

ARDUINO-BASED DIGITAL NOTICE BOARD USING ANDROID PHONES

By

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Notice Board is an exceptional fundamental gadget in any institution or public utility places like bus stations, railway stations, shopping centers, etc. But disseminating information by pasting various notices day-to-day is not appealing because it requires a separate person to take care of it. This paper provides a way of disseminating information on an electronic notice board wirelessly using Bluetooth technology, which provides user authentication to avoid the misuse of the system. The notice can be composed either by text or speech using Google 'Speech-to-text' technology. The design and implementation were achieved using Arduino UNO microcontroller. In addition to the normal information that can be displayed on the notice board, date, time and temperature of the environment can also be displayed using DS3231 RTC. A dedicated Android phone is used for composing, updating and sending information to the electronic notice board. The program for the system was coded in C/C++ using Arduino integrated development environment. The result shows considerable gain in confidentiality, security, reliability and reduction in cost.

Keywords: Android phone, TFT-LCD, Arduino UNO board, Microcontroller atmega328p, Wireless module, DS3231 RTC

INTRODUCTION

Android phones and other devices that use Android OS are becoming more ubiquitous. Various technological areas in the field of Telecommunication, as well as Embedded Systems, have come very near to the common people. On daily basis the number of people that gets android phones are on the increase. A day will come, somewhere in the future, when the android devices are referred to in the same class of Food, clothing, and shelter. With the openness, flexibility and features that android offers, it would be convenient to control our activities with an Android devices

Bluetooth wireless technology is becoming a popular standard in the communication arena, and it is one of the fastest growing fields in the wireless technologies. Bluetooth technology handles the wireless

part of the communication channel; it transmits and receives data wirelessly from these devices. While a mobile phone is simply more than a phone these days, the number of applications being built on a wide range of platforms for mobile phones is astounding. This particular functionality uses Android Application. The demand for wireless technology is growing not only in industrial applications but also for domestic applications such as reaching where cable or fiber could not.

Automation is the most frequently and a recurring decimal in the field of electronics. The hunger for automation brought many revolutions in the existing technologies. The difficulty of using manual display of notices at public places by humans is becoming practically impossible, especially in such places as airports, train and bus stations and ultramodern

conference centres. Some of these difficulties are evident in poor visibility, low frequency of information display and poor reach. The design carried out in this paper fills the above gaps. This design uses Arduino board hosting ATmega328p microcontroller. Fig. 1 shows a picture of Arduino UNO board with some of its key elements labeled. It plays the most important role in this project. In addition to the ATmega328 microcontroller, the board has the following elements: 14 Digital IO pins, 6 Analogue Input pins and 6 Analogue Output pins. The dedicated analogue input pins take analogue values (i.e., voltage readings from a sensor) and convert them into a number between 0 and 1023. The board can be powered through USB or with 9V AC adapter with five software selectable power saving modes. Detailed specification of the Arduino UNO microcontroller based board can be found in (Arduino, 2012)

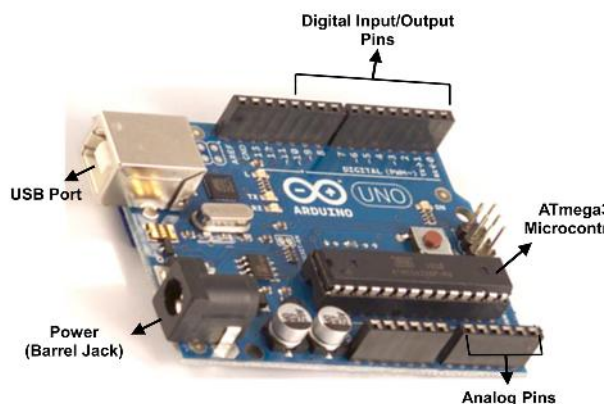


Fig. 1 Arduino UNO Boarded

Android is a software stack for mobile devices that includes an operating system, middleware, and key applications. Android boasts a healthy array of connectivity options, including Wi-Fi, Bluetooth, and wireless data over a cellular connection (for example, GPRS, EDGE (Enhanced Data rates for GSM Evolution), and 3G). Android provides access to a wide range of useful libraries and tools that can be used to build rich applications. In addition, Android contains a full set of tools that have been built from the ground up alongside

the platform providing developers with high productivity and deep insight into their applications.

A number of works on digital notice boards have been reported. In Bhumi Merai et al (2015) a smart notice board was developed that used microcontroller AT89c52 programmed in assembly language. Another work uses Visual Basic 6.0 to provide the database for the system (Chandan Varma et al, 2016). Ritu Sing et al. (2015) designed a keyboard driven electronic notice board. The problem with this design is the bulky nature of keyboards, which has limited portability.

In this paper an Android-based digital notice board that uses Arduino microcontroller board is presented. The wireless notice board is capable of displaying date, time and temperature of the environment and information sent from an authorized Android phone either by text or speech. The good thing about this work is the possibility of leveraging on the benefits of phones powered by Android operating system and the simplicity of the entire system.

SYSTEM DESIGN

The block diagram of the proposed wireless notice board is depicted in Fig. 2. The wireless module (HC-06) uses the Bluetooth wireless technology which allows the transmission/reception of data from Android phone to the microcontroller. The wireless module, DS3231 RTC and buzzer are interfaced to the microcontroller. The message sent through predefined application from user Android mobile phone is received by the wireless module. Wireless module feeds this information to the microcontroller which processes it and displays it on the TFT-LCD display. Furthermore, the microcontroller horns a buzzer for every new message and then append the time the message was posted below the message. To perform this intelligent task, the ATmega328 is loaded with an intelligent program written using Arduino IDE.

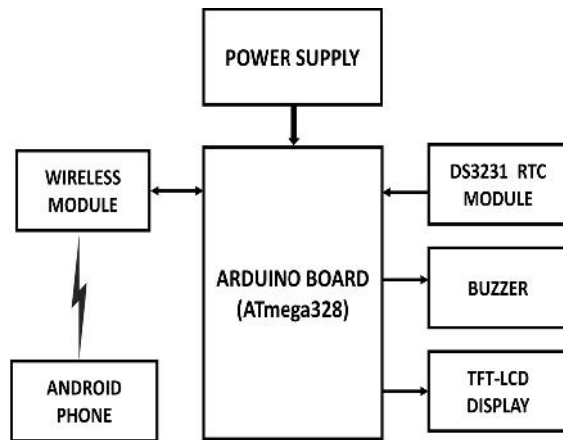


Fig 2. Block Diagram of Android Based Digital Notice Board

Hardware Requirement

To successfully carry out the design and implementation of this work the devices used were: Arduino UNO (ATmega 328p), wireless Module (HC - 06), Real-time clock DS3231, Buzzer, TFT LCD (thin-Film Transistor Liquid Crystal Display) and power supply. The "Arduino uno is an open source physical computing platform based on a simple input/output (I/O) board and a development environment that implements processing languages" (Massimo, 2011). The choice of Arduino was driven mostly by its availability and low cost. Other important reasons for its choice include: its multiplatform environment; ability to run on Windows, Macintosh, and Linux; its programmability via a USB cable, rather than a serial port. Arduino provides a easy way to build a faster and better prototypes. The full specification for the Arduino UNO board can be found in (Arduino, 2012)

The DS3231 is used to keep track of when the notice was posted and to provide the temperature of the environment. It is a low-cost, extremely accurate I²C real-time clock (RTC) with an integrated temperature-compensated crystal oscillator (TCXO) and crystal. The device incorporates a battery, and maintains accurate timekeeping when main power to the device is interrupted. The buzzer signals the presence of a new

notice in the system such as a doorbell, that makes a buzzing sound. The TFT-LCD Monitor Display is used to display the notices at real time operation and the temperature of the environment in the system. This project uses regulated 5V, 500mA power supply 7805 three-terminal voltage regulator is used.

Software Requirement

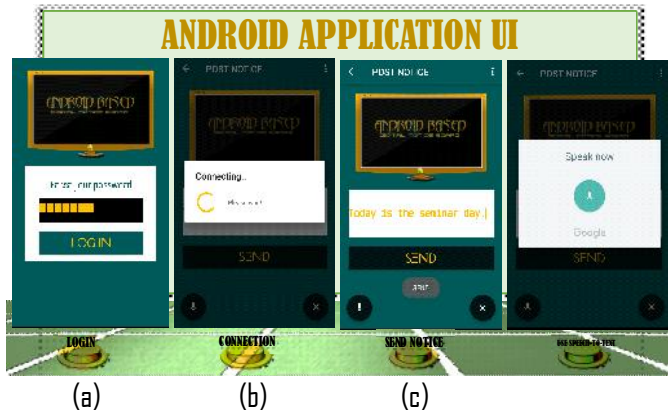
In addition to Windows operating system this design uses Arduino open source integrated development environment (IDE) and Android Studio IDE. The IDE is a special program running on a computer that allows one to write sketches (programs) for the Arduino board. After the code has been written and uploaded it is further translated to C programming language, which is subsequently converted to the assembly language of the microcontroller by avr gcc compiler.

The Android IDE provides the fastest tools for building apps for every type of Android device. This constitutes the digital notice board interface, which facilitates the entry of appropriate command for the notice board. In fact it is the command center of the entire digital notice board. The instruction is passed to the notice board through an android app and Arduino Atmega328 microcontroller. A typical Android app is designed for a smartphone even for a tablet PC running on the Android OS. Android apps are written in the Java programming language and use Java core libraries. The application used for the system is developed using java and XML in the Android Studio.

The design features app with four activities, which are demonstrated in Fig 3. The activities are: authentication, connection, post text and post speech-to-text activities.

The authentication activity grants access only to authorized users. After a valid password has been entered access to the app is granted leading to a posting of text or a prompt to speak the words that should be

posted on the notice board by using Google Speech-to-text app.



(a) (b) (c) (d)
 Fig. 3 App Activities, a) Authentication page, b) Connection page, c) Post text page, d) Post Speech-to-text page

Programming the Arduino Board

Arduino IDE, which is shown in Fig. 4 is an integrated development environment where all the components of the Arduino Board are programmed. Here, Arduino UNO with ATmega328 is programmed using C/C++ programming language, which allows it to serve as a controller for all other components in the system using the Arduino Uno board. The program is loaded into the microcontroller using a USB (universal serial bus) cable. The system and interface algorithms are depicted in Fig. 5 and Fig. 6 respectively.

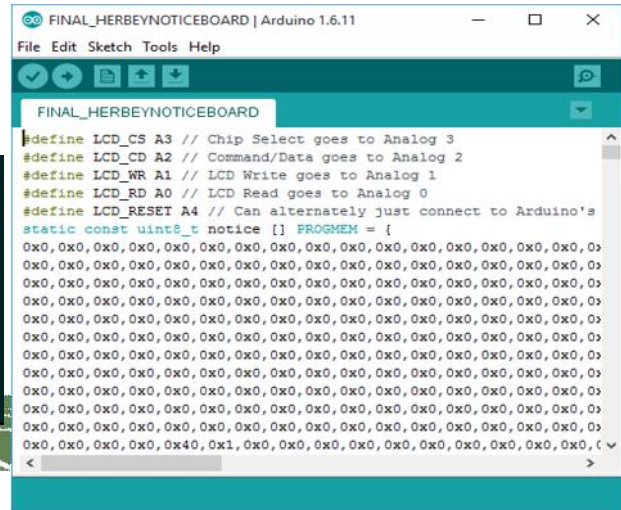


Fig 4. Arduino IDE

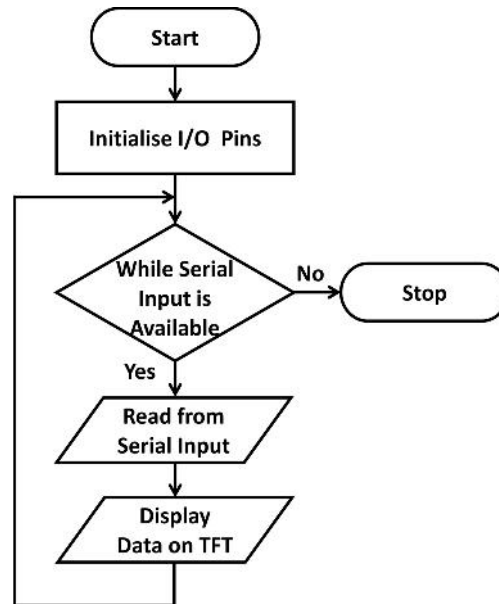


Fig. 5 System Flowchart

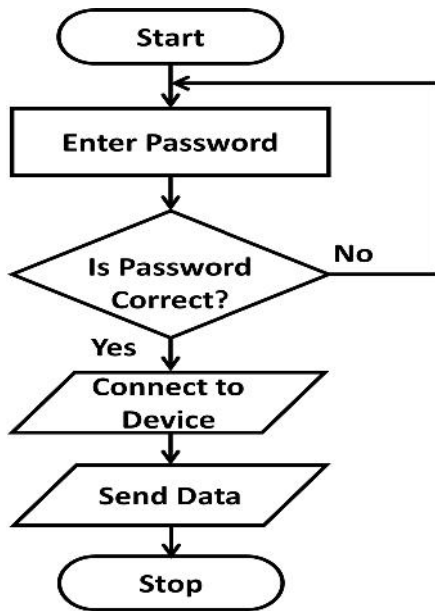


Fig. 6 Interface Flowchart

Using electronic design techniques appropriate for this work the schematic diagram of Fig. 7 was developed for all the components excluding an Android phone. This is true as the phone communicates with the circuit via Bluetooth and need not be included in the schematic diagram.

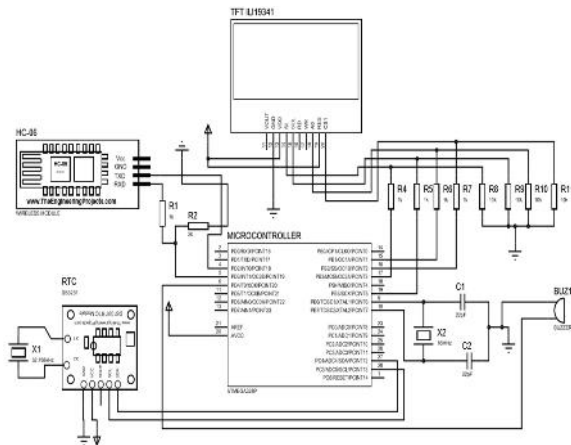


Fig. 7 Schematic diagram of the Arduino-based Wireless Notice Board

Consequently, it is the wireless module that should be an integral part of the schematic in accordance with Fig. 2 that shows the block diagram of the entire system.

DEVICE CONSTRUCTION

After the design was completed and verified, all the components necessary for the physical realization of the design was gathered and assembled together as shown in Fig. 7. The HC-06 module has four pins VCC, GND (ground), RX (receiving serial interface terminal) and TX (transmitting serial interface terminal). These pins are connected to the appropriate Arduino board terminals as shown in Table I. This connection allows for data exchange between the wireless module and the ATmega328p microcontroller on the Arduino board.

Table I: HC-06 Pins connection to Arduino Board

WIRELES MODULE (HC-06)	ARDUINO UNO (ATmega 328p)
VCC	Arduino 5V
GND (ground)	GND
RX (serial interface, receiving terminal)	Digital Pin 2
TX (serial interface, transmitting terminal)	Digital Pin 4

Following the disparity in voltages of RX pin and Arduino output voltage, a voltage divider was employed to reduce the voltage from 5V to 3.3V of the Rx pin of the HC-06. In order to achieve this reduction, a voltage divider circuit was used by utilizing equation (1) with R1 = 20K Ohm and R2 = 10K Ohm. Substituting these values and Vin = 5V in equation (1) you obtain approximately 3.3V.

$$V_{out} = \frac{R_2}{R_1 + R_2} * V_{in} \tag{1}$$

Fig. 8 depicts the connection of the HC-06, which was first mounted on a breadboard and the Arduino board. The two resistors form the voltage divider circuit to protect the RX line of the Bluetooth module.

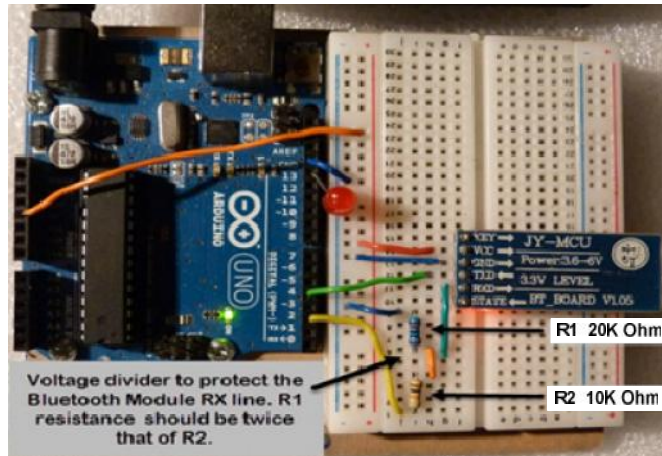


Fig. 8: Physical Connection of the HC-06 to the Arduino Board

RESULTS AND DISCUSSION

Testing

After the design, implementation and construction of the system, incremental testing was undertaken to test each component and interconnections as each was added. Fig. 3 demonstrates the functionality of the developed Android App with four activities. The connection of the wireless module to the Arduino was tested and the result obtained on the serial monitor of the Arduino programming interface is shown in Fig. 9. The TFT LCD was also connected to the Arduino Uno board to display the data obtained from the wireless module which was sent from the android application. Lastly, the RTC module was connected to the Arduino Uno board in I²C connection, which keeps track of when the data was sent and displays the date, time and temperature of the environment as depicted in Fig. 9.



Fig. 9 Packaging and Final Testing

CONCLUSION

Arduino-based wireless notice board was designed, verified and constructed using Arduino prototype board. Post construction test was carried out and the system performed as expected. This system is cost effective as any notice can be sent from any Android phone and guarantees security through authentication. The system is capable of displaying the notice using Bluetooth within a distance of 30 meters which is sufficient for this type of application. This design provides two options for composing the notice, depending on the choice of the authorized user speech or text can be used to send notice. This is possible by leveraging on the Google "speech-to-text" application programming interface to send data to the system. Although this device is cost effective and secure, there is still room for improvement especially by using newer wireless technology to increase the range. Furthermore the text can be made to scroll across the notice board. In place of the buzzer a speaker can be incorporated into the design for audio announcements suited for use in the airports, train and bus stations.

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