Waiting Signal Confirmation System Using Smart Sensors

Kyu-Ho Kim, Ki-Young Lee, Jeong-Jin Kang, Myeong-Bok Choi, Kyeong-Su Jang, Yun-Sik Lim

Abstract--- With the recent development of information communication technologies, smartphones also achieved a huge development. As smartphones have become a commonplace, most people around the world use smartphones everywhere they go. There are growing numbers of people who use smartphones while walking, which result in a spike in accidents caused by being distracted while walking. Especially many accidents occur at crosswalks. On another note, there are many IoT products being launched with the fourth industrial revolution. This study aims at designing and configuring a wait signal confirmation system using Arduino in traffic lights using IoT technologies. It makes it easy to identify the location and wait time of signals using Arduino and it is expected that through this, it will prevent accidents resulting from the use of smartphones while walking.

Index Terms: IoT; Arduino; Sensor; Smart Phone; GPS

I. INTRODUCTION

According to statistics by Pew Research statistics, the Republic of Korea was found to have the highest internet and smartphone usage ratio in major countries around the world [1]. The use of smartphones and communication tools shifted to internet services such as messenger and social media, and according to statistics by the Ministry of Science and ICT and the National Information Society Agency, 18.6% of all smartphone users exhibited excessive dependency on smartphones in 2017 [2]. In the past, there was a higher percentage of watching TV and surfing the internet on free time, but now, there are more people starting to use their smartphones. In Korea, over 40 million people now use smartphones [3,4].

With the increased use of smartphones in Korea, there are also a growing number of accidents and incidents related to this. There is a high percentage of accidents that occur while walking due to distraction When walking while using smartphones, people tend to look down instead of ahead and therefore, it is difficult for them to know whether there is something in front of them or if the traffic signal changed [5,6]. There are many accidents that occur at crosswalks because of this and since many cases involve collision with cars, it can even lead to serious consequences including death.

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This study proposes a wait signal checking system to guarantee safety of pedestrians [7]. A relatively cheap Arduino was used to configure the system in this study. It uses an RGB detection sensor to detect changes in signal lights and uses a GPS module and Bluetooth [8] to identify information and location of the subject in the application.

II. RELATED WORKS

A. Crosswalk Accident

Accidents that occur on crosswalks is between a pedestrian and automobile so there is a high possibility for severe injury or even death when an accident occurs. Due to the recent surge in smartphone users and a growth in the number of people using smartphones while walking, there has also been an increase in accidents while walking due to distraction [9]. I believe that the reason for the increase in traffic accidents is due to distraction caused by smartphones. Various solutions have been proposed to prevent accidents, but they still occur frequently.

B. IoT

IoT (Internet of Things) connects things, people and space via the internet and is a connection network of things, people and services to create, collect, share and utilize information. IoT is comprised of three major technologies (sensing technologies, wired/wireless communication and network infrastructure technologies, IoT service interface technologies). IoT platform is an IoT service interface technology to provide the functions of things configured by sensing technologies, wired/wireless communication and network infrastructure technologies as a service [10]. Unlike the past when the internet was connected to computers or mobile phones with wireless internet functions, IoT is an internet that connects everything in this world including desks, automobiles, bags, trees, pets, etc [11].

C. Arduino

Arduino is an open-source based single board microcontroller and it refers to the development tools and environments related to completed boards. It was first made based on AVR (Automatic Voltage Regulator) and Atmel AVR-type boards record the highest sales currently. In addition to this, there are products that use ARM-type Cortex-M0 (Arduino Pro) and Cortex-M3 (Arduino Due) as well. Arduino receives values from multiple switches and sensors to control external devices such as LEDs and motors to configure products and services that can interact with the environment [12].

D. RGB Color Detection Sensor Module

It is a sensor that detects colors and can read RGB values through its internal photodiode. The sensor that detects color when distinguishing the color of dyes when saving photos in digital cameras is called the RGB color detection sensor. It is provided together with four LEDs to project light and it can be turned on or off depending on the situation (LED pin High=ON). The optimal color detection distance is 1 cm so it must be taken up close to the object and it can use 3.3V to 5V, and energy consumption is about 25 mA even when all LEDS are turned on [13].

E. GPS Module

GPS (Global Positioning System) is a global navigation satellite system that computes the current location of the user by receiving signals sent from a GPS satellite. It is commonly used for navigation devices in airplanes, ships and automobiles, and recently, it is also being highly used in smartphones and tablet PCs. GPS computes the distance between the GPS satellite and GPS receiver to find the coordinates. If we know the exact location and distance of a GPS satellite, it is possible to know the exact location with just three GPS satellites [13].

III. SYSTEM DESIGN AND IMPLEMENTATION

A. System Design

This study aims at receiving information using an Arduino board and RGB color detection sensor that detects the color of subjects, as well as bidirectional communication between Arduino and applications to overcome the current limitations of the existing Android [8]. The wait signal checking system was built using Bluetooth communication for synchronization and a GPS module that can identify the location of the target. A system that shows information, notifications and position of a target on a smartphone using such wait signal checking system is proposed. The system blueprint for this is shown in Figure 1.

This blueprint uses a color detection module that can detect changes in colors in traffic lights and an Arduino module with GPS functions. Furthermore, a system in which Bluetooth communication and QR codes can be used to check the information through an application was proposed. Change of signals in traffic lights is identified and analyzed using Arduino RGB color detection sensor. The GPS module identifies the latitude and longitude of a target. The Bluetooth module transmits the above information to smartphone application to help detect signal changes for users and displays the target's location on the smartphone map. The application is interlinked with Arduino using Bluetooth communication. By selecting the target through search function, this application can identify the QR code for easy access of information on the target. Also, information on signal changes detected through color detection sensors are notified to the smartphone via application cookie notifications. In addition, it is possible to easily and quickly find the location of the subject identified through GPS module.

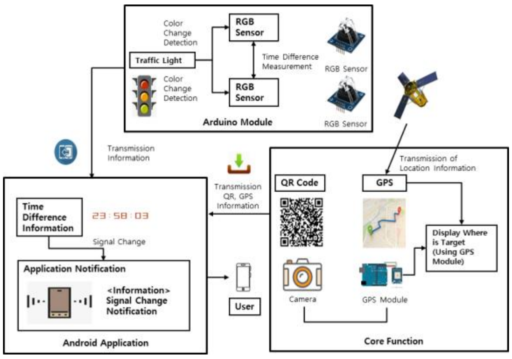

Fig. 1System Architecture

B. System Implementation

The system in this study is configured in Microsoft Windows 7 Home Premium K 64 bit operating system and Android Minimum Required SDK is API 14: Android 4.0 (Ice Cream Sandwich), while the Target SDK was configured with API 18: Android 4.4.2 (Kit Kat).

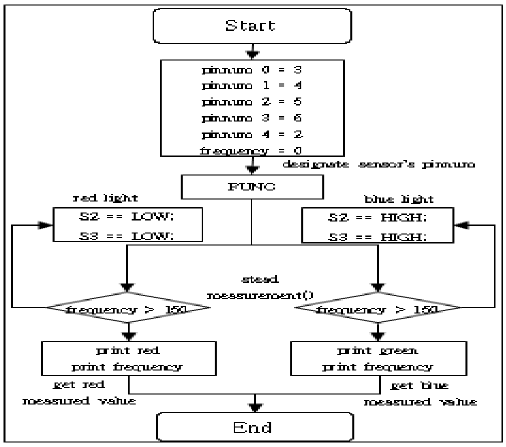

Fig. 2Arduino RGB Sensor Flow

The above Figure 2 is Arduino RGB sensor algorithm. Using the next algorithm, it first designated the pin number of RGB sensor. Afterwards, it designates S2 and S3 pins of the sensor as LOW to measure red light and then the blue light is designated as HIGH. The frequency variable that measures light is designated in the red light and blue light each and once the measured value exceeds 150, it was set to notify the user that the corresponding color signal is currently operating. Arduino and GPS module were interconnected to provide the location of the target using latitude and longitude when wanting to know the location of the target. A Bluetooth module was used for the application to receive the value measured by Arduino module. The application module uses a QR code reader to identify the QR mode using a camera for easier uploading of information.

C. Implementation Results

The configuration results of the system proposed in this study are as shown in Figures 3, 4, 5 and 6.Figure 3 shows the screen when the initial search screen is clicked or the QR code is read and there is a button to see the application

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search window, color measurement value and Google map, and a button for sending cookie notifications.

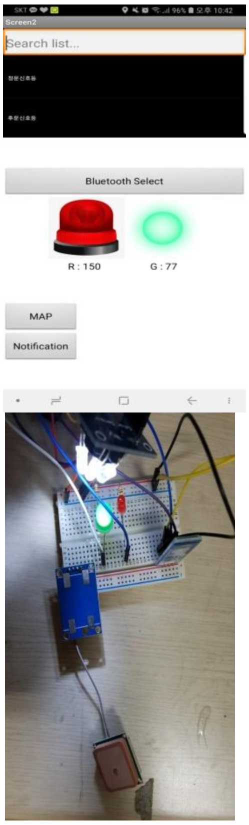

Fig. 3 System Implementation Results 1

Figure 4 shows the result values shown on the application by receiving the color detection values by connecting with smartphone via Bluetooth using the Bluetooth module. The sensor measurement values can be checked through this.

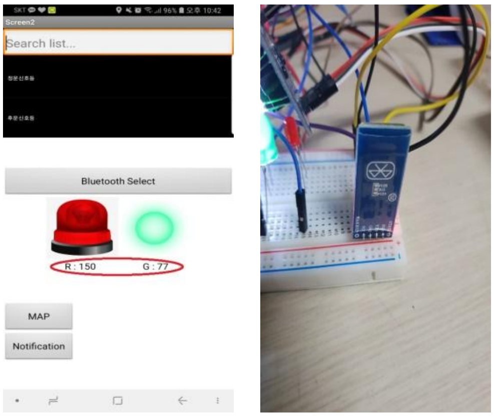

Fig. 4 System Implementation Results 2

Figure 5 shows a red mark on Google Map by measuring the latitude and longitude when searching the location of the target using GPS module.

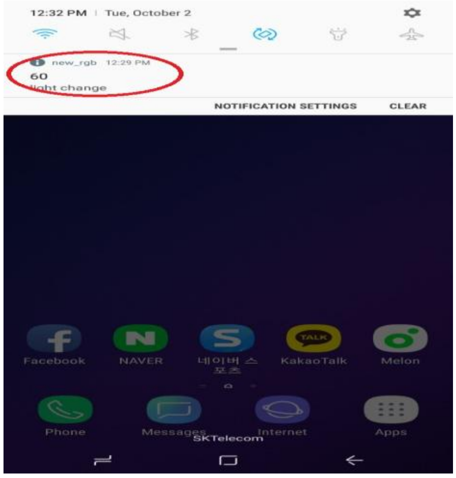

Fig. 5 System Implementation Results 3

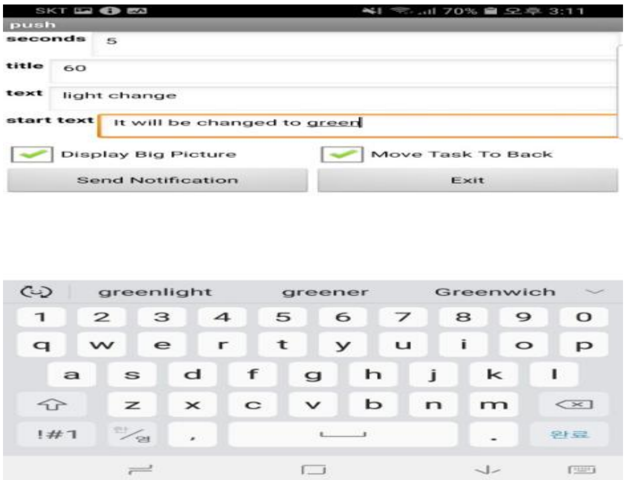

Fig. 6 System Implementation Results 4

Figure 6 is the system that sends information on signal changes as smartphone cookie notifications when the send button is pressed after entering the seconds, title and contents in the application.

IV. PERFORMANCE EVALUATION AND RESULT

Performance evaluation on the wait signal checking system using Arduino measured how accurately light was measured to send the measured values and the accuracy level of GPS module. The results in Table 1 exhibit that the light measurements of RGB detection sensor module are consistent and make accurate measurements. Red and green LEDs were measured 50 times for every 30 seconds in a dark environment to find the mean values of red and green.

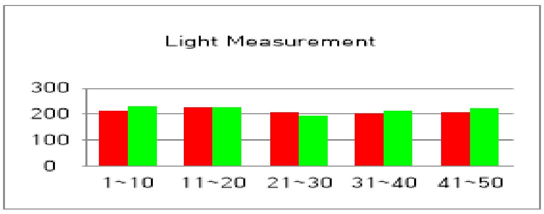

Fig. 7 Measurement Comparison

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Figure 7 is a chart for easier visualization of measurements between 1 and 10 seconds in Table 1. The bar on the left refers to the red measurements and the bar on the right represents green measurement values. The chart shows that almost all of the measurements exceeded 150 and that there were very small differences.

The below Table 2 shows that there were almost no margins of errors of measurements when the latitude and longitude were measured using a GPS module to receive the coordinates. Though there were some differences, they were very small and the margin of error was so small that it was difficult to find differences when displayed on the map.

Table 1Measurement Comparison

	Current latitude	Measurement latitude	Latitude error
1	37.454554	37.456800	-0.000246
2	37.456872	37.456824	-0.000048
3	37.456610	37.456568	-0.000042
4	37.456735	37.456700	-0.000035
5	37.456735	37.456715	-0.000020

Table 2Error of Measured Position

	Current longitude	Measurement longitude	longitude error
1	127.169435	127.169414	-0.000021
2	127.169400	127.169247	-0.000153
3	127.169400	127.169382	-0.000118
4	127.169384	127.169398	+0.000014
5	127.169427	127.169431	+0.000004

Figure 8 is a chart for easier visualization of Table 2. The blue line represents latitude and longitude during measurement and the red line represents the latitude and longitude of GPS module during measurement. It shows that there were very little differences with the measured values of latitude and longitude. Like Table 2, there was close to no difference when displayed on the map.

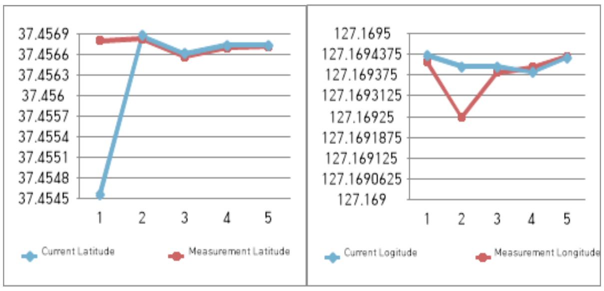

Fig. 8First Result of Performance Evaluation

V. CONCLUSION

This study configured a signal checking system using an Arduino board, RGB sensor, Bluetooth communication module and GPS module. This system can identify the current signal of a traffic light in the smartphone environment and also reduce accidents that occur at crosswalks due to distraction by sending a cookie notification to the smartphone when the signal changes.

It was configured in a way that it requires cookie notification to be entered and sent manually to send to mobile phones. However, it will be further improved to send notifications automatically when signals change in future.

REFERENCES

1. http://www.yonhapnews.co.kr/bulletin/2018/06/22/0200000000AKR20180622141000017.HTML?from=search
2. https://www.msit.go.kr/web/msipContents/contentsView.do?cateId=mssw311&artId=1374954
3. Joon-Seok Jung, Jong-Man Kwon, Joseph Mfitumukiza, Soon-Ho Jung, Min-Woo Lee, Jaesang Cha, "IoT Enabled Smart Emergency LED Exit Sign controller Design using Arduino", *International Journal of Advanced Smart Convergence(IJASC)*,Vol. 6, No. 1, pp. 76-81, 2017.
4. Jun-Won Ho, "Code-Reuse Attack Detection Using Kullback-Leibler Divergence in IoT", , *International Journal of Advanced Smart Convergence(IJASC)*, Vol. 5, No. 4, pp. 54-56, 2016.
5. Yong-Min Kim, Woo-Suk Lee, Oh-Seok Kwon, Kye-Dong Jung, Jong-Yong Lee, "Adaptive method for selecting Cluster Head according to the energy of the sensor node", *International Journal of Advanced Culture Technology(IJACT)*, Vol. 4, No. 2, pp. 19-26, 2016.
6. Eun-Soo Choi, Min-Soo Kang, Yong Gyu Jung, Jean Kyung Paik, " Implementation of IoT-based Automatic Inventory Management System", *International Journal of Advanced Culture Technology(IJACT)*, Vol. 5, No. 1, pp. 70-75, 2017.
7. Hyeon-Jun Lee, So-Young Moon, R.Young-Chul Kim, Hyeon-Seung Son, "Constructing Effective Smart Crosswalk Traffic Light Mechanism Through Simulation Technique", Korea Information Science, KIISE Transactions on Computing Practices, Vol. 22, No. 2, pp. 113-118, Feb. 2016.
8. Shoewu, O., N. T. Makanjuola, L. A. Akinyemi, and A. O. Ogunlewe. "Received Signal Strength in a Macrocell in Lagos Environs Using Finite Element Method." Review of Computer Engineering Research 2.2 (2015): 47-64.
9. http://www.metroseoul.co.kr/news/newsview?newscd=2018051300087#cb
10. Kyoung-Hun Lee, Doo-Young Kim, Se-Heon Song, Sang-il Lee, Jae-Hyun Park, "IoT Platform Implementation and Service Operating Method for Private Networks", *Journal of the Korea Information Processing Society*, Vol. 5, No. 5, pp. 109-116, May. 2016.
11. Haseeb, M., Abidin, I. S. Z., Hye, Q. M. A., & Hartani, N. H. (2018). The Impact of Renewable Energy on Economic Well-Being of Malaysia: Fresh Evidence from Auto Regressive Distributed Lag Bound Testing
12. Approach. *International Journal of Energy Economics and Policy*, *9*(1), 269-275.
13. Shoewu, O., L. A. Akinyemi, and F. O. Edeko. "Effects of Climatic Change OnGsm Signal in Lagos Metropolitan Terrain." Review of Environment and Earth Sciences 1. 2 (2014): 46-61.
14. Dong-Gun Kim, Ho-Se Lee, So-Young Kim, Hyung-Woo Lee, "LBS/GPS based Bicycle Safety Application with Arduino", *Journal of the Korea Internet Of Things Society*, Vol. 2, No. 1, pp. 7-15, 2016.
15. https://terms.naver.com/entry.nhn?docId=3571552&cid=59088&categoryId=59096