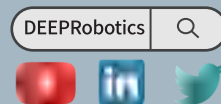


DEEP Robotics

Quadruped Robot Power Patrol Inspection Solution

DEEP Robotics
云深处科技

Dedicated to the ultimate combination
of locomotion and intelligence to build a bright robotic future



To Reach Us

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DIGITAL REVOLUTION

Trends & Challenges

Speeding Digitalizing Transformation

The world is heading to the 4th industrial revolution, data and electricity are the foundation of industrial production.

The technological revolution and industrial revolution are on their way to a new era; digitalization and intelligenization were becoming key factors in high-quality electric industry development. During the national fourteenth “Five-year” plan, our country is promoting digitalize power inspection. There are 60 thousand converting stations and 300 thousand power supply stations waiting for digitalizing transform.

Power grid, converting station and power supply station are one of the most important infrastructures in the country, its stable operation is the priority of the development of the economy and living, and there are many problems are needed to be solved in the process. of transforming traditional power inspection into smart management, unmanned inspection.



Current Issues

Manual Inspection

- Repeated Work**

Most of the power stations are still using manual inspection, which high repetitive and intense.
- Inconsistency**

Inspection outcome is easily affected by personal issues, mental state, and work experience; miss-inspections and errors often occur.
- Safety Issue**

Extreme conditions like storms, haze, and hail are threats to inspectors safety.
- Employment**

Inspection position hiring problems, shortage of personnel, aging problems.

Traditional Robotic Inspection

- Limited Adaptability**

Unable to operate on unstructured terrains, difficult to suit to the complex environment in power stations like stairwells, grassland, and muddy ground. Traditional robotics inspection cannot deploy flexibly due to lots of blind spots in the inspection area.
- Cost**

It is a huge cost to modify the environment for using wheeled or tracked robots.
- Technology to be optimized**

Old methods are difficult to adapt to the requirements of the new situation.
- Complicated system**

Unable to work in & outdoor at the same time; too many types of robotic deployment out there, huge workload.

Comparisons

	Wheel	Track	Rail	Quadruped
Stair	×	×	×	✓
Cobbled Road	×	✓	×	✓
Grassland	×	✓	×	✓
Inspection pathway	Limited	Limited	Unchangedable	Flexible
In & Out door	×	×	✓	✓
Falls Auto-Recover	×	×	×	✓
Environmental Modification	Needed	Needed	Needed	No Needed

X20

Smart Power Patrol Inspection

Net.Weight	57.3kg	Ingress Protection	IP66 (Power on)
Standing Size	850mm	Inspect Speed	1m/s
Range	12km	Mini.Traffic Width	1m
Duration	2-4h	Mini.Traffic Hight	1m

All-Terrian

Able to cross over 20cm high obstacles and stairs, 30 ° slope, other complex conditions like grassland, cobbled road, ponding; No need to modify the original environment, can work both in & outdoor.

Modules

Plenty of applicable choices with Bi-spectrum camera, 5G network, BDS/GPS/RTK, Gas sensor, Partial discharge detector, and robotic arm.

Auto-Charging

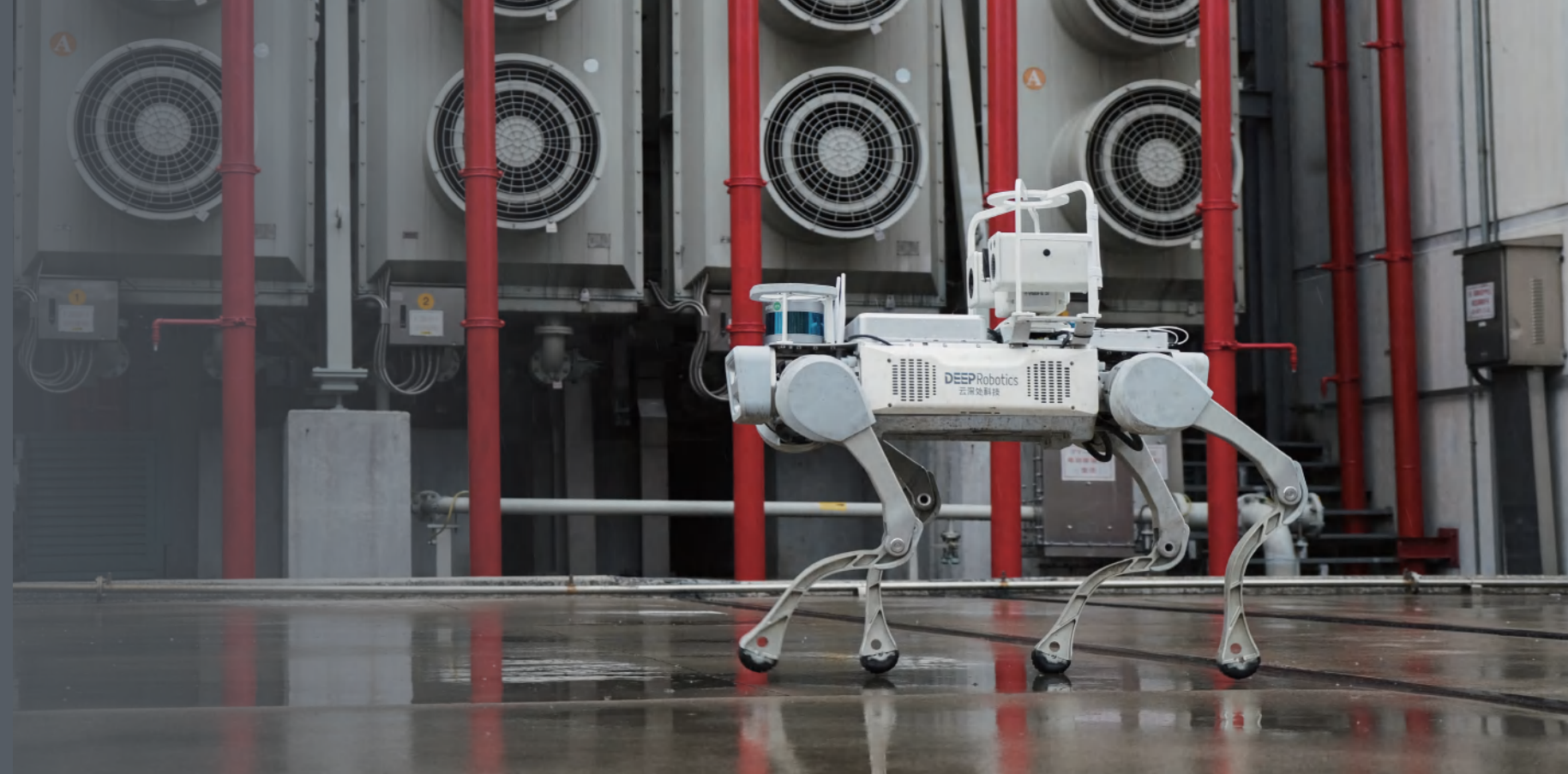
Infinite working cycle

Auto-Navigation

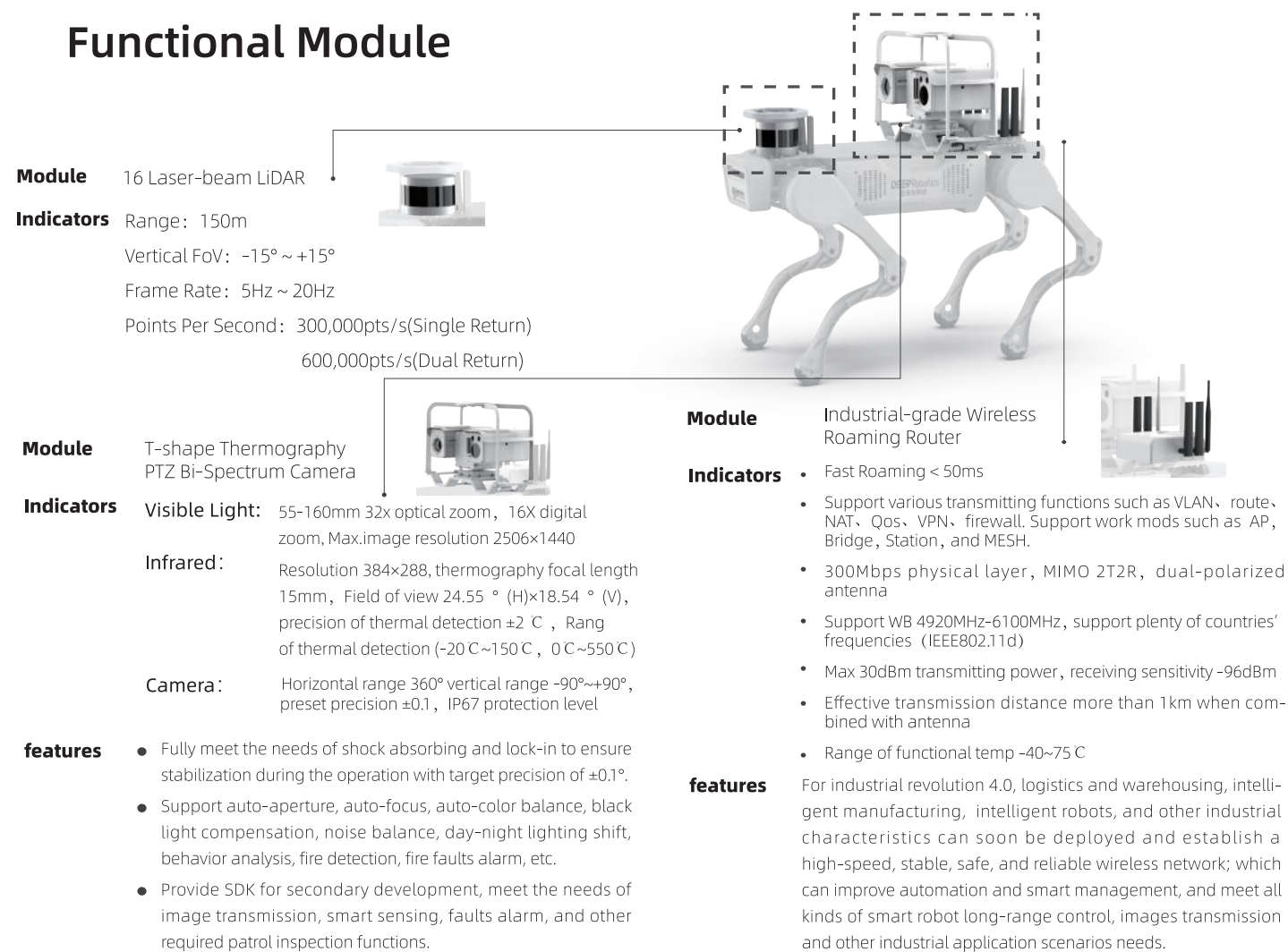
Locating precision <3cm

Industrial Protection

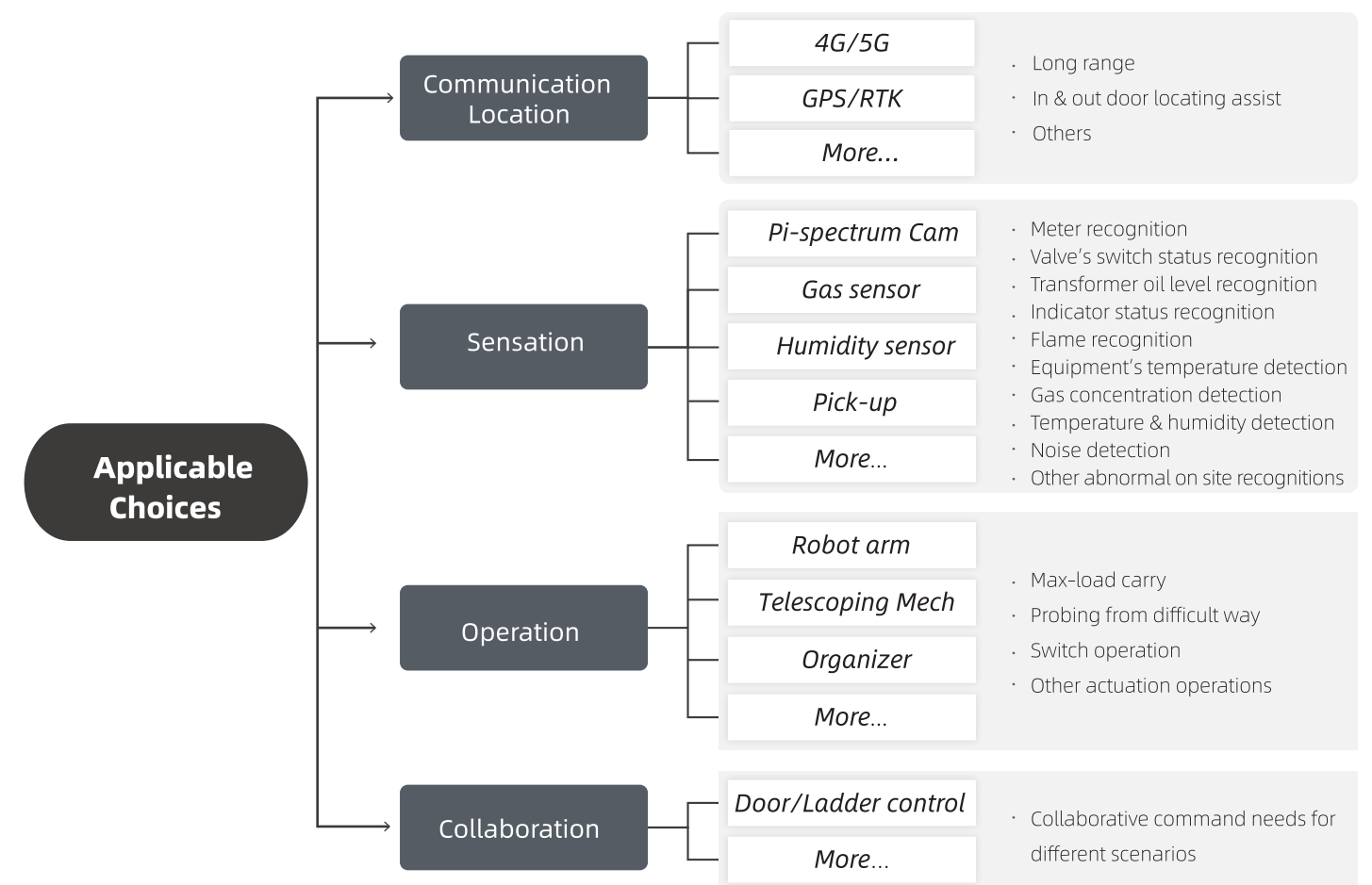
Water-proof, Dust-proof, All-weather



Functional Module

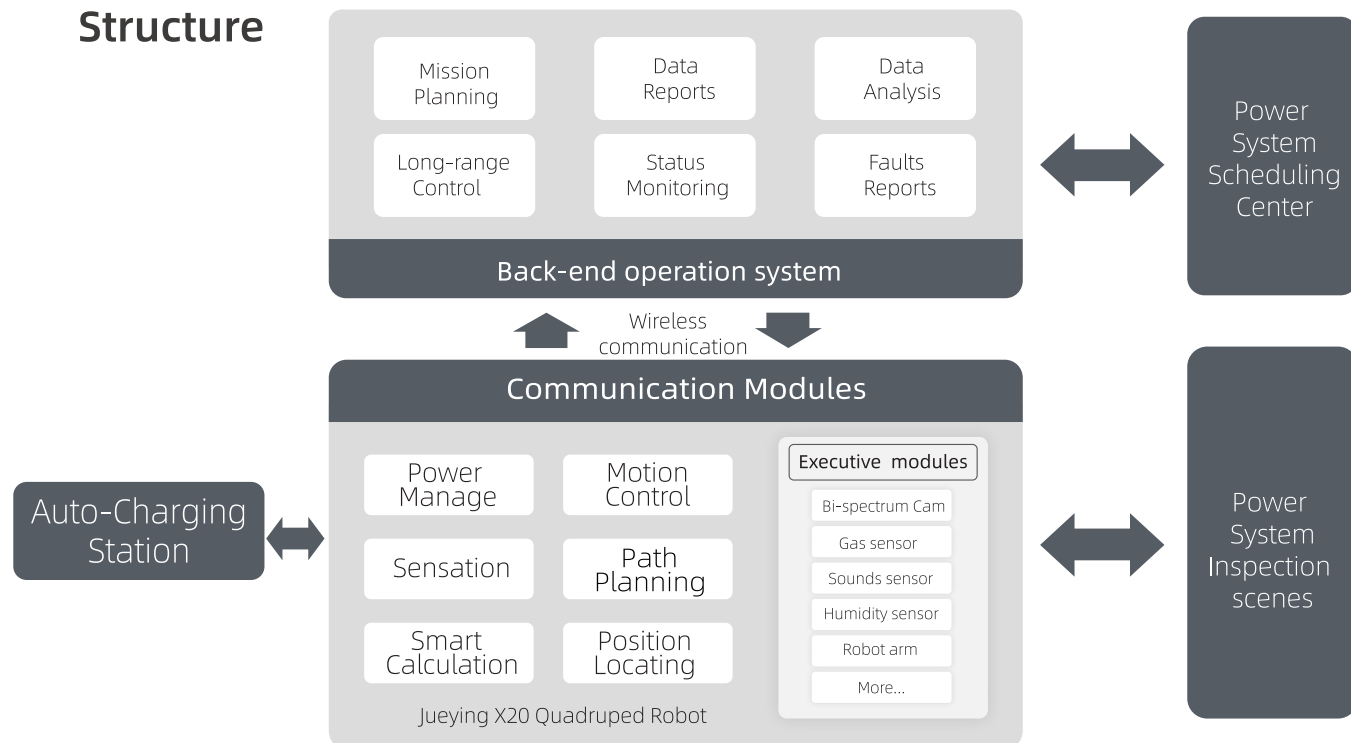


Modules Structure

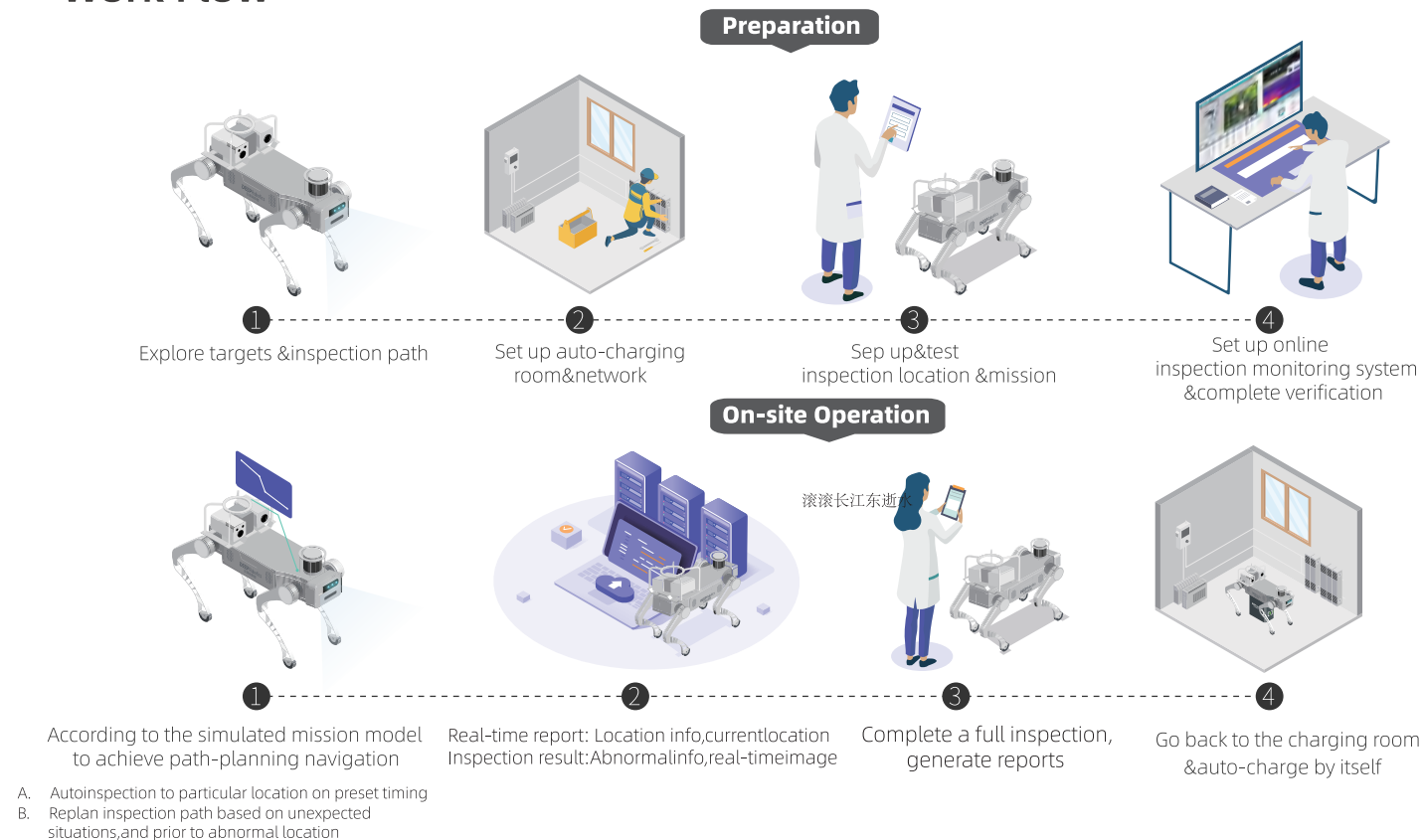


- X20 QUADRUPEL ROBOT
- Smart Power Inspection Solution

Structure



Work Flow



"Digital Twins"



Hi-Precision
Point Cloud
Data Collecting



1:1 Replicated Real
Site Environment



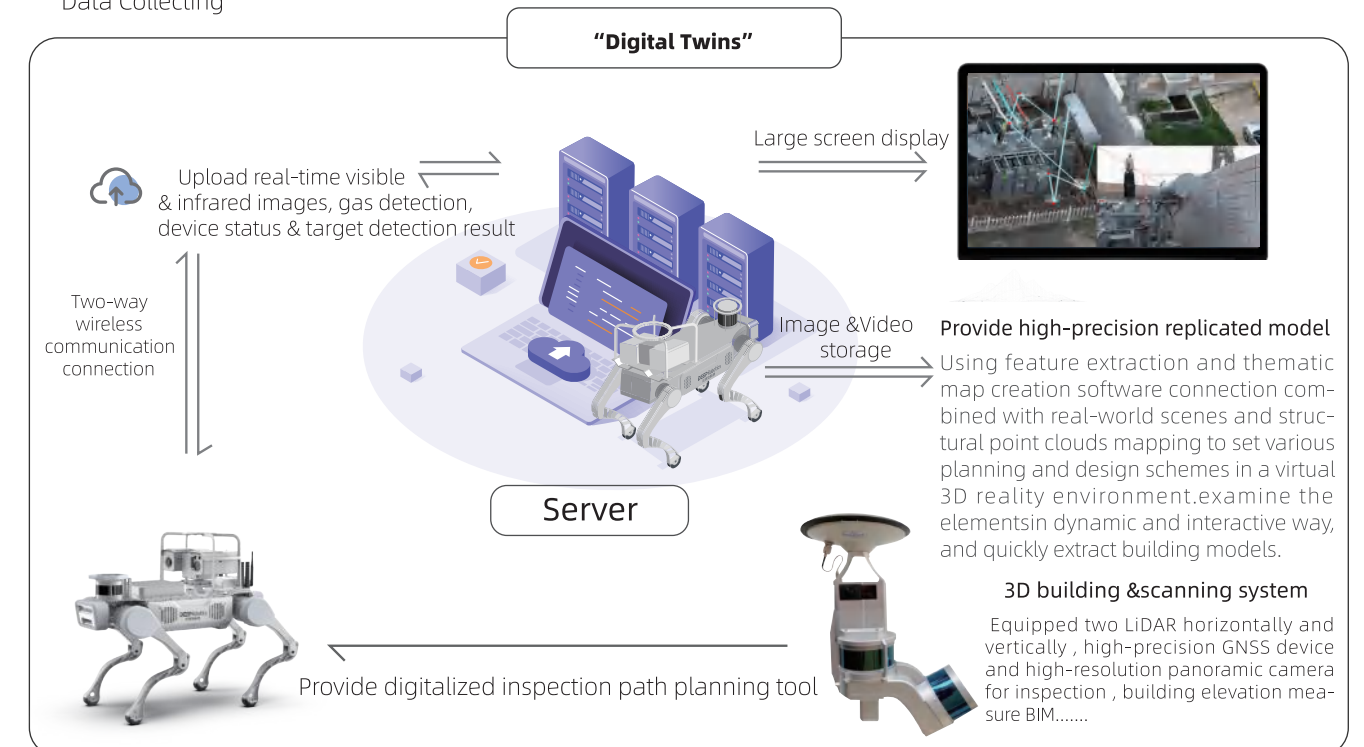
Quick Deployment



Inspection
In Details

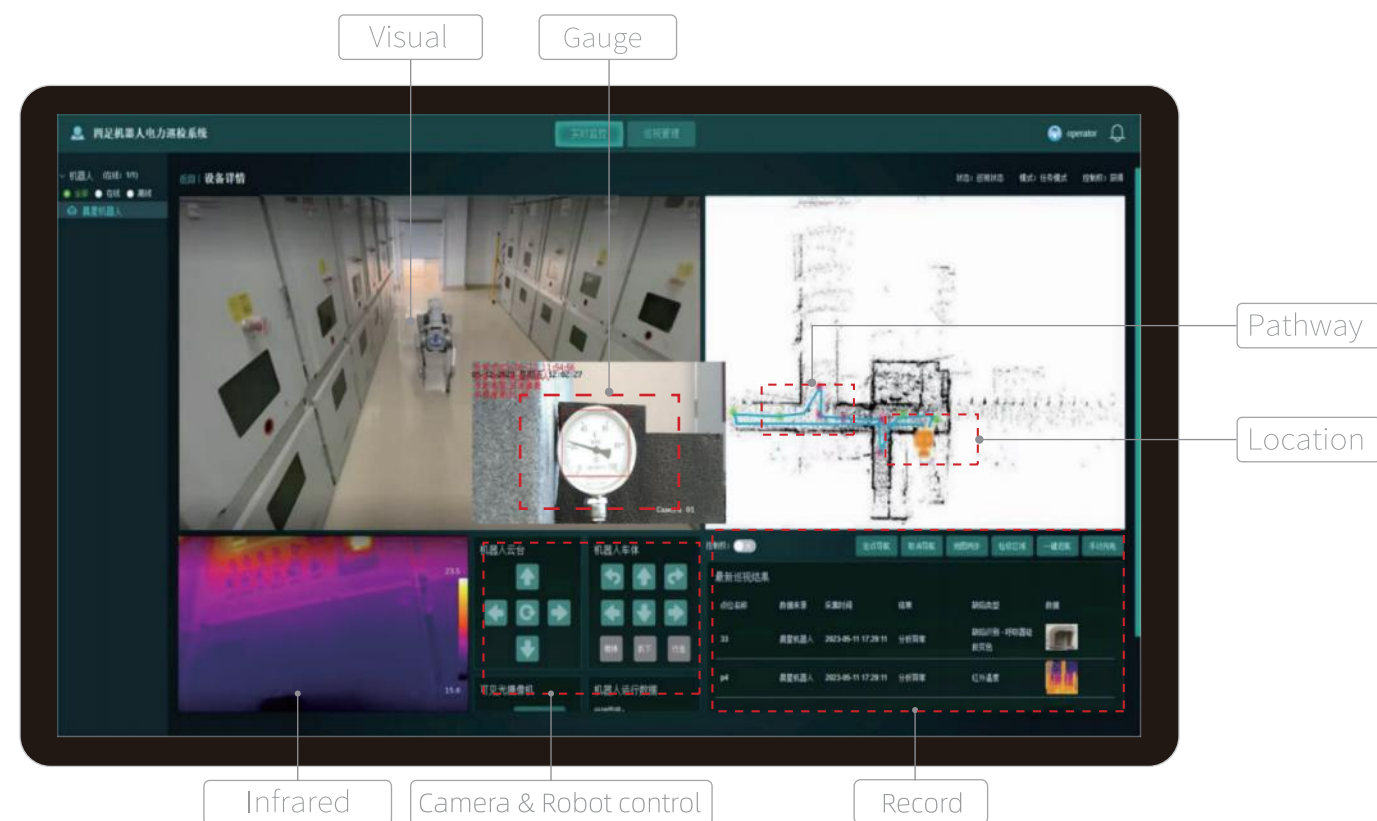


Stimulation
Prediction Analysis

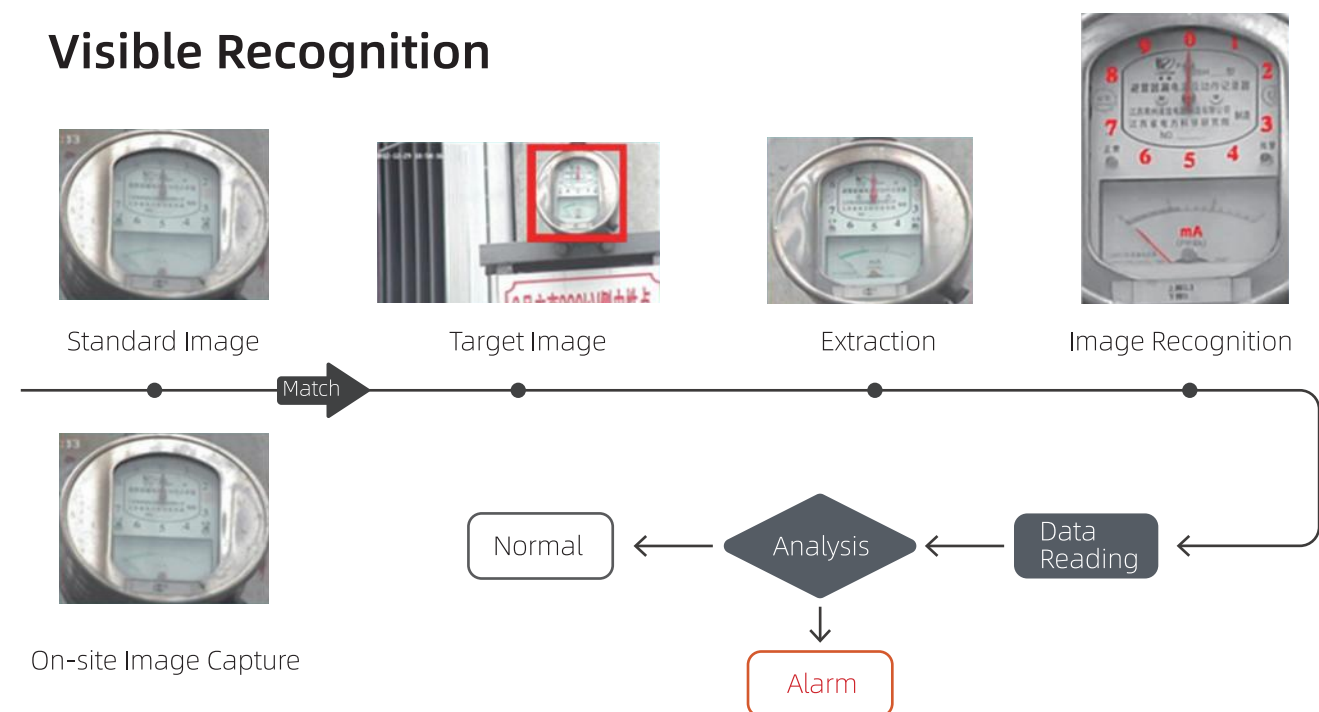


- INTELLIGENT PATROL INSPECTION
- **Smart Inspection Platform**

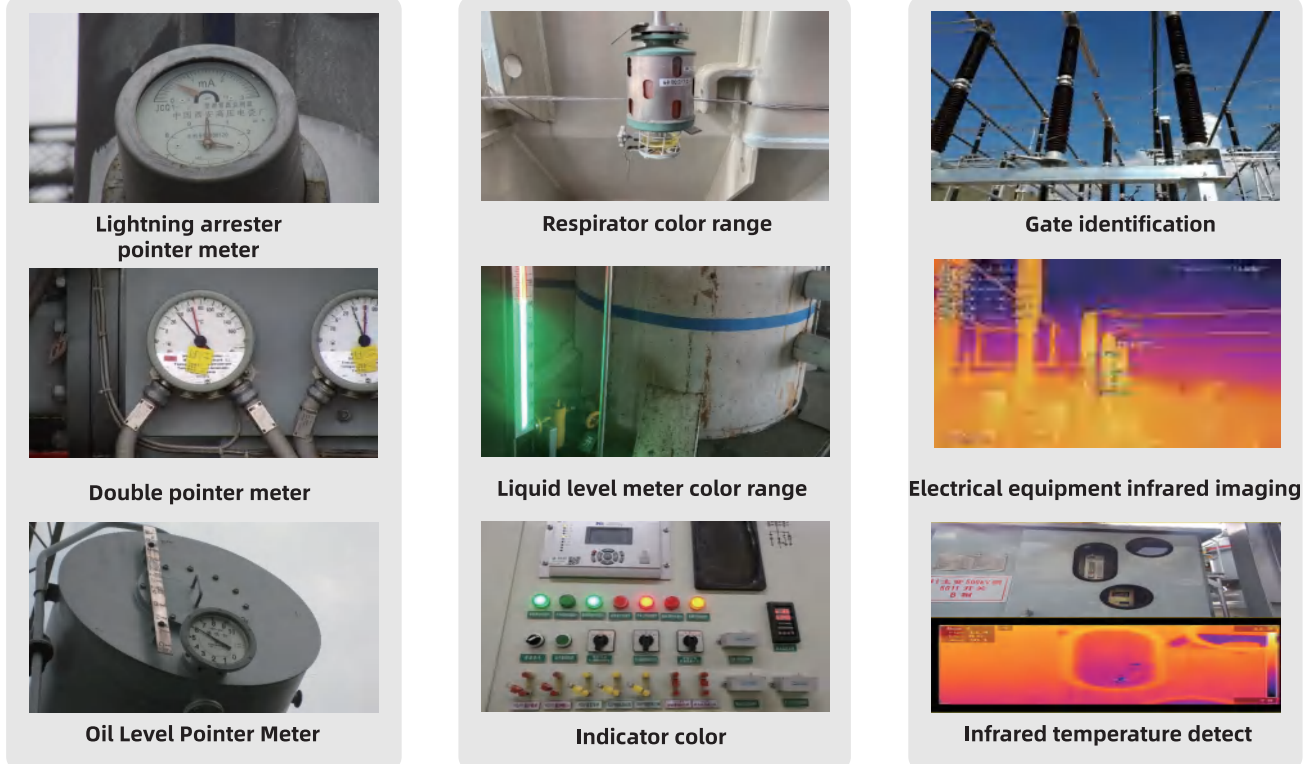
System & Functions



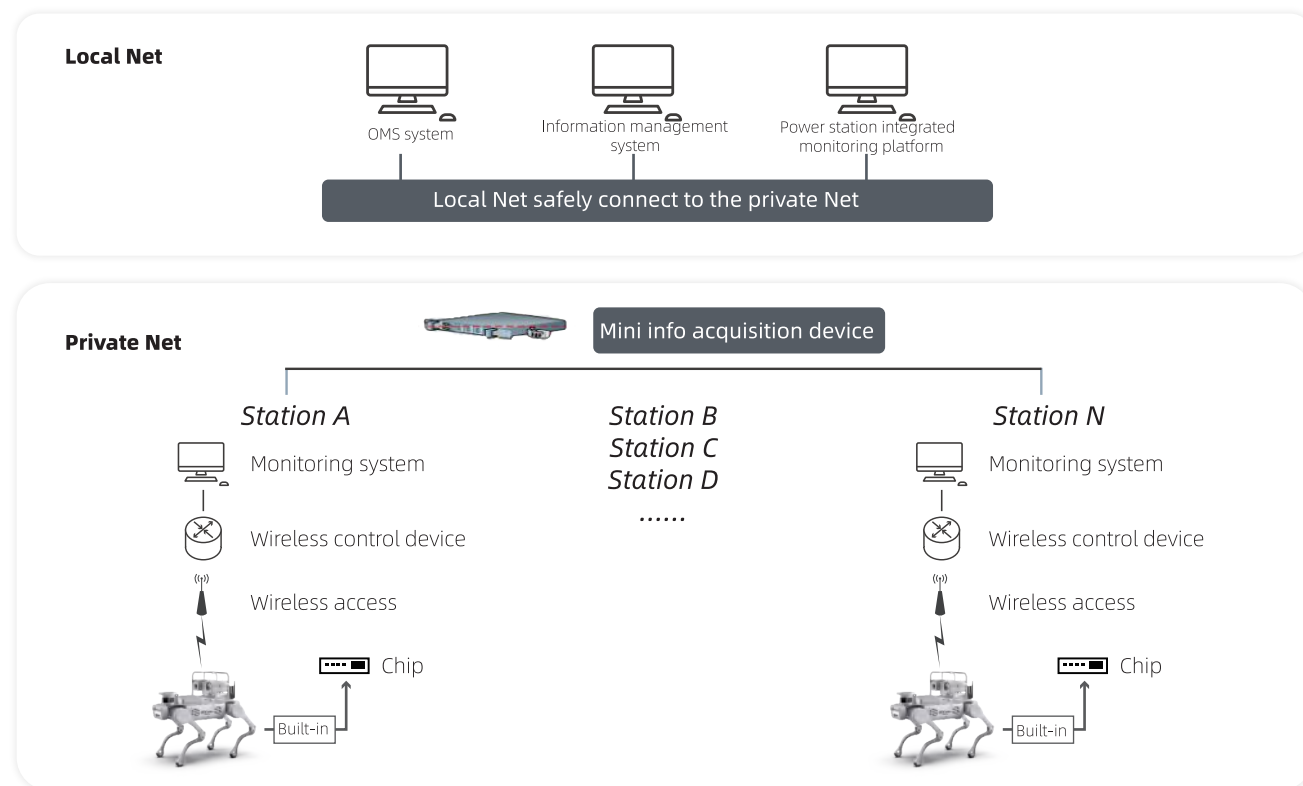
Visible Recognition



Visible Recognition



Network



- X20 QUADRUPED ROBOT
- Application Case

Inspection in Zhejiang State Grid Power Station



Background

The space at the inspection point of the substation is narrow and the environment is complex. It is necessary to climb stairs, across various obstacles to enter the indoor area; the outdoor area has different surfaces such as stone, grass, and mud. Manual inspection is difficult to fully meet the requirements of safe operation of modern substations, and the traditional inspection robots are mostly wheeled, which can not continuously work on irregular ground. If the environment is modified, the cost is huge.

Outcome

A converter station in Zhejiang used X20 intelligent quadruped robot for power inspection. As a smart machine that shows strong mobility like walking, running, jumping, and climbing, and being able to operate inspections without changing the original environment. After long-term testing, X20 showed high adaptability to cobblestones, grass, slopes, and other unstructured outdoor terrains. For the first time in 2022, X20 has completed the full process of robot dog inspection with data uploads, data analysis, generating results & reports, and defect warnings.

Significantly Improve Efficiency

Unmanned/Less manned

Only 1 robot dog for $\pm 800\text{kV}$ EHV converter station

In & Out Door Inspection

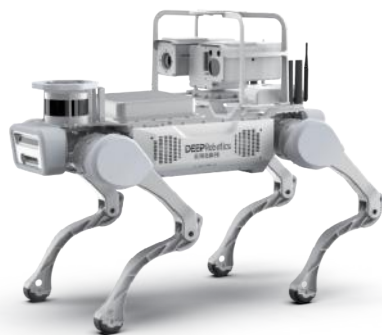
1 robot dog full-scene coverage

Shorten Inspection Distance

Boots efficiency, reduce workload

Reduce Operators' workload

Inspection under hash condition like storm, hail, low temp



Improve Level of Digitalization

Full access to the central control system, upload real-time data

24h All-Weather Operation

Operator can know all situation in house (from far distance)

All-Terrian Full-Scene Coverage

Detect defects in time, prevent accident, and ensure safe operation of all devices

Other Application Cases



A customized integrated robot base on Jueying. Until the end of Jan 2022, the robot has conducted power station inspection 87 times, a total reduce manual inspection work time by 380h, and participated in remoted emergency treatment 5 times, reducing manual handling 35h.

Through the secondary development of Jueying X20, the device now has been deployed in a power station in the XiongAn district, which effectively achieves full-scene coverage auto-inspection.



A secondary developed robot base on Jueying with a robot arm, the robot has been deployed in Stat Grid in Hebei province, and the new X20 upgrade will soon be used.



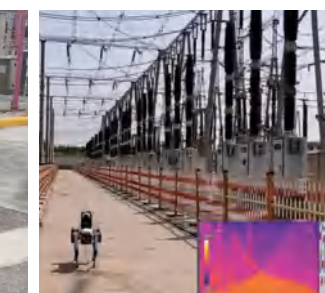
in Zhejiang



in Yunnan



in Yunnan



in Shanxi