Home Automation System

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English Version 1.0

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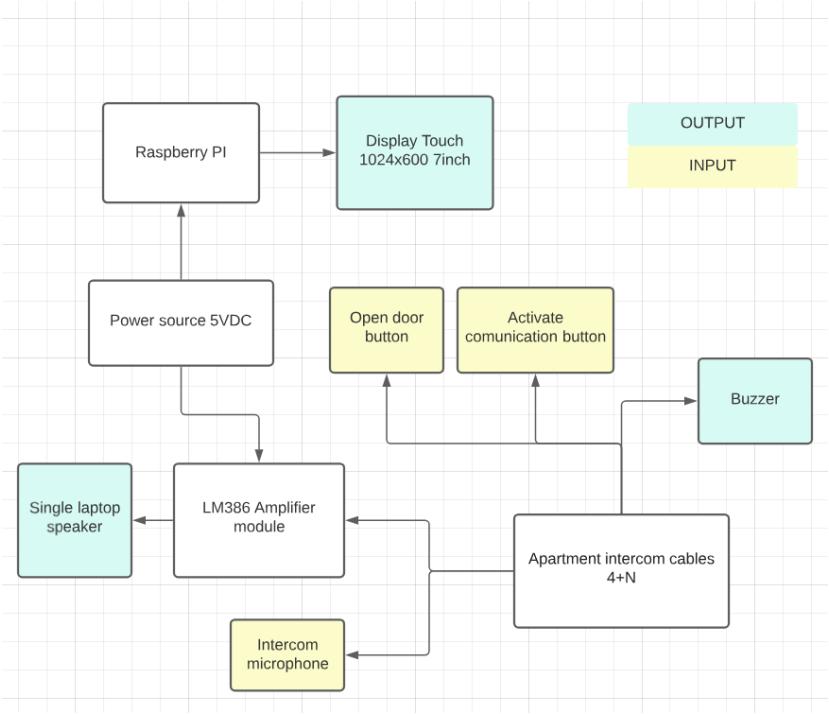
1 Introduction

The home automation system illustrated in this project is designed as a replacement for the current entire electrical system of my home: the system is currently composed of a common 220VAC electrical system equipped with circuit breakers located in the electrical panel, switches and buttons for the lights and electrical sockets scattered around the house, shutters with electric motors and nothing else in particular.

The main idea is to create a system with features that improve the ease of use of home devices and increase the interfacing capabilities with the system via smartphones, sensors, NFC key chains etc.

The center of the system will be composed of a Raspberry board which allows high level interfacing with web applications via more common devices, such as smartphones or computers, connected to the local network and an Arduino board which will directly access the devices in the home, respond to the input devices and will carry out control on the output devices; the two boards will have to communicate to make the necessary changes to the system state in response to high-level inputs on Raspberry and to update the information regarding the system state in response to low-level inputs on Arduino.

2 Control Panel



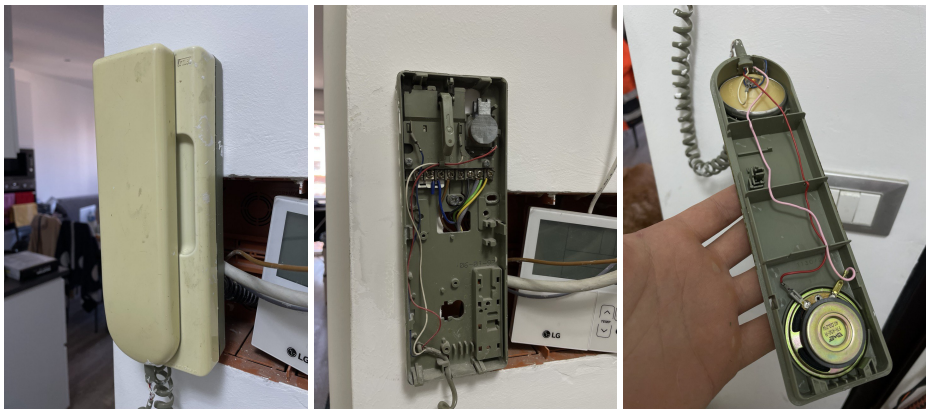
- Conceptual diagram of the control panel

- Final result

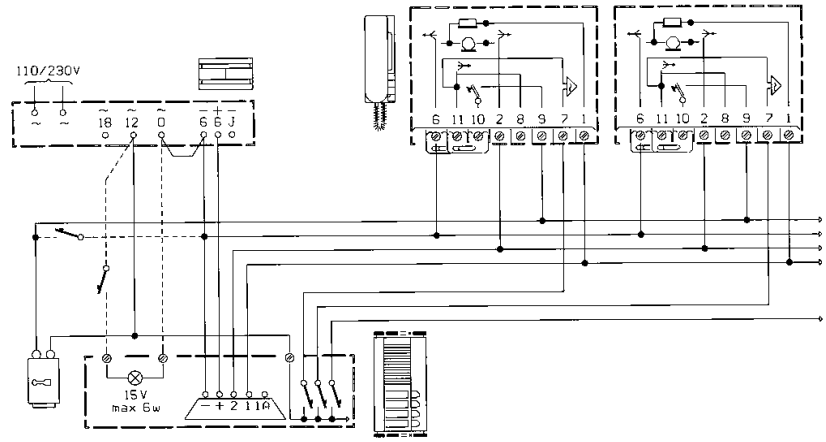
The control panel is a physical part of the home automation system with the functionality of an access point to the system and allows you to obtain information about the home and modify its current state.
To achieve these features, an easy-to-use touchscreen display is used connected to the Raspberry board.

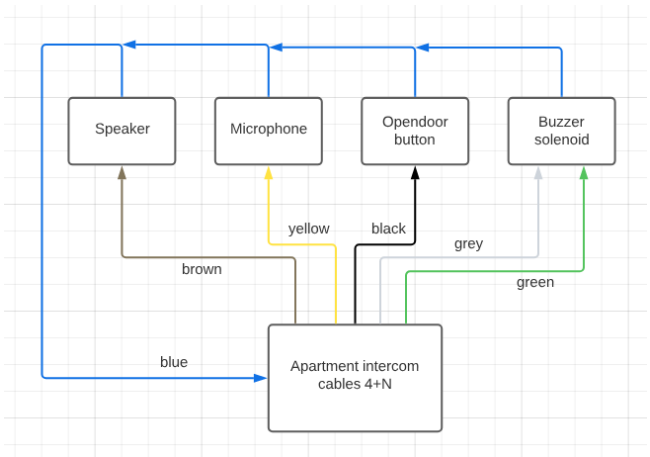
2.1 Intercom

An important functionality of this panel is to integrate within it the components necessary to entirely replace a domestic intercom as the latter is extremely dated and of low quality.
To replace the intercom it is necessary to document and analyze the device currently in use, Urmet 1130/1 intercom; From studying this, various information can be obtained: the intercom system of the condominium operates at 12VAC for opening the door and for activating the buzzer (bell) of the apartment, the communication is of the full-duplex type and the intercom itself is connected to a group of 5 cables different in color and functionality.



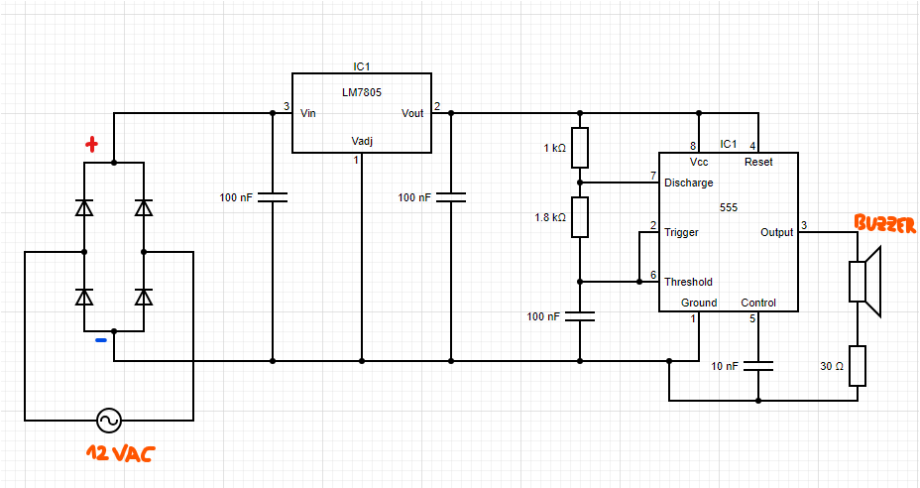
- Urmet 1130/1 intercom and internal wiring



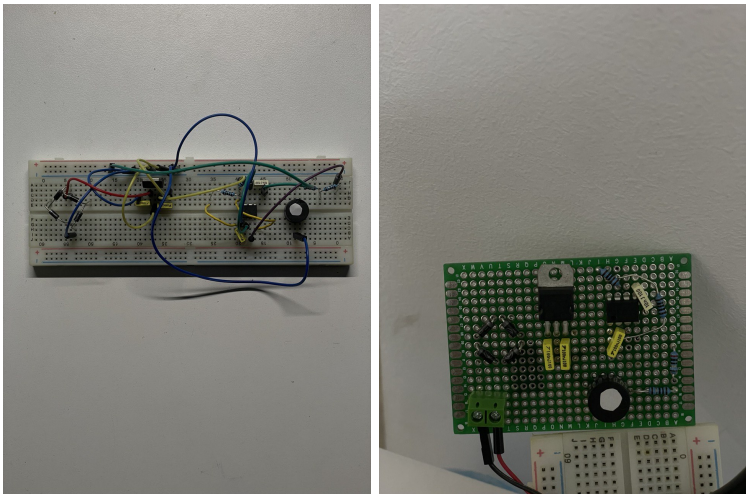


- Intercom system diagram of the condominium and simplified diagram of the previous intercom

The replacement for the current intercom will be different in terms of functionality, in fact it will allow you to listen to the user on the other side in hands-free mode or with an amplified speaker so you don't need to get close to the speaker to hear well.
The new components of the intercom include the same microphone as the handset (as it is of sufficient quality), a speaker with LM386 amplifier module, a steel button to replace the door opener button, a steel switch to activate/deactivate communication with the other side and a specially created circuit to replace the buzzer (doorbell). We also introduce a power supply that converts 220VAC into 5V 3A Max which will have a much more important role later and will be described better later but at the moment it is limited to supplying 5V to the LM386 audio amplifier module.
The buzzer replacement circuit has the functionality of a better quality buzzer and to achieve this it initially rectifies the incoming 12VAC with 4 1N4001 diodes in rectifier bridge, steps down the 12VDC DC voltage to 5VDC with an LM7805 voltage regulator and supplies it to a NE555 circuit to build a 3.1kHz square wave to give to an EK2146 buzzer that works with frequencies between 2.5kHz and 4.5kHz.

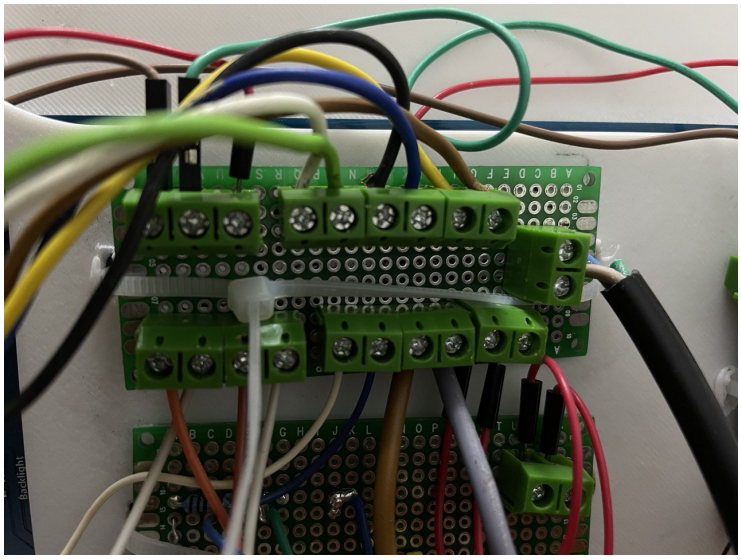


- Circuit diagram of the new buzzer



- Prototype of the buzzer circuit and circuit soldered onto the board

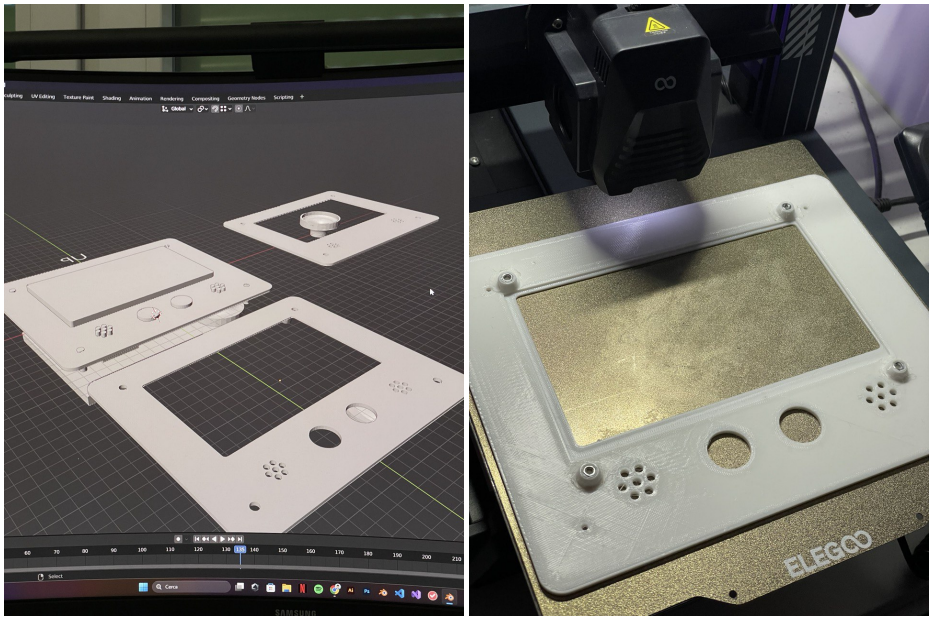
To connect all the components together (button, switch, new buzzer, speaker, microphone, power supply) you need a board with several screw terminal blocks; a circuit specially designed to accommodate the intercom system cables entering the apartment on one side and the power supply and control panel cables on the other.



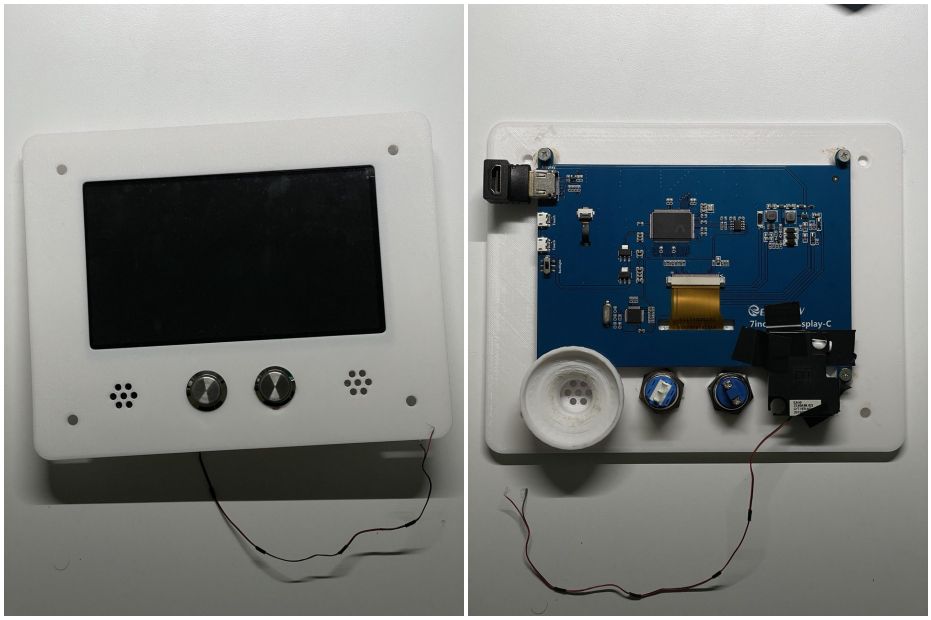
- Board with terminal blocks to connect the various cables

2.2 Circuitry accommodation

Once the components have been defined and operation has been verified with a test (connecting the system to the intercom system), a place must be created for this circuitry: the original cover of the junction box provides the measurements to create a new piece equipped with 3D printing Precisely measured openings for the various button, switch, screen, speaker and microphone.
The 3D object is designed with Blender3D by carefully measuring the various components and taking into account all the factors during the subsequent 3D printing phase and a first prototype is created to be printed to evaluate the reliability of the sketch and the possible corrections to be introduced, including the factors to be evaluated certainly take into account the errors during measurement, the overall dimensions and the structural characteristics (too thin and fragile / too thick and bulky).



- Digital 3D model on Blender3D and first print



- First test with the components inserted (front/rear)

2.3 Conclusions

Checking the functionality of the panel confirms perfect functioning even for the screen which is not yet connected to the Raspberry board; Subtle changes are now made to the 3D model of the circuitry housing and new prints are made in order to have everything positioned perfectly and be able to seal the panel inside the wall.

- Final tests of operation and closing of the panel in the wall

The next step is now the project of the electrical system in which the Arduino and Raspberry boards will be introduced and which can be accessed via the display of this control panel.