A Study on Safe School Zone System using LabVIEW

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Abstract

The total number of deaths by traffic accidents is decreasing every year in our country. However, in 2009, children died in traffic accidents at a rate of 2.3 deaths per 100,000 children, which was higher than the average of OECD countries (1.9 deaths per 100,000 children). In particular, traffic accidents are showing rapid increase in school zone during the past 2 years because of problems in the designation and management of school zone. Traffic safety facilities such as road sign, reflector mirror, speed bump have the ultimate limit of vehicle accidents prevention. Thus, in school zone, children safety is still not guaranteed due to illegal parking and the absence of driver's awareness of safety. Therefore, In order to protect children from traffic accidents within school zones, we have realized a safe school zone system, which enables the drivers to better know the intended school zones and creates pedestrian environment through unmanned monitoring camera, using LabVIEW.

Keywords: School Zone, LabVIEW, Monitoring, Zigbee Communication

I. Introduction

The total traffic accidents in our country have declined each year from 20495 in 2005 to 18092 in 2009 (Road Traffic Authority, 2009). During the past three years, the traffic accidents in School Zone had not changed with 349 in 2005, 323 in 2006, 345 in 2007, while the accidents in 2008 and 2009 showed an abrupt increase of 50% compared to the past three years. During the first quarter of 2010, the accidents in 16 cities also showed an increase of 23%, compared to the same period in 2009 (Ministry of Public Administration and Security, 2010). Considering the above reports, School Zone has been recognized as a ‘Traffic accident black spots’, even though School Zone is designated to protect children from traffic accidents.

According to the encyclopedia, School Zone is an area on a street near a crosswalk leading to a kindergarten and an elementary school (within a radius of 300 m) that has a likely presence of pedestrians. If an area is designated as a ‘School Zone’, in which traffic signals and road signs can be established and parking places cannot be established on the road located at the main entrance to the elementary school. Also, within protected area during a specific time before and after school, an automobile traffic and stopping or parking may be prohibited or limited, and the speed of a vehicle can be limited less than 30 km/h.

However, according to papers focused on analysis of traffic and management within School Zone of our country (K. Lee, 2008; Y. Kim, 2008; E. Kim, 2008; S. Lee, 2006; Y. Oh, 2009), the traffic management was not working properly, compared with other advanced nations. And because there was not investment of walking environments but merely investment of traffic safety facilities within School Zone, careful management was not carried out. With only Traffic safety facilities (traffic sign, reflector, speed bump, etc), fundamental prevention of traffic accidents is difficult.

Currently, because of lack of Vehicle safety and driver safety awareness in School Zone, children safety is still not secured. Therefore, to overcome these problem, our paper will suggest IT-based management system in School Zone with engineering student’s viewpoint and in accordance with the ultimate goal
of engineering education. In this paper, on the basis of some problems in children safety zone indicated by several previous reports, we tried to make drivers intensify public recognition of School Zone and construct safe pedestrian environments through unmanned monitoring system to prevent traffic accidents. This system is realized with LabVIEW program using micro controller and zigbee communication (Park, 2005).

II. Experimental

1. System configuration

[Fig. 1] is a configuration of an overall system which consists of three main parts. The first part is a model of School Zone installed with traffic safety facilities in order to form pedestrian environments in children safety zone. The second is main monitoring screen using unmanned camera. The last is monitoring screen of driver which make driver strengthen public recognition of School Zone.

[Fig. 2] is a block diagram of the developed system. This system can be divided by the DAQ (Data acquisition) part to control signal lamps and LED lights, and the MCU (Micro Controller Unit) part to control ultrasound sensors and LCD monitors.

The Infrared Sensors are located at the five sites. The sensors at the start point and end point in School Zone are controlled by DAQ but the rest of the sensor is controlled by the MCU. The DAQ board and Web-cam are controlled and monitored by LabVIEW program (Mihura, 2001; Kwak, 2009). The main monitoring and driver monitoring can exchange all information of School Zone with each other through Zigbee communication.

2. MCU

A MCU is typically used as a systems controller, with many conditional operations and frequent changes in program flow. In this paper, we used ATmega 128 produced by ATMEL company. The role of Atmega 128 is to control infrared sensors, ultrasonic sensors, LCD monitor.

3. Zigbee communication

The information about the speed of cars in this paper can be communicated using LabVIEW’s VISA function. In main monitoring, Zigbee module is set to master and communication environments (9600 Transfer Rate, 8 data bits, parity-none, 1 stop bit, non-flow control) are assigned using ‘VISA write’ function and the information is transmitted. In driver monitoring, Zigbee module is set to slave and the same communication environments as that of the main monitoring are assigned and the information is received by ‘VISA read’ function.

III. Results and discussion

1. School zone model

[Fig. 3] shows the School Zone model which includes traffic safety facilities such as road sign, signpost (traffic messages and speed), signal light, crosswalk, traffic warning light, red ASCON, roadway striping & pavement marking plans, speed bump and traffic road work light. When the vehicle is recognized by first infrared sensor located in the starting point of School Zone, LCD monitor display a message of school zone (“Here is the school zone”) and an initial
driving speed (“The speed is 00 km/h”) by checking through the ultrasonic sensor. Using two-color LED placed near the road sign of School Zone, the green LED turns on at keeping the regulation speed (less than 30 km/h) and the red LED turns on at violating the speed. As LED color is changed by the car speed and LCD monitor displays the driving speed, the drivers are able to recognize the own driving speed and then that can make them induce low-speed drive and prevent over speed. The aim of this system, which alerts drivers to the dangerous situation in advance, is to avoid traffic accidents by an over-speeding vehicle.

The LEDs are also used for signal light control of crosswalk. The green signal light can be controlled depending on children pace and the red signal light is changed with 3~4 second interval after ending the green light because children have enough time to cross the road in school zone. LED lights, installed along the road, flicker during a specific time before and after school. The LED lights have a role for clear division between sidewalk and road. They help children not to cross in a street illegally and make the locations of School Zone better known to drivers. Thus, without jaywalking, children can safely commute to and from school though the flicker of LEDs in School Zone during a specific time before and after school.

2. Main monitoring

[Fig. 4] shows the main monitoring system designed with LabVIEW graphical programming language. The system has four main components on display screen. Part 1 displays infrared sensor data and turn-on time of LED. Part 2 shows speed value and Zigbee communication and Part 3 shows web-cam image. Part 4 shows vehicle moving image and signal lamp. This system can monitor the overall status of transport stream in real time within School Zone though the unmanned monitoring camera. Therefore this provides safe pedestrian environment within School Zone and plays a central role in the effective management and operation of School Zone. If it is connected with an emergency medical service system and local transportation department, it is expected both quick accident emergency treatment and a marked reduction of the injured person.

[Fig. 5] shows a block diagram of main monitoring system. If cars pass through School zone, the infrared sensor recognizes them and delivers the sensor data to LabVIEW program by DAQ board. The data of the infrared sensor is converted to the speed value of the car by some calculation of LabVIEW program.

As a vehicle is detected by the sensor, web-cam is operated and an image of the vehicle is transferred and then the video of Web-Cam is shown in LabVIEW monitoring system. If the vehicle speed is over regulation speed of 30 km/h, the moving images are automatically captured and the alarm is sounded. And the signal light and LEDs around School Zone can be controlled to turn them on/off during a specific time. The calculated speed is recorded in the file system in real-time and is delivered to the driver’s monitor through zigbee communication.

[Fig. 6] is a screen that displays the recording files in real-time ([Fig. 6] (B)) and the saved image at violation of speed limit (30 km/h) ([Fig. 6] (A)). [Fig. 7] shows the recorded information of vehicle speed calculated with the sensor signal in real-time.
3. Driver monitoring

Although a lot of traffic safety equipments are currently established in School Zone, most drivers pay no attention to the existing traffic signal system in School Zone. Thus the purpose of this system is to intensify the driver's recognition about speed limit within school zone. [Fig. 10] shows the monitoring screen of driver where the driving information is provided by Zeebee communication. The speed value is displayed at normal speed but the warning signal and alarm sound generate at speed violation (more than 30 Km/h) because the sound is more effective to increase the driver's recognition about speed.
violation. [Fig. 11] is to show a block diagram of the monitoring system.

IV. Conclusion

Traffic accidents in School Zone have rapidly increased in recent two years. The reason is that traffic environment within School Zone is very poor and most drivers have a weak recognition about School Zone. Traffic management focused on traffic safety facilities has a limit to fundamental precautions against traffic accidents. Therefore, to overcome these problems, our paper developed management system in School Zone using LabView program. And we tried to make drivers intensify public recognition of School Zone and construct safe pedestrian environments through unmanned monitoring system to prevent traffic accidents.

The developed system consists of three main parts. The first part is a model of School Zone installed with traffic safety facilities in order to form pedestrian environments in children safety zone. The second is main monitoring screen using unmanned camera. The last is monitoring screen of driver which make driver strengthen public recognition of School Zone. The system can monitor the overall status of transport stream in real time within School Zone though the unmanned monitoring camera. Therefore this provides safe pedestrian environment within School Zone and plays a central role in the effective management and operation of School Zone. If it is connected with an emergency medical service system and local transportation department, it is expected both quick accident emergency treatment and a marked reduction of the injured person.

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