Case Study

UNISECU
www.unisecu.kr

Smart Crosswalk System Enhances Road Safety With Automated Pedestrian Detection

1. The Challenge

Automatic Pedestrian Recognition for Crosswalks

Pedestrian crossing systems traditionally rely on open-loop technologies such as push buttons and fixed timers, which are not capable of adapting to vulnerable road users like the elderly, children or mobility-aid users. The local authorities in Korea identified this as a challenge and wanted to modernize the existing system. Unisecu, which has significant expertise in developing AI-based intelligent transportation systems (ITS), took charge of creating a smart crosswalk solution that focuses on ensuring the safety of all vulnerable road users.

New generations of pedestrian crossing technologies that leverage sensors to detect pedestrian activity around crosswalks have emerged, thus adding intelligent feedback to the traffic control system. To ensure smooth traffic flow, these systems must activate crosswalk signals based on reliable detection of pedestrians waiting to cross the road.

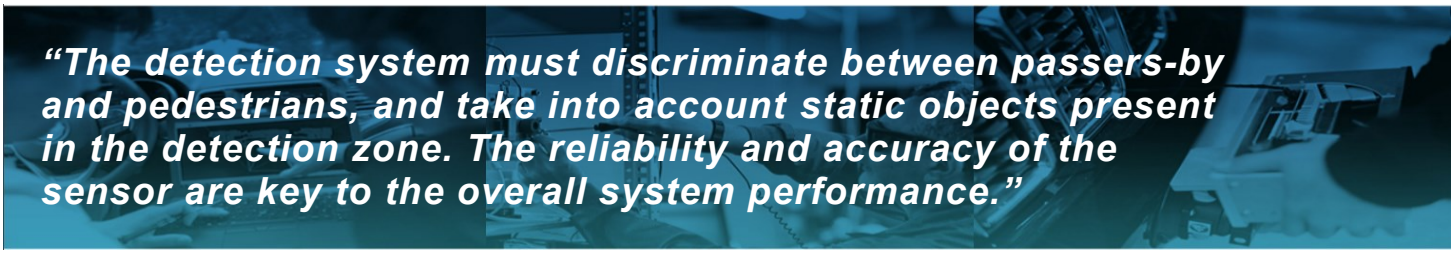
Alternative detection technologies face multiple challenges, especially with discriminating waiting pedestrians from passers-by and static objects. For example, a passer-by walking over the crosswalk waiting zone may activate the crosswalk signal when no one is actually waiting to cross the road. Such detection errors often lead to frequent light changes, which disrupt regular traffic flow and potentially put pedestrian safety at risk.

To develop this solution, Unisecu had to achieve the critical balance between accuracy, detection range, computing resources, adaptability to lighting and weather conditions, and overall cost. At that time no available solution was able to address all these factors at once. Radar technologies were considered and benchmarked against solid-state LiDARs, but radars with comparable performance ended up being expensive, while the deep learning algorithms required too many computing resources. After due consideration, LeddarTech's 2D LiDAR sensors emerged as the clear choice in this application, being able to bridge the cost-performance gap while providing utmost reliability.

System Requirements

Entering this project, Unisecu identified two key elements for its success: first, the accuracy in detecting pedestrians and, second, the overall cost of the system. More specifically, the following criteria were also established:

- Reliability of coverage of the pedestrian waiting area (sensor range)
- Geometric suitability of the sensors to cover the area at an angle
- Adaptability of the sensors, and reliability of sensor data in varying lighting (e.g., day, night…) and weather (e.g., rain, snow…) conditions
- Ability to isolate static objects in the waiting zone
- Adaptability of the system to unpredictable pedestrian behavior (e.g., wheelchair users, children…)
- Reduction of overall social cost



"The detection system must discriminate between passers-by and pedestrians, and take into account static objects present in the detection zone. The reliability and accuracy of the sensor are key to the overall system performance."

2. The Solution

Smart Crosswalk System

Unisecu's Smart Crosswalk system consists of three pieces of equipment combined into one integrated system:

1) Automated crosswalk system
2) Control unit
3) Traditional push-button crosswalk

The goal of the automated crosswalk system is to control the crosswalk signal by predicting the pedestrians' intention, i.e., distinguishing whether they mean to cross the street or simply pass through the sensor of the scanning zone.

Unisecu has selected LeddarTech's Leddar™ M16 2D LiDAR modules to develop and produce its smart crossing systems for their high level of accuracy, ability to cover large areas, and competitive cost which makes the price of the complete solution very attractive. The solid-state design of the Leddar M16 makes it a very durable LiDAR solution that improves the system's overall lifespan.

The "scanning zone" is defined by the common region between the LiDAR sensor's field of view (FoV) and the physical waiting zone for the crosswalk. Static objects within this scanning zone produce a detection signature that could be easily isolated by the tracking algorithms of the software. Since the entire FoV of the sensor is output at once, it becomes more straightforward to pre-emptively define any shape of the scanning zone.

When a pedestrian enters the scanning zone, a 1 sq. meter virtual 2D "bounding box" is placed around the detected object, and its movement within the zone is tracked within the software (Figure 1). Once the bounding box stops moving, a timer is initiated and increments as long as the object remains within the bounding box and the latter remains within the zone. When the timer reaches a predetermined threshold (representing the pedestrian's intention to cross the road), the control unit sends the trigger to activate the crosswalk lights.

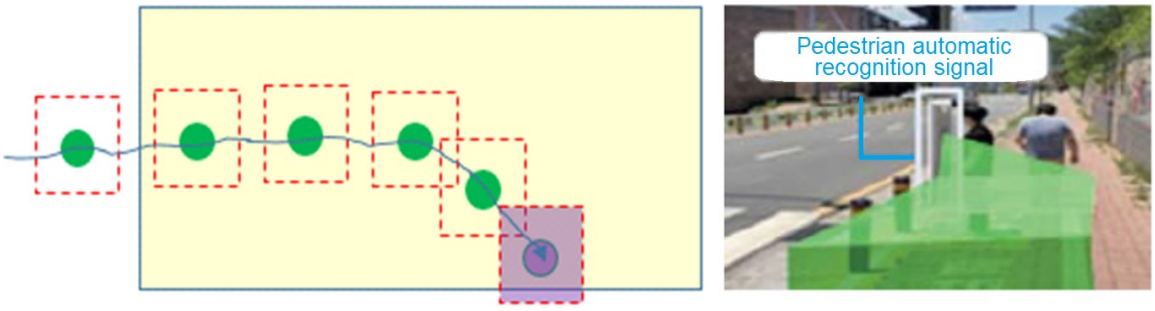


Figure 1 – Recognizing pedestrians: pattern of a pedestrian waiting to cross the street within the detection area

However, when a passer-by walks across the detection area, their bounding box will move in and out of the zone without starting the counter to trigger the lights (Figure 2). Even if the passer-by briefly stops within the zone and starts the counter, the predetermined threshold will generally prevent the crosswalk lights from being activated.

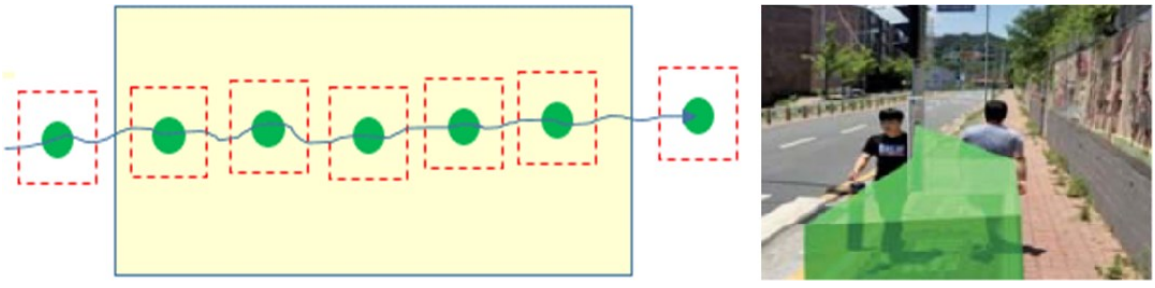


Figure 2 – Recognizing passers-by: pattern of a passer-by crossing the detection area

Another important feature of the system is its ability to discriminate static from dynamic objects by customizing the sensor scanning area, which allows to exclude elements like benches, trash cans or poles from the detection zone and to focus on the free space areas.

3. The Outcome

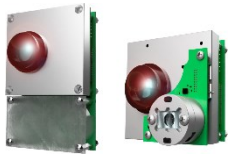
The Smart Crosswalk solution by Unisecu has been recognized as an “excellent product” by the Korean government. It has also been selected to be part of a smart crosswalk pilot project implemented by the Korean government and installed in front of the Presidential Archives building in Sejong City. The solution has also been selected for pilot projects by LH (Korea Land and Housing Corporation[1]) and has been installed in 18 developing cities and five metropolitan cities across Korea, totalling around 600 sets.

About Unisecu

Company name:	Unisecu Co., Ltd
Address:	4, Gimhae-daero 2283beon-gil, Gimhae-si, Gyeongsangnam-do (Bonghwang-dong), Korea
Business areas:	Intelligent transportation systems (ITS), speeding/signal violation enforcement systems, smart-city solutions, license plate recognition systems, video surveillance systems production and software development
Website:	http://unisecu.kr

Related LeddarTech Products

Leddar™ Sight
2D flash LiDAR sensor



Leddar™ M16
2D flash LiDAR modules

For more information, visit leddarsensor.com

[1] Korean government-owned corporation responsible for the development of land in cities, and the maintenance and management of land and housing.