镭神智能
LeiShen Intelligent System

The leader in the global LiDAR industry

LiDAR Intelligent Railway Monitoring Solution:

Limit of Foreign Object Intrusion

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1.Preface

The intrusion and limit of foreign object in train tracks occurs mostly in highway cross-railway sections, adjacent sections of highway and railway parallel, near construction sections, railway main lines, and sections in mountainous areas where collapse may occur. It has the characteristics of suddenness, irregularity and unpredictability. Leishen Intelligent has launched two types (**Vehicle-mounted** and **Roadside Fixed-Checking Point**) of intelligent monitoring solutions: intrusion and limit of foreign object in Railway, based on the train operation characteristics and relying on the leading lidar sensing technology. The solutions aim at problems that seriously threaten the safety of rail operations such as **unidentified falling objects and personnel intrusion.**

The core of this scheme design is based on lidar which can quickly, accurately and massively obtain the point cloud data of the location of foreign objects in the protection area. By preprocessing the point cloud data and matching the visual sensor, the volume and location of the obstacle can be accurately captured in real time, danger situation is displayed in time through terminal display software, alarms, etc., to provide drivers with timely warning signals, so as to effectively avoid accidents.
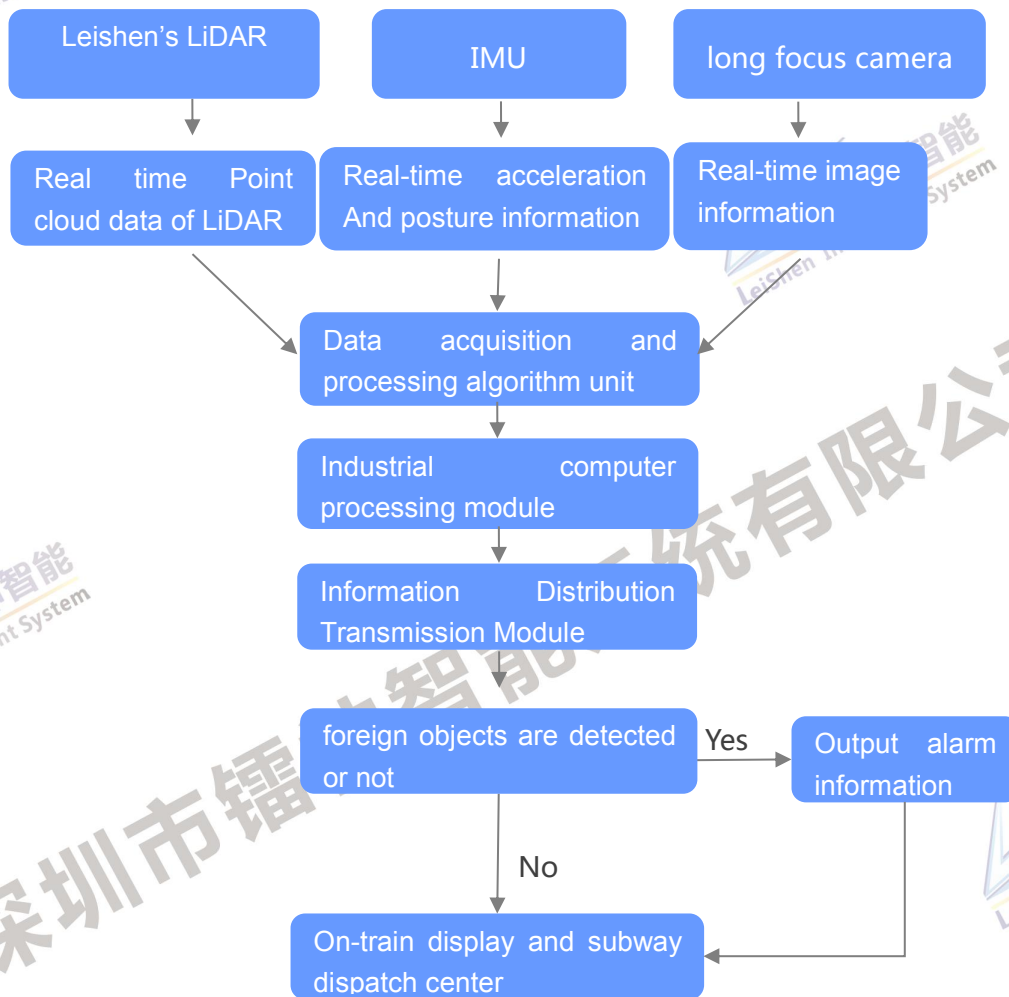
2.Vehicle-mounted Intelligent Monitoring System

Leishen's Vehicle-mounted Intelligent Monitoring System for intrusion and limit of foreign object in Railway can be used in high-speed railway, train, metro and so on.It can monitor the presence of foreign objects in the front track in real time as the train runs, which provides full escort for the running train.

At the same time, the system also integrates an inertial measurement unit (IMU), which integrates the data of IMU and lidar, and can create high-precision three-dimensional maps of the entire track through the leading three-dimensional modeling algorithm of Leishen Intelligent.
It can achieve real-time precise positioning, obtain the exact current position of the train, and provide more accurate station information in train operation, After calibrating the location of the subway station according to the map data.

Leishen's Vehicle-mounted Intelligent Monitoring System is mainly composed of lidar, long focus camera, IMU, data acquisition and processing algorithm unit, industrial computer processor module, and information distribution and transmission module.

The system architecture diagram is as follows:

```
Leishen's LiDAR          IMU              long focus camera
       │                  │                      │
       ▼                  ▼                      ▼
Real time Point    Real-time acceleration   Real-time image
cloud data of LiDAR  And posture information  information
       │                  │                      │
       └──────────►  Data acquisition and  ◄─────┘
                     processing algorithm unit
                              │
                              ▼
                     Industrial computer
                     processing module
                              │
                              ▼
                     Information Distribution
                     Transmission Module
                              │
                              ▼
                     foreign objects are detected ──Yes──►  Output alarm
                     or not                                  information
                              │                                  │
                             No                                  │
                              ▼                                  │
                     On-train display and subway  ◄─────────────┘
                     dispatch center
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Picture 1   System flow

(1)　Leishen Lidar: As the core sensor of the system, Leishen CH120 Lidar can scan and detect obstacles in the railway safety monitoring area in real time, and provide real-time high-precision three-dimensional point cloud data for the operating environment within the space radius of 260-280m.

(2) Long focus camera: Unifying the world coordinate system parameters through calibration and lidar, to provide fusion detection data for obstacles detected by lidar in the safe area, and further provide more realistic image information of obstacles.

(3) IMU: To provide real-time acceleration and attitude angle data for 3D modeling and real-time positioning of trains.

(4) Data acquisition and processing algorithm unit: It is the core algorithm module, including real-time acquisition and preprocessing of image information of lidar, IMU and camera; According to the preset safety monitoring distance and the point cloud characteristics of the scanning track of the lidar, the monitorable range is segmented, and the detection and contour orientation information of the target in the ROI area are output; According to the distance and orientation information of the target obtained by the precise detection of the lidar, the camera vision module is fused to further extract and report the obstacle image information; the lidar and IMU data are fused to perform real-time positioning.

(5) Industrial computer processor module: For the entire system and algorithm operation hardware platform, it provides various sensors and signal transmission interfaces. At the same time, the high-performance processor

guarantees the real-time basis for big data processing and foreign body alarm algorithm calculations.

(6) Information Distribution Transmission Module: The obstacles and positioning information detected and processed by the system are returned to the cab and dispatch center in real time. If a foreign body is found, an alarm message will be given in time to remind the driver to make an emergency response or the train will automatically brake.

3. Roadside Fixed-checking Point Intelligent Monitoring System

Leishen's Roadside Fixed-checking Point Intelligent Monitoring System, according to the train operating environment, can be installed in the roadside of the track where foreign matter intrusion is frequent and around the platform. Through the all-day intelligent monitoring of high-risk areas, timely warning of foreign matter intrusion can be carried out. Effectively improve the efficiency of risk handling.

This system is mainly composed of Radium Lidar, camera, data acquisition and processing algorithm unit, industrial computer processor module, information distribution and transmission core control unit, alarm system and remote server. The system architecture diagram is as follows:
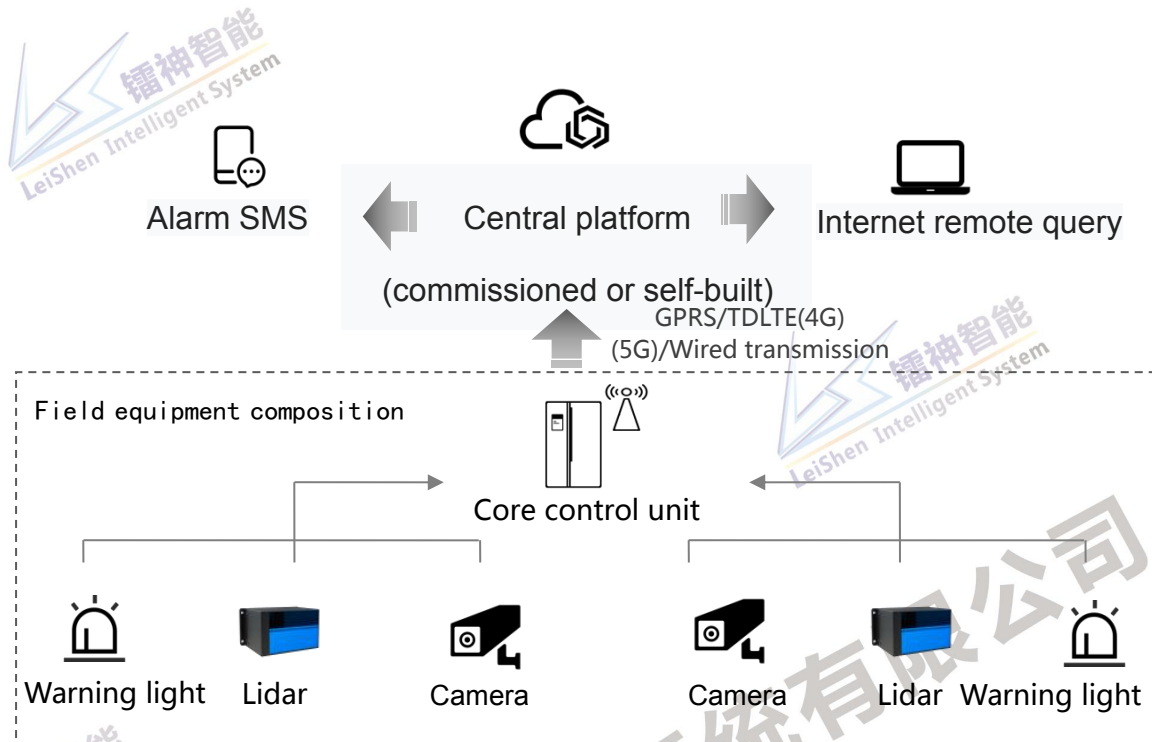
Picture 2

system architecture diagram

(1) Leishen Lidar: It is the core sensor of the system. Leishen CH120 Lidar can scan and detect obstacles in the railway safety monitoring area in real time, and can provide real-time high-precision three-dimensional point cloud data for the operating environment within a space radius of 50-100m.

(2) Camera: Through calibration and lidar world coordinate system parameters, it provides fusion detection data for obstacles detected by lidar in the safe area, and can further provide more realistic image information of obstacles.

(3) Data acquisition and processing algorithm unit: It is the core algorithm module, including real-time acquisition and preprocessing of lidar and

camera image information; real-time processing of dynamic target data of lidar point cloud within the monitoring range according to the preset safety monitoring range ;Further extract and report the obstacle image information based on the distance and azimuth accurately detected by the lidar.

(4) Industrial computer processor module: Provides various sensors and signal transmission interfaces for the entire system and algorithm operating hardware platform. At the same time, the high-performance processor ensures the real-time basis for big data processing and foreign body alarm algorithm calculations.

(5) Information distribution and transmission core control unit: Distribute and report abnormal target alarm information within the set monitoring range.

(6) Warning system: Generally, there are remote warning lights to send a warning in a remote distance.

(7) Remote server module: the remote dispatch center or workstation that receives the alarm signal.
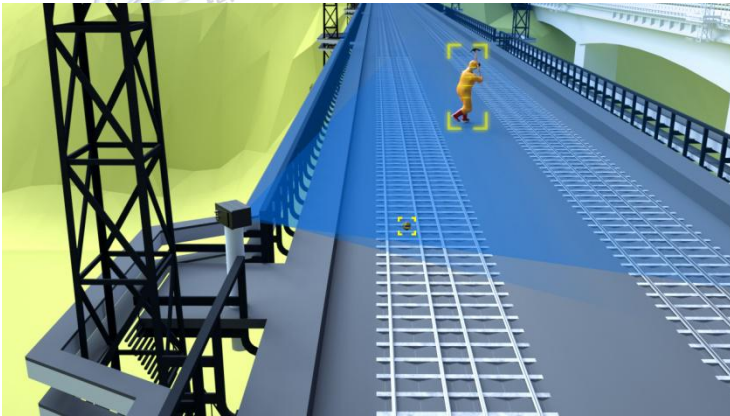
4.System Features

(1) High safety of non-contact collection

Laser scanning technology adopts the non-contact scanning target method for measurement and the point cloud of the object is directly collected. The data is accurate and reliable. It is very suitable for detecting and alerting foreign objects in remote distance.

(2) Fast and high sampling rate

The data acquisition rate of Leishen CH series lidar can reach hundreds of thousands of points per second.

(3) Real-time, dynamic and proactive

The system scans are all collecting and processing modules in a real-time dynamic environment, and actively scan the scene, knowing the danger of the front track in advance, and gaining more emergency braking time.

(4) High resolution, high precision, high density

Lidar can acquire massive amounts of data with centimeter-level accuracy, and can perform high-density repeated angle overlap acquisition.

(5) High light resistance, free from environmental interference

Lidar is a pulsed laser with high anti-light in nature, which is not affected by natural light and high-brightness light when 2 trains in passing. At the same time, the protection level is IP65

(6) Data fusion with vision sensor

The visual sensor enhances the acquisition of detected color calibration and other information, makes the target information more clear and detailed, and provides system safety redundancy.

5.Effect Display of System
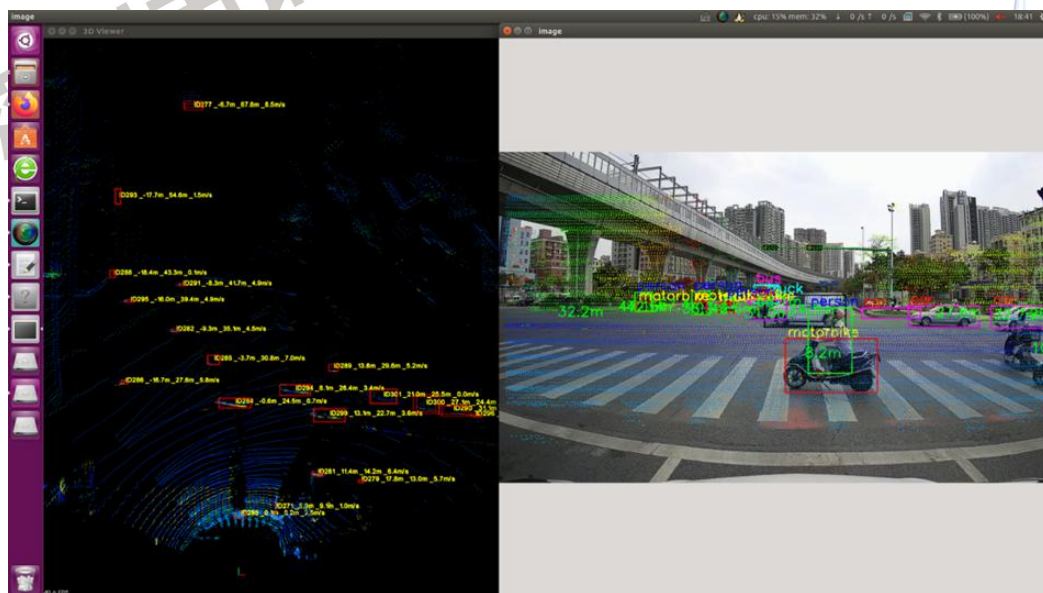
    The above picture is the road test video picture of the automatic driving multi-sensor fusion target detection and recognition and pose real-time output algorithm currently developed by Leishen Intelligent.Multi-sensor

fusion based on Leishen's intelligent multi-channels lidars and cameras. Through the processing of the corresponding algorithm developed, road segmentation information is obtained in real time, and various vehicle types in the ROI area of the road segmentation are detected, identified and classified And output of information such as angle, distance and movement trend.This is similar to the principle of track detection, which is to divide the area of the railway track in the front detection range in advance, and then detect the obstacles in the divided area, identify and classify, and detect and output information such as angle, distance, and size.

The following picture shows the actual measurement effect of Leishen's vehicle-mounted track line foreign body intrusion limit monitoring system

6.Equipment List

(1) Vehicle-mounted Intelligent Monitoring System

No.	Name	Spec.	Qty.	Company
1	Lidar	Model：CH114 Range(radius)：260-280m Communication Interface：Ethernet interface Precision：±3cm	1	LeiShen
2	Camera		1	
3	IPC		1	
4	IMU		1	

(2) Roadside Fixed-checking Point Intelligent Monitoring System

No.	Name	Spec.	Qty.	Company
1	Lidar	Model：CH120 Range(radius)：50-100m Communication Interface：Ethernet interface Precision：±3cm	1	LeiShen
2	Camera		1	
3	IPC		1	

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