

## MAKING A VOICE CALL USING ARDUINO UNO R3 AND GSM GPRS SHIELD A-GSM v2.68

Ana-Maria IUJĂ, Marian ALEXANDRU

Transilvania University, Braşov, Romania (iuja.ana@gmail.com,  
marian.alexandru@unitbv.ro)

DOI: 10.19062/1842-9238.2016.14.2.16

**Abstract:** *This paper describes how to integrate a GSM module with Arduino and make them to call a particular mobile number. For this project, the GSM module is interfaced with the prototyping platform Arduino Uno R3, which makes the hardware circuitry simple and easy to be coded, using the C based programming environment Arduino Software IDE.*

**Keywords:** *Arduino Uno, GSM Shield, GPRS, Voice Call*

### 1. INTRODUCTION

Over the years, Arduino has become one of the most accessible and flexible open-source projects for building interactive objects that can sense and control external devices.

Arduino and Arduino-compatible boards use printed circuit expansion boards called *shields*, which plug into the normally supplied Arduino pin headers. This way the Arduino board is interfacing with the world: shields can provide motor controls, GPS (Global Positioning System), Ethernet, LCD (Liquid Crystal Display), or bread boarding (prototyping). Several shields can also be made DIY (Do It Yourself) [1].

In the last 10 years, many application ideas were implemented using the Arduino board and the GSM/GPRS shield: remote control of appliances (send SMS while you are at your office to turn on or off your washing machine at home), remote weather station or a wireless sensor network (create a sensor node capable of transferring sensor data to a web server), interactive voice response system (couple the GPRS shield with an MP3 decoder and a DTMF decoder – besides an Arduino), vehicle tracking system (couple the GPRS shield with an Arduino and GPS module, install it in the car and publish your location on the Internet) [2].

In order to understand how a mobile phone can be realized using the Arduino Uno R3 and the A-GSM shield, there must be specified what a mobile phone is: an electronic device used for mobile telecommunications over a cellular network of specialized base stations known as cell sites. A cell phone offers full Duplex Communication and transfer the link when the user moves from one cell to another. As the phone user moves from one cell area to another, the system automatically commands the mobile phone and a cell site with a stronger signal, to switch on to a new frequency in order to keep the link. This sophisticated device is using SMD components, microprocessor, flash memory, etc. In addition to the circuit board, it also has antenna, LCD (Liquid Crystal Display), keyboard, microphone, speaker and battery [3].

The A-GSM shield allows the Arduino board to make calls using a GSM library. The high performance GSM GPRS module (Quectel M85) with worldwide coverage and integrated GSM antenna bring flexibility and easiness in integration of the platform and application. The shield is configured and controlled via its UART (Universal Asynchronous Receiver/Transmitter) using simple AT (Attention) commands [4].

A cell phone can be used with any cellular networks around the globe if the proper SIM card is inserted in it. This fact is possible because there is a device inside the cell phone which follows a global standard (GSM), enabling the connection with different cellular networks. The mobile phones have built in GSM modules, which can be used by the processor inside the phone to make a call, send or receive message or even connect with the GPRS network.

Voice call: how does it work? In multiple applications, the microcontroller based systems requires to be connected to the GSM network, which will enable the user to control the system by sending messages or making a call. Therefore, a separate GSM module is used rather than using the mobile phones. There are GSM modules that allow serial communication with microcontroller based systems. The communication is realized by sending or receiving AT commands [3].

## 2. SYSTEM IMPLEMENTATION AND EXPERIMENTAL RESULTS

**2.1 Equipment used.** The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital I/O pins (of which 6 can be used as PWM – Pulse Width Modulation - outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button [4].

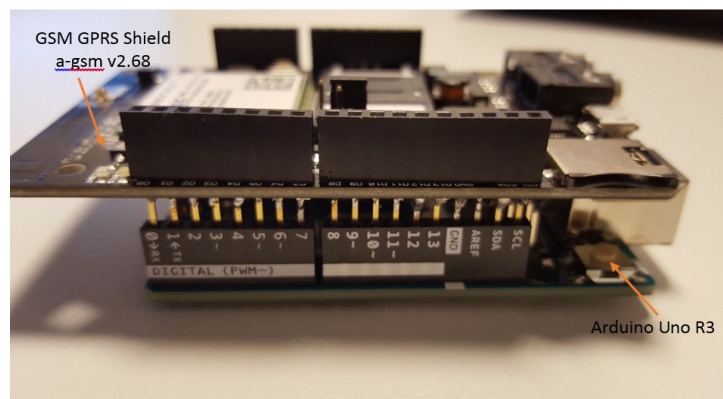


FIG. 1. Equipment used

The A-GSM v2.68 shield GSM / GPRS / SMS / DTMF for Arduino and Raspberry PI is a quad band Quectel M85 module. It has the GSM antenna integrated and the uFL connector for the external antenna, dual sim 850/950/1800/1900 MHz, 3-5V TTL serial interface and two 3.5mm jacks for headphone (700mW RMS) and microphone [5].

In order to connect the shield to Arduino, it was stuck directly into Arduino board (after a set of pins was pasted to the board – FIG. 1.). Arduino is connected to the laptop through the USB cable. For completing the system, a SIM card, a microphone and a set of headphones are also needed.

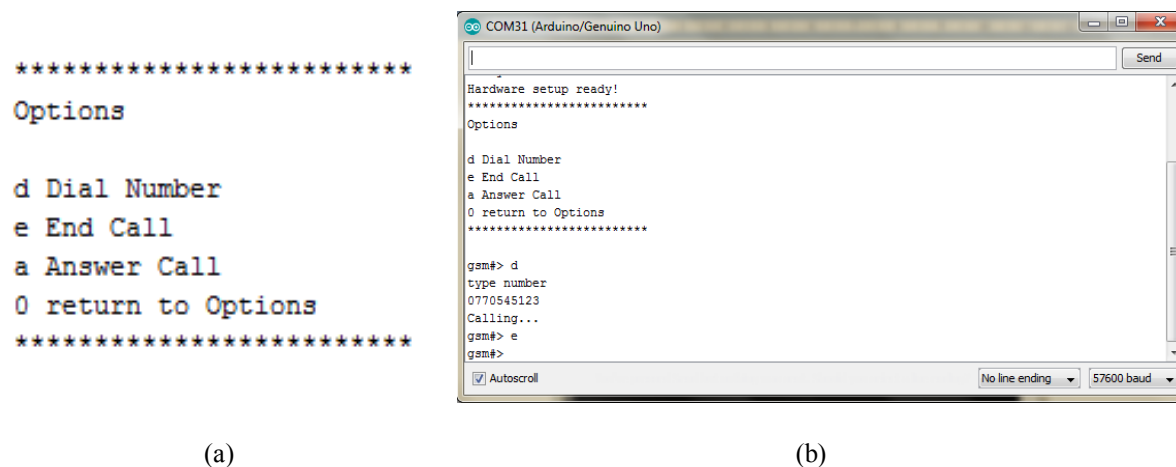
**2.2 Application Description.** Arduino is an open-source prototyping platform based on easy-to-use hardware and software. The board can be controlled by sending a set of instructions to its microcontroller. To do so, the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing, must be used [4].

The Arduino IDE (Integrated Development Environment) contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them [6].

Before uploading the sketch, it needs to be selected the correct items from the **Tools > Board** (select Arduino/Genuino Uno) and **Tools > Port** (the correct port can be checked in Windows Device Manager > Ports > USB serial device > COM32) menus.

Two digital pins of Arduino are used for serial communication between Arduino and GSM module. Two PWM enabled pins of Arduino have to be selected (for this particular system - pins 2 and 3). This method is possible by using the SoftwareSerial Library of Arduino. SoftwareSerial is a library of Arduino which enables serial data communication through other digital pins of Arduino. The library replicates hardware functions and handles the task of serial communication [7].

After the code is uploaded, the serial monitor (**Tools > Serial Monitor**) initializes the data exchange with the connected board, on the selected port. Initially, the board is reset. After the data exchange is initialized, a menu will be displayed for the user (FIG 2. (a)), in order for him to select the option he wants to perform.



**FIG. 2.** (a) Menu displayed for the user; (b) Typing the phone number

When the Arduino board receives through the serial the 'd' value, the user has to insert the phone number he wants to dial (FIG. 2. (b)).

Afterwards, Arduino commands the A-GSM shield through AT commands. Many functions of the phone can be accessed by AT commands (FIG 3 (a)). Cell phone manufacturers also define their own AT commands. If a command is accepted, OK is returned, along with response (FIG 3. (b)). If command is not recognized, ERROR is returned. Some commands will be accepted in certain phone states and rejected in others.

The board may also receive calls. When the shield detects a call (the RING command will be displayed while monitoring the serialized shield – e.g. Tera Term), the user can answer the receiving call by sending the 'a' value to the Arduino board.

```
sendATcommand ("ATA", "OK", "ERROR", 2);
```

The user has also the option to end the on-going call by sending the ‘e’ value to the Arduino board.

```
sendATcommand("ATH", "OK", "ERROR", 2);
```

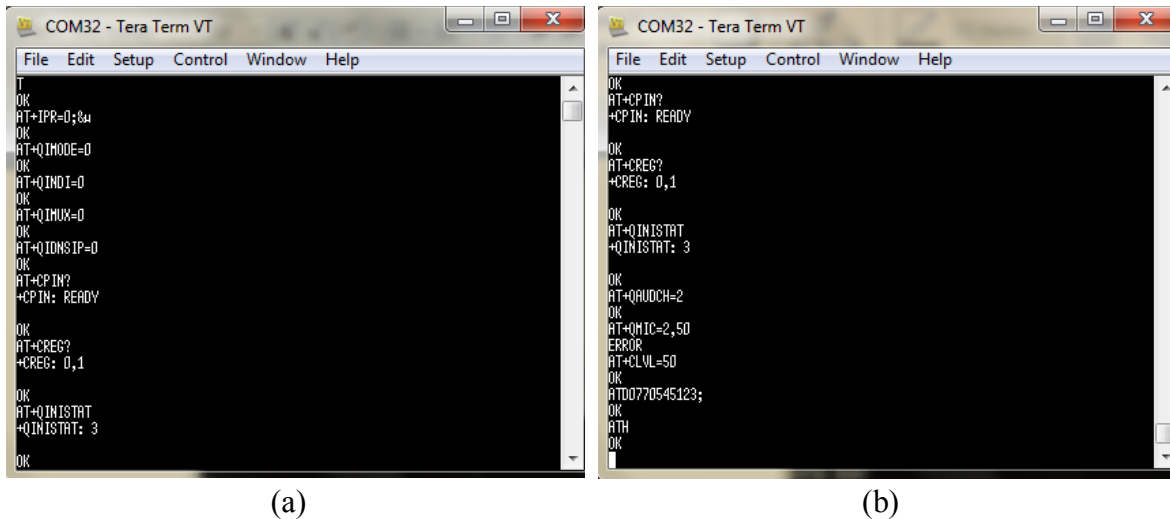


FIG. 3. (a) Hardware setup; (b) Making/Ending a call

When none of the displayed options are selected, the user will receive the ‘Bad Command’ message and he will be redirected to the main menu.

### 3. CONCLUSION AND FUTURE WORK

The system presented in this paper is the first step made in realizing the design of a cell phone, by exploring various materials, shapes and functions (make/receive a phone call, reject an incoming call). Although there are multiple options when choosing to make an open source, open hardware cell phone; combining the Arduino Uno with the A-GSM v2.68 shield offers multiples opportunities for this system to be continuously developed and improved.

The application can be upgraded by adding new functionalities such as: make and receive text messages, include a phone book and a caller id, keep the time.

### 4. REFERENCES

- [1] \*\*\* *Arduino Explained* [online], Available: everything.explained.today [February, 2016];
- [2] \*\*\* *GPRS Shield v1.0?* [online], Available: <http://www.seeedstudio.com> [February, 2016];
- [3]\*\*\* *Mobile Phone Communication. How it works?* [online], Available: <http://www.electroschematics.com> [March, 2016];
- [4] \*\*\* *What is Arduino?* [online]. Available: <http://www.arduino.cc> [March, 2016];
- [5] \*\*\* *GSM GPRS Shield A-GSM v2.68* [online], Available: <http://www.robofun.ro> [April, 2016];
- [6] \*\*\* *Arduino Software (IDE)* [online]. Available: <http://www.arduino.cc> [April, 2016];
- [7] \*\*\* *How to Interface GSM Module to Arduino-Send and Receive SMS* [online], Available: <http://www.circuitstoday.com> [April, 2016].