DEEPERCEPTION

Intelligent Inspection Operation and Maintenance | Digital Operation | Grid-related Services | High Temperature Thermal Field Modeling and Control

INNOVATION BREAKTHROUGH LEADERSHIP

INTELLIGENT ENERGY AND POWER COMPREHENSIVE MANAGEMENT SOLUTION PROVIDER

COMPANY INTRODUCTION

Beijing deeperperception technology co., ltd.(abbreviated as " Deeperperception ")was established in June 2017. It has set up 8 subsidiaries and 3 offices across the country. It is a national high-tech enterprise with intelligent energy and power as its main business and a "specialized, refined, distinctive and innovative" small and medium-sized enterprise in Beijing. It has obtained multiple certifications including CMMI, ISO and aviation enterprise certifications, and has been serving the five major power generation groups, six smaller power generation groups and local state-owned energy enterprises all year round. It has twice appeared on CCTV News as a representative of hardcore technology enterprises.

Deeperperception empowers different subdivisions of the energy and power fields with artificial intelligence technology, helping enterprises reduce operating costs, improve power generation efficiency, standardize management processes and enhance power quality. It is also committed to becoming the best domestic comprehensive management solution provider for intelligent energy and power.

Deeperperception has always adhered to the development path of independent research and development and independent innovation. By leveraging its technical expertise in unmanned aerial vehicle flight control, artificial intelligence pattern recognition and the robotics field, it has launched a complete set of intelligent inspection, operation and maintenance solutions for new energy power stations. Up to now, it has applied for more than 100 intellectual property rights in total, including invention patents.

Deeperperception attaches great importance to the combination of technology and industry. Its core employees are stationed on the front line of the site all year round, deeply grasping industry standards and understanding business needs. They continuously improve the product implementation through engineering optimization and interdisciplinary approaches and continue to create new value for customers.

8+ SUBSIDIARY

3+ OFFICE

BEIJING DEEPERPERCEPTION
Corporate Headquarters Algorithm Research Center

WUXI HAINA INTELLIGENCE
Engineering Research and Development Center

DEEPERPERCEPTION (HANGZHOU)

DEEPERPERCEPTION (CHENGDU)

DEEPERPERCEPTION (JINAN)

HAINAN HAINA INTELLIGENCE
Smart Offshore Wind Power Business Department
International Headquarters

JIANGSU DEEPERPERCEPTION
Manufacturing Center

FUJIAN DEEPERPERCEPTION
Intelligent operation and maintenance department
Operation and maintenance center

REGIONAL OFFICES
Shenzhen Office Yinchuan Office Urumqi Office

COMPANY QUALIFICATIONS

BEIJING'S SPECIALIZED, SOPHISTICATED, UNIQUE AND INNOVATIVE SMALL AND MEDIUM-SIZED ENTERPRISES

HIGH-TECH ENTERPRISE CERTIFICATE

QUALIFICATION CERTIFICATE FOR SERVICE CAPABILITY LEVEL OF CIVIL UNMANNED AERIAL VEHICLE ENTERPRISES

INVENTION COLUMN CERTIFICATE

COMPUTER SOFTWARE COPYRIGHT REGISTRATION CERTIFICATE

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UNMANNED AERIAL VEHICLE (UAV) INTELLIGENT INSPECTION OF WIND TURBINE BLADES

The intelligent inspection platform for wind turbine blades is an efficient inspection scheme for wind turbine blades constructed using unmanned aerial vehicles and AI algorithms. It can achieve fully automatic acquisition of all-round and dead-angle-free images of wind turbine blades. Paired with an intelligent defect analysis engine, it truly enables one-click takeoff and report output.

PRODUCT CHARACTERISTICS

- **STATIC INSPECTION:** ARBITRARY SHUTDOWN POSTURE, CLOSE-RANGE HIGH-DEFINITION SHOOTING, NON-HOVERING FLIGHT PATH.
- **DYNAMIC INSPECTION:** AUTOMATIC YAW RECOGNITION, AUTOMATIC MAINTENANCE OF SAFE DISTANCE, AND PRECISE CAPTURE OF BLADE TRAJECTORIES.
- **FULL COVERAGE:** WINDWARD, LEEWARD, LEADING EDGE, TRAILING EDGE, ENGINE ROOM, TOWER BARREL
- **ARTIFICIAL INTELLIGENCE:** INDUSTRY-LEADING, MILLIMETER-LEVEL DEFECT IDENTIFICATION, DEFECT LOCALIZATION, AND DEFECT CLASSIFICATION.
- **RESULT PRESENTATION:** PRECISE BLADE SPLICING, FREE SWITCHING BETWEEN TWO-DIMENSIONAL AND THREE-DIMENSIONAL DISPLAYS.
- **HANGAR SUPPORT:** FULL SUPPORT FOR HANGAR ACCESS IN BOTH DYNAMIC AND STATIC INSPECTIONS.

STATIC INSPECTION

Lock the wind turbine when it is shut down to ensure that its posture remains fixed. The unmanned aerial vehicle (UAV) approaches the wind turbine and flies around its blades to collect high-definition images and identify subtle defects on the surface of the blades.

Inspection condition	Inspection duration	Defect size
The fan shuts down. The wind speed is lower than 8m/s	20minutes	millimeter-level

DYNAMIC INSPECTION

The wind turbine operates normally. With the blades rotating, the unmanned aerial vehicle flies around the wind turbine, quickly collecting images of the blades and completing the inspection without sacrificing power generation.

Inspection condition	Inspection duration	Defect size
The wind speed of the fan is lower than 8m/s	10minutes	centimeter-level

DEFECT IDENTIFICATION

Missing parts, surface contamination, surface corrosion, paint repair, paint peeling, gel coat peeling, glass fiber corrosion, leading/trailing edge cracking, bulging, cracks, blade tip damage, lightning strike, icing, fracture (structural damage).

ACCURACY RATE: ≈92%

DETECTION RATE: ≈94%

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WORKFLOW FOR STATIC INSPECTION OF WIND TURBINE BLADES

① BASIC DATA PREPARATION

The center coordinates of the wind turbine, the blade dimensions, the nacelle dimensions and the tower diameter.

② INSPECTION ROUTE PLANNING

Modeling route generation, 3D modeling of wind turbines and inspection route generation.

③ AUTONOMOUS INSPECTION FLIGHT

Unmanned aerial vehicle (UAV) autonomous inspection and high-definition image acquisition.

④ INTELLIGENT DEFECT ANALYSIS

Inspection platform data management and intelligent defect identification.

WORKFLOW FOR DYNAMIC INSPECTION OF WIND TURBINE BLADES

BASIC DATA PREPARATION > INSPECTION ROUTE PLANNING > AUTONOMOUS INSPECTION FLIGHT > INTELLIGENT DEFECT ANALYSIS

Matrice 350 RTK + Zenmuse P1

Matrice 350 RTK + Autonomous flight controller + Dynamic flight load

HARDWARE EQUIPMENT FOR STATIC INSPECTION

HARDWARE EQUIPMENT FOR DYNAMIC INSPECTION

ONSHORE WIND POWER

OFFSHORE WIND POWER

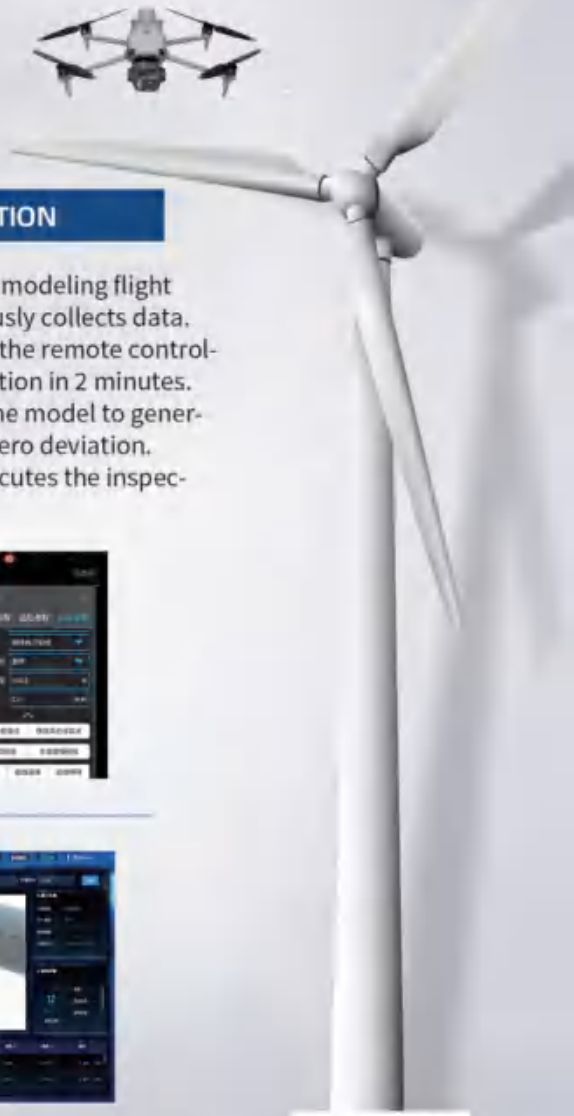
DEEPERCEPTION

STATIC INSPECTION OF WIND TURBINE BLADES BY UNMANNED AERIAL VEHICLE 2.0

The traditional inspection method of wind turbine blades not only has problems such as high operation risk, poor inspection effect, long cycle, and large data errors, but also the existing UAV inspection technology is faced with challenges such as strict requirements for the shutdown attitude, dependence on the experience of the drone operator, high hardware costs, and low data processing efficiency. Therefore, Tuzhi Technology has innovatively developed an intelligent static inspection solution for wind turbine blades by UAV based on "DJI Mavic 4E and online 3D modeling analysis".

3-STEP INTELLIGENT INSPECTION

20 MINUTES, THE FULL INSPECTION OF A SINGLE UNIT CAN BE EFFICIENTLY COMPLETED.



一、BASIC DATA COLLECTION

Collect parameters such as the GIS coordinates of the wind turbines, hub height, wind turbine rotor radius, etc., and establish an information database of the wind turbines in the wind farm.

二、INTELLIGENT OPERATION

1. Automatically generate the modeling flight path, and the UAV autonomously collects data.
2. Perform local modeling via the remote controller to complete 3D reconstruction in 2 minutes.
3. AI automatically analyzes the model to generate an inspection route with zero deviation.
4. The UAV autonomously executes the inspection and safely returns.

三、AI-BASED DEFECT RECOGNITION

The inspection data is uploaded to the integrated intelligent inspection platform for wind power, photovoltaic power and transmission lines. The AI algorithm accurately identifies the defects and automatically generates an inspection report.

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FOUR CORE ADVANTAGES SET A NEW BENCHMARK IN THE INDUSTRY

SAFE OPERATION

Based on the DJI M4E drone, advanced flight control and obstacle avoidance technologies, as well as excellent wind resistance capabilities, ensure flight safety.
The global flight route and the 3D visualization of the wind turbine model make the flight path clearly visible. The intelligent collision detection simulation allows for worry-free flying without any concerns.

ULTRA-LOW THRESHOLD

Online modeling with the remote controller doesn't require an internet connection, and 3D real-scene modeling can be completed within two minutes.
Based on the DJI Pilot2 remote controller APP, it conforms to the habits of the vast majority of pilots, and operations can be completed with simple clicks.
With intelligent model analysis, it can match the posture of any wind turbine, perfectly track the arc of the blade tip, and ensure that key positions are not missed during shooting.

AI INTELLIGENT ANALYSIS

AI can identify defects at the millimeter level, covering eight major categories of defects, with an accuracy rate of over 90%. Visualized reports will be automatically generated, including damage location and repair suggestions.

REDUCE COSTS AND INCREASE EFFICIENCY

The full inspection of a single wind turbine, from takeoff to landing, only takes 20 minutes.
It doesn't require any third-party hardware devices, and the comprehensive cost is only 35% of that of traditional solutions.
For on-site operation, only a drone and a remote controller are needed. One person operating one drone can start the work with a light load and without any burden.

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COMPREHENSIVE HEALTH MANAGEMENT SYSTEM FOR WIND TURBINE BLADES

To address the industry challenges of high costs caused by wind turbine blade failures, as well as the inefficiency and high risks associated with traditional manual inspections, Tuzhike Technology has developed an innovative intelligent monitoring solution that integrates multiple technologies. This solution employs a "multi-in-one" monitoring system that combines vibration monitoring, image recognition, lightning protection system monitoring, and multispectral inspections. By integrating these technologies with neural network algorithms and big data analysis, the system enables real-time detection of blade surface defects, precise identification of internal damage, tracking and early warning of lightning strike events, and detection of hidden defects, providing comprehensive health monitoring. This system not only significantly improves inspection efficiency and safety, but also reduces maintenance costs by more than 50% through intelligent diagnosis and early warning of both internal and external defects, offering an integrated health management service for wind turbine blades from condition sensing to intelligent diagnosis.

BLADE VIBRATION MONITORING SYSTEM

BLADE LIGHTNING CURRENT MONITORING SYSTEM

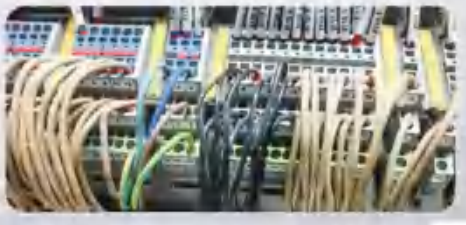
LIGHTNING ARRESTER WIRE BREAKAGE MONITORING SYSTEM

INTEGRATED FAULT DIAGNOSIS SYSTEM

REAL-TIME VIDEO INSPECTION SYSTEM FOR BLADES

UAV-BASED MULTI-SPECTRAL PATROL INSPECTION SYSTEM FOR BLADES

Due to the lack of comprehensive methods for inspecting and evaluating the overall condition of wind turbine blades, data from different sources remain isolated, and various systems are incompatible, making it difficult to achieve a full, dynamic, and continuous monitoring of blade health. Additionally, some inspection methods are affected by harsh environmental conditions such as low temperatures and high altitudes, leading to reduced accuracy and requiring auxiliary means for verification. Therefore, this solution aims to achieve comprehensive monitoring of the blades and integrate data from multiple sources for unified analysis.



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Shandong Region: Mr. Gu, 15201227271

A COMPREHENSIVE CONDITION MONITORING SCHEME FOR WIND TURBINE BLADES BASED ON MULTI-SOURCE DATA FUSION

Blade Vibration Monitoring:
A tri-axial low-frequency vibration sensor is installed inside each blade to monitor the vibration parameters in the axial, flapping, and edgewise directions. By comparing the data from all three blades, structural anomalies in the blades can be detected.

Blade surface video monitoring:
A camera pan-tilt unit is installed on the nacelle weather vane bracket. By utilizing artificial intelligence algorithms such as machine vision and image analysis, the system enables real-time monitoring and analysis of blade surface video images, providing timely early warnings for defects such as cracks and damage.

Blade lightning current and lightning arrester wire breakage monitoring:
The system monitors whether the lightning protection wire is broken. In the event of a lightning strike on the blade, the system immediately triggers an alarm, detects the intensity of the lightning energy, and notifies maintenance personnel to shut down the turbine for inspection in order to prevent secondary damage.

Multispectral intelligent inspection:
Multispectral intelligent inspection is used to detect potential faults or defects on wind turbine blades, including missing components, surface contamination, corrosion, repainting, paint peeling, gel coat delamination, fiberglass corrosion, leading/trailing edge cracking, blistering, cracks, tip damage, lightning strikes, ice accretion, and structural fractures. The inspection is carried out using a drone equipped with a multispectral camera, which collects blade images. AI algorithms are then applied to process and analyze the images, accurately identifying the type and location of defects. The inspection results are fed back for fault diagnosis and analysis within the system.

CORE FEATURES AND HIGHLIGHTS

Comprehensive monitoring:
By collecting data through vibration sensors, image sensors, audio detection, and lightning protection systems, the system determines whether a fault exists, triggering alarms and enabling coordinated operation.

Combining real-time monitoring with comprehensive inspection:
Cameras and microphones on the nacelle monitor the blade conditions in real time to enable early fault warning; the UAV inspection system performs detailed inspections of the blades to accurately locate faults.

Lightning Arrester Line Real-time Monitoring:
The system continuously monitors the conductivity status of the lightning arrester line and issues early warning signals when a conductivity issue is detected. Advanced blade lightning arrester line detection technology is employed, which evaluates the line' s load-carrying and conductive performance by measuring the weak charge carried by the arrester line, thereby identifying potential issues such as line disconnection or poor contact. This method is significantly more efficient than traditional manual or UAV-based lightning protection inspections.

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EP-INSPECT-OR001

INDOOR OVERHEAD RAIL ROBOT

OR001 IS AN INTELLIGENT INDOOR MACHINE ROOM INSPECTION ROBOT DEVELOPED BY TUZHI TECHNOLOGY FOR THE CHARACTERISTICS OF THE POWER INDUSTRY. EQUIPPED WITH HIGH-PRECISION SENSORS SUCH AS VISIBLE LIGHT CAMERAS, INFRARED THERMAL IMAGERS, AND PARTIAL DISCHARGE DETECTORS, THE ROBOT CARRIES OUT INSPECTIONS OF POWER EQUIPMENT, UPGRADING THE ORIGINAL MANUAL INSPECTION OPERATIONS TO AUTOMATIC MACHINE INSPECTIONS.

PRODUCT FEATURES

- **SLIDING CONTACT LINE POWER SUPPLY AND NETWORK:**
  Supports 7×24-hour uninterrupted inspection.
- **HIGH-STRENGTH LIFTING ARM:**
  Enables full-coverage inspection of indoor cabinets at different heights.
- **SAFETY PROTECTION:**
  Detects obstacles in the travel space through laser sensors to achieve autonomous and safe operation.

BASIC FUNCTIONS

- STATE AND VALUE RECOGNITION FOR INDICATOR LIGHTS, PRESSURE PLATES, POINTER METERS, SWITCH STATUS, ETC., WITH A READING ERROR OF LESS THAN 5%.
- EQUIPMENT TEMPERATURE MEASUREMENT
- EQUIPMENT PARTIAL DISCHARGE DETECTION
- SOUND ACQUISITION AND REMOTE TRANSMISSION OF OPERATING EQUIPMENT
- REMOTE VOICE INTERCOM
- ANALYSIS AND ALARM FUNCTIONS FOR EQUIPMENT DETECTION DATA
- ON-SITE ENVIRONMENTAL TEMPERATURE, HUMIDITY, AND GAS DETECTION
- TWO-WAY INFORMATION INTERACTION BETWEEN THE ROBOT AND LOCAL BACKGROUND
- ANTI-COLLISION FUNCTION

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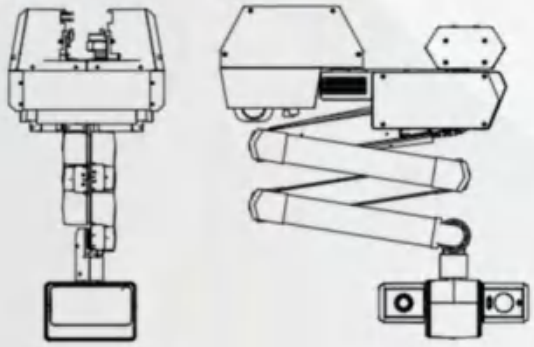
THREE - VIEW DRAWINGS



SYSTEM ARCHITECTURE

RECOMMENDED ACCESSORIES

APPLICATION SCENARIOS

It can be widely applied to indoor environments such as distribution rooms, relay protection rooms, switch rooms, GIS rooms, and mechanical rooms, reducing the burden on operation and maintenance personnel.

APPLICATION CASES

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INSPECTION OF THE PROGRESS AND QUALITY OF PHOTOVOLTAIC INFRASTRUCTURE CONSTRUCTION

For the construction of centralized plain, mountainous, floating photovoltaic power stations as well as distributed power stations, drones are used to collect images at the construction site, generating orthophoto maps and image point cloud data. These data can automatically identify construction progress markers such as strings, brackets, and inclined beams. It can cooperate with the hangar to achieve remote automated inspections.

PRODUCT CHARACTERISTICS

- DIRECTLY PARSE THE DATA OF BID SECTIONS, SUB-ARRAYS, AND STRINGS IN CAD.
- AUTOMATICALLY GENERATE INSPECTION ROUTES FOR SUB-ARRAYS AND EXECUTE THEM AUTOMATICALLY WITH THE HANGAR.
- SUPPORT TERRAIN-FOLLOWING FLIGHT PATH PLANNING FOR PRECISE SHOOTING OF THE CONSTRUCTION STATUS.
- THE AI ALGORITHM IDENTIFIES THE POSITIONS OF STRINGS AND CONDUCTS QUALITY INSPECTIONS ON THE INCLINATION ANGLES OF STRINGS, BRACKETS, AND INCLINED BEAMS.
- GENERATE HIGH-PRECISION ORTHOPHOTO IMAGES TO VIEW THE PANORAMIC VIEW OF THE OVERALL STATION CONSTRUCTION PROGRESS.
- STATISTICAL RESULTS OF THE CONSTRUCTION OF BID SECTIONS AND SUB-ARRAYS AT ANY TIME

DEFECT IDENTIFICATION

Photovoltaic string

Photovoltaic mounting bracket

Photovoltaic inclined beam

ACCURACY RATE:

Photovoltaic string >97%

Photovoltaic mounting bracket >98%

Photovoltaic inclined beam >97%

DETECTION RATE:

Photovoltaic string >100%

Photovoltaic mounting bracket >98%

Photovoltaic inclined beam >89%

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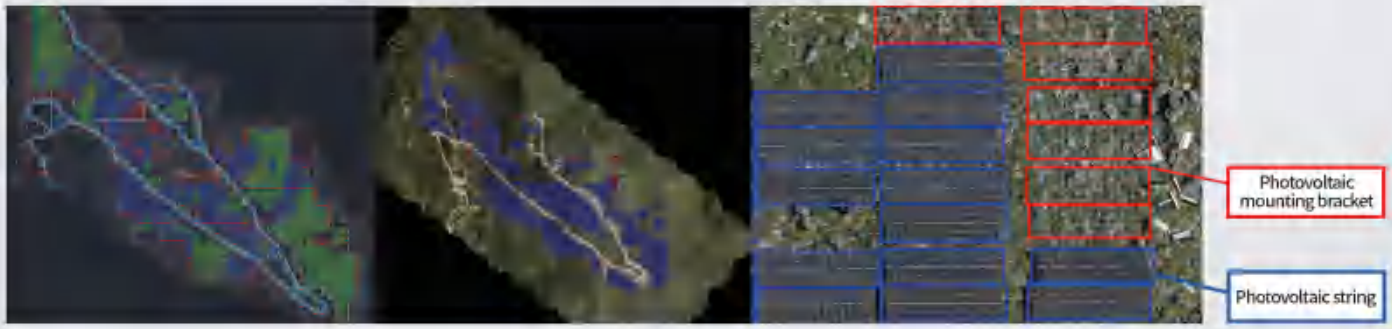
CONSTRUCTION PROGRESS TRACKING CONSTRUCTION QUALITY TRACKING

CAD PARSING AND MATCHING

Formulate CAD drawing standards, automate the CAD analysis process, extract structured data, and match it with the image recognition data.

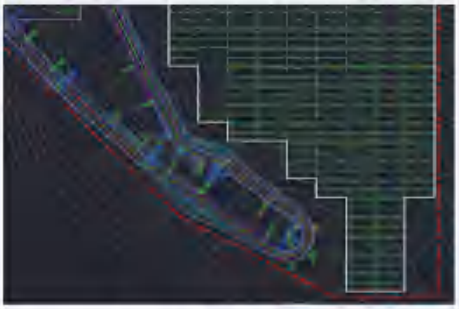
POWER STATION IMAGE RECOGNITION

Identify the brackets and components in the orthophoto, and extract the geographical locations of the relevant parts.



TRACKING OF COMPONENT INSTALLATION POSITIONS

Carry out the identification of brackets and components in the orthophoto, extract the geographical locations of the relevant parts, and perform position matching with the CAD drawings to ensure the correct installation positions of the bracket components.



THE POSITION OF
THE STRING IN CAD

THE POSITION OF
THE ACTUALLY INSTALLED STRING

ILLEGAL INSTALLATION AND
MISSING INSTALLATION

IDENTIFICATION OF THE INSTALLATION ANGLES OF PHOTOVOLTAIC MODULES

Extract the brackets and photovoltaic modules from the three-dimensional point cloud data. Then, based on their structural features, identify the orientations of the photovoltaic modules and compare them with the drawings to ensure that the installation angles of the photovoltaic modules comply with the design specifications.

CALCULATION OF THE
STRING POSITION (X, Y, Z)

INCLINATION ANGLE CALCULATION

ACTUAL INSTALLATION INCLINATION

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UNMANNED AERIAL VEHICLE (UAV) INTELLIGENT INSPECTION FOR PHOTOVOLTAIC POWER STATIONS

To meet the operation and maintenance requirements of plain, mountainous, floating, and distributed photovoltaic power stations, unmanned aerial vehicles (UAVs) are used for highly efficient inspections of photovoltaic modules. These UAVs can automatically identify defects such as hot spots, diode problems, and zero-current issues, and automatically classify the defect levels. At the same time, they achieve precise defect location at the module level. Handheld devices are used for navigation to complete the recheck and defect elimination. It also supports the access of original string IV data or IV diagnosis results, enabling the integrated analysis of IV-CV.

PRODUCT CHARACTERISTICS

- SUPPORT IV-CV INTEGRATED DIAGNOSIS, CONDUCT TARGETED INSPECTIONS ON LOW-EFFICIENCY STRINGS, ACCURATELY LOCATE FAULTY COMPONENTS, AND QUANTITATIVELY ANALYZE THE LOSS OF POWER GENERATION.
- PRECISELY LOCATE DEFECTS AT THE MODULE LEVEL AND VISUALLY PRESENT HIGH-DEFINITION 2D/3D MODELS OF THE POWER STATION.
- SUPPORT DEFECT NAVIGATION VIA HANDHELD PADS, AND COMPLETE DEFECT RECHECKS AND DEFECT ELIMINATION RECORDS WITH THE HELP OF INFRARED PROBES.
- SUPPORT FULLY AUTOMATIC INSPECTIONS IN THE HANGAR, AUTOMATICALLY IDENTIFY METEOROLOGICAL CONDITIONS, AND EXECUTE TASKS AT FIXED TIMES OR PERIODICALLY.
- THE AI ALGORITHM CAN RECOGNIZE, LOCATE, AND CLASSIFY CENTIMETER-LEVEL DEFECTS.
- SUPPORT THE ANALYSIS OF CAD SUB-ARRAY AND STRING DATA. DIVIDE SUB-ARRAYS AND NUMBER STRINGS ACCORDING TO THE REQUIREMENTS OF POWER STATION CONSTRUCTION (CUSTOM NUMBERING IS ALSO AVAILABLE).
- SUPPORT THE AUTOMATIC GENERATION OF INSPECTION ROUTES ACCORDING TO SUB-ARRAY AREAS, ACHIEVING FULL COVERAGE OF REGIONAL STRINGS. SUPPORT TERRAIN-FOLLOWING ROUTE PLANNING FOR ACCURATELY PHOTOGRAPHING DEFECTIVE COMPONENTS. ALSO SUPPORT THE GENERATION OF SELF-ADAPTIVE TRACKING ANGLE ROUTES FOR TRACKER STRING UNITS.

DEFECT IDENTIFICATION

- Dust accumulation on photovoltaic modules
- Partial shading
- Diode failure
- Weed shielding
- String open circuit
- Module breakage

ACCURACY RATE ≈ 92% **DETECTION RATE ≈ 94%**

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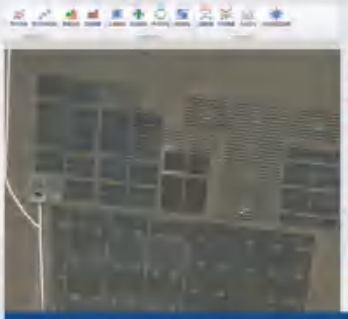
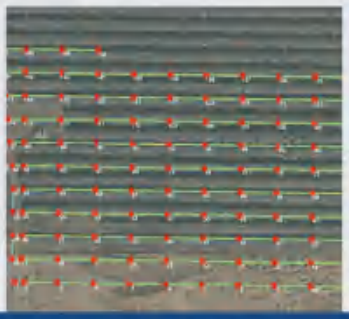
WORKFLOW FOR PHOTOVOLTAIC MODULE INSPECTION



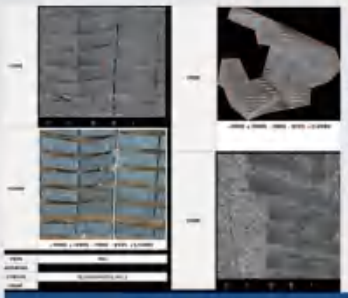
POWER STATION MODELING



ROUTE PLANNING

INSPECTION FLIGHT

INTELLIGENT RECOGNITION



AUTOMATIC
REPORT GENERATION

FAULT NAVIGATION
AND HANDLING

LIVE STREAMING
THROUGHOUT THE PROCESS

FULLY AUTOMATIC
INSPECTION

Matrice 350 RTK

Zenmuse H30T

DJI Airport 2

Matrice 350 Fixed hangar

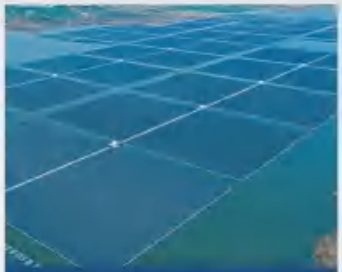
Vehicle-mounted hangar

HARDWARE DEVICES FOR INTELLIGENT INSPECTION OF PHOTOVOLTAIC POWER STATIONS

APPLICATION SCENARIO

MOUNTAINOUS
PHOTOVOLTAIC POWER STATION

PLAIN PHOTOVOLTAIC POWER STATION



PLAIN PHOTOVOLTAIC POWER STATION

PLATEAU PHOTOVOLTAIC POWER STATION

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UNMANNED LAND-BASED AIRCRAFT CARRIER PLATFORM FOR PV POWER STATIONS

Photovoltaic (PV) power stations typically occupy large areas, and traditional manual inspections are inefficient, risky, and difficult to fully cover. Drone inspections offer significant advantages: they can quickly reach any location and perform flexible inspections; through multi-angle high-definition imaging, they can accurately identify component damage, hotspots, and fire hazards. At the same time, they are not restricted by terrain and can autonomously plan flight paths and intelligently analyze data, greatly improving inspection efficiency and accuracy.

Fixed airports have limited coverage, while vehicle-mounted mobile airports still require manual operation. To maintain an unattended operation feature and improve coverage efficiency, the best solution is to use autonomous inspection vehicles equipped with drone systems. This approach not only expands the working range but also enables efficient and intelligent inspections.

INTELLIGENCE
Autonomous Mobility and Deployment Function

CONTROL
Automatic Takeoff, Landing,and Parking of Drones

CONTROL
Remote Monitoring and Management

SURVEY
Digital large-screen visualization presentation

UNMANNED VEHICLE AND DRONE COLLABORATIVE INSPECTION SYSTEM

The photovoltaic intelligent inspection system integrates advanced technologies such as artificial intelligence, big data, drones, unmanned ground vehicles, data fusion, and AI-based intelligent analysis. It is also integrated with a 3D digital twin subsystem to help energy enterprises achieve integrated management of photovoltaic areas. The system enables intelligent identification of various panel faults and defect tracking, thereby improving power generation efficiency and reducing safety risks.

Centered around drones and unmanned ground vehicles, the system is equipped with advanced sensors and combines intelligent control systems with self-diagnostic fault detection systems to perform centralized inspections and fully automated management of photovoltaic power stations. It aims to build a smart energy management platform that supports "unmanned operation, minimal on-site staffing, centralized monitoring, and intelligent maintenance."

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Southwest China Region: Mr. Tang, 13518136964
Northeast China Region: Mr. Chen, 13910439039
Shandong Region: Mr. Gu, 15201227271

UNMANNED VEHICLE AND DRONE COLLABORATIVE PATROL: CORE FUNCTIONS AND KEY FEATURES OF THE SYSTEM

High-Performance Mobility Chassis

The combination of independent suspension, Ackermann steering, and off-road tire design enables the unmanned vehicle to maintain stability and maneuverability even on rough and uneven terrain. The vehicle' s frame is built with a steel skeleton, ensuring long-term stability and durability for sustained operation in off-road conditions.

Autonomous Mobility and Deployment Function

The system is capable of driving and navigating on site roads through its own propulsion and navigation system, enabling it to flexibly reach designated locations. It can autonomously move and rapidly deploy within a certain range according to mission requirements.

Automatic Takeoff, Landing, and Parking of Drones

The system is equipped with an advanced automatic guidance system that enables precise control of the drone' s takeoff and landing. Inside the hangar, there are dedicated parking zones and securing devices to ensure the safe and accurate parking of the drone. Through sensors and control systems, the hangar can monitor the drone' s position and status in real time, enabling efficient drone scheduling and management.

Distant Takeoff and Landing Function for Drones

The entire system supports the capability of takeoff and landing at different locations. The unmanned ground vehicle (UGV) can take off from point A, and after takeoff, it continues moving to point B. Once the drone completes its mission, it lands at point B, thereby reducing battery consumption that would otherwise occur during a return flight.

Remote Monitoring and Management

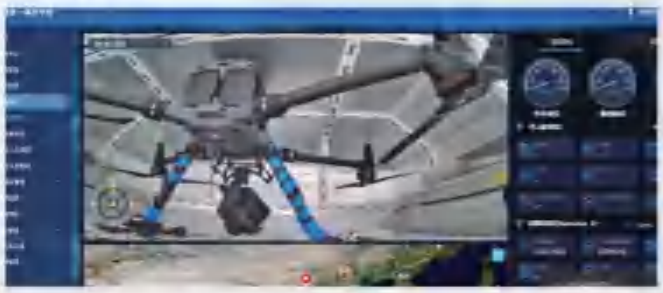
The system supports remote monitoring and management. Operators can monitor and control the operational status of the unmanned mobile hangar and the condition of the drones in real time, from anywhere via the network. In the event of any abnormalities, the hangar can automatically trigger alarms and send relevant information to the operators, enabling timely response and handling.

Visual Presentation

Through a digital display screen, the power station model and analysis results are presented in a more concise and user-friendly manner.

Mobile Power Replenishment Function for Drones

After the drone returns to the unmanned vehicle, the vehicle can provide power replenishment to the drone. During the charging process, the unmanned vehicle can move to the next takeoff location, significantly enhancing operational efficiency.



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EP-INSPECT-WR001

INTELLIGENT INSPECTION ROBOT

WR001 is an intelligent inspection robot developed by Tuzhi Technology for the characteristics of the power industry. Equipped with high-precision sensors such as visible light cameras, infrared thermal imagers, and noise sensors, the robot carries out inspections of power equipment, upgrading the original manual inspection operations to automatic machine inspections.

PRODUCT FEATURES

- UTILIZES 3D LASER MAPPING TECHNOLOGY TO CREATE A PRECISE POINT-CLOUD MODEL OF THE ENVIRONMENT, ENABLING EXCEPTIONAL ADAPTABILITY THROUGH REAL-TIME SPATIAL AWARENESS AND ACCURATE POSITIONING.
- EQUIPPED WITH INDEPENDENT SUSPENSION AND SHOCK ABSORPTION SYSTEMS, THE ROBOT NAVIGATES SLOPES UP TO 30° WITH STABILITY, ENSURING SEAMLESS OPERATION ACROSS UNEVEN TERRAIN.
- INTEGRATED SAFETY FEATURES INCLUDE LASER COLLISION AVOIDANCE, ANTI-FALL PHOTOELECTRIC SENSORS, AND EMERGENCY STOP BUMPERS, PROVIDING MULTI-LAYERED PROTECTION FOR RELIABLE AUTONOMOUS OPERATION.

BASIC FUNCTIONS

- **METER DETECTION:** Reads and inspects the status of various types of meters, with a reading error of less than 5%.
- **EQUIPMENT TEMPERATURE MEASUREMENT:** Temperature measurement accuracy reaches ±2% or ±2℃.
- **NOISE DETECTION:** Detect equipment noise (optional).
- **INTELLIGENT ALARM:** Analyzes measurement data and triggers alarms for threshold exceedances.
- **ENVIRONMENTAL LINKAGE:** Initiates inspection operations in response to environmental conditions (temperature, humidity, rainfall, and wind speed).
- **AUTONOMOUS CHARGING:** Completes charging automatically based on battery level.
- **SAFETY PROTECTION:** Adopts various advanced sensors to ensure the safe operation of the robot.

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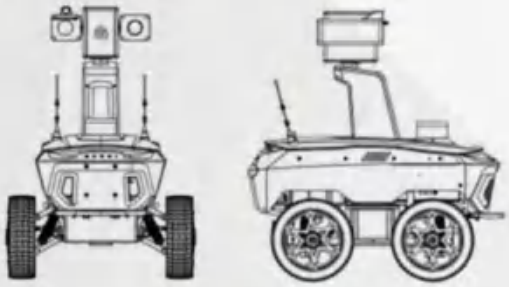
THREE - VIEW DRAWINGS



SYSTEM ARCHITECTURE

RECOMMENDED ACCESSORIES

APPLICATION SCENARIOS

It can be widely applied to outdoor environments such as substations, step-up stations, main power plant buildings, and traction substations, reducing the workload of operation and maintenance personnel.

APPLICATION CASES

DEEPERCEPTION

INTELLIGENT INSPECTION ROBOT FOR THE INNER CAVITY OF WIND TURBINE BLADES

The WTB-INSPECT-INR001 is the world's first lightweight intelligent inspection robot designed for the inner cavity structure of wind turbine blades. The robot is equipped with a four-wheel drive chassis, which can accurately adapt to the complex cavity environment. Through a remote controller, the robot can enter the inner cavity of the blade in a semi-autonomous way. With an ultra-high-definition panoramic camera and an AI visual analysis system, it can automatically identify and quantitatively evaluate defects such as bulges, wrinkles, delamination, and cracks at the millimeter level. At the same time, it generates a digital inspection report for manual review. It breaks through the pain points of traditional manual inspection, such as low efficiency, many blind spots, and high safety risks, and provides an intelligent solution for the full life cycle management of blades.

LIGHT

Lightweight design
User-friendly design

SMOOTH

All-terrain
Four-wheel drive
obstacle-crossing chassis

SURVEY

Panoramic vision
Fusion technology

INTELLIGENCE

Specialized AI intelligence
Defect diagnosis

THE WORLD'S FIRST LIGHTWEIGHT INTELLIGENT INSPECTION ROBOT FOR THE INNER CAVITY OF WIND TURBINE BLADES

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FIVE CORE ADVANTAGES SET A NEW INDUSTRY BENCHMARK

LIGHTWEIGHT AND CONVENIENT DESIGN

The overall weight is less than 8 kg (including the robot body and battery). When packed, it is as compact as a carry-on suitcase, allowing a single person to carry it to the nacelle of a wind turbine at a height of 100 meters. It can be quickly deployed at high altitude in just one minute. After inspecting one blade, the robot's battery can be replaced within one minute to quickly proceed to the next blade inspection.

MINIATURIZED MODULAR DESIGN FOR EXTREME INSPECTION OF DEEP BLADE CAVITIES

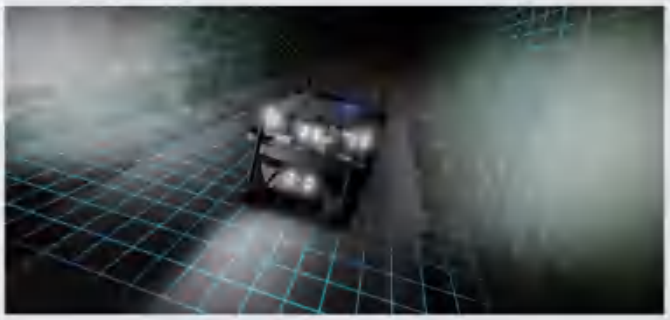
The control components and inspection equipment of the robot are specially designed for scenarios with narrow spaces. They are highly miniaturized and integrated. The minimum cross-section of the robot body is 22*21 cm, enabling it to reach the narrow cavity area at the blade tip that traditional equipment cannot access, with an inspection coverage rate of over 85%.

ALL-TERRAIN FOUR-WHEEL DRIVE OBSTACLE-CROSSING CHASSIS

Innovative trailing arm independent suspension combined with a four-wheel drive architecture chassis enhances the robot's obstacle-crossing, anti-vibration, and climbing capabilities. It has achieved a breakthrough in climbing a 20° steep slope and overcoming vertical obstacles of 40mm. With a uniquely designed adaptive tread pattern, it maintains zero slippage and passability in the resin environment inside the wind turbine blade cavity.

PANORAMIC VISUAL FUSION TECHNOLOGY

Through visual combination, multiple high-resolution cameras are intelligently stitched together to generate a 180° ultra-wide-angle field of view. Paired with high-intensity supplementary lighting, it supports uninterrupted inspection by the robot without stopping during movement. A single photo can complete the inspection process that traditionally requires five separate shots, increasing the efficiency by 300%.



SPECIALIZED AI DEFECT DIAGNOSIS

Adopting a deep learning algorithm architecture, and based on a more advanced backbone network and multi-scale feature fusion technology, it can effectively capture subtle defects inside wind turbine blades (such as cracks, corrosion, and coating peeling). Even defects under complex backgrounds or low-contrast lighting can be identified. Meanwhile, through data enhancement strategies and an attention mechanism, the model has stronger robustness against interferences like shadows, reflections, and stains within the blade cavity, reducing the false detection rate.

DEEPERCEPTION

INTELLIGENT UAV INSPECTION OF COLLECTOR LINES

For the transmission towers and power lines of the collector circuits, drones are used to conduct refined inspections of tower component defects and visible light inspections of power line corridors. These drones can automatically identify components and the types of component defects, and classify them according to the components and defects. In addition, remote automated inspections can be achieved in cooperation with drone hangars.

PRODUCT CHARACTERISTICS

- SUPPORT LINE LASER POINT CLOUD MODELING TO GENERATE LINE DIGITAL INFORMATION.
- SUPPORT REFINED INSPECTION OF TRANSMISSION TOWERS AND CONDUCT DEFECT DETECTION FOR ELECTRICAL COMPONENTS.
- SUPPORT THE INSPECTION OF VISIBLE LIGHT CHANNELS ALONG THE LINE, AND CONDUCT DEFECT DETECTION FOR LINE HANGINGS.
- SUPPORT DUAL-LIGHT DETECTION, WHICH CAN MEASURE THE TEMPERATURE OF KEY COMPONENTS AND IDENTIFY COMPONENTS WITH ABNORMAL TEMPERATURES.
- THE AI ALGORITHM IDENTIFIES THE TYPES OF COMPONENTS AND FORMS OF DEFECTS AND CLASSIFIES THEM INTO CORRESPONDING LEVELS.
- SUPPORT HANGAR INSPECTION: THE HANGAR OPERATES FULLY AUTOMATICALLY AND SUPPORTS TIMED AND PERIODIC TASKS.

ANALYSIS OF THE GEOMETRIC MORPHOLOGY OF THE LINE

By accurately measuring the spatial positions, shapes, and structures of power lines, the health status of the lines can be evaluated.

ANALYSIS OF OBSTACLES AND CROSSING SITUATIONS

The analysis of obstacles and crossings mainly focuses on identifying and analyzing the interferences between power lines and surrounding obstacles (such as trees, buildings, roads, etc.). This helps to eliminate potential hazards in advance.

WORKING CONDITION SIMULATION

Through computer models, the performance of power lines under simulated extreme weather and other operating conditions is simulated, so as to predict the performance and potential risks of the lines under various environmental factors.

DEFECT IDENTIFICATION

Nests, foreign objects, component detachment, component deformation, component damage, component corrosion, component rust

≈97%
ACCURACY RATE

≈96%
DETECTION RATE

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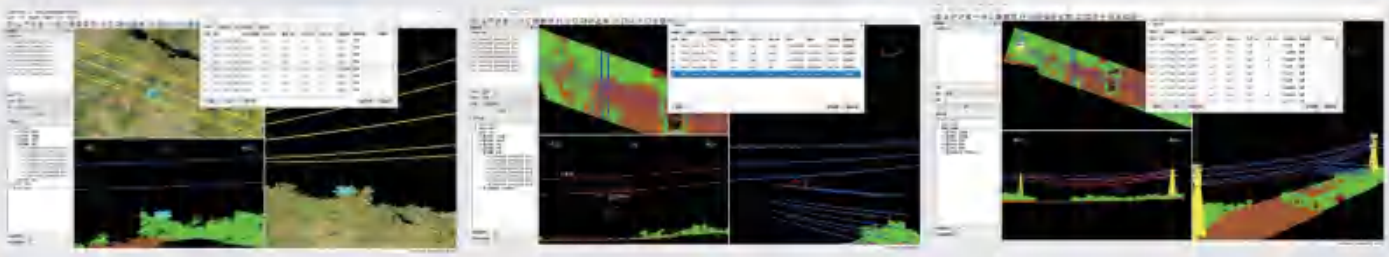
INSPECTION OF COLLECTOR LINE CORRIDORS

The defect analysis of UAV channel inspection refers to the analysis of channel hazards based on the collected and processed 3D point cloud data, including the safety analysis of obstacles such as vegetation, buildings, the ground, and various important crossing objects.

WORKFLOW OF TRANSMISSION LINE CORRIDOR INSPECTION

Route planning ▶ Point cloud data acquisition ▶ Data analysis



REFINED INSPECTION OF POWER POLES AND TOWERS

The refined inspection of overhead transmission lines using drones first involves autonomous inspection route planning based on the three-dimensional point cloud data of the power poles and towers. Then, the drone is controlled via the planned routes to conduct automatic flights and take photos of the poles and towers. Finally, the captured photos are automatically sorted, and the defects on the poles and towers themselves are marked.

WORKFLOW OF REFINED INSPECTION FOR POWER POLES AND TOWERS

3D ROUTE PLANNING
- Point cloud data sorting
- Autonomous inspection route planning
- Route inspection and editing

AUTONOMOUS INSPECTION FLIGHT
- Visible light image acquisition
- Thermal imaging data acquisition

DATA ANALYSIS
- Defect analysis
- Report output

Matrice 350 RTK + Zenmuse L2 + Zenmuse H30T

DJI Mavic 3T

HARDWARE DEVICES FOR INTELLIGENT UAV INSPECTION OF COLLECTOR LINES

FLIGHT ALONG THE COLLECTOR LINES

Intelligent algorithms - Leveraging the latest flight-following algorithms, the unmanned aerial vehicle (UAV) is capable of fully automated flight, precise tracking, and seamless line-following operations. It can automatically detect line bifurcations, pop up prompts for users to select the target line, and then smoothly fly along the chosen line.

Super Computing Power - Equipped with a high-performance computing platform, it can support real-time vegetation encroachment detection, display dangerous points along with their distances. This significantly boosts the efficiency of transmission line inspection and defect elimination operations.

DEEPERCEPTION

INTEGRATED INTELLIGENT INSPECTION PLATFORM FOR WIND - SOLAR LINES AND SUBSTATIONS

The integrated wind-solar line and substation platform is an intelligent inspection solution designed for wind power, photovoltaic, and power line equipment. It aims to enhance the operation and maintenance efficiency and safety of energy facilities. This platform integrates multiple advanced technologies, including unmanned aerial vehicle (UAV) inspection, artificial intelligence analysis, big data processing, and cloud platform management, comprehensively elevating the intelligent, automated, and digital levels of the inspection process.

PRODUCT CHARACTERISTICS

INTEGRATED OPERATION AND MAINTENANCE OF WIND-SOLAR POWER LINES AND SUBSTATIONS

Full Life Cycle Management of Photovoltaic, Wind Turbines, Collector and Transmission Lines, and Substations; Unattended Operation with Minimal Staffing

UNIFIED DISPATCHING OF UNMANNED EQUIPMENT

Unified management and coordinated use of drones, robots and IoT sensors.

INTENSIVE APPLICATION OF PLATFORM SYSTEMS

Highly Scalable Platform: Enhance Efficiency and Reduce Costs Hierarchical Permissions: Use functions as needed, eliminating data silos.

INTEGRATED MANAGEMENT OF MULTIPLE STATIONS

Achieve the centralized operation and management mode Improve the management level of multiple stations

CENTRALIZED PROCESSING OF STATION DATA

Operation data of stations, inspection and maintenance data, and meteorological environment
Unified standards, anomaly identification, benefit evaluation, and index prediction

PROMOTION AND APPLICATION OF ADVANCED TECHNOLOGIES

Artificial intelligence, big data, digital twins, unmanned devices
Preliminary research and testing, pilot applications, and unified promotion

PLATFORM FRAMEWORK

The interactive information presented to the end-users is mainly accomplished through the GIS platform in the form of realistic 3D visualization.

It contains various specific business logics and can be expanded according to business requirements. It fully supports survey, infrastructure construction, and operation & maintenance applications.

It includes all the basic platform functions, interfaces with algorithms and data, and provides support for the application layer. It offers computational support for data analysis of various types of equipment and enables the integration of different algorithm models.

Built on top of the hardware system, it stores and manages various types of data. Through the big data management platform, the data is sent to the algorithm center for analysis and utilization.

Provide basic support for the entire system, connect to various hardware devices, including the integrated drone hangar system used for automated flight control.

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INTEGRATED INTELLIGENT INSPECTION PLATFORM FOR WIND - SOLAR LINES AND SUBSTATIONS

HOME PAGE OF THE INTEGRATED MANAGEMENT PLATFORM

OVERVIEW PAGE OF WIND TURBINE DEFECTS

DETAILS PAGE OF WIND TURBINE DEFECTS

WIND TURBINE INSPECTION ROUTE PLANNING PAGE

PV DEFECT OVERVIEW PAGE

PV DEFECT DETAILS PAGE

PV INSPECTION ROUTE PLANNING PAGE

HANGAR MANAGEMENT PAGE

LINE DEFECT DETAILS PAGE

STEP-UP SUBSTATION DEFECT DETAILS PAGE

DEEPERCEPTION

INTELLIGENT VISUAL CONTROLLER FOR MONOCRYSTALLINE FURNACE

The intelligent visual controller for monocrystalline furnaces is a set of intelligent visual control systems developed by deeperperceptionTechnology. Based on digital image processing, machine vision, pattern recognition, deep learning and other technologies, it conducts research on the key technical indicators of the Czochralski monocrystalline silicon process. This system can deeply sense various indicators inside the furnace and assist the operators in monocrystalline silicon factories with crystal pulling work. It has significantly improved the problems in the past crystal pulling process, such as the need for a large amount of manual operation, huge errors, low efficiency, uneven products, and low utilization rates. The intelligent visual controller for monocrystalline furnaces can offer intelligent and personalized functions for formulas, increasing the crystal pulling operation efficiency of workers by 20%.

PRODUCT CHARACTERISTICS

- THE MEASUREMENT ERROR IS SMALL, WITH THE DIAMETER MEASUREMENT ERROR LESS THAN ±0.2 MM. THIS ENABLES THE CLIENT'S YIELD RATE OF MONOCRYSTALLINE SILICON RODS TO BE HIGHER THAN THE INDUSTRY AVERAGE.
- IT CAN MEASURE THE AVERAGE BRIGHTNESS OF THE ENTIRE LIQUID SURFACE, REDUCING THE NOISE CAUSED BY SUDDEN CHANGES IN THE BRIGHTNESS OF PART OF THE LIQUID SURFACE AND GREATLY IMPROVING THE ACCURACY OF TEMPERATURE MEASUREMENT.
- THE ACCURACY RATE OF WIRE BREAKAGE DETECTION IS AS HIGH AS 98.7%, FAR EXCEEDING THE INDUSTRY STANDARD.
- IT ADOPTS AN ADVANCED METHOD FOR MEASURING THE LIQUID LEVEL DISTANCE. IT CAN MEASURE THE ABSOLUTE VALUE OF THE LIQUID LEVEL DISTANCE USING A MONOCULAR CAMERA.
- THE METHOD OF COMBINING WITH NEURAL NETWORKS IS ADOPTED TO DETECT THE BIFURCATION MORPHOLOGY. COMPARED WITH TRADITIONAL FEATURE EXTRACTION METHODS, IT HAS STRONGER GENERALIZATION ABILITY AND A WIDER RANGE OF ADAPTABILITY.

PRODUCT FORM

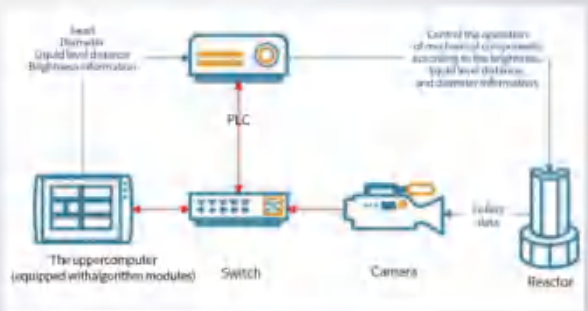
THE INTELLIGENT VISUAL CONTROLLER SYSTEM FOR MONOCRYSTALLINE SILICON REACTORS CONSISTS OF TWO PARTS: SOFTWARE AND HARDWARE.

THE SOFTWARE PART:

Windows System Services for Intelligent Visual Controller
Customized interface for intelligent visual controller

THE HARDWARE PART:

High-performance fanless industrial computer
Industrial-grade touch display
High-definition industrial cameras and lenses
Gigabit industrial POE switch



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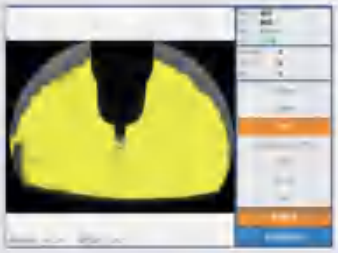
THE MAIN FUNCTIONS OF THE INTELLIGENT VISUAL CONTROLLER FOR A SINGLE CRYSTAL FURNACE

DIAMETER MEASUREMENT

The aperture of the monocrystalline silicon crystal is completed by fitting a circle, so as to calculate the diameter of the monocrystalline silicon rod. This method has strong anti-interference ability, high measurement accuracy, and can be adapted to various furnace types.

BRIGHTNESS MEASUREMENT

Through digital image processing technology, the liquid surface area in the image is screened. Then, the brightness of the screened liquid surface area is measured, which ensures the stability of brightness measurement. Compared with traditional measurement methods, this approach can better reflect the overall temperature situation inside the furnace.



SHAKING DETECTION

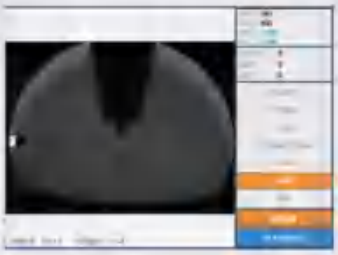
To prevent the abnormal shaking of the crystal from causing the monocrystalline silicon to hit the baffle and pose a danger, the visual controller detects the degree of crystal shaking in real-time. When it exceeds the set threshold, an alarm will be issued to inform the operator in advance for manual intervention.

ABSOLUTE LIQUID LEVEL DISTANCE MEASUREMENT

Our company is the first in the industry to adopt a method of measuring the actual distance between the liquid surface and the baffle using a single camera. Through the calibration system, the absolute distance between the liquid surface and the baffle can be directly measured at one time, minimizing human involvement to the greatest extent and assisting other modules in achieving more precise control of the temperature inside the furnace.

Most other solutions in the industry mainly use the method of measuring the width of the reflection at a fixed position to make an approximately linear positive correlation estimate to obtain an approximate distance. However, the linearity between the measurement results and the actual values is poor, and it is difficult to ensure consistency among different furnace runs and different furnace units.

Compared with the previously used methods, the current solution calculates based on the camera imaging principle. A strict linear relationship can be maintained between the calculation results and the real values. By means of pre-calibration or camera parameter calculation, the real distance between the liquid surface and the draft tube can be obtained.



BROKEN LINE DETECTION

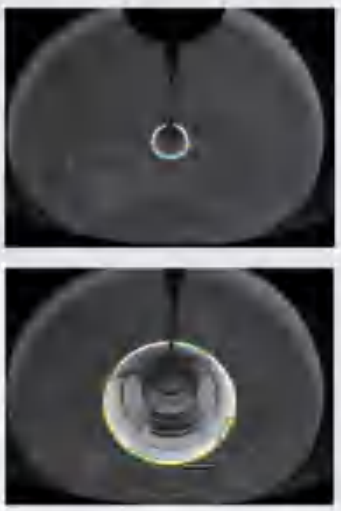
By means of deep learning, a large amount of production data is collected for calibration to train the broken line detection model. The accuracy rate of the broken line detection of deeperperception Technology can reach 98.7%, which is much higher than that of other companies in the same industry using traditional image processing methods.

SHOULDER RELEASE AND BIFURCATION DETECTION

Bifurcation detection: In the production of Czochralski monocrystalline silicon, different manufacturing processes have distinct requirements regarding the size and angle of the shoulder bifurcation. To exert control over the shoulder shape, it is essential to accurately measure the current bifurcation state, specifically its size and angle.

The bifurcation forms are highly diverse. Traditional feature extraction methods find it difficult to cope with such complexity. These traditional approaches have poor generalization and scalability, and a limited scope of application. Neural networks can better handle this problem; however, they are plagued by slow computational speeds and high hardware costs.

Our company combines traditional features with neural networks. We not only utilize general image features but also incorporate neural networks trained with a large number of samples. At the same time, we perform model pruning, compression, and optimization of algorithm performance. On this basis, it can accurately and stably detect the position and size of bifurcations while maintaining an extremely high running speed. Even on the CPU of a low-end industrial control computer without a dedicated graphics processing device, the speed can still reach over 30 frames per second.



DEEPERCEPTION

AI EMPOWERS THE INTELLIGENT PRODUCTION OF PREFABRICATED BUILDING COMPONENTS

Beijing deeperperception technology co., ltd.has delved into the front line of the production of prefabricated building components. By truly identifying the pain points in production, leveraging its own technological advantages, and clarifying the boundaries of technology and business, it has spent two years developing a comprehensive set of intelligent technology solutions for the prefabricated building component production line. This solution package includes multiple intelligent products for the prefabricated building component production line, such as the flatness detection system for component finishing surfaces and the collaborative finishing system with robotic arms, the energy-saving control system for intelligent steam-oxygen sheds, the real-time detection system for the running track of mold platforms, and the intelligent rebar counting system.

CORE PRODUCTS

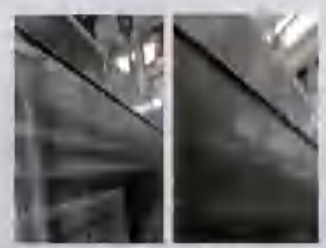
01 FULLY AUTOMATIC STEEL BAR LAYING AND BINDING ROBOTS

Drawing on on-site business practical experience, process technologies, and artificial intelligence technology, it replaces manual labor to perform automatic steel bar placement. It consists of a steel bar laying machine with an adaptive spacing adjustment function and a fully automatic robotic arm unit for flexible binding. It supports functions such as reading CAD drawings, automatic adjustment of transverse and longitudinal bar supports, positioning and deduplication of steel bar joints, as well as flexible binding with adjustable strength. For a steel bar working group, the number of workers can be reduced by one-third, while the output can be doubled simultaneously.

BINDING METHODS	Cross intersection
BINDING SPEED	<=2.5S/Joint
APPLICABLE STEEL AR SPECIFICATIONS	Maximally supportable 42*30mm
APPLICABLE BINDING WIRE DIAMETERS	0.8mm-2.5mm
THE DIRECTION OF THE BINDING WIRE TAIL	The binding wire is parallel to the direction of the transverse reinforcement.
THE LENGTH OF THE BINDING WIRE TAIL	Automatic adjustment
BINDING STRENGTH	Automatic adjustment is made based on intervals of 1/4 turn
BINDING FORCE	Mimic manual binding
SAFETY	Stop when the front end of the binding gun touches the steel bar.
APPLICABLE STEEL BAR SPACING	1-3cm

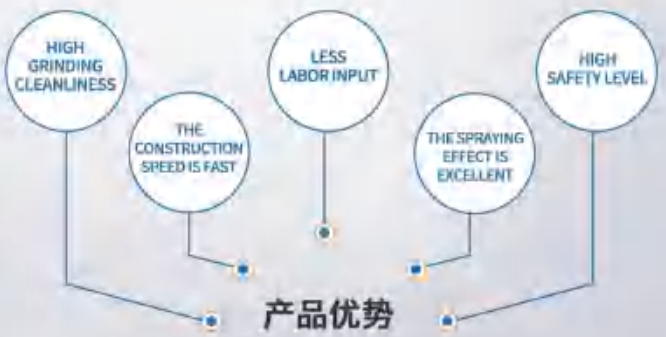
02 FULLY AUTOMATIC STEEL BAR LAYOUT AND BINDING ROBOT

Combining automated machinery technology with advanced intelligent control technology, it can be applied to mold cars of various specifications, achieving fully automatic one-key grinding and spraying. It ensures that the grinding cleanliness is above 98% and boosts the efficiency by 70%. Moreover, it features extremely high safety and quality stability.



COMPARISON PICTURES OF THE INSIDE OF THE MOLD BEFORE AND AFTER THE OPERATION

CONSTRUCTION DRAWINGS ON SITE



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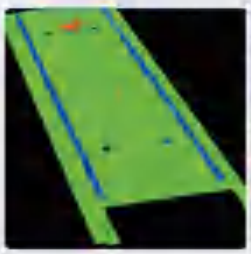
03 FULLY AUTOMATIC FLATNESS DETECTION ROBOT

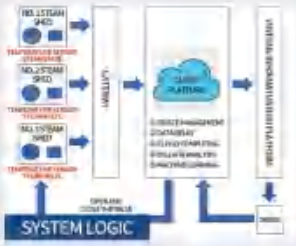
Images are formed through high-precision line-scan laser equipment, paired with a point cloud processing engine, enabling millimeter-level detection of the component surfaces. The detection rate for convex and concave points reaches over 99%, with a detection error of less than 2 mm. This significantly improves the construction efficiency during the flatness detection process.



HIGH IMAGING ACCURACY	The detection rate of convex and concave points of this product is above 99%, ensuring that the detection error of PC components is less than 2 mm.
THE CONSTRUCTION SPEED IS FAST	The time required for this product to complete one overall construction process is only 50% of that of manual processing.
LESS LABOR INPUT IS REQUIRED	After the construction is carried out with this product, only one person is needed to perform simple operations, which greatly saves the labor input.
GOOD QUALITY STABILITY	It can significantly improve the stability of product quality and ensure a 99.99% pass rate.

04 AUTOMATIC ENERGY-SAVING CONTROL SYSTEM FOR STEAM CURING SHED

Combining technologies such as the Internet of Things, intelligent data analysis, and automatic control, this system corrects in real-time through the feedback of dynamic state values in superposition based on historical data analysis. It then calculates the ideal control values for steam curing temperature, humidity, etc. for intelligent steam curing. As a result, energy consumption can be reduced by more than 40%, significantly cutting down production costs.



SYSTEM LOGIC

SYSTEM INTERFACE

LESS PRODUCTION TIME
The single steam curing time can be saved by more than 1 hour.

HIGH TEMPERATURE MEASUREMENT ACCURACY
The measurement accuracy is ±1 degree.

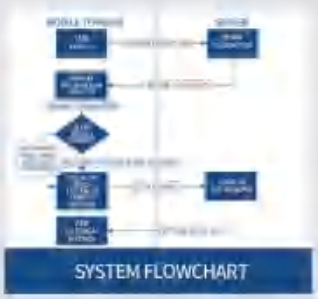
LOW COST INVESTMENT
The average energy consumption is reduced by 40%.

HIGH PRACTICALITY
One-key valve control on the mobile phone.

05 INTELLIGENT REBAR COUNTING SYSTEM

The intelligent rebar counting system based on computer vision can quickly calculate the number of rebars through handheld shooting. It can be widely applied in fields such as rebar manufacturing and construction engineering. This system supports practical functions like on-site shooting or photo reading from the album, quantity statistics and automatic classification, manual correction, as well as the query of historical data statistics. This product significantly improves the accuracy and efficiency of counting, increasing labor efficiency by more than five times.

INTELLIGENT QUANTITY STATISTICS

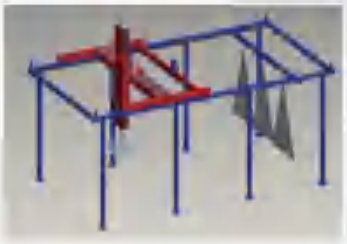


SYSTEM FLOWCHART

06 FULLY AUTOMATIC SURFACE FINISHING ROBOT

The fully automatic surface finishing robot is developed for the troweling process after pre-steam curing. With a high-precision laser measurement system and a unique dual-degree-of-freedom adaptive surface finishing robotic arm, it can automatically complete the flatness measurement and surface finishing in one cycle.

It has two functions for surface finishing. Both its working efficiency and precision are much higher than those of manual work. The on-site measured data shows that, on the premise of meeting the precision requirement of 2 mm, the overall efficiency can be increased by more than 100%.



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