

Panic Button for Large Housing Area through Bluetooth Wireless Communication

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Article Info

Volume 83

Page Number: 8118 - 8124

Publication Issue:

March - April 2020

Article History

Article Received: 24 July 2019

Revised: 12 September 2019

Accepted: 15 February 2020

Publication: 09 April 2020

Abstract

Radio Frequency (RF) becomes very popular as wireless communication medium for control technology. Wireless control technology could be accomplished via RFID, WIFI or Bluetooth. Each has its own strength and specific purposes. Between WIFI and Bluetooth, WIFI has better advantages with regards to strength, multi user, distance and etc. While Bluetooth is for single user and short distance. Nevertheless Bluetooth is free means without subscription with Telco. Transmission distance for Bluetooth is short therefore this project is targeting to design an extender for extending the distance of transmission. The design has been tested for one application involves with monitoring system for guard house. A single user communication between house and guard house through 3 Bluetooth Extenders has been experimented with aim to overview its transmission effectiveness. The result shows the transmission is very reliable and consistent in terms of valid data sent and received.

Keywords; Bluetooth, Extender, Surveillance, Matrix, Display

I. INTRODUCTION

Surveillance monitoring system has shown drastic improvement in-term of its technology, features and application. The system has been integrated with many things after the era of smart Hand Phone that entered the technology. Real time monitoring becomes easier through Hand Phone with 4G WIFI communication. Suspicious or intruder can be visualized, analyzed and action can be taken within few minutes therefore the crime can be stopped and prevented. Nevertheless in recorded CCTV immediate action could not be accomplished to stop the crime due to recorded time delay. In guarded housing area those monitoring the live video are normally the security guard. They are stationed in guard house and work continuously to analyze the CCTV for any intruder breaking the area, house and etc. However they were cases where the guard and the system cannot detect the intruder but the owner of the house notified the suspicious through its own

CCTV. Hence the owner desperately need help to stop the intruder. A panic message is sent to inform the security guard. The whole process could be slow which involve number of events such as send message, communication with the guard, informing the situation and decision to rush to the location. The result would be unsatisfactory and very unpromising to the owner.

In many cases prevention is more crucial compared to recorded data using CCTV. Prevention can stop the suspicious and minimize severe harm that possibly occurred to the owner and more importantly safeguard life and the properties. An effective alarm system for large housing area is proposed with aim to overcome slow action from the guard house. Simple system but very effective in preventing rather recording the action. The proposed system has been designed, constructed and tested which is summarized in this article. It uses multiple Bluetooth devices for transmitting warning signal.

Bluetooth has capacity to propagate signal within 100m or less depending on the type of the devices. In Section II the process of pre-programmed the devices is described then followed by the coding for microcontroller for receiving and sending signals. The third section describe the design of Matrix display board for indicating location of house in the housing area. The final section discuss the function of the whole system and outcomes of the research work.

II. BLUETOOTH COMMUNICATION

a) Type of Bluetooth Devices

Bluetooth is pre-programmed device to transmit and receive series of data. It just need low voltage (+3.3V) to operate the Bluetooth stick. Unlike WIFI device, Bluetooth is free without subscription from Telco. Bluetooth comes with variety of range and hardware. Range is referring to the distance of signal transmission/receiver while hardware is referring to the features of the stick. Features include its function as Master and slave, others either master or slave. The cheapest Bluetooth stick is HC-05 and HC-06. The Bluetooth stick can propagate signals up to 10M. The higher capacity RN-42 has stronger distance that capable to propagate at 100M range. In the experiment stage two types of Bluetooth have been tested which are HC-05 and RN-42. HC-05 is cheap and easy to change the internal ID. RN-42 has longer coverage but it is not programmable for its internal ID.

b) Coding The ID for Bluetooth

ID for Bluetooth is a pre-code for pairing the device. Each device is allowed to lock and pair with another device as long as the device is within the range. HC-05 is designed for programmable ID. The process to change is simple which require microcontroller such as Arduino board. First the Bluetooth stick and Arduino board are connected through their two pins, Tx and Rx. The complete connection is shown in Figure 1.

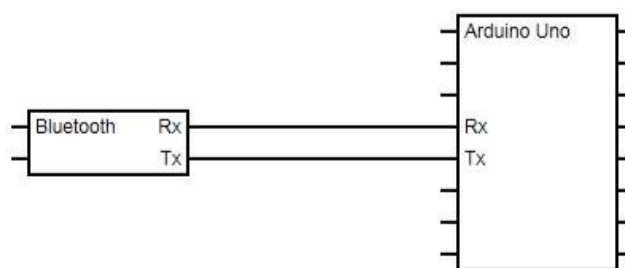


Figure 1: Connection for ID Configuration

The connection between Bluetooth stick and Arduino must connect with same Pin label, Rx and Tx. Once the Bluetooth stick is power up the LED indicator will start to blink. The Bluetooth stick must change to Mode configuration either by pressing a small button during power up. The process to change the Mode is explained in [5]. Configuration is required to change the ID for auto pairing. Pairing ID will make the Bluetooth stick to search it's paired or partner. The process to configure the Bluetooth starts with activating serial communication tool in Arduino debugger.

Once the USB port is selected the Arduino board is linked with Arduino debugger. Using the standard commands as listed in Table 1, the pre-contents of the Bluetooth stick can be changed. The first step is to test the connection using command AT. If the result is OK means both sides are ready to communicate. Other commands are similar by typing the full term of the command.

TABLE I. BLUETOOTH HC-05 COMMAND

No	BLUETOOTH HC-05	
	COMMAND	FUNCTION
1	AT	Check the connection.
2	AT+NAME	See default name
3	AT+ADDR	See default address
4	AT+VERSION	See version
5	AT+UART	See baud rate
6	AT+ROLE	See role of Bluetooth module(1=master/0=slave)
7	AT+ LINK	Create ID Slave for Master

For changing the contents of the Bluetooth, the command must use equal key such as

"AT+PSWD=2987". The process to change ID is summarized as follow:

In Table 2, use command ADDR to display the address of the Bluetooth slave. Every Bluetooth should have different number. Copy the address for programming the Bluetooth Master.

Table II. Bluetooth Hc-05 Slave

No	BLUETOOTH SLAVE	
	COMMAND	Result
1	AT	Check Connection
2	AT+ADDR	3014:9:230502
3	Copy the address	

TABLE III. BLUETOOTH HC-05 MASTER

No	BLUETOOTH MASTER	
	COMMAND	Result
1	AT	Check Connection
2	AT+LINK =	3014,9,230502
3	AT+LINK	3014:9:230502

Set a similar connection for Bluetooth Master. Double check the Baud rate of the Bluetooth stick which should be same as Bluetooth Slave. In this project baud rate 9600 baud has been used. Next use command LINK to insert the address of Bluetooth slave, e.g. AT+LINK = 3014,9,230502. Test again the command to check ID code will be 3014:9:230502. Once the code is saved, the master Bluetooth will search its pair only for connection.

C. Bluetooth Extender

Bluetooth range is short specifically for HC-05. Another issue is the signal cannot propagate through tick wall. In housing area the location of houses are not straight forward. The signal needs to change direction in order to arrive to its destination. In this project the destination is the security guard house. Figure 2 shows the illustration of the entire system comprising four Bluetooth Extenders.

III. PREPARE YOUR PAPER BEFORE STYLING

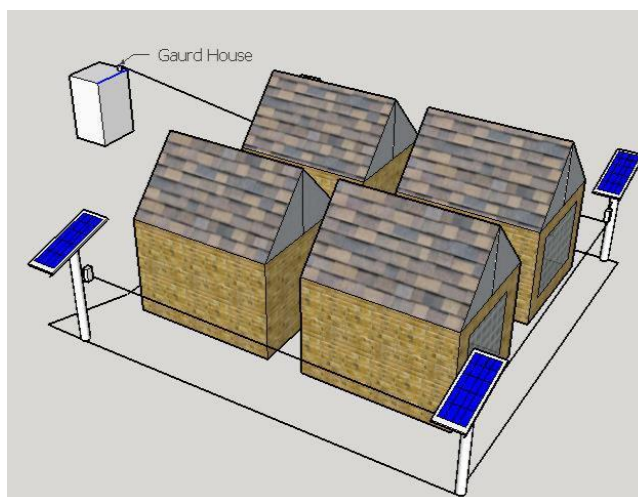


Figure 2: Project Illustration

Each extender is power up by a Solar Charger for continuous power supply. The direction of Bluetooth signal for each of them is aligned to ensure they can communicate effectively. Bluetooth signal is known as short distance range and weakening by blocking object. The function of the new extender is to overcome the two weakness and extending the application as good as WIFI device.

Bluetooth extender functions to extend transmission range for Bluetooth. Single Bluetooth has coverage approximately 10 M and could go for 100 M for Bluetooth type RN-42. Each extender has two Bluetooth sticks and a control board (Arduino board). The two Bluetooth sticks are enable through two Tri-State gates. The control board is swapping control signal for receiving data and re-transmitting the data via second Bluetooth stick. The circuit diagram of the Bluetooth extender is shown in Figure 3.

The process of extending the data requires two Bluetooth sticks. Bluetooth 1 receive signals while Bluetooth 2 is re-transmit the data. Arduino or control board is configured to acknowledge the receiving signal and immediately change the mode to re-transmit the signal through Bluetooth 2 by changing the Enable pin (En1 and En2). In this

circuit Tri-State is used for full isolation between Bluetooth 1 and Bluetooth 2 due to sharing wire lines, Rx and Tx. Bluetooth enable means Rx and Tx pins are connected to the respected Bluetooth stick. When new signal is received through interrupt signal, the new data is saved. Bluetooth 1 is off and Bluetooth 2 is enable. The saved data is resend through Bluetooth 2. Immediately after the data has been channel out, the enable pin is swap back to normal for next waiting mode. The design has been tested and it is fully functioned according to the proposed specification.

The total cost to build up the complete circuit is less than 30 rm. Arduino board and Bluetooth Stick HC-05 have been widely used and nowadays they are very low cost. The compiler software is also free and downloadable at Arduino Website [6]

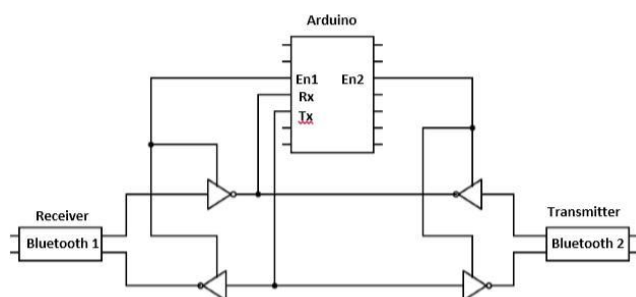


Figure 3: Bluetooth Extender Circuit

Figure 4 shows the Flowchart of controlling Rx and Tx pin. Arduino has build-up Function that simplified the process of code configuration. Function such as Serial.available is used to acknowledge the board on new in-coming data. When the data is received at Rx pin, the Arduino will acknowledge to response as interrupt. The board will save the data into allocated buffer. After finishing reading the data using Serial.read function, Arduino change the mode into transmitting the data to Tx pin. Enable pin for Bluetooth 2 is activate and the data is sent to Extender 2 using Serial.println function. Extender 2 will repeat the same process of

Extender 1, therefore the same signal is being transmitted wirelessly and unlimitedly.

All the Functions in Arduino that have been used in the Flowchart are summarized in Table IV.

Table IV. Arduino's Functions

No	BLUETOOTH EXTENDER FLOWCHART	
	COMMAND	FUNCTION
1	Serial.available	Acknowledge in-coming signal at Rx
2	Serial.println	Write data to Tx
3	Serial.read	Receive data and save
4	DigitalWrite	Set logic at Pin out
5	Delay	Delay routine
6	Pinmode	Set Pin as Out/In
7	Serial.begin	Configure Baud rate

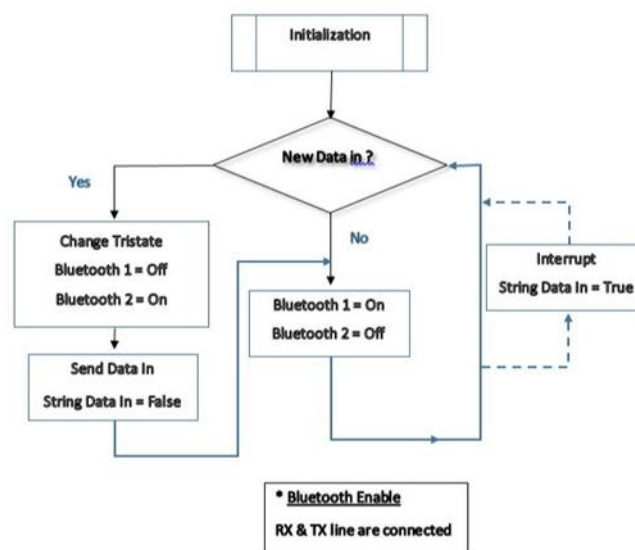


Figure 4: Bluetooth Extender Flow Chart

Figure 5 shows the experimental work that has been carried out to verify three issues

- Pre-Code for Bluetooth Stick
- Locking Search between Master and Slave
- Transmit signal through three extenders

Each Bluetooth stick in extender circuit must be configured to function as master or slave. In this experiment receiver is configured as master while

transmitter is functioned as slave. When two extenders are activated Master for extender 2 will look ID for slave in extender 1. They are pairing automatically due to their identical ID. In the experiment all the configuration for the pairing process have been tested and the extenders are working perfectly.

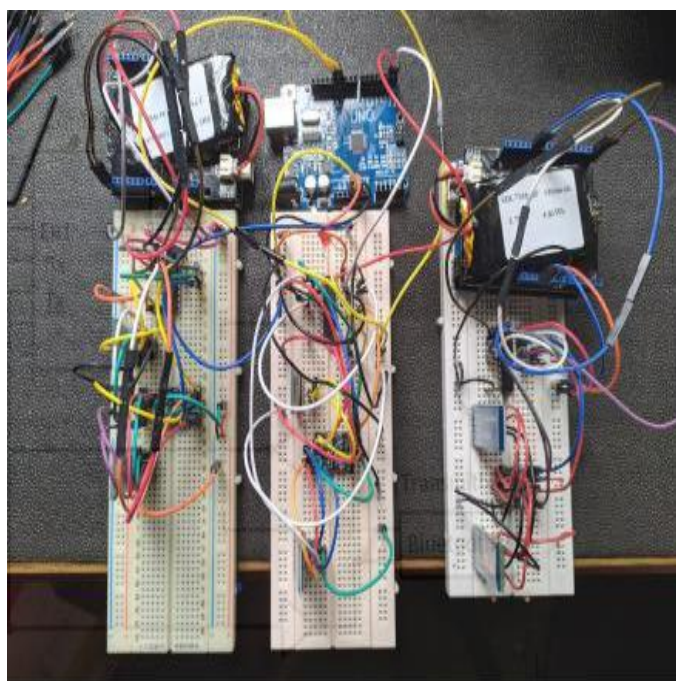


Figure 5: Experiment using 3 Extenders

The next step is to transmit dummy signal through apps Bluetooth Terminal HP-05. This apps is free and installed in Android Hand Phone. Two Hand phones were used for sending and the other Hand Phone is for receiving data. All the extenders are power up by a small batteries. The batteries could be charged by solar charger in the prototype stage. After connecting all the components which include two Hand phones and 2 extenders the data was successfully transmitted as shown in Figure 6

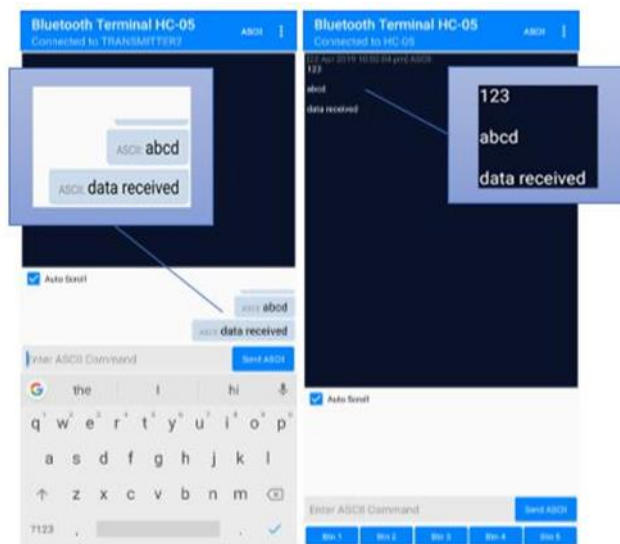


Figure 6: Data Sent and Received

Here on the left hand side, the data were sent while on the right hand side the same data have been received. In the configuration, the baud rate for all the devices include Hand Phone was 9600 baud.

IV. DISPLAY BOARD



Figure 7: Prototype Board for Monitoring Security System

This board is representing location of individual house in the housing area. Figure 7 shows the prototype board with LED indicating the location of house. Each house has specific code for the system to turn on the LED. There are several type of connections that can be used but matrix connection is experimented as the most suitable for this application. The main factor is due to the number of

LED which can be increased by adding new row and column for higher number of location. Example 7 x 7 gives 49 house locations while 8 x 8 give 64 number of houses. Second factor is on brightness of the LED. Matrix display is run by scanning method which maximize current drive to the LED. Therefore LED turn on with maximum high brightness. Even though the current is high, the repetition time to trigger is fast (1/20 s) which will not damage the LED. The repetition time is very important to make sure the LED is not over-drive and the brightness is fully bright.



Figure 10: Duty cycle for Single Frame

Each frame has duty cycle 0.43 ms (0.72 ms – 0.29 ms) and constantly free run for good brightness. The signals for triggering row and column are calculated through delay subroutine reflecting to the time for duty cycle in Arduino board. In the flow chart the board starts with initializing all the constants and counter. The previous coordinate for X and Y are cleared. Secondly the board is checking new coordinate whether new request is available. The same Function is used, Serial.available to check external request signal. Then Serial.read will read the new coordinate code and stored in display buffer for loop subroutine to generate row and column signals as shown in Figure 8 and 9. The signals are repeated within the loop until new request is came in and updating the new coordinate. The whole designed flow for the code is summarized as shown in Figure 11:

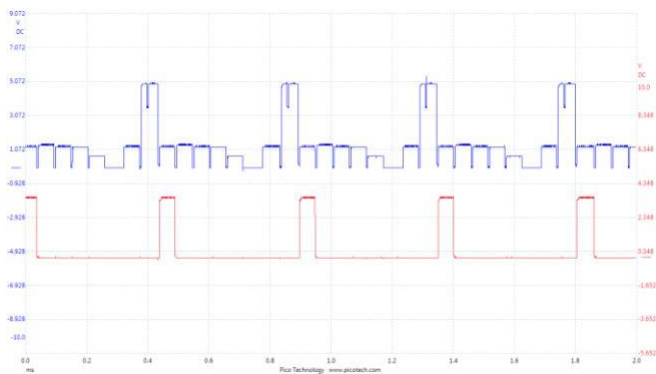


Figure 8: Matrix Signals 1 x 2

Figure 8 shows the signals that has been applied to Matrix display board for column (1) and row (2) while Figure 9 is for column (2) and row (6).

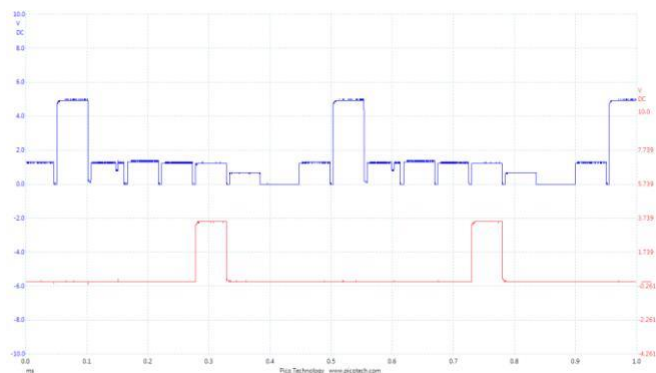


Figure 9: Matrix Signals 1 x 5

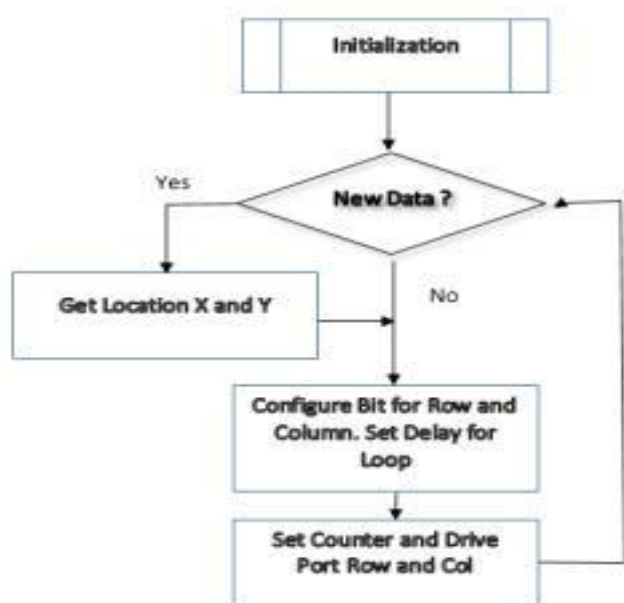


Figure 11: Loop Flow Chart for Matrix Display

V. DISCUSSION

Prevention is very much important. In most of criminal cases damage and death are the consequence of crime. System that help the owner to stop the crime at early stage would give better solution. One of the solution is using panic button switch which is installed at isolated area. The system will trigger siren for alerting people as a result prevent the crime to happen. In CCTV people are spending hours a day to watch live video monitoring their property, children and etc. Many system has good surveillance technology but slow support from authorities would jeopardize the result. Fast action is very crucial to some extent. Once crime has been detected, people are chasing to drive or stop the crime as fast as possible. However due to some reasons the owner cannot arrive on time. Other scenario people are hiring guard to support monitoring and patrolling housing area. In large housing area, small number of guards will not be able to cover the whole area. Assistant such as CCTV is required for them to view the big area. Further, location of crime is also unpredictable due to isolated house which make the guards notable to identify the specific house. Hence the new feature for surveillance system is introduced that helping

the guard recognizing specific house. Each house has its ID code for recognition. Once the owner press the panic button a code is being sent through Bluetooth transmission to the guard house. The guard can easily recognize the location as the LED indicating the house start blinking. They immediately deploy to the location for investigation.

VI. ACKNOWLEDGMENT

I would like to express my gratitude towards my research team mate, member of Electronic Section and final year student for their kind co-operation and encouragement which help me in completion of this project. I would like to express my special gratitude and thanks to campus, UniKL BMI for giving me such attention and time.

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