Introduce of iron-X
By TESR

ROS2

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iron-X's appearance

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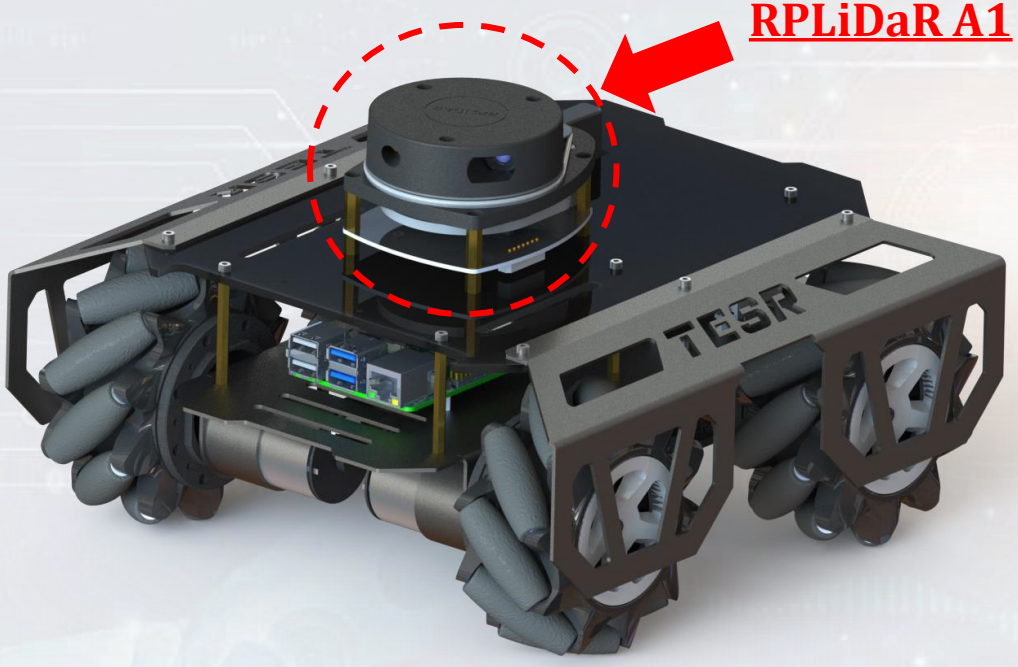
iron-X's components

- Overview



Top Cover & Chassis Shield

iron-X's components

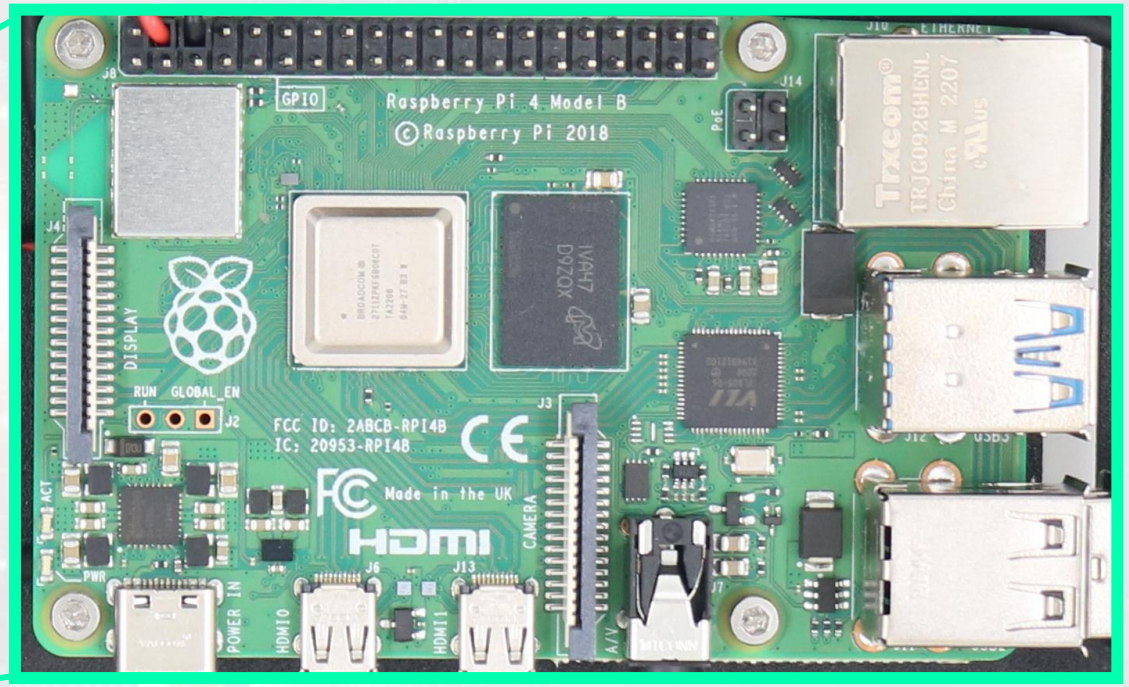
- Chassis

Mecanum Wheel

iron-X's components

- **Chassis**

Raspberry Pi 4B 4GB



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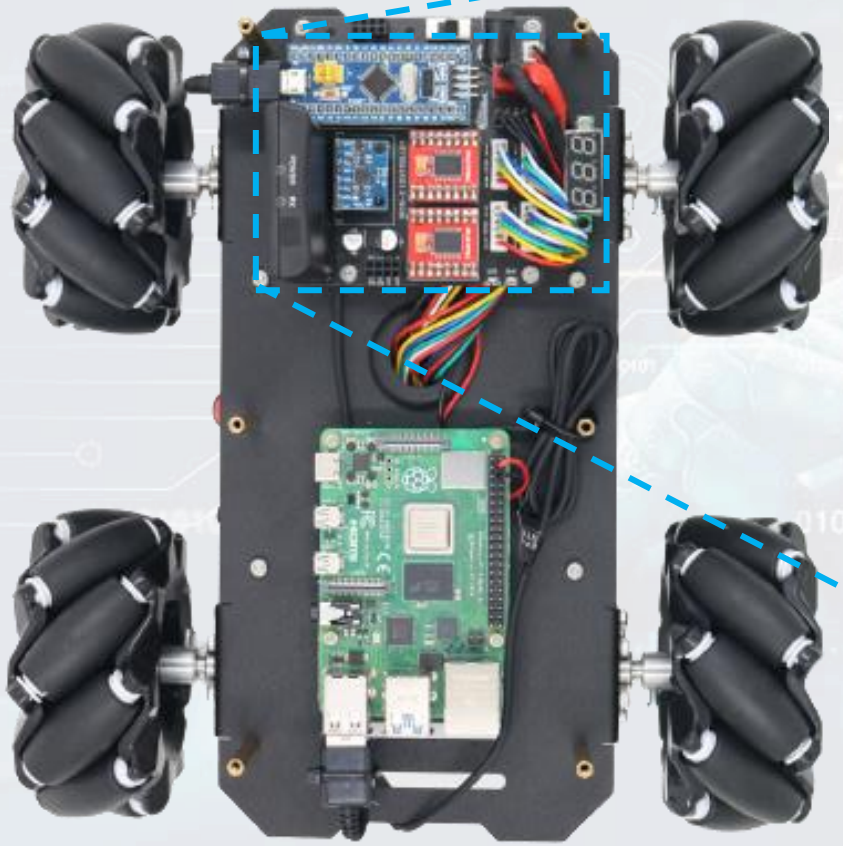
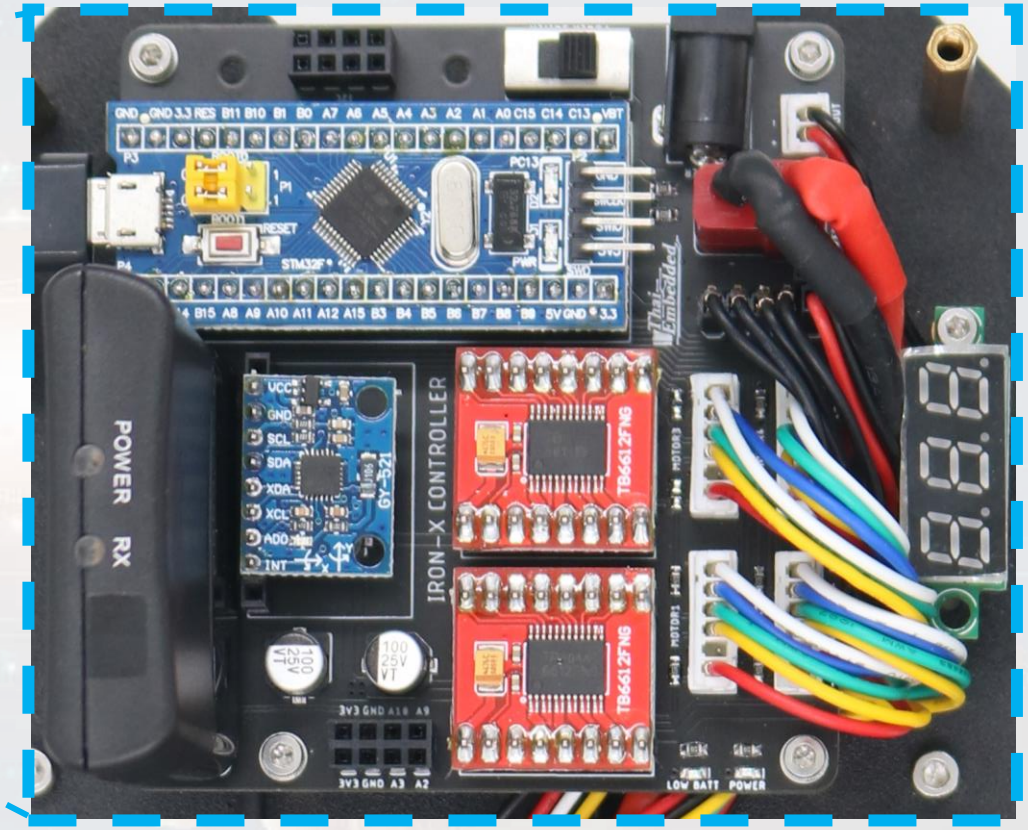
iron-X's components

- Chassis



IRON-X CONTROLLER



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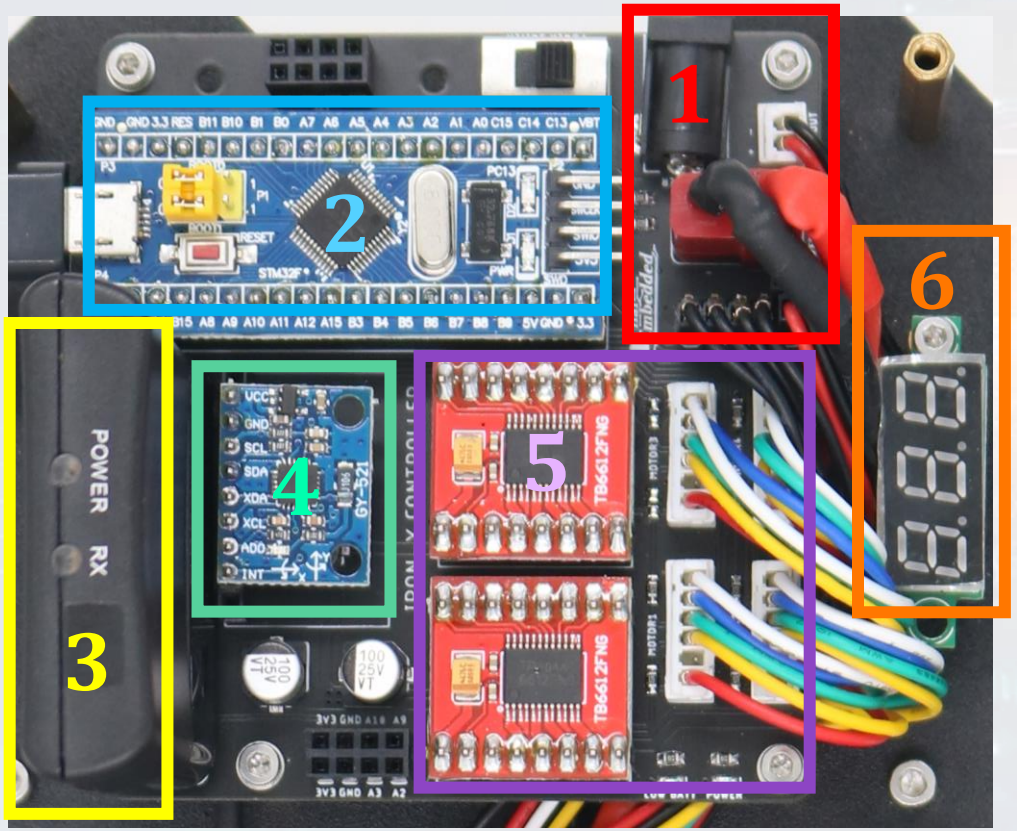
iron-X's components

- iron-X controller



List of iron-X controller component

1. Power Supply
2. STM32 Microcontroller
3. Joystick module
4. IMU Sensor
5. Motor Drive
6. Battery level display

Specification of iron-X

Product Model	Raspberry Pi 4B Mecanum ROS Robot
Kinematic model	IRON X Series 1 Mecanum wheel all-directional movement
Programming language	Noetic Version , Bottom C, ROS/C++/Python
ROS Controller	Raspberry pi 4B 4G, TF Card 32G
ROS Controller System	Raspbian
Virtual Machine System	Ubuntu 20.04 LTS + ROS Noetic or ROS Foxy Fitzroy
Motion controller	TESR STM32 Controller
Laser radar	RPLIDAR A1
Maximum speed	linear velocity 1.2m/s angular velocity 7.8 rad/s
Electric machine	DC reduction motorEncoder 360 Pulse/Round)

Specification of iron-X

Product Model	Raspberry Pi 4B Mecanum ROS Robot
IMU	Acceleration gyroscope
Charger	14V 1.5A Charging Electrical Appliances (3 CFCC Certification)
power supply outlet	12.6v@1.5A
Body material	high strength aluminium alloy sheet surface oxidation sandblasting)
Wheels	Mecanum Wheels 97 mm
Robot Size (WxLxH)	250 mm x 250 mm x 160 mm
Weight	2.5 kg
Maximum load	8 kg
Battery capacity	12V 2200 mAh
Renewal time	8 to 20 hours (differences in usage state)

Iron-x forward kinematics

$(V_{linear\_x}, V_{linear\_y}, \omega_z)$ → **Iron-x forward kinematics** → $(N_{rpm\_M1}, N_{rpm\_M2}, N_{rpm\_M3}, N_{rpm\_M4})$

$$V_{linear} = \omega \bullet r$$

$$V_{linear} = \frac{2\pi N_{rpm}}{60} \bullet r$$

$$N_{rpm} = \frac{60 \bullet V_{linear}}{2\pi r}$$

$$V_{\text{tangential}} = \omega_z \bullet \frac{(D_x + D_y)}{2}$$

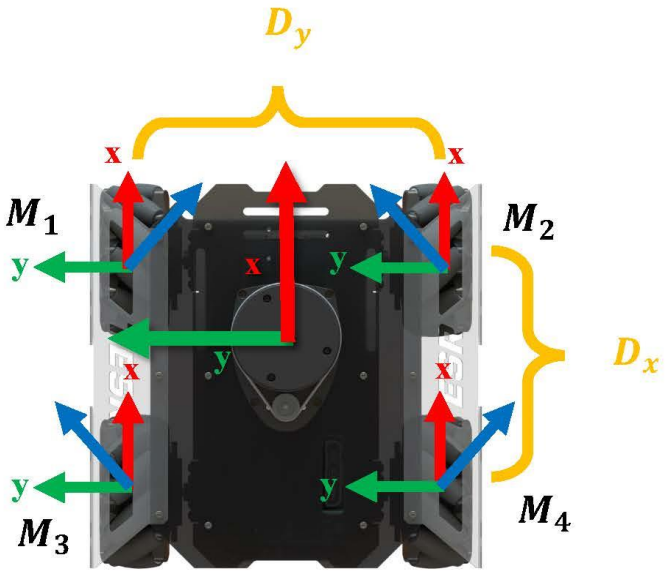
$$\boxed{N_{rpm\_\tan} = \frac{60 \bullet V_{\text{tangential}}}{2\pi r}}$$

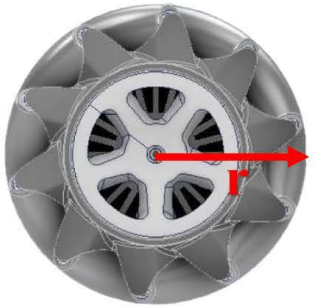
$$\boxed{N_{rpm\_x} = \frac{60 \bullet V_{linear\_x}}{2\pi r}}$$

$$\boxed{N_{rpm\_y} = \frac{60 \bullet V_{linear\_y}}{2\pi r}}$$

$$\begin{aligned}
N_{rpm_M1} &= N_{rpm_x} - N_{rpm_y} - N_{rpm_\tan} \\
N_{rpm_M2} &= N_{rpm_x} + N_{rpm_y} + N_{rpm_\tan} \\
N_{rpm_M3} &= N_{rpm_x} + N_{rpm_y} - N_{rpm_\tan} \\
N_{rpm_M4} &= N_{rpm_x} - N_{rpm_y} + N_{rpm_\tan}
\end{aligned}$$

$M_{anticlockwise}$ +
$M_{clockwise}$ -





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Iron-x inverse kinematics

$(N_{rpm\_M1}, N_{rpm\_M2}, N_{rpm\_M3}, N_{rpm\_M4})$ → **Iron-x inverse kinematics** → $(V_{linear\_x}, V_{linear\_y}, \omega_z)$

$$V_{linear} = \frac{2\pi N_{rpm}}{60} \bullet r$$

$$N_{rpm\_x} = \frac{(N_{rpm\_M1} + N_{rpm\_M2} + N_{rpm\_M3} + N_{rpm\_M4})}{4}$$

$$N_{rpm\_y} = \frac{(-N_{rpm\_M1} + N_{rpm\_M2} + N_{rpm\_M3} - N_{rpm\_M4})}{4}$$

$$N_{rpm\_\tan} = \frac{(-N_{rpm\_M1} + N_{rpm\_M2} - N_{rpm\_M3} + N_{rpm\_M4})}{4}$$

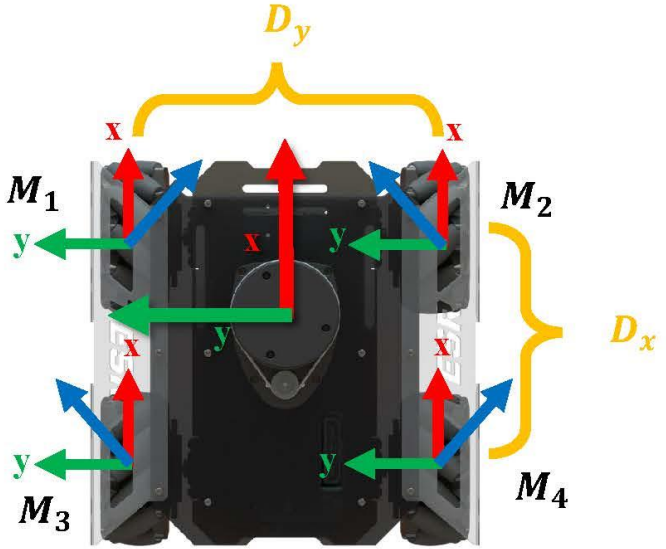
$M_{anticlockwise}$ +
$M_{clockwise}$ -

$$V_{linear\_x} = \frac{2\pi N_{rpm\_x}}{60} \bullet r$$

$$V_{linear\_y} = \frac{2\pi N_{rpm\_y}}{60} \bullet r$$

$$V_{tangential} = \frac{2\pi N_{rpm\_\tan}}{60} \bullet r$$

$$\omega_z = \frac{V_{tangential}}{\left(\frac{D_x + D_y}{2}\right)}$$



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Iron-x Mecanum wheels direction

Right turning

Left turning

Forward

Backward

Right

Left

Right forward

Left forward

Right backward

Left backward

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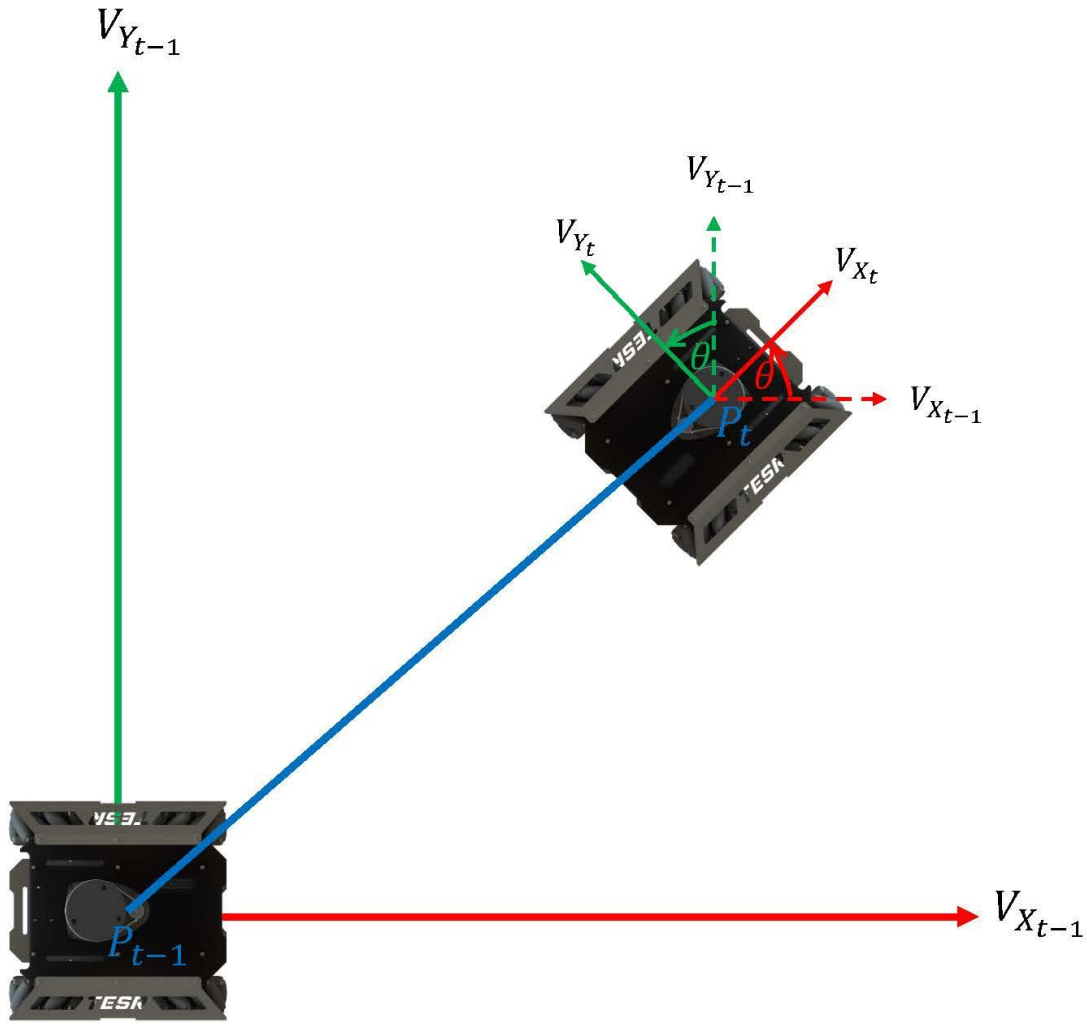
Iron-x velocity to odom pose



$$S_{\Delta x} = (V_{xt} \cdot \cos(\theta) - V_{yt} \cdot \sin(\theta)) \cdot \Delta t$$

$$S_{\Delta y} = (V_{xt} \cdot \sin(\theta) + V_{yt} \cdot \cos(\theta)) \cdot \Delta t$$

$$\theta_{\Delta t} = \omega_z \cdot \Delta t$$

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iron-X's packaging

Overview

Front-view

Top-view

Isometric-view

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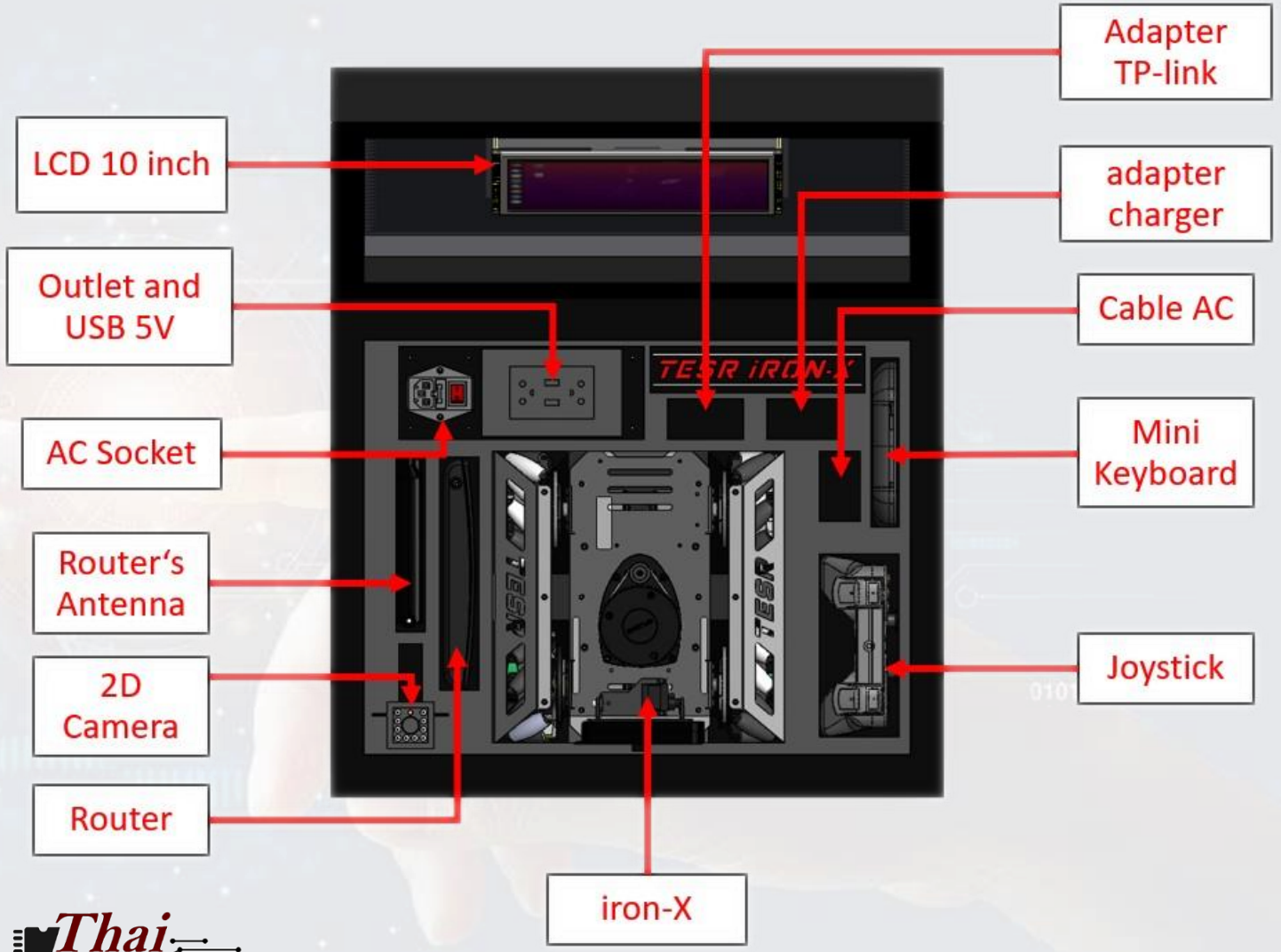
iron-X's packaging

Package check list



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TESR Co., LTD

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จังหวัดนนทบุรี 11000