

# Integration of Asterisk IP-PBX with ESP32 Embedded System for Remote Code Execution <sup>†</sup>

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**Abstract:** This paper explains the design and construction of a platform that implements the ESP32 embedded system and connects it to a telephone asterisk plant, to exchange data on both sides, commands sent from a telephone to the esp32 and make calls from an order of sending from a digital input of esp32. It is a low-cost device that can be implemented through the use of Wi-Fi, and as a use in the industry, it has a role in analogue communication in buildings, for example.

**Keywords:** sensors; wireless fidelity; internet of things; microcontrollers; ESP32; embedded systems

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## 1. Introduction

Internet of Things is a concept based on the connection of electronic devices with each other or through the Internet, which has been generating expectation for years as it is expected to be a great driver of digital transformation in homes and cities, as well as in companies. IP telephony has taken a central role in the information highway so that the network can interconnect each home and each business through a packet switching network [1,2].

In this work, the Asterisk pbx was used based on the Issabel Linux distribution, which allowed to create dial plans to receive calls from the users and through an IVR to make a POST request to the ESP32 platform, which within its code has established methods that for investigation, allowed to move a servo motor and turn on led lights. Since the communication was bidirectional, from the side of the ESP32, push buttons were connected, which when pushed, sent commands to the code execution esp32, within this code a POST is made to a site ready to listen to POST requests in the Apache server that runs ISSABEL, this web service, performs an internal code execution through Asterisk and allows to raise telephone calls using Festival as a voice dictation service [3].

The connectivity technology used was Wi-Fi, the possibilities that this work opens up for a real application are several, among them the use of esp32 technology to connect with IP-PBX inside buildings, an additional infrastructure different from the IP will not be necessary.

## 2. Materials and Methods

1. Operating System Linux Issabel [4].
2. Dev Kit ESP32 by espressif
3. Softphone IP PhonerLite
4. Oracle VM VirtualBox [5].

### 3. Experimental Work and Results

A Wi-Fi connection was configured that was common to the three components of the work, the SERVER IP-PBX, the SOFTPHONE client and the ESP32 see Figure 1a, the SERVER IP-PBX works as a bridge in the communication between the ESP32 and the users that use a softphone, although it can be a hardphone too, said server receives POST requests through a web form Figure 1b.

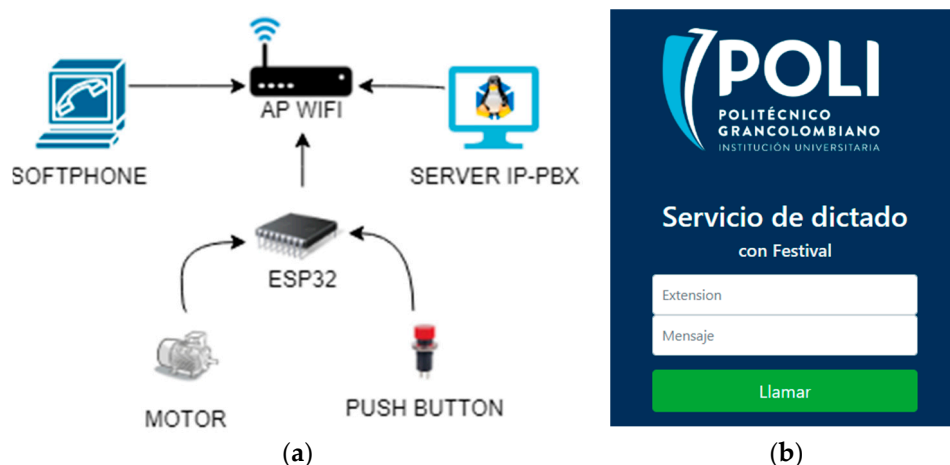


Figure 1. (a) Device topology; (b) web form.

The received web requests are interpreted in bash language and make a PORT request through curl in Linux, to send the POST request again to ESP32 and this perform an action like opening a garage, which can be seen implemented in Figure 2.

Also in Figure 2, you can see two buttons, which allow interacting from the esp32 to the SERVER-PBX, making automatic calls, which use the voice dictation of the service included in Issabel called Festival, which is a Text To Speech, and was given a use for example to warn if someone is pressing the P or G button.

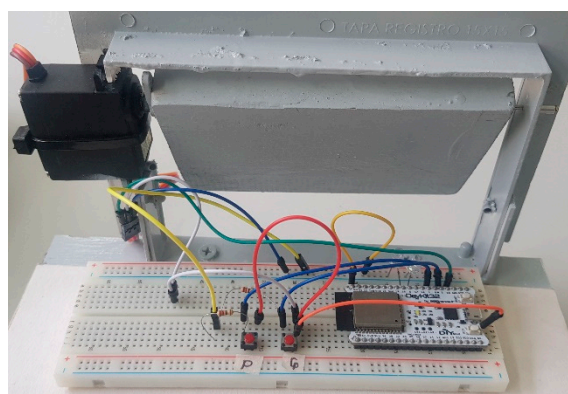


Figure 2. Implementation of ESP32 with servo motor.

The implementation of the work allows the use of this connection architecture in a real case such as analogue cytophony, which can be replaced in its common point by an esp32 and in the end users by ip telephony, allowing to obtain greater benefits such as interacting with actions to be executed remotely and not only the voice.

**Author Contributions:** All work was done by J.P.B.L.

**Conflicts of Interest:** The author declares no conflict of interests.

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