MECHATRONICS AND ROBOTICS

Wireless Communication

LECT- 16:-

Wi-Fi

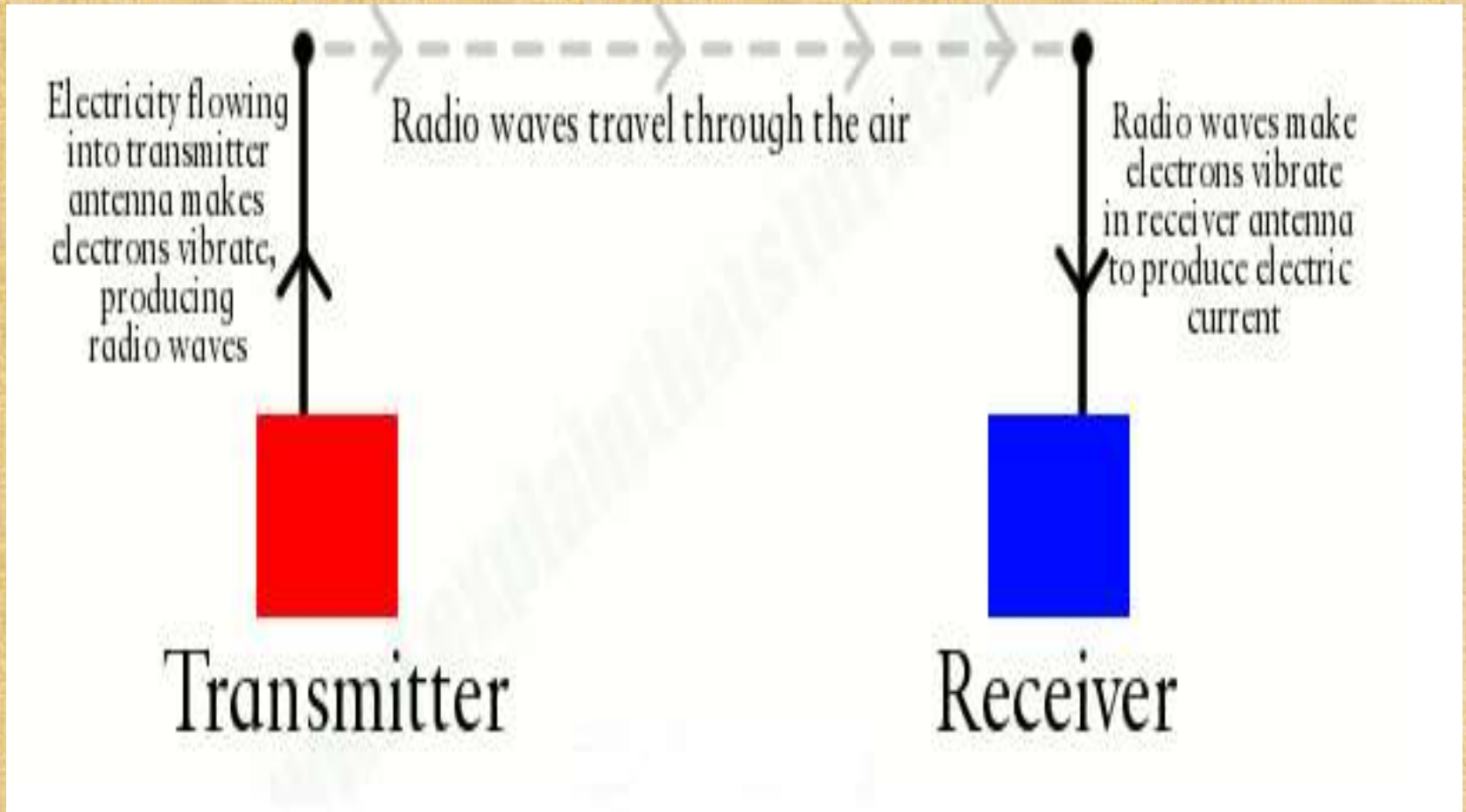# Wireless Communication LECT- 16:- Wi-Fi

MECHATRONICS AND ROBOTICS

SECTION 2

TOPIC:- Wireless communication

Wi-Fi features, working, interfacing and programming with Arduino

From radio to Wi-Fi

Electricity flowing into transmitter antenna makes electrons vibrate, producing radio waves

Radio waves travel through the air

Radio waves make electrons vibrate in receiver antenna to produce electric current

Transmitter

Receiver

From radio to Wi-Fi

➢Radio is an invisible game of throw-and-catch. Instead of throwing a ball from one person to another, you send information, coded as a pattern of electricity and magnetism, from a transmitter (the thrower) to a receiver (the catcher)—both of which are kinds of antennas.

➢The transmitter is a piece of equipment that turns electrical signals (such as the sound of someone speaking, in radio, or a picture, in TV) into an oscillating electromagnetic wave that beams through the air, in a straight line, at the speed of light (300,000 km 186,000 miles per second).

➢ The receiver is a mirror-image piece of equipment that catches the waves and turns them back into electrical signals—so we can recreate the radio sounds or TV pictures.

From radio to Wi-Fi

➢The more powerful the transmitter and receiver, the further apart they can be spaced. Radio stations use gigantic transmitters, and that's why we can pick up radio signals from thousands of miles away on the opposite side of Earth.

➢Wireless Internet is simply a way of using radio waves to send and receive Internet data instead of radio sounds or TV pictures. But, unlike radio and TV, it is typically used to send signals only over relatively short distances with low-power transmitters.

➢**The basic concept of radio**: sending messages from a transmitter to a receiver at the speed of light using radio waves. In wireless Internet, the communication is two-way: there's a transmitter and receiver in both your computer (and handheld device) and the piece of equipment (such as a router) that connects you to the Internet.

What is Wi-Fi?

What is Wi-Fi?

➢Wi-Fi is a wireless networking protocol that allows devices to communicate without direct cable connections.

➢Wi-Fi is a wireless networking technology that allows devices such as computers (laptops and desktops), mobile devices (smart phones and wearables), and other equipment (printers and video cameras) to interface with the Internet.

➢ It allows these devices--and many more--to exchange information with one another, creating a network.

➢It's technically an industry term that represents a type of wireless local area network protocol based on the 802.11 IEEE network standard.

What is Wi-Fi?

➢Wi-Fi is the most popular means of communicating data wirelessly, within a fixed location.

➢A wireless router is simply a router that connects to your computer (or computers) using radio waves instead of cables.

➢It contains a very low-power radio transmitter and receiver, with a maximum range of about 90 meters or 300 ft.

➢The router can send and receive Internet data to any computer in your home that is also equipped with wireless access .

➢Internet connectivity occurs through a wireless router. When you access Wi-Fi, you are connecting to a wireless router that allows your Wi-Fi-compatible devices to interface with the Internet.

What is Wi-Fi?

➢There should be two possibilities in communicating with the Wi-Fi connection that may be through access point to the client connection or client to client connection.

➢It is making popular choice for home and business networks.

➢Wi-Fi has been developed for mobile computing devices, such has laptops, but it is now extensively using for mobile applications and consumer electronics like televisions, DVD players and digital cameras.

What is a wireless router?

➤ Wireless routers are commonly found in homes. They're the hardware devices that Internet service providers use to connect you to their cable or Internet network.

➤ A wireless router is sometimes referred to as a wireless local area network (WLAN) device. A wireless network is also called a Wi-Fi network.

➤ A wireless router is a device that performs the functions of a router and also includes the functions of a wireless access point.

➤ It is used to provide access to the Internet or a private computer network.

Features of Wi-Fi

➢ Ease of Use in Wi- Fi Technology

➢ No need for cabling in Wi-Fi Technology

➢ High Capacity Load Balancing

➢ Scalability

➢ Network Management System

➢ Indoor as well as Outdoor coverage options

➢ Ability to Measure Performance

➢ Network Access Control

➢ Ability to communicate with both 2.4 GHz devices and 5 GHz devices

➢ Web Content/Application Filtering

➢ Mobile Device Management

➢ Roaming

➢ Switching

Working Principle of Wi-Fi

➢Wi-Fi is a high speed internet connection and network connection without use of any cables or wires.

➢The easiest way to understand Wi-Fi is to consider an home or office.

➢The main requirement for Wi-Fi is that there's a device that can transmit the wireless signal, like a router, phone, or computer.

➢In a typical home, a router transmits an internet connection coming from outside the network, like an ISP, and delivers that service to nearby devices that can reach the wireless signal.

Working Principle of Wi-Fi

➢The wireless network is operating three essential elements that are radio signals, antenna and router.

➢The radio waves are keys which make the Wi-Fi networking possible.

➢The computers and cell phones are ready with Wi-Fi cards.

➢Wi-Fi allows the person in order to get access to web any place in the actual provided area.

➢You can now generate a system within Resorts, library, schools, colleges, campus, personal institutes and so on…

Working Principle of Wi-Fi
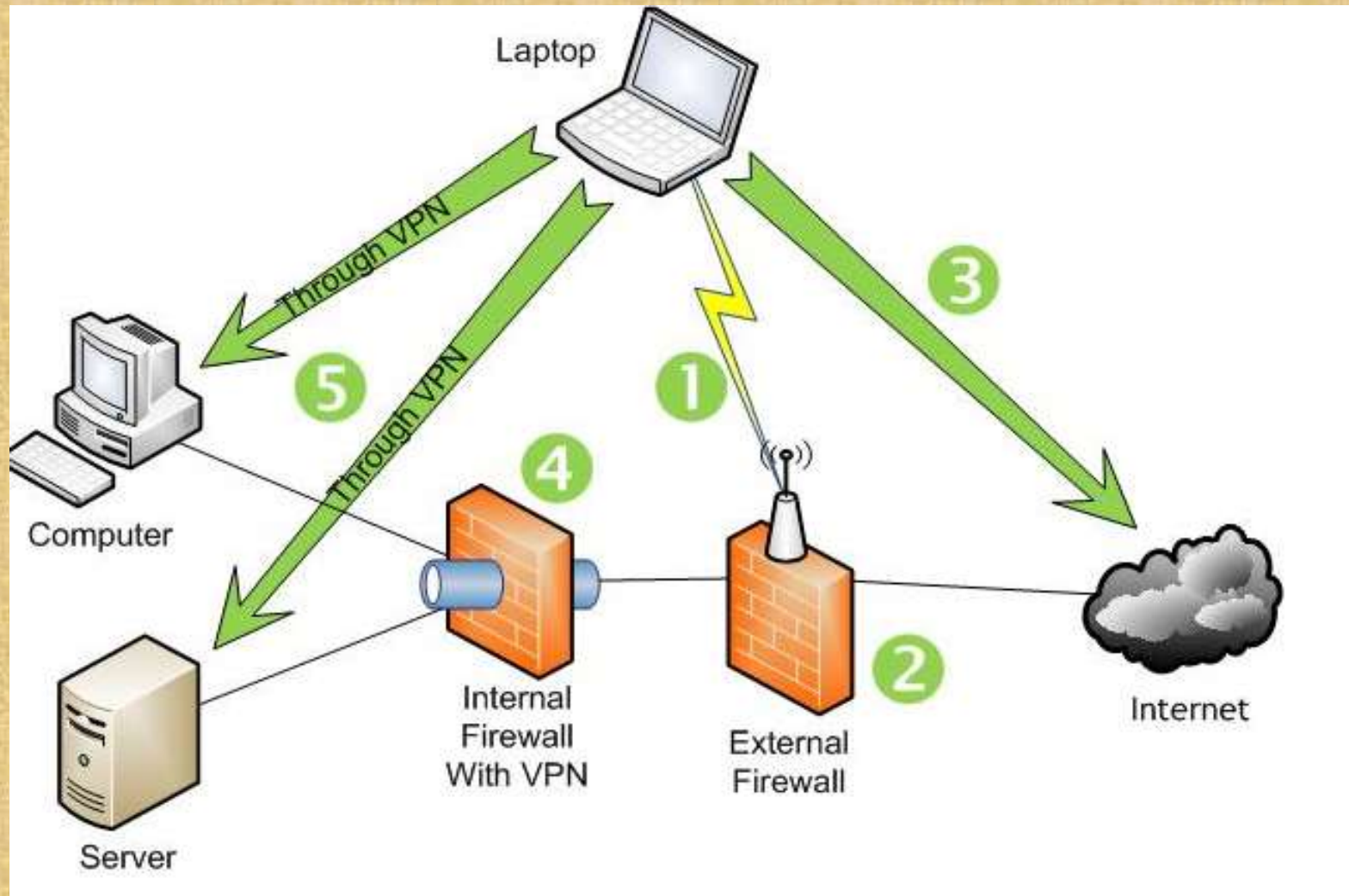
Working Principle of Wi-Fi

➢The radio signals are transmitted from antennas and routers that signals are picked up by Wi-Fi receivers, such has computers and cell phones that are ready with Wi-Fi cards.

➢Whenever the computer receives the signals with in the range of 100-150 feet for router it connect the device immediately.

➢The range of the Wi-Fi is depends upon the environment, indoor or outdoor ranges.

➢ The Wi-Fi cards will read the signals and create an internet connection between user and network.

Working Principle of Wi-Fi

➢The speed of the device using Wi-Fi connection increases as the computer gets closer to the main source and speed is decreases computer gets further away.

➢In a typical home, a router transmits an internet connection coming from outside the network, like an ISP, and delivers that service to nearby devices that can reach the wireless signal.

➢Another way to use Wi-Fi is a Wi-Fi hotspot so that a phone or computer can share its wireless or wired internet connection, similar to how a router works.

Security

➢Security is important element in the Wi-Fi technology. Security is our personal decision but having a wireless connection we should pay attention to protect our private details.

➢ We can connect easily to unsecured wireless routers. The problem is any one is connected to your wire less router using the data like download games, download apps and planning terrorist activities, shirring illegal music and movie files etc.

➢So it is necessary to provide security to the wireless technologies based devices.

How to make the Security?

➢All routers have a web page that you can connect for configuring the Wi-Fi security. And turn on WEP (Wire Equivalence Privacy) and enter a password and remember this password. Next time when you will connect your laptop Wi-Fi router will ask you to enter the connection password and you enter that password.

What are Wi- Fi frequency bands?

➢Frequency bands are ranges of radio wave frequencies used to transmit data in the wireless spectrum, and can further be broken down into Wi- Fi channels.

➢The higher the frequency, the faster the data transmission and shorter the signal range.

➢WiFi frequency bands are frequency ranges within the wireless spectrum that are designated to carry Wi-Fi: 2.4 GHz and 5 GHz.

What are Wi- Fi frequency bands?

➢Wi-Fi IEEE 802.11 is used by many devices from smart phones to laptops and tablets to remote sensors, actuators televisions and many more.

➢It is used as the main wireless communications bearer in wireless LANs as well as for small home WLANs as well.

➢There are several frequency bands within the radio spectrum that are used for the Wi-Fi and within these there are many channels that have been designated with numbers so they can be identified.

➢Many Wi-Fi channels and Wi-Fi bands are normally selected automatically by home Wi-FI routers, for larger wireless LANs and systems it is often necessary to plan the frequencies used.

What are Wi- Fi frequency bands?
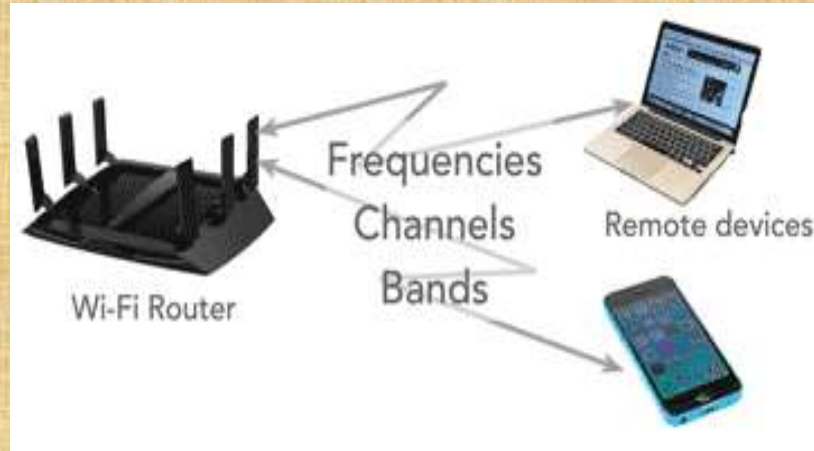
➢Even for home systems where Wi-Fi extenders and Wi-Fi repeaters are used, it is helpful to understand which frequencies are available and how these can be best used.

➢By using some simple settings in the Wi-Fi router and wireless extenders, it is possible to make improvements to the Wi-Fi installation network speed.

Wi-Fi IEEE Standards - 802.11

➢**IEEE 802.11** refers to the set of **standards** that define communication for wireless LANs (wireless local area networks, or WLANs).

➢**IEEE 802.11** is a set of protocols that specifies the sort of communications that can occur on a Wi-Fi network on various wireless frequencies.

➢**IEEE 802.11** defines an over-the-air interface between a wireless client and a base station or between two wireless clients.

Specifications in the 802.11 family

➢There are several specifications in the 802.11 family

1) 802.11 – This pertains to wireless LANs and provides 1 - or 2-Mbps transmission in the 2.4-GHz band using either frequency-hopping spread spectrum (FHSS) or direct-sequence spread spectrum (DSSS).

2) 802.11a – It is the one of a series of wireless technology. That defines the format and structure of the radio signals sent out by WI-FI networking routers and antennas.

3) 802.11b - is the one of a series of wireless technology. 802. 11b support bandwidth 11mbps. Signal in unregulated frequency spectrum around 2.4 GHz. This is a low frequency compared with Wi-Fi-802.11a means it is working reasonable distance.

Specifications in the 802.11 family

It is interference with micro owns cordless phones and other appliance. It is low-cost; signal range is good using home appliance.

4) 802.11g - This pertains to wireless LANs and provides 20+ Mbps in the 2.4-GHz band.

5) Wi-Fi-802.11n- The 802.11n is the newest WIFI technology. It was designed to improve on 802.11g .The amount of bandwidth supported by utilizing multiple wireless signals and antennas instead of one. It supports 100 mbps bandwidth and increased signal intensity.

802.11 systems & frequency bands

A summary of the bands used by the 802.11 systems is given below

IEEE 802.11 VARIANT	FREQUENCY BANDS USED
802.11a	5GHz
802.11b	2.4GHz
802.11g	2.4GHz
802.11n	2.4 & 5 GHz

Wi- Fi Module - ESP8266

➢ESP8266 is a low-cost WiFi module that belongs to ESP's family. which you can use it to control your electronics devices anywhere in the world.

➢It has an in-built microcontroller and a 1MB flash allowing it to connect to a WiFi.

➢The TCP/IP protocol stack allows the module to communicate with WiFi signals.

➢The maximum working voltage of the module is 3.3v so you cant supply 5v as it will fry the module

Wi- Fi Module - ESP8266

ESP8266: Pinout

Pin 2__GPIO 0
Pin 1__Rx
Pin 8__Vcc
Pin 7__RST
Pin 6__CH-PD
Pin 5__Tx
Pin 4__GND
Pin 3__GPIO 2
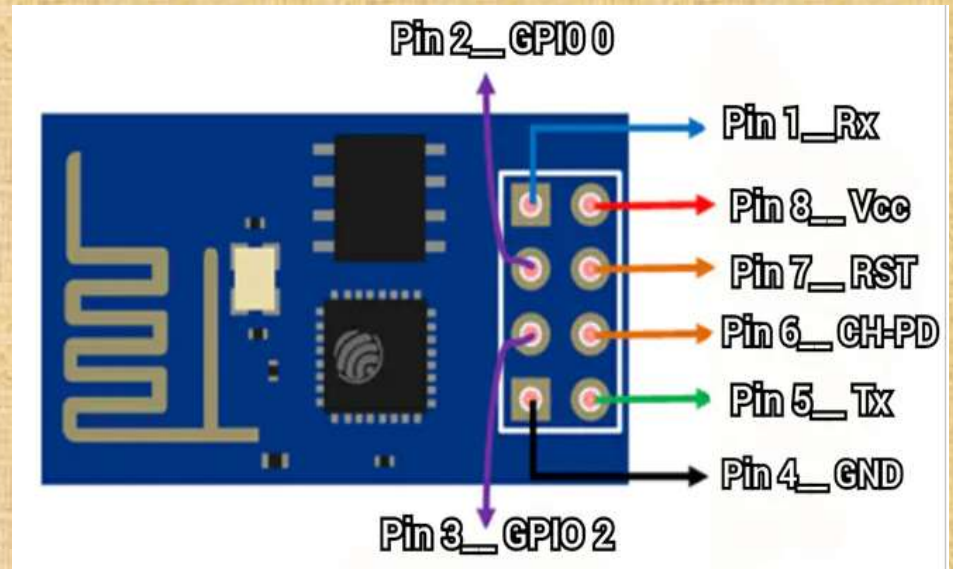
ESP8266: Pinout

pin 1 _____ Rx -- connect it to Rx of Arduino

pin 2_____GPIO 0--connect it to ground while uploading the code to arduino IDE
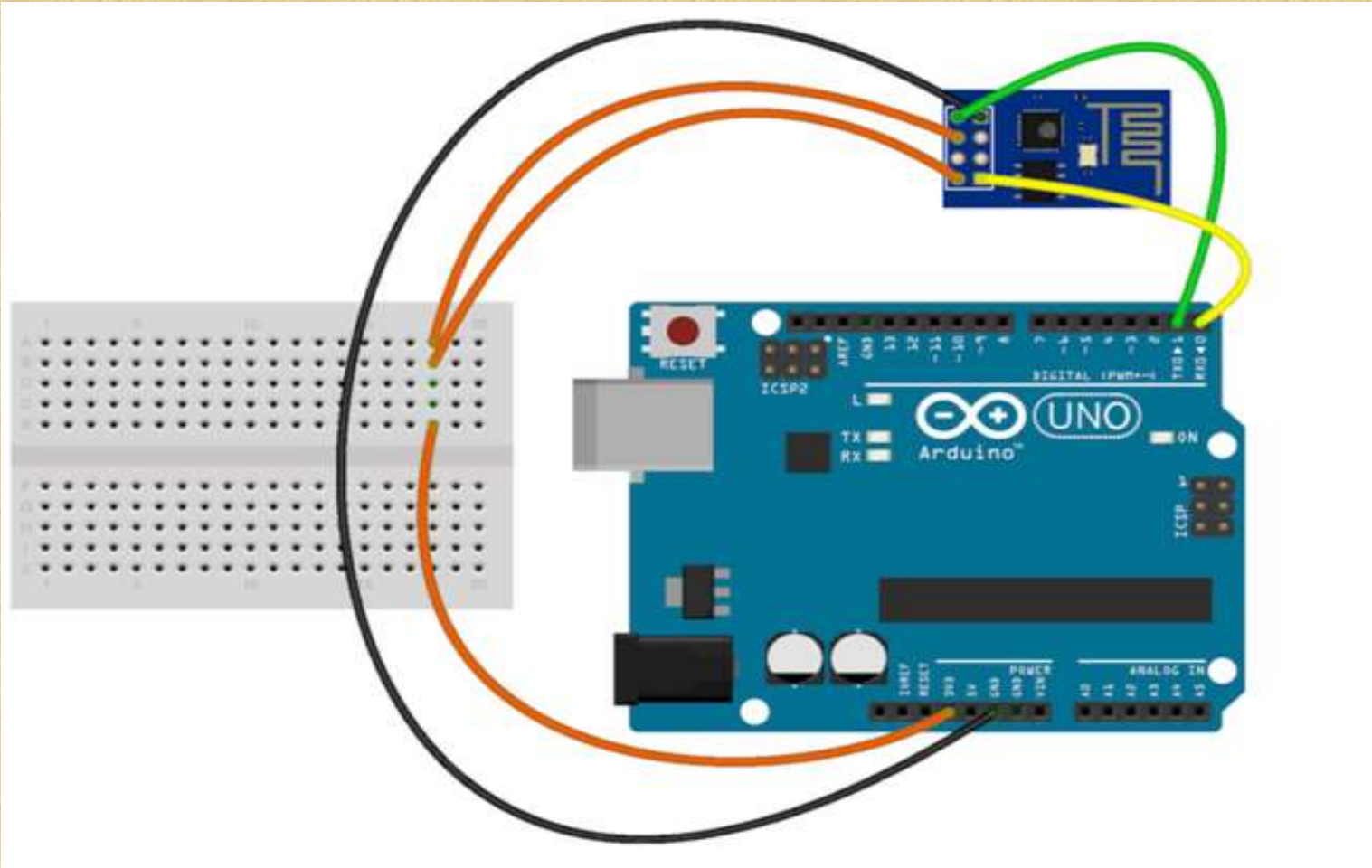
pin 3_____GPIO 2

pin 4_____ GND--connect it to ground

pin 5_____Tx--connect it to Tx of Arduino

pin 6_____CH_PD(EN) -- connect it to 3.3v

pin 7_____RST(reset)--(not necessary) connect it to 3.3v for normal operation

and 0v(GND) for reset

pin 8_____Vcc--supply 3.3v from Arduino or from an external source

Interfacing with Arduino

Interfacing with Arduino

Basic Serial Communication using ESP8266 With Arduino UNO

```
/ Basic serial communication with ESP8266
// Uses serial monitor for communication with ESP8266
//
//  Pins
//  Arduino pin 2 (RX) to ESP8266 TX
//  Arduino pin 3 to voltage divider then to ESP8266 RX
//  Connect GND from the Arduiono to GND on the ESP8266
//  Pull ESP8266 CH_PD HIGH
//
// When a command is entered in to the serial monitor on the computer
// the Arduino will relay it to the ESP8266
//
```

Interfacing with Arduino

```
#include <SoftwareSerial.h>
SoftwareSerial ESPserial(2, 3); // RX | TX

void setup()
{
   Serial.begin(9600);    // communication with the host computer
   //while (!Serial)   { ; }


   // Start the software serial for communication with the ESP8266
   ESPserial.begin(9600);
    Serial.println("");
   Serial.println("Remember to to set Both NL & CR in the serial
monitor.");
   Serial.println("Ready");
   Serial.println("");
}
```

Interfacing with Arduino

```
void loop()
{
   // listen for communication from the ESP8266 and then write it
to the serial monitor
   if ( ESPserial.available() )
 {
Serial.write( ESPserial.read() );
  }
   // listen for user input and send it to the ESP8266
   if ( Serial.available() )
 {
 ESPserial.write( Serial.read() );
 }
}
```

Advantages

1)Wireless laptop can be moved from one place to another place.

2) Wi-Fi network communication devices without wire can reduce the cost of wires.

3) Wi-Fi setup and configuration is easy than cabling process.

4) It is completely safe and it will not interfere with any network.

5) We can also connect internet via hot spots.

6) We can connect internet wirelessly.

Disadvantages

1) Wi-Fi generates radiations which can harm the human health.

2) We must disconnect the Wi-Fi connection whenever we are not using the server.

3) There are some limits to transfer the data, we can't able to transfer the data for long distance.

4) Wi-Fi implementation is very expensive when compared to the wired connection.

Applications

1) Mobile applications
2) Business applications
3) Home applications
4) Computerized application
5) Automotive segment
6) Browsing internet
7) Video conference

Difference between Bluetooth and Wi-Fi

Bluetooth	Wi- Fi
Bluetooth has no full form.	Wi-Fi stands for Wireless Fidelity.
Bluetooth is actually connect short-range devices for sharing information .	Wi-Fi is used for providing high-speed web access or internet.
It requires Bluetooth adapter on all devices for connectivity.	Wi-Fi requires wireless adapter on all devices and wireless router for connectivity
Bluetooth consumes low power.	Wi-Fi consumes high power.
The security of Bluetooth is less.	Wi-Fi provides better security than Bluetooth.
Bluetooth is less flexible means in this limited users.	Wi-Fi supports large amount of users.
The radio signal range of Bluetooth is 10 meters.	Wi-Fi range is 100 meters.
Bluetooth require low bandwidth.	Wi-Fi requires high bandwidth.

THANKS