Using the Arduino Board and a Bluetooth Module in a Home Automation System Managed Locally Via a Smartphone

Lumpungu Lutumba Kevin[1]; Muhongya Alima Johanes[2]; Mbala Nsimba Michael[1]; Zana Lambati Aimé[1]; Alidor Kazadi[1]; Mukuna Tende Théophile[2]; Brunette Musau Lumpungu[3,4]

[1] Geophysics research Center, Environmental Geophysics Department
[2] Higher Institute of Applied Techniques (ISTA) Electronics Section Kinshasa, Democratic Republic of the Congo
[3] Higher Institute of Education of Gombe, Democratic Republic of the Congo
[4] University of Kinshasa Faculty of Economics

Abstract; At the beginning of the era of new technology, home automation is becoming increasingly important. Home automation applies to multiple applications in a home. Whatever the rooms, contexts and needs, home automation adapts to the public. Radiators, water, shutters, garages, gates, lighting, music, ventilation, video, alarms, household appliances, home automation allows you to program, automate and control remotely or not all the elements of a home from a central computer or a cable connected to an electrical panel. Nowadays, a home automation center is able to communicate, whether by computer or telephone, in order to inform about the status of an installation, generate alerts and control a house located on the other side of the world, from an office or a car.

Keywords: Arduino Board, Bluetooth and Android Module.

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I. INTRODUCTION

Home automation is a system that allows us to control and manage our home devices remotely. Home security includes property protection, but also, fortunately, the protection of people and property. This system turns lights on and off, activates a socket for use, manages energy, and provides comfort, all combined in a home. Home automation can be applied to multiple uses in a home. Regardless of the rooms, contexts, and needs, home automation adapts to the public. Radiators, water, shutters, garages, gates, lighting, music, ventilation, video, alarms, household appliances, home automation allows you to program, automate, and control all the elements of a home remotely or not from a central computer or a cable connected to an electrical panel. The main objective is Create a home automation system using an Arduino board and a Bluetooth module, all controlled by a smartphone or computer. In our project, we will use an Arduino board as a microcontroller, it is the engine of our project, a Bluetooth module for interconnection or data exchange and a smartphone for control and instruction. The configuration of this document is as follows. . Section I; In this part, we will present an introduction to home automation;

Section II this section will present the Android system, the Bluetooth module and the Arduino board Section III would introduce our proposed system and gives the overview of the system, Section 4 describes the application and Section 5 concludes our article.

II. METHODS USED

➤ *To Develop our Article, We sed the Following Methods:*
   The analytical method, which consists of conducting an in-depth analysis of the basic concepts of object-oriented programming, the Arduino module, and the Bluetooth modem adapter module.

- The experimental method, which allowed us to create and program the source code in the Arduino PIC microcontroller following several tests.

- The documentary technique, which allowed us to use, or have used, various works related to our work.

III. PRESENTATION CONCERNING ANDROID, ARDUINO AND BLUETOOTH.

In this section, we will briefly introduce three disciplines: Android, Arduino, and Bluetooth, and discuss the impact of home automation on new technology. Over time, mobile telephony has evolved into different generations.

• Android is an open source operating system, developed as a software stack, which means: it is a set of programs designed to provide solutions for mobile phones.

Android is a system that allows applications to be moved to various external storage media such as microSD cards. This functionality depends on the permissions and settings in the application's manifest file (AndroidManifest.xml), which can allow, favor, or prohibit it.
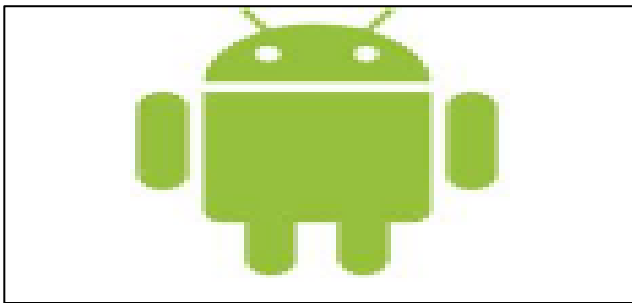

Fig 1 Android Logo

• Bluetooth management is mainly conducted through three classes. Bluetooth Adapter: Like the Wi-Fi Manager, this class allows you to manage other Bluetooth devices and initiate communications with them. BluetoothDevice: An object that represents the remote device. Bluetooth Socket and BluetoothServerSocket manage an established connection. To connect two devices via Bluetooth, one of them must be accessible (displayed) In order to proceed, the user is required to give consent to enter discovery mode.
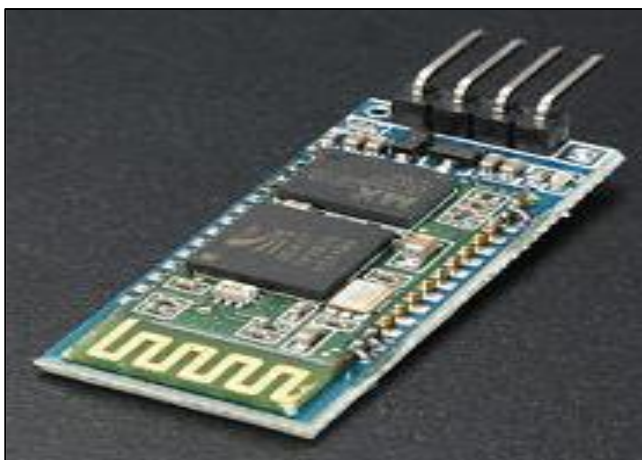

Fig 2 Wireless Bluetooth Transmitter-Receiver

• The Arduino serves as an electronic prototyping platform that integrates both hardware and software.

It embodies a collection of interactive objects designed for creative applications, which includes a printed circuit board and a programming environment.

➢ *Hardware*

• With an 8-bit Atmel AVR microcontroller
• Connectors for all operations, whether digital or analog inputs
• Elements facilitating the use of the USB port for programming and communication o A USB Type B connector (standard square)
• An Arduino board measuring 5.5 cm by 7 cm and 1.5 cm thick. ♣ A power connector

➢ *Software*

• A separate programming environment that combines a code editor, compiler, and bug detection
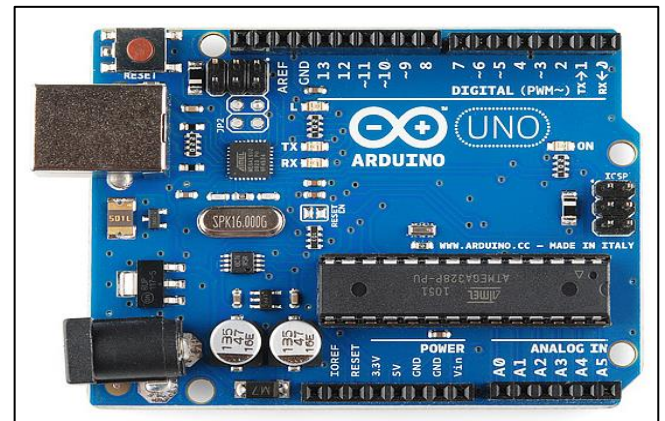• And open-source code libraries to extend the microcontroller's functionality.

Fig 3 Arduino board

The Arduino Development Environment, also known as IDE, is an application designed in Java, inspired by the Processing language. This IDE allows you to write and modify a program, then transform it into a sequence of instructions that the board can interpret. The microcontroller executes the program sequentially, starting from the top and working downwards.
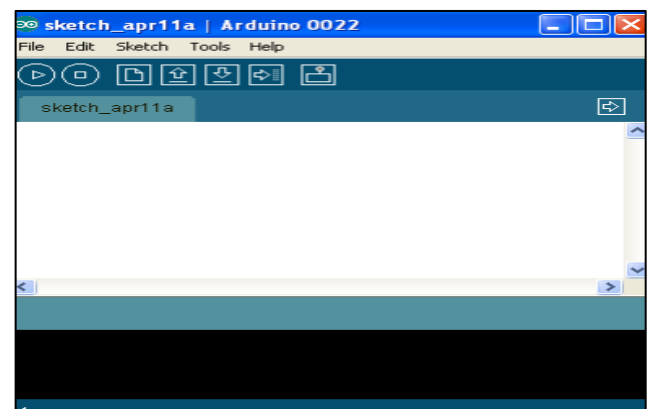

Fig 4 the Sketch Structure of a Program

Optical fibers have several advantages and disadvantages in the field of telecommunications. Among the advantages are extremely low signal losses: depending on the type of fiber, attenuation can reach approximately 0.1 dB/km and approximately 0.35 dB/km at 1.3 μm. This means that after distances of 15 km and 8.6 km respectively, the signal power decreases by 50%. This characteristic allows optical communications to be carried out over distances exceeding 100 km without the need for intermediate amplification. A light-emitting diode, often referred to by the acronym DEL or LED (for "light-emitting diode" in English), is an optoelectronic component that emits light when an electric current passes through itThis particular kind of diode allows current to travel exclusively in one direction (the forward direction, similar to a conventional diode), while the opposite direction is known as the as the monochromatic or polychromatic radiation through the conversion of electrical energy when activated by the current.
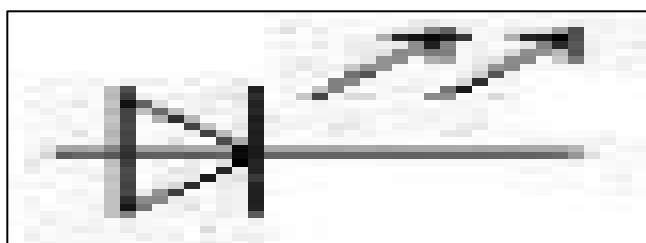

Fig 5 DEL

A photoresistor is a resistance that varies depending on the illumination it receives.

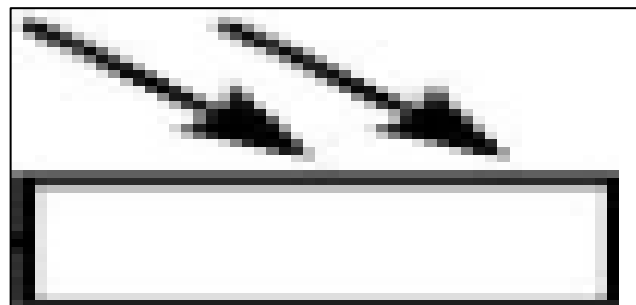Its operation is based on the photoelectric effect in an N-type semiconductor.

Fig 6 Photoresistor

IV. DESCRIPTION OF THE APPLICATION DEVELOPMENT SYSTEM

In this section, we will comprehensively detail the various blocks that make up the home automation platform of our system. We will discuss the preliminary study as well as its operation.

> *Presentation of the System Block Diagram*

In fact, to be able to access certain features of the system directly from your smartphone or tablet, the application will also allow communication with the Arduino module, the Bluetooth adapter card and the optical fiber transmission support.
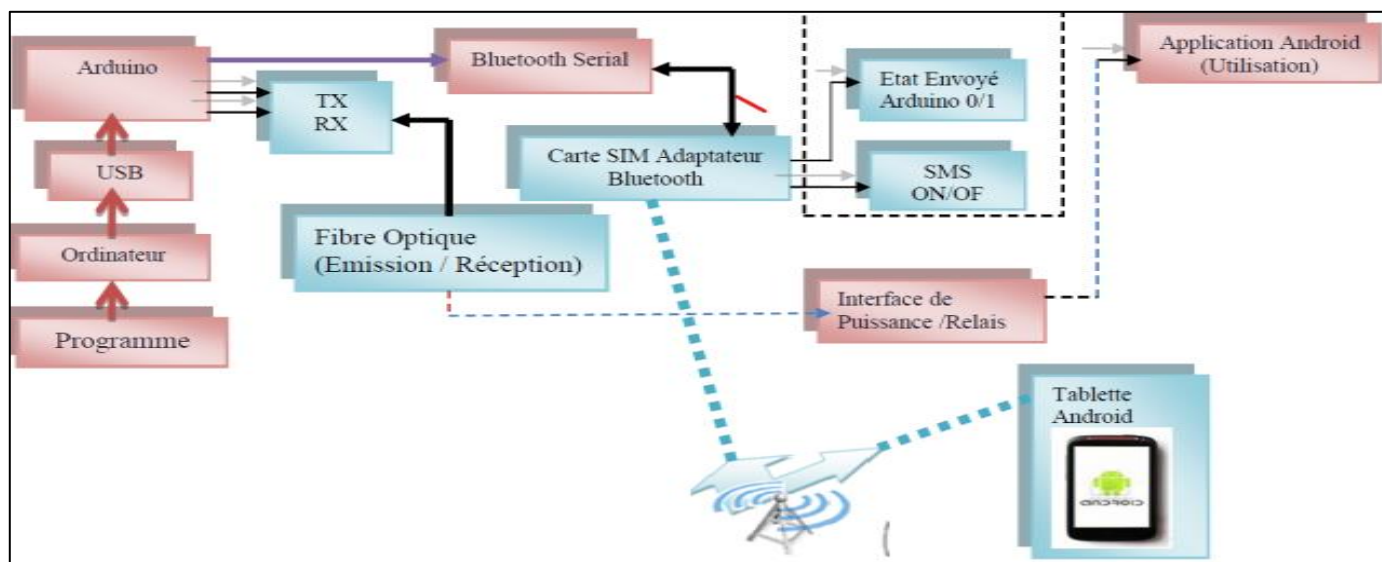

Fig 7 Present the Home Automation Platform

This computer block allows us to connect the Arduino electronic interface board to the home devices to be controlled. Indeed, the terminal's program would be developed in Java Android and the connection would be a serial link.

Regarding the user interface, it would be developed in Java Processing, understandable with Arduino Uno and Java Android.

The Arduino open-source electronic prototyping board is a central computer that contains resources for Android development and other computer systems such as the SIM card adapter, Bluetooth module, and is equipped to communicate with them.

The Arduino module's hardware is optimized to provide rapid response to a large number of requests from the Bluetooth adapter module software and Bluetooth hardware,

and a large amount of RAM, Random Access Memory, and other memory allow for very rapid access to information.

➢ *TTL to RS232 Logic Signal Converter*

The TTL-to-RS232 converter allows any TTL serial device, such as microcontrollers and other peripherals, to communicate with the computer. A converter is required because the computer and the microcontroller do not communicate in the same language. The microcontroller communicates using TTL voltage levels: 0V and 5V. The computer uses RS232 voltage levels:
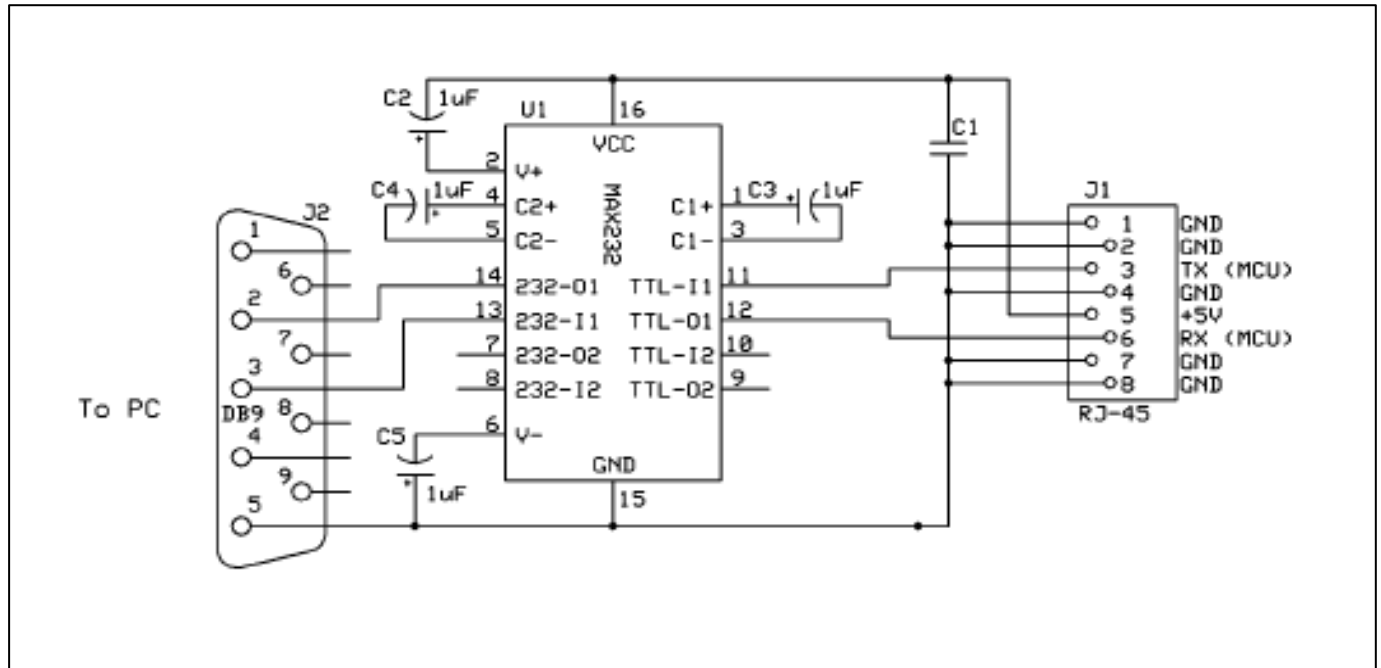

Fig 8 The Converter Diagram

➢ *Bluetooth*

It is a telecommunications standard for short-range wireless communication that enables electronic devices to exchange information with each other.It enables devices to connect with one another without the use of cables, over short distances. The fundamental objective of Bluetooth is to simplify the transfer of data or voice between devices equipped with a low-cost radio circuit, over a distance of approximately ten to less than one hundred meters, while consuming little power. This technology is increasingly integrated into mobile phones, allowing them to interact with computers, personal assistants and, in particular, hands-free devices such as Bluetooth headsets. The latter function as advanced audio headsets, offering remote control options. Bluetooth technology allows us to reach speeds of around 1 Mbps, The Bluetooth standard establishes three classes of transmitters, each offering varying ranges depending on their transmission power.

Two devices can exchange information even if they are separated by a wall. Furthermore, Bluetooth devices have the ability to detect each other without requiring user intervention.

This module will allow us, initially, to control the outputs of an Arduino board using a mobile phone or an Android tablet with Bluetooth connectivity, while allowing us to view the status of these outputs on the screen of the device used.

➢ *Material environment*

To carry out this project, we used the following equipment:

- Samsaung Note 20;
- ARDUINO board;
- The Bluetooth adapter SIM card;
- Optical fiber (transmission/reception pair);
- The Arduino Uno prototyping board module incorporated with the microcontroller;
- A 220V pilot light for the experiment;
- An Arduino USB cable for connecting to the computer;
- Power electronic components;
- The SNEL mains with a 220V power supply

Table 1 Different Bluetooth classes

Classe	Puissance (affaiblissement)	Portée
I	100 mW (20 dBm)	100 mètres
II	2,5 mW (4 dBm)	15-20 mètres
III	1 mW (0 dBm	10 mètre

➢ *Connecting The Arduino Board With the Bluetooth Module to the Arduino*

The Arduino board is connected with the bluetooth module via the optoelectronic pair (optical fiber).. The first is I2C for the Shield based on a PN532 chip. The second is connected via SPI based on an RC522 chip. Although the I2C bus is particularly well-suited for this type of setup, the PN532 chips share the same addresses, which made it impossible for us to use this protocol with two Shields. The Adafruit PN532 Shield is powered by 5 volts, while the second is powered by 3 volts. The latter is therefore less powerful and has a slightly shorter range. To manage the transmission of information between the smartphone and the Arduino, we use the "Android.Arduino.Bluetooth" library.
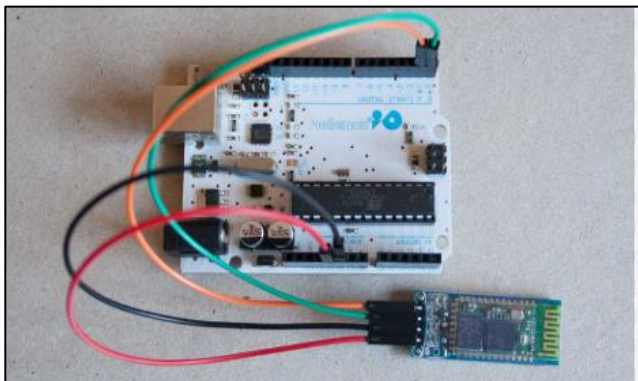

Fig 9 Arduino assemblies and Bluetooth modules

The library is initialized with certain parameters, allowing the application to be started when the Arduino is connected to the smartphone, or to indicate the download address if it is not present. At the reception level on the smartphone terminal side, we use the basic functions of Android 4.0. That is, to read the buffer from the USB connector. To achieve this, we grant permission for the Android application to interact with the USB accessory (the Arduino).The initialization information for the "Android.Arduino.Bluetooth" library must be the same as on the smartphone. Once the connection between the two devices is created, we read the buffer cyclically. To add some

interactivity between the user and the application, we thought it would be a good idea to create communication between the user's smartphone or tablet and our home automation system. The functioning of the system relies on two subsystems: the hardware subsystem, which encompasses the electronic components of the system; and the software subsystem, which pertains to the programming aspect.. We set out to implement a home automation system that would allow us to remotely access a home, office, or any other location via an Arduino module, a Bluetooth adapter, or fiber optics, in order to control electrical, mechanical, pneumatic, and other equipment. Controlling a lamp via an Arduino board and the Bluetooth adapter module with fiber optics, which is acknowledged from transmission to reception by a third-party Android phone or tablet, sends "ON" or "OFF" text messages to our smartphone. The Arduino board connected to the computer returns an acknowledgment of the action with a "1" or "0," and the smartphone transmits this information to the phone sending the command. We have specified The port to which the Arduino is connected using the following principles:

- Press "Connect open" to establish an interactive connection between the Bluetooth hardware and the Bluetooth software.
- Pressing ON closes the relay (current flows)

When you are finished, press "Disconnect close." The system is powered via the 220V mains, with an integrated triac to convert 220 volts to 5V to power all the components. The Arduino is not powerful enough to power the entire Android tablet, the lighting of a lamp and the optical fiber receiver accumulating more than 700mA in consumption (maximum delivered by the Arduino) we have set up a routing card To turn on the lamp at the reception output, simply launch the Android Java script via the smartphone. The system is controlled via a simple relay, thus allowing the lighting of the lamp to be controlled by activating or deactivating the On/Off switch of the power supply. This allows the Arduino to be powered.
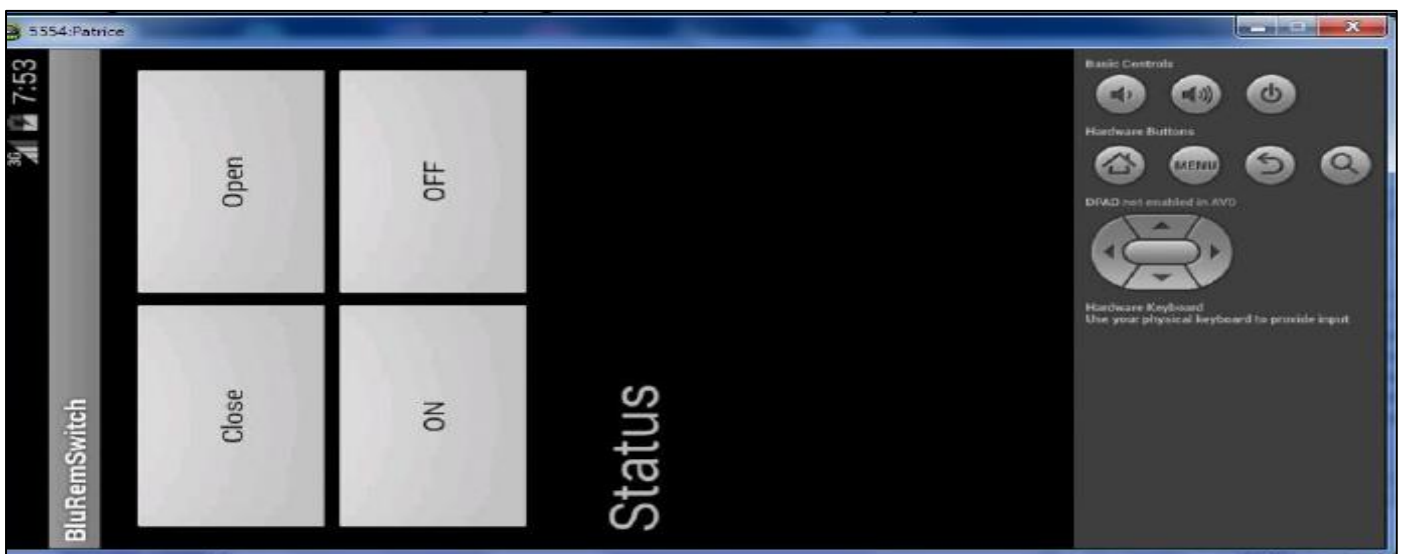

Fig 10 Software Appearances for Application.

V. CONCLUSION

We have reached the end of our project. During this project, we explored the field of home automation, which encompasses all new information and communication technologies (NICT) applied to buildings. This project allowed us to acquire all the skills required for a computer, electronics, and telecommunications engineer. First, we developed a software solution on Android, one of the two applications of which is connected to an Arduino microcontroller. The Arduino code we developed allows us to manage commands such as activating a lamp. Finally, we designed and implemented the home automation platform to ensure the smooth operation of the entire system. After careful consideration, we opted for an Android-based solution, primarily to take advantage of the technologies essential to the efficient completion of our project. This also allowed us to deepen our knowledge of Android programming.

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