Hardware Setup

Required Hardware

- DJI Matrice 100
- DJI Zenmuse XT
- DJI Guidance
- Hokuyo URG-04LX-UG01
- Onboard Computer (preferably the Intel Nuc)
- 4 DJI Expansion Bays
- LIPO Battery and Battery Monitor (recommended)

Required Software

- DJI Guidance Assistant
- DJI Go App
- DJI Assistant 2

Step 1 – Setting up the Matrice 100 and Guidance

The DJI Matrice 100 User Manual has a thorough setup guide to get the Matrice 100 running for all types of applications, which can be found on the DJI [website](#)¹. There is also a manual for the Guidance system which is also on the DJI [website](#)². This document will outline the specific setup that was used for this project. It is recommended to go through this guide and the DJI guide at the same time.

1. Check the Frame Arms
 - a. Identify the four arms as marked M1 through M4.
2. Remove the Upper Plate and Battery Compartment from the Center Frame
 - a. Remove the 4 M2.5x5 screws attaching battery compartment to the rails.
 - b. There are 4 M2.5x8 screws per mounting rail which all must be removed from the upper plate. The upper plate DOESN'T have curved sides.
 - c. Remove the remaining 16 M2.5x5 screws from the upper plate.
3. Mounting the Frame Arms
 - a. Mount the frame arms in their respective arm slots of the center frame, which are marked M1 through M4.
 - b. Make sure the inner arm fasteners are the curved fasteners and the outer arm fasteners are the 3-degree fasteners. If not, replace them accordingly.
 - c. Connect the 3 motors cables and LED cable of each arm to the corresponding ESC which are marked M1 through M4. Make sure to match the color of the cables and the color of the ports.
 - d. Connect the antenna cable of each arm to the corresponding antenna ports marked M1 through M4. The ports are on the bottom side of the Matrice 100, and it is recommended to use the cable tie to help organize the antenna cables.
4. Mounting the Battery Compartment and Gimble
 - a. Pull the Aircraft Status Indicator cable, CAN cable, signal cable, and power cable through the wire outlet of the lower plate on the front right side. The front side is between motors 1 and 2.

- b. Connect the 10-pin and 8-pin gimbal cables to their respective ports on the flight controller on the center frame.
 - c. Connect the gimbal lock to the gimbal mounting plate using the 4 Phillips screws given.
 - d. Connect the 10-pin and 8-pin gimbal cables to their respective ports on the gimbal lock.
 - e. Mount the gimbal mounting plate the dampers, and the dampers to the upper plate of the center frame.
 - f. Mount the upper plate back onto the center frame using the 16 M2.5x5 screws, followed by the 8 M2.5x8 screws for the rails. The notch on the upper plate should be on the left side the center frame. The left side is between motors 2 and 3.
 - g. Re-mount the batter compartment on the bottom plate with the 4 M2.5x5 screws, making sure not to block the cables coming out of the bottom plate. The terminals of the battery compartment should be facing the rear of the aircraft, which is between motors 3 and 4.
 - h. Open the cover of the battery compartment by removing the screw on the side.
 - i. Connect the Aircraft Status Indicator cable, CAN cable, signal cable, and power cable to their respective ports in the battery compartment. The flight controller power and signal cables are the closest to the terminals, the CAN cable is in the middle, and the aircraft status cable is the farthest from the terminals.
 - j. Pull the battery power cable through the hole on the battery cover and connect it to the XT60 port of the center frame.
5. Mounting Expansion Bays
- a. The base plate is screwed to each side plate by 2 M2.5x5 screws.
 - b. Mount the first expansion bay to the top rails using 4 M2.5x5 screws. Mount a second expansion bay on top of the first using 4 M3x5 screws.
 - c. On top of the second bay attach the guidance core securely. Make sure the arrow on the core is pointing towards the front of the aircraft.
 - d. Mount a third expansion bay on top of the second bay using 4 M3x5 screws.
 - e. Mount the last expansion bay on the battery compartment using 4 M3x5 screws.
6. Mount the GPS (not as in the manual)
- a. Obtain 2 wood or plastic rods approximately X inches long and X inches in diameter.
 - b. Slide the rods into the back of the aircraft behind the back fasteners of arms 3 and 4. Then touch the tops of the rods together to create a triangle on the back of the craft.
 - c. Tape or epoxy the rods into place. Packing tape was used in our implementation.
 - d. Tape of epoxy the GPS to the very back of the rods so it sits nicely between the 2 rods.
 - e. Connect the GPS the GPS CAN port.
 - f. This is done because if the GPS is in the standard position the Nuc board creates E&M waves largen enough that interfere with GPS, so the GPS needs to be moved away.
7. Mounting Guidance

- a. The downward facing guidance sensor is mounted the expansion bay under the battery compartment.
- b. The guidance brackets should be mounted through the front two holes of the expansion bay, with the guidance bar mounted to the brackets. The VBUS port should be pointed to the front of the aircraft.
- c. The remaining brackets should be mounted the top expansion bay in all directions with the bars mounted on the brackets. The order and direction of the sensors don't matter except for the fact that the VBUS ports should face upwards.
- d. Connect the VBUS ports on the guidance core to the sensors. VBUS 1 goes to the front, VBUS 2 goes to the right, VBUS 3 goes to the back, VBUS 4 goes to the left, VBUS 5 goes to the bottom.
- e. The CAN-Bus cable goes from the guidance core to the CAN-Bus port on the center frame of the aircraft.
- f. Connect the XT30 power cable on the guidance core to a XT30 power port on the center frame of the aircraft.

Step 2 – Attaching the peripherals

1. Attaching the Nuc
 - a. Place the Nuc on top of the top expansion bay.
 - b. Tie the Nuc down with 2 overlapping zip ties.
 - c. Use a USB to UART port to connect the Nuc to the aircraft through the UART port on the center frame of the aircraft.
2. Attaching the LIDAR
 - a. Tape down the LIDAR directly above the gimbal.
 - b. Use a USB to USB-mini cable to connect the LIDAR to the Nuc board.
3. Attaching the LIPO battery
 - a. Velcro down the LIPO battery on the upper plate of the center frame. Use the LIPO to power the Nuc.
 - b. It is recommended to buy and attach a battery monitor to the LIPO since LIPO's only function well under certain conditions and can create potential fire hazards if used incorrectly.

Step 3 – Getting the Machine Flying

1. Calibrate guidance.
 - a. Connect the guidance core to a computer with DJI Guidance Assistant using a micro-USB cable.
 - b. Open DJI Guidance Assistant and select the standard tab.
 - c. Aircraft type is DJI MATRICE 100.
 - d. Guidance sensor positions are all at 0.
 - e. Obstacle sensing can be enabled or disable at your discretion. It is recommended to turn it on with a safe distance of 2 meters.
 - f. The velocity level for our craft is set to 7, and the breaking sensitivity is set to 5.
 - g. Select the calibrate tab.
 - h. Select the calibrate button and follow the onscreen instructions.
 - i. For best results make sure there is sufficient lighting, no reflections on the computer screen, and a flat screen is used.

- j. Select the view tab and preview all sensors to make sure they respond and work appropriately.
2. Calibrate the compass.
 - a. Tap the system status bar in the app and select calibrate and follow the on-screen directions.
 - b. First hold the aircraft horizontally and rotate 360 degrees.
 - c. Then hold the aircraft vertically and rotate 360 degrees.
 - d. Restart if the aircraft status light goes red at any point.
3. Attach the propellers.
 - a. Identify the 2 motors with white dots and the 2 motors without white dots.
 - b. Attach propellers with white dots on the motors with white dots by pushing down and spinning the propeller in the direction indicated on the propeller.
 - c. Attach propellers without white dots on the motors without white dots by pushing down and spinning the propeller in the direction indicated on the propeller.
4. Make sure the aircraft battery, LIPO battery, controller, and device are sufficiently charged.
5. Fly.

Links

1. <http://www.dji.com/matrice100/info#downloads>
2. <http://www.dji.com/guidance/info#downloads>