HC-06 Bluetooth based driver module for emergency LED Multi-Directional Indicator

Joonseok Jung*, Jongman Kwon*, Joseph Mfitumukiza**, Soonho Jung***, Minwoo Lee****ⓒ,
Jaesang Cha**** *Regular Members*

ABSTRACT

In this paper we present the search on HC-06 Bluetooth based driver module for emergency LED Multi-Directional Indicator. Nowadays, a growing trends in which electronic displays such as LED, LCD or plasma monitors are being installed in public places like bars, stores, entertainment areas, restaurants, lobbies, etc. In this paper, the study is curried out on efficiency of HC-06 Bluetooth module based controller driver that relates generally to the field of emergency signage management systems for displaying various indicator contents remotely on electronic displays in public and privates venues. It allows user smart devices interaction remotely with digital signage by providing content for displaying on at least one display in a venue. Depending on the emergency case, HC-06 Bluetooth based driver module proves the high efficiency as well as good performance of processing and communicating remotely the indicator based message that is displayed from a venue management control system by using smart devices. The system combines smart device that linked to HC-06 Bluetooth module with ATmega168/328 embedded micro controller which result by switching the displayer containing the digital signage indicator based message.

Key Words : Digital signage indicator, HC-06 Bluetooth module, Smart device, LED, LCD or plasma monitor, wire-free real-time remote control module.

I. Introduction

The legibility and comprehension of digital signage indicator based message in a public or private venues, buildings is of crucial importance to everybody in case of emergency or temporal special case happening to the related areas for the purpose of safety with less panic. The efficiency and good performance of controlled emergence digital signage system determines both indoor or outdoor reliability and safe route compare to the existing emergency lighting design which is static and non-controllable [1].

Recently, smart devices are becoming more popular and powerful with high performance processors, larger storage capabilities and more communication methods. Bluetooth modules which is mainly used for data exchange, add new features to smart devices [2].

Bluetooth technology proved to be integrating with smart devices which is its main advantage for digital device users where by it has transferred traditional wired digital devices into wire-free remote data communication devices. The Bluetooth 5 specifications currently in new version of Bluetooth technology delivers connectionless IoT, advancing beacon and location-based capabilities as well as associated set of communication protocols and usage profiles in various domains such as in home, enterprise and industrial [3]. The communication range, the link speed and transmit power level for Bluetooth proven to support low cost, power efficient, SoC implementation of the current technology. The core specification defines all layers of the Bluetooth protocol stack. The Bluetooth stack differs from the classical seven-layer networking model in some ways. These differences are primarily to support ad hoc connectivity among participating nodes, while conserving power and accommodating devices that lack resources to support all

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*(주)이도링크, **서울과학기술대학교 미디어IT공학과, ***서울과학기술대학교 IoT연구센터,
****서울과학기술대학교 나노IT디자인융합대학원 정보통신미디어공학전공
ⓒ교신저자 : alsdnya@gmail.com
접수일자 : 2017년 02월 10일, 최종게재확정일자 : 2017년 02월 20일

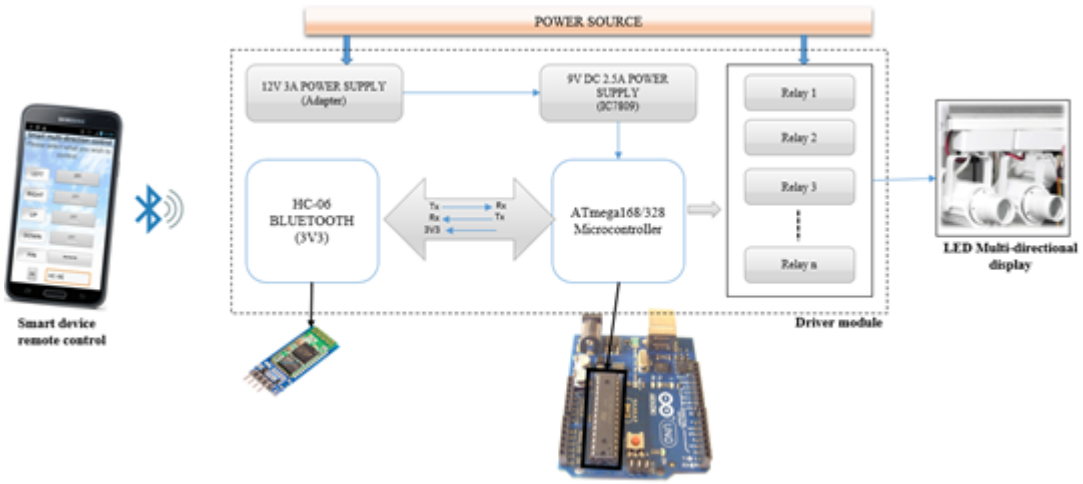


Figure 1. Driver module block diagram

layers of the classical networking stack [1][4].

Bluetooth is unique in offering the front-end RF processing integrated with the baseband module on-chip integration lowers the costs of network interface and the small size makes it easy to include Bluetooth chips in the devices such as the case of the module proposed in this research study. Wireless Sensor Networks and Internet of Things-based smart home is becoming an important ambient-assisted living environment for individuals, where necessary care can be provided at the time of need, and wellness can be measured and predicted.

The limitation of the existing emergency lighting systems, the lighting based emergency directions are fixed and uncontrollable which ca not be emerged into current and future IoT technologies where by the system is reliable, efficient, flexible, economical, real-time controlling (ON/OFF switching) and realistic wellness sensor networks for smart infrastructure in general [5].

This paper presents the design and implementation of HC-06 Bluetooth based driver module that can be packed with LED to facilitate wire-free real time controlling by using smart devices. It can be interfaced with ubiquitous connectivity and distributed intelligence of the IoT with wire free switching and sensing technology that is becoming the core of upbeat remote monitoring and control [6]. Thus the user sends text based command from smart device application to control multi-directional indicators based message. Particularly, this module has the feature of process and communicate multiple digital signage indicator based message to different displays at the same time.

Ⅱ. Related Work

Existing signage display system design is conducted by situating luminaires to disclose specific hazards and highlight safety fixed and non-controllable signs, and provide illumination to assist safe travel along the escape route [7]. Considering the existing design, this paper propose the design of HC-06 Bluetooth based driver module that serves as controller of digital signage by displaying multi-directional indicator based message. This should be performed regardless of whether it is an emergency escape route or an open area. The typical application of such module is wire-free remote controlling and monitoring of various digital signage indicators based messages and brings greater convenience as well as higher energy efficiency.

Ⅲ. Background Research

HC-06 Bluetooth module used in this research, is a wireless transceiver module with a bit error rate of -80dBm and with output power that can change in the range of -4dBm to +60dBm [8]. The Bluetooth specifications in version 4, defines an interesting key features for IoT as well as a radio frequency (RF) wireless communication interface and the set of communication protocols.

The data packet length extension, speed link and transmit power level for HC-06 Bluetooth module were proven to support low-cost, power-efficient as well as convenient module implementation of the current

technology. The block diagram of HC-06 Bluetooth base driver module controller is shown from figure 2.

Ⅳ. Hardware System Design

The hardware design of the proposed module consists of HC-06 Bluetooth module, ATmega168/328 micro-controller integrated in the Arduino board, SPDT relay, 12V-DC SMPS module and related electronic components (capacitors and resistors).

The SPDT relay used in the design has 5 pins as shown in Figure 2 below. Pin 1and pin 3 are the coil pins and pin 1 serves as data pin and it is connected to the Arduino digital pin. The pin 3 is the ground it is connected to the GND pin from the Arduino. The pin 2 is the common contact pin where by it is connected to the power of the LED (digital signage indicator display) in this design. The pin 4 is the pin called normal open (NO) and it is connected to the power line of the LED.

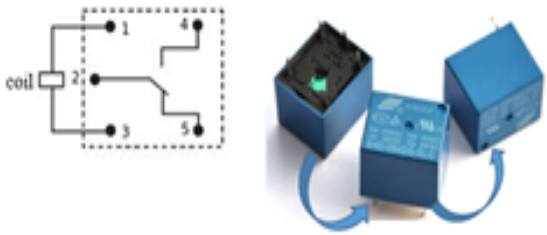


Figure 2. 5V SPDT relay

Bluetooth is a frequency-hopping spread-spectrum system. This means that the radio hops through the full spectrum of 79 or 23 RF channels using a pseudorandom hopping sequence. The hopping rate of 1,600 hops per second provides good immunity against other sources of interference in the 2.4-GHz band [9]. The link speed is 1 Mbps, which is easily achieved using a simple modulation technique (Gaussian Frequency Shift Keying, or GFSK). A more complex modulation technique could achieve a higher rate, but GFSK keeps the radio design simple and low cost. From figure 2 below shows the schematic design and layout of HC-06 Bluetooth module which is mainly consists of four pins (Tx, Rx, Vcc and GND) [10].

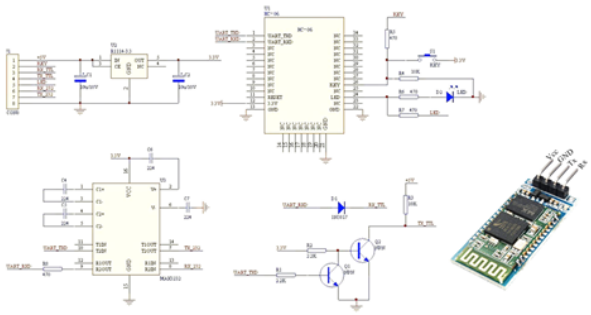


Figure 3. Schematic diagram of HC-06 Bluetooth module

The HC-06 module is powered by 3.3V. In case it connected to the Arduino UNO board with 5V the communication lines from and to the module are supposed to be 3.3 volts [11]. This require the voltage divider to be applied in the circuit as shown from the figure 5 below.

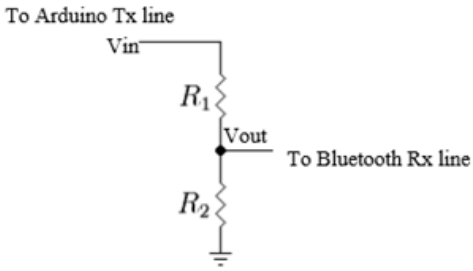


Figure 4. Voltage divider

$$Vout = \frac{R2}{R1+R2} Vin \qquad (1)$$

In this case any combination of resistors can be used as long as R2 is twice the value of R1.In case there is no resistor in hand, and Arduino UNO board is being used, the 3.3V positive voltage regulator can be used [12]. The input pin of the voltage regulator is connected to Arduino Tx line, the ground pin to the Arduino ground line and the output pin of the voltage regulator to the Bluetooth Rx line.

1. Low level schematic design board of the driver module

This paper present a circuit design of HC-06 Bluetooth based driver module proposed to be package with LED which can display multiple indicator based message.

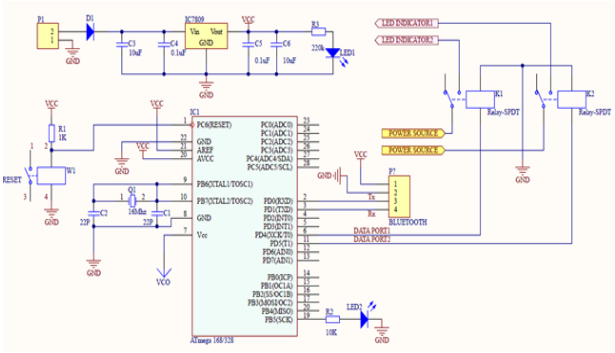


Figure 5. Low level schematic design of the module

From figure 5 above, normally SPDT relay with the pinout shown from figure 3, pins 2 and 4 act identically to the two terminals of a switch. Through HC-06 Bluetooth module the command is sent to digital I/O of AT mega168/628 (Arduino module) to control the LED indicator, when it is high, voltage is applied and as the results switch turns ON, and the signal transferred to the related LED indicator. The power source of each LED is connected to the common terminal of the relay. The command sent to the micro-controller, is recognized in the source code embedded into the micro-controller.

V. Results and Discussion

The ATmega 168/328 microcontroller (Arduino UNO board) consists of a single file, but different Arduino boards are being used, two separate but almost identical files are required. As any other Arduino program, two main parts can be identified: the setup block and the looping loop. The setup block is called only once, just when the board starts or is rebooted11. During this block, the board is configured to open the required serial ports at a specific baud-rate (the DF-Bluetooth module's default, 57600 bits/s). Additional configurations like setting the Bluetooth module's power to null, or initializing some clock parameters are also done in the setup block. From the figure 9 below shows the framework of the messages sent between the android application for smart devices and Arduino device.

The android based LG smart phone is used to implement the evaluation application of the proposed WayFinder to find escape path using emergency exit

HC-06 Bluetooth device is interfaced to the ATmega168/328 microcontroller (Arduino UNO board) for linking smart device with LED indicator based message displayer by using Arduino source code. The remote operation is achieved by smart device (smart-phone/ tablet) with android OS, upon a GUI based touch screen operation. Transmitting end uses an android application device remote through which commands are transmitted. At the receiver end, these commands are used for controlling the LED multi-directional indicator in all directions through RF signal. The following figure 7 shows the implemented sample module and its output results.

Figure 6. Flow chart for Arduino to android communication

Figure 7. Implemented sample of the driver board

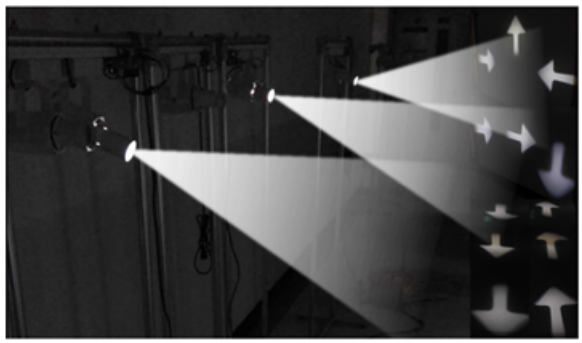


Figure 8. LED Multi-directional indicator driven buy implemented circuit LED driver board

The above figure 7, 8 shows the results of tested LED multi-directional indicators based message controlled by integrated HC-06 Bluetooth based driver module in the LED using smart device. The circuit board and smart device interfacing (driver module) testing is achieved successfully.

VI. Conclusion

In in this paper, the design and implementation of HC-06 Bluetooth based driver module controller for emergency LED multi-directional indicator based message is presented. The design consists of HC-06 Bluetooth module, ATmega 168/328 microcontroller (Arduino UNO), smart device, LED. The emergency multi-directional indicator are controlled by using smart device remotely which operates according to the user commands received from the smart device android application GUI via the implemented driver module. Such design add the features of smart device into portable remote controller as well as LED applications into smart signage designs. It is noted that the proposed system can be applied directly to remote control of many industrial devices.

References

[1] F. Halsall, Data Communications, Computer Networks and Open Systems, Fourth Edition. Addison-Wesley, 1996.

[2] N. Sriskanthan, F. Tan, and A. Karande, “Bluetooth based home automation systems,”Journal of Microprocessors and Microsystems, vol. 26, pp. 281-289, 2002.

[3] Kim Y. S., Lee J. W., et al., “Mobile advertisement system using data push scheduling based on user preference” in WTS'09. Wireless Telecommunications Symposium, pp. 1-5, 2009.

[4] Pravin Bhagwat, “Bluetooth: Technology for Short-Range Wireless Apps” Industry report

[5] Younis, M.; Senturk, I.F.; Akkaya, K.; Lee, S.; Senel, F. Topology management techniques for tolerating node failures in wireless sensor networks: A survey. Comput. Netw. 2014, 58, 254–283.

[6] Robert Morrow, "Bluetooth Operation and Use" New York, McGraw-Hill, 2002.

[7] Steven L. Gurley, System and method for interacting wirelessly with digital signage. US Patent US 2007/0252891 A1

[8] H. Kanma, N. Wakabayashi, R. Kanazawa, and H.Ito, “Home appliance control system over Bluetooth with a cellular phone,” ICCE 2003, IEEE International Conference on Consumer Electron., pp. 380-381, 2003.

[9] P. M. Corcoran, F. Papai and A. Zoldi, “User interface technologies for home appliances and networks,” IEEE Trans. Consumer Electron., vol. 44, No. 3, pp. 679-685, Aug. 1998.

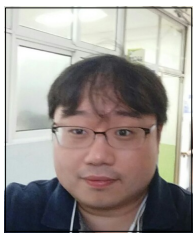
[10] T. Salonidis et al., “Distributed Topology Construction of Bluetooth Personal Area Networks,” Proc. IEEE Infocom 2001, IEEE Communication Society, New York, 2001.

[11] Tsao W. H., “Location-Based SMS Information Push System - Its Architecture, Design, and Applications”, Graduate Paper of Department of Information Management, Tatung University, 2007.

[12] G. Miklos et al., “Performance Aspects of Bluetooth Scatternet Formation,” poster presentation at Mobile Ad Hoc Networks and Computing (MobiHOC 2000), IEEE/ACM workshop, Aug. 2000.

저자

정 준 석(Joonseok Jung) **정회원**



・2014년 ~ 현재 : ㈜이도링크 과장

<관심분야> : IoT, LoRa, 홈 네트워크, USN, RFID

권 종 만(Jongman Kwon) **정회원**

・2011년 : 부산대학교 기술사업정책과 석사

・1994년 ~ 1999년 : SK텔레콤 대리

・1999년 ~ 2007년 : 한국알카텔루슨트 팀장

・2007년 ~ 2008년 : 스타패스테크 이사

・2008년 ~ 2012년 : 아이리얼(주) 부사장

・2012년 ~ 현재 : ㈜이도링크 대표이사

<관심분야> : IoT, RTLS, 홈 네트워크, USN, RFID, UWB 솔루션

비투무키자 조셉(Joseph MFITUMUKIZA) **정회원**

・2010년 ~ 2015년 : Kigali Institute Of Science and Technology (KIST) 전자통신공학 대학교졸업

・2015년 ~ 현재 : 서울과학기술대학교 미디어 IT공학과 석사과정

<관심분야> : 방송통신, IoT, 안드로이드

정 순 호(Soonho Jung) **정회원**

- 1994년 ~ 2000년: LG반도체 ASIC Design 연구원
- 2000년 ~ 2007년 : 승전상사 응용기술팀 연구원/마케팅
- 2008년 ~ 2015년 : 서울과학기술대학교 나노IT디자인융합대학원 박사 졸업
- 2015년 ~ 현재 : 서울과학기술대학교 IoT연구센터 산학협력중점교수

<관심분야> : USN, 모니터링시스템, LED통신, 유무선 홈 네트워크, 유무선통신기술, LSI 설계

이 민 우(Minwoo Lee) **정회원**

- 2013년 3월 ~ 2015년 8월 : 서울과학기술대학교 나노IT디자인융합대학원 공학석사
- 2015년 9월 ~ 현재 : 서울과학기술대학교 나노IT디자인융합대학원 박사과정

<관심분야> : LED-IT 응용기술, 무선통신기술, UWB, 영상전송기술

차 재 상(Jaesang Cha) **정회원**

- 2000년 : 일본 東北(Tohoku)대학교 전자공학과 공학박사
- 2002년 : 한국전자통신연구원(ETRI) 무선방송 기술연구소 선임연구원
- 2008년 : 미국 플로리다 대학교 방문교수
- 2005년 ~ 현재 : 서울과학기술대학교 전자IT미디어공학과 교수

<관심분야> : LED-ID, 조명IT융합신기술, LBS, ITS, UWB, 무선 홈 네트워크, IoT응용기술 등