Under Vehicle Inspection System

Contents:

1.Introduction:

The fixed vehicle under-body inspection system is an integrated information management solution that combines multiple functions including vehicle chassis image acquisition, display, matching, and early warning. By integrating computer technology, image processing, video processing, and optical technologies, the system boasts broad applicability and a comprehensive field of view (FOV) coverage, enabling compatibility with various vehicle models. Additionally, it features easy installation for practical deployment.

1.1 This system is suitable for:

*Safe zones or counter-terrorism areas, such as: airports, government office buildings, prisons, bank storage facilities, embassies, military camps, ports, police stations, etc.

*Customs stations and border checkpoints

Main area parking lot

Large conferences and toll station entrances

The system can efficiently block the passage of vehicles carrying bombs, weapons, biochemical hazardous materials, pharmaceuticals, contraband, illegal immigrants, and dangerous individuals.

The system can be installed in two different configurations: portable and buried. Customizable configurations are supported upon special request.

1.2 System Interface： Four smaller windows display four individual video signals respectively.

2.Functional characteristics ：

·The device can capture monochrome or color vehicle chassis images through the scanning module. Advanced high-quality CCD sensors ensure high resolution and high-definition image

quality of vehicle chassis images. Intelligent algorithms effectively maintain the integrity of vehicle chassis images.

·The system can operate in two modes: external triggering mode and fully automatic mode. In fully automatic mode, the system performs dual-directional scanning of the vehicle underside image.

·The device can monitor and record 4 signal channels (optional).

·The system automatically records vehicle passage moments and names the bottom vehicle images along with other surveillance footage.

·The system supports switching between English and Chinese interface languages, and allows setting different permission levels, including administrator privileges and regular user privileges.

·The system allows temporary vehicle stops above the camera.

·Image storage and retrieval

·The system supports both JPEG and BMP formats simultaneously.

·The system can store no fewer than 26,000 vehicle images. When the number of vehicles exceeds the preset upper limit, the system can cyclically and automatically overwrite and update previous images.

·The system can automatically count the number of vehicles passing through and generate a table containing detailed records.

·The system can retrieve specific vehicles based on their passage time.

● image control

① The system can adjust brightness....

② The system can magnify the undercarriage image up to a maximum of 16 times.

·The system can compare the current chassis image with standard images stored in the database, and supports convenient zooming operations via mouse or keyboard

·The system can transmit license plate and vehicle under-body images to the server.

·The system is scalable for transmitting control signals.

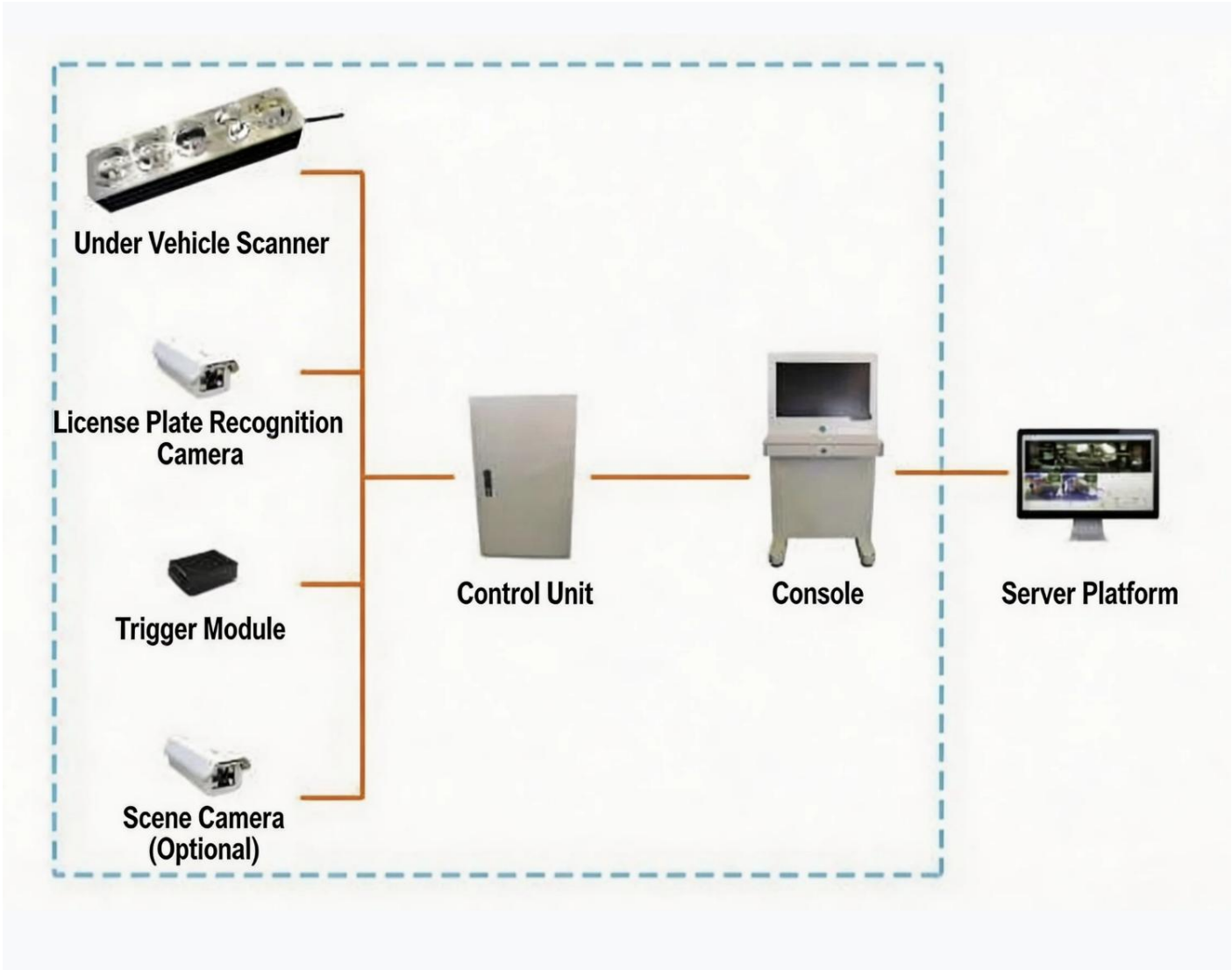
3.Features:

- Auto digital line scan, high-resolution undercarriage imaging.
- Decision Response Time: 2-3 seconds
- Applicable to variety of vehicles, wide vision.
- Multi-Language Interface Design.

- IP68 high degree of protection, anti-seismic,adapting to any climate environment.
- Test will be completed during the vehicle maneuvers without stopping, adapted to different speed.
- Strong expansion capability, can easily achieve all kinds of linkage control(such as anti-collision system, barrier,etc.).
- Multi entrance management model, and statistics of entering and exiting vehicles.
- Flexible detection process can be made on site to satisfy the needs of various work conditions.
- Image monitoring, video recording for different scenario
- Undercarriage image can be stored, retrieved, searched or compared with other images.
- Whole image display on monitor, can zoom, playback, sign in the images, stretching and cutting, etc
- The image is automatically stored, deleted: Save not less than 10,000 pictures, expired pictures will be deleted automatically

4.Hardware configuration:

The under-vehicle inspection system mainly consists of an under-vehicle scanner, an operation console, a control unit, a license plate recognition camera, a trigger module, and a scene camera, as shown in the figure below:



4.1 Chassis camera and lighting device：

√ Main computer √ Acquisition equipment √ Lighting equipment √ Operating equipment √ Auxiliary equipment

4.2 Main parameter ：

▲ Complete imaging of the entire vehicle chassis with no omissions, and images are clear, intact, and free from distortion. Objects with a diameter less than 1 mm can be observed clearly.

▲ IP68 protection rating, resistant to pressure and impact

▲ Features 4-channel scene image monitoring and video recording capabilities, with English/Chinese language switching support

▲ Image vertical resolution: 2048 pixels

▲ Field of view width: over 4.0 meters

▲ Effective viewing angle: Greater than 175°

▲ Auxiliary lighting:>100W

▲ Speed: 1–60 km/h

▲ Load-bearing capacity:>30 tons

▲Waterproof rating: IP68

▲ Interface: RS232/RS422

▲ Storage temperature: -35°C to +70°C

▲ Operating temperature range: -10℃ to +60℃

4.3 Under vehicle scanner:

① Auxiliary lighting for under-vehicle scanner

② Stainless steel protective cover for lens and auxiliary lighting

③ Under-vehicle scanning camera and lens

④ Scanning information transmission and power terminal, for transmitting scanning results and supplying internal power

⑤ Mounting frame

4.4 Operation Console:

- 22-inch monitor
- Operation console

- Start switch
- Keyboard and mouse tray
- High performance industrial computer

4.5 Control Unit:

4.6 License plate recognition camera:

4.7 System parts introduction:

Under-body Safety Inspection System			
2	**Under-vehicle Safety Inspection System Software**		1、★Testing criteria: The equipment must undergo at least 62 tests conducted by the Ministry of Public Security Testing Center in accordance with the GA/T 1336-2016 standard, and provide a Ministry of Public Security inspection report as proof; 2、The undercarriage image is captured using a color linear array CCD scanning method. 3、★Scanning method: Linear scanning, with three modes including coil triggering, video detection, and manual triggering; 4、Field of view angle: ≥178 degrees;

			5、Chassis image storage format: standard BMP or JPEG image format; 6、Startup time: The total startup time for all system components should be less than 1.5 minutes. 7、The undercarriage resolution must be ≥12000×7500. 8、Environmental parameter functions: Enables display and storage of environmental parameters such as temperature, humidity, and atmospheric pressure on the software interface, with automatic upload to the server. 9、The image repository must contain at least 1.2 million vehicle under-vehicle images. 10、★Speed measurement function: Measures vehicle speed as it passes through the scanner; 11、When the vehicle passes through the under-vehicle scanner at non-uniform speed or at rest, the under-vehicle image is displayed completely, and the states of vehicle motion and stoppage can be detected. 12、★When the vehicle passes through the scanner at speeds of 1-80 km/h, the system's image display time shall be ≤1 second; 13、★The system automatically triggers an alarm when red, green, or blue foreign objects exceeding 5cm in size appear under the vehicle. 14、The system automatically counts the number of inspected vehicles and generates a table. 15、★under-vehicle image display: Full horizontal color display with support for horizontal and vertical mirroring operations; 16、under-vehicle image zooming feature: Minimum magnification of 16x, allowing localized image

			enlargement.
3	**under-vehicle scanner**		1、Induction lighting control module: four sealed single-cell LED surface light sources; 2、Field of view angle: ≥178 degrees; 3、Installation ground level height: The vertical height difference between the scanning device and the designed installation ground level shall be less than or equal to 2.5 cm. 4、★The overall protection rating of the scanner complies with IP68 waterproofing requirements. The camera unit and supplementary light unit within the scanning device housing also meet the IP68 specifications outlined in GB4208-2008 (submerged at 1m depth for 1 hour). 5、Maintainability: The system scanning device should adopt a modular design, with LED fill lights and scanning cameras capable of independent disassembly, as well as easy assembly and maintenance. 6、The middle section of the vehicle under-vehicle scanning device housing can withstand stress levels of no less than 201MPa with relative deformation below 0.01. 7、The system is equipped with an induction lighting control module that automatically detects and switches the light source upon vehicle passage. 8、Operating temperature range for under-vehicle scanner: -40°C to +85°C; 9、★Anti-fogging function for scanners: The under-vehicle scanner maintains operation at 40°C for 12 hours, followed by immediate cooling to 0°C for 2 hours, preventing water mist condensation inside the chamber.
4	**System host**		

			1. 22-inch LCD monitor 2. Hard drive: 1TB; 3. Processor: 2.2 GHz; 4. Memory: 4GB; 5. Ports: Features 4 USB ports, 2 COM ports, 2 network ports, and an HDMI port. 6. Temperature: -25 to 70°C; Humidity: 5% to 95%; 7. The operating table is constructed from cold-rolled steel plate material.
5	**indicator**	1 unit	Industrial-grade displays with a size of 22 inches or larger can be installed using either embedded or suspended mounting methods.
6	**System cabinet**	1 set	It features an attractive appearance, rational design, and convenient operation.
7	**License plate recognition camera**		1．License plate cameras capture images of the inspected vehicle's front and license plate, with the system supporting multi-channel scenario camera expansion. 2．Main processor: High-performance DSP; 3．Number of pixels: 1920 (H) × 1080 (V); 4．Connection method: Network 5．Video compression standards: H.264/MPEG4/JPEG; 6．Equipped with a 1/3-inch high-speed CMOS sensor, dual-stream code, auto-aperture, and electric lens, it supports standard ONVIF2.4 and GB28181 protocols, featuring motion detection and white LED light suppression capabilities. 7．Working environment: Operating temperature ranges from-15°C to +70°C, with humidity levels between 10% and 90%. 8．The average recognition time was ≤15 ms.
8	**under-vehicle Scanning System Control Unit**		1、The vehicle under-vehicle safety inspection system features 2 optocoupler input/output interfaces, 3 TTL level input/output interfaces, and 4 relay input/output interfaces. 2、Features dustproof and waterproof structural design; 3、Built-in air vacuum pump; 4、★ Equipped with temperature, humidity, and pressure

			sensors; 5、The system is equipped with an anti-fogging protection module; 6、The communication interface supports two types: RS232 and RS485.
9	**Dedicated connection data cable**	3 items	1. 10-meter scanner data cable; 2. 10-meter license plate camera data cable; 3. The data cable from the control unit to the cabinet is 10 meters long.

5.Construction Preparation：

5.1 Before installation,as below need to be confirmed:

1. Whether inspect the installation site before.
2. The Scene surveillance cameras need or not. If yes, how about the quantity and the location?
3. The location of distribution box, the wire length between distribution box and car scanner.
4. The location of operation floor, the distance between operation floor, car scanner and distribution box.
5. The vehicle plate number capture camera' support point,the distance between operation floor,camera and distribution box.
6. Sending the Construction drawings and requires to customer in advance.Whether the customer is allowed to carry out excavation and construction at the relevant site.
7. Please contact the builders in advance, and And requires to equip with galvanized steel pipe, cement, sand and other materials

6.Installation Guidelines:

According to the site design, a clear fixed vehicle scanner, distribution box, induction coil, license plate recognition camera, the specific location of the pipeline installation equipment and direction of connecting cables . Confirming the location of the vehicle under the scanner according to the scene, Please note the following several factors:

1. Channel Width

According to the width of the channel to calculate the center-line of the channel, buried Under Scanner in coincident position of the fixed vehicle safety inspection scanning imaging

device center-line and the center-line of the channel.

2. The Length of the Longest Vehicle Entering the Channel

To ensure that all vehicle chassis information is scanned, the length of the longest vehicle entering the channel is counted .The distance between fixed vehicle inspection image equipment buried Location and the release gate must satisfy the parking of longest vehicle.

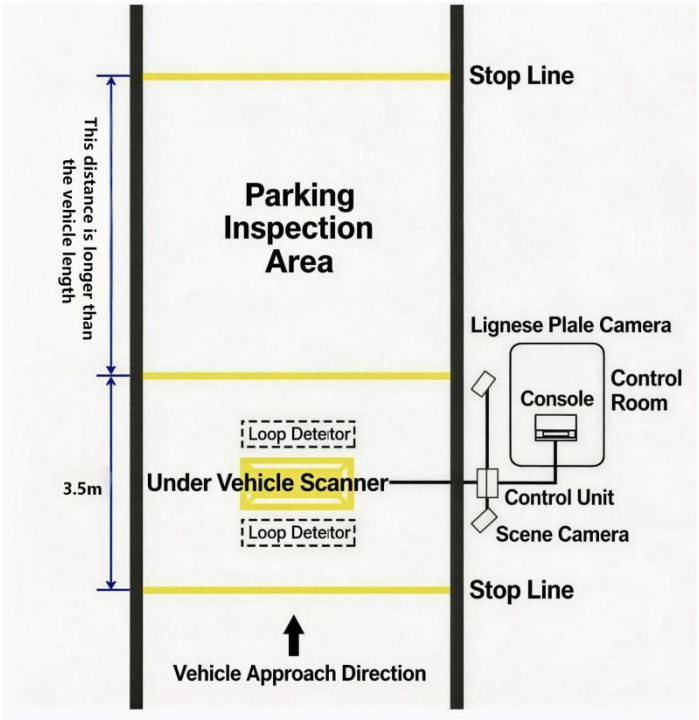
3. Channel Underground Pipeline and Cable Laying Situation

Buried location of fixed vehicle inspection Scanning imaging equipment must avoid underground pipes and cables, from interference.

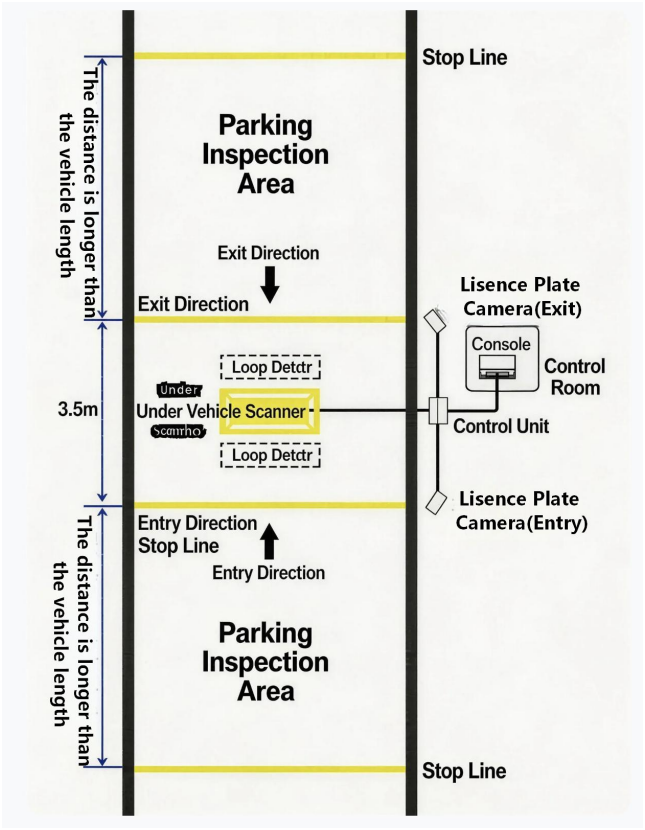
When confirming the location of fixed vehicle inspection scan imaging equipment , then confirm the location of induction coil, license plate recognition cameras and environmental control equipment to install specific location in accordance with the relative position of a clear.

6.2 Scene Layout

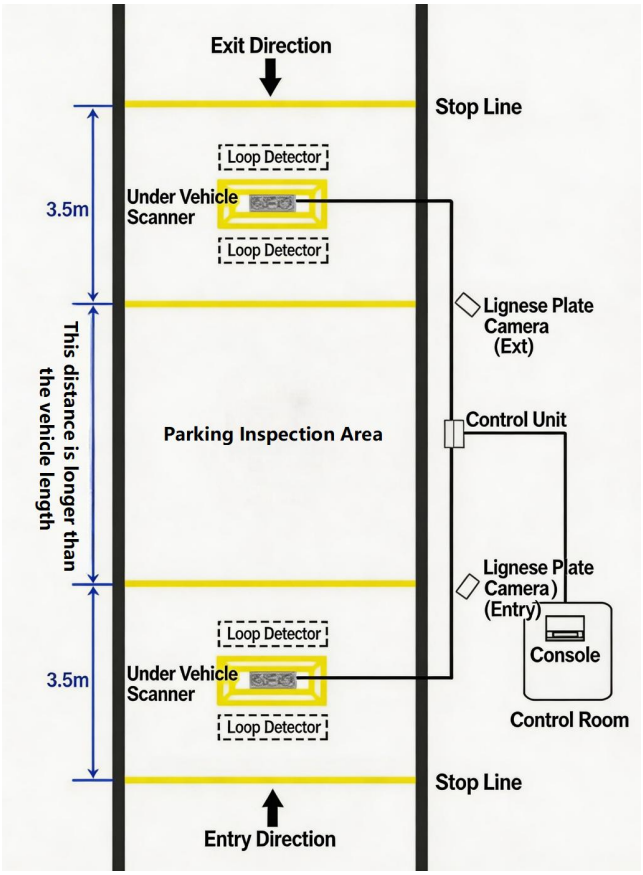
Conventional Scene Layout：



Scene Layout for Two-Way Single Lane (One Scanner)：



Scene Layout for Two-Way Single Lane (Two Scanners)：



6.3 Location Selection：

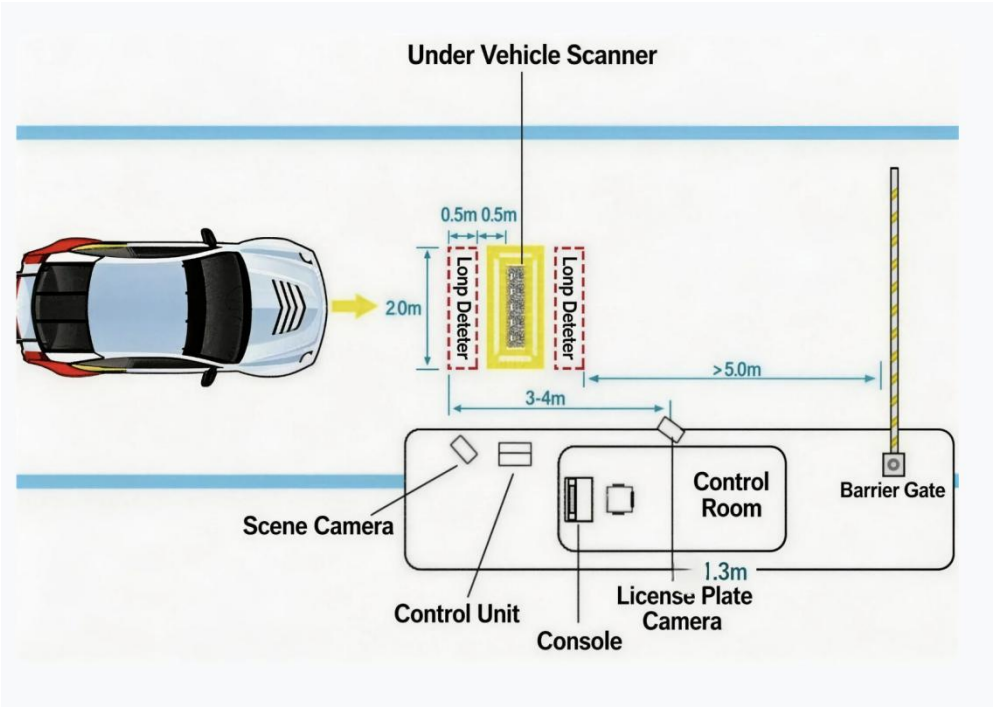
The design shall be made according to on-site conditions, with the specific installation locations of the fixed under-vehicle scanner, control unit, loop detector, license plate recognition camera, various pipeline equipment, as well as the routing of connecting cables clearly defined.The burial location of the under-vehicle scanner shall be determined based on on-site conditions, generally considering the following factors:

Lane Width:
Calculate the center line of the lane according to its width, and install the under-vehicle scanner at a position where the center line of the fixed under-vehicle security inspection scanning imaging system coincides with the center line of the lane.

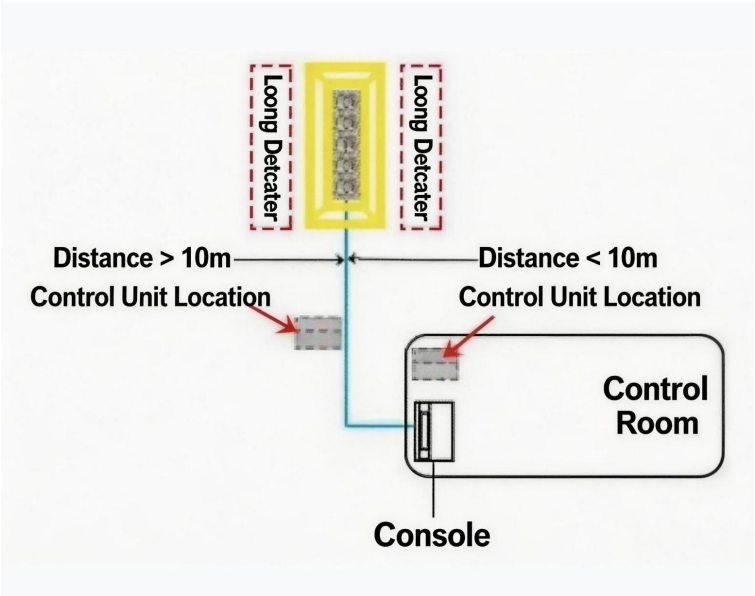
Length of Vehicles Entering the Lane:
To ensure complete scanning of the chassis information of all incoming vehicles, the length of the longest vehicle entering the lane shall be counted, so that the distance from the burial location of the fixed under-vehicle security inspection scanning imaging system to the release barrier can accommodate the parking of the longest vehicle.

Layout of Underground Pipelines and Cables in the Lane:
The burial location of the fixed under-vehicle security inspection scanning imaging system must avoid underground pipelines and cables to prevent interference.

After confirming the burial location of the fixed under-vehicle security inspection scanning imaging system, the specific installation positions of the loop detector, license plate recognition camera and environmental control equipment shall be defined according to their relative positions.



For routine installation, reference may be made to the above floor plan. However, the layout and distance between components may vary slightly at different installation sites.If the distance between the scanner and the control room exceeds 10 meters, it is recommended to install the control unit next to the scanner. If the distance is less than 10 meters, it is recommended to place the control unit together with the operation console. The placement of the control unit shall be determined according to the on-site space and distance.In addition, the control room can be located on either the left or right side of the driver, with no restriction on position.



The under-vehicle scanner shall be installed at the center of the single lane, and the distance between the barrier and the rear loop detector must be greater than the length of one vehicle.

6.4 Required Tools：

For installation of under-vehicle scanner and frame:Concrete cutter, powerful electric drill (hole puncher), 40mm galvanized steel pipe
For camera fixing:Electric hammer, electric drill, expansion bolts, PVC pipes, etc.
Concrete requires several days for curing. During construction, steel plates may be needed to cover the concrete when vehicles pass through during the curing period.

6.5 Required Materials：

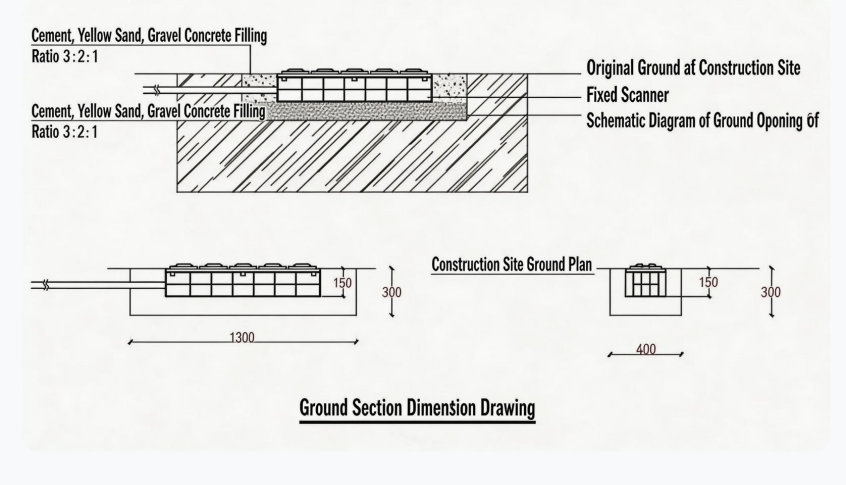
Several PVC pipes, several 40mm galvanized steel pipes, 90° elbows.The length of pipes shall be determined based on on-site conditions.

6.6 Civil Construction：

Construction shall be carried out at the positions specified in the drawings.The specific installation process includes:Excavation → Embedding of under-vehicle scanner and loop detector → Cable routing and pipe threading → Pipe laying (40mm galvanized steel pipes, 25mm PVC pipes) → Sand and gravel backfilling and compaction → Overall system commissioning → Line marking

Actual construction photos are shown below：

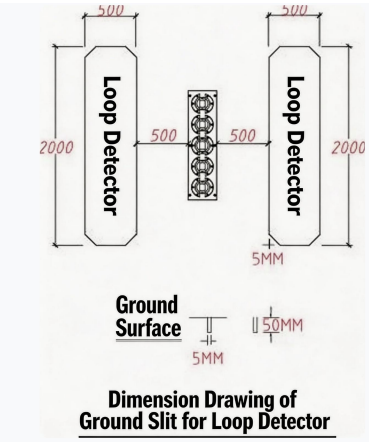
For the excavation dimensions of the scanner housing, please refer to the floor plan below:



6.7 Technical Requirements:

The bottom of the installation frame must rest on solidified concrete steps to achieve load-bearing capacity.
During concrete back-filling, sand and mortar shall be filled on both sides simultaneously to prevent displacement of the stainless steel housing caused by unilateral back-filling.
Do not fill sand and mortar to the full at one time, which may create air bubbles inside; tamp the material with tools while back-filling layer by layer.
The part of the stainless steel panel above the ground (approximately 5mm above ground level) shall be plastered into a gentle slope with sand and mortar and smoothed to a finish.
Upon completion of the above steps, cover the sand and mortar with absorbent materials and sprinkle water for curing. Curing takes 48 hours in summer. In winter, salt water shall be added to the mortar and thermal insulation measures shall be applied to the surface; vehicles may pass after 3 days.

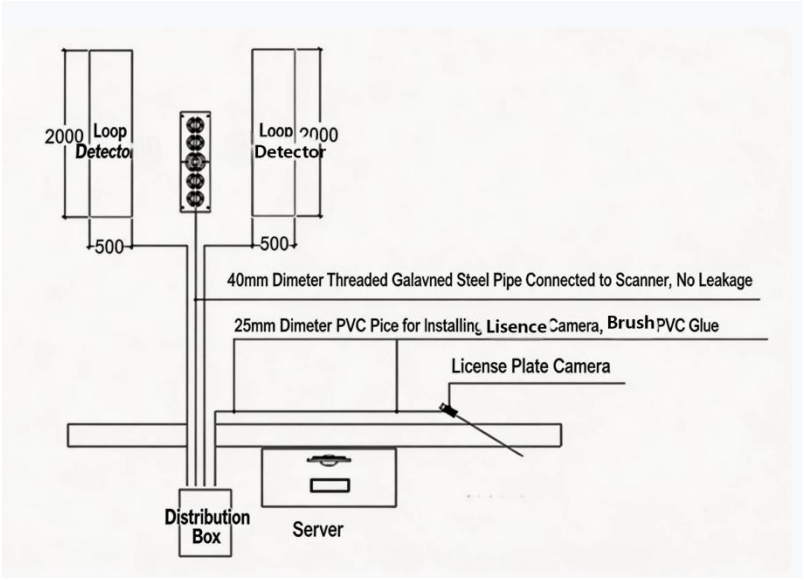
6.8 Drawing of Loop Detector Opening Dimensions：



As shown in the figure, the loop detector is 2000mm long and 500mm wide. The ground slot

shall be 50mm deep and 5mm wide.No metallic materials are allowed within 1 meter around the coil. If one side is close to an iron gate, a minimum distance of 500mm from the gate must be maintained.

6.9 Preliminary Pipe Layout and Wiring Plan：



6.10 Technical Description：

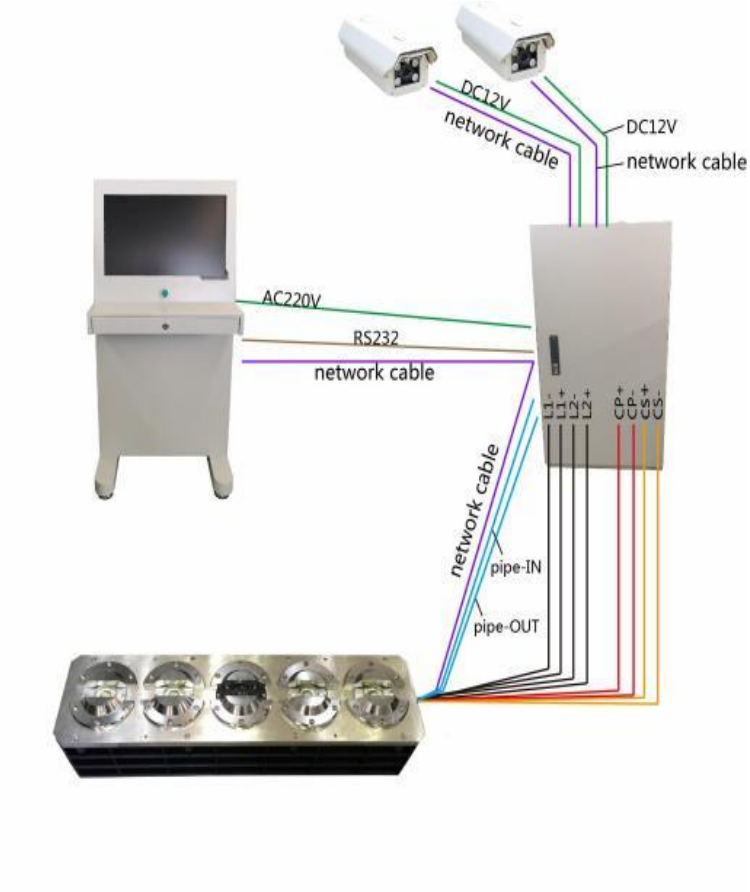
The drawing shows threaded galvanized steel pipes with a diameter of 40mm. The connection between the scanner cable joint and the galvanized steel pipe must be made with threaded connectors to ensure water tightness. If necessary, neutral silicone sealant or foam adhesive shall be used to fill the gaps. Minimize the use of elbows to avoid difficulties during cable threading.

PVC pipes with a diameter of 25mm may be used for wiring in the non-inductive area of the loop detector (area outside 2000×500mm) and for camera cables. PVC adhesive shall be applied at all PVC pipe joints.

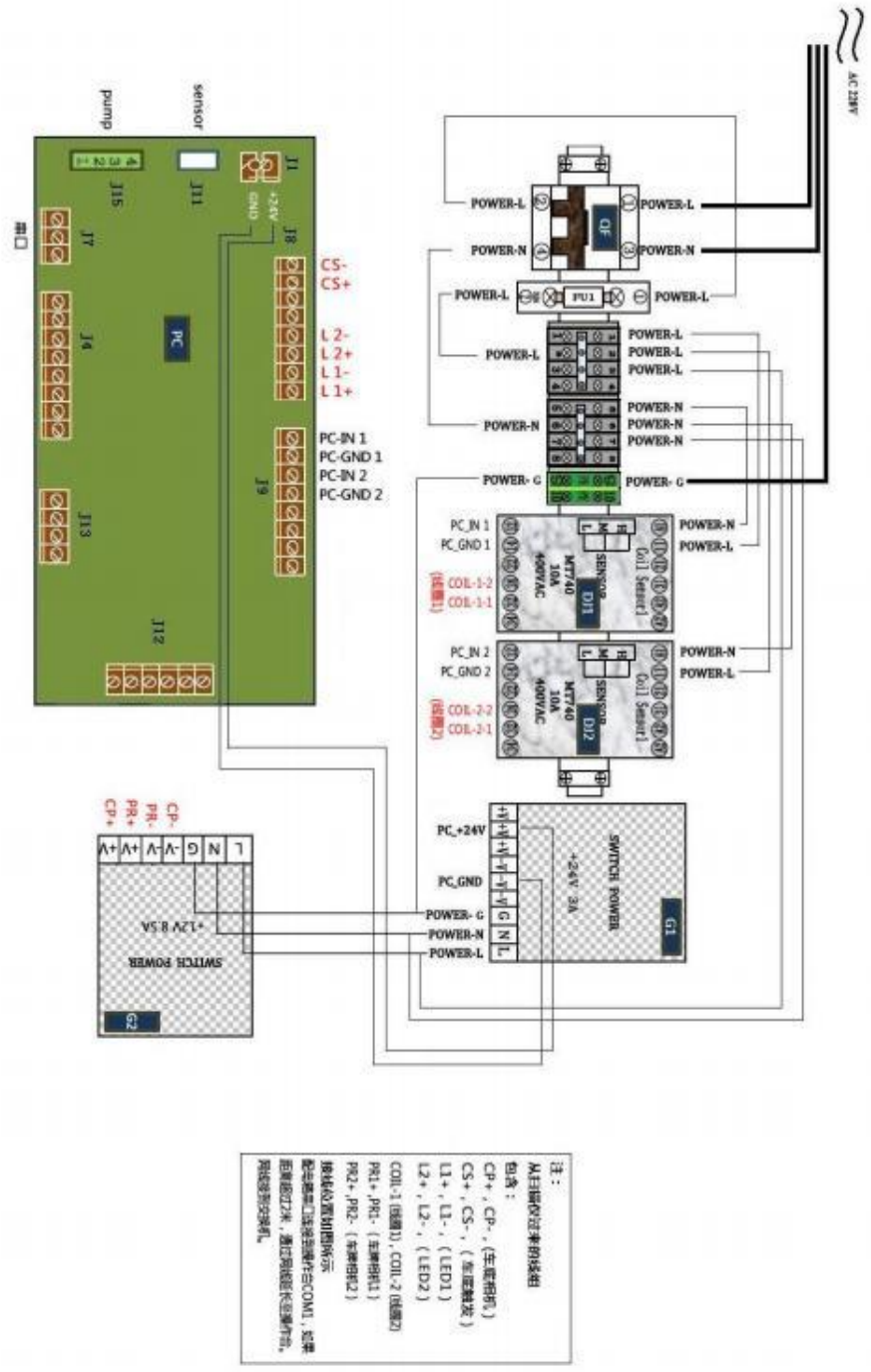
Before embedding camera conduits, confirm the total number of cameras, the positions and distances between each camera, the distribution box and the operation console (server), as well as the number of cables required between them (refer to the following system connection diagram). Only after confirmation shall preliminary pipe layout be carried out.

The cable for each coil shall be wound 5 turns. After winding, the outgoing cable must be tightly twisted, with a minimum of 20 twists per meter to prevent interference. The outgoing cable shall be free of joints.

6.11 Wiring:



6.12 Wiring connection:

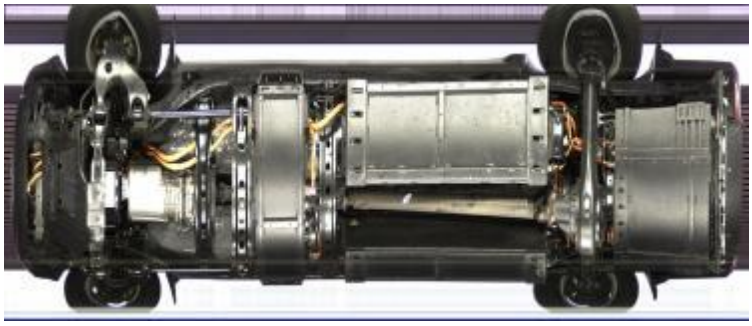


7.Overall System Commissioning：

After the system is installed and connected, it enters the commissioning stage, which mainly includes undercarriage imaging commissioning and license plate recognition commissioning.

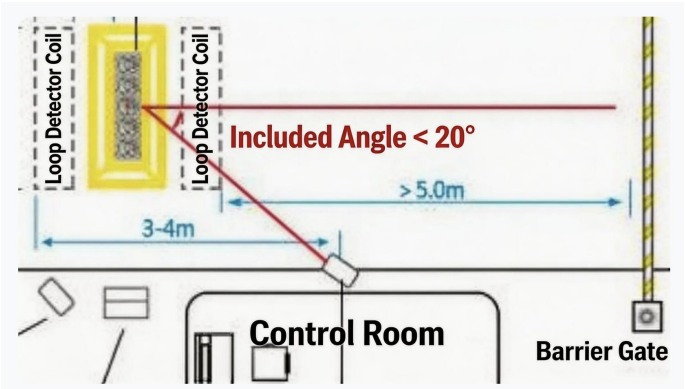
1) Undercarriage Imaging Commissioning

Click the “Under-Vehicle Security Inspection System” icon on the desktop to launch the application. Enter the corresponding username and password to access the software interface.Let a vehicle pass the under-vehicle scanner at a normal speed (1–30 km/h). During this process, observe whether the scanner’s LED lights are illuminated and whether an under-vehicle image appears on the software interface.If the LED lights light up normally and a similar image as shown below is displayed, the undercarriage imaging is functioning properly.



2) License Plate Recognition System Commissioning

A) Stop the vehicle at a position ready to trigger the loop detector, and adjust the camera focus to ensure the license plate is clearly visible.
B) The angle between the license plate capture camera and the vertical direction of the under-vehicle scanner is recommended to be less than 20 degrees; the ideal angle is 0 degrees, as shown in the figure.
C) During commissioning, the width of the license plate should occupy 1/4 to 1/6 of the license plate display window in the software, with the optimal ratio being 1/5, as shown in the figure.



7.2 Sealing & Line Marking：

After the system is installed and commissioned with no faults, neutral glass glue shall be applied to seal the under-vehicle inspection system (at screw holes and other positions). To achieve better inspection results, corresponding guide lines and warning lines shall be painted.

8.Software Operation Instructions：

8.1 Software Login：

(1) Double-click the `VehicleScan.exe` file to open the login window.

(2) Enter the correct username and password (default username: 1, default password: 1), then click <Login>.

(3) If you are an administrator, click <Register> to manage software users.

(4) Click <Exit> to close the interface.

Note:
Registered users indicate the number of registered users stored on the current computer.

8.2 Software Operation Interface：

After normal startup, the device automatically enters working mode, with the main interface shown in the figure below. After use, select [Exit] to close the software.

1. Under-Vehicle Image Zoom Function：

Function	Description
Zoom	Under-vehicle images are zoomed and displayed in the "Real-Time Window" or "Browse Window". When the mouse is inside the window, 1× to 16× zoom is available via the mouse wheel and up/down arrow keys. Drag-and-drop viewing is supported by holding the left mouse button.
Panorama	Under-vehicle images are tiled in the "Real-Time Window" or "Browse Window" (default setting).

2. Image Browsing Function：

The "Real-Time Window" displays live under-vehicle images, while the "Browse Window" views historical images (default: Real-Time Window). The two windows can be switched via buttons, with functions described below.

Function	Description
Browse	Loads saved image files.
Previous	Views the previous under-vehicle image in the current folder.
Next	Views the next under-vehicle image in the current folder.

8.3 Setting Acquisition：
Under the "Acquisition" menu on the main interface, start and stop acquisition can be set.

Function	Description
Start	The system enters working mode. The under-vehicle camera starts acquisition, and the system automatically detects vehicle passage via algorithms.
Stop	The under-vehicle system stops acquisition.

8.4 Parameter Settings：
Setting Root Directory：
(1) Select [Parameter Settings > Root Directory] to enter the root directory settings interface.

(2) Enter the path directly in the text box or click the button to select a suitable path, then click <OK> to complete the operation.

The system default path is: `D:\UnderVehicleInspection`. The system automatically creates this path on first use; use of this path is recommended.

Setting Camera Parameters：
(1) Select [Parameter Settings > Camera Parameters] to enter the camera parameter settings interface.

(2) Set camera-related parameters, with key parameters described below.

Parameter	Description
Edge Sharpness	Adjusts the edge algorithm threshold for the vehicle undercarriage. Higher values improve edge detection. (Recommended: 12, modification not recommended.) Note: For front detection, increase the value for false triggers, decrease if the front is not detected. For rear detection, decrease if detected early, increase if not detected.
GAMMA	Gamma correction for under-vehicle images. Smaller values reduce highlight contrast, increase shadow contrast, and brighten the image. Larger values have the opposite effect. A value of 7 yields the original image. (Recommended: 7)
Exposure Time	Adjusts the exposure time of the under-vehicle camera. (Recommended: 320μs)
Gain	Adjusts image contrast. Higher gain increases contrast but also noise. Increase for dark images. (Recommended: 6)
Correction Start Line	Use default "Blue Start" if the exit is on the driver’s side; set to "Red Start" if on the passenger’s side. (Default: Blue)
Serial Port Normal/Abnormal	Indicates serial port connection status: "Serial Port Normal" (connected) or "Serial Port Abnormal" (disconnected).

| High/Low Speed Mode | Matches frame rates for high-speed and low-speed vehicles. (Default: High Speed Mode) |

(3) Click <OK> to finish configuration.

8.5 Creating a Station：
(1) Select [Parameter Settings > Create Station] to enter the station creation interface.

(2) <Create Station> establishes station information with the following parameters:

Parameter	Description
Station Name	Automatically generated based on entered A/B lane numbers (A-B), consistent with the station name in the station management module of the under-vehicle server software, and created automatically.
Number of Lanes	Number of lanes managed by the station (max. 2). Select based on actual under-vehicle scanners. If set to 1, leave B lane information blank.
Lane A / B	Lane No.: Numeric or alphabetic identifier for the lane. Scanner IP: Default for A/B lanes; must match the under-vehicle camera IP if modified. Host NIC IP: PC network card IP connected to the A-lane under-vehicle switch.
License Plate Camera	IP and password pre-set; must match the camera IP if modified.
Scene Camera	Number of scene channels: Select 0, 1, 2, or 3 based on access quantity. Scene IP and password: Enter according to on-site cameras.
Image Judgment Server Parameters	Server Image Judgment Switch: Enable if an under-vehicle server is used and enter the server IP; disable otherwise. Server IP: IP address of the server computer for under-vehicle image judgment, to which client images are transmitted.

(3) Click <OK> to generate and send station information to the under-vehicle server, where it is automatically added to station management. Re-enter and confirm if station information changes.

8.6 Setting Platform Connection Parameters：
(1) Select [Parameter Settings > Platform Connection Parameters] to access the interface for third-party platform integration. This function can be enabled or disabled as needed.

Parameter	Description
Platform IP	IP address of the platform receiver.
Platform Port	Port number of the platform receiver.
URL	HTTP path (interface address).

(2) Click <OK> to complete configuration.

8.7 Standard Under-Vehicle Image Library：
(1) Select [Parameter Settings > Standard Under-Vehicle Image Library A / B] to enter the library settings interface.

(2) Provides templates for under-vehicle comparison. Click <Search> to load all under-vehicle images in the root directory matching license plate and date criteria to the data source. Select items and click <Load> to import to the database (left blank window); click <Delete> to remove selected items.

(3) Auto Add to Standard Library: When checked, the system automatically sets the latest image of the same license plate as the standard template. If unchecked, manual confirmation is required.

Standard Under-Vehicle Image Library A

Standard Under-Vehicle Image Library B

(4) Click <Exit> after setup.

8.8 Under-Vehicle Comparison Display：
(1) Select [Parameter Settings > Under-Vehicle Comparison Display A / B] to enter the comparison interface. When enabled, the system automatically searches the standard library for the recognized license plate and displays the comparison result when a vehicle passes.

(2) Click <Select Standard Library> in this state to replace the current library.

Lane A Comparison Schematic

Lane B Comparison Schematic

Lanes A & B Comparison Enabled Simultaneously Schematic

8.9 Enabling Login Dialog：
When checked, the login dialog shown below appears after launching the under-vehicle client. If unchecked, the software interface opens directly.

8.10 Enabling Information Overlay：
Enabled by default. When checked, license plate number and passage time are overlaid at the top of all under-vehicle images; disabled if unchecked.

8.11 Logout：
To close the software, select [Exit] and confirm to log out.