



**ANDROID BASED DOT-MATRIX LED DISPLAY SCROLLING TEXT
CONSOLE**

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ABSTRACT

For a mass information spread, a speaker is used to reach more people at once. While the use of speaker creates a lot of noise pollution, a dot-matrix display used all around the world to convey message to the public audience is much more convenient and efficient. A dot-matrix led display is a display device used to convey information on machines, clocks, railway departure indicators and many other devices.. The display consists of a dot matrix of led lights that works by switching on or off selected lights. A common problem is the display is usually placed at high place to make it visible yet this poses a problem to reprogram the display if there is any new message to be written. The project uses an arduino Uno that communicate with an android phone through a bluetooth module to reprogram a dot-matrix display. Through this, the display can show new message wirelessly using an app used by an android mobile phone.

ABSTRAK

Untuk penyebaran ke media massa, pembesar suara biasanya digunakan untuk menyampaikan maklumat. Penggunaan pembesar suara mewujudkan banyak pencemaran bunyi manakala paparan dot-matriks yang digunakan di seluruh dunia untuk menyampaikan mesej kepada orang ramai adalah cara yang lebih mudah dan berkesan. Paparan dot-matriks ialah paparan yang biasa digunakan untuk menyampaikan maklumat mengenai mesin, jam, petunjuk berlepas kereta api dan lain-lain. Paparan terdiri daripada lampu LED yang akan dinyalakan dan dipadamkan. Satu masalah biasa adalah apabila paparan diletakkan di tempat yang tinggi bertujuan untuk memudahkan orang ramai melihatnya tetapi ini menjadi masalah apabila ada mesej baru yang ingin disampaikan. Projek ini menggunakan Arduino Uno yang berkomunikasi dengan telefon android melalui modul bluetooth untuk mengprogram semula paparan dot- matriks. Melalui ini , paparan boleh menunjukkan mesej baru tanpa wayar menggunakan aplikasi yang digunakan oleh telefon bimbit android .

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LIST OF ABBREVIATIONS

APK	Android Application Package
API	Application Programming Interface
DC	Direct Current
EUSART	Enhanced Universal Synchronous Asynchronous Receiver Transmitter
GSM	Global System for Mobile Communication
GUI	Graphical User Interface
IDE	Integrated Development Environment
LCD	Liquid Crystal Display
LED	Light Emitting Diode
SDK	Software Development Kit
TCP	Transmission Control Protocol
UART	Universal Asynchronous Receiver Transmitter
UI	User Interface
USART	Universal Synchronous Asynchronous Receiver Transmitter

CHAPTER 1

INTRODUCTION

1.1 Background

In this fast expanding technological world, information is being transfer into many types and form. Each and every of them convey information by its specific need, like a mobile phone transferring real time data during calls or computer server that store massive data that can be excess throughout the world in a blink of an eye. As for this device, the information is being visually transmitted from the dot matrix display straight to the viewers.

This report will elaborate in all the necessary design and the creation of the remote programing device for LED display using an android OS system interface which includes the following component: smartphone, LED display, Bluetooth module, arduino microcontroller and a basic circuit. The project is aimed to be used as an alternative way to program the LED display to ease the user the trouble to bring the display panel down from its usually high positioned place to the point that the LED display can be program from afar as the Bluetooth range can support.

An LED display device is commonly used to display information on various things like clock, advertisement sign and railways departure indication. For this project, is it to be used a several dot matrix LED display to display the desired output that is received from the smartphone through the Bluetooth connection between them.

The aim for this project is to design a working LED display that can be use and be program by any smartphone user using an android interface with an application specifically develop to use the Bluetooth capability of the phone and communicate with another Bluetooth module thus remotely program the LED display.

1.2 Problem statement

The most common problem using the LED display comes when to reprogramming it. From the complexity of the LED display driver itself to the tedious work of getting the display down and putting it back up. There is also the probability to damage the display driver if the wrong programing code is placed in them and the accidental damage while working with the fragile display.

Several method have been made to combat this problem and perhaps to most popular method is to use wire or just placing the display at easier height but the method would rather cause more down side than the benefit it brings. The usage of long and thick wire may not be suitable in most scenario and by placing the display at lower height it could drastically hinder the amount of visibility viewers can get from the display.

Thus by using a remote programing device for LED display using an android OS system interface can greatly ease the user and end the manual labor need to reprogram an LED display.

1.3 Objective

In this research, the objective is to design the mean to wirelessly transfer serial data from an android phone to send new text message for the dot-matrix to display.

- (i) To create an android application that able to access the Bluetooth capabilities in the phone module.
- (ii) To control an Arduino using an android OS interface through a Bluetooth.
- (iii) To be able to reprogram an LED dot-matrix display.

1.4 Scope of Study

In this research, the following works are to be completed

- (i) Develop an application for android using programing software
- (ii) Identify and study the component required to establish the bluetooth connection
- (ii) Analyze the possible method of coding that enable the remote programing to be done.

1.5 Outline of Thesis

This thesis consists of five chapters. In chapter 1, what being discuss is about the project objective, scope and summary of the overall works. Literature review are placed in chapter 2 where it explain the method of the project being conducted and what areas are tested in previous project. In chapter 3, the methodology of the project on both hardware and software are presented in detail. The result and outcome of the project are documented in chapter four. Lastly in chapter 5 contain the conclusion and future recommendation regarding the project.

CHAPTER 2

LITERATURE REVIEW

2.1 Chapter Overview

In this chapter, all previous related projects that have a few similarities with the project are reviewed. Through the understanding of others' previous work, further improvement can be made and more ideas can be extracted to make the project better. Some of the thesis also shows their future recommendation for the continuity of their project, this would highly help to guide the project as it tries to improve on an area where no one had tried to improve yet.

In the literature review, information is searched to know more about the dot-matrix display and the way to control it. The project not only uses a bluetooth technology on the phone but together with a bluetooth module. This communication through two bluetooths is essential to the project as it is one of the project objectives. The nature of the project is the establishment of the communication between the display panel through its bluetooth module and the phone using the apps developed to access the phone bluetooth function and form a two-way communication.

2.2 Type of Microcontroller

There are many type of microcontroller available in the open market with a lot of function. Two of the microcontroller giants are the PIC and AVR. Both companies produce a similar product with their own set of IDE compiler. Despite PIC cheap microcontroller AVR in the past years had release a series of highly adaptive single board microcontroller called Arduino. The Arduino series comes with various add on such as motor, Wi-Fi shield and many. The DIY nature of the Arduino series promotes user to experiment and tweak with the product with many online resource available as reference.

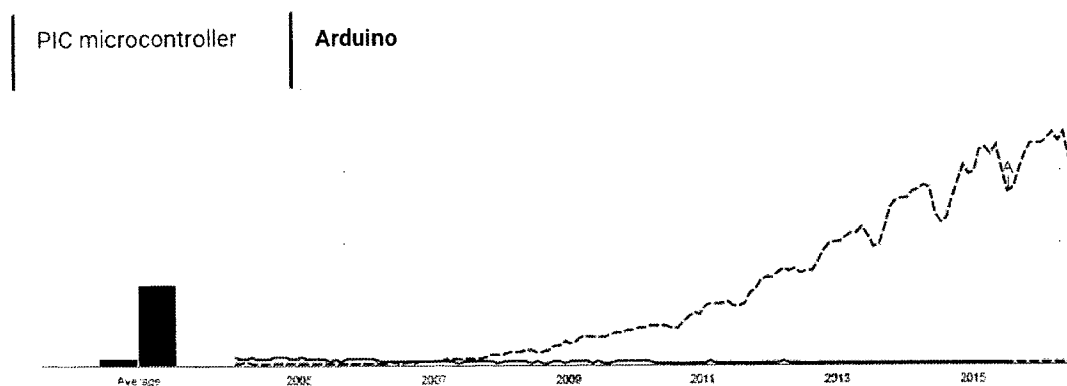


Figure 2.1: Microcontroller usage trend from 2005-2015

Source: Google Trend (2015).

In this research, the chosen microcontroller is the Arduino series as it provides more user friendly design and a simple to understand IDE software. Reason upon choosing the Arduino is further discuss in the thesis.

2.3 Related Projects and Articles

The mean of this project is to establish a connection between two Bluetooth devices and transfer serial data from one Bluetooth to another. There are a lot of data that can be transfer through the Bluetooth connection but at a limited speed. The communication link will be done by the phone Bluetooth while the Arduino will have a Bluetooth module connected to it to link both devices. Using Arduino had ease the overall project as the example and support for the device can be found as it is an open source type of software. The maker of the Arduino also kindly provides each and every example that a beginner user would need to familiarize the user with both Arduino interface and its programing language.

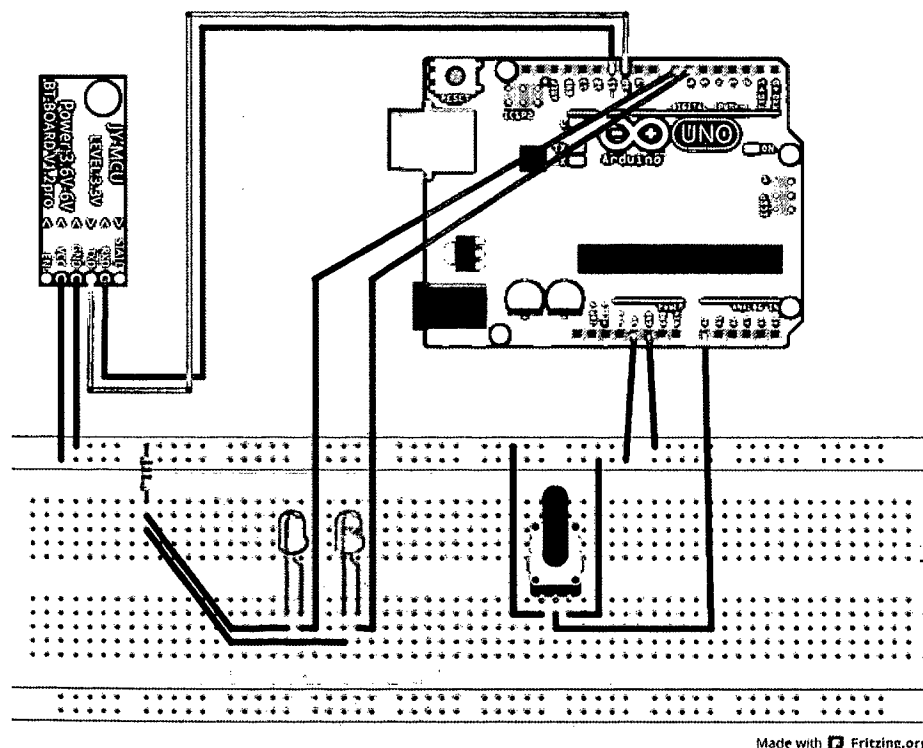


Figure 2.2: Arduino and Bluetooth connection example.

Source: Fritzing Tutorial example (2014).

2.4 QuizPower: A Mobile app with App Inventor and XAMPP Service Integration

The reason that this project is being review is because it has a similar propose and function in terms of it programing. The project intention is to make an app to provide students a way to study course material in an engaging and effective manner. At its current stage the app is intended strictly for use in a mobile app with App Inventor course, although it provides the facility to be adapted for other courses by simply changing the web data store. Development 'occurred during the spring semester of 2013. Students in the course played a vital role in providing feedback on course material, which would be the basis for the structure of the quiz as well as the questions. The significance of the project is the integration of the MIT App Inventor service with a web service implemented and managed by the department [1].

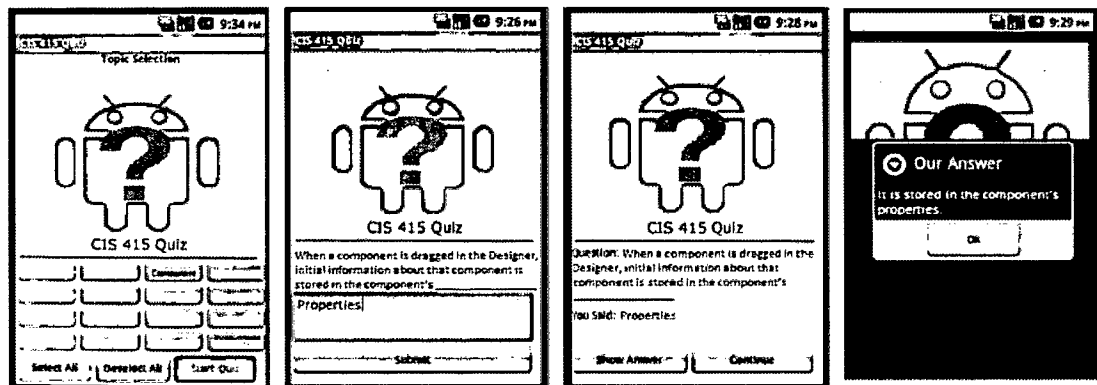


Figure 2.3: QuizPower user experience sample.

Source: David Meehan, University of New Hampshire (2013).

As to fulfill the objective of the project, the app should be able to provide the user an interface for them to write their text. The text is then being displayed back on the phone display through app to make sure the text is correct just like the QuizPower app that provide user with and interface to type in desired text.

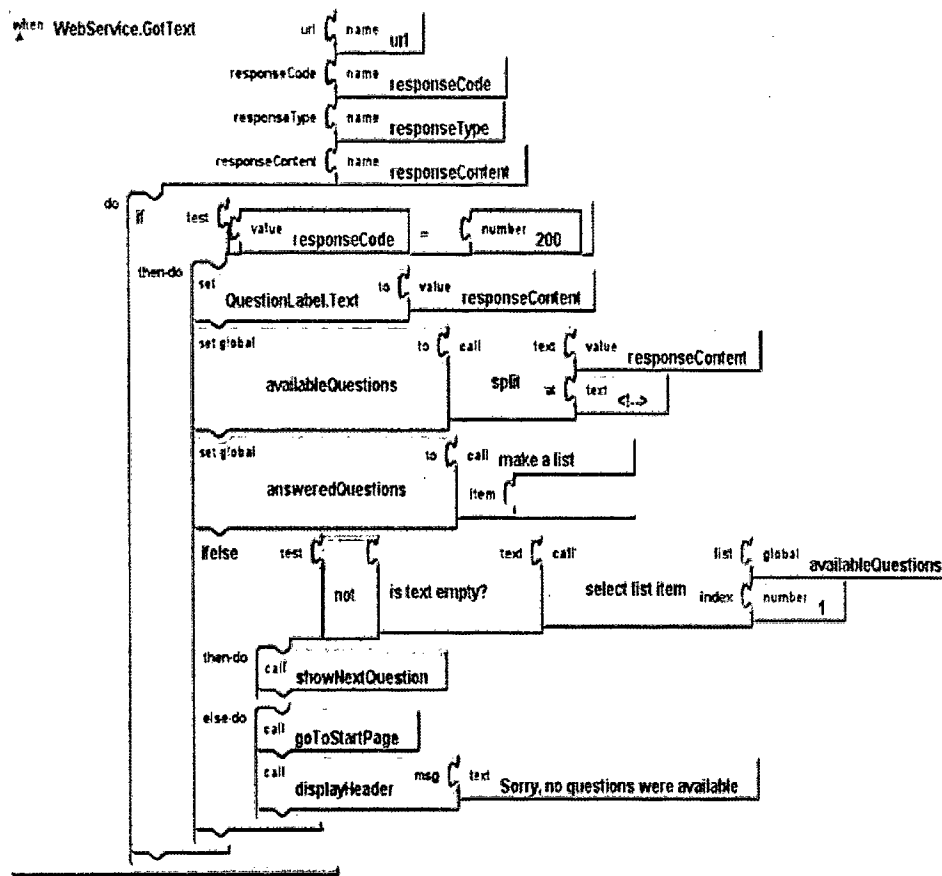


Figure 2.4: QuizPower Blocks Editor.

Source: David Meehan, University of New Hampshire (2013).

The app inventor version used in Figure 2.4 is the MIT App Inventor that is an online app maker for both android and IOS phones. The app maker are divided into 2 part that is the designer interface where all the user intended interface are being place with different layout to choose from and another part is the block programming area where the app programing are being write. The block programing uses its own type of language where different colors of block represent different type of command that is being build up by dragging the block to the intended command that would be executes.

2.6 Arduino Serial Communication

Used for communication between the Arduino board and a computer or other devices. All Arduino boards have at least one serial port (also known as a UART or USART): Serial. It communicates on digital pins 0 (RX) and 1 (TX) as well as with the computer via USB. To access this function, the use pins 0 and 1 for digital input or output will be disabled. By using the Arduino environment's built-in serial monitor to communicate with an Arduino board we can use the serial monitor button in the toolbar and select the same baud rate used in the call to `begin()`[2].

Arduino Mega example:

```
// Arduino Mega using all four of its Serial ports
// (Serial, Serial1, Serial2, Serial3),
// with different baud rates:

void setup(){
  Serial.begin(9600);
  Serial1.begin(38400);
  Serial2.begin(19200);
  Serial3.begin(4800);

  Serial.println("Hello Computer");
  Serial1.println("Hello Serial 1");
  Serial2.println("Hello Serial 2");
  Serial3.println("Hello Serial 3");
}

void loop() {}
```

Figure 2.6: Arduino multiple serial example.

Source: <http://www.arduino.cc/en/Serial/Begin>

In order for the Arduino to communicate with Bluetooth module through the RX/TX connection, the following code in Figure 2.6 will have to be used. One of the reasons is to start the connection and another one is to set the baud rate of the connection.

2.7 Fundamentals of Physical Computing for Programmers

In order to drive all 64 LED light in a single dot-matrix display, a multiplexer is need to reduce the amount of pin needed to control the LEDs. Without a led driver, it would take 64 individual pin from the Arduino to control a single panel. As the objective of the project it to make a scrolling text, the uses of at least 7 panels will be used in the project totaling up to 448 LEDs that need to be control at the same time. An LED driver is the most suitable and logical thing to be use in this kind of condition. A Max7219 chip can be used to control all 64 LED at the same time while just utilizing a single pin out from the Arduino.

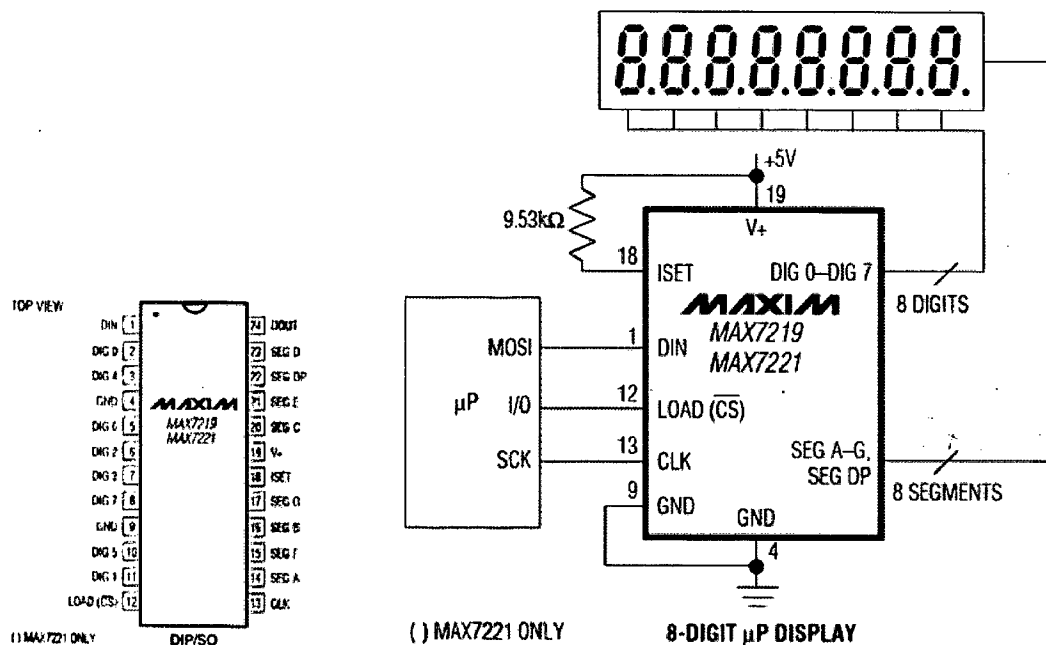


Figure 2.7: Max7219 pin out example to drive 7 segment displays.

Source: <http://datasheets.maximintegrated.com/en/ds/MAX7219-MAX7221.pdf>

The Max7219 can set each of the 64 LEDs independently and by cycling through the rows it will look like they're all lit at the same time. The Max 7219 chips have constant-current drivers there for eliminating the need of separate current-limiting resistors on every LED. The current drive is set using one resistor as the value is different and in this case the resistor connected to the ISET pin is connected to Vdd (power), not ground. The table 2.1 show the current-setting resistor values for the Max7219 chips is shown in Figure 2.7. Note that the values in this table change depending on the forward voltage V_f of the LEDs with the value in kilo-ohms [3].

ISEG (mA)	V_{LED} (V)				
	1.5	2.0	2.5	3.0	3.5
40	12.2	11.8	11.0	10.6	9.69
30	17.8	17.1	15.8	15.0	14.0
20	29.8	28.0	25.9	24.5	22.6
10	66.7	63.7	59.3	55.4	51.2

Table 2.1: Rset vs. Segment Current and LED Forward Voltage.

Source: <http://datasheets.maximintegrated.com/en/ds/MAX7219-MAX7221.pdf>

CHAPTER 3

METHODOLOGY

3.1 Introduction

In this chapter, it will be to describe the whole project development process and its requirement along the way. The chapter will focus on the methods of how the project being design and fabricated from the electrical view up until its programing method. The detail process of the project will be shown on the flow chart below.

3.2 Project Flow Chart

As shown in the Figure 3.1, the overall process of the project sequence is determined by the priority plus the process that needed to be accomplish first before moving on to another part of the project. It also being use the keep track the work needed to finish the project as well the time needed to be allocated in specific process such as the development of the android application that require more time to be finish.