METAL DETECTOR

Submitted to the university of Calicut in partial fulfillment of

the Requirement for the degree of

B.Sc Physics

By

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MARCH 2023

VALUED EXAMINER:

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To certify that the following students have done the project titled as “Metal Detector” under the supervision of Ms. Jessy K Benny in partial fulfillment of requirements for the Bsc Physics degree (CUCBCSS) during June 2020 to March 2023 of Calicut University.

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CERTIFICATE

This is to certify that the project METAL DETECTOR is the work carried out by Anitta Johnson under my supervision in partial fulfillment for the B.Sc Physics degree (CUCBCSS) during June 2020 to March 2023.

Dr.HAISEL MATHEW. **Ms Jessy k Benny**

(Head of department) **(Supervising Teacher)**

DECLARATION

I hereby declare that this project entitled METAL DETECTOR submitted in partial fulfillment of the requirement for the BSc Physics Degree(CUCBCSS) of Calicut university is the work done by me under the supervision of Ms.Jessy K Benny.

I further declare that this is not previously formed the part of any degree, Diploma or other similar title.

Place: Guruvayur **ANITTA JOHNSON**

Date:31.03.2021

ACKNOWLEDGEMENT

Primarily I would like to express my thanks of gratitude to Lord Almighty who showed his blessings on us to bring up this project to form we have always wanted. I extend my word of gratitude to MS. Jessy K Benny , Our class in charge, for being source of support within such a limited time frame.

I express my heartfelt gratitude to the head of our department, Dr. Haisel Mathews for her words of wisdom and constant guidance without which the project would have been futile.

I sincerely express my profound gratitude to our Principal Rev. Sr. Dr. JEESMA Therese who has always managed to see to it that our efforts did not go in vain.

Finally but immensely , thanks to each member of our group who stood by me as all one, staff members of Physics department and my parents for believing in me and helping with good guidance whenever I was in need.

Although this project has been prepared with utmost care and deep routed interest, even then I accept respondent and imperfection.

ANITTA JOHNSON

TABLE OF CONTENT

Chapter 1

Abstract

Metal detectors are extensively used to find undesirable metal objects in processed food. In such a typical metal detector, the coils are coaxially arranged with the transmitting coil in the center and two receiving coils on the sides. The receiving coils are connected to a differential amplifier. When the magnetic field generated in the transmitting coil is disturbed by metal objects, the amplitude and phase of the output voltage of the differential amplifier change, and, thus, the existence of foreign metal pieces is detected. The relationship between the amplitude and phase of the output and the electromagnetic properties of the metal objects, however, has only been discussed experimentally so far. The authors have already developed the SRPM method to simultaneously estimate the electrical and magnetic properties of a spherical sample by vectorially measuring the difference in the impedance of two circular solenoid coils, one with and the other without a sample. An attempt is made to theoretically analyze the properties, such as size, conductivity, and permeability of the metal objects from the output, i.e., amplitude and phase of the metal detector. Based on this method, an equation to estimate the vector voltage induced in the receiving coil by the metal object is derived by using a spherical sample to simplify the analysis.

Chapter 2

PROJECT DESCRIPTION.

The main purpose of this project is **to build a sensing system, which can help to detect moving or stationary object.** help to detect metal presence immediately by making a sound. Compared to expensive x-ray inspection technologies, metal detection technologies are more feasible, innovative, and assures safety and product quality. They are a perfect solution across the entire range of metals for manufacturing the quality. This technology becomes a huge part of everyone's life with many uses from work to safety. Detectors in airports, office building, schools, etc. help to detect people bringing any weapon onto the premises.There are different types of metal detectors and each is used for different purposes. Most commonly it is used for security check-ups for weapons or other objects which are metal or stainless steel. There are different metal detectors for commercial use and for detecting metal in food. Such metal detectors can also be used for household purposes

Chapter 3

AIM

The main purpose of this project is **to build a sensing system, which can help to detect moving or stationary objects.** One of the main benefits of using detectors is **to avoid the entry of sharp objects - such as knives and blades - and firearms**. This is essential to maintain security in locations with high density and/or potential targets for a criminal act such as airports, football stadiums, government offices, and larger companies.

Chapter 4

INTRODUCTION.

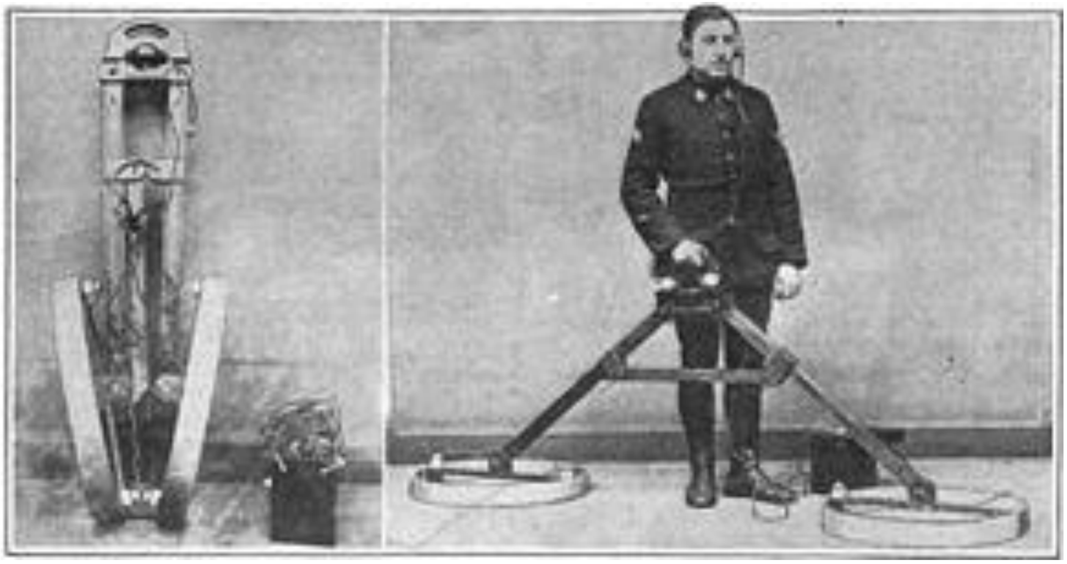
Metal detector is a very common device that is used for checking persons, luggage or bags in shopping malls, hotels, cinema halls, etc. to ensure that person is not carrying any metals or illegal things like guns, bombs etc. Metal Detectors. There are different types of metal detectors like hand held metal detectors, walk through metal detectors and ground search metal detectors. Metal detectors can be created easily and the circuit for a basic metal detector is not that complex. A **metal detector** is an instrument that detects the nearby presence of metal. Metal detectors are useful for finding metal objects on the surface, underground, and under water. The unit itself, consist of a control box, and an adjustable shaft, which holds a pickup coil, which can vary in shape and size. If the pickup coil comes near a piece of metal, the control box will register its presence by a changing tone, a flashing light, and or

a needle moving on an indicator. Usually the device gives some indication of distance; the closer the metal is, the higher the tone in the earphone or the higher the needle goes. Another common type are stationary "walk through" metal detectors used at access points in prisons, courthouses, airports and psychiatric hospitals to detect concealed metal weapons on a person's body.

U.S. Army soldiers use a military standard metal detector

The simplest form of a metal detector consists of an oscillator producing an alternating current that passes through a coil producing an alternating magnetic field. If a piece of electrically conductive metal is close to the coil, eddy currents will be induced (inductive sensor) in the metal, and this produces a magnetic field of its own. If another coil is used to measure the magnetic field (acting as a magnetometer), the change in the magnetic field due to the metallic object can be detected.

In this project, we have designed a simple DIY type Metal Detector Circuit using very simple components that can be used in our homes and gardens.



An early metal detector, in 1919, used to find un-exploded bombs in France after World War I

In 1841 Professor Heinrich Wilhelm Dove published an invention he called the "differential inductor".[1] It was a 4 coil induction balance, with 2 glass tubes each having 2 well insulated copper wire solenoids wound around them. Charged Leyden jars (high voltage capacitors) were discharged through the 2 primary coils, this current surge induced a voltage in the secondary coils.[2] When the secondary coils were wired in opposition the induced voltages cancelled as confirmed by the Professor holding the ends of the secondary coils. When a piece of metal was placed inside one glass tube the Professor received a shock. This then was the first magnetic induction metal detector, and the first pulse induction metal detector.

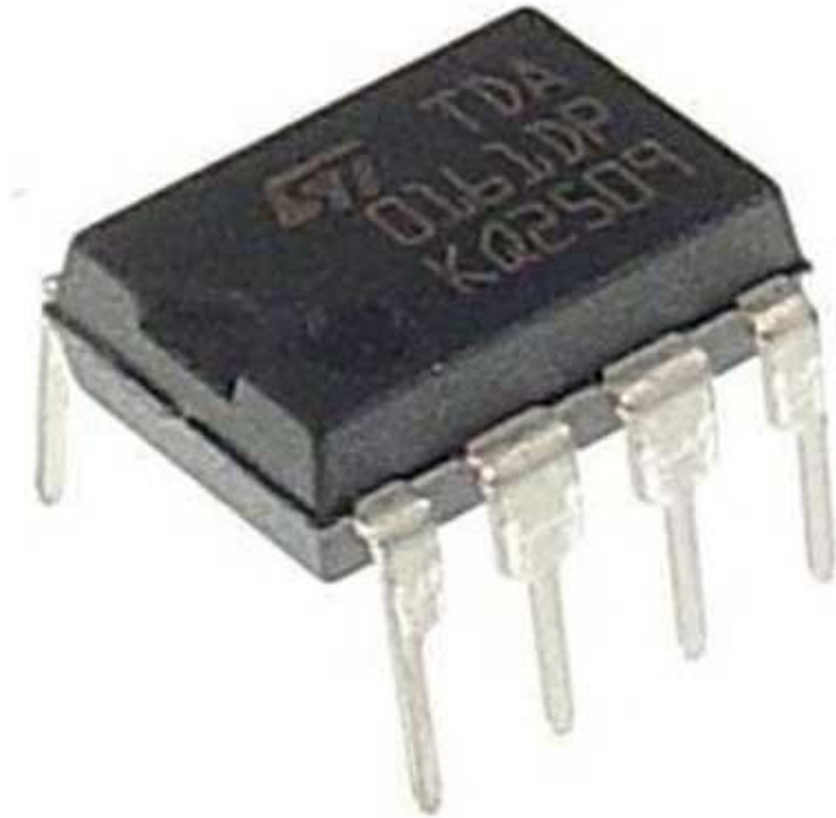
Chapter 5

COMPONENTS

COMPONENTS NAME	SPECIFICATIONS	QUANTITY
TDA0161 Proximity detector		1
Capacitor	47nF (ceramic capacitor code 473)	**2**
Resistor	1K ohm ,330K ohm ,100 ohm	**1,1,1**
Potentiometer	5K ohm	**1**
Transistor	2N2222A(NPN)	**1**
Buzzer	5V	**1**
Copper	Copper wire of 26-30 AWG is taken and it is wound into a coil of 5 to 6 cm and 140 to 150 turns	

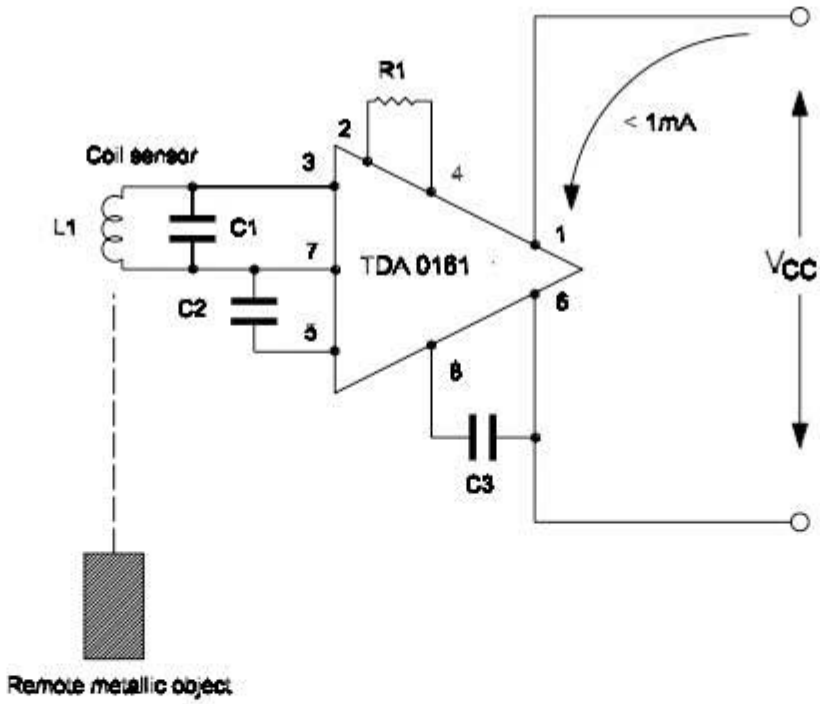
TDA0161 PROXIMITY DETECTOR

TDA0161 are monolithic integrated circuits that can detect the variations in high frequency Eddy current losses. They can be designed for detection of metallic body. They can act as oscillators with the help of external tuned circuit. The output signal level is altered when any metallic object is approaching towards the coil of the circuit. Basically, the output signal varies due to change in the supply current. The supply current does not depend upon the supply voltage. It becomes high when any metallic body is approaching else remains low. The normal high output is 10mA whereas normal low output is 1mA.

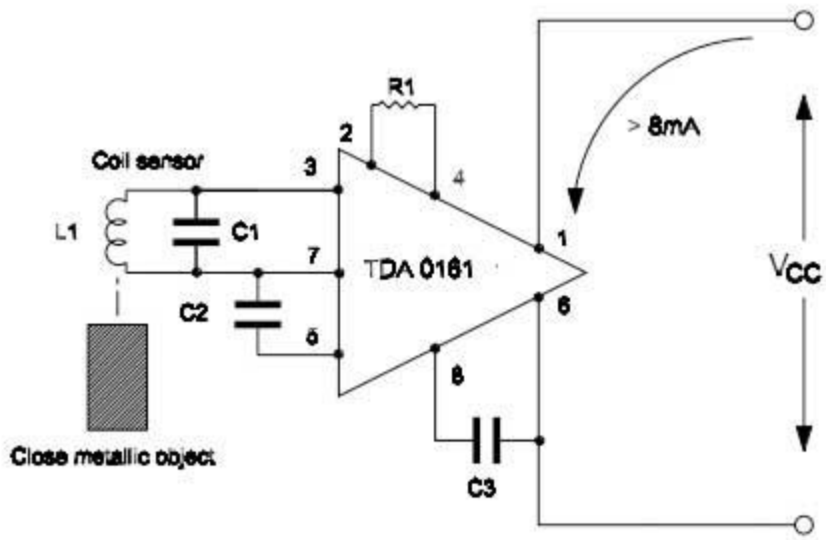


Working of TDA0161 IC.

When the metallic body is at the remote place, the Rp (tuned circuit loss resistance) becomes higher than the external resistance R1 which connected between pin 2 and pin 4. Hence the oscillation is sustained and the value of supply current becomes 1mA.



When the metallic body is approaching near the coil L1, the value of Rp (tuned circuit loss resistance) becomes smaller than the external resistance R1. As a result the oscillation comes to halt and the value of supply current becomes 10mA.



The value of Rp is determined by the eddy currents induced in the metallic body by the coil L1. The pin diagram of TDA0161 is given below:

Applications

TDA0161DP IC-Proximity Detector IC for Metal Detection These monolithic integrated circuits are designed for metallic body detection by sensing variations in high-frequency Eddy current losses. Using an externally-tuned circuit, they act as oscillators. The output signal level is altered by an approaching metallic object.

Features/Specs:

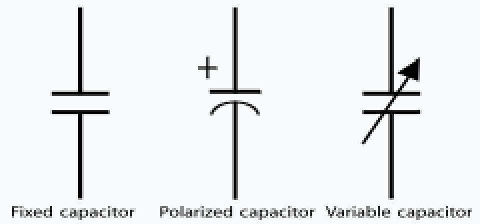
- Maximum Supply voltage: 35V
- Max Operating Temperature Range: +150ºC
- Maximum Output current: 50mA
- Storage temperature range: -55°C to +150°C

CAPACITOR 47 nF.

A **capacitor** is a device that stores electrical energy in an electric field by virtue of accumulating electric charges on two close surfaces insulated from each other. It is a passive electronic component with two terminals.

Invented	Ewald Georg von Kleist, Pieter van Musschenbroek (1745–1746, independently)

Electronic symbol



The effect of a capacitor is known as capacitance. While some capacitance exists between any two electrical conductors in proximity in a circuit, a capacitor is a component designed to add capacitance to a circuit. The capacitor was originally known as the **condenser**,[1] a term still encountered in a few compound names, such as the *condenser microphone*.
The physical form and construction of practical capacitors vary widely and many types of capacitor are in common use. Most capacitors contain at least two electrical conductors often in the form of metallic plates or surfaces separated by a dielectric medium. A conductor may be a foil, thin film, sintered bead of metal, or an electrolyte. The nonconducting dielectric acts to increase the capacitor's charge capacity. Materials commonly used as dielectrics include glass, ceramic, plastic film, paper, mica, air, and oxide layers. Capacitors are widely used as parts of electrical circuits in many common electrical devices. Unlike a resistor, an ideal capacitor does not dissipate energy, although real-life capacitors do dissipate a small amount (see Non-ideal behavior). When an electric potential difference (a voltage) is applied across the

terminals of a capacitor, for example when a capacitor is connected across a battery, an electric field develops across the dielectric, causing a net positive charge to collect on one plate and net negative charge to collect on the other plate. No current actually flows through the dielectric. However, there is a flow of charge through the source circuit. If the condition is maintained sufficiently long, the current through the source circuit ceases. If a time-varying voltage is applied across the leads of the capacitor, the source experiences an ongoing current due to the charging and discharging cycles of the capacitor.

The earliest forms of capacitors were created in the 1740s, when European experimenters discovered that electric charge could be stored in water-filled glass jars that came to be known as Leyden jars. Today, capacitors are widely used in electronic circuits for blocking direct current while allowing alternating current to pass. In analog filter networks, they smooth the output of power supplies. In resonant circuits they tune radios to particular frequencies. In electric power transmission systems, they stabilize voltage and power flow.[2] The property of energy storage in capacitors was exploited as dynamic memory in early digital computers,[3] and still is in modern DRAM

A **ceramic capacitor** is a fixed-value capacitor where the ceramic material acts as the dielectric. It is constructed of two or more alternating layers of ceramic and a metal layer acting as the electrodes. The composition of the ceramic material defines the electrical behavior and therefore applicationsCeramic capacitors, especially multilayer ceramic capacitors (MLCCs), are the most produced and used capacitors in electronic equipment that incorporate approximately one trillion (10^{12}) pieces per year.[1]

Ceramic capacitors of special shapes and styles are used as capacitors for RFI/EMI suppression, as feed-through capacitors and in larger dimensions as power capacitors for transmitters.

Application of ceramic capacitors.

- Class 1 ceramic capacitors offer high stability and low losses for resonant circuit applications.
- Class 2 ceramic capacitors offer high volumetric efficiency for buffer, by-pass, and coupling applications.

RESISTORS…

(1Kohm, 330ohm, 100ohm).

A **resistor** is a passive two-terminal electrical component that implements electrical resistance as a circuit element. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages, bias active elements, and terminate transmission lines, among other uses. High-power resistors that can dissipate many watts of electrical power as heat may be used as part of motor controls, in power distribution systems, or as test loads for generators. Fixed resistors have resistances that only change slightly with temperature, time or operating voltage. Variable resistors can be used to adjust circuit elements (such as a volume control or a lamp dimmer), or as sensing devices for heat, light, humidity, force, or chemical activity.

Resistors are common elements of electrical networks and electronic circuits and are ubiquitous in electronic equipment. Practical resistors as discrete components can be composed of various compounds and forms. Resistors are also implemented within integrated circuits.
The electrical function of a resistor is specified by its resistance: common commercial resistors are manufactured over a range of more than nine orders of magnitude. The nominal value of the resistance falls within the manufacturing tolerance, indicated on the component.

Application

the main uses of resistor is to control the flow of current. In a resistor, electrons have a collision with ions which slows down the flow of electricity and lowers the current and also produces heat. If a resistor is said to have high resistance then it means less current flows in it for the given voltage.
Some applications and uses of resistor are listed below:

- Circuit functions
- Dividing voltage
- Heating
- Frequency and timing

- LEDs and transistor

Resistor usage in Circuit Functions

There are various types of resistors that work according to the usage range. In that, we can set the resistance by using a knob kind of feature. Changing resistance will affect the flow of current inside the circuit. For example, this type of resistor is used in controlling the speed of a motor, pitch of a musical tone, loudness of an amplifier, etc.

Resistor is used for Diving Voltage

Dividing the voltage works when some components need to work in a much lesser voltage than the supplied input voltage. Connecting the resistors in a series will help to drop the voltage across each resistor equally, thus, assisting the appliances smoothly which works in those conditions.

It is also used for Heating

Because of the nature of generating heat when conducting current, resistors are used in a heater, toaster, microwave, electric stove, and many more heating appliances. In a light bulb, the metal filament glows white-hot due to the very high temperature produced from the resistance when electricity is passed through it.

Resistor → 1 k ohm

Resistor→330 ohm

Resistor→100ohm

POTENTIOMETER (5 kohm).

A **potentiometer** is a three-terminal resistor with a sliding or rotating contact that forms an adjustable voltage divider.[1] If only two terminals are used, one end and the wiper, it acts as a **variable resistor** or **rheostat**. The measuring instrument called a potentiometer is essentially a voltage divider used for measuring electric potential (voltage); the component is an implementation of the same principle, hence its name.
Potentiometers are commonly used to control electrical devices such as volume controls on audio equipment. Potentiometers operated by a mechanism can be used as position transducers, for example, in a joystick. Potentiometers are rarely used to directly control significant power (more than a watt), since the power dissipated in the potentiometer would be comparable to the power in the controlled load.

Application.

Potentiometers are rarely used to directly control significant amounts of power (more than a watt or so). Instead they are used to adjust the level of analog signals (for example volume controls audio equipment), and as control inputs for electronic circuits. For example, a light dimmer uses a potentiometer to control the switching of a TRIAC and so indirectly to control the brightness of lamps.

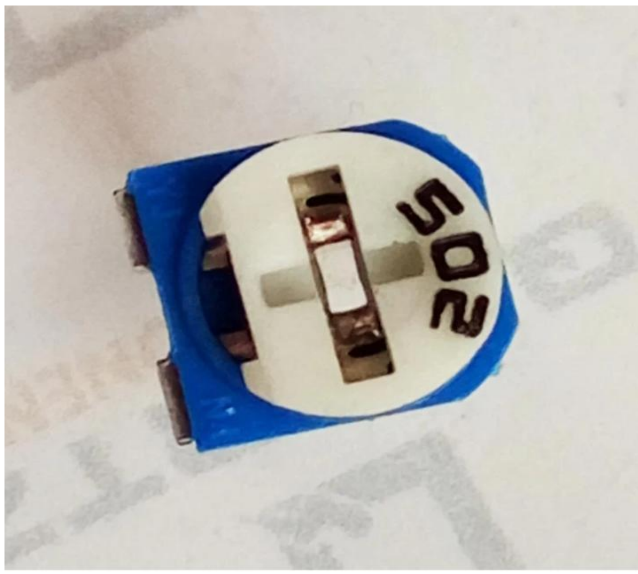
Preset potentiometers are widely used throughout electronics wherever adjustments must be made during manufacturing or servicing.

User-actuated potentiometers are widely used as user controls, and may control a very wide variety of equipment functions. The widespread use of potentiometers in consumer electronics declined in the 1990s, with rotary incremental encoders, up/down push-buttons, and other digital controls now more common. However they remain in many applications, such as volume controls and as position sensors.
potentiometer is an instrument for measuring voltage or 'potential difference' by comparison of an unknown voltage with a known reference voltage. If a sensitive indicating instrument is used, very little current is drawn from the source of the unknown voltage. Since the reference voltage can be produced from an accurately calibrated voltage divider, a potentiometer can provide high precision in measurement. The method was described by Johann Christian Poggendorff around 1841 and became a standard laboratory measuring technique.[1]
In this arrangement, a fraction of a known voltage from a resistive slide wire is compared with an unknown voltage by means of a galvanometer. The sliding contact or

wiper of the potentiometer is adjusted and the galvanometer briefly connected between the sliding contact and the unknown voltage. The deflection of the galvanometer is observed and the sliding tap adjusted until the galvanometer no longer deflects from zero. At that point the galvanometer draws no current from the unknown source, and the magnitude of voltage can be calculated from the position of the sliding contact. This null balance measuring method is still important in electrical metrology and standards work and is also used in other areas of electronics

.

This 5K ohm compact linear Potentiometer with plastic dust-cap is suitable for bread board as well as PCB. This is center tap type so two pins will .



TRANSISTOR (2N2222A NPN).

A **transistor** is a semiconductor device used to amplify or switch electrical signals and power. The transistor is one of the basic building blocks of modern electronics.[1] It is composed of semiconductor material, usually with at least three terminals for connection to an electronic circuit. A voltage or current applied to one pair of the transistor's terminals controls the current through another pair of terminals. Because the controlled (output) power can be higher than the controlling (input) power, a transistor can amplify a signal. Some transistors are packaged individually, but many more in miniature form are found embedded in integrated circuits.

Austro-Hungarian physicist Julius Edgar Lilienfeld proposed the concept of a field-effect transistor in 1926, but it was not possible to actually construct a working device at that time.[2] The first working device to be built was a point-contact transistor invented in 1947 by American physicists John Bardeen and Walter Brattain while working under William Shockley at Bell Labs. The three shared the 1956 Nobel Prize in Physics for their achievement.[3] The most widely used type of transistor is the metal–oxide–semiconductor field-effect transistor (MOSFET), which was invented by Mohamed Atalla and Dawon Kahng at Bell Labs in 1959.[4][5][6] Transistors revolutionized the field of electronics, and paved the way for smaller and cheaper radios, calculators, and computers, among other things.

Most transistors are made from very pure silicon, and some from germanium, but certain other semiconductor materials are sometimes used. A transistor may have only one kind of charge carrier, in a field-effect transistor, or may have two kinds of charge carriers in bipolar junction transistor devices. Compared with the vacuum tube, transistors are generally smaller and require less power to operate. Certain vacuum tubes have advantages over transistors at very high operating frequencies or high operating voltages. Many types of transistors are made to standardized specifications by multiple manufacturers.

The **2N2222** is a common NPN bipolar junction transistor (BJT) used for general purpose low-power amplifying or switching applications. It is designed for low to medium current, low power, medium voltage, and can operate at moderately high speeds. It was originally made in the TO-18 metalThe 2N2222 is considered a very common transistor, and is used as an exemplar of an NPN transistor. It is frequently used as a small-signal transistor, and it remains a small general purpose transistor[6] of enduring popularity.

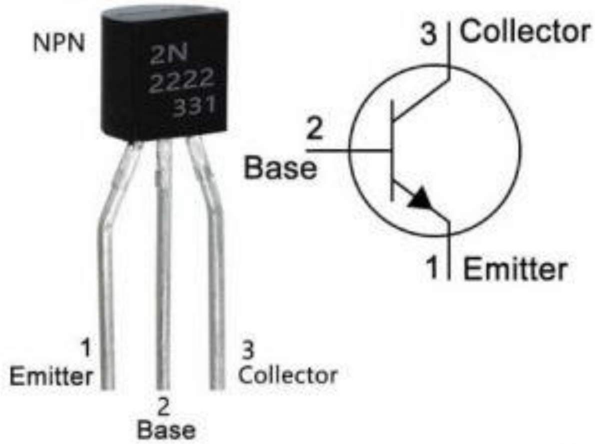
The 2N2222 was part of a family of devices described by Motorola at a 1962 IRE convention. Since then it has been made by many semiconductor companies, for example, Texas Instruments.

2N2222A transistor offers constant DC collector current like 800mA, so it is necessary to use where low to medium current is necessary. It functions on the value of high transition frequency like 250MHz through 10ns delay time, 225ms storage time, 60ms fall time & 25ms rise time. It is available in the TO-92 package.

Alternative 2N2222A transistors are; BC636, BC549, BC639, 2N2369, BC547, 2N3055, 2N3906, 2N3904 & 2SC5200. Equivalent 2N2222 transistors are; 2N3904 (PNP), 2N2907 (PNP), 2N3906 (PNP), S9014, BC637, BC148, MPS2222, 2N4403, PN2222, KTN2222 & KN2222.

2N2222A Transistor Pin Configuration

The **pin configuration of the 2N2222A transistor** is shown below. This transistor includes three pins & its each pin functionality is discussed below.



2N222A Pin Configuration & Symbol

- **Pin1 (Collector):** This is the first pin of the transistor & it is an o/p pin. The main function of this pin is to provide transistor current toward the o/p load.
- **Pin2 (Base):** The base pin is a control pin & it is a second pin of the transistor. The main function of this pin is to control the current from emitter to base.
- **Pin3 (Emitter):** The emitter pin is the third pin of the transistor & it is used to drain out the complete current of the transistor.

The **key characteristics of 2N2222A** are discussed below.

- The transistor's completer power should not go above 500mW.
- The maximum handling frequency capacity is 250MHz.
- The maximum tolerance is 60V across its two terminals like base & collector.
- For the 10mA collector current & for 10V, the DC current is approximately 75mA.

Advantages

The main **advantages of using the 2N2222 transistor** include the following.

- This is the most commonly used type of transistor
- In electronic circuits, most of the switching applications can be done by using this transistor
- It is capable of handling fairly high magnitude currents as compared to other similar transistors.
- This transistor switches the load current with 800 mA through it, which is high as compared to others.
- So this capability will make the device ideal in the applications of linear amplifiers.
- Small size

- Less weight
- Voltage gain is high
- Low source voltage
- Low cost
- Longer life

Buzzer (5 v).

A **buzzer** or **beeper** is an audio signaling device,[1] which may be mechanical, electromechanical, or piezoelectric (*piezo* for short). Typical uses of buzzers and beepers include alarm devices, timers, train and confirmation of user input such as a mouse click or keystroke.

History

Electromechanical

The electric buzzer was invented in 1831 by Joseph Henry. They were mainly used in early doorbells until they were phased out in the early 1930s in favor of musical chimes, which had a softer tone.

Piezoelectric

Piezoelectric buzzers, or piezo buzzers, as they are sometimes called, were invented by Japanese manufacturers and fitted into a wide array of products during the 1970s to 1980s. This advancement mainly came about because of cooperative efforts by Japanese manufacturing companies. In 1951, they established the Barium Titanate Application Research Committee, which allowed the companies to be "competitively cooperative" and bring about several piezoelectric innovations and inventions.

Application.

Present day applications include:

- Novelty uses
- Judging panels
- Educational purposes
- Annunciator panels
- Electronic metronomes
- Game show lock-out device
- Microwave ovens and other household appliances
- Sporting events such as basketball games
- Electrical alarms
- Joy buzzer (mechanical buzzer used for pranks)

COPPER WIRE.

Copper has been used in electrical wiring since the invention of the electromagnet and the telegraph in the 1820s.[1][2] The invention of the telephone in 1876 created further demand for copper wire as an electrical conductor

Copper is the electrical conductor in many categories of electrical wiring.[3][4] Copper wire is used in power generation, power transmission, power distribution, telecommunications, electronics circuitry, and countless types of electrical equipment.[5] Copper and its alloys are also used to make electrical contacts. Electrical wiring in buildings is the most important market for the copper industry.[6] Roughly half of all copper mined is used to manufacture electrical wire and cable conductors

Applications

Electrolytic-tough pitch (ETP) copper, a high-purity copper that contains oxygen as an alloying agent, represents the bulk of electrical conductor applications because of its high electrical conductivity and improved annealability. ETP copper is used for power transmission, power distribution, and telecommunications.[5] Common applications include building wire, motor windings, electrical cables, and busbars. Oxygen-free coppers are used to resist hydrogen embrittlement when extensive amounts of cold work is needed, and for applications requiring higher ductility (e.g., telecommunications cable). When hydrogen embrittlement is a concern and low electrical resistivity is not required, phosphorus may be added to copper.[8]

For certain applications, copper alloy conductors are preferred instead of pure copper, especially when higher strengths or improved abrasion and corrosion resistance properties are required. However, relative to pure copper, the higher strength and corrosion resistance benefits that are offered by copper alloys are offset by their lower electrical conductivities. Design engineers weigh the advantages and disadvantages of the various types of copper and copper alloy conductors when determining which type to specify for a specific electrical application. An example of a copper alloy conductor is cadmium copper wire, which is used for railroad electrification in North America.[5] In Britain the BPO (later Post Office Telecommunications) used cadmium copper aerial lines with 1% cadmium for extra strength; for local lines 40 lb/mile (1.3 mm dia) and for toll lines 70 lb/mile (1.7 mm)

Chapter 6

PRINCIPLES OF METAL DETECTOR

- When the LC circuit that is L1 and C1 has got any resonating frequency from any metal which is near to it, electric field will be created which will lead to induces current in the coil and changes in the signal flow through the coil.
- Variable resistor is used to change the proximity sensor value equal to the LC circuit, it is better to check the value when there is coil not near to the metal. When the metal is detected the LC circuit will have changed signal. The changed signal is given to the proximity detector (TDA 0161), which will detect the change in the signal and react accordingly. The output of the proximity sensor will be of 1mA when there is no metal detected and it will be around 10mA when coil is near to the metal
- When the output pin is high the resistor R3 will provide positive voltage to transistor Q1. Q1 will be turned on and led will glow and buzzer will give the buzz. Resistor r2 is used to limit the current flow.
- There are three main parts in the metal detector circuit: the LC Circuit, the Proximity Sensor , output LED and the Buzzer. The coil and the capacitor C1, which are connected in parallel, will form the LC circuit.

- Proximity sensor(TDA0161), is triggered by this LC cirucit if any metal is detected.The Proximity sensor will then turn on the led and produces alarm using buzzer.

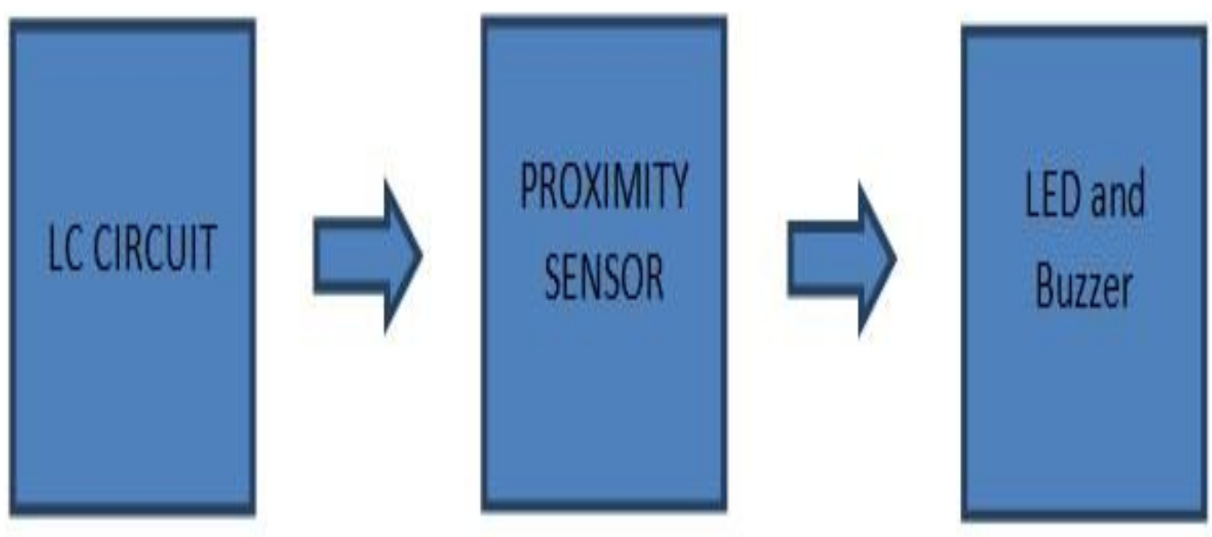
- **LC Circuit:** LC circuit has inductor and capacitor connected in parallel.This circuit sarts resonating when there is same frequency material near to it. The LC circuit charges capacitor and inductor alternatively.When the capacitor is charged fully ,charge is applied to inductor.

- Inductor starts charging and when charge across the capacitor is nil, it draws charge from the inducutor in reverse polarity. Then inductor charge is reduced and again the process repeats.Note inductor is a magnetic field storage device and capacitor is electric field storage device.

- **Proximity Sensor:** The proximity sensor can detect the objects with out any physical interference. The proximity sensor will work same as infrared sensor, proximity also release a signal, it will not give output unless and until there is no change in the reflected back signal.

- If there is a change in signal it will detect and give the output accordingly. There are different proximity sensors for example to detect plastic material we can use capacitive type proximity and for metals we should use inductive type.

BLOCK DIAGRAM..



Chapter 7

Working and construction

The LC Circuit, which consists of L1 (coil) and C1, is the main metal detector part of the circuit. With the help of this LC Circuit, which is also called as Tank Circuit or Tuned Circuit, the TDA0161 IC acts as an oscillator and oscillates at a particular frequency.

When the LC circuit detects any resonating frequency from any metal which is near to it, electric field will be created which will lead to induces current in the coil and changes in the signal flow through the coil.

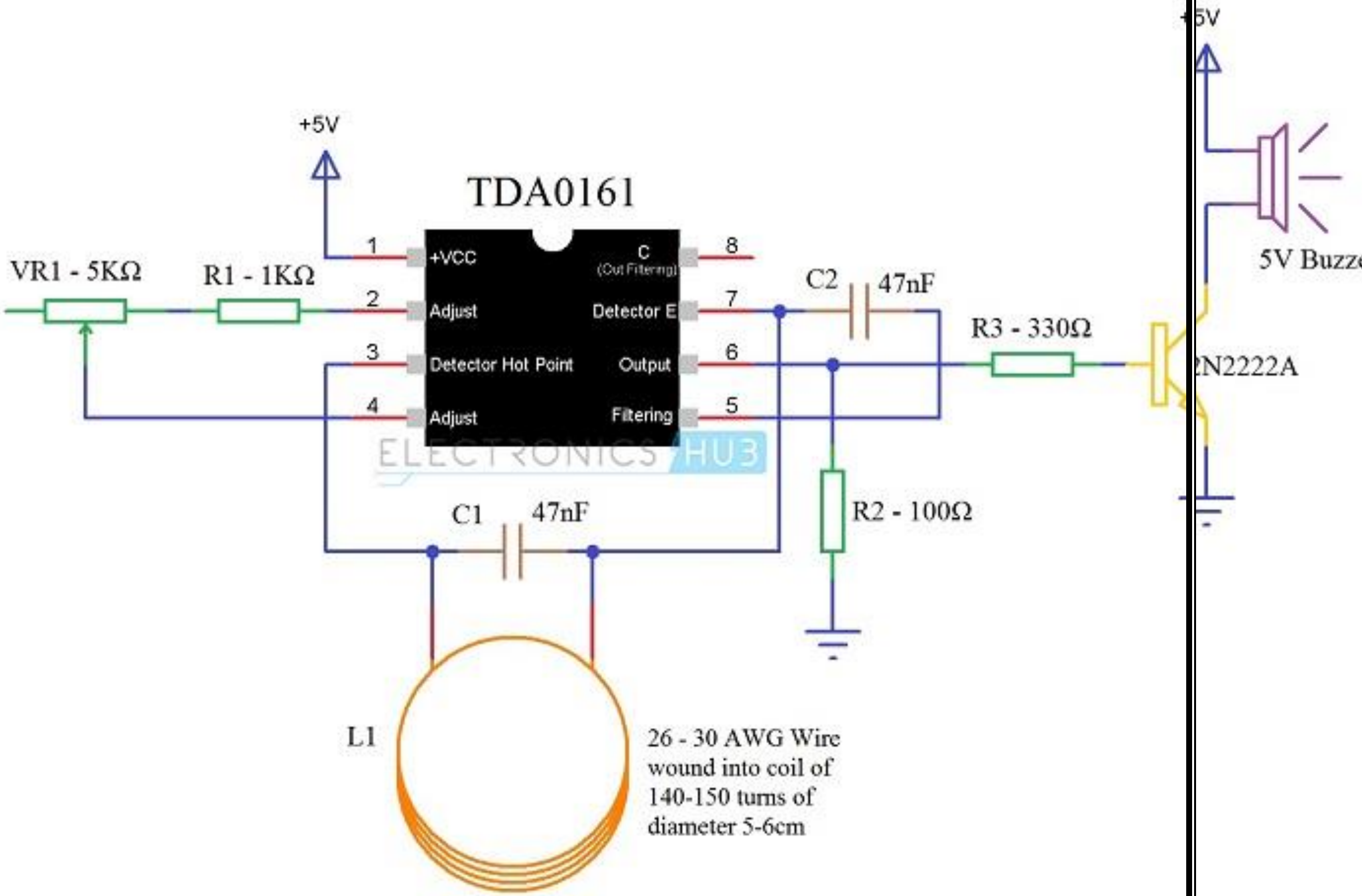
Variable resistor is used to change the proximity sensor value equal to the LC circuit, it is better to check the value when the coil is not near any metal object. When the metal is detected, the LC circuit will have changed signal.

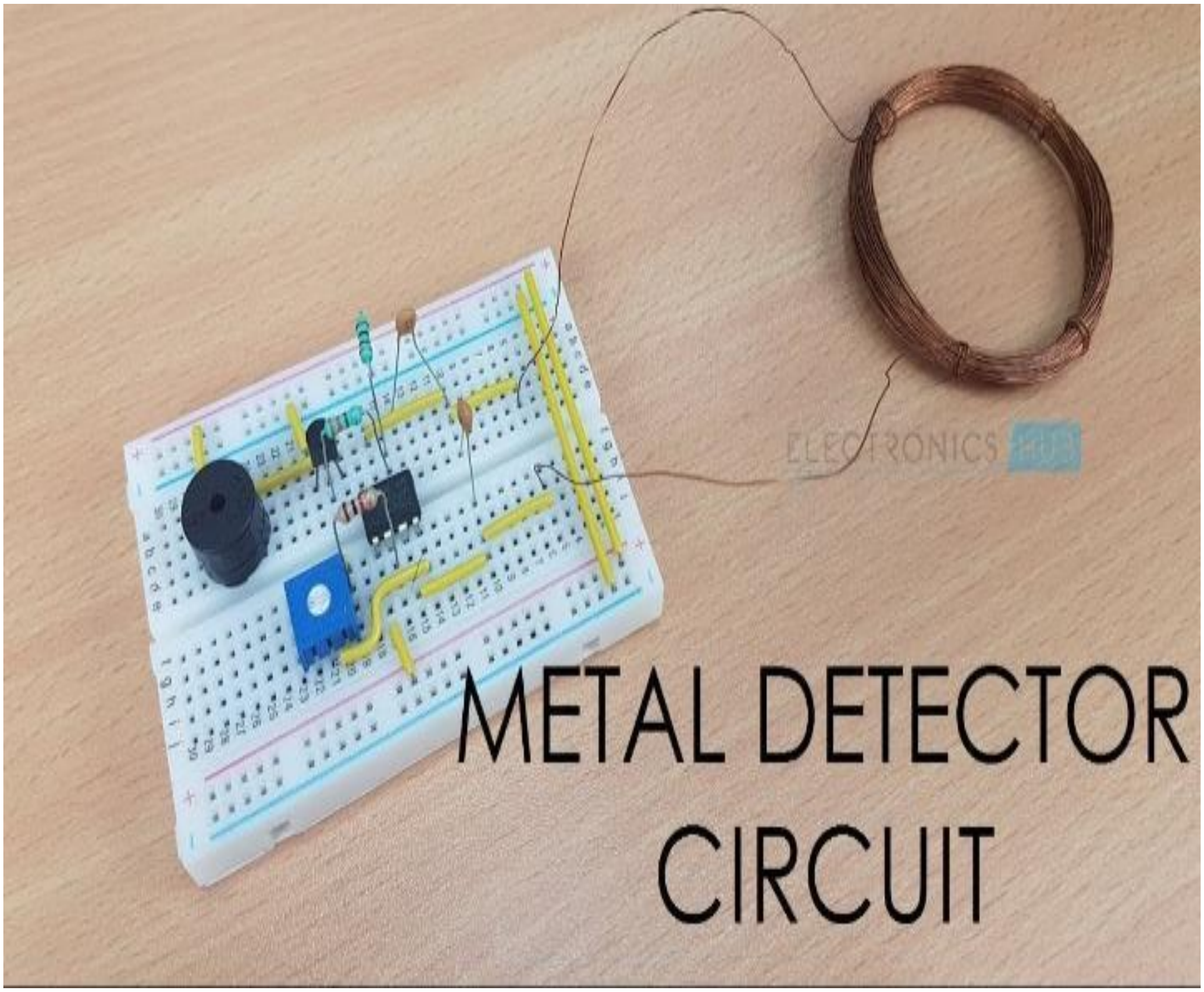
The changed signal is given to the proximity detector (TDA 0161), which will detect the change in the signal and react accordingly. The output of the proximity sensor will less than 1mA when there is no metal detected and it will be around 10mA (usually greater than 8mA) when coil is near to the metal.

When the output pin is high, the resistor R3 will provide positive voltage to transistor Q1. Q1 will be turned on and LED will glow (not shown in the circuit) and buzzer will be activated.

Circuit Diagram

The following image shows the circuit diagram for the metal detector circuit.




ELECTRONICS HUB
METAL DETECTOR
CIRCUIT

Chapter 8

APPLICATION OF METAL DETECTOR.

- This simple Metal Detector can be used to identify metals like iron, gold, silver etc.
- Since it is a simple project, we can use this in our home to scan for nails, metal scraps etc. which are not easily spotable by naked eye.
- **Archaeology**

Metal detectors are widely used in archaeology with the first recorded use by military historian Don Rickey in 1958 who used one to detect the firing lines at Little Big Horn

- **Industrial metal detectors**

Industrial metal detectors are used in the pharmaceutical, food, beverage, textile, garment, plastics, chemicals, lumber, mining, and packaging industries.

Contamination of food by metal shards from broken processing machinery during the manufacturing process is a major safety issue in the food industry. Metal detectors for this purpose are widely used and integrated into the production line.

- **Civil engineering**

In civil engineering, special metal detectors (cover meters) are used to locate reinforcement bars inside walls. American metal finders are a term that refer to the devices and equipment or instruments made by American companies or manufacturers , that can be used to find or detect metal objects nearby or buried underground such as silver or golden coins or small jewelry and so on. Metal finders' more accurate term is: Metal Detectors, as the metal detector's main function is to detect the presence of metal objects including buried metal targets such as gold treasures, bronze statues, archaeological artifacts made of different metal types. Demining, also known as mine removal, is the method of clearing a field of landmines.

- **Military**

The aim of military operations is to clear a path through a minefield as quickly as possible, which is mostly accomplished using equipment like mine plows and blast waves.

Humanitarian demining, on the other hand, aims to clear all landmines to a certain depth and make the land secure for human use.

The process of finding or detection of mines done by a special designed metal detector exclusively developed to detect mines and bombs.

- **Pharmaceutical**

metal detector helps make final packaged foods and other pharmaceutical products free from metal components as per the GMP standards and various other country-based certifications.

Chapter 9

ADVANTAGES AND DISADVANTAGE S

ADVANTAGES

- The Proximity Detector IC TDA0161 based Metal Detector Circuit is a very simple and easy to construct metal detector that can be used to detect small metals in our homes, offices and gardens.

- There is need for any microcontroller as the Proximity Sensor will be sufficient to implement the project.

DISADVANTAGE

- The main disadvantage of this Metal Detector Circuit is the range of detection. The metal object has to be at a distance of 10mm for the detector to detect it.

Chapter 10

CONCLUSION

This project has been developed considering the need of low cost. The equipment is compactv, simple in design and can be used pratically anywhere . This metal detectors is very commonly used for checking persoms, luggage or bag in shopping malls, hotels, cinema halletc. To ensure that the person is not carrying any metals or illegal things like guns, bombs etc… .

Chapter 11

REFERENCE

- **https://www.electronicshub.org/metal-detector-circuit/**