Adapted from: https://mocomi.com/bluetooth/

https://kids.britannica.com/students/article/Wi-Fi/545141#:~:text=The%20wireless%20networking%20technology%20known,devices%20over%20small%20geographic%20areas.

https://kids.kiddle.co/IP_address#:~:text=Kids%20Encyclopedia%20Facts,long%20number%20written%20in%20binary.

Module 12-Networking

For this module you will need:

- Your car constructed from Module 11
- An android phone or laptop/desktop with Chrome

Endure the battery pack switch is OFF.

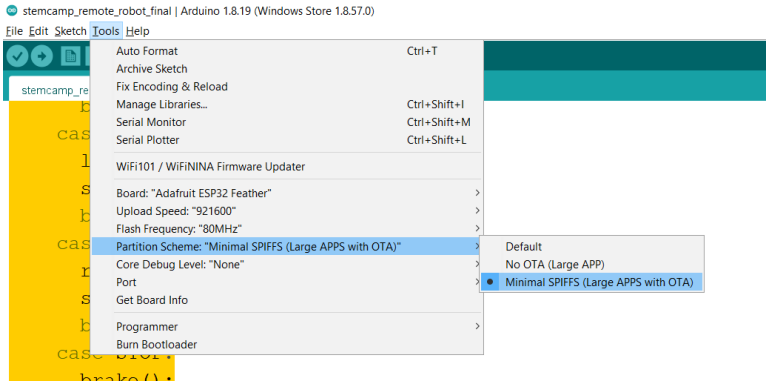
Ensure the USB cable is plugged into the computer.

Open **stemcamp_connected_robot.ino**

Edit Line 18, and 19 and 20 appropriately.

```
18  #define BLE_NAME "ESP32-Team-X-YOURNAME"
19  const char* ssid = "KSUGuest";
20  const char* password = "kennesaw";
```

In your Arduino IDE go to Tools->Partition Scheme->Minimal SPIFFS



Upload the sketch to your ESP32.

Once completed, unplug your USB cable.

Jumper wire the 5V power rail to the 5V pin of the ESP32.

Turn the battery pack power switch ON

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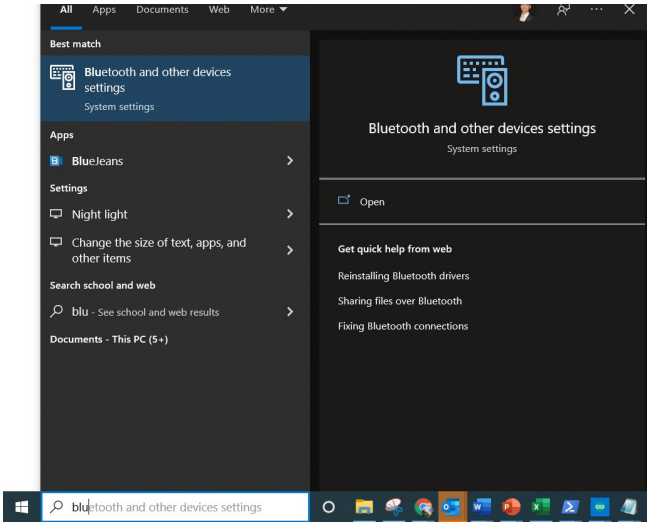
Connect to your robot car

If on a laptop, enable Bluetooth



Turn Bluetooth on:

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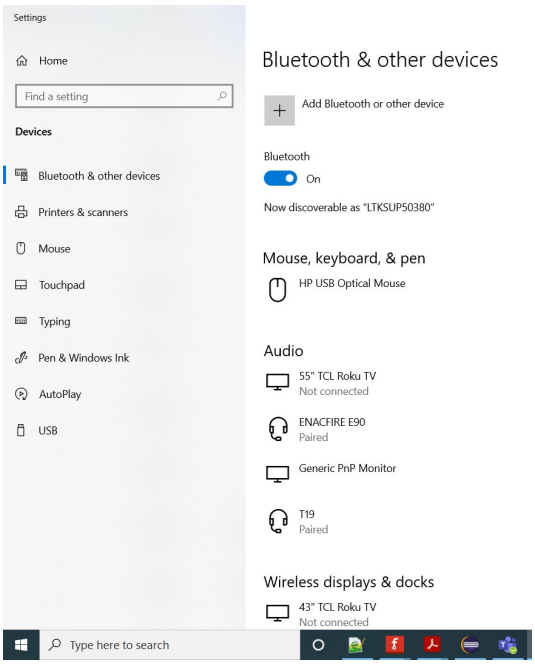
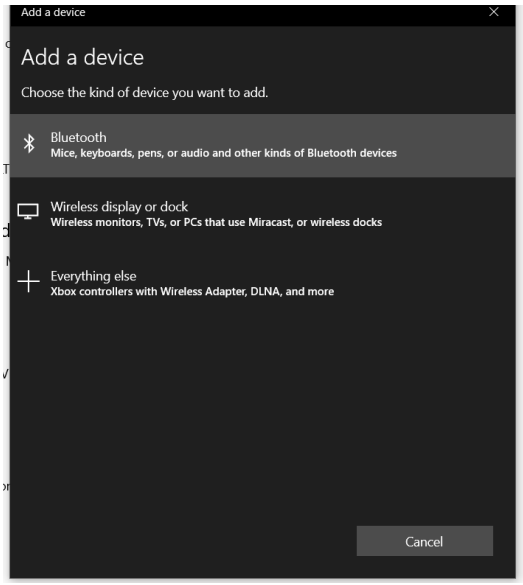
https://kids.kiddle.co/IP_address#:~:text=Kids%20Encyclopedia%20Facts,long%20number%20written%20in%20binary.



Click Add Bluetooth, Select Bluetooth



Select your Device

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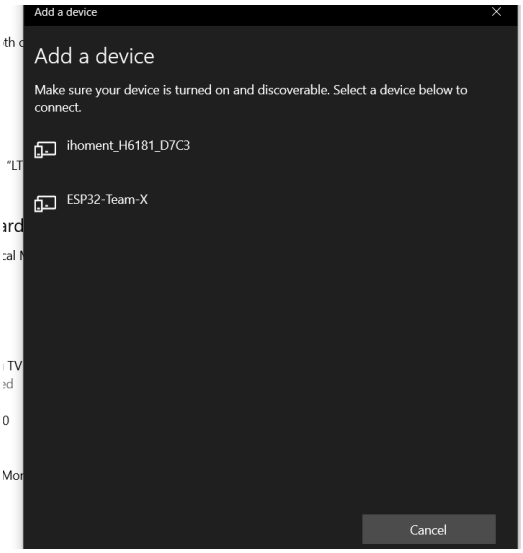
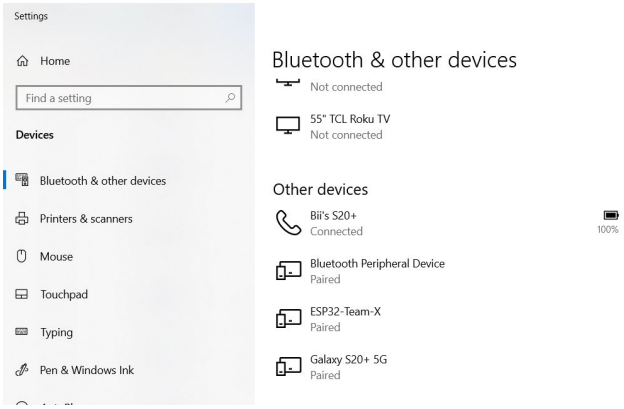
https://kids.kiddle.co/IP_address#:~:text=Kids%20Encyclopedia%20Facts,long%20number%20written%20in%20binary.



If you have trouble connecting press the RST button on the ESP32, and try again.



It should be paired.

From an android device: swipe down and ensure that Bluetooth is on.

Proceed below (for either laptop/desktop or Android phone, iOS is not supported):

Open Chrome web browser.

Navigate to:

https://www.raddmusic.com/rover/

Click Connect

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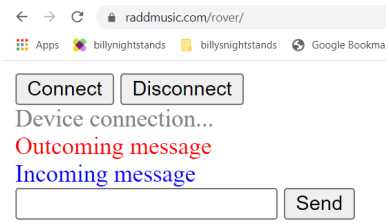
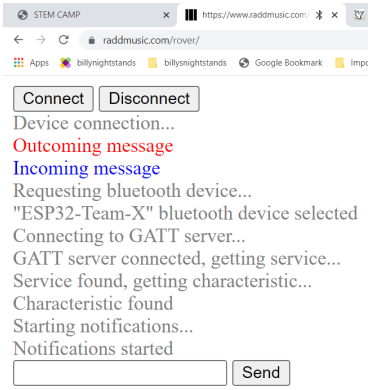
https://kids.kiddle.co/IP_address#:~:text=Kids%20Encyclopedia%20Facts,long%20number%20written%20in%20binary.



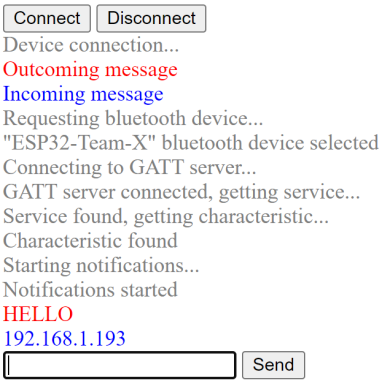
If you don't see your device, press the RST button on the ESP32.

Click connect again. Select your device and pair.



After seeing "Notifications started", enter: HELLO in the textbox and click send.

The ESP32 will return it's IP address in blue.



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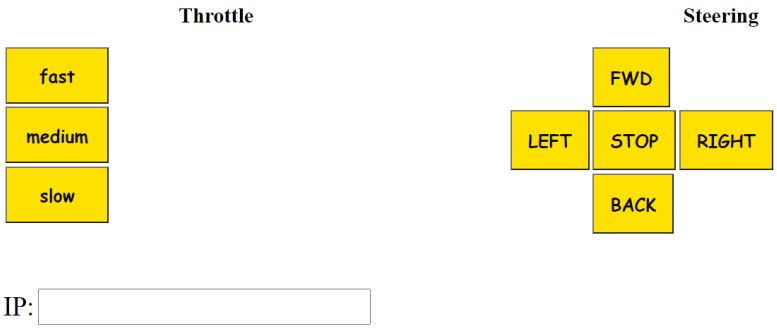
https://kids.kiddle.co/IP_address#:~:text=Kids%20Encyclopedia%20Facts,long%20number%20written%20in%20binary.

Copy this IP address and write it down.

Open a new tab.

Navigate to the URL posted at the stem camp:

http://X.X.X.X:PPPPP



The controller will be displayed.

Type in the IP address from before. (you do not need to hit enter)

Begin to drive your device over Wi-Fi!

What is Bluetooth?

Bluetooth is an open wireless technology used for exchanging of data over short distances with the help of short-wavelength radio transmissions from fixed and mobile devices, creating personal area networks (PAN) with high levels of security. It was created by the telecom company Ericsson in 1994.

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Why is Bluetooth Called Bluetooth?

The word "Bluetooth" comes from the by name of the tenth-century king Harald I of Denmark who united Danish tribes into a single kingdom. The implication is that Bluetooth does the same with communication protocols, uniting them into one universal standard.

The bluetooth logo is a combination of extremely rare Viking inscriptions and King Haralds initials.

Bluetooth is managed by the Bluetooth Special Interest Group (SIG), a not-for-profit trade association that oversees the development of Bluetooth standards and the licensing of the Bluetooth technologies and trademarks to manufacturers. A whopping 15,000 companies fall under the SIG in the areas of telecommunication, computing, networking, and consumer electronics.

Bluetooth Uses and Implementation –

- Bluetooth uses a radio technology called frequency-hopping spread spectrum, which chops up the data being sent and transmits chunks of it in the frequency range of 2,400-2,483.5 MHz. This range is the globally recognized Industrial, Scientific and Medical short-range radio frequency band.
- Bluetooth enables a secure way to connect and exchange information between devices such as faxes, mobile phones, telephones, laptops, personal computers, printers, Global Positioning System receivers, digital cameras, and video game consoles.

Communication and Connection –

- A master Bluetooth device can communicate with a maximum of seven devices, though not all devices support this limit. The devices can switch roles, by agreement, and the slave can become the master (for example, a headset initiating a connection to a phone will begin as the master, initiator of the connection; but may later prefer to be the slave).
- At any given time, data can be transferred between the master and one other device. Since it is the master that chooses which slave to address, being a master is a lighter burden than being a slave. Being a master of seven slaves is possible but being a slave of more than one master is difficult.

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Devices –

- Bluetooth exists in many products, such as the iPod Touch, Lego Mindstorms NXT, PlayStation 3, PSP Go, telephones, the Nintendo Wii, and some high definition headsets, modems, televisions and watches.
- The technology is useful when transferring information between two or more devices that are near each other in low-bandwidth situations. Bluetooth is commonly used to transfer sound data with telephones or byte data with hand-held computers. Bluetooth protocols simplify the discovery and setup of services between devices. Bluetooth devices can advertise all of the services they provide.

What is Wi-Fi?

The wireless networking technology known as Wi-Fi (wireless fidelity) uses radio waves to transmit data at high speeds over short distances. Wi-Fi is often used in local area networks (LANs), computer networks that link computers and devices over small geographic areas. Because Wi-Fi allows LANs to operate without cables and wiring, it has become a popular choice for home and business networks.

Wi-Fi can also be used to provide wireless broadband Internet access for devices such as laptops, smartphones, e-readers, and electronic gaming consoles. Wireless-enabled devices are able to connect to the Internet when they are near areas that have Wi-Fi access, called “hot spots.” Hot spots have become common, with many public places such as airports, hotels, bookstores, and coffee shops offering Wi-Fi access. A version of Wi-Fi called Wi-Fi Direct allows connectivity between devices without a LAN.

The origins of Wi-Fi technology can be traced to 1985. In that year the U.S. Federal Communications Commission (FCC) released several bands of the radio spectrum for unlicensed use. Technology firms began building wireless networks and devices to take advantage of the newly available radio spectrum. However, devices from different manufacturers were rarely compatible. To solve this problem, in the 1990s industry leaders came up with a common standard for wireless technology. The Institute of Electrical and Electronics Engineers (IEEE) approved it in 1997. Two years later a group of major companies formed the Wireless Ethernet

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Compatibility Alliance (WECA, now the Wi-Fi Alliance), a global nonprofit organization created to promote the new standard. WECA named the new technology Wi-Fi.

Under the IEEE Wi-Fi standards, the available frequency bands are split into several separate channels. These channels overlap in frequency, and therefore Wi-Fi uses channels that are far apart. Within each of these channels Wi-Fi uses a “spread spectrum” technique in which a signal is broken into pieces and transmitted over multiple frequencies. Spread spectrum enables the signal to be transmitted at a lower power per frequency. It also allows multiple devices to use the same Wi-Fi transmitter.

Wi-Fi signals are often transmitted over short distances—usually less than 330 feet (100 meters)—in indoor environments. Because of that, the signal would reflect off walls, furniture, and other obstacles. It thus arrived at multiple time intervals and caused a problem called multipath interference. In the 1990s Australian engineer John O’Sullivan and his research team at the Commonwealth Scientific and Industrial Research Organisation (CSIRO) developed a method to reduce the interference. They built a small computer chip that breaks down signals into various tones that make it through the interference. Through several techniques the signals are reassembled when they reach their destination. This improvement makes wireless networks safe and reliable.

What is an IP address?

An **IP address** (short for **Internet Protocol address**) is a label which is used to identify one or more devices on a computer network, such as the internet. It can be compared to a postal address. An IP address is a long number written in binary. Since such numbers are difficult to communicate, IP addresses are usually written as a set of numbers in a given order. Devices using IP addresses use the internet protocol to communicate.
The Internet Assigned Numbers Authority assigns IP addresses to regional internet registries (RIRs). The RIRs assign them to Internet Service Providers. Internet Service Providers then assign IP addresses to their customers. Very often, people have a router or gateway at home, to which they connect computers, printers, and other devices. These routers or gateways are often configured to assign "local" IP addresses to the devices that are connected. Each address has two parts: One that specifies the computer or group of computers, and another which specifies the network. A device can have more than one IP address. Certain

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types of IP addresses are used to address a group of devices, while others are used to address only one device. Certain types of addresses are unique, others can be re-used. A number of IP addresses are used for special purposes, for example to obtain an IP address automatically. An IP address is converted to physical or Media Access Control Address using the Address Resolution Protocol (ARP). If an IP address is your phone number, then your MAC address is your name. You may change your phone number, but your name will not change.