DATA TRANSFER USING LI-FI TECHNOLOGY
PEIZO BASED VISITOR SENSING WELCOME MAT

20EC5203 - ELECTRONIC DESIGN PROJECT I

A PROJECT REPORT

Submitted by

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SAMAYAPURAM – 621 112

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SAMAYAPURAM - 621 112

BONAFIDE CERTIFICATE

Certified that this project report titled **"DATA TRANSFER USING LI-FI TECHNOLOGY","PEIZO BASED VISITED SENSING WELCOME MAT"** is the bonafide work of **MADHUSEELAN N(811722106046),SUTHAKARAN A(811722106117), VENKAT V(811722106122)** who carried out the project under my supervision. Certified further, that to the best of my knowledge the work reported here in does not from part of any other project report or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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INTERNAL EXAMINER **EXTERNAL EXAMINER**

DECLARATION

We jointly declare that the project report on **"DATA TRANSFER USING LI-FI TECHNOLOGY", "PEIZO BASED VISITED SENSING WELCOME MAT"** is the result of original work done by us and best of our knowledge, similar work has not been submitted to "**ANNA UNIVERSITY CHENNAI**" for the requirement of Degree of **BACHELOR OF ENGINEERING**. This project report is submitted on the partial fulfillment of the requirement of the award of Degree of **BACHELOR OF ENGINEERING**.

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2 DATA TRANSFER USING LI-FI TECHNOLOGY

LIST OF FIGURES

LIST OF ABBREVIATIONS

LED	-	Light Emitting Diode
IC	-	Integrated Circuit
PCB	-	Printed Circuit Board
LI – FI	-	Light Fidelity

CHAPTER-1

COMPONENTS

1.1 PCB BOARD:

A Printed Circuit Board (PCB) is a fundamental component in electronics, providing a platform for connecting and supporting electronic components. It consists of layers of conductive material, typically copper, laminated onto a non-conductive substrate such as fiberglass or plastic. PCBs are designed with specific patterns of conductive traces, pads, and vias to establish electrical connections between components like resistors, capacitors, and microchips.

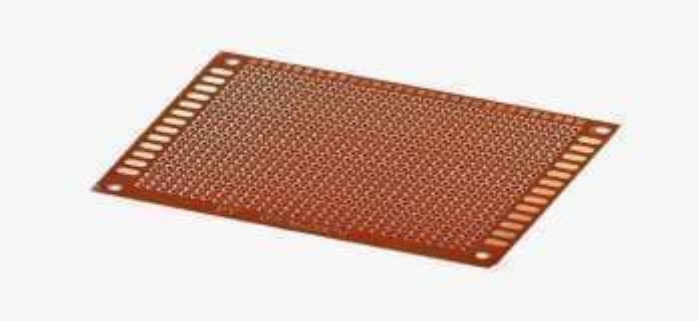

Figure :1.1 PCB board

PCBs come in various types, including single-layer, double-layer, and multi-layer designs, depending on the complexity of the circuit. They are used in a wide range of applications, from consumer electronics like smartphones and computers to industrial equipment and medical devices.

1.2 LED:

Light Emitting Diodes (LEDs) represent a groundbreaking technology with wide ranging applications across diverse industries. Functioning on the principle of electroluminescence, LEDs emit light as a result of electrons moving within a semiconductor material. The advantages of LEDs are manifold. They excel in energy efficiency by converting a significant portion of electrical energy into visible light, surpassing traditional incandescent bulbs that dissipate a substantial amount as heat. This not only contributes to lower electricity bills but also aligns with global efforts towards energy conservation. The durability of LEDs is a key asset, attributed to their solid-state construction, lacking delicate components like filaments or glass bulbs.

Figure:1.2 LED

Beyond their use in indicators and displays, LEDs play a pivotal role in driving technological advancements. Their low power consumption makes them ideal for battery-operated devices, while their contribution to energy efficiency aligns with sustainability goals. In the automotive industry, LEDs are extensively used in headlights and taillights, improving visibility and safety. The continual evolution of LED technology underscores its importance in shaping a more sustainable and technologically advanced future.

1.3 POWER SUPPLY:

A battery stands as a fundamental component in the realm of portable electronics, operating as a versatile electrochemical device designed to store and deliver electrical energy through a controlled chemical reaction. Typically composed of one or more electrochemical cells, a battery consists of positive (cathode) and negative (anode) electrodes immersed in an electrolyte solution. The chemical interaction between these components, when a circuit is closed, triggers a reaction that results in the flow of electrons, generating electrical energy. Alkaline batteries, for instance, are ubiquitous in everyday devices due to their reliability and cost-effectiveness. Lithium-ion batteries, renowned for their high energy density and rechargeable nature, are prevalent in various applications, including smartphones and electric vehicles. Nickel-cadmium batteries, also rechargeable, find their niche in portable electronics, offering a balance between efficiency and longevity. Alkaline batteries are ideal for low-drain devices, while lithium-ion batteries shine in applications demanding compactness and high energy storage.

Figure:1.3 Battery

Rechargeable batteries, a notable category, contribute significantly to sustainability efforts by minimizing waste and promoting resource efficiency. Particularly economical for devices with frequent usage patterns, rechargeable batteries not only reduce environmental impact but also prove cost-effective over time. Batteries serve as omnipresent power

sources, indispensable for a broad spectrum of electronic devices. Their role extends from powering small everyday gadgets to being the driving force behind electric vehicles. In an era where electronic devices are integral to daily life.

1.4 RESISTOR:

A resistor is a fundamental electronic component that opposes the flow of electric current. It is a passive two-terminal device with the primary function of controlling or limiting the amount of current passing through a circuit. Resistors are crucial in electronics for adjusting voltage levels, protecting components from excessive currents, and defining time constants in various applications. Resistors come in various types, including fixed resistors with specific resistance values and variable resistors like potentiometers and rheostats that allow manual adjustment. The resistance of a resistor is measured in ohms (Ω) and is governed by Ohm's Law, which relates the voltage (V),
current (I), and resistance (R) in a circuit through the equation $V = I \times R$. In electronic circuits, resistors play essential roles in voltage dividers, signal conditioning, and setting bias points for active devices like transistors.

Figure:1.4 Resistor

Moreover, in setting bias points for active devices like transistors, resistors contribute to stabilizing and controlling the operation of these

components. They are also employed in filters, oscillators, and numerous other applications where precise control of electrical parameters is necessary. Resistors are foundational components in circuit design, offering control and stability in the flow of electric current, contributing to the overall functionality and performance of electronic systems. In summary, resistors are foundational components in circuit design, offering control and stability in the flow of electric current.

1.5 CAPACITOR:

A capacitor is a fundamental electronic component that stores and releases electrical energy in a circuit. It consists of two conductive plates separated by an insulating material called a dielectric. When a voltage is applied across the plates, an electric field is established, causing the accumulation of positive and negative charges on the respective plates. Capacitors are versatile components with various applications in electronics. They play a crucial role in smoothing voltage fluctuations, filtering signals, and providing energy storage in circuits. The ability to store electrical energy temporarily makes capacitors valuable in timing circuits, coupling AC and DC signals, and decoupling power supplies. Capacitors come in different types, including electrolytic capacitors, ceramic capacitors, and tantalum capacitors, each with specific properties suited to different applications. The capacitance of a capacitor, measured in farads (F), indicates its ability to store charge.

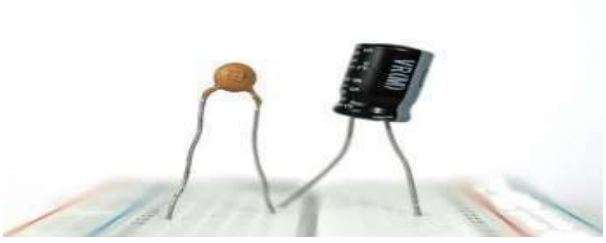

Figure:1.5 Capacitor

In electronic circuits, capacitors are essential for stabilizing power supplies, eliminating noise, and facilitating the proper functioning of various electronic components. They play

integral roles in audio systems, power amplifiers, filters, and numerous other electronic devices, contributing significantly to the efficiency and performance of electrical systems.

1.6 INTEGRATED CIRCUIT:

An Integrated Circuit (IC) is a compact arrangement of interconnected electronic components, such as transistors, resistors, capacitors, and diodes, fabricated on a semiconductor material. The miniaturized design of an IC allows for the integration of multiple functions and electronic circuits into a single chip, providing a significant advancement in electronic technology. Digital ICs, such as microprocessors and memory chips, process binary information, enabling the operation of computers and digital devices. Analog ICs, like operational amplifiers (op-amps) and voltage regulators, are designed for continuous signal processing, common in audio amplifiers and power supplies. The 555 timer IC and the 741 op-amp are notable examples.

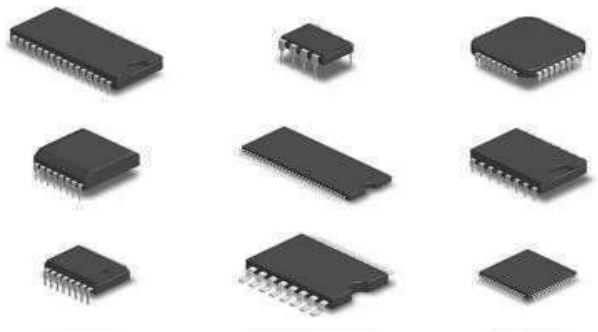

Figure:1.6 Integrated circuit

The 555 timer is widely used for generating time delays, pulse-width modulation, and oscillations. The 741 op-amp, on the other hand, is versatile and commonly used in amplifiers and signal processing applications. The compact nature of ICs enables the creation of complex electronic systems while minimizing space requirements, power consumption, and manufacturing costs. Integrated Circuits have

revolutionized the field of electronics, contributing to the development of countless electronic devices, from computers and smartphones to medical equipment and communication devices.

1.7 BUZZER:

A buzzer, a straightforward yet essential component in electronics, functions as an a device designed to produce sound when an electrical current is applied. Operating as a transducer, the buzzer converts electrical energy into audible sound waves, making it a valuable component for providing alerts and notifications in various electronic devices. The basic construction of buzzers typically involves a vibrating element, which could be a diaphragm or a piezoelectric crystal, and an electromagnetic coil. When an electric current flows through the coil, it generates a magnetic field. This magnetic field interacts with the vibrating element, causing it to vibrate and produce sound waves. The vibration frequency determines the pitch or tone of the sound emitted by the buzzer. Buzzers serve a wide range of applications, finding use in alarms, timers, notification systems, and any scenario where an audible alert is necessary.

Figure: 1.7 Buzzer

In electronic circuits, the operation of buzzers is often controlled by oscillators or timer circuits. These circuits dictate the frequency at which the buzzer vibrates, resulting in distinct tones for different purposes. For instance, in an alarm system, a buzzer might be designed to emit a continuous, attention-grabbing tone, while in a timer application, it may produce intermittent sounds to indicate specific intervals or events. Different buzzer designs and types cater to specific needs, allowing engineers and designers to choose the most suitable option for their intended purpose.

1.8 SOLAR PANEL:

A solar panel is a compact photovoltaic (PV) device that converts sunlight into electrical energy. It consists of many solar cells connected together in series or parallel, depending on the required voltage and current. These solar cells are made of semiconductor materials, typically silicon, which absorb photons from sunlight and generate a flow of electricity through the photovoltaic effect. Small solar panels are often used in applications where space is limited or where low power is required, such as charging small devices, powering sensors, or providing energy for remote equipment.

Figure:1.8 solar panel

The efficiency of a small solar panel depends on factors like the type of material used in the solar cells, the panel's surface area, and the intensity of sunlight it receives. While small solar panels may not produce large amounts of power, they are highly portable and can be used in various applications, including in portable solar chargers, garden lights, or small gadgets. This makes them an ecofriendly option, particularly for powering low-energy devices or systems in remote or off-grid locations.

1.9 CONNECTING WIRES:

Connecting wires form the indispensable infrastructure of electronic circuits, serving as the vital conduits that establish electrical pathways and facilitate the seamless flow of electric current. These wires, typically composed of conductive materials like copper or aluminium, play a fundamental role in ensuring the proper functioning of circuits, both on breadboards and within complex electronic systems. The primary function of connecting wires is to link various components within a circuit, creating the necessary electrical connections for the circuit to operate as intended. Their conductivity allows for the transmission of electrical signals between different elements, forming the essential links that enable communication and cooperation among circuit components.

Figure:1.9 Connecting wires

Different lengths accommodate diverse circuit layouts, while distinct colours aid in visually distinguishing between various connections. This visual clarity becomes particularly crucial during the prototyping and experimentation stages of electronic system development, where designers and engineers need to troubleshoot and optimize circuit con configurations. In essence, connecting wires are not just functional and the effective or else components; they are integral to the design, organization, and functionality of electronic circuits. As technology advances, the importance of well-organized connecting wires remains paramount in the pursuit of innovation and progress in the field of electronics.

1.10 SPEAKER:

A speaker is an electronic device that increases the strength of a signal, making it more powerful without altering its original content. It is commonly used in audio, radio frequency (RF), and signal processing applications. Amplifiers take input signals, such as weak electrical currents or sound waves, and boost their amplitude to drive output devices like speakers, antennas, or other systems.

Figure:1.10 Speaker

key characteristics of amplifiers include gain, bandwidth, efficiency, and linearity. Advances in amplifier technology continue to enhance performance, making them integral

to modern technology in areas such as wireless communication, music production, and scientific instrumentation.

1.11 AUX CABLE:

An aux cable, short for auxiliary cable, is a simple and widely used audio cable designed to transmit sound between devices. It usually features a 3.5mm connector, making it compatible with various electronic devices such as smartphones, laptops, car stereos, headphones, and speakers. This cable allows users to play music or audio files directly from one device to another, ensuring a clear and uninterrupted connection**.**

Figure: Aux cable

Aux cables are available in different lengths and designs, often with reinforced materials for durability. They support stereo sound and, in some cases, microphone functionality, making them versatile for multiple audio setups.

1.12 3.5 MM JACK

The 3.5mm jack, also known as the headphone jack or aux jack, is a standard audio connector used for transmitting audio signals between devices. It features a small, cylindrical plug with a diameter of 3.5mm, commonly found on devices like smartphones, laptops, headphones, and car stereo systems. The 3.5mm jack has three or four sections, known as TRS (Tip-Ring-Sleeve) or TRRS (TipRingRing-Sleeve), respectively. The TRS configuration supports stereo audio (left and right channels), while TRRS also includes a microphone connection, often used in headsets.

Figure: 3.5 mm jack

The 3.5mm jack has been a universal standard for years, making it easy to connect various audio devices. It offers a reliable, wired connection that provides high-quality audio with minimal latency, without the need for batteries or pairing.

1.13 SWITCH

An on/off switch is a fundamental component in electronic circuits, allowing users to control the flow of electrical current. It is a simple switch that can be toggled between two positions: "on" and "off" When the switch is in the "on" position, it completes the circuit, allowing current to flow. Conversely, when the switch is in the "off" position, it breaks the circuit, interrupting the flow of current.

Figure: Switch

CHAPTER-2

DATA TRANSFER USING LI-FI TECHNOLOGY

2.1 ABSTRACT:

Li-Fi (Light Fidelity) is an emerging wireless communication technology that utilizes visible light to transmit data. It provides high-speed, secure, and efficient data transfer by modulating light intensity to encode data. This technology offers a promising alternative to traditional Wi-Fi by leveraging the vast spectrum of visible light, which is relatively underutilized compared to radio waves. Li-Fi provides benefits such as higher data transfer rates, improved security due to line-of-sight communication, and reduced size component interference, making it ideal for environments where radio frequency-based communication may face limitations. The technology employs LEDs as the light source for data transmission and photodiodes for reception, enabling faster and more energy efficient communication. This paper explores the principles, advancements, and applications of Li-Fi technology, highlighting its potential in fields such as healthcare, automotive, and smart cities

2.2 INTRODUCTION:

Wireless communication technology, enabling data transfer through the modulation of visible light. Unlike traditional Wi-Fi, which relies on radio frequency (RF) waves, Li-Fi utilizes light-emitting diodes (LEDs) to transmit data, offering several advantages such as faster speeds, enhanced security, and reduced electromagnetic interference. With the global demand for higher bandwidth and faster internet speeds, Li-Fi promises to significantly

improve data transfer rates and network reliability. Its primary advantage lies in the use of the visible light spectrum, which is far less congested compared to the radio frequency spectrum, allowing for the transmission of large volumes of data with minimal interference. Additionally, Li-Fi offers superior security, as light signals cannot pass through walls, ensuring more secure communication within defined spaces.

2.3 COMPONENTS USED:

- Solar panel - 5&6V (1)
- LED - 1W (1)
- Aux cable - 1
- 3.5mm jack - 2
- Amplifier Speaker - 1
- Battery - 9v (1)
- Connecting Wires - As required

2.4 CIRCUIT DIAGRAM:

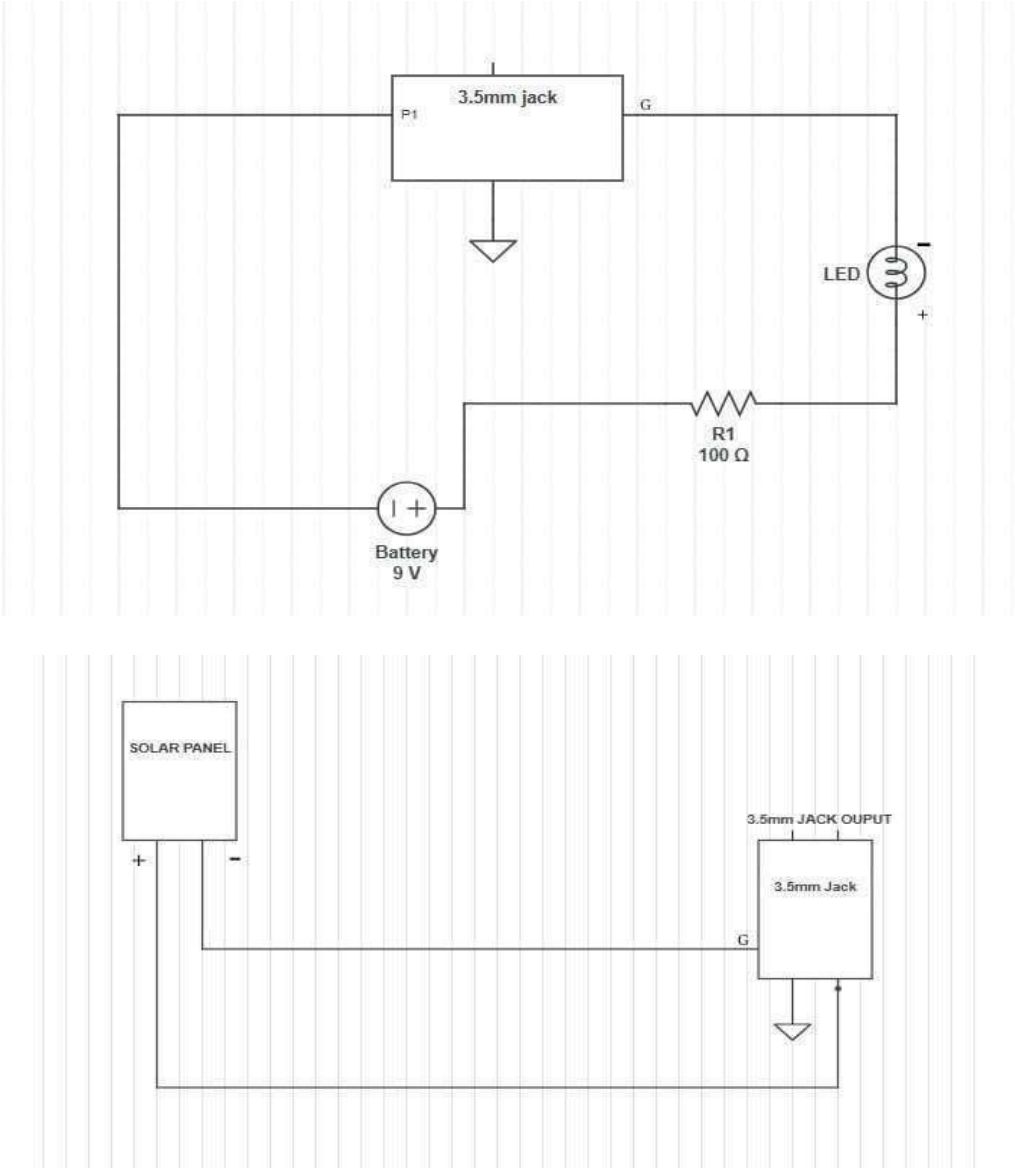

Figure: 2.4 Circuit Diagram of Data transfer using Li-fi Technology

2.5 WORKING MODEL

Figure:2.5 Working Model

Li-Fi technology operates by transmitting data through visible light waves using light-emitting diodes (LEDs) as the light source. The LEDs act as a medium for communication by rapidly switching on and off at speeds imperceptible to the human eye. This modulation of light intensity encodes digital data, which is then transmitted to a receiver. At the receiving end, a photodiode or light sensor detects the variations in light intensity and converts them into electrical signals. These signals are then decoded to retrieve the original data. The system requires a direct line of sight or reflection to ensure

reliable communication, as light does not penetrate walls. Li-Fi enables highspeed data transfer, leveraging the vast bandwidth of the visible light spectrum, which is much larger

than that of radio waves. The technology is ideal for environments requiring minimal electromagnetic interference, such as hospitals, airplanes, and industrial setups.

2.6 BLOCK DIAGRAM:

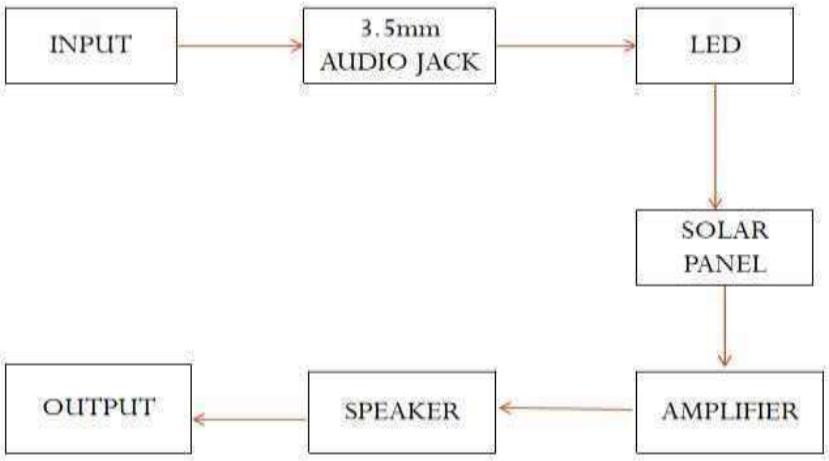

Figure:2.6 Block Diagram

INPUT: This represents the audio signal source, such as a mobile phone, MP3 player, or other devices. It sends audio signals for processing

3.5mm AUDIO JACK: This is a standard connector used to transmit audio signals from the input device to the system. It acts as a bridge between the input device and the next component.

LED: The LED indicates system activity or provides visual feedback. It could also be used as part of a circuit that interacts with the solar panel.

SOLAR PANEL: The solar panel converts sunlight into electrical energy. This energy powers components like the amplifier or LED, making the system energy-efficient.

AMPLIFIER: The amplifier increases the strength of the audio signal received, ensuring that the output is loud and clear through the speaker.

SPEAKER: The speaker converts amplified audio signals into sound waves, making the output audible to users.

OUTPUT: The output represents the final audio or sound produced by the speaker, completing the system's function.

2.7 ADVANTAGES:

- Under water Communication
- Aviation Industry
- Aerospace
- Marine communication

2.8 APPLICATIONS:

- High speed data transfer
- Energy efficiency
- High data transmission rates
- Environment friendly

CHAPTER – 3

PEIZO BASED VISITOR SENSING WELCOME MAT

3.1 ABSTRACT:

A piezoelectric-based visitor sensing welcome mat is an innovative solution that utilizes piezoelectric sensors to detect and respond to the presence of individuals. These mats are equipped with piezoelectric materials that generate an electrical charge when subjected to pressure, allowing them to detect footsteps or other physical interactions. The primary application of such a system is in automating welcome messages or actions triggered by the entry of visitors into a designated area. This technology is particularly useful for smart homes, retail environments, or security systems, where it can serve as an unobtrusive and reliable means of detecting foot traffic. The piezoelectric sensors embedded within the mat convert mechanical energy into electrical signals, which are processed to determine the presence, weight, and even the number of individuals stepping onto the mat. The ability to integrate these mats with other smart systems enables a wide range of possibilities, from greeting visitors with personalized messages to activating security protocols.

3.2 INTRODUCTION:

One such innovation is the piezoelectric-based visitor sensing welcome mat, which uses piezoelectric sensors to detect pressure and motion from foot traffic. The mat's embedded sensors generate an electrical signal when subjected to pressure, allowing it to detect the presence of individuals stepping on it. This concept provides a non-invasive, reliable, and

cost-effective method for automating actions or responses based on human interaction. In various applications such as smart homes, retail settings, and even offices, the mat can trigger personalized responses like welcoming messages, activating lights, or notifying homeowners or staff of visitor arrival. Additionally, in security applications, the mat can serve as a discreet intrusion detection system by identifying unauthorized entry. The integration of piezoelectric materials into these systems not only offers a seamless, low maintenance solution but also supports sustainable energy harvesting by converting mechanical energy into electrical energy.

3.3 COMPONENTS USED:

- PCB board - 1
- Resistor - 1K and 1M (1,1)
- Integrated Circuit - NE 555 Timer (1)
- Buzzer - 1
- Capacitor - 100uF (1)
- Battery - 9v
- Connecting wires - As Required

3.4 CIRCUIT DIAGRAM:

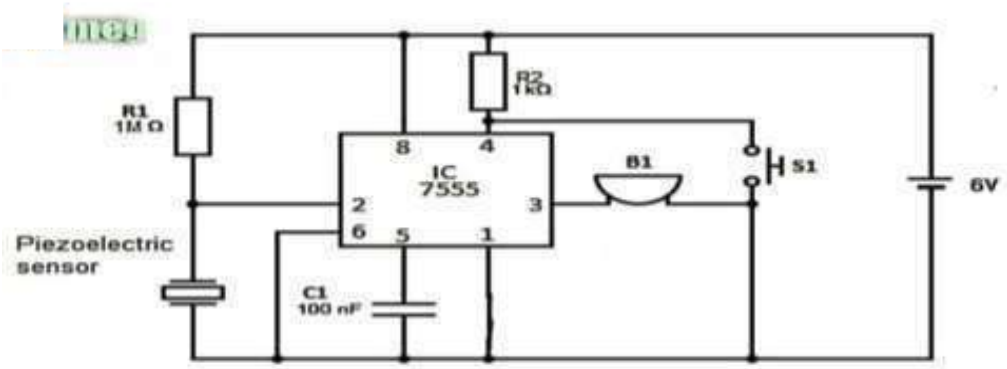

Figure:3.4 Circuit Diagram

3.5WORKING MODEL:

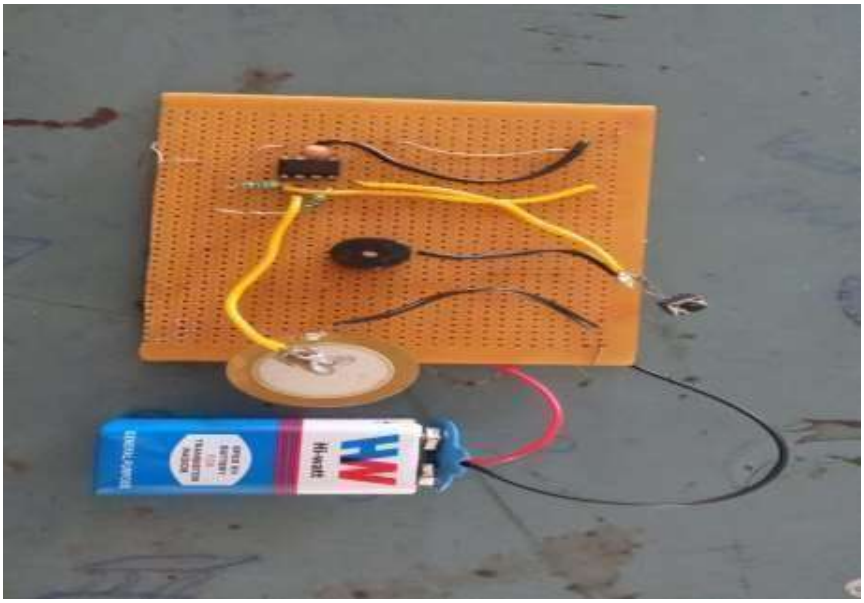

Figure 3.5 Working Model

Footstep Detection: When a visitor steps on the mat, their footstep vibrations are captured by piezoelectric sensors embedded within the mat. These sensors convert mechanical stress into electrical energy. Signal Generation: The piezoelectric sensors generate electrical signals in response to the footstep vibrations. These signals are weak and require amplification. Signal Amplification: The electrical signals are amplified by an amplifier circuit to increase their strength and quality. Signal Processing: The amplified signals are processed by a micro controller, which filters, analyses, and interprets the signals to detect the visitor's presence. Triggering Response: Upon detecting a visitor, the micro controller triggers a response, such as activating an LED light, playing a welcoming message, or sending a notification to a connected device.

3.4 BLOCK DIAGRAM:

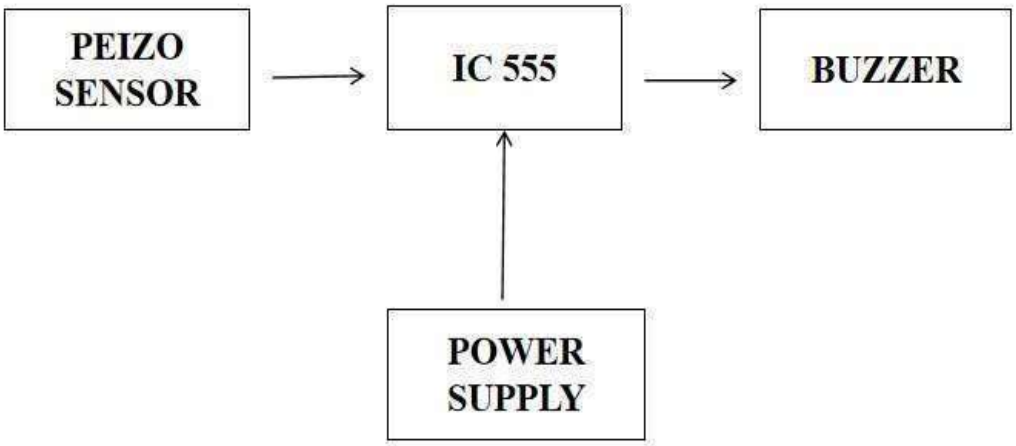

Figure:3.6 Block diagram

IC 555 timer: IC 555 timer is one of the most versatile and widely used integrated circuits in electronics. It can work as a timer, oscillator, or even

flip-flop in its applications. The IC 555 works in three main modes: monostable or one pulse generation, a stable or continuous pulse generation, and bistable or on/off switch. Its internal configuration consists of a comparator, flip-flop, discharge transistor, and a voltage divider. Users may adjust the external resistors and capacitors to determine the timing intervals or oscillation frequency. The IC 555 finds application in pulse generation, PWM control, time delay circuits, and signal modulation. Its reliability and simplicity make it essential for hobbyists and professionals.

Buzzer: A buzzer is an electronic device used to create sound signals, widely used in alarms, indicators, and electronic devices. It operates by converting electrical energy into mechanical vibrations through a piezoelectric element or electromagnetic coil. Once the circuit is energized, it produces an audible tone or beep. Buzzers are of two types: active or self-contained with an internal oscillator and passive, requiring an external driving circuit. They are compact, energy efficient, and versatile and thus suitable for applications like warning systems, timers, and notification devices in industrial and consumer electronics. Their simplicity ensures reliable sound production.

Power Source (9V Battery): The 9V battery functions as the essential power source for the entire circuit. It supplies the required voltage and current to ensure proper functioning of the components. The stability and reliability of the power source are crucial for consistent and predictable circuit behaviour.

Piezo Sensor: This is the input device. A piezoelectric sensor generates a voltage when it detects vibrations, pressure, or impact. It's often used to sense mechanical change.

3.7 ADVANTAGES:

- Low Power Consumption
- Durable and Long-Lasting
- Customizable
- Easy Installation

3.8 APPLICATIONS:

- Retail Stores
- Hotels and Hospitality
- Offices and Reception Areas
- Home Automation

CHAPTER 4

CONCLUSION

Li-Fi technology, a revolutionary advancement in wireless communication, has demonstrated its potential as a high-speed, efficient, and secure method for data transfer. one of the most significant advantages of Li-Fi is its ability to deliver ultrafast data transfer rates while utilizing the existing infrastructure of LED lighting. This dual-purpose functionality makes Li-Fi an energy-efficient and cost effectively solution. Moreover, Li-Fi's reliance on visible light ensures that it is not susceptible to electromagnetic interference, making it ideal for use in environments like hospitals, airplanes, and industrial settings where such interference additionally, Li-Fi provides enhanced security, as light cannot penetrate walls, reducing the risk of unauthorized access.

The piezo-based visitor sensing system offers an innovative and efficient approach to enhancing visitor interaction and automated greetings in various environments. By utilizing piezoelectric sensors, the system accurately detects the presence of visitors through vibrations or pressure changes, ensuring reliable and cost-effective operation. The system is energy-efficient, durable, and responsive, making it an ideal choice for modern applications where traditional sensors may falter due to environmental conditions. Its ability to integrate with smart systems further enhances its functionality, enabling personalized welcomes or triggering additional automated actions such as lighting, sound, or security alerts. This project paves the way for broader adoption of piezoelectric sensors in smart, automated environments.

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