IoT + NRF24L01 X NodeMCU12e: An Applied Survey on Data Sending via Radio

Bento, Antonio Carlos

Pontificia Universidade Católica de São Paulo, Brazil

Teconlogies of Intelligence and Digital Design

acb01@hotmail.com 55 11 991.925.824

Abstract: The results of this study demonstrate the use for sending and receiving radio signals using the NRF24L01 device in conjunction with the NodeMCU12e, normally used in creating projects for the internet of things. Due to the increase in the creation of solutions using the internet of things, the motivation for the development of this project started from the personal observation, during the development of different types of projects that allow the transmission of data using devices of the Arduino type. The results obtained allowed to conclude on the benefits and possibilities that the NRF24L01 Device together with the NodeMCU 12e are able to offer, in the use of different types of projects, which require transmission and reception of data at a distance, the projects normally serve different areas , such as health, robotics, automation, providing greater mobility and data readability.

Keywords: NodeMCU12e; NRF24L01+; Arduino; Radio; Transmission.

Generalization of scientific results

Introduction

The motivation for the development of this study was based on personal and professional experience in developing and participating in courses and classes on automation and robotics, in which Arduino devices are used to attend projects involving the Internet of Things or IoT (Internet of Things), needs were identified for the transmission of data at a distance, this being a resource that allows communication between different devices in different locations.

As a general objective, it should be demonstrated the types of devices and their characteristics, as well as, an example application should be presented, which will allow sending the data between the devices, thus allowing an understanding and testing of a basic environment, which may collaborate for future projects, involving a larger environment, considering the different types of environments and devices.

As a specific objective, the communication scheme between the NodeMCU 12e devices in conjunction with the NRF24L01 should be presented, the latter being used for data transmission, a small amount of data should be sent, for example, the programming language should be be the C ++ language used in the Arduino Uno development tool.

These devices were selected because of their low cost and ease of configuration, there being a lot of technical reference, which served as the basis for this study, these devices are also commonly used during the disciplines of robotics, home and business automation, being this is a common need presented in companies, hospitals and residences.

As expected results, it is intended to demonstrate the use of the devices, presenting their main characteristics, as well as a demonstration of construction of a practical application for sending and receiving data, validation of the results analyzing the data that were transmitted, as well as the presentation of the communication scheme between the devices.

Due to the large amount of resources and devices, it is intended to present a basic solution, which meets different types of projects, regardless of their size and configuration, it is hoped that with these results the reader can use this material as a guide for the creation of their projects.

Methods and materials
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It should be used an applied or technical research as explained by Marconi and Lakatos [16] which presents technical characteristics using the specific devices for the internet of things, with the results obtained with the construction and configuration of the devices, it is intended to demonstrate how must be used for communication between a set of devices.

A basic research should be developed, as Marconi and Lakatos explains [16], it is a bibliographical review of subjects that will serve as a basis for the studies, considering as main topics, the studies developed on the Internet of Things, as well as the study of manuals and documents of the devices, besides materials available by the manufacturers, in this way with the knowledge acquired should be applied in the construction of the prototype.

After reading and understanding the construction and configuration of devices, an application for the transmission of data in the C ++ language must be created, together with the Arduino IDE, which will serve as the basis for the construction of the prototype and serve as the object of validation of the results, which are consolidated and presented by the applications that should be used during construction.

The NodeMCU 12e device was chosen because of its low cost, its large storage capacity, and it has higher speed and resources, compared to Arduino Uno as demonstrated in the studies presented by Bento [5] [6] [7] [7] 8], which presents a study with.
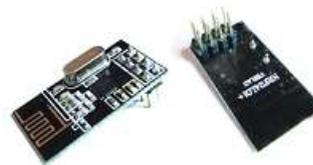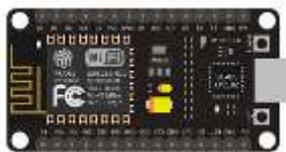
NRF24L01+

NodeMCU
12e

Figure 1: Devices NodeMCU 12e. [26], NRF24L01+ [1].

For the development of the test environment, two sets of devices, two NodeMCU12e and two NRF24L01, to simulate the

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transmission and reception, should be necessary for the two NodeMCU12e devices configured correctly according to the shown.

The connection to the computer for the transfer of code must be done by a micro USB cable, in one of the devices the transmission code must be uploaded and the other device must be uploaded the reception code.
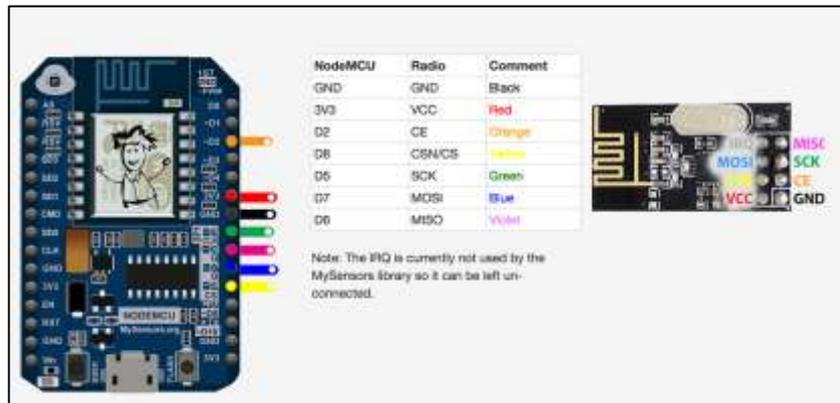

Figure 2: Connection schema with the devices NRF24L01+ X NodeMCU 12e.

With the two sets of devices available, it should be necessary to make the connection using the diagram shown, great care must be taken, especially with the power connections, so as not to damage the devices during use.

After that, it should be necessary to configure the Arduino IDE software, this for the identification of the NodeMCU, configurations of the libraries and connections with the computer, other details that should not be discussed during this study, is the type of computer, as it will depend on the platform that the user uses, for these tests was used a Notebook with Windows 10, version of the IDE of Arduino 1.8.2.
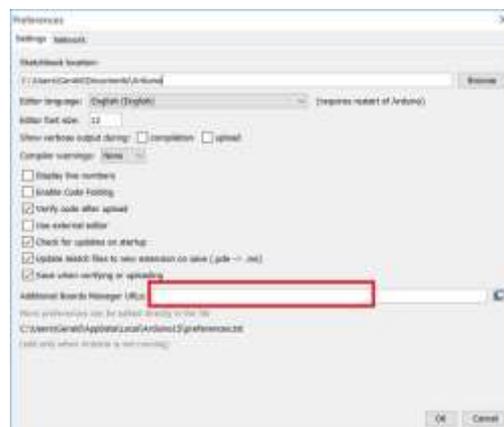

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Figure 3: Propierties screen from Arduino IDE for setup the NodeMCU 12e with the Json address.

In the properties screen shown above, you need to include the address of the NodeMCU library by copying the address:

http://arduino.esp8266.com/stable/package_esp8266com_index.json

After setting the properties of the IDE to the json address, it is necessary to load the libraries of the device, for this it is necessary to go to the library menu and search for ESP8266, then several options should appear in this case it is necessary to select the model ESP8266 Community and click Install, as shown.
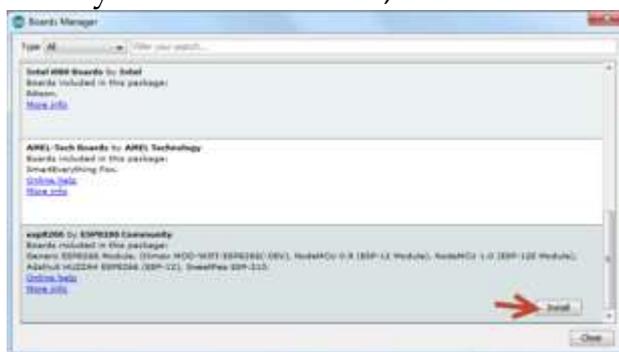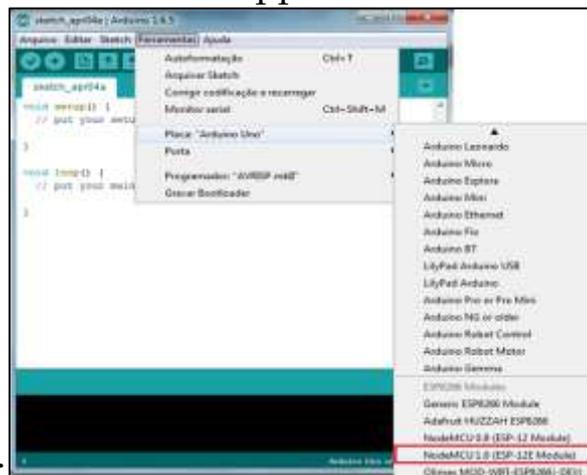

Figure 4: Device for ESP8266 install on the Arduino.

After the correct installation of the libraries is necessary to select the device in the Arduino IDE, it should appear available in the

device menu, as shown below:

Figure 5: Arduino IDE menu selecton for NodeMCU 12e.

After selecting the device, it should be necessary to select the port and communication, in this case it is necessary to note that for each type of computer the port number should be changed, according to availability by the computer, the following is an example.

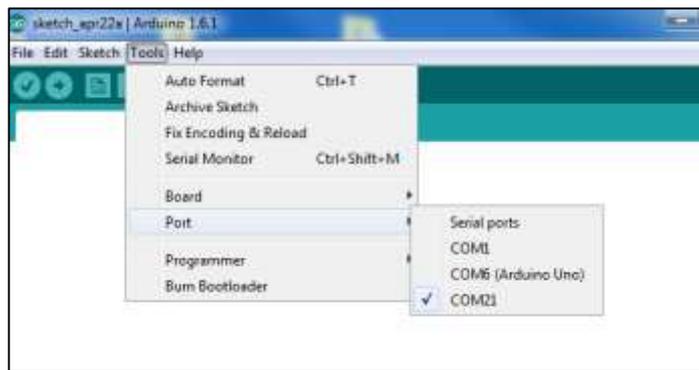**Generalization of scientific results**

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Figure 6: Selection the comm port for the NodeMCU 12e on the Arduino IDE.

With the NodeMCU [19] and NRF24L01 [20] devices configured correctly according to the connection scheme, and with the NodeMCU12e connected with the USB cable, it should be necessary to transfer the transmit code below to the NodeMCU12e, you need to copy the download code below and upload to the NodeMCU, noting if the process will be successful,

How to explain Nedelkovski [18], the code bellow will allow the transfer and receive data from Arduino Uno and NRF24L01, in this case the Arduino Uno was replaced with the NodeMCU 12e, because that is using the Arduino IDE:

Transferring data code:

```
#include <SPI.h>
#include <nRF24L01.h>
#include <RF24.h>
RF24 radio(7, 8); // CE, CSN
const byte address[6] = "00001";
void setup() {
  radio.begin();
  radio.openWritingPipe(address);
  radio.setPALevel(RF24_PA_MIN);
  radio.stopListening();
}
void loop() {
  const char text[] = "Hello";
  radio.write(&text, sizeof(text));
  delay(1000);
}
```

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After uploading the code to the NodeMCu configured with the NRF24L01, it is necessary to upload the reception code to another available NodeMCU12e device, it must also be configured and connected to another NRF24L01, to simulate data reception in this you should also upload the code below.

Receiving data from NodeMCU 12e:

```
#include <SPI.h>
#include <nRF24L01.h>
#include <RF24.h>
RF24 radio(7, 8); // CE, CSN
const byte address[6] = "00001";
void setup() {
  Serial.begin(9600);
  radio.begin();
  radio.openReadingPipe(0, address);
  radio.setPALevel(RF24_PA_MIN);
  radio.startListening();
}
void loop() {
  if (radio.available()) {
    char text[32] = "";
    radio.read(&text, sizeof(text));
    Serial.println(text);
  }
}
```

For more code description details can be found at Nedelkovski [18]:

After the proper configuration and transfer of the codes to the NodeMCU devices, it is necessary to connect the NodeMCU that should be the receiver of the data in the computer and activate the serial monitor of the Arduino IDE, the transmitting device should only be connected by the mini USB cable in a port on the same computer, or another, so that you can follow the transmission.

To display the results, the serial monitor screen is displayed, sending the word Hello, available in the transmitting device code NodeMCU, as previously shown.
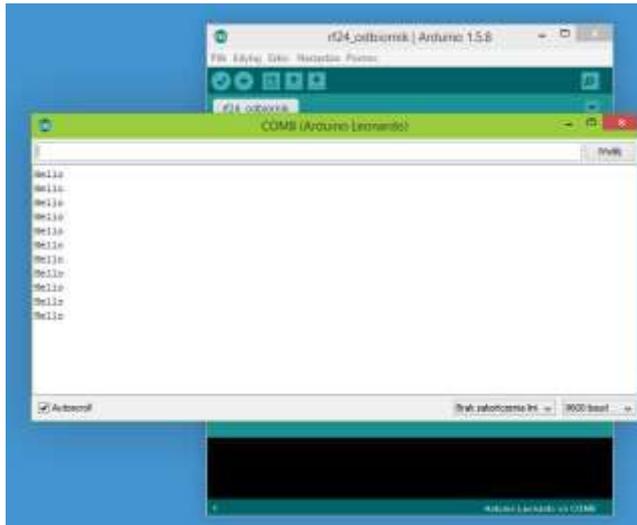
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Figure 7: Arduino IDE serial monitor receiving data with the NRF24L01+ X NodeMCU 12e,.

Conclusions

The results presented validate the transmission and reception of data, using the NodeMCU12e and NRF24L01 + devices, serving as a model to be used in different projects that use the internet of things, the tests demonstrated the viability of the configurations, as well as a viable use for this configuration of devices, with a great use and without problems of use.

An application for this project may involve sending and receiving data on devices such as temperature sensors, heart rate, pressure meters, power overload, alarms, remote control for different types of devices that require control out of range user, in this way these results can be widely used in a very large range of projects.

The use of the NodeMCU12e device, provided greater speed and control over the configurations and data transmission, facilitating the whole process, unlike the Arduino Uno, which despite having a low cost, lacks more advanced features such as memory, speed and processing, although in the development of this project, basic resources were used, without much complexity.

Experience with the Arduino IDE development platform has provided a pleasant and easy installation and development of Internet solutions of Things, so new solutions should be developed to meet more specific projects, which include other devices such as sensors and transmitters .

Although the NodeMCU12e device has internet access capabilities, it has not been used since it is understood that the project

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is local, without the need to send data over a long distance, as for other countries, or even out of the reach of your home town.

Transmission distance tests were performed, which showed that in a closed environment, the range of radio transmission by the NRF24L01 +, was approximately 15 meters, considering obstacles such as walls, furniture, elevators among other installations, this allows to conclude that in floors depending on the position of the receiving device, it is possible to perform a data transmission and reception.

Because there are a large number of code libraries, in addition to solutions created by different users, it was possible to develop a study on more advanced resources, I understand the different projects and solutions developed by other users, who faced different difficulties in their projects, this is a big advantage over the internet model of things.

A major concern has also been identified with the connection of the devices, since a wrong connection, especially those involving the power connections, can damage the devices, this point of the project demanded more attention and care, but nothing that the documentation used do not have as reference and guidance, especially in the manufacturers' documents.

Acknowledgements

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