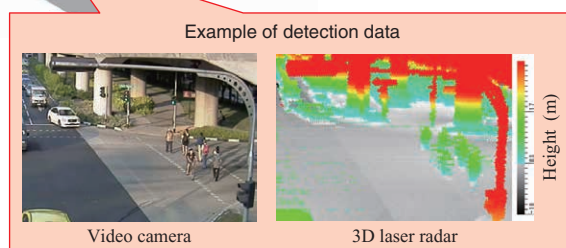
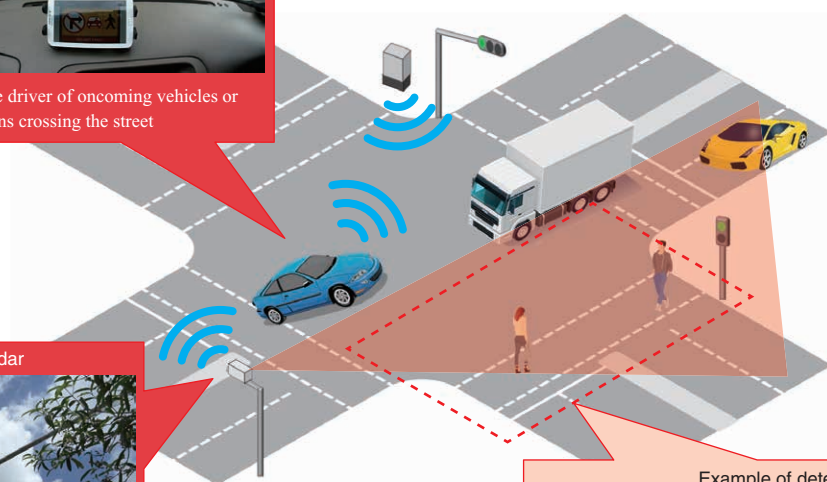


Monitoring Intersections to Alert Drivers

Practical application of 3D laser radar is close at hand in playing a central role in the Intelligent Transport Systems

Intelligent Transport Systems (ITS) mediate the exchange of information between vehicles, roads, and people in order to prevent car accidents, avoid traffic jams, and address environmental problems and other challenges. After repeated demonstration experiments in Japan and Singapore, practical application of IHI's 3D laser radar for preventing accidents at intersections is close at hand.



Example of system configuration for facilitating safe driving

Eyes that tell vehicles the road conditions at a nearby intersection

There are many kinds of ITS around us. Examples include the Vehicle Information and Communication System (VICS), as well as the Electronic Toll Collection System (ETC) and Driving Safety Support Systems (DSSS) that transmit information to vehicle-mounted navigation systems to inform drivers of road conditions like traffic jams and lane closures. In a DSSS, information is sent from infrared beacons to On-Board Units (OBU, VICS-compatible car navigation units), which display relevant illustrations on the monitor and make sounds to inform drivers of any hazards. In Japan, the National Police Agency took the initiative from July 2011, in putting such a system into practical use to provide a margin of safety to prevent traffic accidents. Moving beyond this conventional DSSS, academic, business, and governmental circles are developing pilot programs for next-generation DSSS to enable on-board units to determine which information is necessary depending on the operating conditions of their vehicles. One such initiative is led by the UTMS (Universal Traffic Management Systems) Society of Japan. The 3D laser radar developed by IHI (hereinafter called “laser radar”) is employed at the core of equipment for facilitating safe driving mainly at intersections.

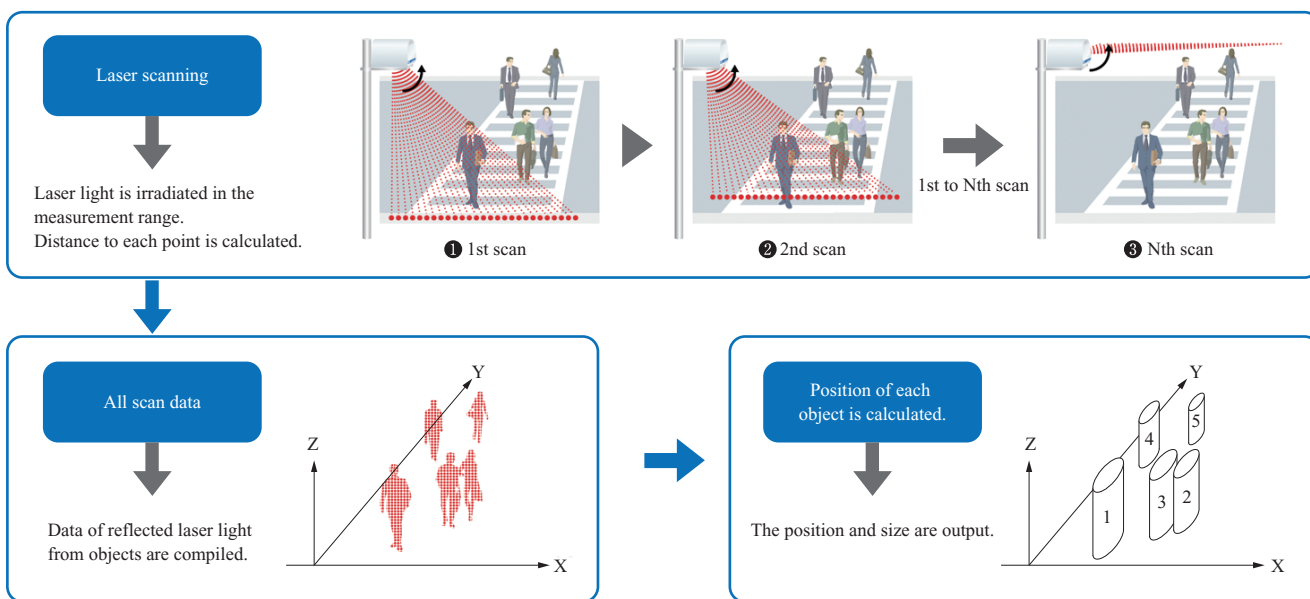
Meanwhile, a pilot program is being spearheaded by the Cabinet Office. This Cross-ministerial National Project for Science, Technology and Innovation is striving to develop an automated driving system (for autonomous cars) as a part of the Strategic Innovation Promotion Program (SIP). Laser radar also serves as the eyes for these autonomous cars, conveying information from intersections to them. The first step for achieving automated driving is the development of a system for sharing vehicle-to-vehicle (V2V) information

among vehicles to prompt appropriate driving control. For instance, an automated braking system that reacts when the distance between cars drops below a certain threshold so as to avoid rear-end collisions has already been put into practice. An additional infrastructure-to-vehicle (I2V) system is needed to communicate road conditions to vehicles to prompt appropriate driving control. Such a system judges how to direct vehicles that are approaching an intersection. IHI’s laser radar is at the core of the latter system that provides information on vehicles and pedestrians at intersections.

In fact, IHI’s laser radar has already been practically applied to a system that detects obstacles in railway crossings and warns approaching trains (refer to “3-D Laser Radar Level Crossing Obstacle Detection System,” IHI Engineering Review Vol. 41, No. 2, pp. 51-57). For this purpose, more than 1 600 Laser Radars have been installed in Japan and 127 units installation are ongoing in Italy. In recent years, IHI has been delivering 200 to 300 units annually, counting those sold both in Japan and abroad. The development of a laser radar for ITS was commenced at around the same time as that for railway crossings. Practical application is finally on the horizon after pilot programs both in Japan and abroad.

Instant identification of objects with reflected laser light

Simply put, a laser radar is a device for quickly scanning and monitoring a certain space. Laser light is irradiated onto the road surface while scanning in horizontal and vertical directions to calculate the distance to each irradiated spot by measuring the time it takes for the light to be reflected back to the unit. It takes about 0.3 seconds to cover the space starting from a stop line and moving across an intersection 3 or 4 lanes in width and about 150 m in depth. Constant monitoring of an



Method for detecting vehicles and pedestrians

intersection in this manner makes it possible to gauge the height and width of any object that enters the space and how fast it is approaching the intersection. A program written by IHI determines whether the approaching object is a car, a motorcycle, or a pedestrian. In addition, the movement is captured and traced from the moment the object enters the monitored space to send a signal to represent the movement in real time. If a vehicle with a DSSS compatible on board device approaches an intersection with this system, the on board device receives the information from the laser radar to display an alert according to the designed standards. The display will appear differently depending on the manufacturer of the navigation system. But as far as the voice alert, a unified standard is applied by organizations and companies involved in ITS in order not to confuse drivers with different kinds of voice guidance.

Advantage of all-weather capability and fast data processing

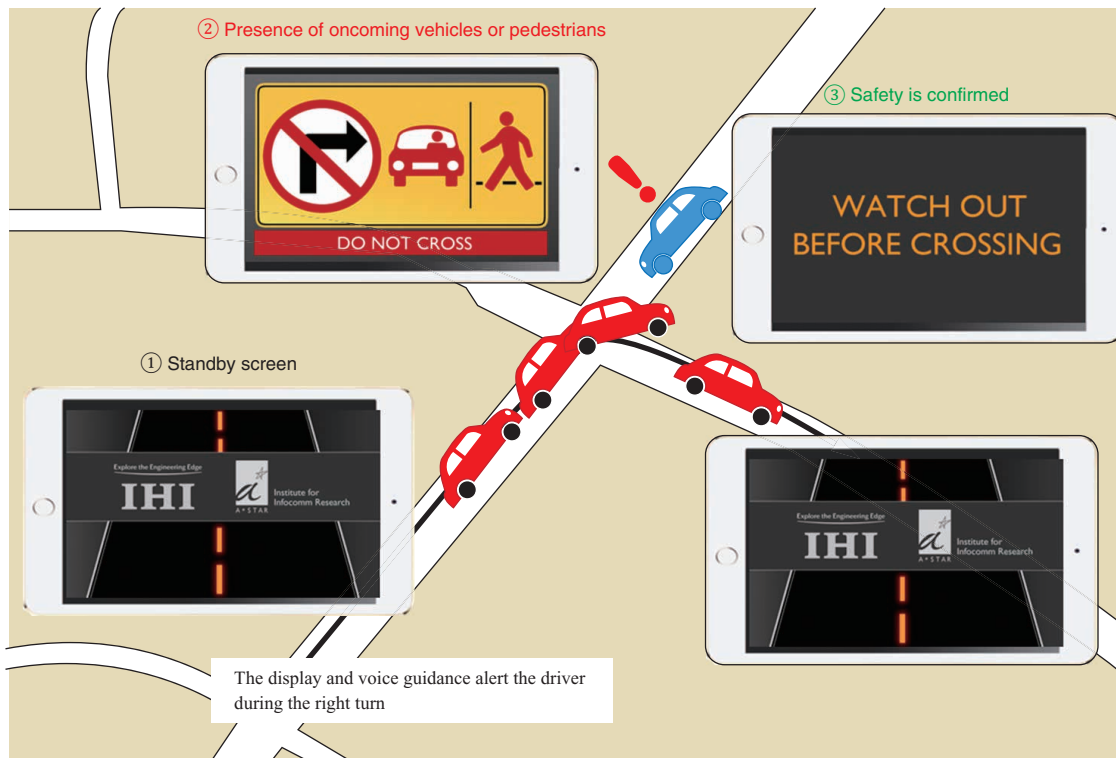
Reportedly, most intersection accidents involve accidental contact between vehicles turning right and those advancing straight, or pedestrians crossing intersections getting hit by vehicles turning right. During a right turn, the driver of a bus or large truck sometimes experience difficulty noticing the vehicles in the oncoming lane. Even in such a situation, the system monitors any movements in the oncoming lane to facilitate the right turn. The system informs the driver of any movements of bicycles or pedestrians on the crosswalk the vehicle is approaching after turning right.

A position for deploying the laser radar at the intersection and the direction for monitoring the road depends on the kind of information service intended by a service provider. Radar positions and directions are determined after traffic analysis, accident analysis by the police, and on-site surveys, but they are normally installed to provide vehicles travelling on busy roads with traffic information.

Video images from a video camera offers another way to monitor space. Unfortunately, these cameras are often incapable of measuring distances or capturing accurate images during certain hours of the day or types of weather, including nighttime and rain. In this regard, laser radar is more adaptable to surrounding environments. In short, the advantages of laser radar are a wider scanning range, faster scanning, and smaller files sizes than video for recording and distribution, which enables a simple device with the processing power of a PC to make appropriate real time judgments without relying on a huge server. Incidentally, the evaluation software was also developed by IHI. This original software selectively processes the data that a service provider needs instead of processing all information.

Pilot program in Singapore

IHI has introduced a technology attaché system, in which junior and mid-career engineers are stationed overseas for an extended stay to engage in marketing research, explore useful technologies, and conduct joint research with local public institutions and universities so as to plan a project leading to new business in the future.



Example of display for facilitating safe driving (pilot program in Singapore)

Prior to the establishment of IHI Asia Pacific in April 2012, a technology attaché has been deployed to Singapore since October 2010 in addition to New York and London.

Singapore has been dubbed “the world’s testing ground.” The advanced information society with a tiny territory that fits inside the Yamanote Railway loop line in Tokyo attracts many pilot programs by companies from every corner of the world. The government is known to offer generous support to such experiments. Thanks to the local attaché, IHI signed a comprehensive R&D agreement with the A*STAR (Agency for Science, Technology and Research) of Singapore. The partnership extends across the three areas of information and communication, production technologies, and environmental science and engineering. A demonstration of ITS technologies was commenced in December 2012 as a part of the partnership.

In Phase 1, the on-site survey and system design for a six-lane intersection in Jurong district was followed by the installation of two laser radars. Data was then accumulated to check if these radars reliably detected target objects (e.g., vehicles, motorcycles, and pedestrians), to make sure there was no misdetection and that detection is not affected during certain hours or types of weather, such as nighttime, rain, and so forth. Taking advantage of the left-hand traffic like in Japan, radars were examined in terms of their effectiveness in preventing accidents involving vehicles turning right and other vehicles advancing straight, as well as pedestrians. The pilot program was continued in fiscal year 2015 to make the service a reality in the near future. The company intends to enhance the offered functions and services based mainly on the accumulated data and to advocate the wider application of DSSS in Japan and beyond.

Venturing into the world with ITS that embodies smart technologies of Japan

ITS pursued by Japan mediates the exchange of information among vehicles, roads, and people to build a safe traffic system. As mentioned earlier, V2V systems including those preventing rear-end collisions are almost a commercial reality thanks to technologies developed by automobile companies. Communication between I2V with laser radar as featured here will also be put into practical use in the near future mainly at intersections. Unfortunately, no system has been developed for alerting pedestrians about approaching vehicles although a detection system with a laser radar at an intersection can already inform vehicles of the presence of pedestrians. Some automobile manufacturers are developing applications using smartphone, to alert pedestrians. But they need to accumulate and examine data related to traffic safety. Accordingly, services are being explored to reliably inform pedestrians of approaching vehicles and to provide information to regulate traffic signals to prevent the elderly and other vulnerable people in traffic from being stranded in intersections.

Research and development of ITS is conducted through the partnership of industry, academia, and the government. The

government has also set a national strategy to promote infrastructure and related services as a package, not only in Japan, but throughout the world. The package would include technologies for automated driving, traffic sensing, and the safety of pedestrians. The laser radar made by IHI is expected to continue to play a core role as a reliable device to make that possible.

Note:

Terms such as “turning right” included in this report are based on countries where traffic drives on the left-hand side of the road (e.g., Japan, Singapore...).

The systems in this report can also be applied in countries where traffic drives on the right-hand side of the road.

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