Vidyalankar Institute of Technology

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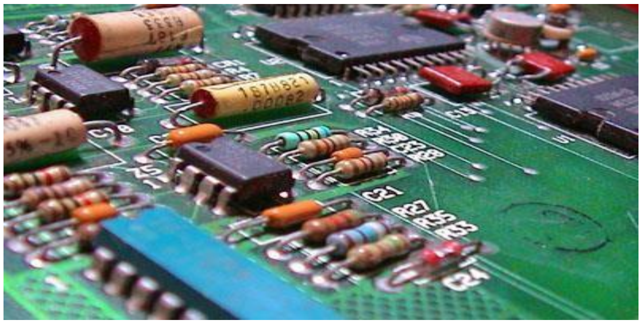
STEM WORKSHOP MANUAL

"Learn the Engineering with FUN"



Concept and Design

By

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Dedicated to all Pre-University Teachers who are inspiring future Engineers.

Preface

The primary objective of this manual is to provide STEM education through electronics experiments in a do-it-yourself style and make engineering fun. Working for years in the university higher education system, we have learned the importance of creativity and design. Teaching STEM through hands-on teaching with Fun could be more exciting for the students and teachers. Inculcating scientific temperament, designing, and creative concepts at a young age always pays off at the university level. This manual will not just help the pre-university students and teachers in STEM education but may also bring out an innovator in them. In the near future, we will also release this manual in other regional languages.

We would also like to thank many known and unknown resources while preparing this manual. We have acknowledged all references as and when applicable. As the manual editors, we tried our best to make it as error-free as possible, but please let us know your comments/feedback in case of any error.

We would also like to acknowledge the support from our respective organizations, the IEEE Global STEM Program, IEEE Bombay Section, Mumbai Gujarati Sangathan, Rotary RCUK Club and all our students and teacher volunteers in making this program successful.

Best Regards,

Dr.Saurabh Mehta
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Mr.Tanmay Gurav

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[1]

Title: **Simple Basic LED Circuit (How to Use LEDs)**

Aim: To demonstrate how to use LEDs and create basic LED circuits with appropriate current limiting resistors for different power sources.

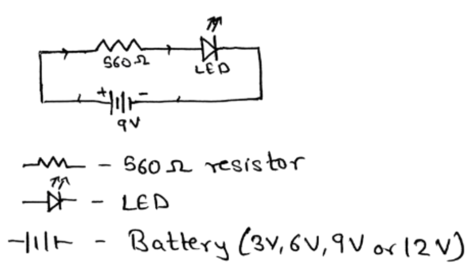
Requirements:

- LEDs
- Power source (3V, 6V, 9V, or 12V)
- Resistors (10 ohms, 390 ohms, 470 ohms, or 560 ohms)
- Connecting wires
- Breadboard

Theory:

LEDs (Light-Emitting Diodes) are widely used for indication and decoration purposes in electronic circuits. However, they cannot be directly connected to a power source without a current limiting resistor, as this would damage the LEDs. The current limiting resistor controls the amount of current flowing through the LED, protecting it from excessive current. In this project, we will explore how to connect LEDs to different power sources and select the appropriate current limiting resistor based on the voltage supplied. The following resistor values are recommended:

Circuit:



Observation:

By following the circuit diagrams and using the appropriate current limiting resistors, the LEDs should light up when the power source is connected. The brightness of the LED may vary based on the voltage supplied and the selected resistor value.

Conclusion:

LEDs are important components in electronic circuits, and it is crucial to use current limiting resistors to protect them from excessive current. By selecting the right resistor value based on the power source voltage, we can safely operate LEDs and create basic LED circuits for various applications.

Learning:

Through this project, you will learn the importance of using current limiting resistors when connecting LEDs to power sources. You will understand how to select the right resistor values based on the voltage of the power source and the LED's requirements. By practicing circuit connections and observing the brightness of the LEDs, you will gain hands-on experience and improve your understanding of voltage requirements and circuit performance. Additionally, you will develop safety awareness regarding the potential risks of not using current limiting resistors. Overall, this project will provide you with practical knowledge and skills for working with LEDs and basic LED circuits.

Reference:

https://www.instructables.com/Simple-Basic-LED-Circuit-How-to-Use-LEDs/

[**2**]

Title: **Simple LED Fader Using Potentiometer**

Aim: To create a potentiometer-based LED dimmer circuit.

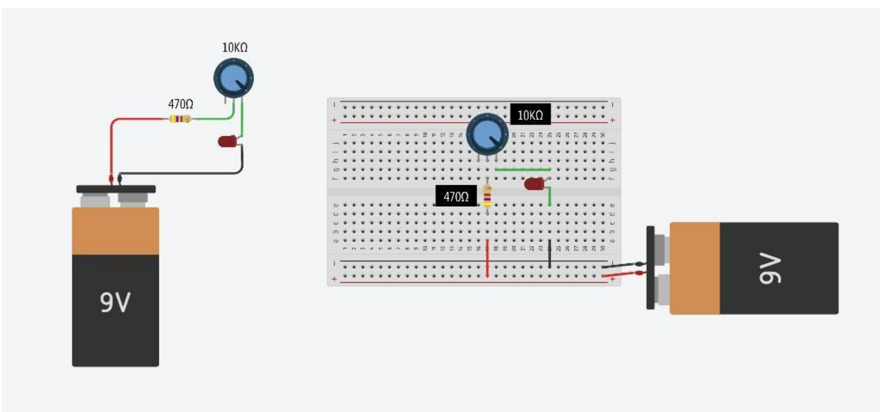
Requirements:

- Breadboard
- Red LED
- 470-ohm resistor
- 10k-ohm (potentiometer)

Theory:

A potentiometer is a three-terminal resistor with a sliding or rotating contact that allows for dynamic variation of resistance. In this project, we will use the potentiometer to control the brightness of an LED. The potentiometer acts as a variable resistor or voltage divider, depending on the circuit configuration.

Circuit:



Observation:

As you rotate the potentiometer knob, the resistance between the wiper and one end of the potentiometer changes. This variation in resistance affects the current flowing through the LED, resulting in a change in brightness.

Conclusion:

By adjusting the potentiometer, you can control the brightness of the LED in the circuit. The potentiometer acts as a variable resistor, allowing for the adjustment of current flow. This simple LED fader circuit demonstrates the use of potentiometers in controlling electrical components.

Learning:

Understand how potentiometers can be used as variable resistors or voltage dividers. Learn how to connect the potentiometer, LED, and resistors in a circuit to control LED brightness. Observe how adjusting the resistance affects the current flow and, consequently, the brightness of the LED.

Reference:

https://makeabilitylab.github.io/physcomp/arduino/potentiometers.html

[**3**]

Title: **Dual LED Flasher Circuit Tutorial**

Aim: Dual LED Flasher Circuit Tutorial.

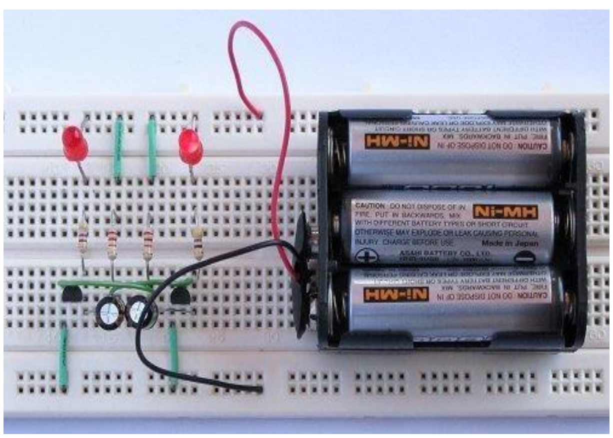
Requirements:

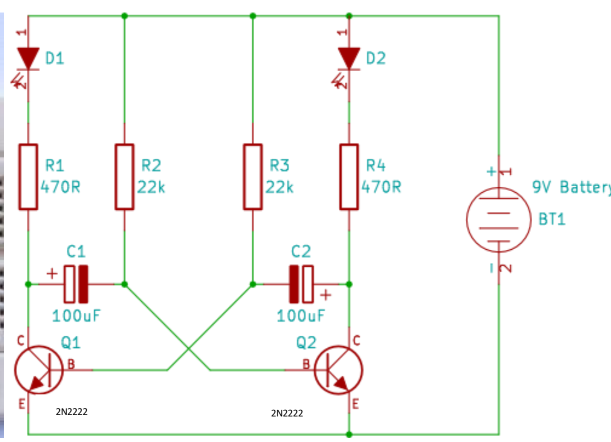
- Breadboard
- Wires
- 9V battery
- 2 x 22k resistors
- 2 x 470 ohm resistors
- 2 x 100uF electrolytic capacitors
- 2 x NPN transistors (2N2222)
- 2 x 5mm red LEDs

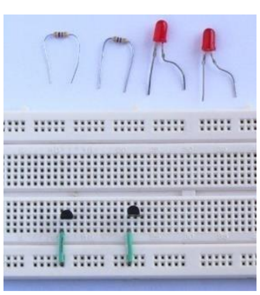
Theory:

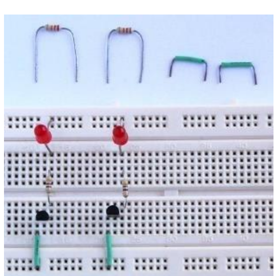
The dual LED flasher circuit uses two NPN transistors as switches to blink the LEDs alternately. When one transistor is on, the corresponding LED connected to its collector lights up, while the other transistor and LED are off. Then, the other transistor turns on, causing the second LED to light up while the first LED turns off. This alternating flashing effect is achieved by the timing components connected to the bases of the transistors.

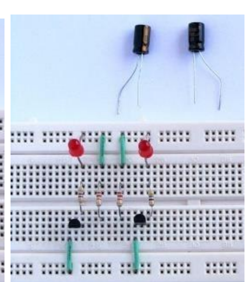
Circuit:

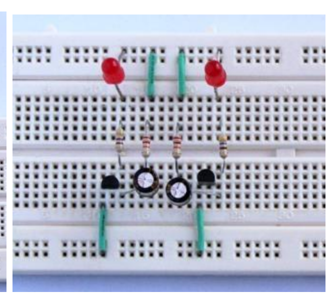












Observation:

When the circuit is powered on, the LEDs will start flashing on and off alternately.

Conclusion:

By following the tutorial and building the dual LED flasher circuit, we have successfully created a circuit that can blink two LEDs in an alternating pattern. This circuit can be used for decorative purposes or as a visual indicator in various electronic projects.

Learning:

- How to connect and wire components on an electronic breadboard.
- The role of transistors as switches in electronic circuits.
- The use of resistors and capacitors to control timing in a circuit.
- How to build a simple dual LED flasher circuit and observe its functionality.

Reference:

https://startingelectronics.org/beginners/start-electronics-now/tut8-dual-LED-flasher/

[**4**]

Title: **LED Flasher Circuit using RGB LED**

Aim: To create an LED flasher circuit using RGB LEDs that can blink in a sequence and drive a 12V LED strip.

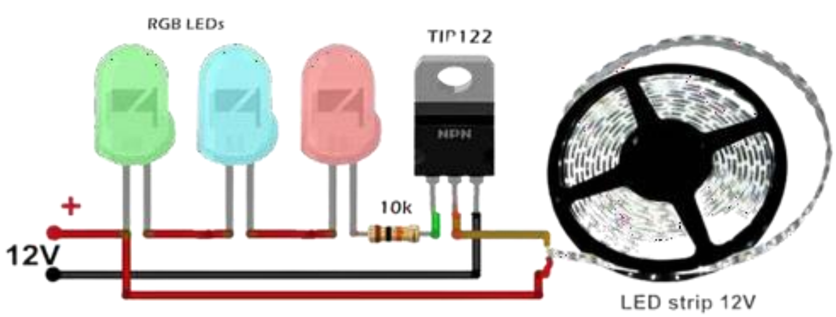
Requirements:

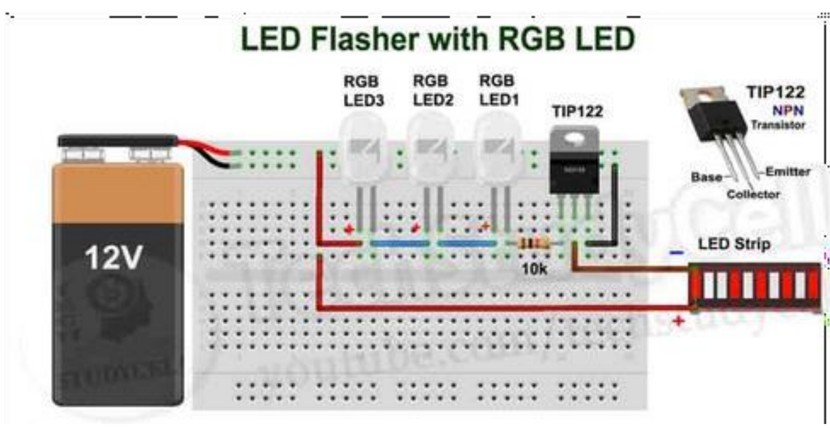
- RGB LED (3 x 5mm)
- TIP122 NPN Transistor (1)
- 10k Resistor (1)
- 12V DC Adaptor
- 12V LED strip
- Breadboard

Theory:

The LED flasher circuit utilizes a sequence of RGB LEDs to create a blinking effect. The RGB LEDs are connected in series, and when power is supplied, they start blinking in a sequential manner. The voltage across the LEDs also varies as the colors change. A TIP122 NPN transistor is connected in series with the RGB LEDs. Each time the RGB LED blinks, a small electric pulse is fed to the base of the transistor. When a positive pulse is received at the base, the transistor turns on, allowing current to flow from the collector to the emitter. As the transistor turns on, the connected 12V LED strip, which is also connected to the collector, starts blinking in sync with the RGB LEDs.

Circuit:





Observation:

When the circuit is powered on, the RGB LEDs and the 12V LED strip will start blinking in a sequence, creating a visually appealing flashing effect.

Conclusion:

By constructing the LED flasher circuit using RGB LEDs and a TIP122 NPN transistor, we have successfully created a circuit that can drive a 12V LED strip and produce a blinking effect. This circuit can be used for decorative purposes or as a visual indicator in various projects.

Learning:

- How to utilize RGB LEDs to create a blinking effect.
- The use of an NPN transistor to control the power supply to the LEDs.
- The importance of sequence and timing in creating visual effects.
- The ability to drive a 12V LED strip using the circuit.
- Basic circuit design and breadboarding techniques.

Reference:

https://easyelectronicsproject.com/mini-projects/led-flasher-circuit-with-rgb-led/

[**5**]

Title: **Motor Direction Control Using DPDT Switch**

Aim: The aim of this project is to control the direction of a motor using a DPDT (Double-Pole Double-Throw) switch.

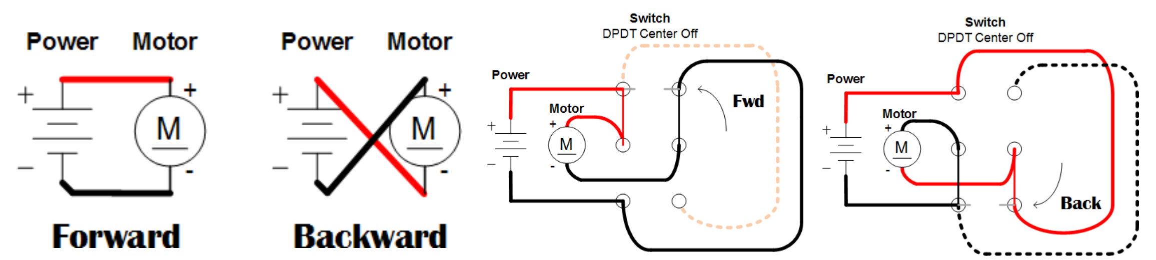
Requirements:

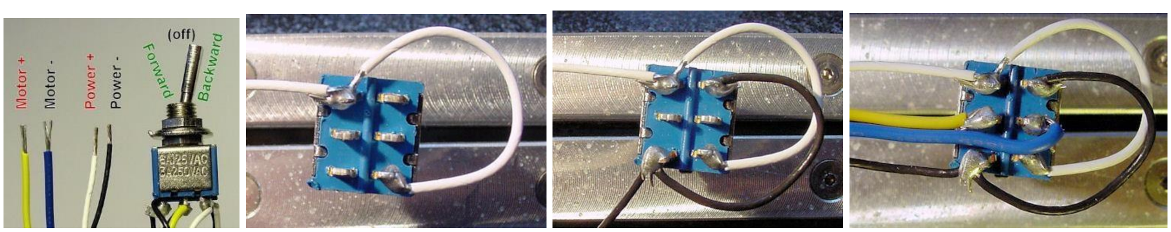
- Motor
- DPDT switch
- Battery
- Wires
- Soldering iron and solder

Theory:

The DPDT switch has six terminals, divided into two sets of three. The center terminals are connected to the motor, while the outer terminals are connected to the battery. By flipping the switch, the connections can be changed, allowing the motor to turn in different directions.

Circuit:





Observation:

The motor will turn in one direction when connected to the battery with the positive terminal connected to the positive motor terminal and the negative terminal connected to the negative motor terminal. The motor will turn in the opposite direction when the battery connections are reversed, with the positive terminal connected to the negative motor terminal and the negative terminal connected to the positive motor terminal.

Conclusion:

By using a DPDT switch, we can easily control the direction of the motor without rewiring it each time.

Learning:

- Understanding the function and wiring of a DPDT switch.
- Identifying the positive and negative terminals of the motor and battery.
- Soldering wires to the switch terminals for secure connections.
- Proper positioning of the switch in the center (off) position before connecting the battery.

Reference:

https://www.robotroom.com/DPDT-Bidirectional-Motor-Switch.html

[**6**]

Title: **IR Obstacle Sensor**

Aim: The aim of this project is to create an obstacle sensor using an IR sensor .

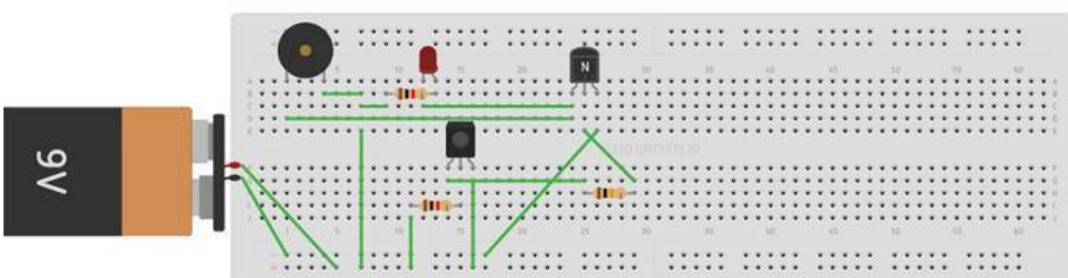
Requirements:

- Breadboard (1x1)
- IR sensor (1x1)
- NPN transistor (1x1)
- Resistors (300 ohm, 10k ohm)
- Buzzer (1x1)
- LED (1x1)
- 9V DC battery
- Jumper wires

Theory:

The IR sensor has three pins: Vcc, Gnd, and Out. When an obstacle is detected, the Out pin sends a logic high signal (+5V), and when no obstacle is detected, it sends a logic low signal (0V). By connecting the appropriate components, we can create a circuit that triggers an alarm (buzzer) and activates an LED when an obstacle is detected.

Circuit:



Observation:

When an obstacle is detected by the IR sensor, the LED lights up and the buzzer sounds.

When no obstacle is detected, the LED remains off and the buzzer is silent.

Conclusion:

By using simple components and the IR sensor, we can create an obstacle sensor circuit without the need for a microcontroller. This project provides a cost-effective solution for obstacle detection and can be extended to other applications such as a fire alarm system by using different sensors.

Learning:

- Understanding the working principle of the IR sensor and its output behavior.
- Identifying the pins of the IR sensor (Vcc, Gnd, Out) and connecting them to the appropriate components.
- Configuring the NPN transistor as a switch to control the LED and buzzer.
- Connecting the positive and negative terminals of the battery to the breadboard.
- Proper placement and orientation of components on the breadboard for a functional circuit.

Reference:

https://www.instructables.com/IR-Obstacle-Sensor-Without-Using-Arduino-or-Any-Mi/

[7]

Title: **How to Build an Automatic Night Light Circuit**

Aim: The aim of this project is to create a circuit that automatically turns on an LED light when it gets dark.

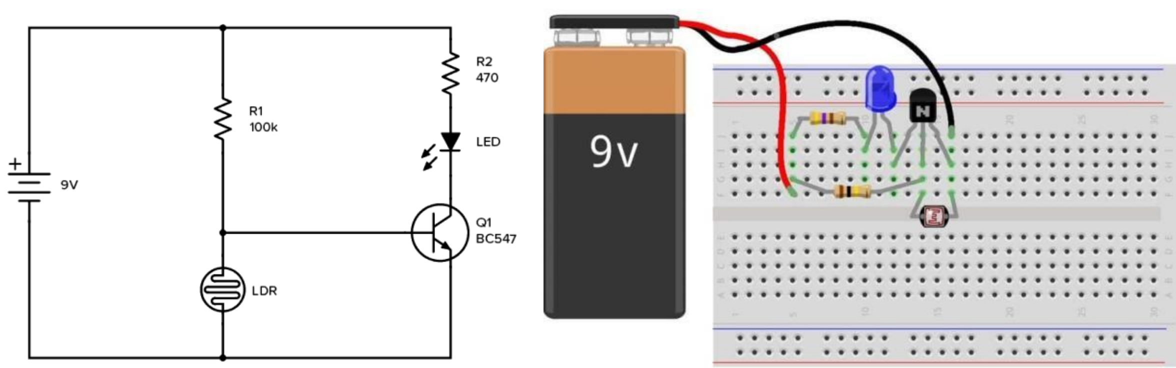
Requirements:

- 9V Battery
- Breadboard
- Photoresistor (around 5kΩ in light, 200kΩ or more in dark)
- Transistor BC547
- Resistor 100 kΩ
- Resistor 470 Ω
- Light-Emitting Diode (LED)

Theory:

The circuit utilizes a photoresistor and resistors to create a voltage divider. When there is a lot of light, the photoresistor has low resistance, resulting in a low output voltage from the voltage divider. This turns off the transistor and cuts off the current to the LED, keeping it off. In the dark, the photoresistor has high resistance, leading to a high output voltage from the voltage divider. This turns on the transistor, allowing current to flow through the LED and light it up.

Circuit:



Observation:

The LED turns on automatically when it gets dark, providing a night light.

Conclusion:

By using a simple voltage divider circuit with a photoresistor and a transistor, we can create an automatic night light that turns on when it gets dark. This circuit is easy to build on a breadboard and can be extended to control bigger and brighter lights.

Learning:

- Understanding the concept of a voltage divider and its application in controlling the transistor.
- Identifying the behavior of a photoresistor based on the amount of light it receives.
- Connecting the components on a breadboard following the circuit diagram.
- Observing the interaction between the photoresistor, resistors, transistor, and LED to control the light output.

Reference:

https://www.build-electronic-circuits.com/night-light-circuit/

[8]

Title: **PIR Motion Sensor Circuit**

Aim: The aim of this project is to connect and test a PIR motion sensor without using an Arduino or any microcontroller. By understanding the components and their connections, we can observe the sensor's functionality.

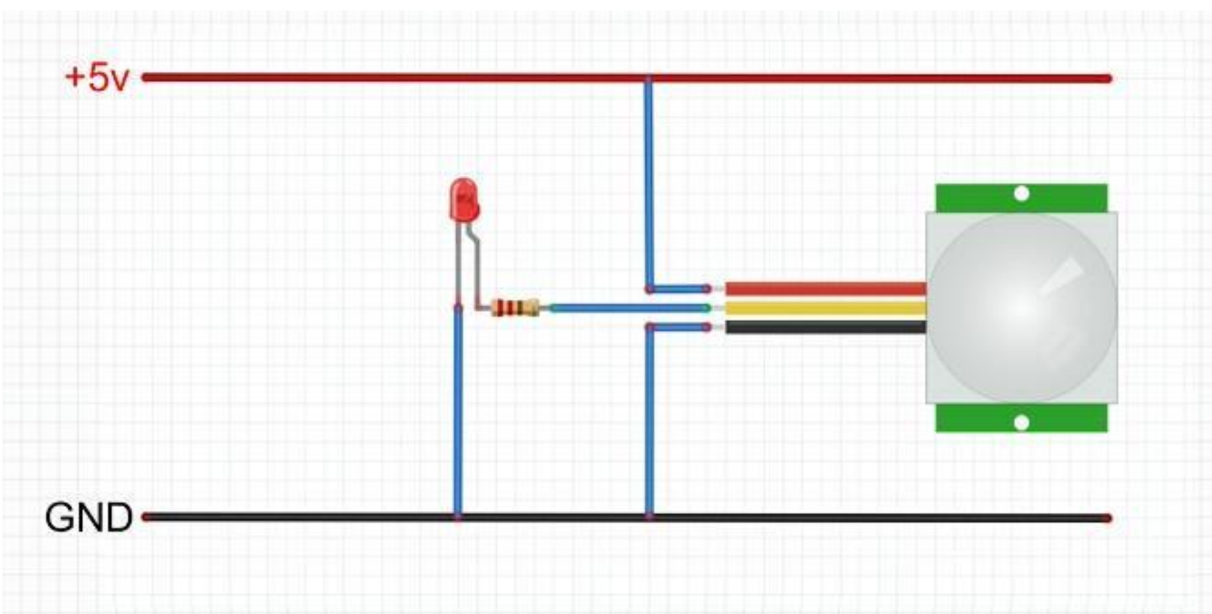
Requirements:

- PIR Motion Sensor Module
- Breadboard
- LED
- 220-ohm resistor
- Power supply (+5V and GND)

Theory:

The PIR motion sensor module consists of a Fresnel lens, pyroelectric sensor, sealed metal can, and circuitry. The lens focuses infrared rays onto the pyroelectric sensor, which detects motion based on changes in the received infrared radiation. The sensor has two balanced PIR sensors that generate a positive differential change when a warm body passes by and a negative differential change when it leaves the sensing area. The circuitry includes the BISS0001 IC, which processes the sensor output and produces a digital output signal. The module also has potentiometers to adjust sensitivity and the duration of the output signal. The trigger mode can be set to non-repeatable or repeatable.

Circuit:



Observation:

By connecting the PIR motion sensor module without an Arduino, we can observe its functionality. When the sensor detects motion, the output pin goes high, and the connected LED lights up. Moving within the sensing range allows us to test the range and adjusting the potentiometers can modify the sensitivity and duration of the output signal.

Conclusion:

The PIR motion sensor module can detect motion and providing a digital output signal. By connecting the necessary components and adjusting the potentiometers, we can observe the sensor's functionality without the need for an Arduino or microcontroller.

Learning:

- Understanding the components of a PIR motion sensor module, including the Fresnel lens, pyroelectric sensor, and sealed metal can.
- Recognizing the balanced PIR sensors and their role in detecting motion.
- Identifying the BISS0001 IC and its function in processing the sensor output.
- Connecting the PIR motion sensor module to a breadboard .
- Observing the behavior of the sensor by testing the range, sensitivity, and duration of the output signal.

Reference:

https://www.instructables.com/PIR-Sensor-Tutorial-With-or-Without-Arduino/

[**9**]

Title: **Simple Water Level Indicator Alarm with Buzzer**

Aim: The aim of this project is to create a water level indicator circuit that can detect the water level in a tank and raise an alarm when the tank is full or reaches a preset level. This electronic solution helps prevent water wastage due to tank overflow.

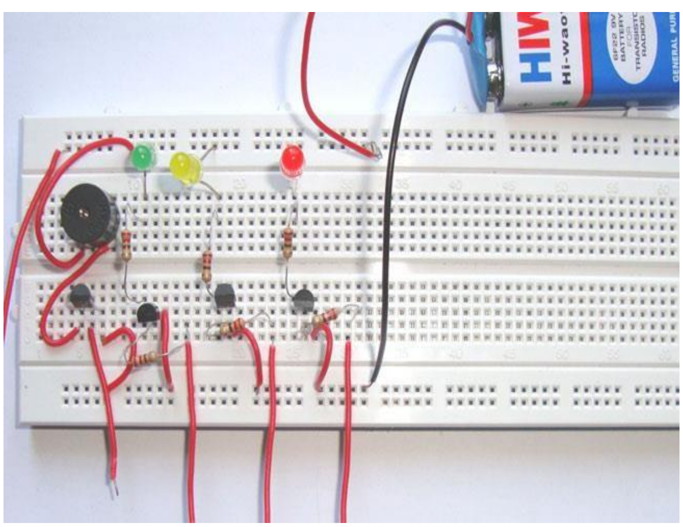
Requirements:

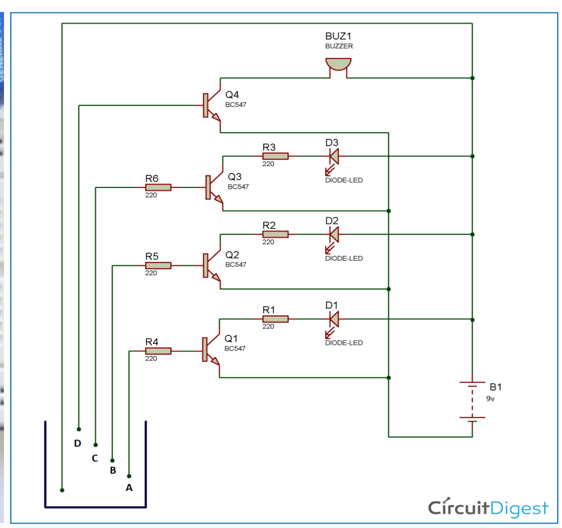
- 4 BC547 transistors
- 6 220-ohm resistors
- 3 color LEDs (red, green, and yellow)
- 1 buzzer
- 5 9V batteries + battery clip
- Breadboard

Theory:

The water level indicator alarm circuit uses transistors as switches to indicate different water levels. The circuit consists of four sections, each dedicated to indicating/alarming a particular water level (A, B, C, D). When the water level reaches point A, the circuit with a red LED and transistor Q1 is completed, causing the LED to glow. Similarly, when the water level reaches point B or C, the circuits with yellow and green LEDs respectively are completed, and the corresponding LEDs light up. When the tank reaches its full capacity (point D), the circuit with the buzzer is completed, and the buzzer starts beeping. Working: Each section of the circuit operates on the principle of using transistors as switches. Initially, when no voltage is applied to the base of transistor Q1, it remains in the OFF state, and the red LED is off. When the water level reaches point A, a positive voltage is applied to the base of transistor Q1 through the water, turning it ON. Current starts flowing from the collector to the emitter, causing the red LED to glow. The resistors at the base of each transistor (R1, R2, R3) limit the maximum base current, while the resistors with the LEDs (R4, R5, R6) drop the voltage across the LEDs.

Circuit:





Observation:

By monitoring the water level in the tank, the corresponding LEDs light up to indicate the current water level. As the water level rises, different LEDs illuminate sequentially. When the tank reaches its full capacity, the buzzer starts beeping.

Conclusion:

The water level indicator alarm circuit provides a simple and effective solution to detect and indicate the water levels in a tank. By using transistors as switches, the circuit enables the activation of LEDs and a buzzer at specific water levels. This project can be enhanced by integrating a microcontroller, such as Arduino, for additional functionalities such as a display and automatic motor control.

Learning:

- Understanding the concept of using transistors as switches in an electronic circuit.
- Recognizing the role of resistors in limiting base current and voltage dropping.
- Constructing a water level indicator alarm circuit using basic components.
- Observing the sequential activation of LEDs and the buzzer as the water level increases.
- Realizing the need for an extended wire for the positive voltage connection in the tank.

Reference:

https://circuitdigest.com/electronic-circuits/simple-diy-water-level-indicator-alarm-circuit

[**10**]

Title: **Simple Gas Sensor Experiment using Resistor, MQ Gas Sensor, Buzzer, and LED**

Aim: The aim of this experiment is to create a simple gas sensor circuit using an MQ gas sensor, resistor, buzzer, and LED. The circuit will detect the presence of gas and raise an alarm by activating the buzzer and LED.

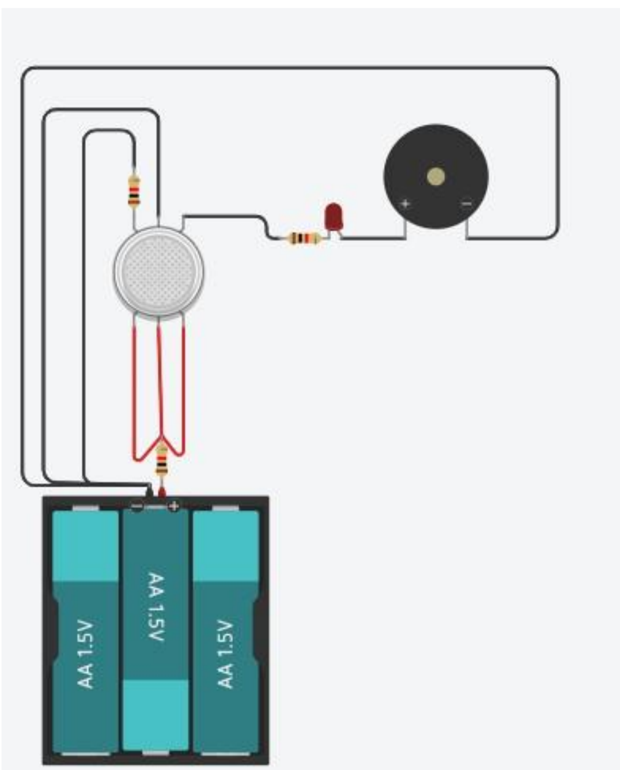
Requirements:

- MQ gas sensor (appropriate for the gas to be detected)
- Resistor
- Buzzer
- LED
- Breadboard
- Connecting wires
- Power source (e.g., batteries)

Theory:

The MQ gas sensor is a type of gas sensor that changes its resistance based on the concentration of the target gas in the environment. In this experiment, the sensor's resistance will be measured, and if it crosses a certain threshold, indicating the presence of gas, an alarm will be triggered. The resistor is used to create a voltage divider circuit to measure the sensor's resistance, and the buzzer and LED are activated when gas is detected.

Circuit:



Observation:

When there is no gas detected, the resistance of the gas sensor remains high, and the voltage across it is below the threshold. The buzzer and LED remain inactive. However, when gas is present and the resistance of the gas sensor decreases, the voltage across it rises above the threshold. This activates the buzzer, causing it to emit a sound, and the LED lights up, indicating the presence of gas.

Conclusion:

The gas sensor experiment demonstrates a basic gas detection circuit using an MQ gas sensor, resistor, buzzer, and LED. By monitoring the resistance of the gas sensor, the circuit can detect the presence of gas and raise an alarm through the activation of the buzzer and LED. This experiment provides a foundation for more advanced gas detection and monitoring systems.

Learning:

- Understanding the principle of gas detection using an MQ gas sensor
- Implementing a voltage divider circuit with a gas sensor and resistor
- Using a microcontroller or comparator to detect changes in voltage.
- Activating an alarm system (buzzer and LED) based on detected gas levels.
- Recognizing the importance of threshold values for gas detection
- Gaining practical experience in constructing and testing a gas sensor circuit

Reference:

https://www.tinkercad.com/things/aHDIUX2M1y1-

https://www.youtube.com/watch?v=wq1bM2EpRdI

[**11**]

Title: **Simple Tilt Sensor Switch Circuit**

Aim: The aim of this project is to create a simple tilt sensor switch circuit that activates an alarm (buzzer) and LED when the sensor is tilted beyond a certain angle. This circuit can be used in tilt prevention devices, alarm systems, and various DIY projects.

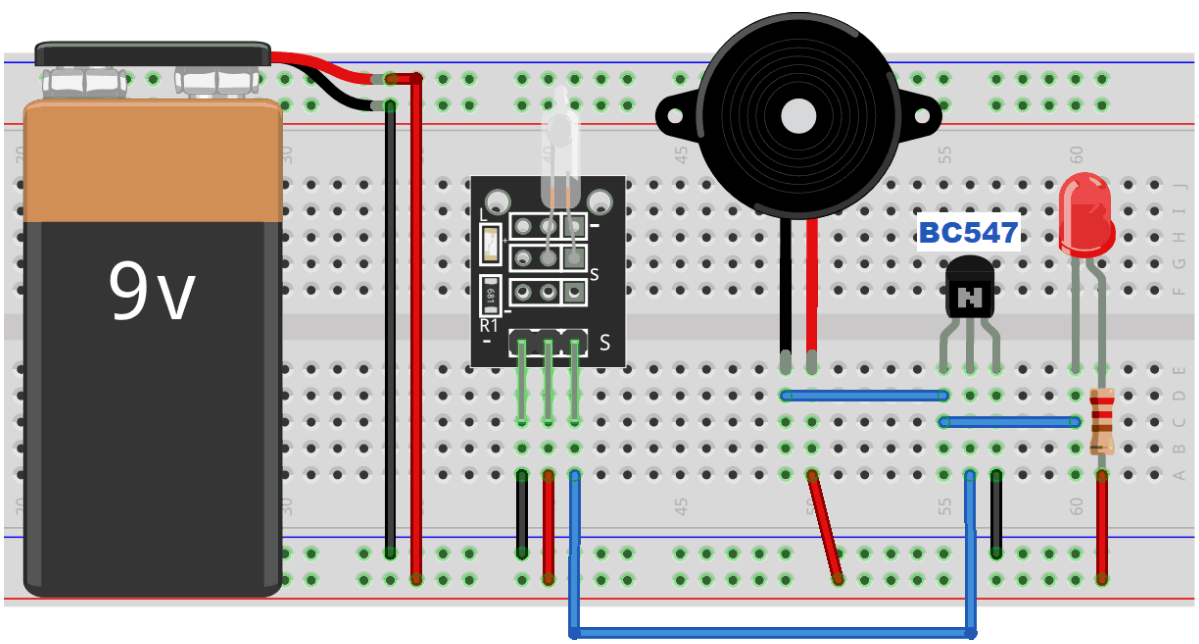
Requirements:

- Mercury switch or tilt sensor
- BC547 NPN transistor
- Buzzer
- LED
- Resistor - 220 ohm
- 9V battery
- Breadboard
- Connecting wires

Theory:

A tilt sensor is a device that opens and closes an electrical circuit when it is inclined beyond a certain angle. In this circuit, we are using a mercury-based tilt sensor. When the sensor is in a vertical position, the mercury ball inside the sensor connects two electrodes, completing the circuit and providing a low output. When the sensor is tilted, the mercury ball moves away from the electrodes, breaking the circuit and providing a high output.

Circuit:



Observation:

When the tilt sensor is in a vertical position, the LED and buzzer remain off, indicating a low output. However, when the sensor is tilted beyond the specified angle, the LED and buzzer turn on, indicating a high output and the activation of the alarm.

Conclusion:

The tilt sensor switch circuit effectively detects tilting motion using a mercury-based tilt sensor. It demonstrates how the sensor's output can be used to control the activation of an alarm (buzzer) and LED. This circuit has various applications, such as in tilt prevention devices, alarm systems, and DIY projects where tilt detection is required.

Learning:

- Understanding the principle of operation of a mercury-based tilt sensor
- Implementing a tilt sensor switch circuit using an NPN transistor
- Connecting and controlling LED and buzzer with a transistor
- Observing the change in output based on the tilt angle of the sensor.
- Applying the circuit in practical applications requiring tilt detection
- Gaining hands-on experience with breadboarding and circuit assembly.

Reference:

https://circuitdigest.com/electronic-circuits/simple-tilt-sensor-switch-circuit-diagram

[**12**]

Title: **Simple Photodiode Circuit**

Aim: The aim of this experiment is to build a basic circuit using a photodiode and understand its functionality as a light sensor.

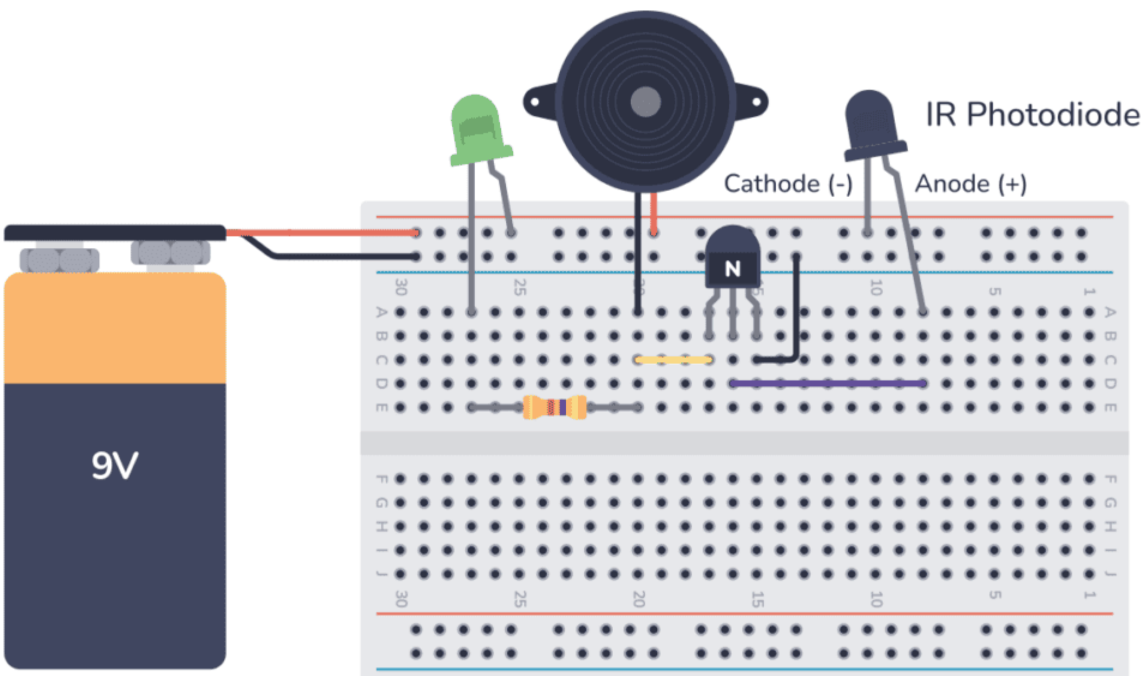
Requirements:

- Photodiode
- Resistor 470 Ohm
- LED
- Breadboard
- BC547 BJT
- Connecting wires
- Power supply (battery or DC source) 9V Battery

Theory:

A photodiode is a semiconductor device that converts light energy into an electrical current. It consists of a p-n junction, where the p-side is positively charged (holes) and the n-side is negatively charged (electrons). When photons strike the photodiode, electron-hole pairs are generated, resulting in a current flow.

Circuit:



Observation:

When light is directed towards the photodiode, the LED will illuminate, indicating the generation of current due to the incident light. The brightness of the LED may vary depending on the intensity of the light source.

Conclusion:

The simple photodiode circuit demonstrates the ability of a photodiode to convert light into an electrical current. By observing the LED's illumination, we can verify the functioning of the photodiode as a light sensor. This experiment highlights the fundamental principle of photodiodes and their practical applications in various light-sensing devices.

Learning:

- Understanding the working principle of a photodiode as a light sensor
- Recognizing the importance of reverse biasing in photodiode circuits
- Familiarity with using resistors to limit current flow and protect the photodiode.
- Hands-on experience in constructing a basic circuit on a breadboard.
- Observing the correlation between incident light intensity and current generation
- Gaining insight into the potential applications of photodiodes in light detection and measurement systems.

Reference:

https://www.build-electronic-circuits.com/photodiode/

[**13**]

Title: **Fire Alarm System**

Aim: Fire Alarm System Using Thermistor

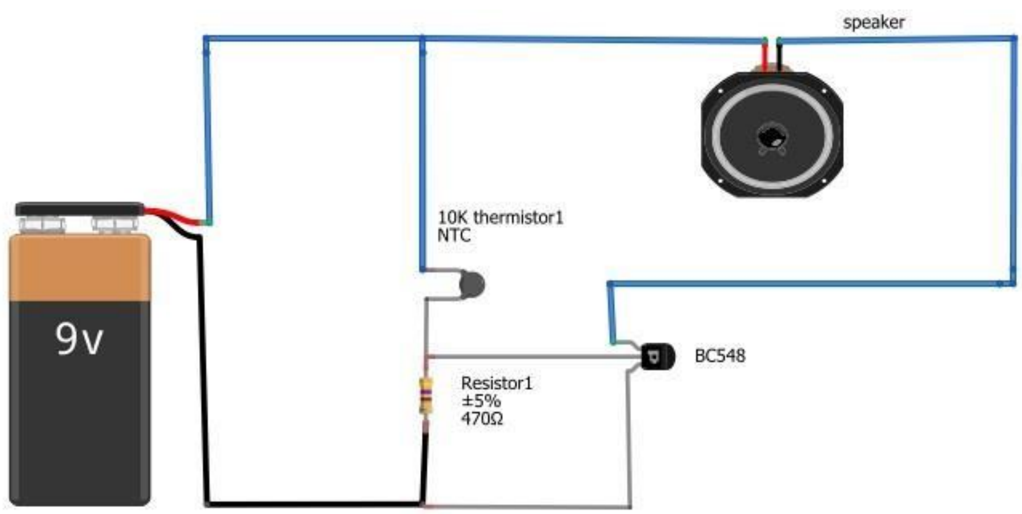
Requirements:

- Thermistor 10K
- Resistor 10K
- Speaker/Buzzer
- BC547 transistor
- 9-volt battery or DC power supply
- Connecting wires
- Breadboard

Theory:

A thermistor is a type of resistor whose resistance changes with temperature. It is a negative temperature coefficient (NTC) thermistor, meaning that its resistance decreases as the temperature increases. By utilizing this characteristic, the thermistor can be used as a temperature sensor in various applications.

Circuit:



Observation:

When the temperature surpasses the predetermined threshold, the thermistor's resistance decreases, causing the transistor to switch on. As a result, the buzzer produces an audible alarm, indicating the presence of high temperature or potential fire.

Conclusion:

The fire alarm system using a thermistor demonstrates a simple and effective method of temperature sensing and fire detection. By monitoring the resistance of the thermistor, the circuit can detect changes in temperature and activate the alarm system when necessary. This project highlights the practical application of thermistors in fire safety systems and emphasizes the importance of early warning systems for fire prevention.

Learning:

- Understanding the behavior of a thermistor as a temperature-dependent resistor
- Implementing a thermistor-based circuit for temperature sensing
- Utilizing a transistor as a switch to control the activation of a buzzer.
- Recognizing the significance of early fire detection and alarm systems
- Gaining practical experience in constructing a functional circuit on a breadboard
- Appreciating the importance of temperature monitoring for ensuring home safety.

Reference:

https://www.electroniclinic.com/what-is-a-thermistor-thermistor-types-thermistor-circuits/

[**14**]

Title: **Reed Magnetic Switch Door/Window Security System**

Aim: The aim of this project is to create a door/window security system using a reed magnetic switch that triggers an alarm when the door/window is opened or closed.

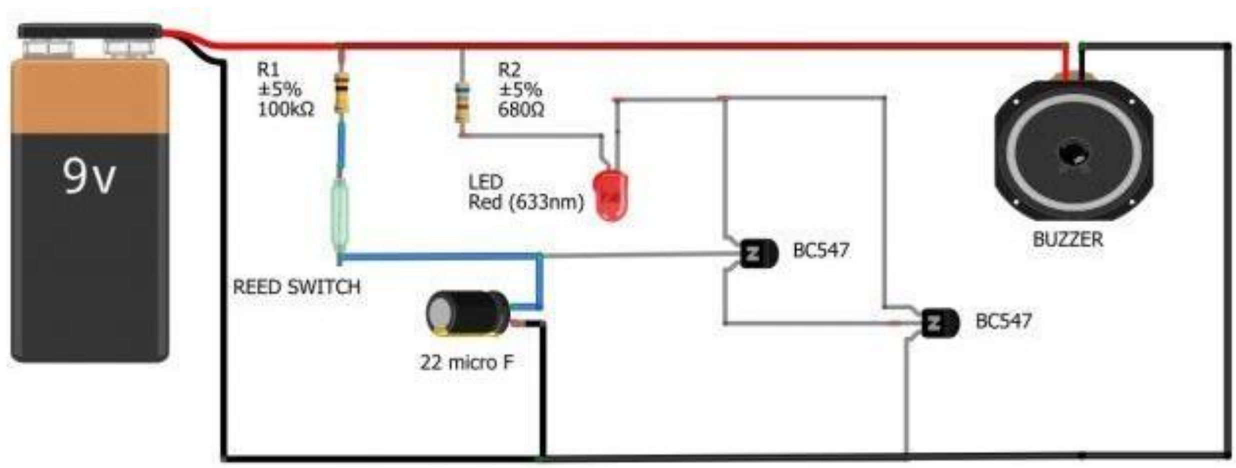
Requirements:

- Reed switch
- Resistor 100kΩ, 680Ω
- LED
- 2 BC547 transistors
- 22μF capacitor
- Buzzer
- 9V Battery
- Connecting wires
- Breadboard

Theory:

A reed switch is a type of magnetic switch that consists of two ferromagnetic reed contacts enclosed in a glass envelope. These contacts close or open depending on the presence or absence of a magnetic field. In this project, the reed switch is used to detect the opening or closing of a door or window.

Circuit:



Observation:

When the door or window is opened or closed, the reed switch detects the presence or absence of the magnetic field. As a result, the LED lights up, and the buzzer produces an audible alarm to alert the user.

Conclusion:

The reed magnetic switch door/window security system provides a simple and effective solution for detecting unauthorized entry or tampering. By utilizing the magnetic properties of the reed switch, the circuit can detect changes in the magnetic field when the door or window is opened or closed, triggering an alarm. This project highlights the practical application of reed switches in security systems and emphasizes the importance of securing entrances to enhance safety.

Learning:

- Understanding the operation of a reed magnetic switch
- Implementing a reed switch-based circuit for door/window security
- Utilizing transistors as switches to control the activation of an LED and buzzer.
- Learning about the role of resistors and capacitors in circuit design
- Gaining practical experience in constructing a functional circuit on a breadboard
- Recognizing the significance of security systems for home and property protection.

Reference:

https://www.electroniclinic.com/reed-switch-working-reed-switch-based-projects-reed-switch-use-with-arduino/

[**15**]

Title: **To study the working of LED circuit used for continuity testing & humidity indicator.**

Aim: To study the working of LED circuit used for continuity testing & humidity indicator.

Circuit Diagram

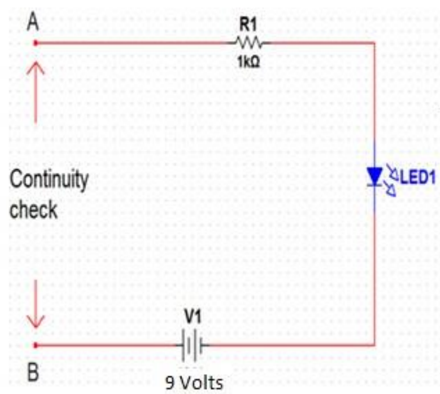


Figure 1A: Continuity Tester Circuit

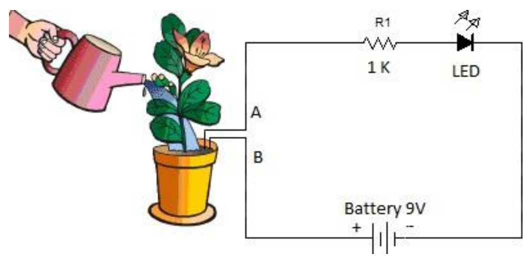


Figure 1B: Plant water need Indicator (Humidity sensor)

Components used:

1. LED to act as output indicator
2. Resistor of 1 Kilo Ohms
3. Battery of 9 Volts as power supply
4. Single standard wires for making connections
5. Battery Connector
6. Bread Board

Procedure:

1. Test the components using multimeter.
2. Mount the circuit as shown in the Figure 4
3. Connect circuit of figure 4 across any other circuit without discontinuity
4. Observe the effect on LED.
5. Connect circuit of figure 4 across any other circuit with discontinuity (some break in circuit)
6. Observe the effect on LED.

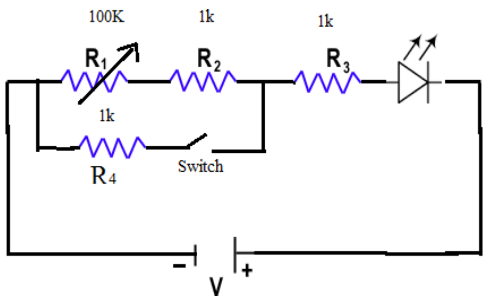
Output:. The output shows that LED glows when circuit is not having any faults or any point of discontinuity and does not glow it is having any faults or discontinuity.

[**16**]

Title: **To study the working of LED circuit used for continuity testing & humidity indicator.**

Aim: To study the working of Light Emitting Diode (LED) circuit for series & parallel.

Circuit Diagram



$$R = \frac{V}{I} \quad \text{By Ohm's Law}$$

$$R_{series} = R_1 + R_2 + R_3$$

$$R_{parallel} = R_{12} \parallel R_4$$

$$R_{parallel} = \frac{R_{12} \times R_4}{R_{12} + R_4}$$

$$R_{Total} = R_{parallel} + R_3$$

Figure 2: Series parallel circuit

Components used:

1. LED to act as an output indicator
2. Resistor of 1k Ohm
3. Potentiometer 100k Ohm
4. Battery of 9 Volts as power supply
5. Single standard wires for making connections
6. Battery connector.
7. Bread Board

Procedure:

1. Test the components using multimeter.
2. Mount the circuit as shown in the Figure 2.
3. Test the continuity at various points.
4. Observe the effect on LED.
5. Vary potentiometer & observe the effect on LED
6. Close switch & observe the effect on LED

Output: Intensity of LED changes when potentiometer varies and switch is closed. Circuits follows Ohms law.

[**17**]

Title: To study the working of LED circuit as a Blown fuse indicator.

Aim: To study the working of LED circuit as a Blown fuse indicator.

Circuit Diagram

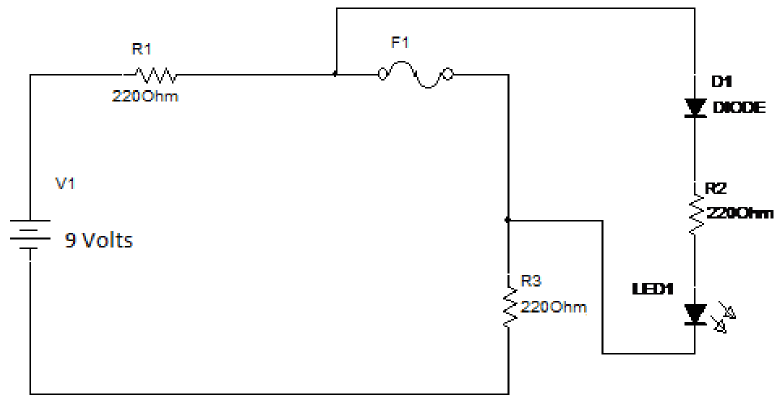


Figure 3: Blown fuse indicator

Components used:

1. LED to act as output indicator
2. Resistor of 220 Ohms (3 Nos.)
3. Battery of 9 Volts as power supply
4. Single standard wires for making connections
5. Battery Connector
6. Fuse wire
7. Diode
8. Bread Board

Procedure:

1. Test the components using multimeter.
2. Mount the circuit as shown in the Figure 3 with Fuse wire connected in circuit.
3. Test the continuity at various points.
4. Observe the effect on LED.
5. Mount the circuit as shown in the Figure 3 without Fuse wire connected in circuit.
6. Test the continuity at various points.
7. Observe the effect on LED.

Output: When fuse is working (connected), it provides short circuit path bypassing LED circuit. So LED is OFF. If fuse is opens the line voltage drives the LED and thus LED glows. Thus blown fuse condition is indicated.

[**18**]

Title: To study the working of LED circuit with transistor as additional controlling switch in circuit.

Aim: To study the working of LED circuit with transistor as additional controlling switch in circuit.

Circuit Diagram

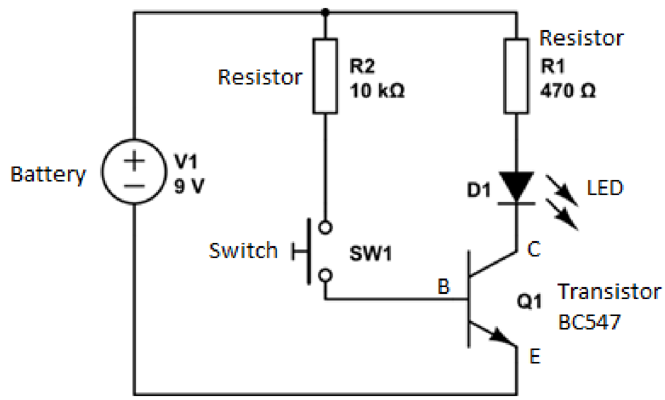


Figure 4: Glowing LED circuit (ON state)

Components used:

1. LED to act as output indicator
2. Resistor of 470 Ohm & 10 Kilo Ohms
3. Battery of 9 Volts as power supply
4. Single standard wires for making connections
5. Battery Connector
6. Transistor BC547
7. Switch
8. Bread Board

Procedure:

1. Test the components using multimeter.
2. Mount the circuit as shown in the Figure 4.
3. Test the continuity at various points.
4. Observe the effect on LED.
5. Repeat step 3 and 4 for the circuit by inverting the connections of LED

Output: The LED glows when circuit is connected as shown in figure 2. Other combinations can also be tried as suggested in ***Experiment 2***(by reversing polarity of LED and power supply). The output shows that LED glows when it receives current in particular direction only because it is a switch which allows current to flow in one direction only.

[**19**]

Title: To study the working of LED circuit as light Sensor.

Aim: To study the working of LED circuit as light Sensor.

Circuit Diagram

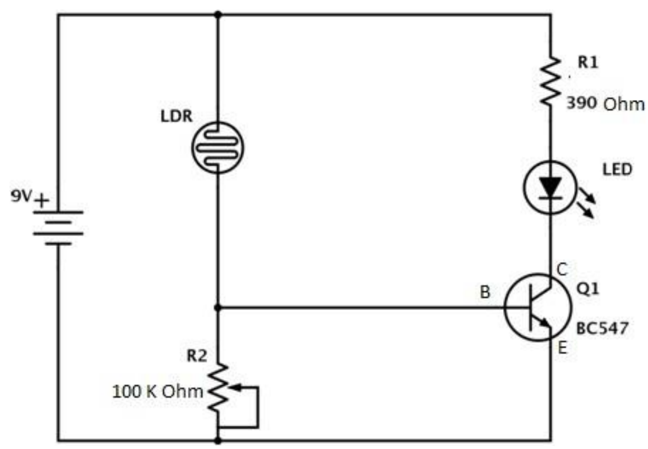


Figure 5: Plant water need Indicator (Humidity sensor)

Components used:

1. LED to act as output indicator
2. Resistor of 390 Ohm
3. Battery of 9 Volts as power supply
4. Single standard wires for making connections
5. Battery Connector
6. LDR (Light Dependent Resistor)
7. Transistor BC 547
8. Potentiometer of 100 Kilo ohm
9. Bread Board

Procedure:

1. Test the components using multimeter.
2. Mount the circuit as shown in the Figure .
3. Test the continuity at various points.
4. Cover LDR with a piece of opaque paper.
5. Observe the effect on LED.
6. Illuminate LDR with a lamp.
7. Observe the effect on LED

Output: LED glows when light is present and switch off when light is absent.

[**20**]

Title: To study the working of LED circuit as temperature Sensor.

Aim: To study the working of LED circuit as temperature Sensor.

Circuit Diagram

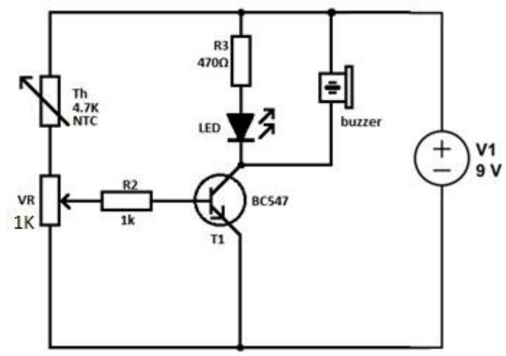


Figure 6: Temperature Sensitive Circuit

Components used:

1. LED to act as output indicator
2. Resistor of 470 Ohm, 1 k Ohm
3. Battery of 9 Volts as power supply
4. Single standard wires for making connections
5. Battery Connector
6. Thermistor 4.7 K ohms
7. Transistor BC 547
8. Potentiometer of 1 K ohm
9. Buzzer
10. Bread Board

Procedure:

1. Test the components using multimeter.
2. Mount the circuit as shown in the Figure 13.
3. Test the continuity at various points.
4. Apply heat externally to Thermistor.
5. Observe the effect on LED.
6. Vary the external heat intensity.
7. Observe the effect on LED.

Output: LED glows when temperature increases and switch off when temperature decreases.

[**21**]

Title: To study the working of LED circuit as pressure sensor.

Aim: To study the working of LED circuit as pressure sensor.

Circuit Diagram:

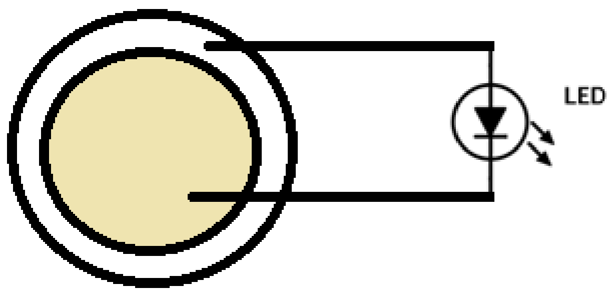


Figure 7: Peizo sensor circuit

Components used:

1. LED to act as output indicator
2. Piezo sensor
3. Single standard wires for making connections
4. Bread Board

Procedure:

1. Test the components using multimeter.
2. Mount the circuit as shown in the Figure 11.
3. Test the continuity at various points.
4. Apply pressure on the inside plate of Piezoelectric Sensor
5. Observe the effect on LED.
6. Vary the intensity of pressure on plate.
7. Observe the effect on LED.

Output: LED glows when pressure is applied at Peizo Switch. The intensity of light is dependent on pressure applied at the plate. This circuit is an example of conversion of physical pressure into electrical energy.

[**22**]

Title: To study the working of mechanical energy to electrical energy converter.

Aim: To study the working of mechanical energy to electrical energy converter.

Circuit Diagram:

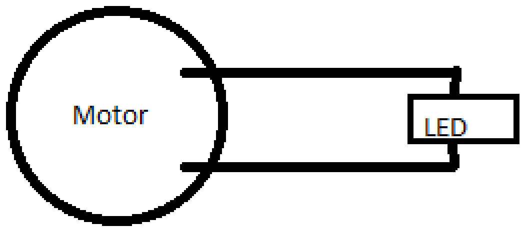


Figure 8: Motor activated LED circuit

Components used:

1. LED to act as output indicator
2. Motor of 1Ampere
3. Single standard wires for making connections
4. Bread Board

Procedure:

1. Test the components using multimeter.
2. Mount the circuit as shown in the Figure 12.
3. Test the continuity at various points.
4. Rotate the shaft of Motor
5. Observe the effect on LED.
6. Vary the rotation speed of Motor shaft
7. Observe the effect on LED**.**

Output: LED glows when the shaft of the motor rotates. This circuit is an example of conversion of mechanical energy into electrical energy.

[**23**]

Title: To study the working of LED circuit as Static **Electricity Detector.**

Aim: **:** To study the working of LED circuit as Static Electricity Detector.

Circuit Diagram:

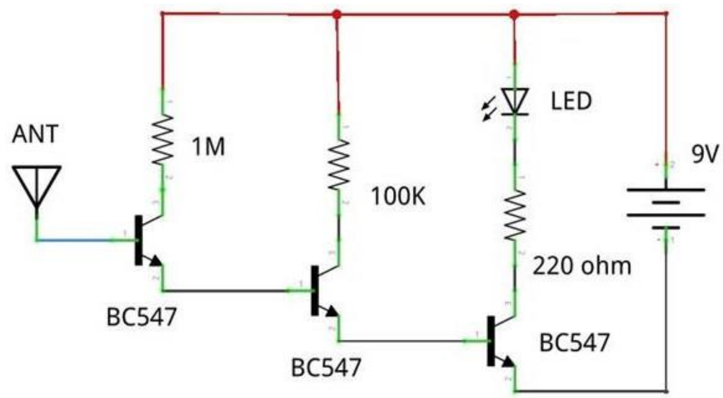


Figure 9: Static electricity sensor circuit

Components used:

1. LED to act as output indicator
2. Resistor of 220 Ohm, 100Kilo ohm, 1 Mega Ohm
3. Battery of 9 Volts as power supply
4. Single standard wires for making connections and Antenna
5. Battery Connector
6. Transistor BC 547 (3 no.)
7. Bread Board

Procedure:

1. Test the components using multimeter.
2. Mount the circuit as shown in the Figure 15.
3. Test the continuity at various points.
4. Extract a piece of wire from the base of the third transistor to act as an antenna to detect charges.
5. Bring your hand close to the antenna.
6. Observe the effect on LED.
7. Repeat step 5 and 6 by bringing a plastic scale near antenna.
8. Repeat step 5 and 6 by bringing a plastic scale after rubbing it on your hairs near antenna.

Output: The led will glow indicating the presence of static electricity when we touch the antenna with any object containing static electricity. The circuit is so sensitive that it can detect your hand even if keep it near to the antenna without touching it.

[**24**]

Title: To study the working of LED circuit activated by sound.

Aim: To study the working of LED circuit activated by sound.

Circuit Diagram

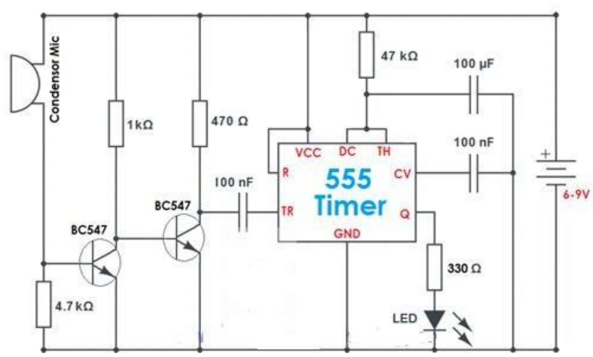


Figure 10: Sound Activated Circuit (Clap switch)

Components used:

1. LED to act as output indicator
2. Resistors of 330 Ohm , 470 Ohm, 1 Kilo Ohm, 4.7 Kilo Ohms, 47 Kilo Ohms
3. Capacitors 100 Nanofarad (2 Nos.), 100 Microfarad
4. Condenser Mic
5. Battery of 9 Volts as power supply
6. Single standard wires for making connections
7. Battery Connector
8. Transistor BC547
9. Timer 555 to act as a trigger
10.. Bread Board

Procedure:

1. Test the components using multimeter.
2. Mount the circuit as shown in the Figure 3.
3. Test the continuity at various points.
4. Speak in the condenser mic and observe the effect on LED.
5. Vary the voice volume at the mic input and observe the effect on LED.

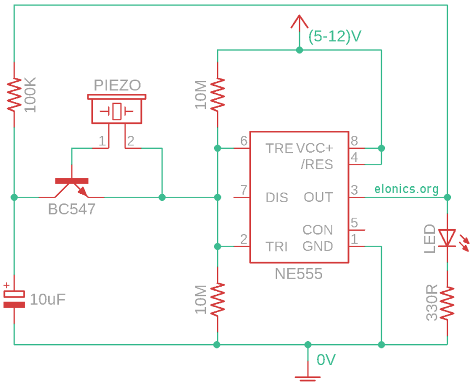
Output: The LED glows when circuit is connected as shown in figure 3 and sound is given as input at condenser Mic. The output shows that LED glows when input sound signal has energy to generate current which can switch on LED. It also shows an example of sound energy conversion into electrical energy.

[**25**]

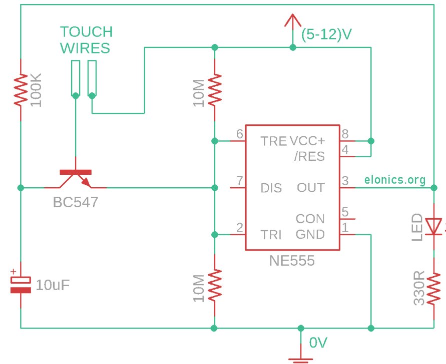
Title: Piezo Electric Knock On-Off Sensor Switch Circuit Using 555 Timer IC

Aim: Create a Tap On Tap Off piezoelectric knock sensor circuit using a 555 timer IC on a breadboard, adjusting output state based on piezo-electric speaker tapping.

Circuit Diagram



PIEZO KNOCK SWITCH SCHEMATIC*



TOUCH ON-OFF SWITCH SCHEMATIC

Components used:

1. 555 Timer IC
2. NPN Transistor (e.g., BC547)
3. Piezo Buzzer
4. LED or any Output Device
5. Resistors: 1 x 100K, 2 x 10M, 1 x (series resistor for LED)
6. 10uF Capacitor
7. Breadboard
8. Breadboard Connectors
9. 5-12V Power Supply

Procedure:

Connect the 555 Timer IC onto the breadboard, connecting Pins 4 (Reset) to Vcc and 8 (Vcc) to the positive rail. Connect Pin 1 (GND) to the negative rail and Pin 5 (Control Voltage) to the positive rail through a 10uF capacitor. Connect Pins 2 (Trigger) and 6 (Threshold) together and connect a 10M resistor to GND and Vcc. Connect the NPN transistor collector to the junction of Pins 2 and 6, connect the base to the piezo buzzer, and connect the emitter to GND. Connect the LED's anode to the collector and cathode to a series resistor. Provide power to the circuit (5-12V).

Output: This tutorial teaches the basic principles of timing circuits, transistor feedback, and touch-sensitive input devices. It involves a piezo buzzer, NPN transistors, and touch-sensitive functionality. The circuit can be used in complex touch-based projects or sensor-based systems, providing insights into timing circuits and transistor feedback.

References: https://elonics.org/piezo-electric-knock-switch-using-555-ic/

Annexure

Components in the Kit
Component
LED
Battery, 9V (power supply)
Single standard wires
Battery Connector
Breadboard
Potentiometer (100kΩ, 1kΩ, 10kΩ, 1MΩ)
Transistor (BJT - BC547, TIP122)
MOSFETs
MQ gas sensor
Reed switch
Photodiode
Thermistor 10kΩ
Mercury switch
PIR Motion Sensor Module
IR sensor
Motor
Piezo sensor
Capacitor (100nF, 100µF)
Condenser Mic
220-ohm resistor ,10k-ohm resistor, 100k-ohm resistor ,470-ohm resistor ,390-ohm resistor ,1k-ohm resistor ,4.7k-ohm resistor, 47k-ohm resistor ,560-ohm resistor ,680-ohm resistor
10Ω - 560Ω resistors
Light-Emitting Diode
RGB LED 3 x 5mm
5mm red LEDs
12V LED strip
TIP122 NPN Transistor
10k Resistor
12V DC Adaptor
2N2222 NPN transistors
100uF electrolytic capacitors
Buzzer
DPDT switch
Soldering iron and soldering wire
Desoldering pump
General-purpose PCB
PCB Hand drill

This kit offers a wide range of components for various electronic projects and applications. It includes fundamental components like LEDs, resistors, and capacitors, as well as specialized ones like transistors, sensors, and switches. Potentiometers and sensors provide adjustable input and feedback, while resistors and capacitors enable impedance matching and signal filtering. Transistors and MOSFETs enable amplification, switching, and signal control. The kit also covers sensors like gas sensors, photodiodes, and PIR motion sensors, integrating environmental awareness and automation. This comprehensive selection of components allows electronics enthusiasts and learners to experiment, learn, and innovate across various projects, fostering an understanding of electronics from basic to intricate applications.