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Design and Implementation of Smart Riding Support System using Micro Chip

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Abstract: Recently, an increasing number of open data and platform are available so that anyone can easily access and use. Therefore, there is virtually no limit in the research and development of products through which one's creative ideas may be realized by using open sources and platforms including public data and Git-Hub. In the present study, an integrated riding support system was designed and realized with the core technology of a navigation that may be easily installed on a bike by using an application based on T-Map API provided by SK Planet and a device including an 8 bit PIC model of micro chip.

Key words: Micro chip, GPS, navigation map, riding, PIC, open API

INTRODUCTION

The Korean government legislated the "Promotion of the Use of Bicycles Act," so called "Bicycle Act," in 2014 and has implemented the Act from January 25, 2016. The government is removing the unnecessary restrictions that limit the use of bicycles by the citizens and promoting continuous use of bicycles (Shin, 2010; Park and Kang, 2014; Kim, 2016). Accordingly, the rate of bicycle utilization is rapidly increase each year and the market of bicycle riding goods is also extending. In addition, the utilization rate of smart phones in Korea is the highest in the world. Hence, products for bicycle riding have been connected with smart phones to provide conveniences and these products are welcomed by many consumers. However, analysis of the systems of existing products shows that each product provides limited functions. The consumers are unable to purchase various products and using many products for one bicycle is very inconvenient. Therefore, with the legislative efforts and social atmosphere for promoting bicycle utilization, a more systematic and active bicycle utilization application and device are required at present (Oh, 2014; Jung *et al*., 2015a, b).

Recently, an increasing number of open data and platform are available, so that anyone can easily access and use. Therefore, the quantity and quality of the research and development of products may be elevated if one's creative ideas are realized by freely using public data, open sources and platforms (Oh *et al*., 2015). In the present study, an application developed by using the T Map Open API which is the representative open API provided by SK Planet was interconnected with a device using a PIC chip model of micro chip to design and realize a system that provides needed bicycle utilization information by overcoming the limitations of the conventional bicycle utilization devices and applications.

Literature review

Location based service: Location Based Service (LBS) collectively refers to services that use various types of real-time information transmitted from mobile devices. Representative examples of LBS are friend search service, navigation and gas station search service during driving and missing child search service. LBS has great growth potential because it is closely related with and complementary to Geographic Information System (GIS) or Intelligent Transport System (ITS). GIS is the fundamental technology of LBS because GIS collects, analyzes and processes the computer data about maps and geographic information. ITS is also closely related with LBS because ITS collects and processes traffic

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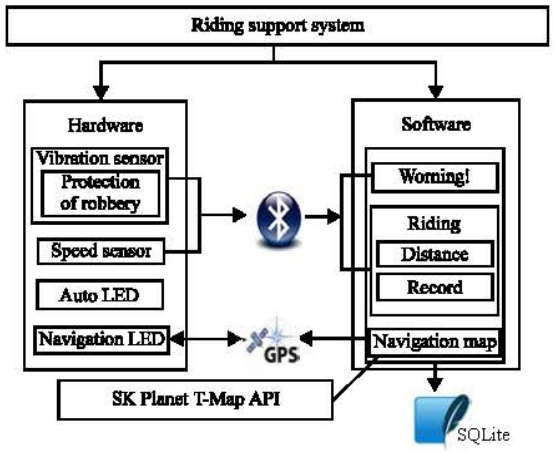

Fig. 1: System architecture

information. Currently, since a domestic or international standard of classifying LBS is unavailable, LBS is classified according to various standards such as characteristics of service, types of service provision, users and applied technologies (Nam *et al*., 2014; Jeon and Choi, 2011).

PIC micro controller: Micro Controller or Micro Controller Unit (MCU) refers to a computer formed as a chip including a microprocessor and an input/output module to perform designated functions. A micro controller or an MCT consists of a CPU core, a memory and a programmable input/output module. It has a memory of NOR flash or EPROM so that a program encoded to perform designated functions is written in the machine language code. An MCU has been designed for embedded applications and are often used for embedded systems. While a Personal Computer (PC) is used for general tasks with various requirements, an MCU is programmed to perform designated functions and tasks and installed to a certain device for utilization. Therefore, the performance of MCU is generally lower than that of a PC and the shape is also different. A PIC model, an RISC processor developed by micro chip is a single micro-processor including a ROM, a RAM and a controller.

Bluetooth beacon service: Beacon service is a smart phone-based local area communication service that finds out users in a local area to enable message transmission and mobile payment. Beacon service that may provide various information services by using local positioning and communication technologies is expected to be the core technology that enables the future integration of online and offline services (Park, 2014; Kang *et al*., 2011).

System design: Figure 1 shows architecture of the riding support system. As shown in the system architecture the riding support system consists of a hardware module and a software module that interact with each other through Bluetooth communication. When the user is away from a designated mobile device in a certain distance, the hardware module detects vibration stronger than a predetermined threshold through a vibration sensor, judges the vibration as an attempt of stealing and then gives a warning message to a mobile devices interconnected through Bluetooth.

The hardware module also measures the speed through a speed sensor and transmits the measured speed to the software module so that the average, maximum and current speed may be displayed in the mobile device and the measurement values may recorded and saved. An LED light is necessary to ride a bicycle at night. Therefore, the hardware module also include an LED and an LED control button. As the navigation map which is the most important element of the software module, the T-Map open API provided by SK Planet, the most representative navigation API was employed.

The pathway from the current position to the destination the remaining distance and the remaining time are provided by using the location tracker sources that are posted in the Git-Hub. About 100 m before the user enters into a turning interval, the software module receives the turning type parameters of the turning interval and transmits them to the hardware module so that the turning information may be displayed on the navigation LED in a way that the user may easily notice. In addition, the riding history and the pathway search history are saved in the DBMS through SQLite.

MATERIALS AND METHODS

System implementation: The system of the present system was realized in the Microsoft Windows 10 Home Premium K 64 bit operating system. For the software module, the Android Minimum Required SDK was realized by using API 10: Android 4.0 (GINGERBREAD_MR1) and the Target SDK by using API 19: Android 4.4.2 (Kit Kat). The hardware module was developed in the MPLAB X IDE v3.25 development environment by using the PIC24FJ256GB106 model of micro chip.

In the realized system as shown in the screen of Fig. 2, the pathway search screen shows the destination search box at the top and the pathway search button as well as the recently searched pathways for the convenience of users. The starting position is set up as the current position of the user. In addition, an autocompletion function was realized for the destination search.

When the user taps the pathway search button after setting the destination in the screen shown in Fig. 2, the

Fig. 2: Destination search screen

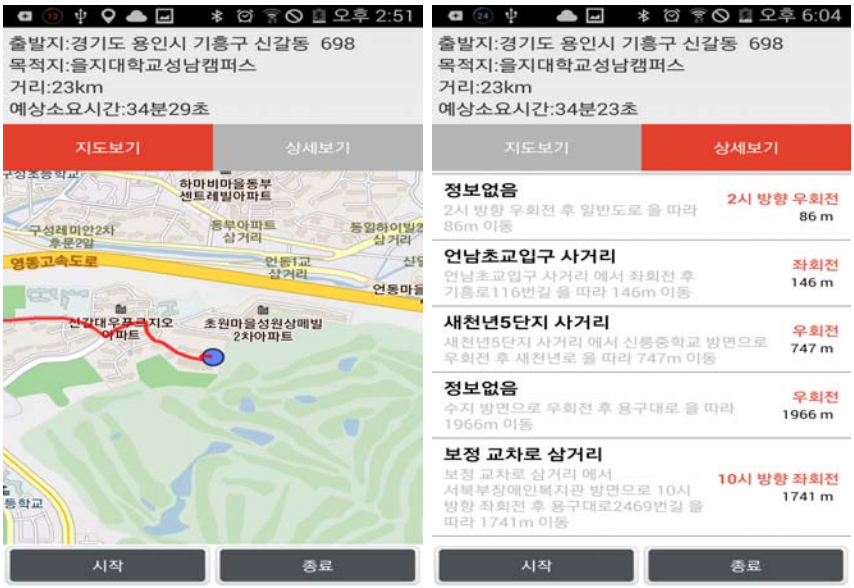

Fig. 3: Path search screen

pathway guideline screen is displayed on the T-Map provided by SK Planet as shown in Fig. 3 showing the PolyLine of the pathway from the current position to the destination. The top of the map displays the distance from the starting point to the destination as well as the predicted duration. When the user selects the "detail view" tap the application provides the detailed pathway including the detailed turning information in each interval, position information and the distance of each interval. When the user taps the "start" button at the bottom of the same screen, the application starts the pathway guidance service, transmitting the turning information in each interval to the user through Bluetooth communication. The micro chip of the device receiving the information not only displays the turning information in a way that the user may easily notice but also shows on the user's device the speed measured by the software module, so that the user may notice. In addition, the headlight function is realized at the front of the bicycle.

RESULTS AND DISCUSSION

Performance evaluationl: In the present study, an experiment was conducted by using the mobile device of Galaxy Note 2 (SHV-E250K) and Android version API 19: Android 4.4.2 (Kit Kat). To investigate the performance of the pathway guidance system of the proposed system a test was performed to see whether the turning information is received at a position 100 m before the first turning interval from the current position. The screen shown in Fig. 4 displays the detailed pathway from the current position to the Seongnam Campus of Eulji University. As shown in the screen, the first turning type is a right turn. Figure 5 shows if the turning type is well displayed before the first turning. The first turning information was well provided. However, when the guidance is provided while the user is moving, the GPS position information values of the current position may be slightly different from the network position values and the difference is dependent on the performance of the mobile device.

A total of 12 turnings were included in the pathway to the destination of the experiment which was repeated 21 times. Table 1 shows the number of errors found in

Table 1: Measurement experimental result

Estimation	Error	Estimation (th)	Error	Estimation	Error
1st	2	8	0	15th	2
2nd	4	9	3	16th	2
3rd	1	10	3	17th	2
4th	3	11	2	18th	5
5th	2	12	2	19th	4
6th	1	13	1	20th	3
7th	1	14	2	21st	3

Fig. 4: Path details screen

Fig. 5: Path guidance screen

each of the 21 experiments. At a total of 252 turnings (12×21) 48 errors were made at an error rate of about 19.04%, indicating that the performance stability needs to be improved.

CONCLUSION

In the present study, open sources and open API which are the elements that are the most appropriate to the coming platform era were positively used to developed a software program that was interconnected with MUC such as PIC, AVR and ARM to propose, design and realize a series of integrated riding supporting systems for comfortable and safe outdoor riding. The system needs to be improved to realize a theft preventing system because the Bluetooth communication between a user's device and a mobile device is possible only in a limited distance. Although, the communication distance is dependent on the Bluetooth modules, the theft preventing system may not work when the user is far away from the bicycle because Bluetooth is basically for local communication. This problem will be solved by further studies. For the practical utilization by users, further studies will be conducted by preparing PCB through Eagle CAD and by performing 3D printing for the outer appearance of the device.

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