SRI VENKATESWARA COLLEGE OF ENGINEERING &TECHNOLOGY

(Autonomous)

Applied Industrial IoT

Wi-Fi Range Extender using Raspberry Pi

ABSTRACT:

In today's modern life, wireless access to the internet is in many cases a necessity. The purpose of the overall project was to design and build a smart mobile repeater. And how to create a portable Access Point with Wi-Fi repeater capabilities. The repeater will navigate an environment in search of the signal strength from a distant router. After it sufficiently acquires a high-level signal, it will act as a relay so that other computers may connect to the router through it. A Raspberry Pi WIFI Extender is a cheap and power efficient way of increasing the total range of your WIFI Network. A WIFI extender differs a fair bit from a WIFI access point. The main difference being that instead of getting its network connection from Ethernet, it instead gets its network

connection from a WIFI adapter. For this reason, to complete this tutorial you will require two WIFI adapters, one of these must be access point capable. You will face a fair bit of degradation in the speed of your network connection when connecting to the WIFI repeater. The main reason for this is that you must wait for the traffic to go over your initial Wi-Fi connection then be repeated from your Raspberry Pi for devices to connect to.

INTRODUCTION:

The wireless access point connects mobile phones or computers in places that do not reach the Internet signal or are weak instead of using wires and cables. In this project we will look for how to design a wireless access point that helps to distribute the Internet and expand the signal range and support the wireless

Internet at home or Business offices or cafes. An extender (Wi-Fi range extender) is a device that takes the radio signal of an access point (AP) of Wi-Fi and rebroadcasts it to create a new group of Extended Service Set Identifier. It is useful for extending the range of an AP to where the wired network cannot reach since installation of AP needs both commercial power supply and the wired network line to serve as the last mile of the Internet. Based on our preliminary experiments, although the extender itself offers slower connection compared to the original AP, it could offer more stable connection at hard-to-reach places. One of the significant factors that affect the internet speed is where the extender is set. Therefore, we investigated extender usage based on the correlation between distance, Received Signal Strength Indicator (RSSI), and the speed of the connection. Through our control experiment for the extender usage, we found that just placing an extender might degrade the performance compared to the direct association to an AP in the service area in the AP

APPLICATIONS:

1.on-line games.

2. virtual reality.

3. high-quality video contents.

4.low latency.

APPARATUS

1. **Raspberry Pi** (any model with Wi-Fi capability, such as Raspberry Pi 3, 4, or Raspberry Pi Zero W)
2. **MicroSD Card** (with Raspberry Pi OS installed)
3. **Power Supply** for the Raspberry Pi
4. **Keyboard, Mouse, and Monitor** (for setup)

5.**Internet Connection**

WIRELESS NETWORKS:

Wireless Communication is a method of transmitting information from one point to other, without using any connection like wires, cables or any physical medium. Generally, in a communication system, information is transmitted from transmitter to receiver that are placed over a limited distance. With the help of Wireless Communication, the transmitter and receiver can be placed anywhere between few meters (like a T.V. Remote Control) to few thousand kilometres (Satellite Communication). A wireless network enables people to communicate and access applications and information without wires. This provides freedom of movement and the ability to extend applications to different parts of a building, city, or nearly anywhere in the world. Many types of wireless communication systems exist, but a distinguishing attribute of a wireless network is that communication takes

place between computer devices. These devices include personal digital assistants (PDAs), laptops, personal computers (PCs), servers, and printers.

WI-FI EXTENDERS:

with any Wi-Fi devices, such that one or multiple re-layers can be installed in any network easily without any modification to the AP or the nodes. L2Relay is a layer-2 solution that exploits many layers 2 functional it is such as carrier sense. It encompasses unique solutions to link quality measurement, rate adaptation, and re-layer selection.

CHANNEL LOAD AP:

In presence of multiple AP/Extenders, a new challenge appears: how to determine the best AP/Extender for each given STA. According to the default Wi-Fi AP selection mechanism, an STA that receives beacons from several AP/Extenders will initiate the association process with the AP/Extender with

the highest received signal strength indicator (RSSI) value. Though simple and easy to implement, this mechanism omits any influence of traffic load and, consequently, can lead to network congestion and low throughput in scenarios with a high number of STAs. Although multiple effective strategies have been proposed in the literature, most of them lack the prospect of real implementation, as they require changes in the existing IEEE 802.11 standards and/or in STAs wireless cards

FULL DUPLEX RELAYS:

An existing Wi-Fi network is a common solution when wireless coverage extension is required in the absence of a connection to the backbone network. Half duplex (HD) Wi-Fi relays employ two different frequencies, time slots, or orthogonal spreading codes to prevent the transmitted signal from interfering with its own receiver. In contrast full-duplex relays (FDR) utilize wireless resources more efficiently by transmitting and receiving simultaneously on the same frequency band, creating the potential of doubling the system

throughput, when compared to their Half Duplex (HD) counter parts [1]. Although FDR has higher transmission efficiency, it suffers from Self Interference (SI) since the transmitted signal by the FDR is received as an in-band blocker by its own receiver.

AP/EXTENDER SELECTION MECHANISMS:

A review of the currently existing AP/Extender selection mechanisms along with the description of the Wi-Fi scanning modes that enable them are explained as follows. Wi-Fi scanning modes in the IEEE 802.11 standard defines two different scanning modes: passive and active [16]. In passive scanning, for each available radio channel, the STA listens to beacons sent by APs for a dwell time. As be cons are usually broadcast by the AP every 100 MS, channel dwell time is typically set to 100- 200 MS to guarantee beacon reception [17], [18]. In active scanning, the STA starts broadcasting a probe request frame on one channel and sets a probe timer. If no probe response is received before the probe timer reaches Min Channel Time, the STA assumes that no AP is working

in that channel and scans another channel alternatively. Otherwise, if the STA does receive a probe response, it will further wait for responses from other working APs until Max Channel Time is reached by the probe timer. Min Channel Time and Max Channel Time values are vendor-specific, as they are not specified by the IEEE 802.11 standard. Indeed, using optimum values to minimize the active scanning phase have attracted research attention. In [18], for instance, the author sets these values as low as 6-7 MS and 10-15 MS, respectively. In addition, these two solutions also integrate the IEEE 802.11k/v amendments but only to provide faster and seamless roaming.

COMPUTER AND MICROCOMPUTER:

A Microcomputer is a type of computers is an integrated system of computer components capable of a wide variety of applications (general purposes) Microprocessor at the heart of the system • Data storage ICs RAM, ROM •

Mass storage elements External Drives, Hard Drives, … • Standard I/O devices monitor, keyboard, mouse, printer, …

RASBERRY PI:

Raspberry Pi is a series of small, single-board computers developed to teach computer science basics to school students and other people in low-income countries. It became a popular and easy to experiment tool to develop school projects, hardware programming, robotics, basic automated machines, circuits, etc. The Uses of Raspberry Pi is a small, quite affordable, and very much capable hardware device called a credit card size computer.

MODELING AND ANALYSIS:

Here are all the parts and pieces we used for the Raspberry Pi Wi-Fi Extender research project, we will need 2 Wi-Fi dongles to be able to complete this research, to work as an access point, a Raspberry Pi 3, a Micro SD card, a 5V2A power supply, a router, Raspberry Pi Case.

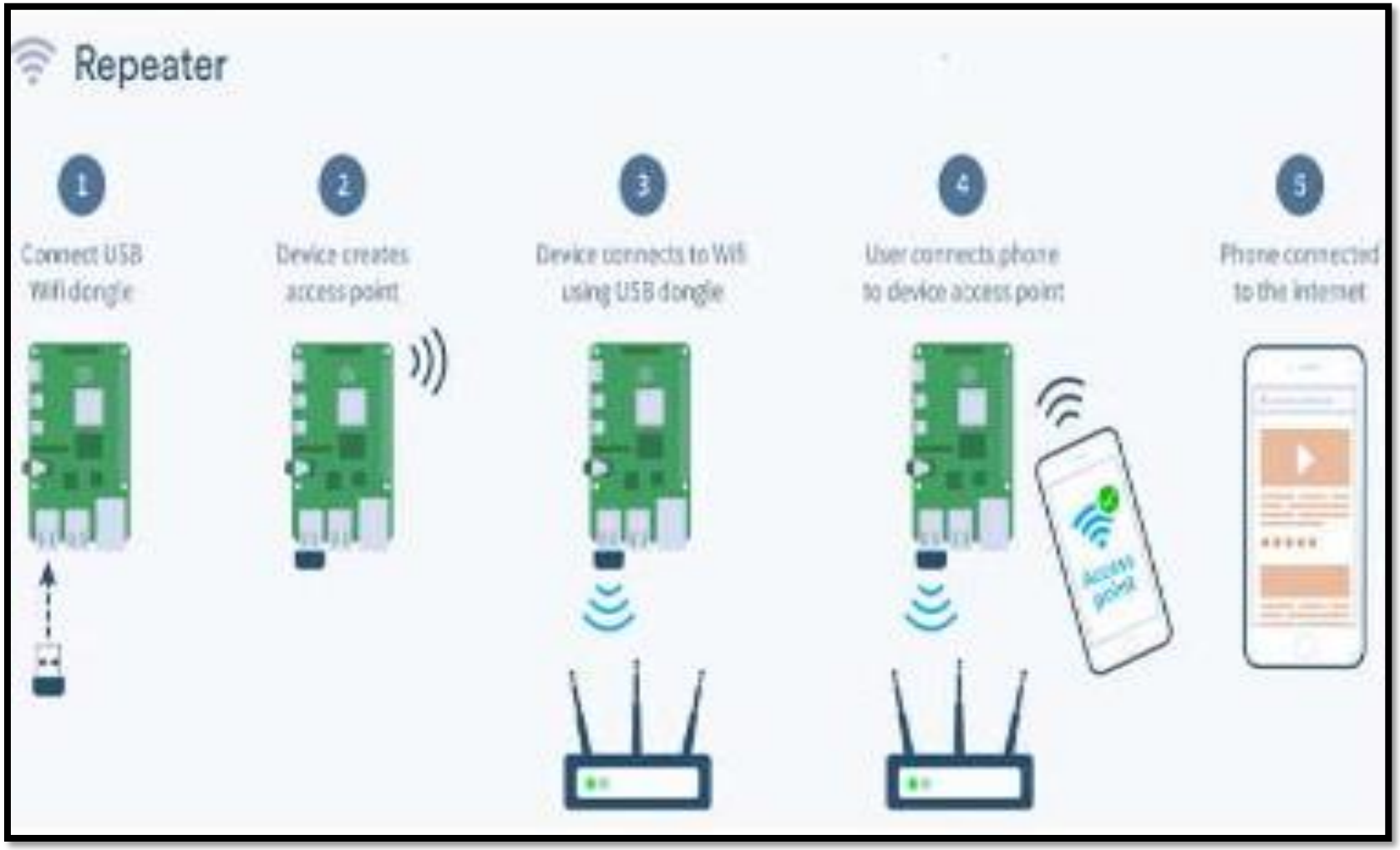
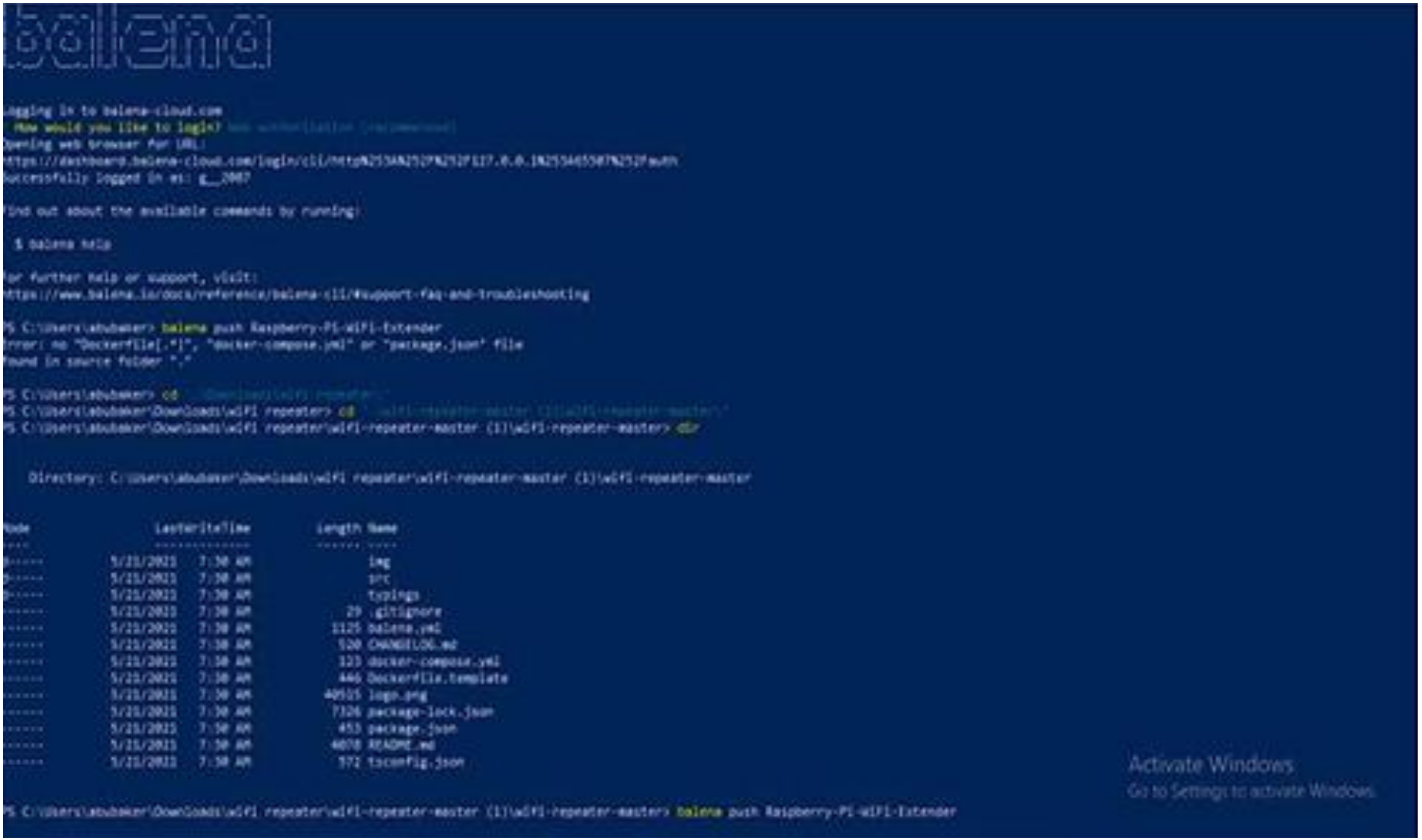


Figure 1: Sample Raspberry pi WIFI extender.

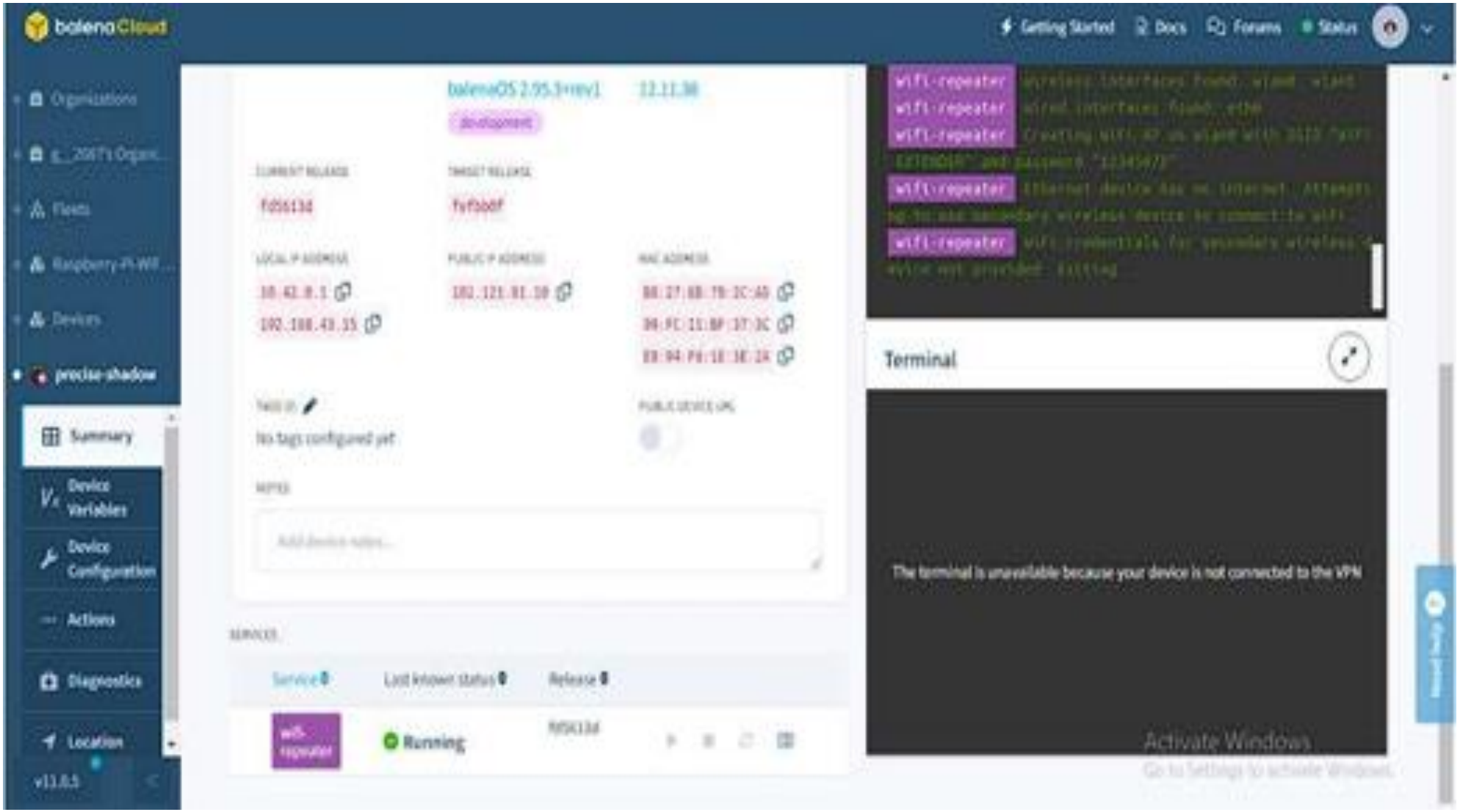
Figure 2: Hardware Elements.

Hardware Elements

RESULTS AND DISCUSSION



The design of the circuit combined by the software and Hardware. The software includes balena program loaded to the Raspberry pi board that embedded in the hardware design and setting up WIFI extender protocols.



CODE OF SOLUTION:

1. Install necessary packages:
   sudo apt update
   sudo apt install hostapd dnsmasq
   sudo systemctl stop hostapd
   sudo systemctl stop dnsmasq

2. **Configure a Static IP for wlan0**: Edit the DHCP client configuration file:
   sudo nano / etc / dhcpcd.conf

Add the following lines at the end:

interface wlan0

static ip_address=192.168.4.1/24

nohook wpa_supplicant

3. configure ‘dnsmasq’:

Backup and edit the ‘dnsmasq’ configuration file:

sudo mv/etc/dnsmasq.conf/etc/dnsmasq.conf.orig

sudo nano /etc/dnsmasq.conf

Add the following:
interface=wlan0
dhcp-range=192.168.4.2,192.168.4.20,255.255.255.0,24h

4. Configure ‘hostapd’:

Create and edit the ‘hostapd’ configuration file:

sudo nano /etc/hostapd/hostapd.conf

Add the following (replace ‘YourSSID’ and ‘YourPassword’):

interface=wlan0

driver=nl80211

ssid=YourSSID

hw_mode=g

channel=7

wmm_enabled=0

macaddr_acl=0

auth_algs=1

ignore_broadcast_ssid=0

wpa=2

wpa_passphrase=YourPassword

wpa_key_mgmt=WPA-PSK

wpa_pairwise=TKIP

rsn_pairwise=CCMP

5. **Enable and Start the Services**:

```
sudo systemctl unmask hostapd
sudo systemctl enable hostapd
sudo systemctl start hostapd
sudo systemctl restart dnsmasq
```

6. **Enable IP Forwarding**:

sudo nano /etc/sysctl.conf

Uncomment the line net.ipv4.ip_forward=1 and save.

To apply the change, run:

sudo sysctl -p

7. **Set Up NAT**:

sudo iptables -t nat -A POSTROUTING -o eth0 -j MASQUERADE

sudo sh -c "iptables-save > /etc/iptables.ipv4.nat”

8.Configure’dhcpcd’:

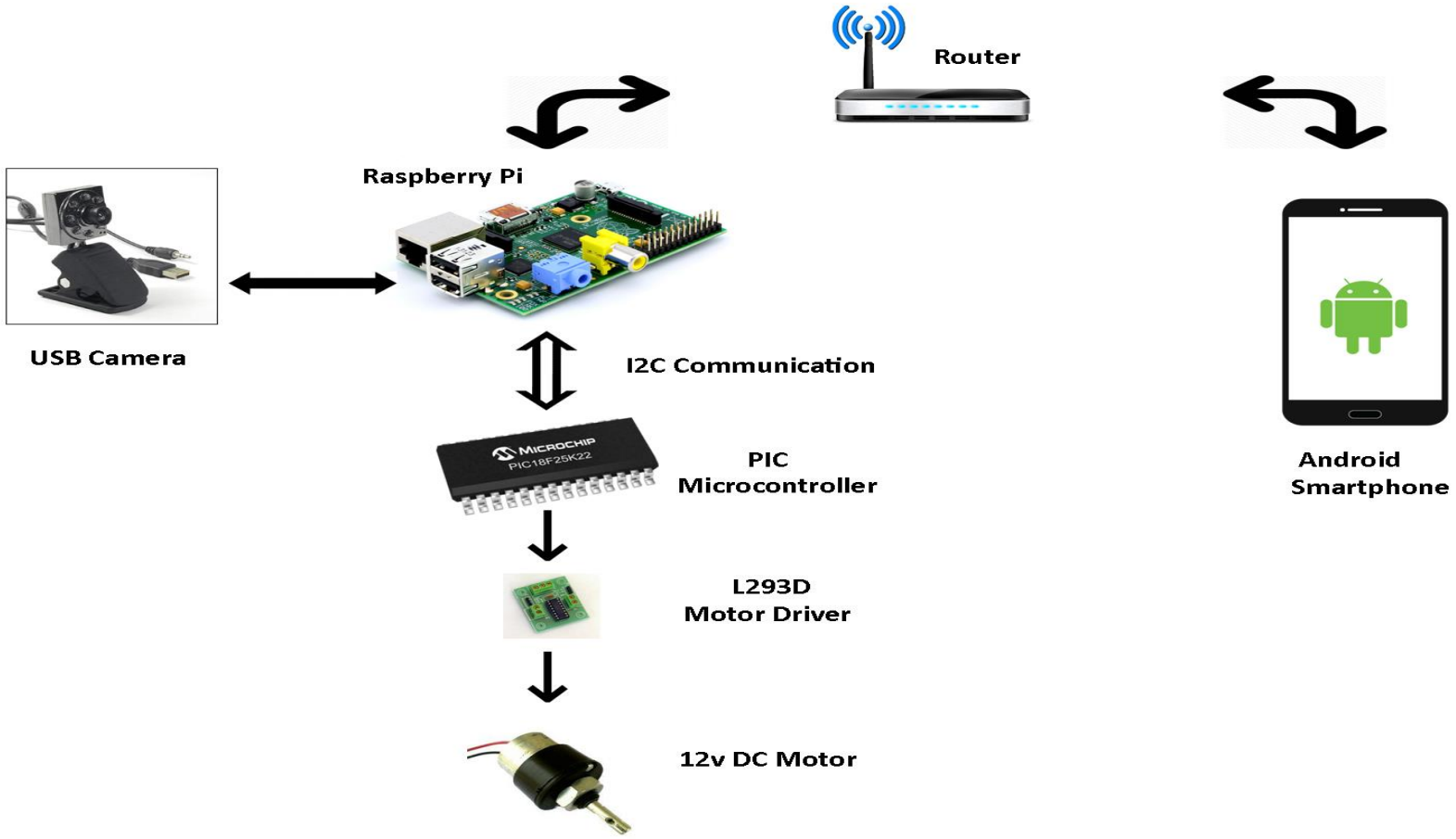
Edit the ‘dhcpcd’ configuration file again:

sudo nano /etc/dhcpcd.conf

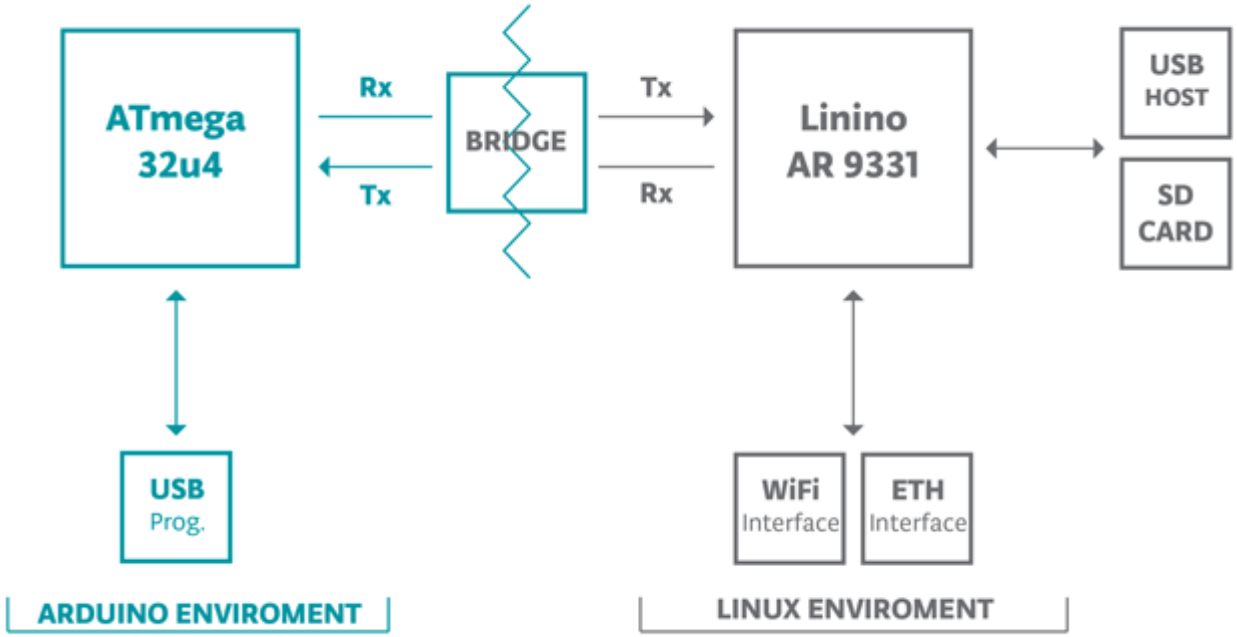
Add:

denyinterfaces wlan0

BLOCK DIAGRAM:


Router
Raspberry Pi
USB Camera
I2C Communication
MICROCHIP
PIC18F25K22
PIC
Microcontroller
L293D
Motor Driver
12v DC Motor
Android
Smartphone

GERBER FILE:



HARDWARE DEMO:

https://drive.google.com/file/d/1R5S3GGTiM1sdAqL54wXd4kddrZQNP83B/view?usp=drivesdk

SOURE LINK:

CONCLUSION:

Navigating through the various networking devices can be a daunting task at first. Most of the devices you see in the networking field look similar but perform differently. Each device has its own personal function which can range from necessary to make your network work to a device that acts more like an accessory to your network. One of these devices which can help your network is a wireless repeater. Making the decision to use a wireless repeater can come to a couple different reasons. Mostly importantly is that you are looking to increase range in your network. Maybe the network signal just isn't strong enough in your home or office. Some of the things that can be improved using a wireless repeater is extending that network to places that are lacking

signal strength, have many users on the same network or you even want some access outside. Wi-Fi repeater dis really just a quick fix to a lack luster network signal that can't be reached via hard wiring.