REVISTA ELECTRO, Vol. 45 pp. 15-20, Oct 2023, Chihuahua, Chih. México
https://itchihuahua.mx/revista_electro
ISSN 1405-2172

DOMOTIC MODEL

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RESUMEN
Actualmente cualquier actividad que no pueda ser realizada mediante herramientas remotas representa una desventaja, competitiva, así como de calidad de vida, parte de lo anterior involucra el nuevo paradigma llamado Inteligencia ambiental (AMI por sus siglas en ingles). Esto aplica también en la automatización de espacios para vivienda. La Domótica consiste en la integración de sistemas presentes en una vivienda capaces de ofrecer al usuario comodidad, gestión energética y versatilidad de control. En este proyecto se muestra la construcción de una maqueta domótica que incluye el desarrollo de una interfaz de usuario en Android y la gestión de sensores y actuadores por Bluetooth con Arduino. Tiene una pantalla LCD16x2 para mostrar la temperatura y humedad de la casa. Un panel de relevadores para control de cargas CC y CA, como: portón, persianas, chapas, aspersores, fuentes, lavadores, luces, etc. o cualquier dispositivo susceptible de controlarlo eléctricamente.
Palabras Clave: Domótica, MIT App inventor 2, Maqueta.

ABSTRACT
Currently, any activity that cannot be carried out using remote tools represents a disadvantage, competitively, as well as in terms of quality-of-life, part of this is the new paradigm called Ambient Intelligence (AMI). This also applies to the automation of housing spaces. Home automation consists of the integration of systems present in a home capable of offering the user comfort, energy management, and control versatility. This project shows the construction of a home automation model, that includes the development of a user interface on Android and the sensors and actuators management by Bluetooth with Arduino. It has a 16x2 LCD screen to show the temperature and humidity of the house. A panel of relays to control DC and AC loads, such as: gate, blinds, plates, sprinklers, fountains, washers, lights, etc. or any device capable of controlling it electrically.
Keywords: Domotics, MIT App Inventor 2, Model.

1. INTRODUCTION

Home automation is a set of systems that allows to automate a home, it comes from the Latin “Domus” which means house and from the Greek word “Tica” which means automatic. It consists of the integration of the various systems or subsystems that are present in any home [1]. The objective is to make available to the user a system that can host a set of systems offering greater comfort and versatility of control. The idea of integration is that, together, these elements interact with each other to achieve a common goal, currently it is considered part of the new paradigm called Ambient Intelligence (AMI) which seeks to empower people’s abilities through digital environments that are sensitive, adaptable and that respond to human needs, habits, gestures and emotions [2].

Home Automation allows sharing the information recorded by all the other subsystems, analyzing them, and generating an action according to certain parameters that can be security, comfort, or energy efficiency. The information on the status of the different systems can be made available to the user through screens or light indicators, it all depends on the level of the implemented system [3].

The user can make the decision to generate different actions through system commands such as closing a certain blind, activating the irrigation system, or turning off lights. Automatically with a previous configuration, the system can execute certain actions if the established parameters are met, such as retracting awnings if the wind is too strong or turning off the lights if there is no human presence in a place in the house.

In the modern world, any activity that cannot be carried out efficiently using remote tools represents a huge disadvantage, both competitively and in terms of quality of life. From this perspective, the automation of spaces and their revitalization with the incorporation of information and telecommunications tools and technologies is more than a frivolous whim, it is an imminent necessity.

There are multiple factors that can characterize the ways of life of people today, for example, older adults who live alone, people with some type of disability and who live independently, even the same vicissitudes of modernity that require everything promptly and save time.

This is how tasks as common as opening or closing a window or a door become a problem; but with the implementation of home automation, the degree of difficulty to perform these tasks decreases [4]. In the current market, there are a large number of very high-level applications on the subject, most of which have high costs and are designed more to generate a luxurious

customer experience than to facilitate the development of a specific activity at people.

The above supposes an intelligent management of the house that are systems capable of automating a residence or building of any type, providing energy management services and responsible consumption, security, well-being, and communication, they can be integrated through internal and external communication networks, wired or wireless, with a control that enjoys a certain ubiquity, from inside and outside the home. It can be defined as the integration of technology in the intelligent design of a closed area [5].

The general objective of this project is to design and build a comfortable and friendly home automation model. Specific objectives include: the management of a user interface software implemented in the Android operating system; the addition of a terminals on control panel, in which you can connect devices to the house's model; sensor reading and actuator actuation managed via Bluetooth with the Arduino microcontroller platform; a 16x2 LCD screen where the temperature and humidity of the house can be displayed.; it should have a relay panel that makes it possible to control actuator devices with direct and alternating voltage loads, such as gates, blinds, plates, sprinklers, fountains, washers, lights and any device that can be manipulated electrically.

2. Domotics

The home automation system can be made up of a specific number of networks, which can be control or communication, can be found inside or outside the facility. Internet access networks that work together to generate greater comfort provide energy management services and communication services [5]. In general, a home automation house has a series of intelligent and autonomous systems that are made up of 3 types of elements [6,7,8,9]:

a) **Sensors** that monitor the environment, record, and send information to the control center.
b) **Home automation controllers** are the units in which all the information collected by the sensors is stored and processed.
c) **Actuators** are the part of the system in charge of executing the orders received from the Home Automation controller.

2.1 Energetic Efficiency

The main advantage of a home automation system is that it can monitor energy consumption and efficiently manage supplies, helping to save energy [4,5]. Energy savings can be achieved in many ways, one of which is to replace inefficient household appliances or appliances with others whose efficiency is improved, but this would imply a high financial cost. Home automation offers tools that allow efficient use of energy resources for housing, whether by consumption of electricity, water, gas, or other fuel. Through energy management, it is possible to save energy and reduce the demand on the system [4,8,10,11,12]. Energy management through home automation allows you to disconnect all those electrical and/or electronic devices whose consumption is high and their non-priority tasks.

2.2 Security

The applications are diverse, as well as in comfort or energy management, ranging from the control of dangerous gases inside the home, or flammable gases, such as gas, which, when there is a leak, the system, once the fact has been detected, is in charge of close the solenoid valve of the gas network, or the solenoid valve of the water network, in the event of a break in the network. Other security elements would be:

a) Access control or alarm.
b) Fire detection.
c) Detection of gas leaks.
d) Detection of water leaks.
e) Avoid electrical overloads [8].

2.3 Confort

Home automation plays a very important role at this point since it has control of the entire property, said control is used mainly to, firstly, make repetitive and routine tasks perform themselves automatically, secondly, program scenes so that the property adapts to the needs of each person.

Comfort is not being able to turn lights on or off, or raise and lower blinds, but being able to do it at any time and from any place, inside or outside the house, simply and easily, and if possible automatically, without losing manual control at no time. Comfort from the point of view of home automation is basically device control [5,8,12] which is divided, to name a few examples, into: lighting control, climate control, opening control, irrigation control , multimedia control, scene generation.

3. METHODOLOGY & MATERIALS

The elements, designs, analysis and simulations of the different subsystems of the home automation model are described in this Section.

3.1 Material

Some of the main electronic components of the home automation system are mentioned next:

a) Arduino UNO
b) LCD 16x2
c) Servomotor
d) LEDs
e) DTH11, Temperature & Humidity sensor
f) 5 to 12 Vdc Fan
g) 12V, 150W Power Supply
h) 4 Relays Board, with 1 NC and NO contact per relay.

Figure 1 shows a 4-relay board that contains 1 normally open contact and another normally closed contact for each relay.

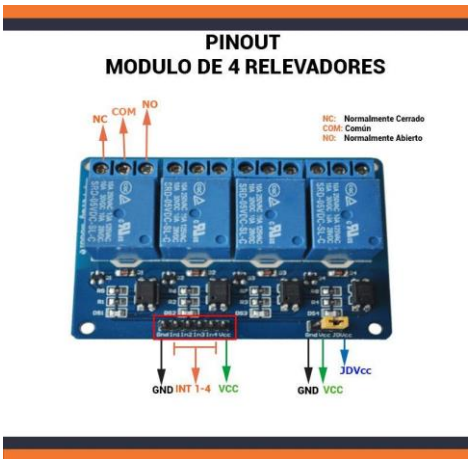

Fig 1. 4-Relays Board.

Other components are shown in Figure 2.

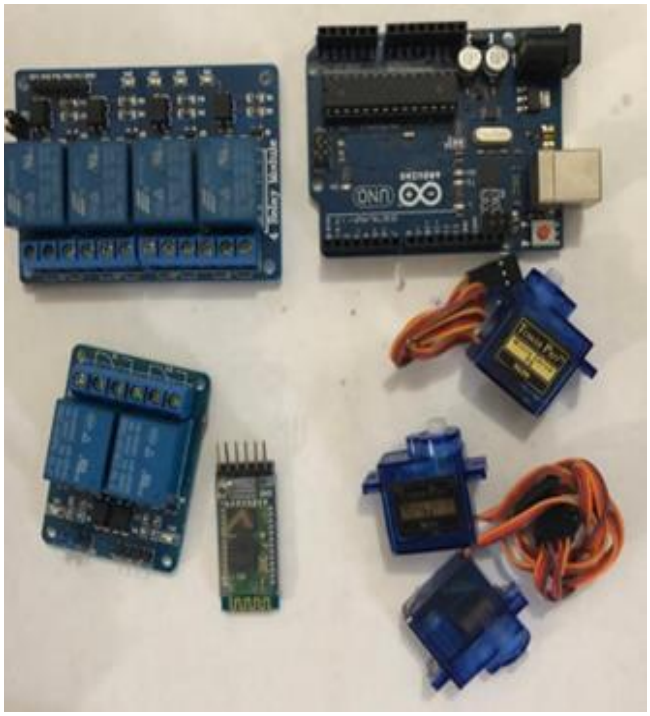

Fig 2. Materials for electronic connections.

3.2 Tinkercad® Simulation

Electrical connection diagrams are made on the Thikercad.com page [13] for programming, simulations and checking the operation of the different home automation subsystems. This provides greater reliability, security and economy in electronic design, before carrying it out physically.

Figure 3 shows the connection diagram of the terminals for simulation in Tinkercad© of servomotors, relays, DC motors, LED lights. Circuits for a DTH11 temperature sensor were also simulated, as well as an LCD screen.

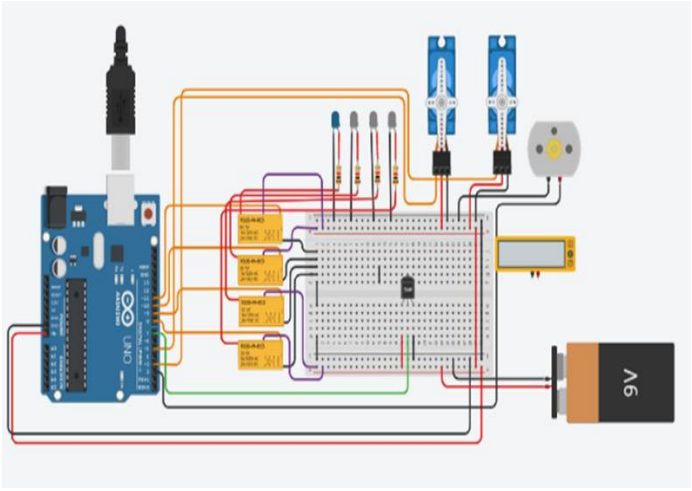

Fig 3. Field diagram for actuators.

Figure 4 shows the Bluetooth connection to the Arduino serial ports in Tinkercad©.

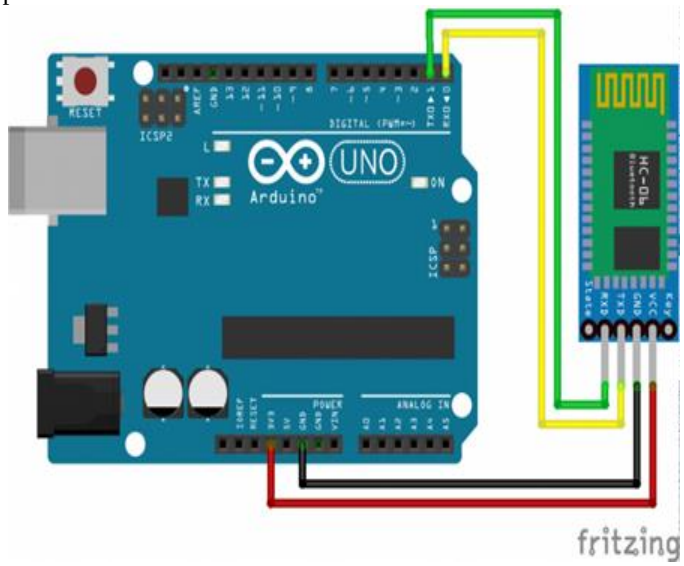

Fig 4. Bluetooth connection.

Figure 5 shows the simulation of the control of an alternating current load by means of Arduino and Relay.

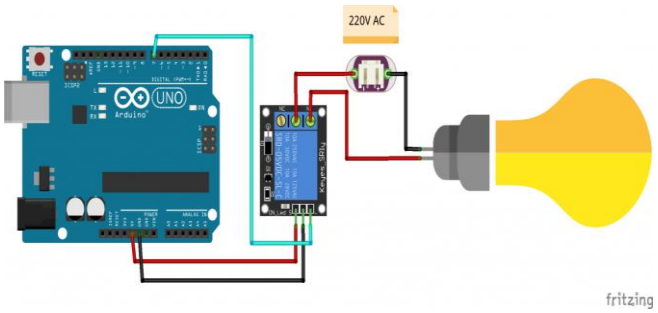

Fig 5. 110VAC load control simulation.

3.3 Relay Box Diagram

A connection diagram is drawn for the external terminals in the control box. This box allows versatility in the connections, since the user can connect the loads he/she wants, with the power supply voltage he needs (Figure 6).

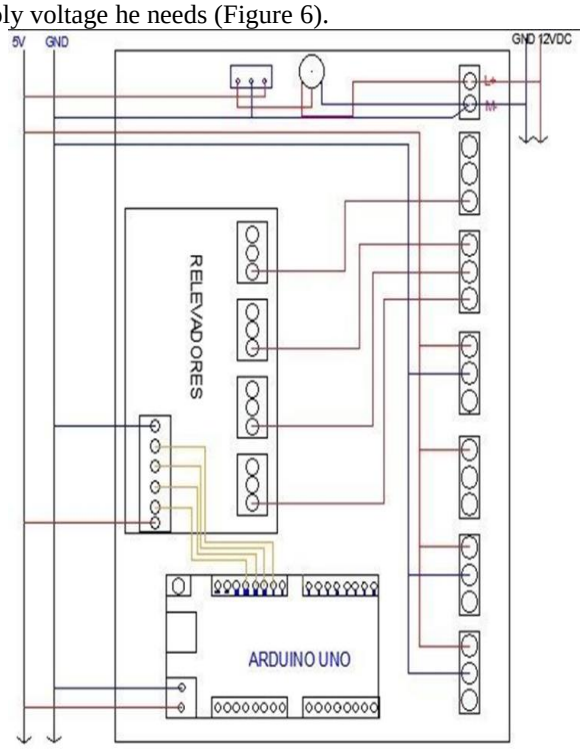

Fig 6. Single line diagram of connections.

3.4 Model

The home automation system needs to be installed somewhere, in a real house it would be quite expensive and laborious. Because of this, it is best to build a mockup that will simplify the demo of the project. To build the model, specific materials and tools are required, as well as great dedication and patience. Figure 7 shows a construction stage of the model.

Fig 7. Installation of lights.

3.5 Wiring Model

The model is wired to be able to connect all the elements of the project such as lights, sensors, motors, etc. This stage of making the model is seen in Figure 8.

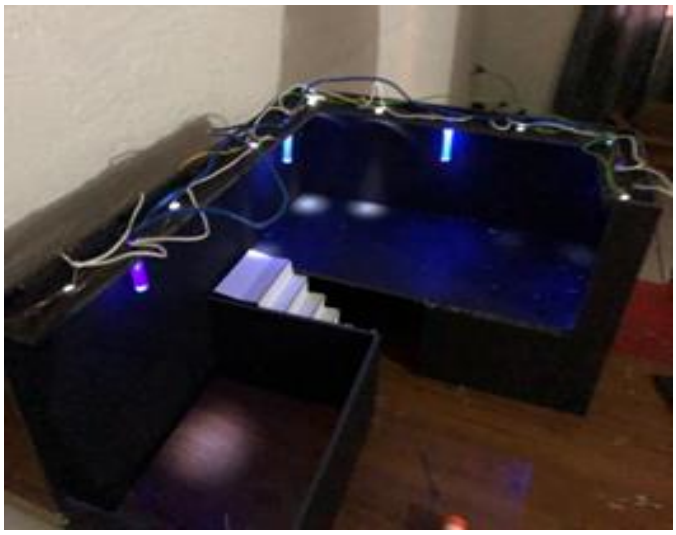

Fig 8. Model with lights on.

4. RESULTS

This section presents the results obtained for the home automation project. Figure 9 shows the control box in which the Arduino controller was installed, the relays, the output terminals. Here, 12 Vdc is fed to the common terminal of the relays.

Fig 9. Installation relays and Arduino to the panel.

Figure 10 shows the finished model with all its elements connected and working.

Fig 10. Finished model.

Figure 11 shows the model at night with its lighting system working.

Fig 11. Finished model, lights on.

Figure 12 shows an LCD screen reporting the temperature and humidity that is obtained from the DTH11 sensor.

Fig 12. Temperature sensor.

As performed by [14], an Android application for cell phones was developed using the MIT App Inventor 2 with Bluetooth software. The App Inventor page was used to provide the application with control via Bluetooth and Arduino.
To get started with the app, you start by creating a new Android project and defining the app name. Then the App is created according to the user. On the left side of the programming IDE the elements that can be added to the mobile screen are shown, in this case only on and off buttons will be used. The main screen of the program is built, and parameters are defined for each element. The Bluetooth client interface is added to make the connection with the physical Arduino [15]. Part of this process can be seen in Figure 13.

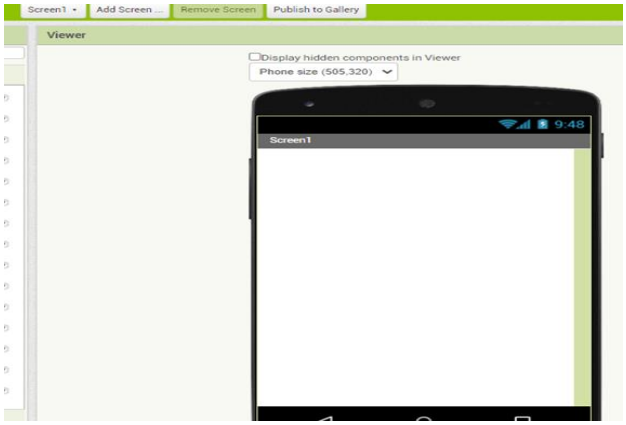

Fig 13. Declaration of the buttons.

On the left side of the online application, you can choose the statements or conditionals that are used, as well as the messages that are used for Bluetooth transmission. Figure 14.

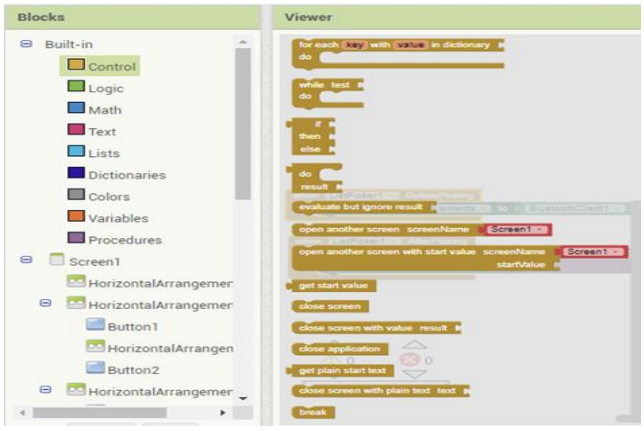

Fig. 14 *Conditionals.*

Different types of messages can also be sent to the Arduino. Figure 15 shows this option in the development software.

Fig 15. Type of message sent to the Arduino.

Figure 16 shows the block programming used.

Fig 16. Block programming.

Each of the buttons is programmed using letters, which will be received by the Arduino via Bluetooth (Figure 17).

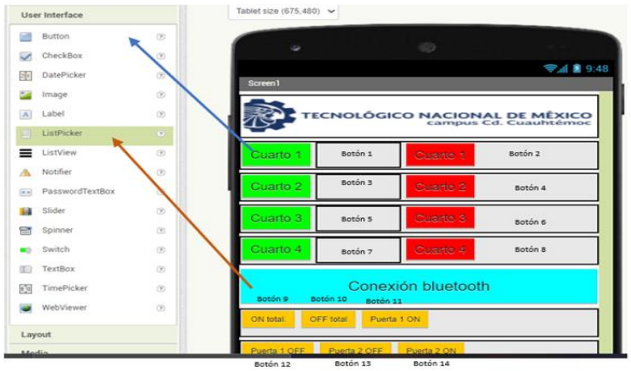

Fig 17. Button statement.

5. CONCLUSIONS

It was possible to meet the general and specific objectives planned for the home automation project. A home automation model was designed and built, with elements such as lights, doors, etc., that constitute it. The model can be controlled through the comfort of a cell phone application and Bluetooth communication. Environmental variables such as humidity and temperature can be displayed, the latter one can be controlled by a fan. There is a panel with relays and connection to external terminals for alternating current loads. Home automation involves a significant investment, but it pays off in comfort and security of a home.

Acknowledgments

The authors are grateful to the TecNM/Instituto Tecnológico de Cd. Cuauhtémoc for the support for this research.

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