ARVIND MAFATLAL GROUP | GET SET LEARN

MORSE CODING

TinkRworks®
PREMIUM LEARNING PARTNER

Contemporary Global Pedagogy:
Aligned with NEP 2020 and NCF 2023

GET SET LEARN

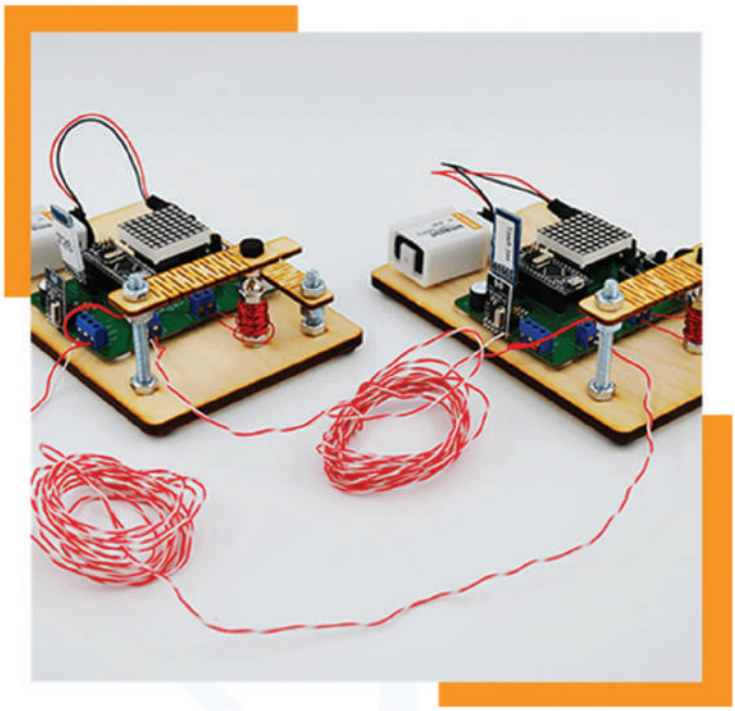
MAF Technologies Private Limited

Table of Contents

Module 1: Introduction to Morse coding

1.1 Introduction

In this project, you will learn how people communicated in the past and now. You'll make a device with two parts: one that uses wires like old telegraphs and another that works without wires, like today's devices.



1.2 Morse code

Morse Code is a way to communicate using short signals called dots and long signals called dashes. Each letter, number, or symbol has its unique pattern of dots and dashes. It was created for telegraphs in the 1830s and is simple but effective. You can learn it by practicing with a telegraph key or flashlight. Even though we have advanced technology, Morse Code is still used in some situations, like radio communication and emergencies. It is a way for people to communicate over long distances while maintaining the secrecy of the data being shared.

Morse Codes

A •–	J •–––	S •••
B –•••	K –•–	T –
C –•–•	L •–••	U ••–
D –••	M ––	V •••–
E •	N –•	W •––
F ••–•	O –––	X –••–
G ––•	P •––•	Y –•––
H ••••	Q ––•–	Z ––••
I ••	R •–•	

Before we understand more about Morse coding, let's understand:
"What is communication?".

1.3 Communication

It is the process of passing information and understanding from one person to another. It involves talking, listening, writing, and even using gestures or facial expressions to get our message across.

It plays a crucial role in interpersonal relationships, teamwork, education, business, and virtually every aspect of human interaction.

1.3.1 Categories of Communication

In general, we can place communication types into FOUR different categories

- **Verbal Communication:** Involves spoken or written words to convey messages, such as face-to-face conversations, phone calls, and speeches.
- **Nonverbal Communication:** Uses gestures, facial expressions, and body language to convey information alongside verbal communication.
- **Written Communication:** Utilizes written symbols, such as letters, emails, and reports, to transmit information and provide a permanent record of messages.
- **Visual Communication:** Relies on visual elements like images, charts, and videos to convey information effectively and capture attention.

1.4 Role of Technology in Communication

Technology helps us to talk and share things quickly. With phones and apps like WhatsApp, we can send messages instantly. Video calls on Zoom or Skype let us see and talk to people far away. It's like magic—making communication easier and more fun!

1.5 What is Technology?

The application of scientific knowledge for practical purposes, especially in industry. Machinery and equipment developed from the application of scientific knowledge. The branch of knowledge deals with engineering or applied sciences.

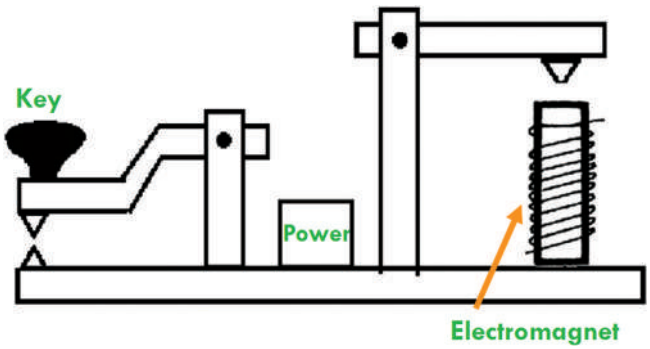
1.6 Telegraph

A telegraph is an old-fashioned texting machine where you press a key to make electrical signals, and those signals travel through a wire to another machine that shows the message. In the olden days, it helped people to pass secret information using dashes and dots from one place to another before phones were invented.

The first part of our project will be a telegraph.

1.6.1 Working Principle

The telegraph has 3 necessary components:

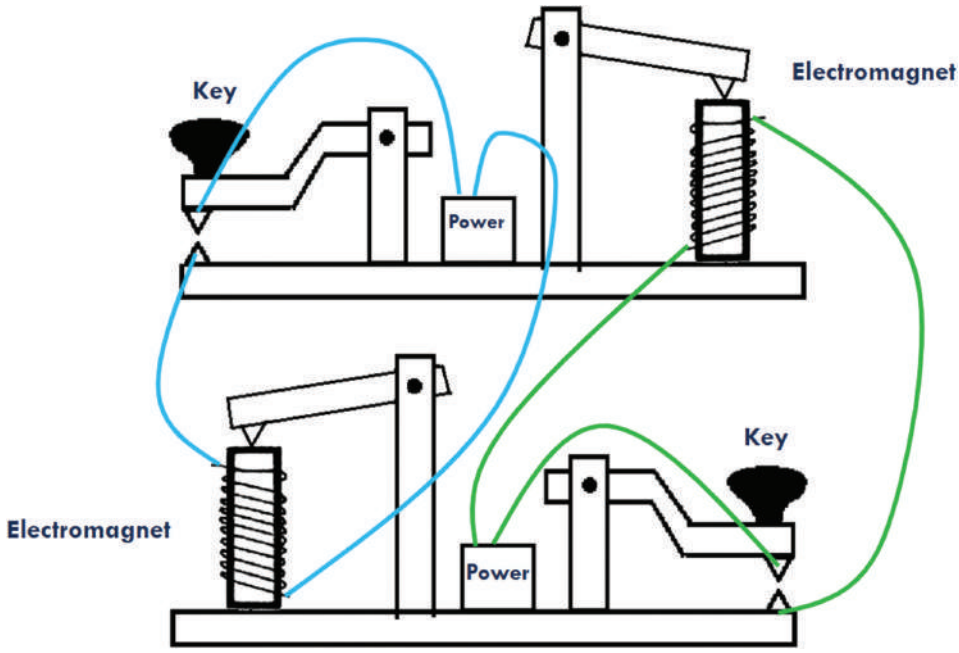


- **Key:** Device used to transmit outgoing messages (operator taps on the key).
- **Electromagnet:** Receives incoming messages.
- **Power Source:** Provides power to the entire system.

1.6.1.1 Working: The person sending the message uses a key to create electrical signals. When they press the key, it completes an electrical circuit. Along the wire, there's an electromagnet and a sounder at the receiving end. When the electrical signal travels through the wire, it activates the electromagnet.

The sender uses Morse Codes, a series of short signals (dots) and long signals (dashes), to represent letters, numbers, and words. For example, a short signal might represent the letter 'E,' and a long signal might represent the letter 'T.'

As the electromagnet is activated, it attracts a metal arm to create clicks or beeps on the sounder. The person receiving the message interprets these clicks or beeps based on Morse Code to understand the message.



Let us cover some essential concepts before we dive into the project:

- **Electricity:** Energy from moving charged particles.
- **Storing Electricity:** Use batteries to convert and store chemical energy as electrical energy.
- **AC vs. DC:** AC alternates direction, used in household systems; DC flows in one direction, common in batteries and electronics.
- **Making a Circuit:** Connect a power source, conductive path, load, and switch to create a closed loop for electricity flow.

Exercise 1

Answer the following Multiple-Choice Questions (MCQs):

1. What is Morse Code primarily used for?

a) Radio broadcasting
b) Text messaging
c) Telegraph communication
d) Email communication

2. Which component of the telegraph is responsible for creating electrical signals when pressed?

a) Electromagnet
b) Power Source
c) Key
d) Sounder

3. What is the purpose of the electromagnet in the telegraph?

a) To transmit messages
b) To interpret Morse Code
c) To receive incoming messages
d) To provide power to the system

4. Which category of communication involves spoken or written words to convey messages?

a) Verbal Communication
b) Nonverbal Communication
c) Written Communication
d) Visual Communication

5. What role does technology play in communication according to the text?

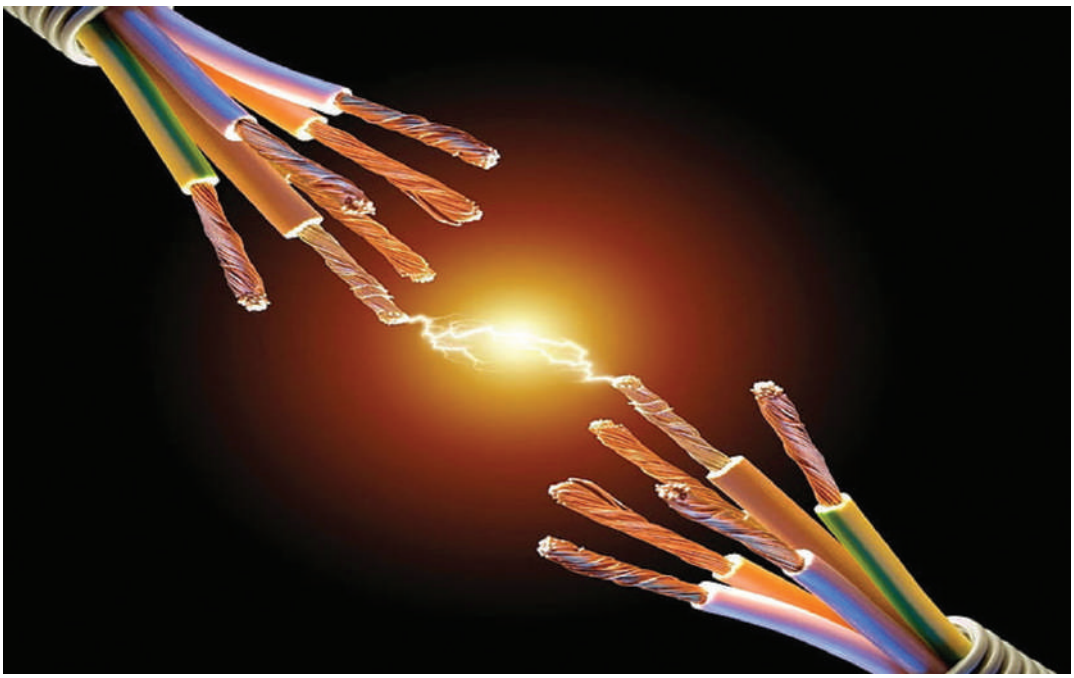
a) It hinders communication effectiveness.
b) It slows down the communication process.
c) It facilitates quick and efficient sharing of messages.
d) It limits communication to face-to-face interactions.

Module 2: Electricity

2.1 Introduction

Electricity is a form of energy that powers many of the electrical devices we use every day. In this chapter, we'll explore the basics of electricity, including how it works and how it is generated.

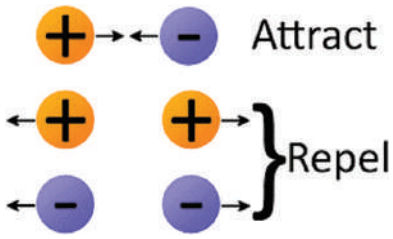
2.2 What is Electricity?



Electricity is generated when tiny particles called electrons move around. They travel in certain materials called conductors, where electrons can move easily. They can be restricted by materials called insulators, where electrons can't move as freely. Let's understand each of them briefly.

2.3 Electrons

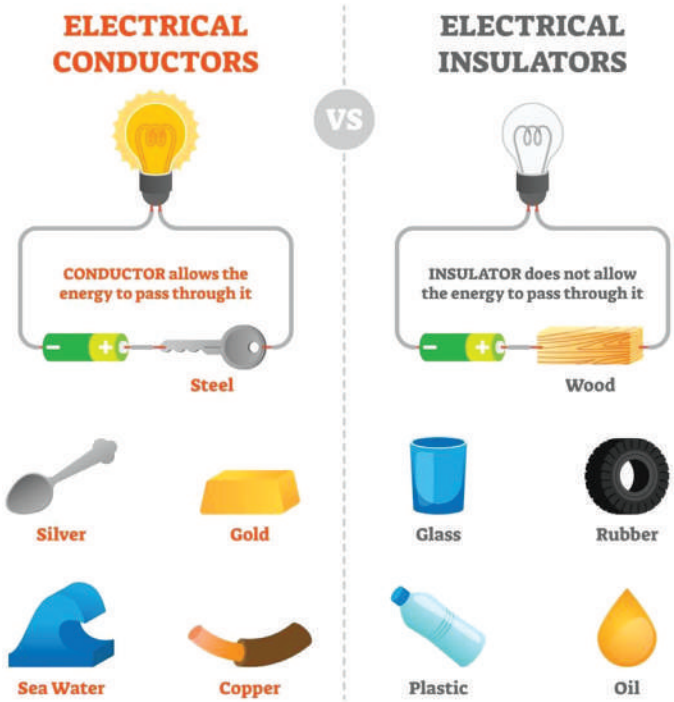
Electrons are negatively charged. Similar to the two sides of a magnet, electrons are attracted to the opposite charge (positive) and they are repelled by the same charge (negative).



2.4 Conductors & Insulators

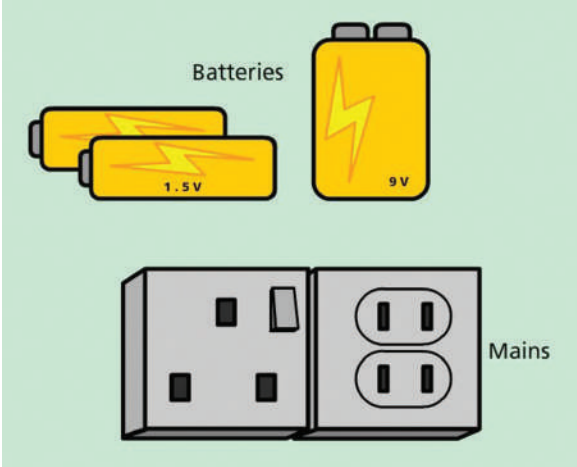
A conductor's atoms hold onto their electrons loosely and they can move from one atom to the next.

Where insulator's atoms hold onto their electrons tightly and their electrons cannot jump from one to the other.



Conductors are surrounded by insulators to prevent electrons from escaping.

2.5 Sources of Electricity

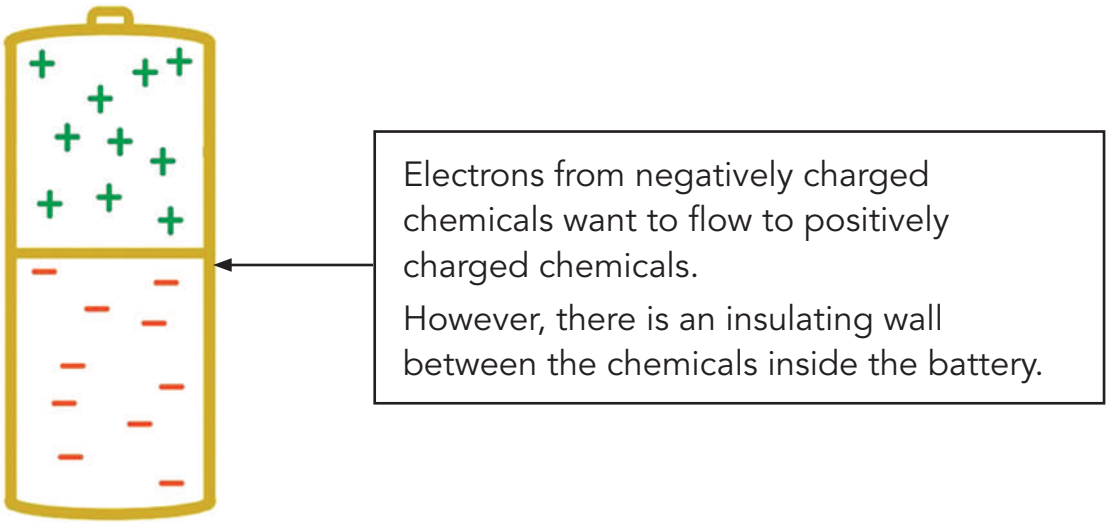


Power sources have positive and negative ends. The ends are separated by a barrier. The positive end has atoms that are missing electrons and the negative end has atoms that have extra electrons.

In our project, we will be using batteries as the power source

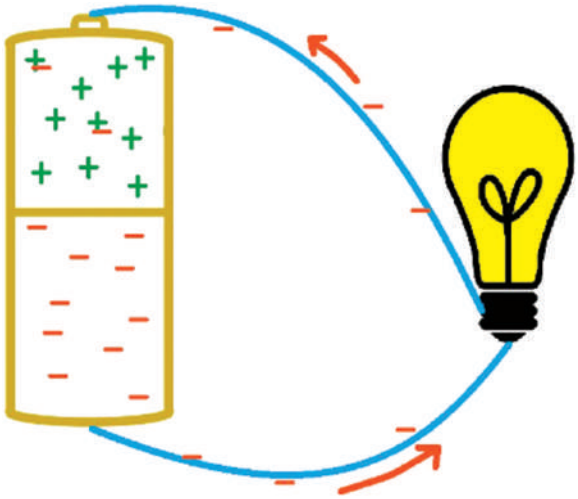
2.6 Batteries

A battery is a place to store electricity as chemical energy. A battery contains two chemicals. One chemical has atoms that are missing electrons (positively charged) and the other chemical has extra electrons (negatively charged).



How does a battery power circuit?

When you put a battery in a circuit, the electrons can then flow from the negative charged chemical to the positive through the attached conductor.

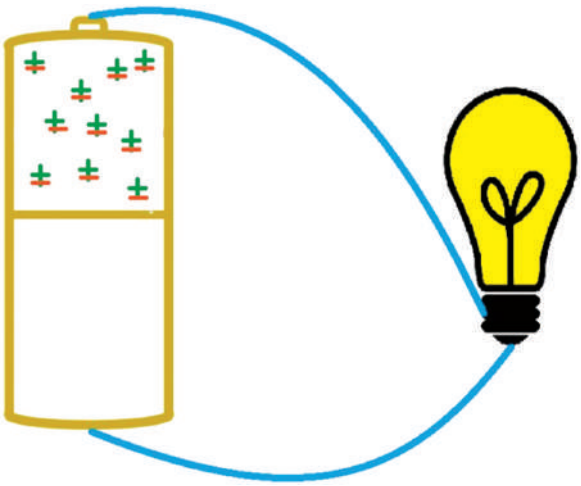


In above diagram, electrons pass through a lightbulb and turn it on.

It is the MOVEMENT of the electrons that powers your devices, not the electrons themselves.

Why does a battery run out of energy?

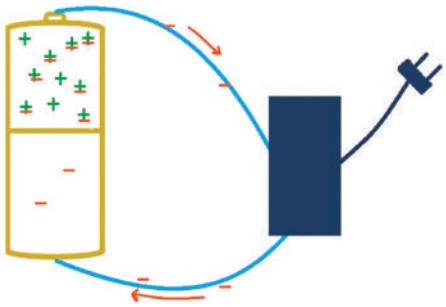
Eventually, all the extra electrons from the negative charged chemical move towards the positive end and made all the atoms neutral.



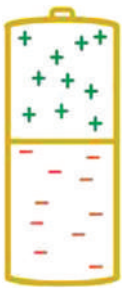
The battery is now out of energy.

Rechargeable batteries

Some types of batteries are rechargeable. The charger forces electrons to flow backwards.



The charger uses electricity (usually from a wall socket) to force electrons to flow in the direction they don't want to go.

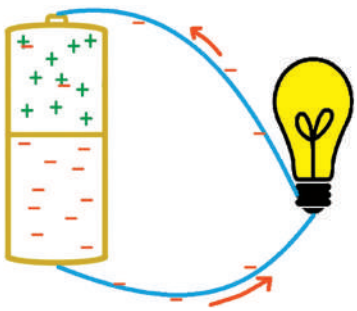


Now the battery is ready to power devices again.

2.7 DC vs AC

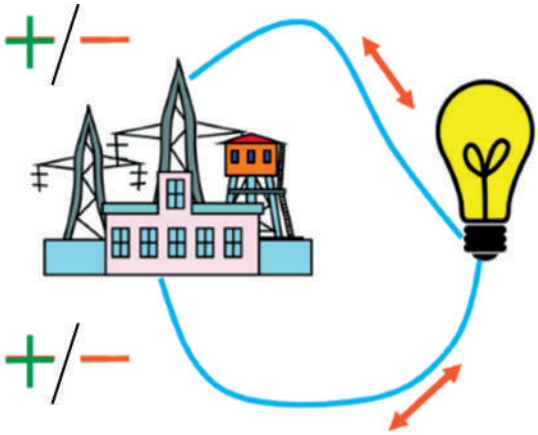
Current is the flow of electrons.

In batteries, electrons flow from a negative location to a positive location.



This is called direct current (DC).

In AC (AC), instead of electrons flowing in one direction, the electrons move back and forth.



2.8 AC Adapters

AC power is used in some electrical items like heaters, incandescent light bulbs, toasters, etc.

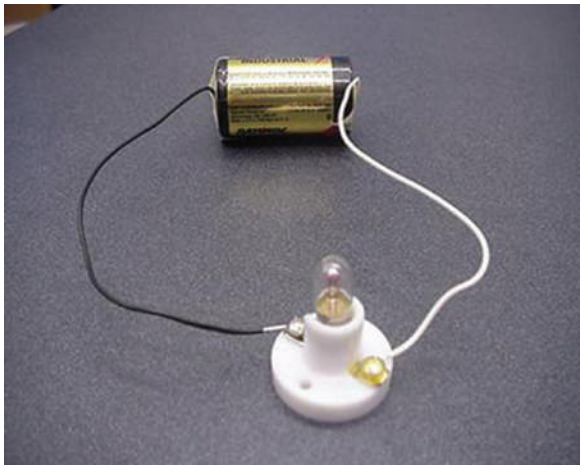
However, a lot of electronic devices require DC. AC from your outlet can be converted to DC that your computer (and other devices) use. That is the thick block or box on your power cord. It is an 'AC Adapter' because it adapts AC power to DC power.

Examples of AC adapters:

2.9 Circuit

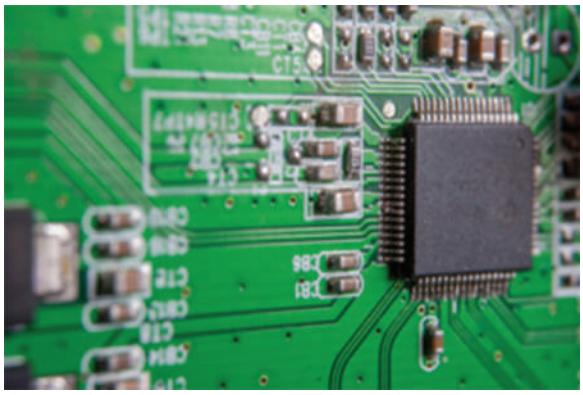
2.9.1 Introduction

Have you ever wondered how electricity travels around to power electrical equipments Well, the secret lies in circuits. Here are a few examples of circuits, like Battery and bulb connection and motor connected to a switch to turn it ON or OFF.



2.9.2 What is a Circuit?

A **circuit** is a highway for electricity. It's a complete path, like a loop, that allows electricity to flow from a power source, like a battery, to a device, like a lamp, and then back again. This flow of electricity is what makes the device work. The circuit components work together to allow the flow of current at specific voltages, currents and resistances.

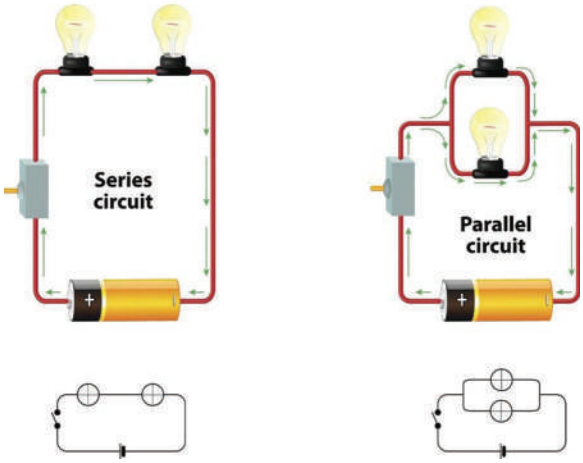


Circuits can be found everywhere, from simple household devices like light bulbs to complex electronic gadgets like smartphones and computers.

Types of Circuits:

Now that we understand what a circuit is and how it works, let's explore the different types of circuits. Circuits can be categorized into **two** main types:

1. **Series Circuit**
2. **Parallel Circuit**

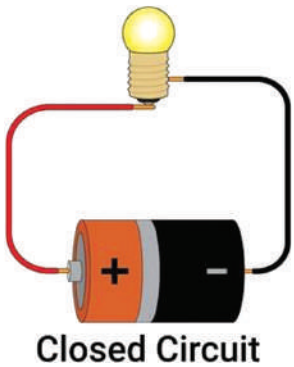


These types describe how the components in a circuit are connected, and they have unique characteristics that affect how electricity flows through them.

Before diving into series and parallel circuits, let's take a closer look at how open and closed circuits play an important role in both series and parallel circuits.

2.9.2 Closed Circuit

A **closed circuit** allows the flow of electrons in the path from a negative terminal to the positive terminal of the battery. It is a complete circuit; therefore, current can flow through it.



Closed Circuit

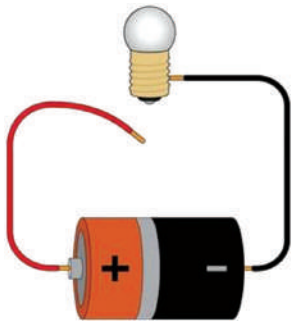
Observe the image. See that the circuit is closed, and the path is complete between the positive and negative terminals of its power source. Therefore, due to the complete circuit, electricity flows smoothly and the light bulb shines brightly.

Some Examples of a Closed Circuit:

- Wiring of speaker systems
- Street lamps
- Car Headlights
- Alarm systems

2.9.3 Open Circuit

An **open circuit** is a circuit where the path of electrons is not connected, or the circuit is incomplete. When the wire is open or not connected, the flow of current from one terminal to another is incomplete. Therefore, the current does not flow through the circuit and hence the circuit is open.



Open Circuit

Observe the image. See that the circuit is open, and the path is incomplete where the red wire is not connected to the battery and only the black wire is connected to the Battery. Therefore, due to the incomplete circuit, electricity does not flow, and the light bulb will not glow.

Examples of an Open Circuit:

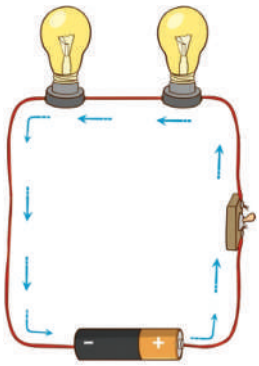
- Light switch
- Socket
- An internal circuit break in a car

Now let's understand how the Series and **Parallel circuit** works.

2.9.4 Series Circuit

In a **series circuit**, two bulbs are connected one after the other in a series i.e. the amount of current flowing through each bulb will be equal. It is also known as an end-to-end connection.

In the diagram shown, Bulb 1 and Bulb 2 are connected in series. When current flows in the circuit, we will observe that an equal amount of current will flow through each bulb.



Series circuit

Example of Series Circuit:

- Table lamp
- Wall mounted switch
- Water Heaters
- Freezer and Refrigerator

Properties of Series Connection:

- **Same Current:** The same amount of current flows through both bulbs because there is only one pathway for the electricity to follow.
- **Voltage Divides:** The voltage across each bulb divides between them, so each bulb receives a portion of the total voltage.
- **Total Resistance:** The total resistance in a series circuit is the sum of the individual resistances of the bulbs.
- **Brightness:** If the bulbs have the same resistance, they will glow with equal brightness. However, if one bulb has higher resistance, it will glow brighter compared to the other bulb.

The formula for the circuit in terms of Ohm's Law:

In a series circuit, Ohm's Law states that the total voltage (**V**) across the circuit is equal to the sum of the voltages across each component. Mathematically, it can be expressed as:

$$V_{Total} = V_1 + V_2 + V_3 + \ldots\ldots\ldots + V_n$$

Where **Vtotal** is the total voltage across the circuit and **V1, V2,....., Vn** are the voltage across each component (in this case, the bulbs).

The total resistance ($\mathbf{R_{total}}$) in a series circuit is the sum of the resistances of each component:

$$R_{Total} = R_1 + R_2 + R_3 + \ldots\ldots\ldots + R_n$$

Simple Numerical Example:

Let's say we have two bulbs connected in series. Bulb 1 has a resistance of 10 ohms (Ω), and Bulb 2 has a resistance of 15 ohms (Ω). If the battery provides a voltage of 12 volts (**V**), we can calculate the total resistance and current flowing through the circuit:

Solution:

$$\begin{aligned} R_{Total} &= R_1 + R_2 \\ &= 10 + 15 \\ &= 25\Omega \end{aligned}$$

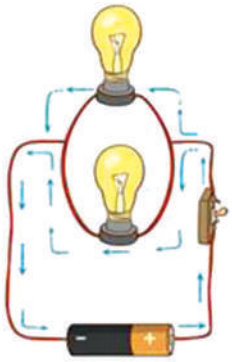
Using Ohm's Law, we can find the current:

$$\begin{aligned} I &= \frac{V}{R_{Total}} \\ &= \frac{12V}{25\Omega} \\ &= 0.48A \end{aligned}$$

So, the current flowing through the circuit is 0.48 amperes (A).

2.9.5 Parallel circuit

In a parallel circuit, each electrical component, like a light bulb, has direct connection to the power source, such as a battery. The setup shown below allows electricity to flow through each component independently, without affecting the others. So, if one component stops working, the others can still operate normally.



Parallel circuit

In the image shown above, Bulb 1 and Bulb 2 are connected to the circuit in parallel. So, when current flows, it gets distributed into two branches and only some amount of current flows through all the two bulbs of the total current.

Example of Parallel Circuit:

- Wiring of car headlights
- Household wiring
- Four slice toasters

Properties of Parallel Connection:

- **Separate Pathways:** Each bulb in the parallel connection has its separate pathway for the current to flow, so they operate independently.
- **Same Voltage:** The voltage across each bulb remains the same as the voltage of the power source.
- **Brightness:** Each bulb in a parallel connection receives the full voltage of the power source, so they will glow with equal brightness. However, if one bulb has low resistance, it will glow brighter compared to the other bulb.
- **Total Current Divides:** The total current flowing from the power source is divided among the branches of the parallel circuit, with the amount of current flowing through each branch depending on its resistance.

Simple Numerical Example:

Let us consider we have two bulbs connected in parallel. Bulb 1 has a resistance of 30 ohms (Ω), bulb 2 has a resistance of 20 ohms (Ω), and the battery provides a voltage of 12 volts (V). Since the bulbs are in parallel, they both receive a full voltage of 12 volts. Calculate the total resistance of the parallel circuit:

Solution:

We know the total voltage is 12V,

$$V = 12V$$

The voltage between bulbs will be equal.

We can use Ohm's Law

$$V = IR$$

To find the total resistance of the parallel circuit use the formula:

$$\frac{1}{R_{total}} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$\frac{1}{R_{total}} = \frac{1}{30\Omega} + \frac{1}{20\Omega}$$

$$\frac{1}{R_{total}} = \frac{2}{60\Omega} + \frac{3}{60\Omega}$$

$$\frac{1}{R_{total}} = \frac{5}{60\Omega}$$

$$R_{total} = \frac{60}{5}$$

$$R_{total} = 12\Omega$$

So, the total resistance of the parallel circuit is 12 ohms (Ω).

Now, to find the current (I) flowing through the circuit using Ohm's Law:

$$I = \frac{V}{R_{total}}$$

$$I = \frac{12V}{12\Omega}$$

$$I = 1A$$

Therefore, the current flowing through the circuit is 1 ampere (A).

Now we have understood the series and parallel circuits. Let's understand the difference between series and parallel circuits.

Differentiate between series and parallel circuits

Here's a simple differentiation between series and parallel circuits:

Series Circuit:

- Components are connected one after the other in a single pathway, forming a loop where the current flows sequentially through each component.
- The same amount of currents flows through all components in the circuit.
- Total resistance is the sum of the individual resistance.
- If one component fails or is disconnected, the entire circuit is interrupted, causing all components to stop working.

Parallel Circuit:

- Components are arranged in such a way that each component has its separate pathway for the flow of electricity.
- Each component operates independently.
- Total resistance is calculated differently, using the reciprocal sum of individual resistances.
- If one component fails or is disconnected, the others can still operate normally, as they are not dependent on each other for current flow.

Exercise 2

Answer the following Multiple-Choice Questions (MCQs):

1. What is electricity primarily characterized by?
   a) Movement of protons
   b) Movement of neutrons
   c) Movement of electrons
   d) Movement of photons

2. What are conductors and insulators primarily distinguished by?
   a) Color
   b) Texture
   c) Ability to hold onto electrons
   d) Ability to resist current flow

3. Which component of a battery contains atoms with extra electrons?
   a) Positive end
   b) Negative end
   c) Center
   d) Shell

4. What is the primary reason for a battery running out of energy?
   a) Loss of electrons
   b) Loss of protons
   c) Neutralization of atoms
   d) Loss of charge imbalance

5. Which type of current flows back and forth?
   a) Direct Current (DC)
   b) Alternating Current (AC)
   c) Static Current
   d) Hybrid Current

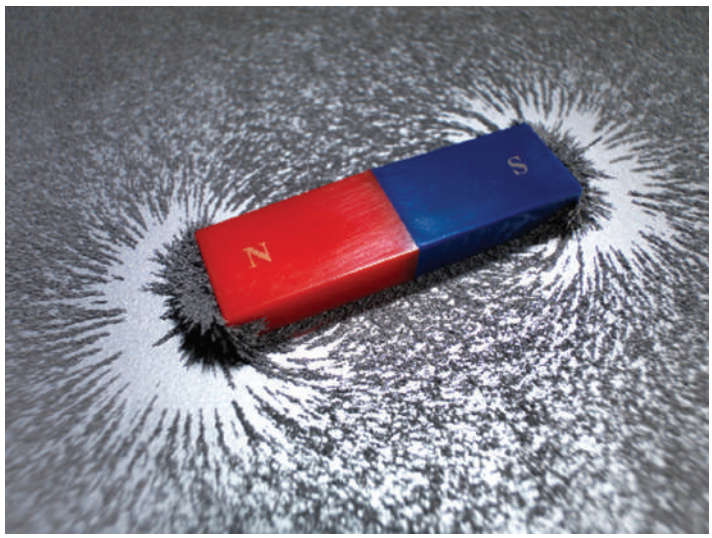
Module 3: Electromagnet

3.1 Introduction

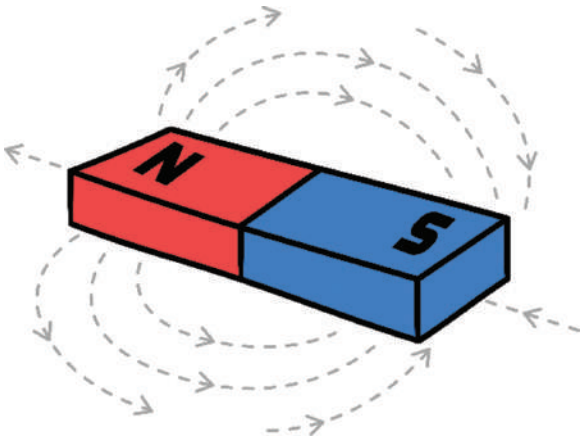
Objects that have a special power to attract certain materials like iron, nickel, and cobalt. They have been used by humans for thousands of years, from simple compasses to complex technologies like MRI machines. Lets understand what are magnets, and how do they work?

3.2 What are Magnets?

Magnets are special objects that can attract certain materials like iron, nickel, and cobalt. They have the power to pull or push things without touching them. This power is called a Magnetic field.



- **Magnetic Poles (North and South):** Every magnet has two ends called poles. One is called the North Pole, and the other is the South Pole. Opposite poles attract each other, while similar poles repel each other.

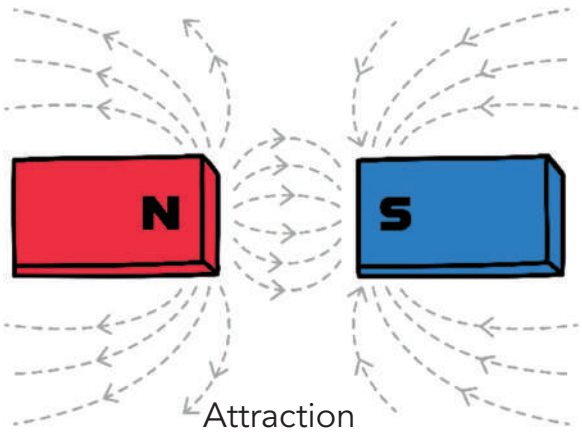


3.3 Importance in Modern Society

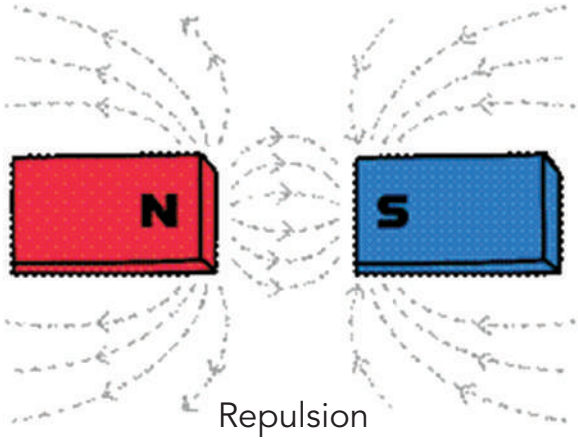
In today's world, magnets are everywhere! They're used in technology, medicine, transportation, and even in our homes. Without magnets, many modern inventions wouldn't be possible.

3.4 Properties of Magnets

- **Attraction and Repulsion:** Magnets can either pull things towards them (**attraction**) or push them away (**repulsion**), depending on how they're positioned.

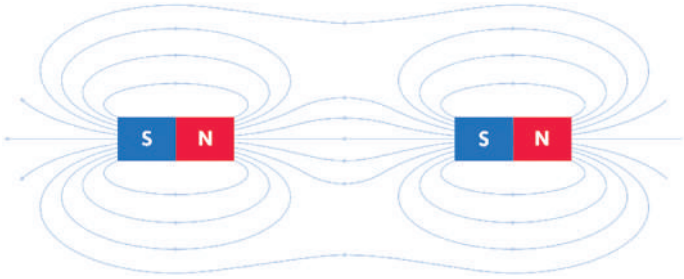


Attraction

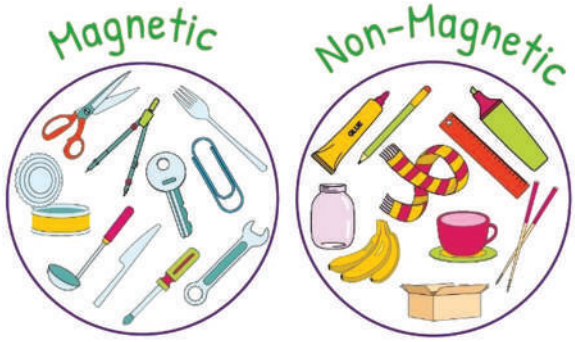


Repulsion

- **Magnetic Fields:** Imagine invisible lines around a magnet that show its power to attract things. These lines are called magnetic fields. It's kind of like a magnet's superpower that you can't see, but you can feel its effects and magnets come in various shapes.

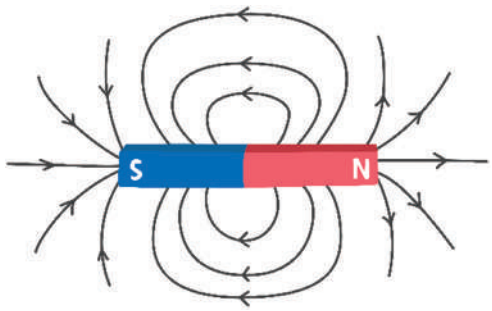


- **Magnetic Materials:** Some materials are naturally attracted to magnets, while others are not. It's like magnets have favourite materials they like to hang out with.

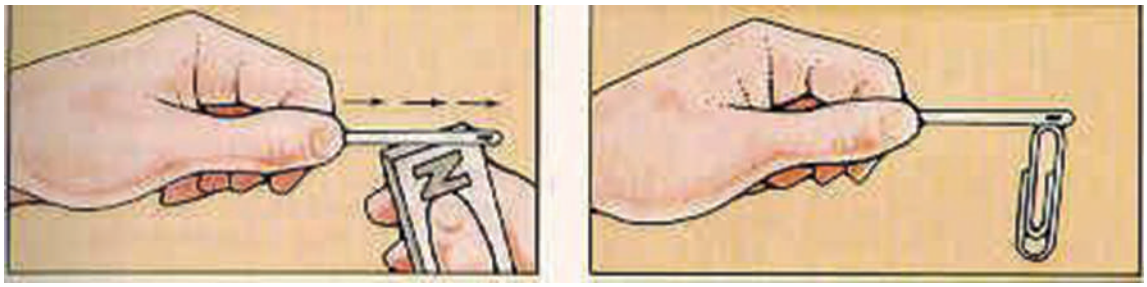


3.5 Types of Magnets

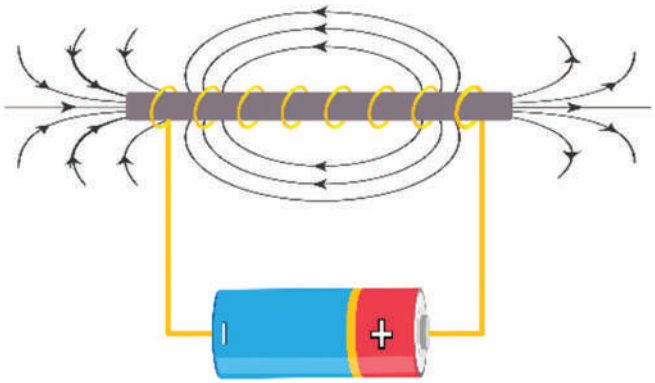
- **Permanent Magnets:** These are magnets that keep their magnetism all the time. They're like the superheroes of magnets.

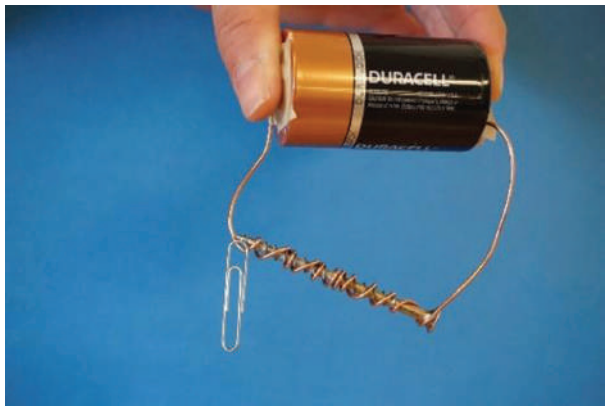


- **Temporary Magnets:** These magnets become magnetic when they're near a permanent magnet but lose their magnetism when the magnet is taken away. They're like magnets on vacation.

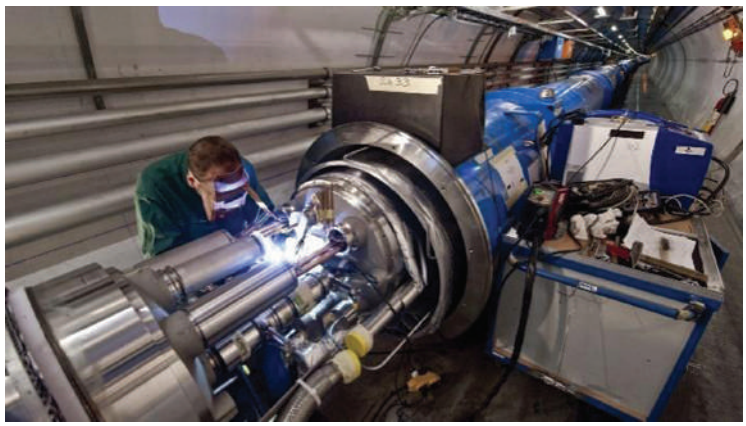


- **Electromagnets:** These are magnets made using electricity. They only work when electricity flows through them. They're like magnets that need a special power source to turn on.





- **Superconducting Magnets:** These magnets are extra powerful and work at super cold temperatures. They're like the champions of magnets.

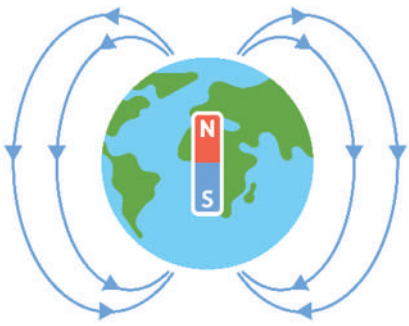


3.6 Applications of Magnets

- **Everyday Uses:** Magnets are used in everyday items like refrigerator magnets, toys, and compasses to make our lives easier.

- **Industrial and Technological Applications:** Magnets are used in machines like electric motors, MRI machines, and maglev trains for transportation and medical purposes.

- **Environmental and Scientific Applications:** Magnets are used in recycling to separate materials, in particle accelerators for scientific research, and to study Earth's magnetic field.



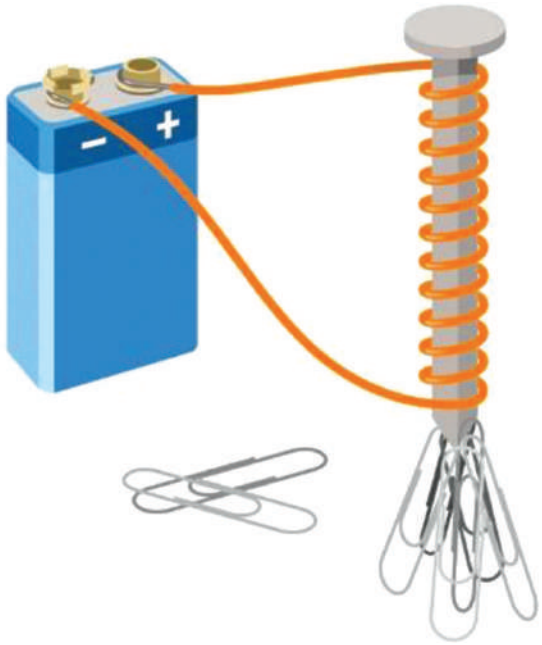
3.7 Electromagnets

Electromagnets are special magnets created by electricity. They only work when there's electricity flowing through them. When the electricity is on, they act like regular magnets, but when it's off, they stop being magnetic.

Now let's understand how it works.

How do Electromagnets Work?

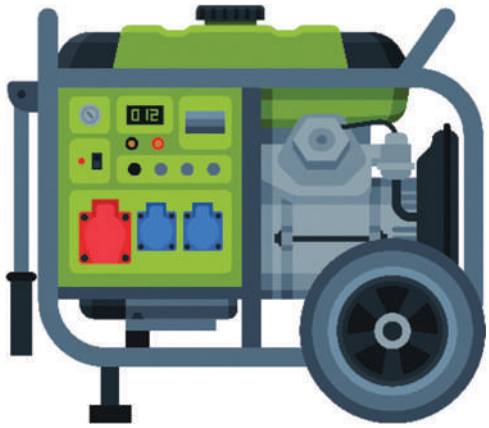
An electromagnet is a type of magnet that uses electricity to generate a magnetic field. It consists of a coil of wire wrapped around a ferrous core, such as iron or steel. When an electric current is passed through the coil, it creates a magnetic field that is much stronger than the magnetic field of the core alone. The strength of the magnetic field can be controlled by varying the amount of current flowing through the coil.



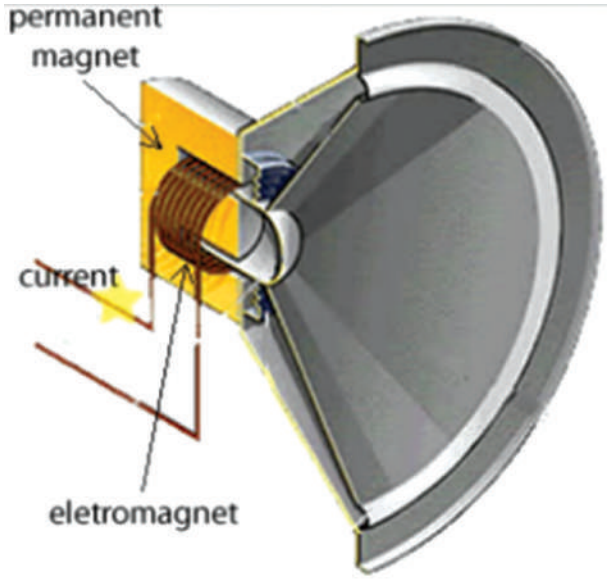
- **Importance and Applications:** Electromagnets are super important! They're used in many things we use every day, like electric motors, doorbells, electric motors, loudspeakers, headphones, and even in advanced machines like MRI scanners in hospitals.

Applications of Electromagnets:

- **Electric motors and generators:** Electromagnets are a fundamental component in electric motors and generators. The interaction between an electromagnet's magnetic field and permanent magnets or another electromagnet's field causes the motor to spin or the generator to produce electricity.



- **Loudspeakers and headphones:** Electromagnets are used in loudspeakers and headphones to convert electrical signals into sound waves. The current variations in the coil create a changing magnetic field that interacts with the diaphragm, causing it to vibrate and produce sound.



- **Data storage devices:** Electromagnets play a crucial role in data storage devices like hard disk drives (**HDDs**). The read/write head in an HDD uses a tiny electromagnet to magnetize tiny regions on the spinning platter, storing digital data.

- **Medical applications:** MRI machines (**Magnetic Resonance Imaging**) utilize powerful electromagnets to generate a strong magnetic field. This field interacts with the atoms in the body, allowing doctors to create detailed images of organs and tissues.

- **Magnets for lifting and sorting:** Electromagnets are widely used in industries to lift and separate heavy objects made of iron or steel. Scrap yards use them to pick up and move scrap metal while recycling facilities use them to separate steel from other materials.

- **Magnetic levitation:** The concept behind magnetic levitation trains (**Maglev trains**) relies on electromagnets. These powerful magnets create repulsive forces that levitate the train above the tracks, enabling frictionless and very high-speed travel.

- **Home appliances:** Even our everyday appliances can use electromagnets. Induction cooktops use rapidly changing magnetic fields to heat cookware directly, while electric doorbells and some fans rely on electromagnets for their operation.

Exercise 3

Answer the following Multiple-Choice Questions (MCQs):

1. What are the primary materials that magnets can attract?
   a) Aluminum and copper
   b) Iron, nickel, and cobalt
   c) Gold and silver
   d) Plastic and wood

2. What is the name given to the two ends of a magnet?
   a) Heads
   b) Tails
   c) North and south poles
   d) East and west poles

3. Which type of magnets keep their magnetism all the time?
   a) Temporary magnets
   b) Electromagnets
   c) Superconducting magnets
   d) Permanent magnets

4. Which are the devices based on the principle of electromagnet?
   a) Electric motors, generators, and loudspeakers
   b) Refrigerators and compasses
   c) MRI machines and maglev trains
   d) All of the above

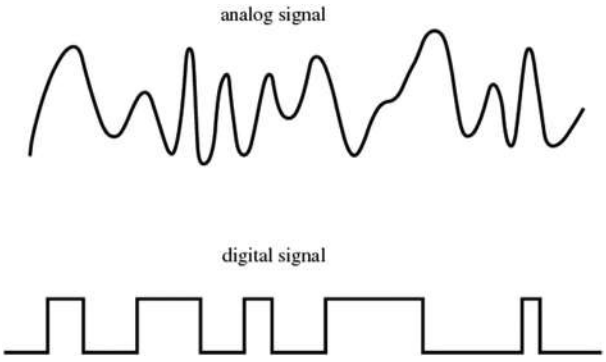
5. How is the strength of an electromagnet controlled?
   a) By varying the number of coils
   b) By changing the type of wire used
   c) By altering the temperature
   d) By adjusting the shape of the core

Module 4: Parts of Morse code

Module 5: Analog Signal

5.1 Introduction

An analog signal is a type of signal that changes smoothly and continuously. It represents information by adjusting its strength, speed, or timing without jumping between fixed values. It's a bit like a smooth wave that can rise and fall gradually. Analog signals are used in things like radios, where the sound gets transmitted smoothly, or in temperature sensors, where the signal changes gradually as the temperature changes.



5.2 Applications of Analog Signals in Communication

In communication, analog signals are used to send information smoothly, like in voice calls or radio broadcasts. Here are some better examples -

- **Voice Communication:** Analog signals have been traditionally used in telephone systems. When you speak on a phone, your voice is converted into electrical signals that vary in amplitude (**loudness**) and frequency (**pitch**). These signals travel through the phone line as analog waves, faithfully reproducing the sound at the receiving end.
- **Radio Broadcasting: AM** (**Amplitude Modulation**) and FM (**Frequency Modulation**) radio are examples of analog communication systems. In AM radio, the audio signal (**voice or music**) modulates the amplitude of a radio wave, while in FM radio, it modulates the frequency. These modulated radio waves are then

transmitted through the air and received by radios, where they're converted back into sound.

- **Television Broadcasting:** Analog signals were used in traditional television broadcasting before the transition to digital. In analog TV, the video and audio signals are combined into a single analog signal and transmitted over the airwaves. Televisions receive these signals, decode them, display the images and play the sound accordingly.
- **Electronic Communication and Modulation:** Electronic communication involves the exchange of information between devices using electronic signals. Modulation is a key technique used in electronic communication to transmit information efficiently over various mediums such as air (**wireless communication**) or cables (**wired communication**).

You can modulate (change) the current of the electricity to affect an outcome.

For example: the dimmer switch.

Electricity is flowing through the switch to your lamp.

When you turn the dimmer down, the current of the electricity goes down. Hence fewer electrons pass through the light bulb and the brightness of the light decreases.

Similarly, if you move the turner up a little, the current increases a little, and the light bulb gets a little brighter.

The signal that the dimmer switch sends to the light is analog.

analog signal doesn't have distinct values like "1", "2" or "3"

It is a range of values where there can be infinite values, like "1.1" or "1.0001," etc.

Advantages and disadvantages of analog signals compared to digital signals:

Advantages:

- **Smooth Sounds and Pictures:** Analog signals give us smooth and natural sounds and pictures, just like real life. This makes them great for things like talking on the phone or watching TV.
- **Easy to Use:** Analog systems are simple and easy to understand. They're like playing with toys that don't need any fancy gadgets.
- **Less Power Needed:** Analog signals don't need as much power to work, which means they can be more energy-efficient in some cases.

Disadvantages:

- **Gets Messy Easily:** Analog signals can get messed up by other noises around them. It's like trying to hear someone talking in a noisy room – sometimes it's hard to understand them.
- **Can't Stay Perfect Forever:** Analog signals can lose their quality over long distances or if they travel through lots of things like wires and machines.
- **No Fixing Mistakes:** If something goes wrong with an analog signal, there's no easy way to fix it. It's like making a mistake while drawing with crayons – you can't just press undo.

That's why we also use digital signals for things like computers and the internet – they're better at staying clear and fixing mistakes.

Exercise 4

Answer the following Multiple-Choice Questions (MCQs):

1. What is the main characteristic of analog signals?
   a) They represent information using discrete values.
   b) They change abruptly between fixed values.
   c) They change smoothly and continuously.
   d) They are digital and discrete.

2. Which modulation techniques are used in traditional radio broadcasting?
   a) Pulse Width Modulation (PWM)
   b) Frequency Modulation (FM)
   c) Amplitude Modulation (AM)
   d) Phase Modulation (PM)

3. What is the advantage of analog signals over digital signals?
   a) Less susceptible to interference
   b) Can stay perfect forever
   c) Easy to fix mistakes
   d) Smooth and natural sounds and pictures

4. What is modulation primarily used for in electronic communication?
   a) Decreasing signal clarity
   b) Increasing signal strength
   c) Reducing power consumption
   d) Transmitting information efficiently

5. Why are digital signals preferred for computers and the internet
   a) They require less power.
   b) They are less susceptible to interference.
   c) They provide smoother sounds and pictures.
   d) They are better at fixing mistakes and staying clear

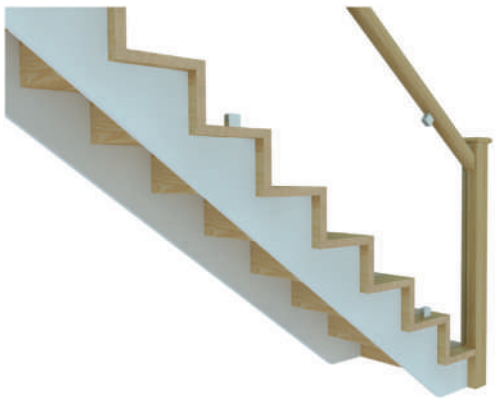
Module 6: Digital Signal

6.1 Introduction

A digital signal is a type of signal that represents information using discrete values, typically binary digits known as bits. Unlike analog signals, which vary continuously in amplitude, frequency, or phase, digital signals have fixed levels or states, usually represented as 0s (**off**) and 1s (**on**).

Think of a slide as being Analog.

Think of stairs as being Digital.



6.2 Applications of Digital Signals

- **Digital photography:** Digital photography provides an excellent example of how digital signals work.

In digital photography, each photo is a grid of squares. For black and white photos, each square has a value that corresponds to how bright the square is.

This number is between 0 & 255 and codes for how dark the square is. The photo is digital because there are only 256 unique values of brightness.

Chapter: Morse Code Project

How your digital Morse code project works

You translate a message into a series of dots and dashes, which you tap out using your button.

The taps are read by your Arduino. Your code calculates how long the button was held down for each tap.

Time:

To know how long the button has been held down, we need to know the time the tap started and the time the tap ended.

Duration = Time Tap Ended – Time Tap Started

Transition:

At the start of a tap, the button goes from being up to being down. This change is called a **transition**.

At the end of the tap, the button goes from being down to being up. This change is also a **transition** but in the opposite way.

To find the duration of a tap, we use this formula:

Duration = Time Tap Ended – Time Tap Started

Duration = (Time at Transition from Down to Up) – (Time at Transition from Up to Down)

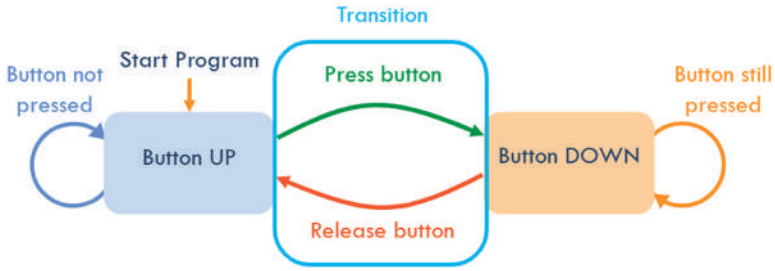
State:

To figure out when these transitions are, we need to know which State the button is in at any particular time.

States: Up or Down

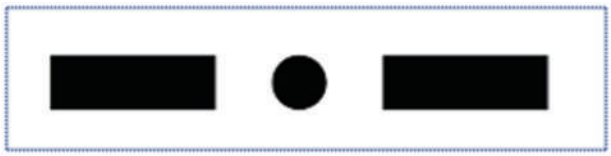
And if that state has recently changed. The coding process of detecting a state change is called a State Machine.

State Machine Diagram:

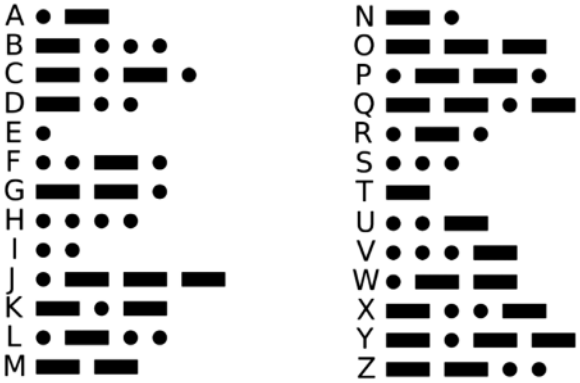


Based on how long the tap was, it is categorized into a '**dot**' or a '**dash**.'

The dots and dashes are put together in a set. A set is separated from another set by a long pause.



The set is translated into a letter.



You send the letter to your partner.

Your partner's Arduino receives the letter and displays it on his/her LED matrix.

Exercise 5

Answer the following Multiple-Choice Questions (MCQs):

1. What distinguishes a digital signal from an analog signal?
   a) Digital signals vary continuously.
   b) Digital signals have fixed levels or states.
   c) Digital signals represent information using continuous values.
   d) Digital signals are represented by waves.

2. In digital photography, how many unique values of brightness are typically used?
   a) 100
   b) 256
   c) 500
   d) 1000

3. How does the Morse code project calculate the duration of a tap?
   a) By measuring the amplitude of the tap.
   b) By counting the number of taps.
   c) By calculating the time the tap started and ended.
   d) By measuring the frequency of the tap.

4. What is a transition in the context of the Morse code project?
   a) A change in state from up to down.
   b) A change in state from left to right.
   c) A change in brightness of the LED.
   d) A change in the frequency of the button tap.

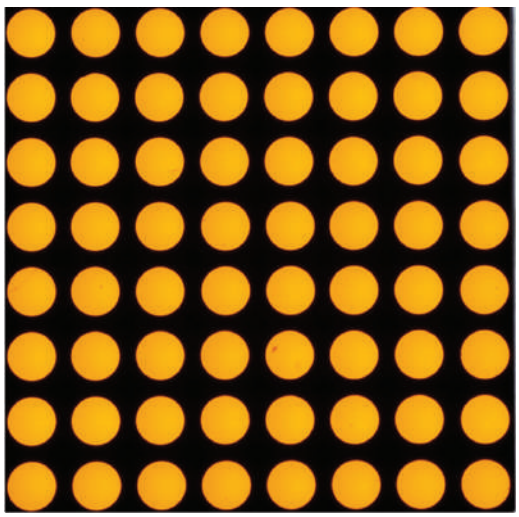
5. What is used to categorize a tap in the Morse code project as a 'dot' or a 'dash'?
   a) The number of transitions.
   b) The intensity of the tap.
   c) The duration of the tap.
   d) The frequency of the tap.

Module 7: LED Matrix

Light matrixes are commonly used in large displays because they are cheaper and more durable than screens.

7.1 Our LED Matrix

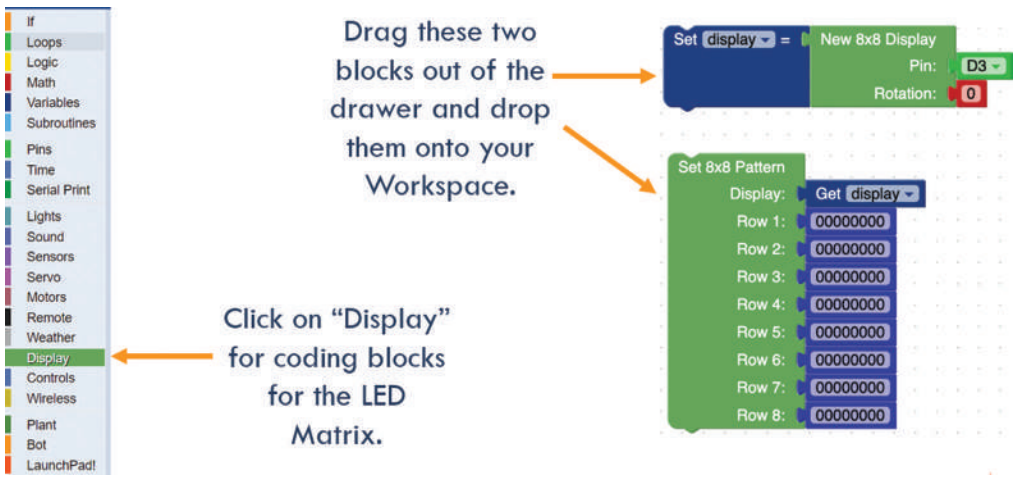
- Our Light matrix is an 8x8 LED grid.
- We have 64 LEDs in our Matrix
- We can program each LED to turn on or off.
- All the lights on this LED Matrix are yellow.



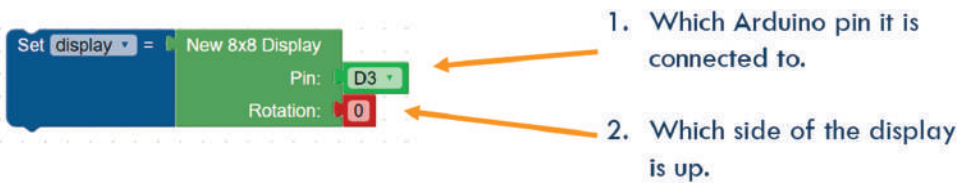
7.2 Uses of LED Matrix

We have seen LED matrix used in traffic lights, scoreboards, architecture etc.

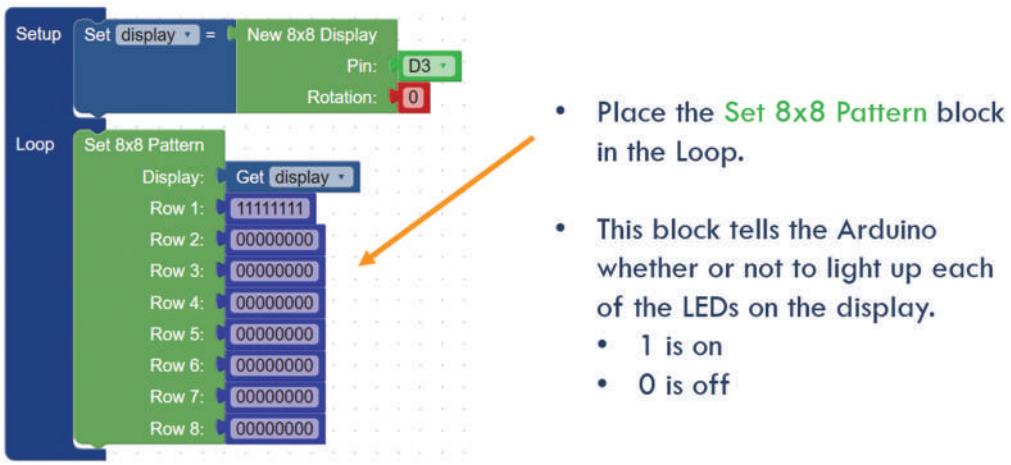
Programming LEDs



LED Setup



Programming Display



Exercise 6

A. Answer the following Multiple Choice Questions (MCQs):

1. What is an LED matrix?

a) A type of display made of light-emitting diodes (LEDs) arranged in rows and columns

b) A type of battery used to power LEDs

c) A software program for controlling LED lights

d) An electronic component used to amplify LED signals

2. How are LEDs typically arranged in an LED matrix?

a) In a single row

b) In a single column

c) In multiple rows and columns

d) In a circular pattern

3. What is the purpose of an LED matrix?

a) To display images or text

b) To generate electricity

c) To emit heat

d) To store data

4. How is each LED controlled in an LED matrix?

a) Individually

b) In groups

c) By random selection

d) Automatically

5. Which of the following is a common application of LED matrices?

a) Traffic lights

b) Microwave ovens

c) Vacuum cleaners

d) Toaster ovens

6. What is the term used to describe the process of controlling the brightness of LEDs in an LED matrix?
   a) Dimming
   b) Amplification
   c) Brightening
   d) Filtering

7. Which of the following statements about LED matrices is true?
   a) They can only display one colour.
   b) They are only used in outdoor lighting.
   c) They are not suitable for displaying images.
   d) They can display multiple colours and patterns.

B. State True or False:

1. The LED matrix used in the Morse Coding project is 8x4.
2. In programming LED s “0” stands for “ON” and “1” stands for “OFF”.

Module 8: Wireless Transmission

8.1 Introduction

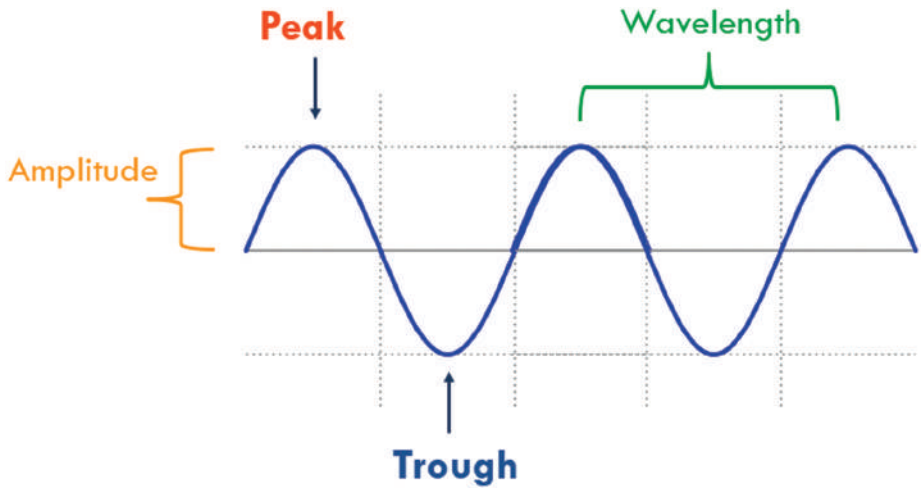
Wireless communications use electromagnetic radiation to transmit information over distances without physical connections like wires or cables. Electromagnetic radiation is the scientific word for light.

Light travels through space in waves that have a repeating pattern of peaks and troughs.

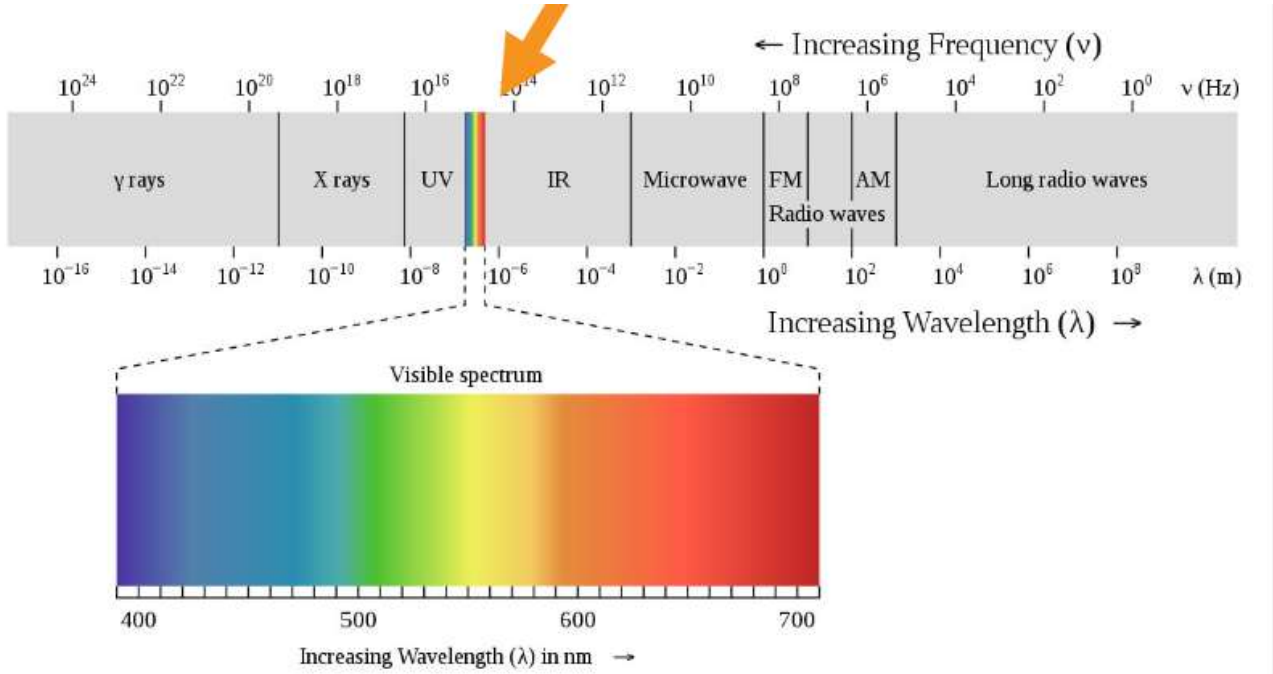
We define these waves with 3 different measurements

- **Amplitude:** Amplitude is the height of a wave and relates to the energy of a wave. In a periodic wave (a wave that fluctuates regularly) it is half the distance between the peaks and the troughs (bottom points of the curve).
- **Wavelength:** Wavelength is the physical distance between 2 peaks. These can vary from fractions of nanometers to kilometres.
- **Frequency:** Frequency is the number of peaks in a unit of time. It is a measure of speed. If you are standing on a beach and 10 waves hit the shore in a minute, then the frequency would be 10 per minute.

Wavelength and Frequency are two sides of the same coin. As wavelength increases, frequency decreases.



8.2 Electromagnetic waves

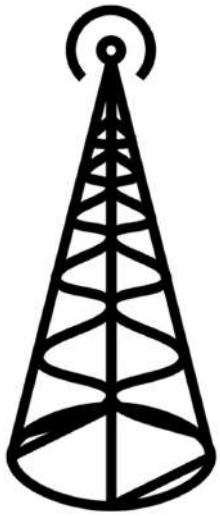


Examples of some wireless devices and their frequency:

1. AM radio – 535 KHz – 1.7 MHz
2. Garage door openers – 40 MHz
3. Baby monitors – 49 MHz
4. R/C airplanes – 72 MHz
5. R/C cars – 75 MHz
6. FM radio – 88-108 MHz
7. Wildlife tracking collars – 215-220 MHz
8. Cell phones – 824-849 MHz
9. Air traffic control radar – 960 MHz-1.215 GHz
10. Global positioning system (GPS) – 1.227-1.575 GHz
11. Deep space radio communications – 2.29-2.30 GHz
12. Our NRF transceiver – 2.4 - 2.525 GHz
13. Wi-Fi router – 2.5 GHz - 5 GHz

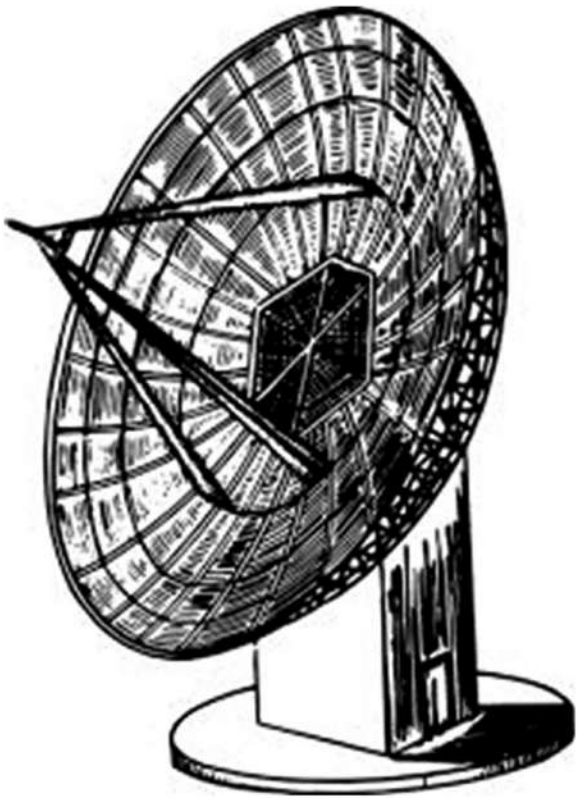
8.3 Transmitter

Transmitters are anything that sends out a wireless signal like radio stations, cell phones, remote controllers, etc. Transmitters can create Electromagnetic waves by turning an electromagnet on and off. This pattern of the ON and OFF creates waves of varying frequency.



8.4 Receiver

The waves the transmitter makes are called a signal. This signal can be picked up by a receiver that is looking for that specific wavelength. This is how different devices like radios work by selecting a frequency.



Exercise 7

A. Answer the following Multiple-Choice Questions (MCQs):

1. What is wireless transmission?

a) Sending data through physical cables
b) Sending data through electromagnetic waves
c) Transmitting data using infrared light
d) Broadcasting data through satellite signals

2. Which of the following is not a form of wireless transmission?

a) Bluetooth
b) Wi-Fi
c) Ethernet
d) Cellular networks

3. What is the primary advantage of wireless transmission?

a) Higher data transfer rates
b) Lower cost of implementation
c) Flexibility and mobility
d) Better security

4. Which technology is commonly used for short-range wireless communication between devices?

a) Wi-Fi
b) Bluetooth
c) Cellular
d) Satellite

5. Which frequency band is commonly used for Wi-Fi wireless transmission?

a) 2.4 GHz
b) 5 GHz
c) Both a and b
d) None of the above

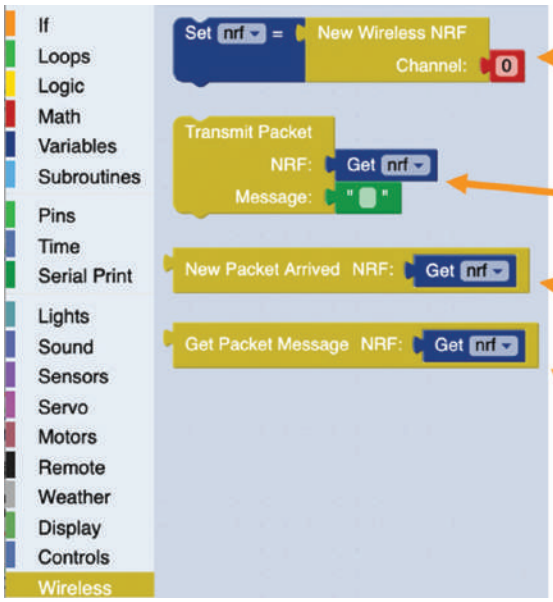
6. What is the range of Bluetooth wireless technology typically?
   a) Up to 10 meters
   b) Up to 100 meters
   c) Up to 1 kilometer
   d) Up to 10 kilometres

B. Fill in the blanks

1. _____ is the process of transmitting data without the use of physical cables.
2. Wireless transmission utilizes _____ waves to carry data between devices.
3. Bluetooth is a short-range _____ technology commonly used for connecting peripherals like keyboards and mice to computers.

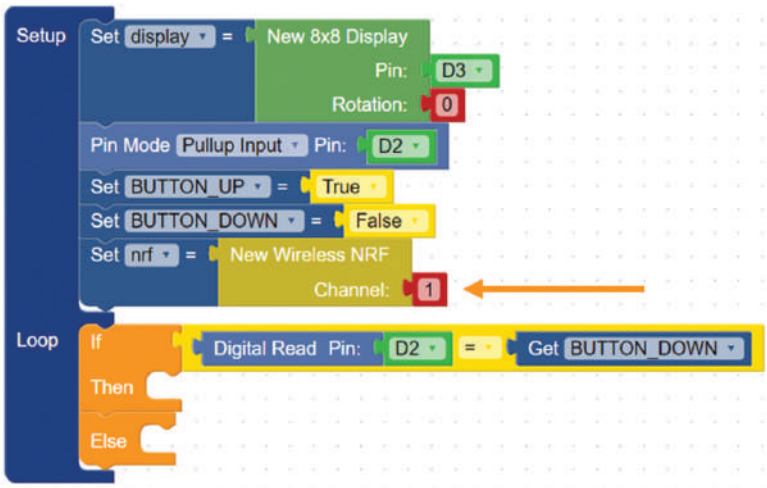
Module 9: Coding Wireless

9.1 Programming NRF Chip



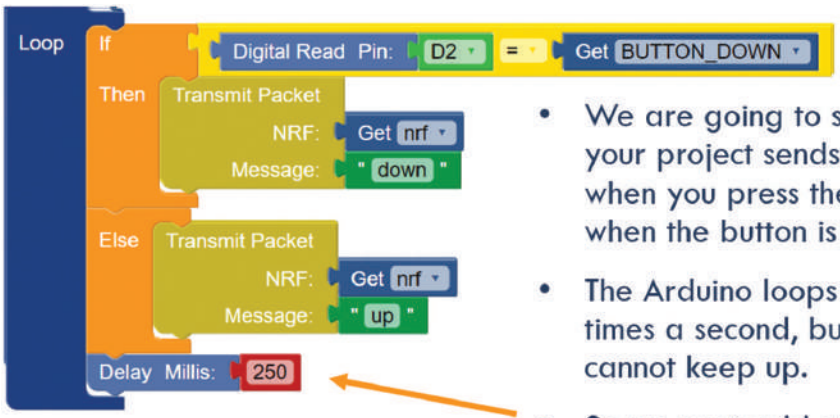
- Sets up the NRF chip and selects a channel to communicate on
- Sends a message
- Checks if you have received a message
- Reads a received message

9.2 Channel Set up



- Add the Set NRF block to your setup.
- Decide which channel you're going to use with the partner project – both need to be on the same *wavelength!*

9.3 Sending message

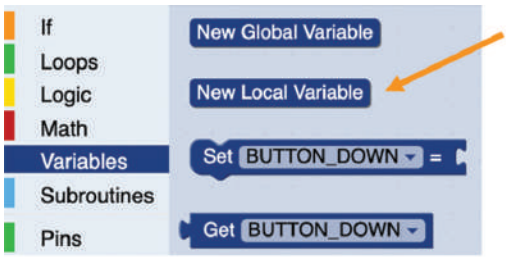


- We are going to set up code so that your project sends the word "down" when you press the button and "up" when the button is not pressed.
- The Arduino loops your code many times a second, but the NRF chip cannot keep up.
- So we must add a small delay to slow it down to a rate that the NRF chip can handle.

9.4 Receiving a message

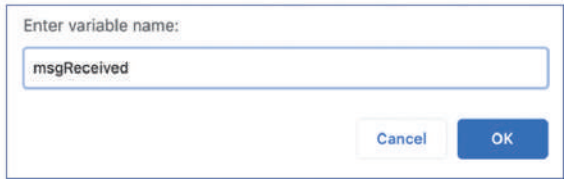
- Receiving a message has two stages.
- First, the code must check whether a new message (packet) has arrived.

- Next, the code must fetch the message. To do that, we'll need a new variable to hold the message.

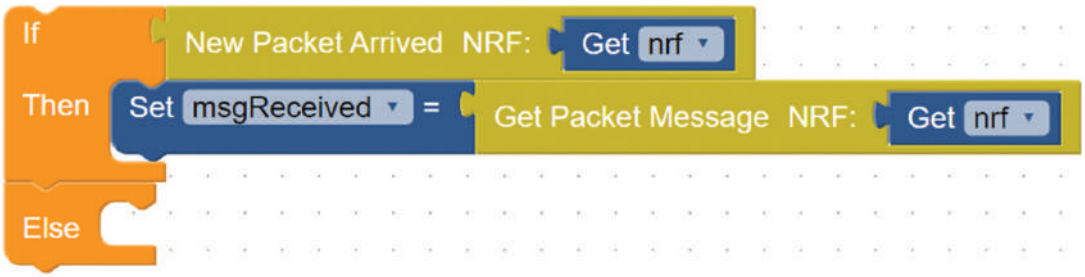


Create a new local variable

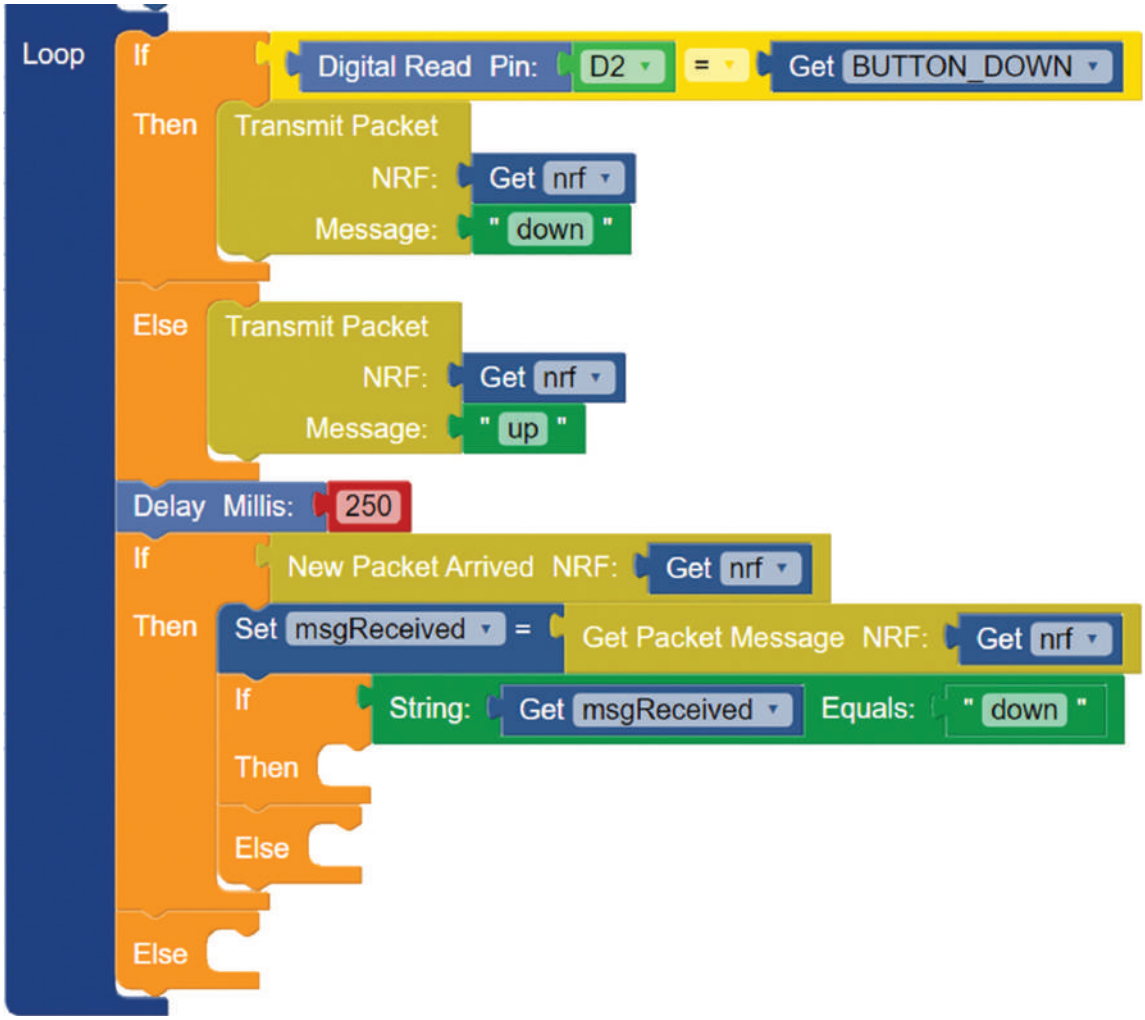
Name it msgReceived
(short for "message received")



- Now, add code to fetch the message and put it into the new variable.



9.5 Final Code



Answer Key

Exercise 1

Multiple Choice Questions (MCQs)

1. c) Telegraph communication
2. c) Key
3. c) To receive incoming messages
4. a) Verbal Communication
5. c) It facilitates quick and efficient sharing of messages.

Exercise 2

1. c) Movement of electrons
2. c) Ability to hold onto electrons
3. b) Negative end
4. a) Loss of electrons
5. b) Alternating Current (AC)

Exercise 3

1. b) Iron, nickel, and cobalt
2. c) North and South poles
3. d) Permanent magnets
4. d) All of the above
5. a) By varying the number of coils

Exercise 4

1. c) They change smoothly and continuously.
2. c) Amplitude Modulation (AM) and B) Frequency Modulation (FM)
3. d) Smooth and natural sounds and pictures
4. d) Transmitting information efficiently
5. d) They are better at fixing mistakes and staying clear.

Exercise 5

1. b) Digital signals have fixed levels or states.
2. b) 256
3. c) By calculating the time the tap started and ended.
4. a) A change in state from up to down.
5. c) The duration of the tap.

Exercise 6

Answer the following MCQ's

1. a) A type of display made of light-emitting diodes (LEDs) arranged in rows and columns
2. c) In multiple rows and columns
3. a) To display images or text
4. a) Individually
5. a) Traffic lights
6. a) Dimming
7. d) They can display multiple colours and patterns.

State True or False

1. False
2. False

Exercise 7

Multiple-choice questions

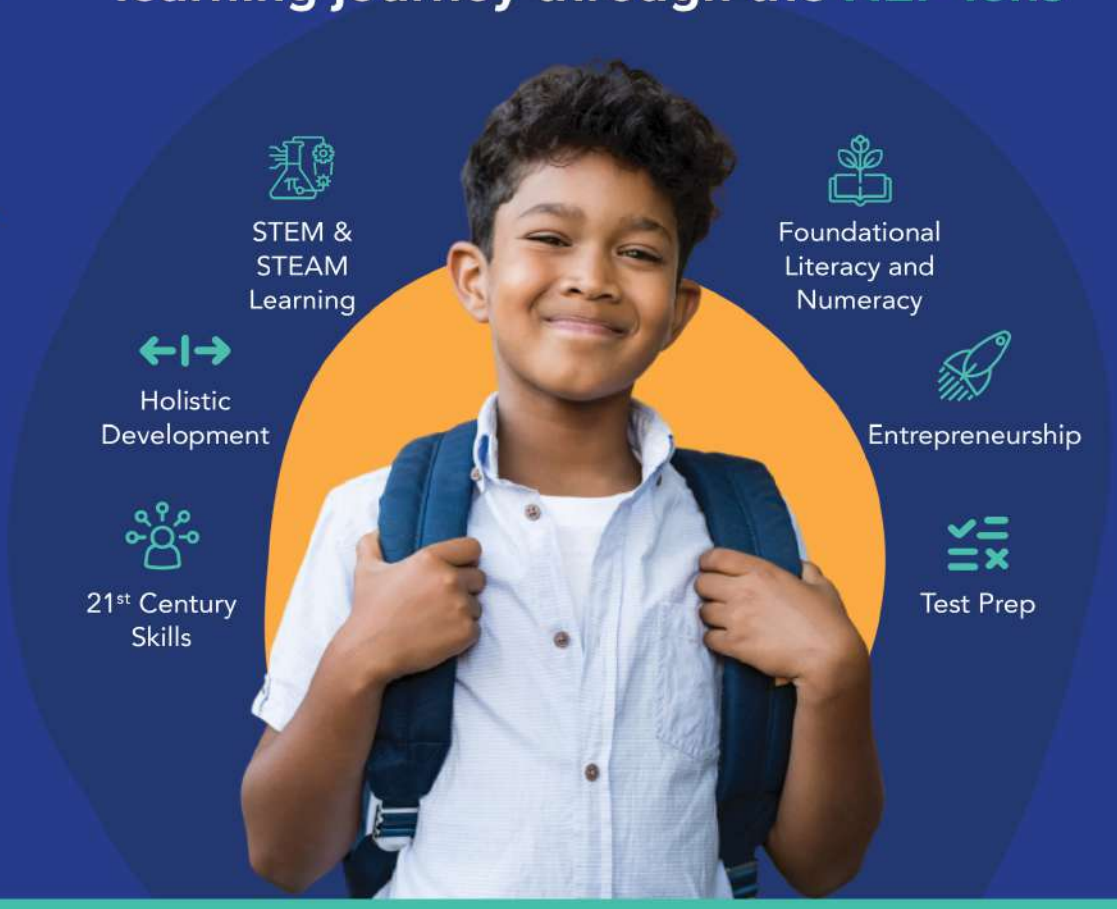
1. b) Sending data through electromagnetic waves
2. c) Ethernet
3. c) Flexibility and mobility
4. b) Bluetooth
5. c) Both a and b (2.4 GHz and 5 GHz)
6. a) Up to 10 meters

B. Fill in the blanks

1. Wireless transmission
2. Electromagnetic
3. Wireless

GET SET LEARN

Get Set Learn helps you personalise your learning journey through the NEP lens



ABOUT GET SET LEARN

We are reimagining school education for the 21st century. Our focus is to build better learning experiences for schools and students. We aim to curate the learning needs of students across multiple grades and age groups onto a single platform and enable schools with new-age solutions to address the challenges of the digital future and the National Education Policy. Get Set Learn is an Arvind Mafatlal Group Company - a 100+ year old conglomerate that has served the school ecosystem for decades.

SCAN TO LEARN MORE

www.getsetlearn.info

+91 8792740014 mailus@getsetlearn.info

www.getsetlearn.info