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# Intelligent Road Safety System Based on Multi-Function Warning Device

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**Abstract:** A warning device for car driving is proposed in this paper, which includes support rods and warning plates. In this device, several display screens are installed on one side of the warning panel. Indicator lights are set on the display screen. A warning board is mounted on the top box. Several radar detectors are mounted on one side of the top box, and the radar detectors correspond to the display screens. Several warning lights are installed on the top box, and the warning lights correspond to several radar detectors. The sliding side of the support rod cleans the unit. The change of positions of the indicator lights based on the radar detectors will be reflected on the display screens, which allows drivers to understand the situation of the road. Therefore, they can prepare for changing lanes and overtaking, and understand the position and speed of all vehicles in this road section in advance.

**Keywords:** Traffic safety; Intelligent traffic; Warning device

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## 1. Background technology

Road safety is something that every driver should understand and master. Adhering to traffic regulations is essential for ensuring road safety. While driving, drivers must possess a comprehensive understanding of various traffic signs and signals, and adhere to traffic rules. This includes adhering to speed limits and refraining from overspeeding, as well as respecting road markings and avoiding haphazard lane changes. Drivers should first observe the surrounding vehicles before changing lanes or turning. However, in some cases, the driver did not look at the rearview mirror before changing lanes, resulting in sudden lane changes. This behavior increases the risk of collisions with trailing vehicles, potentially causing harm to both drivers and their vehicles[1].

Intelligent transportation system uses advanced sensor and algorithm technology to provide real-time traffic information through vehicle detection, traffic flow monitoring, and traffic condition analysis to help drivers make better decisions while driving. Driver behavior research is dedicated to detecting and analyzing the behavior of drivers, so as to improve safety awareness and driving literacy, and reduce traffic accidents. Intelligent driver assistance system uses advanced sensors and algorithm to provide drivers with real-time information and warning to make driving safer and more convenient. Cleaning and maintenance technology refer to the use of advanced cleaning equipment[2] to reduce the need for manual cleaning and maintenance. The integrated traffic safety system integrates different traffic safety systems to form

comprehensive traffic safety solutions to achieve more efficient and safe traffic management. This paper proposes an intelligent road safety system based on a multi-function warning device.

## 2. System survey

This study introduces a road driving warning device, with its surface structure illustrated in Figure 1. The device is designed to enhance the warning system for lane changes in vehicles. The warning board is equipped with multiple display screens on its side, featuring warning lights. A connection box is fixed on top of the warning board. This box is equipped with several radar detectors, which correspond to a display screen. Additionally, several warning lights are mounted on the top of the box, and they correspond one-to-one with the radar detectors. The support rod on the side is connected using a sliding mechanism to facilitate the removal of the device.

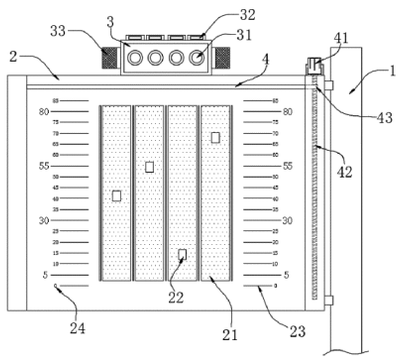


Figure. 1 Schematic diagram of road driving warning device. Description for each number: 1, support rod; 2, warning board; 21, display screen; 22, indicator light; 23, scale line; 24, distance identification; 3, top box; 31, radar detector; 32, warning lights; 33, voice alarm; 4, cleaning rod; 41, drive motor; 42, wire rod; 43, thread plate.

There are two scale lines on one side of the warning board, which are symmetrically distributed. The scale lines correspond to the size of the display screen. On the side of the warning board, the two distance signs correspond to the positions of the two scale lines. Alarms are installed on both sides of the top box, which cooperate with several warning light functions. The top of the warning board is equipped with a motor that drives the cleaning rod. The output end of the drive motor is firmly connected with the wire rod, and the one end of the cleaning rod is fixed with the thread plate is connected to the side wall of the wire rod. The cleaning rod is attached to the side of the warning board and the side walls of several display screens.

The intelligent road safety system utilizes multiple radar detectors to control the position of the warning lights that are displayed. This allows drivers to observe specific driving conditions on the display screen and while changing lanes and overtaking. The system provides advanced information about vehicle location and speed, enhancing road safety for both drivers and pedestrians. Additionally, the warning board is designed with dust-cleaning functions to prevent impurities from obstructing the driver' s view of the device and the road conditions.

## 3. Device implementation

This paper presents the following technical solutions, including a support rod and a warning board. The side of the warning board is equipped with several screens, each screen featuring an indicator light. The warning board is firmly connected to the top box. Several radar detectors are positioned on the side of the top box, corresponding to the number of display screens. The top box also accommodates several warning

lights, matching the number of radar detectors. The support rod is affixed on the side and enables the device to be easily slid for cleaning purposes (Figure 2).

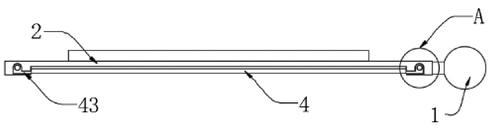


Figure. 2 Schematic diagram of the top-view profile structure

The support rod supports the warning panel. The support pole is installed on the edge of the road, so that the warning sign can be hung above the road for the driver to see. The warning signs correspond to different lanes on the road. Vehicles are scanned and recorded by multiple radar detectors as they move. The display is controlled by data scanned by the radar detector. In this way, the lane that the vehicle is in can be observed through the warning lights. The driver can observe multiple screens and understand the conditions of the road section, be prepared to change lanes and overtake, and grasp the position and speed of all vehicles on the road section in advance. The top box protects and supports radar detectors and warning lights. Warning lights and displays are controlled and triggered by radar detectors. When a tendency of a vehicle turning or a turning signal is detected, the radar detectors will detect whether there are vehicles that pose a safety hazard to the vehicle in multiple lanes. When it is detected that vehicles in other lanes conflict or pose a risk to the vehicles, the radar detector controls the warning lights to issue warnings to vehicles in the corresponding lanes in time. By doing so, the driver would be aware of the safety hazards when changing lanes, and traffic accidents can be avoided. When the equipment is in use, it is easy to be contaminated with impurities and dust Therefore, the warning device is equipped with a cleaning rod that would slide up and down to wipe away the dust on the display screens, so that drivers are able to see the information displayed clearly.

There are two scale lines on one side of the warning sign, the two scale lines are symmetrically distributed, the scale lines correspond to the size of the display screen, and there are two distance marks on one side of the warning sign; the two scale lines are located on multiple display screens on both sides of the area, so that drivers in each lane can analyze and judge the scale marks and indicator lights. By observing the positional relationship between the indicator lines, the driver can judge the distance and driving speed of the surrounding vehicles, which is will be helpful in creating a better driving experience.

Alarms are installed on both sides of the top box, and are matched with multiple warning lights. The alarm can remind the driver to observe the device in time, and remind the surrounding drivers when a driver decides to change lanes, so that the surrounding drivers can slow down or change lanes in time, thus reducing the occurrence of accidents. A driving motor is installed on the top of the warning board, which connects the screw rod at the output end of the driving motor and the threaded plate at the end of the cleaning rod; the driving motor moves the screws up and down to move the cleaning rods (Figure 3).

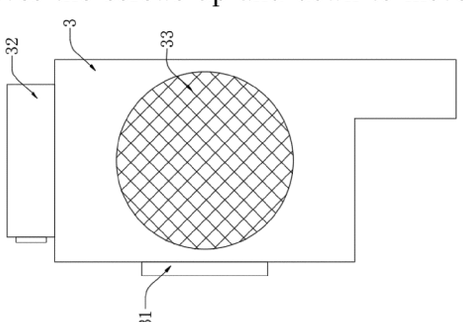


Figure. 3 Schematic diagram of the lateral view structure of each component on the top box

The cleaning rod is attached to the side of the warning sign, where the warning signs and several display panels are located. As the cleaning rod is moved vertically, it acts as support and propels the wiping board to clean the display screen. This mechanism enhances the cleaning effectiveness while preventing any potential damage to both the warning sign and the display screen (Figure 4).

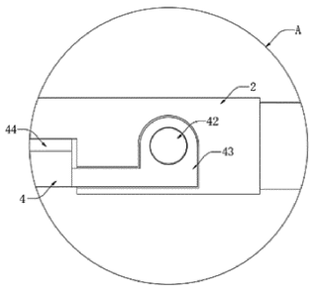


Figure. 4 Enlarged schematic diagram of the structure

## 4. Technology implementation process

### 4. 1. Design phase

The functions and requirements of the equipment should be defined, such as vehicle speed detection, warning information display, sound alarm, etc. The components and modules such as radar detectors, display screens, sound modules, etc should also be determined.

### 4. 2. Radar detection technology

A suitable radar detector should be selected and connected to the control board[3]. Algorithms for radar signal processing should be developed to handle returned radar signals and to extract information about vehicle position and speed. Antenna systems should be designed, encompassing the arrangement and adjustment of antennas to achieve optimal reception of vehicle detection signals.

### 4. 3. Display technology

The right type of display screen should be used, such as LED display. The display would be connected to the control circuit board, and a control program would be written to control the display content. Then, vehicle information and warning will be displayed on the screen through programming, and suitable appropriate fonts, icons and animation should be used.

### 4. 4. Alarm sound

A suitable alarm sound should be selected and connected to the control circuit board[4]. Using sound synthesis technology, the warning message is converted into speech and played through the speaker. This requires a control program to trigger the voice playback of the corresponding alarm information.

### 4. 5. Cleanup mechanism

The structure and driving method of cleaning rod and wiping cotton should be determined, which will be driven by a suitable motor and transmission device. Sensors should be installed to realize automatic detection of dust and impurities, and trigger the cleaning mechanism to work. A control program should be written to coordinate the work of the cleaning mechanism and other modules.

### 4. 6. Control and algorithms

Embedded systems need to be developed along with control programs to facilitate the coordination of

different modules' functions. Algorithms, such as those for vehicle detection and early warning judgments, should also be developed. These algorithms would initiate relevant early warning actions based on the results of the detection process. Furthermore, the integration of the system is essential; this involves connecting and testing the different modules to ensure their effective collaboration and overall stability.

### 4. 7. Testing and debugging

Functional testing to should be carried out to make sure that the device performs its functions. Performance tests, such as vehicle detection accuracy, display effect, sound playback clarity, etc. should also be carried out. Stability and reliability tests should be carried out, including long-term operation and operation in various environments. Besides, the system should be further optimized and debugged, and some improvements should be made.

## 5. Innovation

### 5. 1. Multifunctional design

The device is fully functional and cleverly integrates display screens, indicator lights, radar detectors and warning lights to build a multi-functional system, thereby significantly improving the ability of vehicle lane warning.

### 5. 2. Visual cues and voice alerts

The device uses the built-in photosphere on the display screen, the top warning light and the voice alarms on both sides to provide the driver with a full range of visual prompts and different levels of alarms in a multi-sensory manner, effectively enhancing the driver' s intuitive perception and awareness of the vehicle' s conditions.

### 5. 3. Cleaning function

The cleaning unit consist of rods and wipes to remove dust and debris on the warning signs and displays quickly and efficiently. This innovative design plays a vital role in providing accurate and reliable visual information by ensuring that drivers have a clear view of the display screens at all times.

## 6. Conclusion

The device uniquely integrates smart technology with a multifunctional design, providing drivers with detailed vehicle driving information through the synergy of radar detectors and displays, so that they can better prepare for lane changes and overtaking. In addition, the ingeniously designed cleaning function removes dust and impurities in time to ensure that the device is always visually clear. Overall, the innovative design of the device greatly improves the safety of road driving and the driver' s perception, making a significant contribution to road traffic safety.

## Disclosure statement

The authors declare no conflict of interest.

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