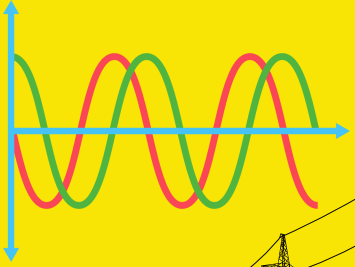
MILO'S MOSFET ADVENTURE

BY YAFET A HAILU

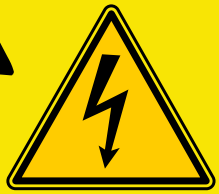

Hi kids! My name is milo, the MOSFET puppy!
And today, I will woof you all there is
to know about my favorite
electrical component--the MOSFET!!
hmmmm... I wonder
do you know what a mosfet is?
Try to guess before we embark on the
journey ahead. Woof!
Hello

If you don't know, do not worry!
that is why I'm here.
First, let me introduce you to
my old pal Collie, the computer.
She will tell you the most important
things to know before MOSFETS
Say Hi Collie!

Hi guys! I'm Collie. I'm a computer. And guess what, I am made of millions of MOSFETS! You'll find out how later. I will now tell you some important terminologies you should know before MOSFETS. Let's start with a circuit.
A circuit is a path that electricity can travel on. It is made of components like wires, LEDs, battery and of course MOSFETs. Think of wires like roads for electricity to travel on.

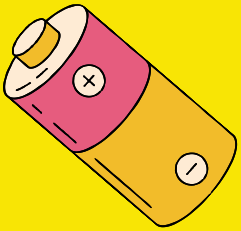


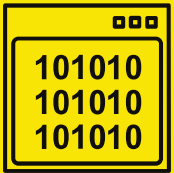
An electric signal refers to the flow of electricity through a material, typically used to convey information or perform tasks within electronic devices. For electricity to travel through wires, it needs to be pushed from one side (the source of electricity) to another. There is a stored energy that does this and it's called voltage. Voltage is measured in Volts



Electricity CANNOT flow without the help of voltage!!

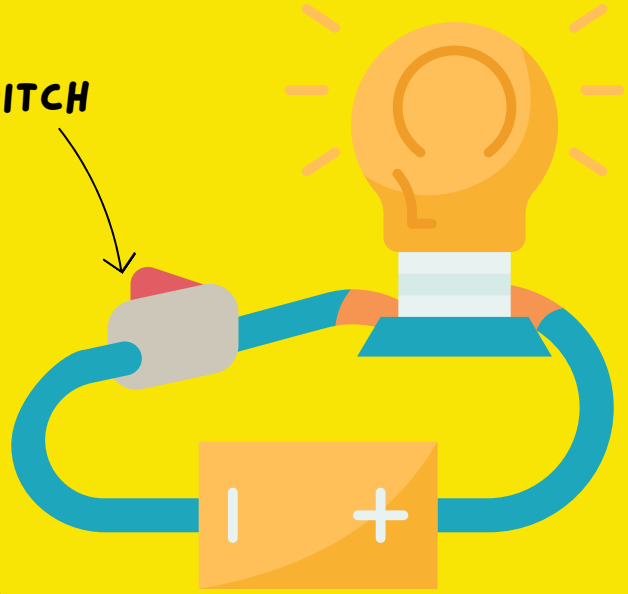
A "low" voltage level generally represents a state that is close to 0 volts. It means there is little or no electric signal. It is represented by a 0.
A "high" voltage level represents a state which is closer to the voltage of the source or a designated voltage level. It indicates the presence of an electric signal and is represented by a 1.

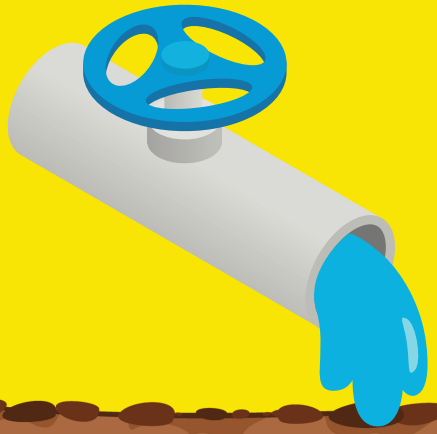




Okay guys. Let's see some more common terms used when talking about MOSFETs
Electric current is the flow of electricity through materials called conductors, like wires. Think of it as a flow of tiny particles called electrons that move from one place to another. Just like water flowing through a pipe, electric current flows through a wire.

A nice example that you may see everyday is a lamp like mine over here.
If we connect a lamp to a battery, it will turn on. We can manually control when it should turn on and off by adding a switch to our circuit.
Like the one I made here.



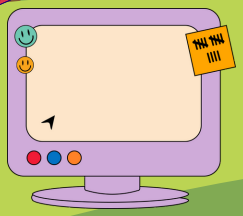


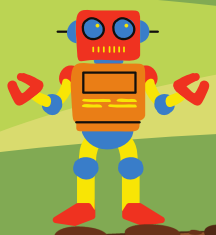
WOOW! that was great Collie. While you're at it, can you also tell our friends about what MOSFETs actually are? I have to get me some delicious barbeque. all this cool science stuff is making me hungry! woof!

of course milo! Don't forget to Save me some too!

Feed Time

A transistor is an electronic device that can amplify or switch electric signals.
A MOSFET is a type of transistor that works like gates that allow or prevent and also control the flow of electric current and is made of a special material called Metal Oxide Semiconductors.
Pheww! Sounds like a lot huh?
let's break it down.



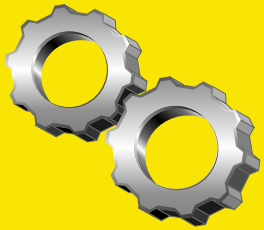


DID YOU KNOW?

TRANSISTORS ARE FOUND IN NEARLY ALL DIGITAL GADGETS, FROM COMPUTERS (LIKE ME) TO CALCULATORS, AND EVEN ROBOTS. WITHOUT THEM, THE WAY WE LIVE WOULD BE COMPLETELY DIFFERENT.

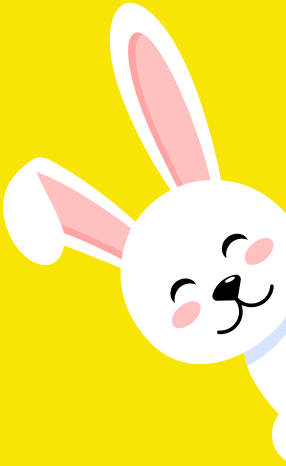
INTERESTING FACT

In a MOSFET, a metal layer is used for the gate electrode part. The gate electrode controls the flow of electric current through the MOSFETs.

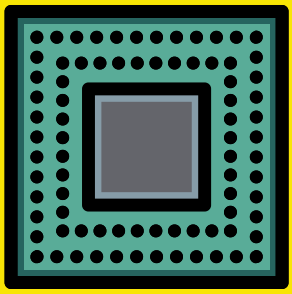


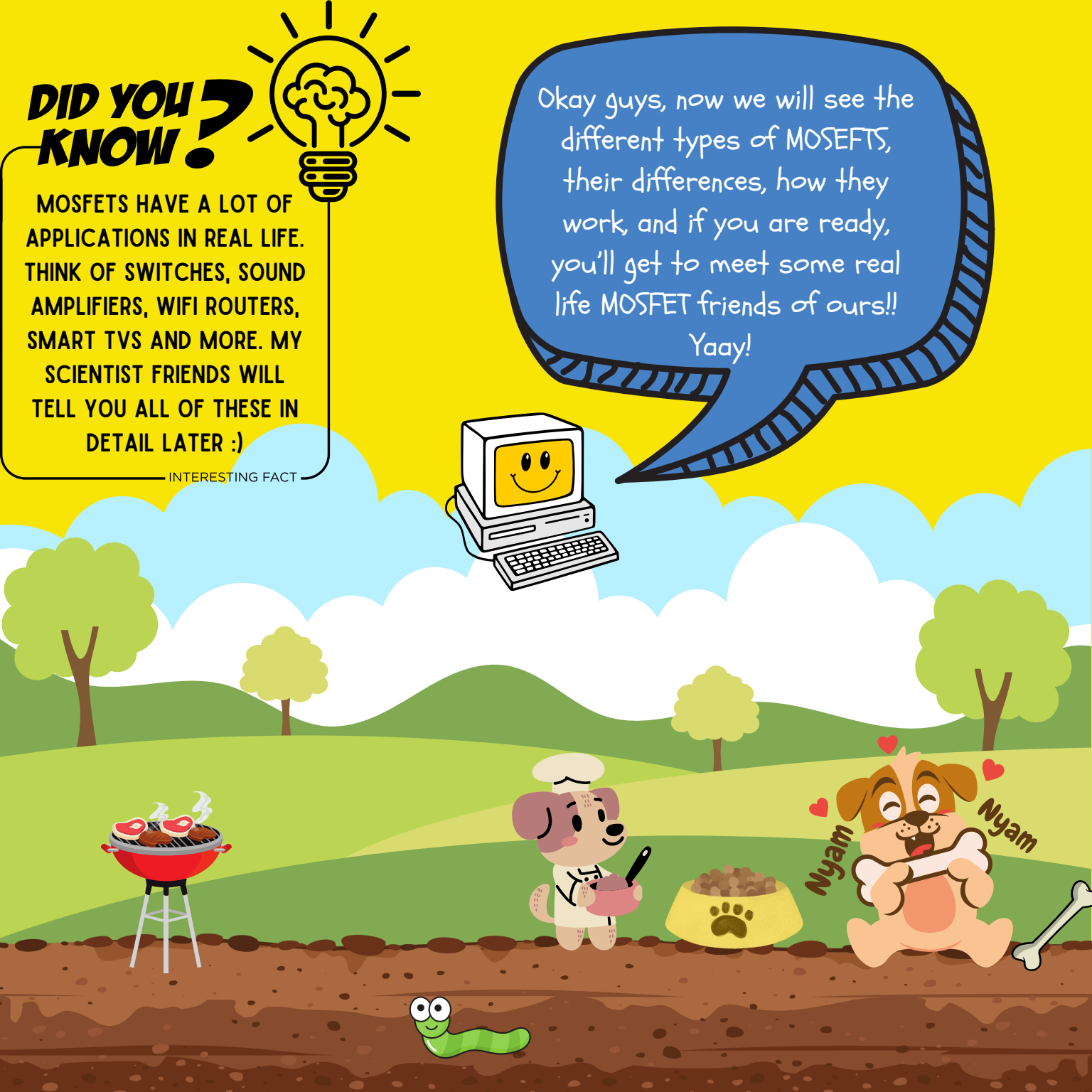
The oxide is a layer that does not allow electric current to pass. It separates the gate electrode from the semiconductor material.

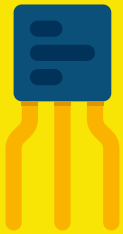
SiO_2



A semiconductor is a material that can conduct (like metal) or not conduct (like rubber) when needed. In a MOSFET, the semiconductor material is typically silicon, which has properties that allow it to control the flow of current.




DID YOU KNOW?
MOSFETS HAVE A LOT OF APPLICATIONS IN REAL LIFE. THINK OF SWITCHES, SOUND AMPLIFIERS, WIFI ROUTERS, SMART TVS AND MORE. MY SCIENTIST FRIENDS WILL TELL YOU ALL OF THESE IN DETAIL LATER :)
INTERESTING FACT
Okay guys, now we will see the different types of MOSEFTS, their differences, how they work, and if you are ready, you'll get to meet some real life MOSFET friends of ours!! Yaay!
Nyam
Nyam



GATE(G)

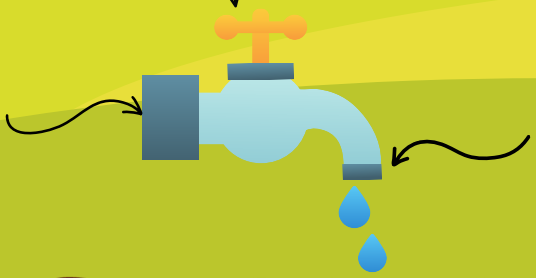
SOURCE(S)

DRAIN(D)

Guess who's back! All fed and strong! On my right, you can see a MOSFET. MOSFETs come in different shapes and sizes, but they all have something in common – they have three legs! Each leg has its own special function. Let's take a closer look!

Gate controls the flow of electric current through the MOSFET. By adjusting the voltage coming to the gate, we turn the MOSFET on or off (1 or 0 signal), just like opening or closing the valve of a faucet to allow more or less water to flow.

Drain is the terminal from which electric particles flow towards the source. This is similar to when we turn on a faucet, and water flows from the pipe towards us.



Source - is where current flows from when the MOSFET is switched on. Think of it as the spout of a water tap. When you turn on the tap, water flows out from the spout, just like when the MOSFET is activated, electric current flows from the source.

Let me tell you some more things about Ground and High voltage sources in electronic systems.

Ground:

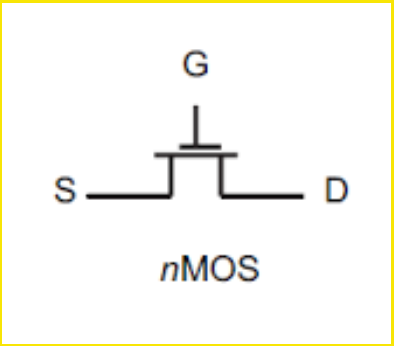
Imagine you are playing a game with your friends, and you want to make sure that everyone is on the same level. In electronics, "ground" is like that level playing field. It is a reference point that we use to measure and compare voltages. It's like a starting point for measuring electrical signals. Its symbol looks like a triangle pointing downwards.

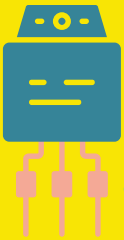
High:

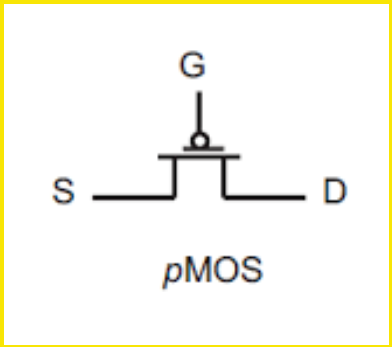
When we talk about "high" in electronics, we mean a higher voltage level compared to ground. Imagine you have a toy car that is on a ramp. When the car is at the top of the ramp, we can say it is at a "high" position. Similarly, in electronics, when we say a voltage is "high," it means it has a higher value compared to ground.

There are two types of MOSFETS.
An n-type MOSFET, commonly called an nMOS, and a p-type MOSFET, which we call a pMOS. So what are nMOS and pMOSes?

An nMOS is formed by an n-type semiconductor material. n-type material has a lot of electrons in its main part called the substrate.
nMOSes like high voltages. When we apply a high voltage to them, their gates open and let electric current flow from Drain to Source. We always connect the source of an nMOS to ground reference voltage.







PMOS is formed by an p-type semiconductor material. p-type material has a lot of positive electric charge carriers in its substrate.
pMOSes like low voltages. When we send a low voltage to them, their gates open and let electric current flow from Source to Drain. We always connect the source of a pMOS to high reference voltage.

GAME TIME!!

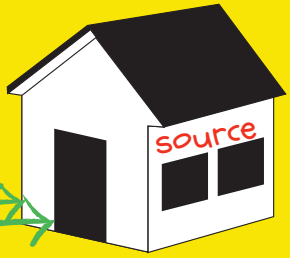
Let's all be electric currents for a minute. And to be an electric current we have to always move when there is voltage pushing us. Now imagine a house. Let's think of the house as the Source of a MOSFET. And the outside as the Drain. The door to the house is...you guessed it, the Gate of the MOSFET! Let's think of a push as a high voltage (1) and a pull as a low voltage (0).

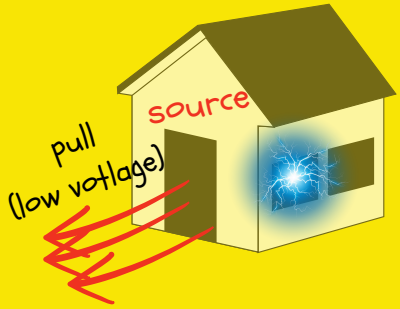
Hi guys, my name is nuff, the nMOS. I will tell you the rules to get into the house. The door will only open when you push it. Which means applying high voltage to the MOSFET's gate. It will not open if we pull it. That is how we nMOSes work. Once u enter the house u are now in the source of the nMOS.

Hey guys, my name is puff, the pMOS. And I will show how you can leave the house. If we wanted to move from the source to the drain, it's like going outside from the house. To go out we have to pull the door, not push it. This is the same as applying low voltage. This is how we pMOSes work.

ELECTRIC CURRENT

push (high voltage)





pull (low voltage)

Drain

Drain

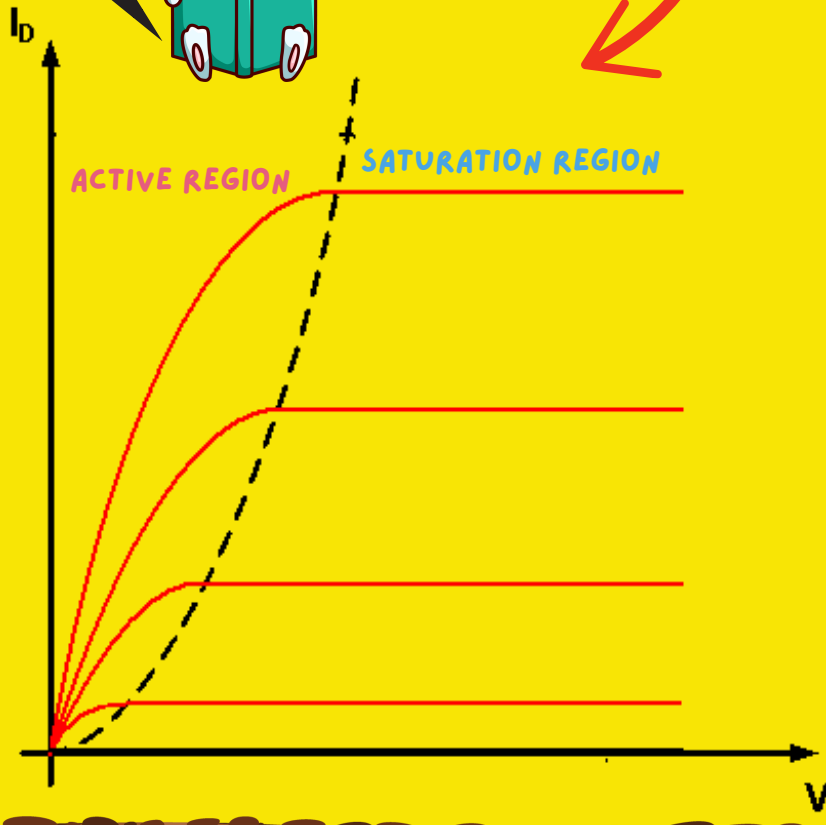
I will now introduce you to my other best friends Bonz, Bo, and Bombon from the world class famous bunny scientists association. They are really excited to meet you and tell you all the ways MOSFETs can be used.

Thank you Milo! Hey guys, We are soooo glad to finally meet you!

MOSFETs can be used in various ways. There are two main ways in which they work. To understand their behavior, we use a special graph called an operating curve. This curve tells us how the MOSFET behaves in different situations. The operating curve looks like a line that goes up and then levels off. We can divide it into two parts.

The first part of the curve, the one that goes up, is like a ramp. It's called the "linear region". In this region, the MOSFET acts like an amplifier. Think of a volume knob on a radio. When you turn the knob a little, the sound gets a little louder. When you turn it more, the sound gets even louder. That's how the MOSFET amplifies signals. It makes small signals bigger.

The second part of the curve, where the line levels off, is called the "saturation region." When the MOSFET is in this region, it acts like a switch that can let a lot of electricity flow or block it completely. It's like turning a faucet all the way on or all the way off.

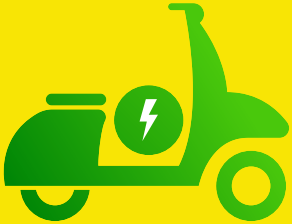


DISUCSSION TIME!

Okay kids! We are almost at the end of our journey. So before we say our goodbyes, can you now list some more devices we use everyday that work with the help of MOSFETs?
Take a few minutes and try to name a few.

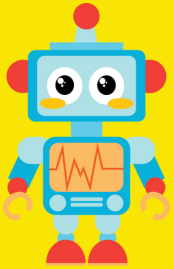
Laptops, tablets, smart phones – MOSFETs ensure that each component in your laptop (the CPU, memory, monitor, etc.) receives the correct amount of electric power to function properly.

When you play music or any sound through a speaker, the electrical signal from the audio source is usually very weak. MOSFETs help boost this weak signal to a higher power level that can produce sound at a louder volume.



In electric motorcycles, MOSFETs act as electronic switches that control the flow of current from the battery to the motor, allowing us to precisely control the speed of the bike.

The MOSFETs in TVs have countless uses. They are used to control the electric power to the TV, the electric current flow to the lights of the screen, allowing us to precisely control the brightness. The other MOSFETs amplify the audio signals from the TV's audio processor.



MOSFETs are also found in Robots. They do important jobs like giving power to different robot parts, making sensor signals stronger, and switching sensor signals on and off. This helps robots understand and use information from their sensors.

We have finally reached our destination, and what an incredible journey it has been! Throughout our adventures, we have learned so much about MOSFETs and their amazing applications. I hope you enjoyed every moment and discovered the fascinating world of electronic devices.

As our time together comes to an end, it's bittersweet to say goodbye. We have grown fond of each other, and we will miss our time together. But remember, you can always revisit our adventures and start anew whenever you want. The world of MOSFETs will always be waiting for you!

Goodbye for now, my dear friends!

Milo, Collie, Nuff, puff, Bonz, Bo, and Bombon :)