DEEPRobotics
云深处科技

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

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DEEPRobotics
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Quadruped Robot

Smart Power Patrol Inspection Solution

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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 intelligenlization 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

Jueying 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

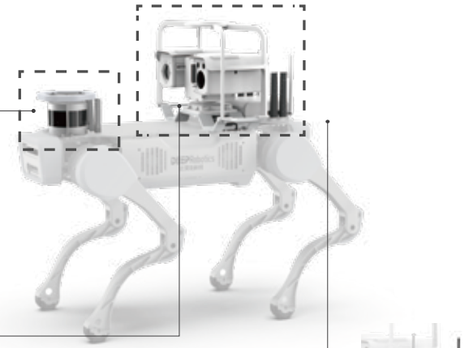
Auto-Navigation

Locating precision <3cm

Industrial Protection

Water-proof, Dust-proof, All-weather

Functional Module



Module 16 Laser-beam LiDAR

Indicators
Range：150m
Vertical FoV：-15°～+15°
Frame Rate：5Hz～20Hz
Points Per Second：300,000pts/s(Single Return)
600,000pts/s(Dual Return)

Module T-shape Thermography PTZ Bi-Spectrum Camera

Indicators
Visible Light: 55-160mm 32x optical zoom，16X digital zoom, Max.image resolution 2506×1440
Infrared: Resolution 384×288, thermography focal length 15mm，Field of view 24.55°(H)×18.54°(V)，precision of thermal detection ±2 ℃，Rang of thermal detection (-20℃~150℃，0℃~550℃)
Camera: Horizontal range 360° vertical range -90°~+90°，preset precision ±0.1，IP67 protection level

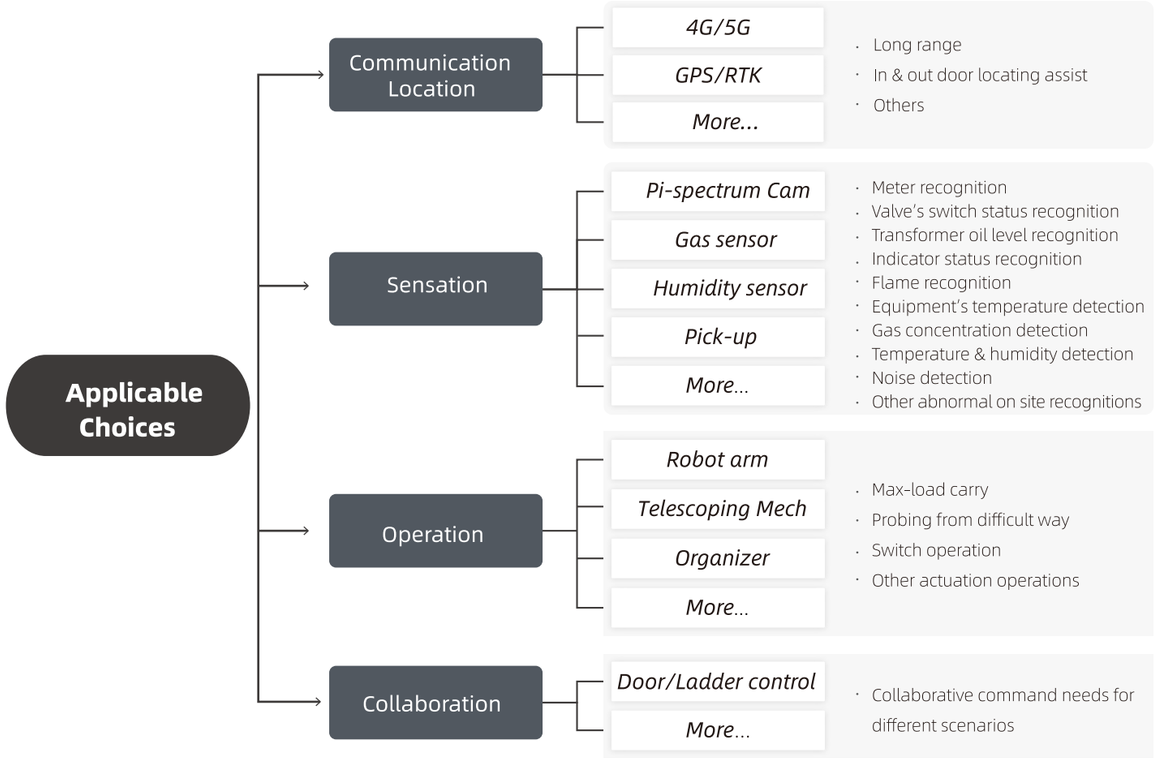
features
- Fully meet the needs of shock absorbing and lock-in to ensure stabilization during the operation with target precision of ±0.1°.
- Support auto-aperture, auto-focus, auto-color balance, black light compensation, noise balance, day-night lighting shift, behavior analysis, fire detection, fire faults alarm, etc.
- Provide SDK for secondary development, meet the needs of image transmission, smart sensing, faults alarm, and other required patrol inspection functions.

Module Industrial-grade Wireless Roaming Router

Indicators
- Fast Roaming < 50ms
- Support various transmitting functions such as VLAN、route、NAT、Qos、VPN、firewall. Support work mods such as AP，Bridge，Station，and MESH.
- 300Mbps physical layer，MIMO 2T2R，dual-polarized antenna
- Support WB 4920MHz-6100MHz，support plenty of countries' frequencies（IEEE802.11d）
- Max 30dBm transmitting power，receiving sensitivity -96dBm
- Effective transmission distance more than 1km when combined with antenna
- Range of functional temp -40~75℃

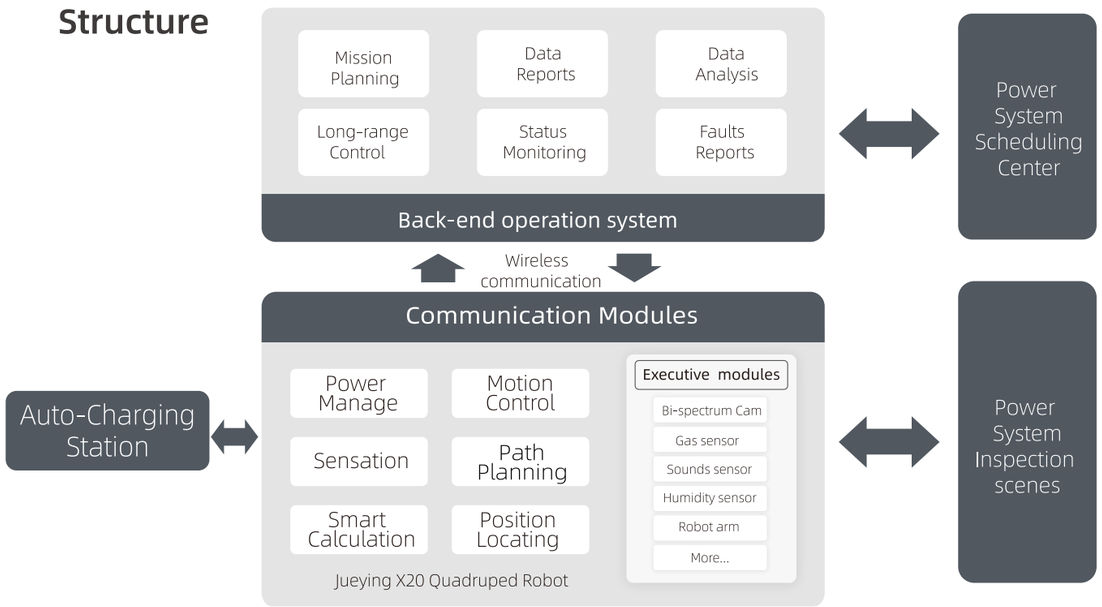
features
For industrial revolution 4.0, logistics and warehousing, intelligent manufacturing, intelligent robots, and other industrial characteristics can soon be deployed and establish a high-speed, stable, safe, and reliable wireless network; which can improve automation and smart management, and meet all kinds of smart robot long-range control, images transmission and other industrial application scenarios needs.

Modules Structure

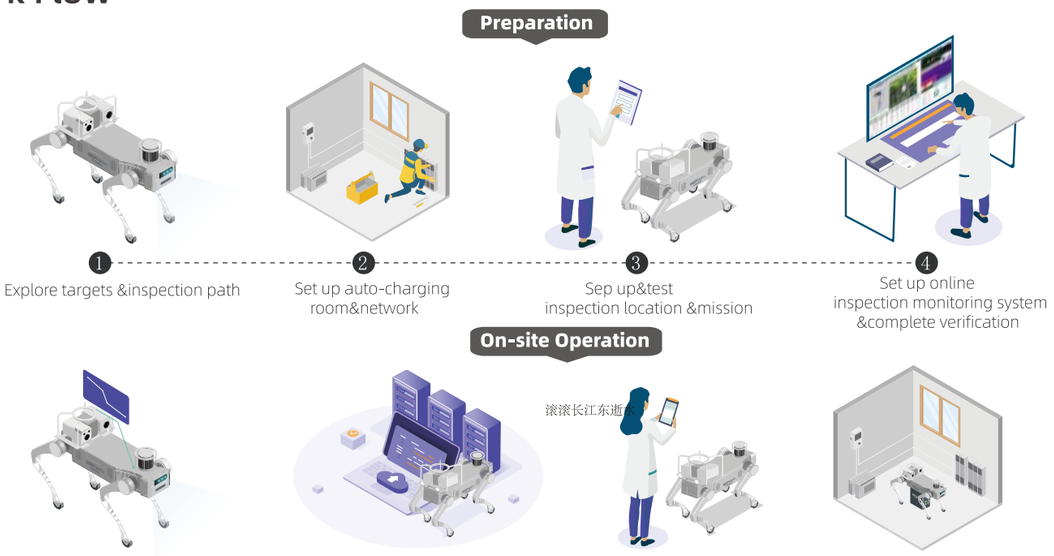


Smart Power Inspection Solution

Structure



Work Flow



A. Autoinspection to particular location on preset timing
B. Replan inspection path based on unexpected situations,and prior to abnormal location

“Digital Twins”

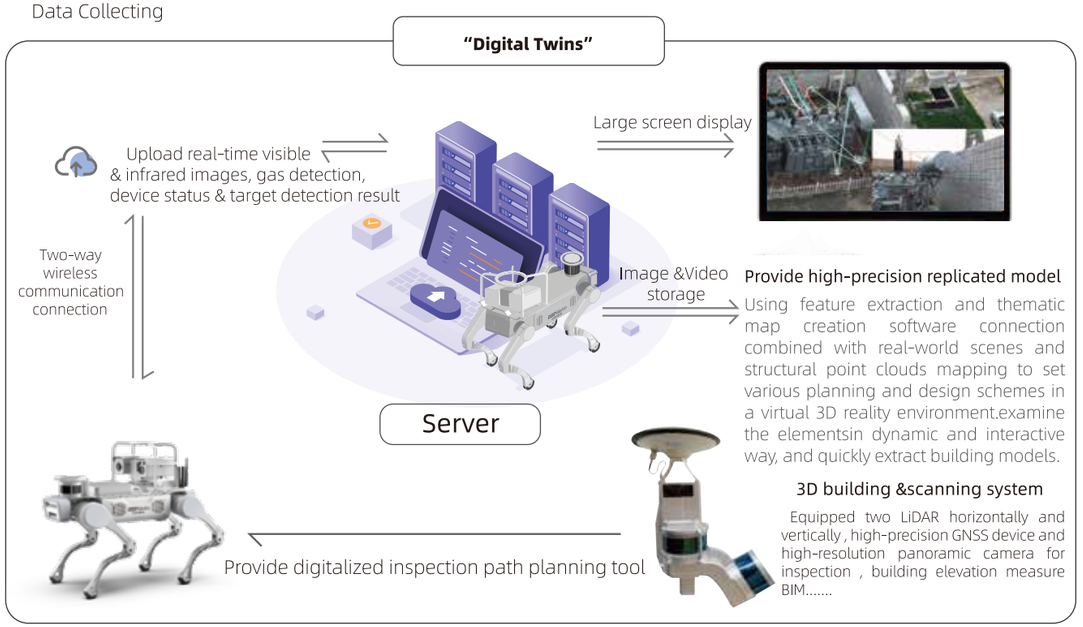
Hi-Precision Point Cloud Data Collecting

1:1 Replicated Real Site Environment

Quick Deployment

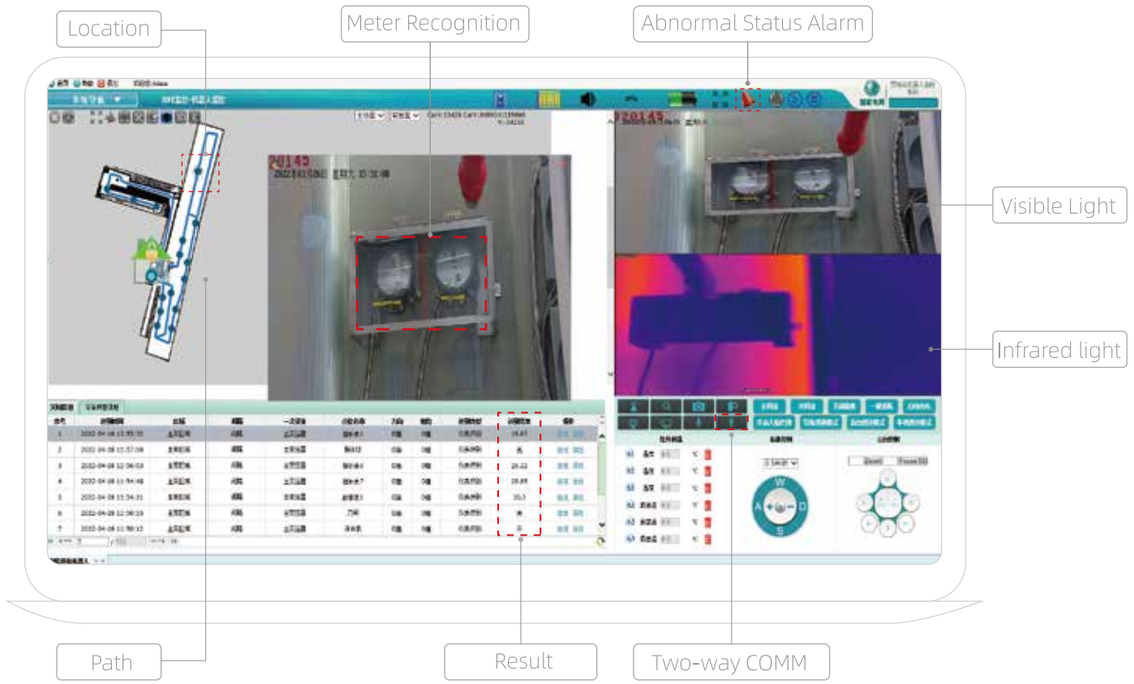
Inspection In Details

Stimulation Prediction Analysis

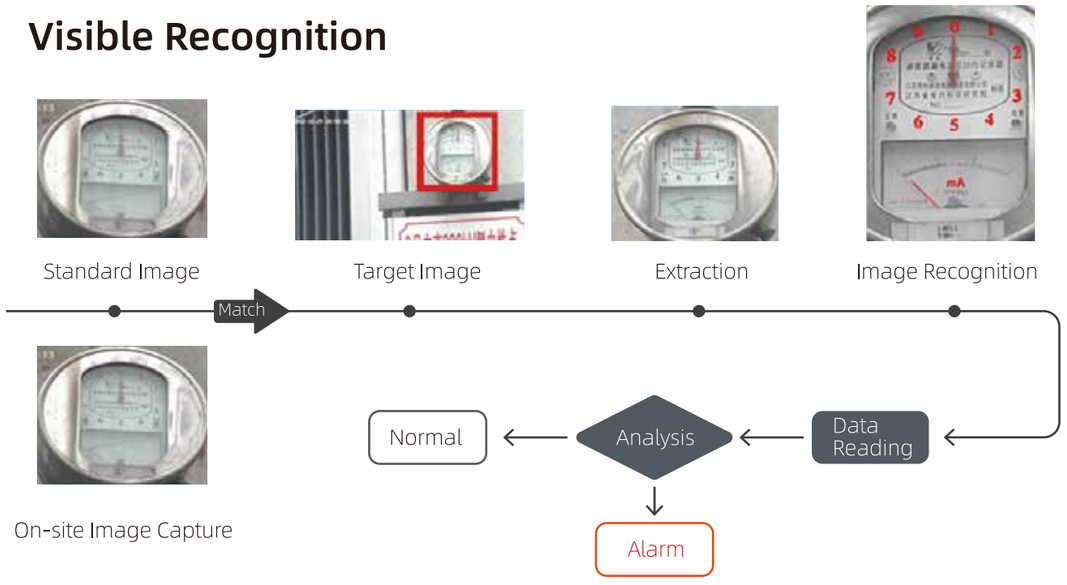


Smart Inspection Platform

System & Functions



Visible Recognition



Visible Recognition

Lightning arrester pointer meter

Double pointer meter

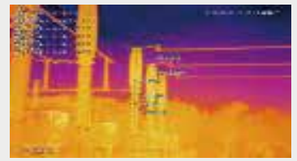
Oil Level Pointer Meter

Respirator color range

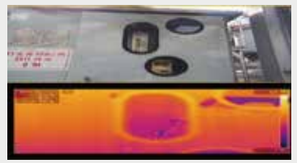
Liquid level meter color range

Indicator color

Gate identification



Electrical equipment infrared imaging

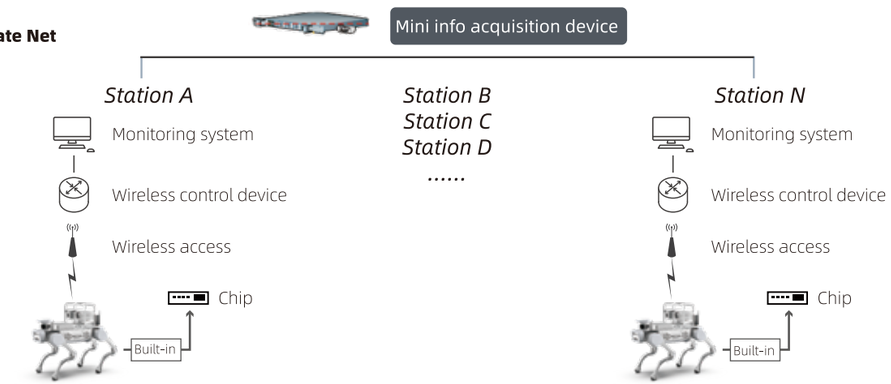


Infrared temperature detect

Network

Local Net

Private Net



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 Jueying 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, Jueying X20 showed high adaptability to cobblestones, grass, slopes, and other unstructured outdoor terrains. For the first time in 2022, Jueying X20 has completed the full process of robot dog inspection with data uploads, data analysis, generating results & reports, and defect warnings.

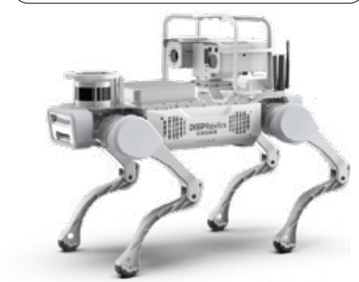
Significantly Improve Efficiency

Unmanned/Less manned
Only 1 robot dog for ±800kv 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