A

Project Report

on

"Solar Based Smart Corridor System"

Submitted By

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Under the guidance of

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WALCHAND COLLEGE OF ENGINEERING, SANGLI

(Government-Aided Autonomous Institute)

2021-2022

WALCHAND COLLEGE OF ENGINEERING, SANGLI
(Government-Aided Autonomous Institute)
DEPARTMENT OF ELECTRONICS ENGINEERING

CERTIFICATE

This is to certify that the Project Report entitled

‘**Solar Based Smart Corridor System**’

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in partial fulfilment for the award of the Degree of
Bachelor of Technology
in
Electronics Engineering
is a record of students own work carried out by them under our supervision and guidance during the academic year 2021-2022

Date: 21/06/2022
Place: Sangli

Prof. S. K. Parchandekar
(Project Guide)

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Abstract

This report presents a Solar Based Smart Corridor System. The system provides an automated lighting system and charging circuit. This detection is based on the motion sensor. The whole system is automated by ESP32 microcontroller. Admin can control the lighting system remotely as the controller has a wi-fi module. The goal of a microcontroller is to interface with subsystems and provide suitable decisions for efficient working of the system. The system will use solar energy from solar panels to perform its work. In the absence or failure of it, the system will work on a battery which is charged with the help of solar power. In failure of these both the system will work on traditional state electricity supply. Thus, the system is made to work on hybrid mode of power supply. To get this system to work efficiently, we have prepared a set of rules. So that entire system will work according to the algorithm developed. So, this system uses eco-friendly energy sources with good efficiency. Also, as the system is robust, scaling of the system based on the need of energy required is relatively easy.

Acknowledgement

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Contents

List of Figures

Chapter 1

Introduction

Nowadays the use of various renewable energy sources, especially solar energy and wind energy has been tremendously increased. Solar energy is a fairly unlimited source of energy. The advantage of solar energy is that it is free, reachable to common people and available in large quantities of supply compared to that of the price of various fossil fuels and oils in the past many years.

Our idea is based on solar energy use for an automated lighting system that will detect if the person is present in the corridor and based on his location, turn on respective light(s). Also, it will turn off the respective lights when the person leaves the corridor. This detection is based on the sensor. This smart corridor system will be extremely useful for different areas like colleges having large campus areas and students who need to wander for their academic/project work at night and also for various industrial campuses.

Another phase of our idea is a mobile charging port. This is one of the features available in our system. When a person needs to recharge his/her mobile, these ports will be extremely useful in those cases. Our solar based circuit will power both the port and the controller implementing smart lighting control. Thus, it will provide a relatively energy efficient solution for the smart corridor system.

- ## Project Idea:

The problem definition is that we need to design a system which will make efficient use of the energy provided to it using solar. The main purpose of this system will be to control the corridor lights effectively and to provide ports to charge smartphones. Use of microcontroller to control these devices can help to increase efficacy and system can be made more robust.

Our system will have two main facilities –

1. Smart Control of Lighting System
2. Availability of Smartphone Charger port

The controlling of these parts will be done by microcontroller. The primary supply for Lighting System as well as the Smartphone charger port will be solar energy. Battery will be used to store the excess solar energy in case system is off. Design of the system will be hybrid that is, it will be able to run both on solar, as well as, conventional source of energy provided by electricity provider.

Consider following example, if a person is in the corridor, then lights should turn on automatically; and similarly, in short time after the person leaves the corridor, they should turn off automatically. Also, the system should be hybrid enough to accommodate old devices. Most of LEDs run on AC power supply while DC is supplied by Solar Panel. With the inclusion of devices such as inverters, we can make sure that system runs on conventional power supply as well as solar power supply.

Modern smartphone has become integral part of a person’s daily life. As the use of smartphone increase, the need for charging facilities for them also increases. Thus, our system also includes mobile charging port to give user ability to use renewable and eco-friendly sources for daily life, thus, overall, helping the nature.

This kind of system can have wide variety of applications. From malls to railway stations, from industrial areas to academic campuses, we can use this system to use eco-friendly energy sources with good efficiency. Also, as the system is robust, scaling of system based on need of energy required is relatively easy.

- # Proposed Work:

❖ Objectives:

- To understand the working of solar based smart electric lighting systems
- To design eco-friendly, robust, innovative and easy to use systems
- To understand efficient ways of power storage
- To develop a Solar based Smart Corridor System which has following features:

  a. Smart Lighting Control

  b. Mobile Charging Port

❖ Methodology:

- First, we divide the project into small sub-parts such as power circuit, solar circuit, smart light system and mobile charge circuit.
- We find the existing ways or technologies for designing these small parts and will try to learn from the existing projects.
- We try to modify the existing system for better performance and better feasibility.
- We find out the cost of required materials and try to collect them from the market and college labs.
- After finalizing the circuit of individual small parts, and designing each sub-system, we combine all of them to the whole system.
- We implement the system on hardware and evaluate the performance.

❖ Expected Outcomes:

- LED tubes powered by solar energy working on the sensor interfaced with the microcontroller.
- Providing the solar based mobile charger with adapter outputs in the corridor.

Chapter 2

Literature Survey

2.1 Solar Powered Mobile Power Bank Systems -

Authors: Sambandh Bhusan Dhal, Arun Agarwal

Year of Publication: 2016

Keywords: Solar Energy, Portability, Disaster Recovery

Description: The objective of this research is to design a Solar Powered Portable Power Bank for mobile phones during disaster events. By using solar panels to produce electrical energy stored in the battery, having a microcontroller with use of relay circuit to improve safety of circuit and using microcontroller integration to indicate battery percentage. Also, it considers minimizing interconnection of wire for portability and handiness.

2.2 Design of Power Bank Mobile using Solar Panel based Microcontroller atmega328 -

Authors: Agus Ismangil, Haddy Prasetya Susanto

Year of Publication: 2008

Keywords: Solar Power Bank, Atmega328 Microcontroller

Description: In this, 5 Volt solar panel functions as a power source, 5000 mAh battery, and microcontroller atmega328 serves as an output that displays the battery indicator through LCD. By programming the controller with required instruction sets to display battery voltage and testing all components to find optimal conditions for greater efficiency of the device.

2.3 Solar Based Mobile Charger -

Authors: Ashlesh Kumar, Amra Fathima

Year of Publication: 2016

Keywords: Solar Mobile Charger, Optimal Battery Storage

Description: Modifying solar powered charger by coupling solar panels with the back-up battery which can store the excess power generated during the day and use it to provide energy to the system in the absence of sunlight. Voltage regulator is used to regulate the output voltage and hence achieve different loads as well as a powering controller which is used to analyse and display battery percentage. Pocket sized and optimal weighted battery is used to make the device portable and handy. Also fabricating solar panels to effectively reduce the size of the entire device.

2.4 Automated Corridor Lighting Control System -

Authors: Mohammed Ahmed, Jemal Worku

Year of Publication: 2016

Keywords: Lighting Control

Description: Here, aim is to design a corridor lighting control system to make the system autonomous and energy saving. Using a specific PLC to control the system which is fast, reliable and power efficient and simple to use and implement. Programming of PLC is done for efficient usage and thus saving electric power with smart push buttons and timer application.

Chapter 3

Design of System

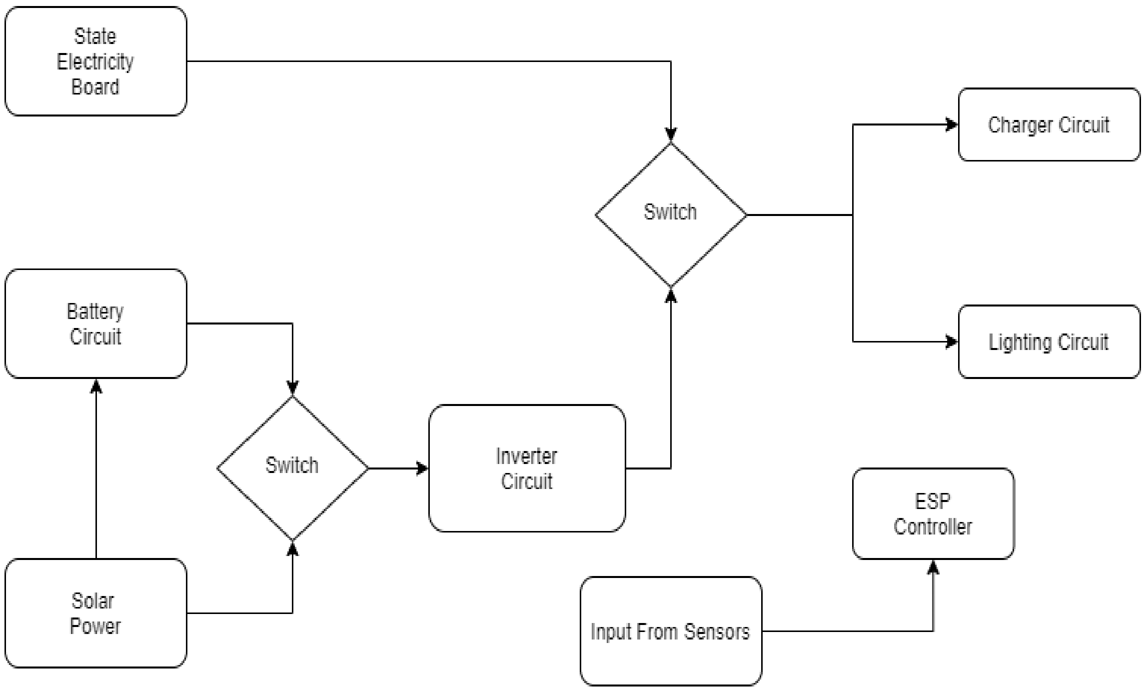

Fig. System Block Diagram

- The above figure shows overall system block diagram which consists of three main parts – Solar power generation and storage Circuit, Power Circuit, Controlling Circuit.
- Solar Power generation and storage Circuit consists of Solar Panel and Battery. Panel provides the necessary energy and Battery is used to store that energy.
- The main component of Power Circuit is Inverter. This is integral part which converts DC given by Solar into AC. Also, furthermore Relays are also used to control LEDs connected using Microcontroller. Mobile Charger Port is provided at the output.

- The Controlling Circuit consists of all the switches, Input from sensors such as motion sensors and also the heart of the circuit – Microcontroller. Here, we use ESP32 for controlling as it can handle IOT functionalities quite easily.

- All the switches i.e., turning ON and OFF of different components is handled by microcontrollers with use of sensors.

- Initially, preference is given to Solar Panel for direct supply. In case it does not provide sufficient power that is, if it is night-time, then stored power from the battery will be used to provide necessary supply.

- Finally, if any of the options, direct power from solar or battery, is not present then conventional State Electricity Board supply will be used to provide necessary power.

- Focussing on the ESP32, it handles checking of all the sensors and performs respective function depending on values given by sensors.

- To provide further ease of access, we configure ESP32 in such a way, that an authoritative person can turn ON or OFF the whole system just by using his smartphone.

- In this manner, our whole system will real time to ensure efficient use of energy and ease of access from the perspective of user all the while implementing technology which uses eco-friendly and renewable source of energy for it’s working.

- **Description of Components:**

Sr. No.	Name of Component	Cost (In ₹)
1.	ESP32 Development Board	500
2.	Solar Panel (50W, 12V)	1800
3.	DC Battery (12V, 7.5Ah)	890
4.	Relay Module	70
5.	AC LED Bulb (10W)	100
6.	IC CD4047BCN	15
7.	Motion Sensor	150
9.	Transformer (12-0-12, 2A)	100
10.	Resistors, Capacitors, Inductors and Diodes	150
11.	Single Sided PCB	100
	Total Cost	3915

❖ Solar Panel –

Fig. Solar Panel

A solar cell panel, solar electric panel, photo-voltaic module (PV) or just solar panel is an assembly of photo-voltaic cell mounted in a framework for installation. Solar panels use sunlight as a source of energy to generate direct current electricity. A collection of PV modules is called a PV panel, and a system of PV panel is called arrays. Arrays of photovoltaic system supply solar electricity to controller in this case.

Solar panel gives solar energy to inverter circuit solar energy is converted into electric energy and stored into battery. During night time output of battery (12V) is given to inverter circuit which converts 12V DC to 230V AC and during day time solar energy which is directly given to inverter circuit.

- **CD4047BCN -**

Low Power Monostable/Astable Multivibrator. The CD4047B is capable of operating in either the monostable or astable mode. It requires an external capacitor (between pins 1 and 3) and an external resistor (between pins 2 and 3) to determine the output pulse width in the monostable mode, and the output frequency in the astable mode. Astable operation is enabled by a high level on the astable input or low level on the astable input. The output frequency (at 50% duty cycle) at Q and Q outputs is determined by the timing components. A frequency twice that of Q is available at the Oscillator Output; a 50% duty cycle is not guaranteed. Monostable operation is obtained when the device is triggered by LOW-to-HIGH transition at + trigger input or HIGH-to-LOW transition at − trigger input. The device can be retriggered by applying a simultaneous LOW-to-HIGH transition to both the + trigger and retrigger inputs. A high level on Reset input resets the outputs Q to LOW, Q to HIGH.

Features

- ■ Wide supply voltage range: 3.0V to 15V
- ■ High noise immunity: 0.45 VDD (typ.)
- ■ Low power TTL compatibility: Fan out of 2 driving 74L or 1 driving 74LS

Special Features

- ■ Low power consumption: special CMOS oscillator configuration
- ■ Monostable (one-shot) or astable (free-running) operation
- ■ True and complemented buffered outputs
- ■ Only one external R and C required

Applications

- • Frequency discriminators
- • Timing circuits
- • Time-delay applications
- • Envelope detection
- • Frequency multiplication

- **ESP32 Module –**

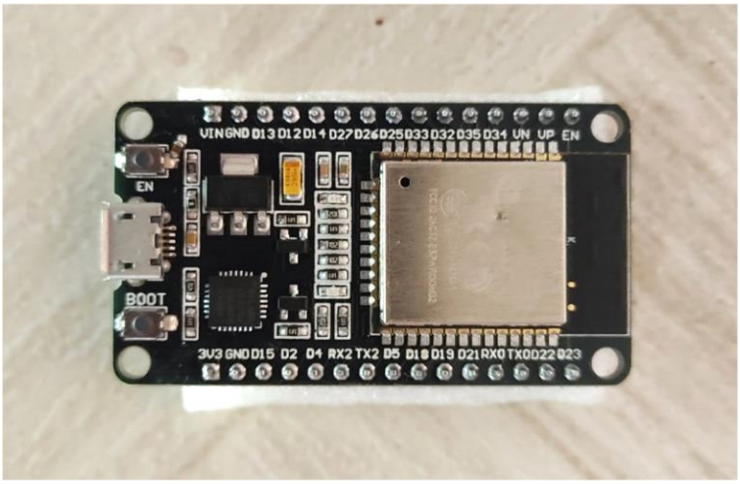

Fig. ESP32 Module

ESP32 is a single 2.4 GHz Wi-Fi-and-Bluetooth combo chip designed with the TSMC ultra-low-power 40 nm technology. It is designed to achieve the best power and RF performance, showing robustness, versatility and reliability in a wide variety of applications and power scenarios.

ESP32 is a highly-integrated solution for Wi-Fi-and-Bluetooth IoT applications, with around 20 external components. ESP32 integrates an antenna switch, RF balun, power amplifier, low-noise receive amplifier, filters, and power management modules. As such, the entire solution occupies minimal Printed Circuit Board (PCB) area. ESP32 uses CMOS for single-chip fully-integrated radio and baseband, while also integrating advanced calibration circuitries that allow the solution to remove external circuit imperfections or adjust to changes in external conditions. As such, the mass production of ESP32 solutions does not require expensive and specialized Wi-Fi testing equipment.

CPU and Memory -

- Xtensa® single/dual-core 32-bit LX6 microprocessor(s)
- CoreMark® score:
  - 1 core at 240 MHz: 504.85 CoreMark; 2.10 CoreMark/MHz
  - 2 cores at 240 MHz: 994.26 CoreMark; 4.14 CoreMark/MHz
- 448 KB ROM
- 520 KB SRAM
- 16 KB SRAM in RTC
- QSPI supports multiple flash/SRAM chips

Advanced Peripheral Interfaces -

- 34 × programmable GPIOs
- 12-bit SAR ADC up to 18 channels
- 2 × 8-bit DAC • 10 × touch sensors
- 4 × SPI
- 2 × I2S
- 2 × I2C
- 3 × UART
- 1 host (SD/eMMC/SDIO)
- 1 slave (SDIO/SPI)
- Ethernet MAC interface with dedicated DMA and IEEE 1588 support
- TWAI®, compatible with ISO 11898-1 (CAN Specification 2.0)
- RMT (TX/RX)
- Motor PWM
- LED PWM up to 16 channels
- Hall sensor

Clocks and Timers

- Internal 8 MHz oscillator with calibration
- Internal RC oscillator with calibration
- External 2 MHz ~ 60 MHz crystal oscillator (40 MHz only for Wi-Fi/Bluetooth)
- External 32 kHz crystal oscillator for RTC with calibration
- Two timer groups, including 2 × 64-bit timers and 1 × main watchdog in each group
- One RTC timer
- RTC watchdog

❖ PIR Motion Sensor:

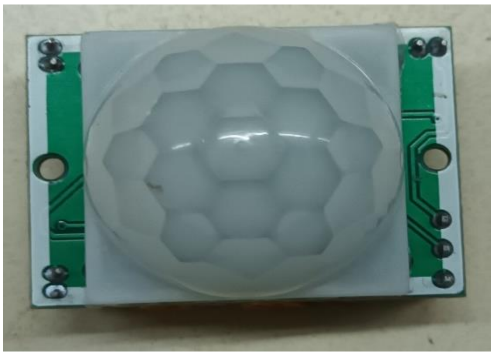

Fig. PIR Sensor

Features:

- Wide range on input voltage varying from 4.V to 12V (+5V recommended)
- Output voltage is High/Low (3.3V TTL)
- Can distinguish between object movement and human movement
- Has to operating modes - Repeatable(H) and Non- Repeatable(H)
- Cover distance of about 120° and 7 meters
- Low power consumption of 65mA

❖ Level Shifter:

As its name suggests, Level Shifter is used to shift the voltage. Here we used I2C Bi-Directional Logic Level Converter of 4 Channels - BSS138. It is used for mutual transformation between 5V TTL to 3.3V TTL. ESP 32 provides 3.3V on GPIO pins so Level shifter is used to convert 3.3V to 5V which is required for PIR sensor and relays.

❖ Voltage Sensor:

To detect the voltage, a Voltage Sensor is used. We used a Voltage Detection Sensor Module 25V. It has input voltage range 0 - 25V DC and voltage detection range is 0.2445V to 25V and voltage analog resolution is 0.00489 V. We used a voltage sensor to detect the voltage of the solar panel and battery.

❖ Relay:

A 5V relay is used as a switch. Relay has 5 pins such as Coil 1, Coil2, Common, Normally Close (NC) and Normally Open (NO). Two coils are used to trigger the relay, normally one is connected to 5V and one is connected to ground. Load is connected to either NO or NC depending on application. If load is connected to NC then load remains connected before trigger and if load is connected to NO then load remains disconnected before trigger.

Chapter 4

Implementation

- **Design of Inverter –**

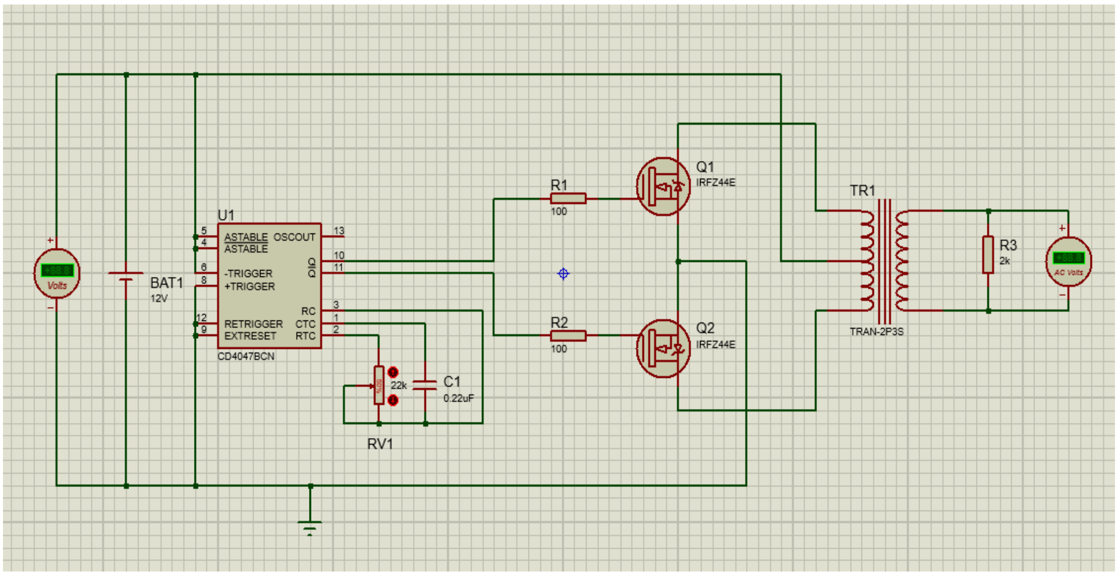

Fig. Inverter Circuit

- Inverter circuit is used to convert 12V DC supply to 230V AC supply.
- Here, we use IC CD4047 acts as a switching pulse oscillating device which is used in astable multivibrator mode.
- IRFZ44n is power MOSFET which is used as a switch and also it is used for driving output power.
- 12-0-12/1A secondary transformer used as a step-up transformer to convert low AC to high AC
- With the help of potentiometer and capacitor, in IC CD4047, as it is configured in astable mode, by varying pot we can change output pulse at Q and Q' pins of CD4047.
- The n-channel IRFZ44 power MOSFET, drain pins are connected with secondary pins of transformer.

- Source pins of both MOSFETs are connected to negative terminal of the battery and common pin in secondary winding is connected to positive terminal of the battery.
- MOSFET switches to ON when the alternate square pulse from Q and Q' drives it.
- Then the secondary winding is forced to induce an alternate magnetic field.
- This magnetic field produces high AC voltage which is approximately 230V.
- Following is the output simulation for the Inverter:

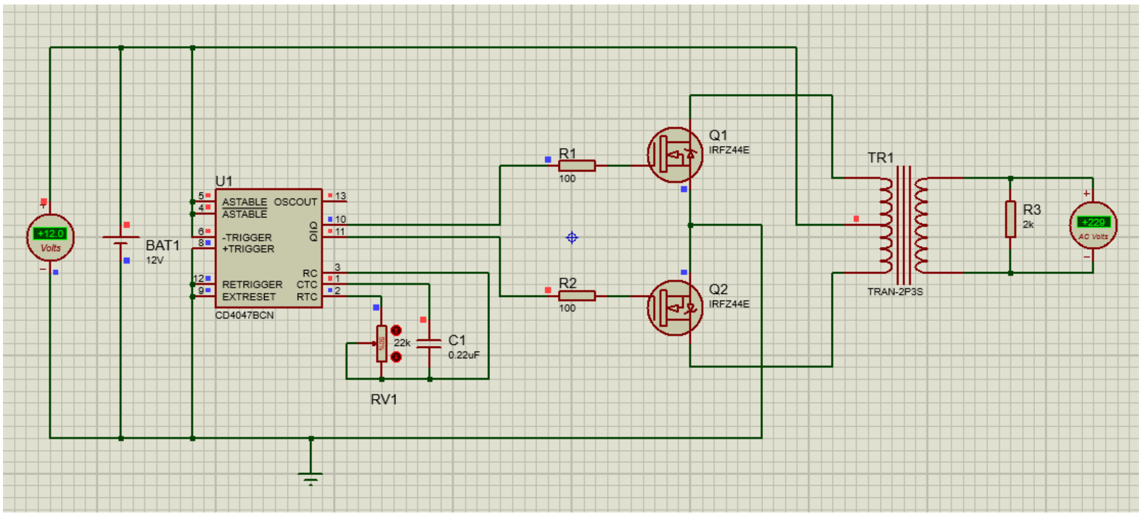

Fig. Inverter Output Simulation

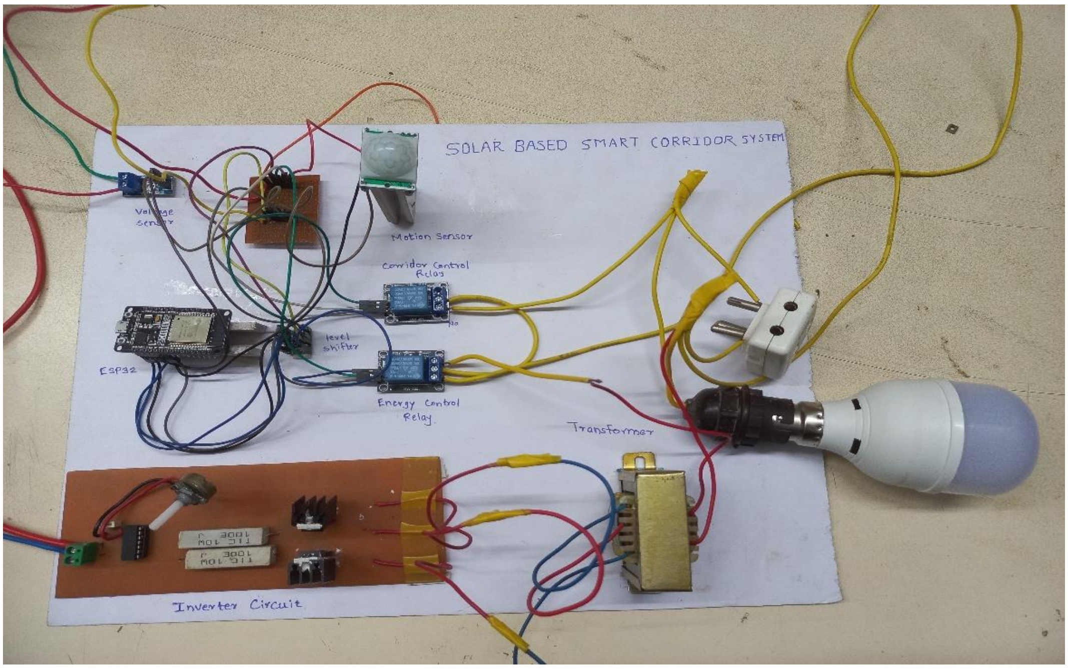

Fig. System Circuit

- **Practical Inverter Circuit –**

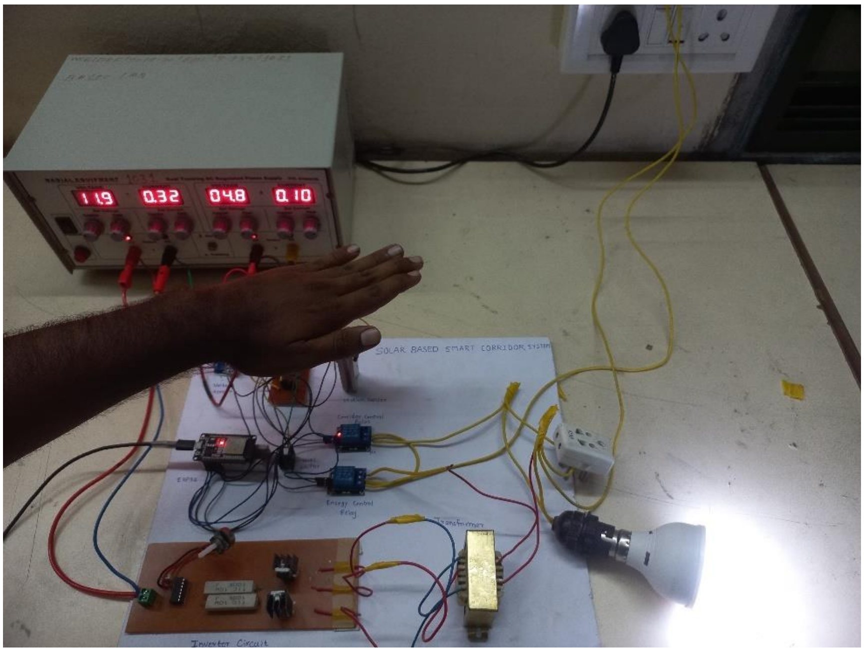

Fig. Inverter ON, LED ON

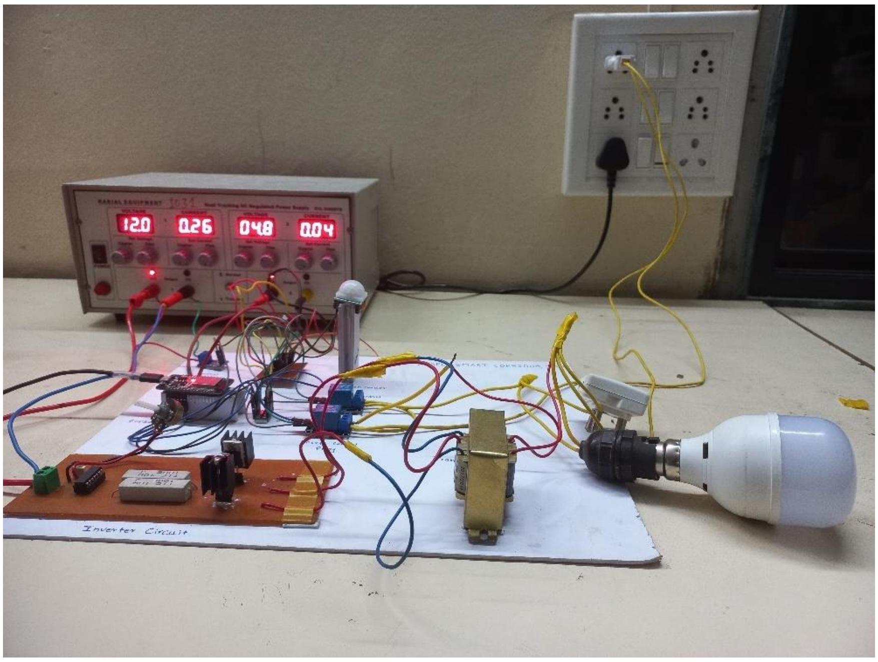

Fig. Inverter ON, LED OFF

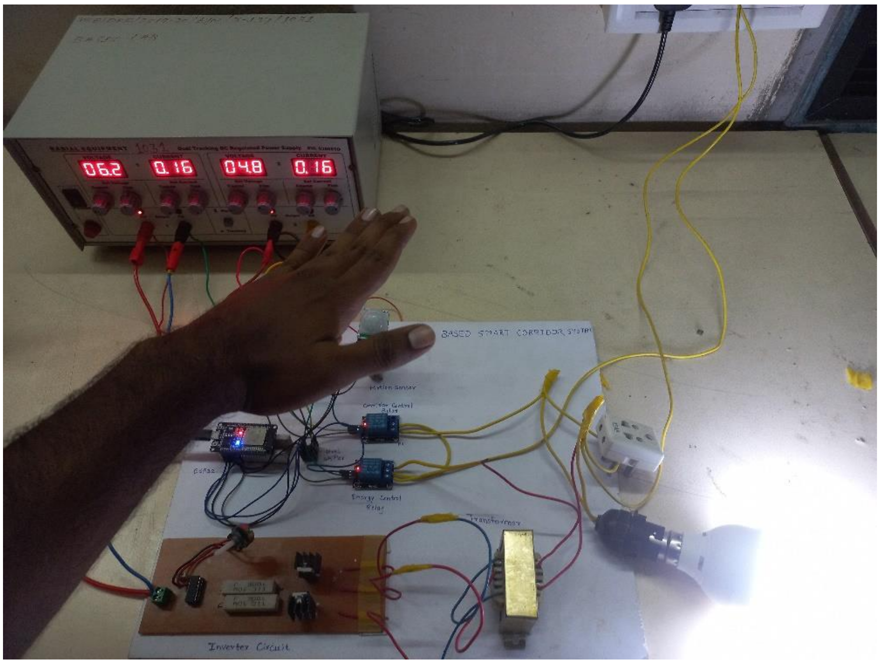

Fig. MSEB ON, LED ON

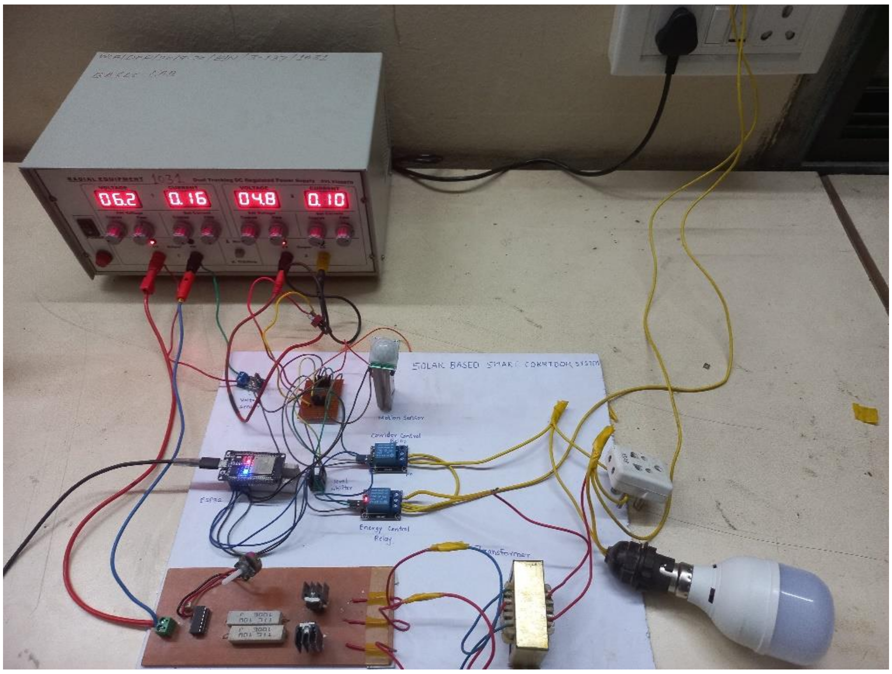

Fig. MSEB ON, LED OFF

- **Algorithm Flowchart –**

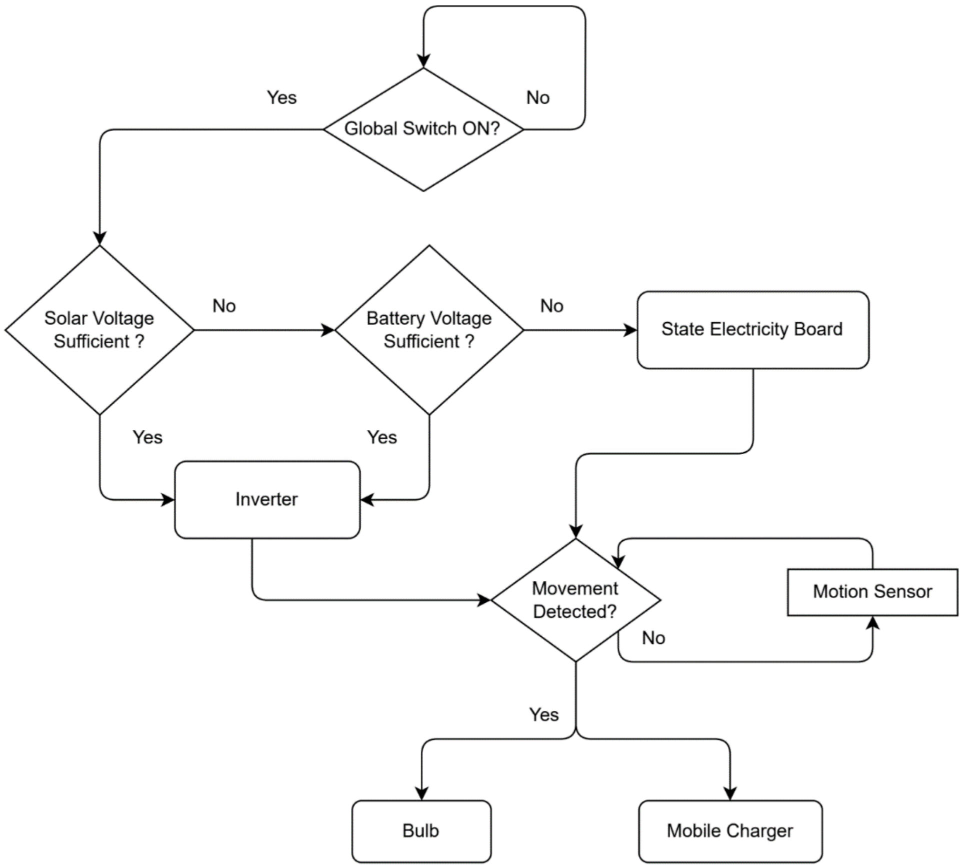

Fig. Algorithm

- At the beginning we check if global switch is ON, the system will work only if it is ON. As ESP32 is dual core we take advantage of each core. One core runs Corridor Control Subsystem while other core runs Energy Control Subsystem.
- In Energy Control Subsystem, we periodically check if energy provided by Solar Panel is sufficient to drive the load, if it is not, then we move towards our battery where solar energy is stored. In case even Battery also does not have sufficient power, we move towards conventional State Electricity Board power supply.
- In Corridor Control Subsystem, we periodically check if a person is detected by motion sensors. If motion sensor detects a person, then respective LED turns ON. And also, mobile charging port is turned ON. As person moves away, LED and mobile charging port will automatically turn OFF.
- Both of these subsystems run in parallel making efficient use of dual core architecture of ESP32.

- **Code Link –**

  https://github.com/kumbharaishwarya/SolarBasedSmartCorridorSystem

Chapter 5

Results And Discussion

- LED tubes powered by solar energy work on the sensors interfaced with the microcontroller. In prototype consisting one motion sensor and one LED, the motion was detected by the motion sensor and the LED was turned on when the motion was detected. This controlling is achieved by the program in ESP32.
- If our system cannot deliver necessary amount of energy in the event of failure of solar energy or storage battery, then this problem is resolved by using a relay which will power the LED and mobile charging ports through the supply from state electricity board.
- The mobile charging ports with adapter outputs are provided in the corridor and the system is designed in such way that if the person is present in the corridor, then only the charging ports will be activated.

Chapter 6

Conclusion And Future Scope

- This report describes Solar Based Smart Corridor System. In this we have used ESP32 as a controller to integrate with sub-systems. Bi-directional Level shifter is used to change voltage from 3.3v to 5v and vice versa. PIR sensor is used as motion sensor which is used to detect presence of person.
- The system works on hybrid mode which is either solar energy through solar panel or battery else traditional state electricity power supply.
- System provides smart lighting system as well as charging ports for mobile. System is controllable remotely with help of Blynk app through wi-fi module on the ESP32. It will minimize use of physical switches.
- For future scope, following points can be considered –
    - System can be made more efficient by applying rotating solar panels.
    - Multiple microcontrollers or cloud along with zigbees and storage devices, to monitor, store and analyze the data.

Chapter 7

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Appendix - A

Research Paper

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Solar Based Smart Corridor System

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Abstract: This paper presents a Solar Based Smart Corridor System. The system provides an automated lighting system and charging circuit. This detection is based on the motion sensor. The whole system is automated by ESP32 microcontroller. Admin can control the lighting system remotely as the controller has a wi-fi module. The goal of a microcontroller is to interface with sub-systemsand provide suitable decisions for efficient working of the system. The system will use solar energy from solar panels to perform its work.

In the absence or failure of it, the system will work on a battery which is charged with the help of solar power. In failure of these both the system will work on traditional state electricity supply. This system is made to work on hybrid mode of power supply.

To get this system to work efficiently, we have prepared a set of rules. So that entire system will work according to the algorithm developed. So this system uses eco-friendly energy sources with good efficiency. Also, as the system is robust, scaling of the system based on the need of energy required is relatively easy.

Keywords: Solar panel, IOT, Mobile charging, Inverter, ESP32, Motion sensor

I. INTRODUCTION

The scarcity of conventional energy resources is the major issue the whole world is facing currently. The major solution to reduce the use of conventional energy especially for electricity is the use of Solar energy as it is available in tremendous unending amounts. To use solar energy in our day to day life we consider places like big organization terraces of houses, corridors, etc which will give us the large surface area to have more solar panels to create more energy. But with the current system for corridor lights for educational campuses or big organizations the wastage of electricity is considerable. The lights and other electric appliances are working even if there is no necessity.

So the proposed smart corridor system uses solar energy but we need to design a system which will make efficient use of the energy provided to it using solar. The main purpose of this system will be to control the corridor lights effectively and to provide ports to charge smartphones. Use of a microcontroller to control these devices can help to increase efficiency and the system can be made more robust.

Our system will have two main facilities –

1) Smart Control of Lighting System
2) Availability of Mobile Charger Port

The controlling of these parts will be done by microcontroller. The primary supply for the Lighting System as well as the Smartphone charger port will be solar energy. Battery will be used to store the excess solar energy in case the system is off. Design of the system will be hybrid, it will be able to run both on solar, as well as, conventional sources of energy provided by electricity providers. Also, the system should be hybrid enough to accommodate old devices. Most LEDs run on AC power supply while DC is supplied by Solar Panel.

With the inclusion of devices such as inverters, we can make sure that the system runs on conventional power supply as well as solar power supply. Modern smartphones have become an integral part of a person's daily life. As the use of smartphones increases, the need for charging facilities for them also increases. Thus, our system also includes a mobile charging port to give users the ability to use renewable and eco-friendly sources for daily life, thus, overall, helping nature. This kind of system can have a wide variety of applications.

From malls to railway stations, from industrial areas to academic campuses, we can use this system to use eco-friendly energy sources with good efficiency. Also, as the system is robust, scaling of the system based on the need of energy required is relatively easy.

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II. PROPOSED SYSTEM ARCHITECTURE

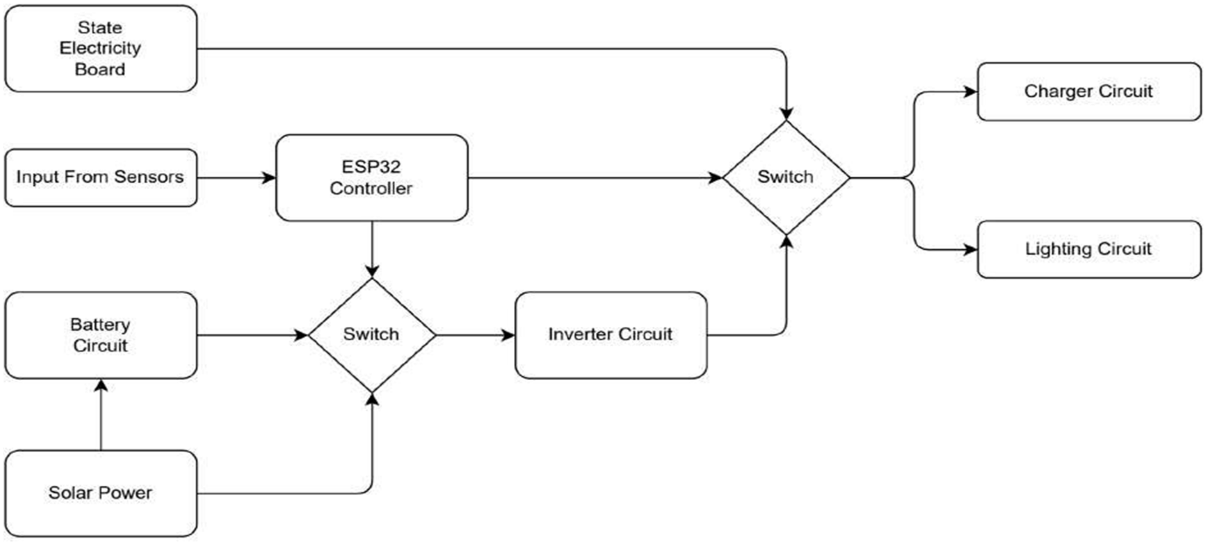

Fig. 1 System Block Diagram For Solar Based Smart Corridor System

The above figure shows the overall system block diagram which consists of three main parts – Solar power generation and storage Circuit, Power Circuit, Controlling Circuit. Solar Power generation and storage Circuit consists of Solar Panel and Battery, Panel provides the necessary energy and Battery is used to store that energy. The main component of Power Circuit is Inverter. This is the integral part which converts DC given by Solar into AC. Also, furthermore Relays are also used to control LEDs connected using Microcontroller. Mobile Charger Port is provided at the output. The Controlling Circuit consists of all the switches, Input from sensors such as motion sensors and also the heart of the circuit – Microcontroller. Here, we use ESP32 for controlling as it can handle IOT functionalities quite easily. All the switches i.e.Turning ON and OFF of different components is handled by microcontrollers with use of sensors.

Initially, preference is given to Solar Panel for direct supply. In case it does not provide sufficient power, then stored power from the battery will be used to provide necessary supply. Finally, if any of the options, direct power from solar or battery, is not sufficient then conventional State Electricity Board supply will be used to provide necessary power. Focusing on the ESP32, it handles checking of all the sensors and performs respective functions depending on values given by sensors. To provide further ease of access, we configure ESP32 in such a way that an authoritative person can turn ON or OFF the whole system just by using his smartphone. In this manner, the system will work in real time to ensure efficient use of energy and ease of access from the perspective of the user all the while implementing technology which uses eco-friendly and renewable sources of energy for its working.

1) ESP32

Fig. 2 ESP32

ESP 32 is a combo chip with a highly integrated solution for Wi-Fi and Bluetooth IOT applications. This chip is designed to achieve best power, RF performance and reliability in more varieties of applications. ESP32 integrates an antenna switch, low noise receiver amplifier. filters and also power management modules.

2) CPU and Memory of ESP32

- Single/Dual core 32 bit LX6 Microprocessor
- It has two Cores
- 448KB ROM
- 520KB SRAM and 16 KB SRAM in RTCAdvanced Peripheral Interfaces:
- 34 programmable GPIOs
- 12 bit SAR ADC up to 18 channels
- 4 x SPI, 2 x I2S, 2 x I2C
- 3 x UART
- Motor PWM
- LED PWM up to 16 channels

3) Solar Panel

Fig. 3 Solar Panel

Solar energy is a fairly unlimited source of energy. The advantage of solar energy is that it is free, reachable to common people and available in large quantities of supply compared to that of the price of various fossil fuels and oils in the past many years. Solar panels use sunlight as a source of energy to generate electricity. We used a solar panel of 50W, 12V. Theway of utilization of solar energy is explained in system operation.

4) PIR Sensor:

Fig. 4 PIR Sensor

PIR is nothing but Passive Infrared motion sensor. Here it uses a pair of pyroelectric sensors to detect if the person is present in the corridor or not. Detection range for indoor PIR is 25cm to 20m and for outdoor PIR detection range is 10m to 150m. It has three terminals such as input, usually 5V, output and ground.

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5) *Level Shifter:* As its name suggests, Level Shifter is used to shift the voltage. Here we used I2C Bi-Directional Logic Level Converter of 4 Channels - BSS138. It is used for mutual transformation between 5V TTL to 3.3V TTL. ESP 32 provides 3.3V on GPIO pins so Level shifter is used to convert 3.3V to 5V which is required for PIR sensor and relays.
6) *Voltage Sensor:* To detect the voltage, a Voltage Sensor is used. We used a Voltage Detection Sensor Module 25V. It has input voltagerange 0 - 25V DC and voltage detection range is 0.2445V to 25V and voltage analog resolution is 0.00489 V. We used a voltage sensor to detect the voltage of the solar panel and battery.
7) *Relay:* A 5V relay is used as a switch. Relay has 5 pins such as Coil 1, Coil2, Common, Normally Close (NC) and Normally Open (NO). Two coils are used to trigger the relay, normally one is connected to 5V and one is connected to ground. Load is connected to either NO or NC depending on application. If load is connected to NC then load remains connected before trigger and if load is connected to NO then load remains disconnected before trigger.

A. *Inverter Proteus Circuit*

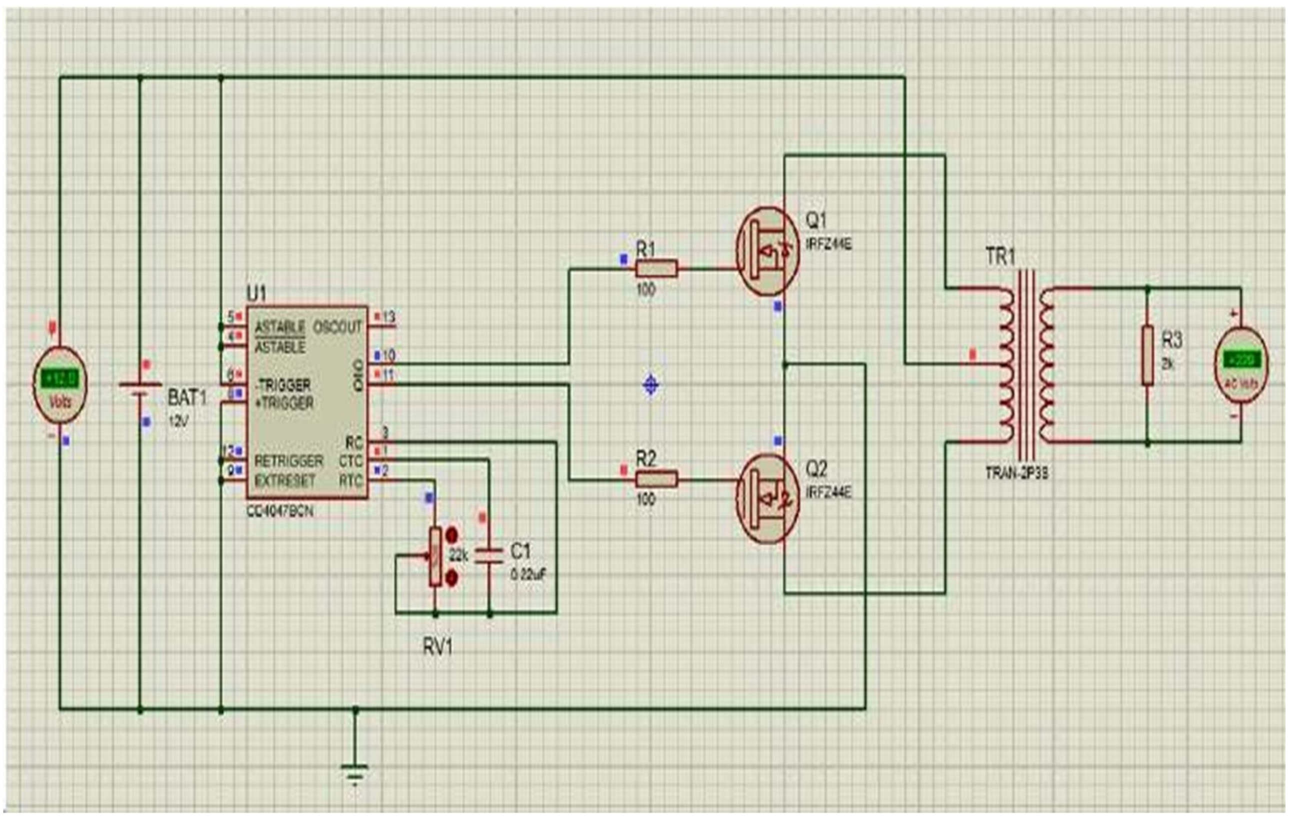

Fig. 5 Inverter Circuit In Proteus

Inverter circuit is used to convert 12V DC supply to 230V AC supply. It mainly contains following sub parts:

1) *Astable Multivibrator:* IC CD4047 is used which acts as a switching pulse oscillating device used in astable multivibrator mode. In CD4047,potentiometer and capacitor is used.As it is configured in astable mode, by varying potentiometer, we can change output pulses at Q and Q' pins(See Fig.5) of CD4047.
2) *MOSFETs:* IRFZ44n is an n-channel power MOSFET which is used as a switch and also it is used for driving output power. and its drain pins are connected with secondary pins of the transformer. Source pins of both MOSFETs are connected to the negative terminal of the battery and the common pin in the secondary winding is connected to the positive terminal of the battery. MOSFET switches to ON when the alternate square pulse from Q and Q' (See Fig-5) drives it.
3) *Transformer:* 12-0-12/1A secondary transformer used as a step-up transformer to convert low AC to high AC. Due to the generation of alternating square wave pulses on Q and Q' (See Fig-5), the secondary winding is forced to induce an alternate magnetic field. This magnetic field produces high AC voltage which is approximately 230V.

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III. SYSTEM OPERATION

A. *Physical System Circuit*

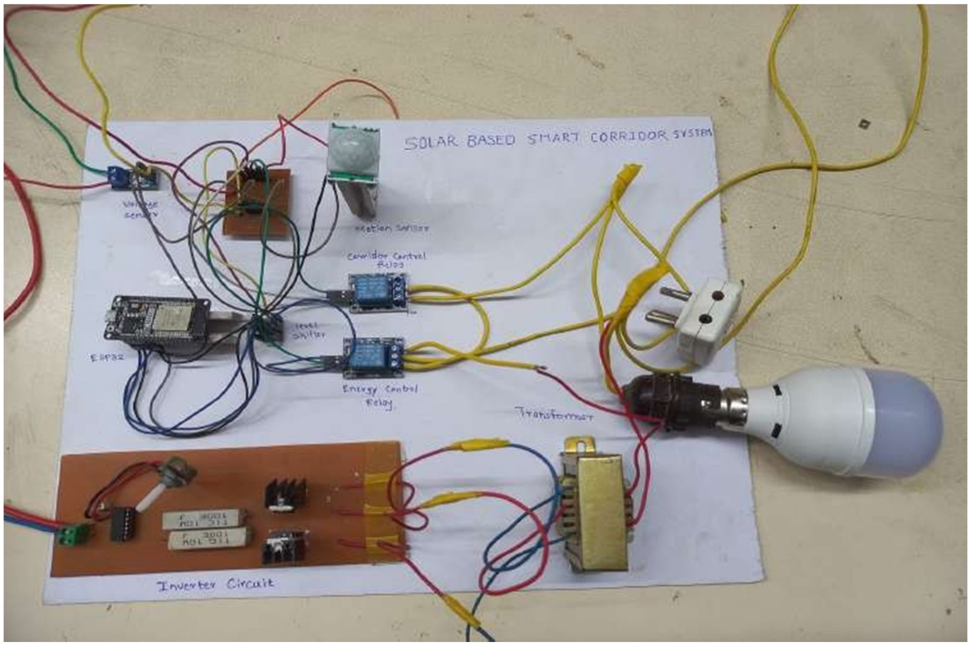

Fig. 6 Physical System Circuit

B. *Algorithm Flowchart*

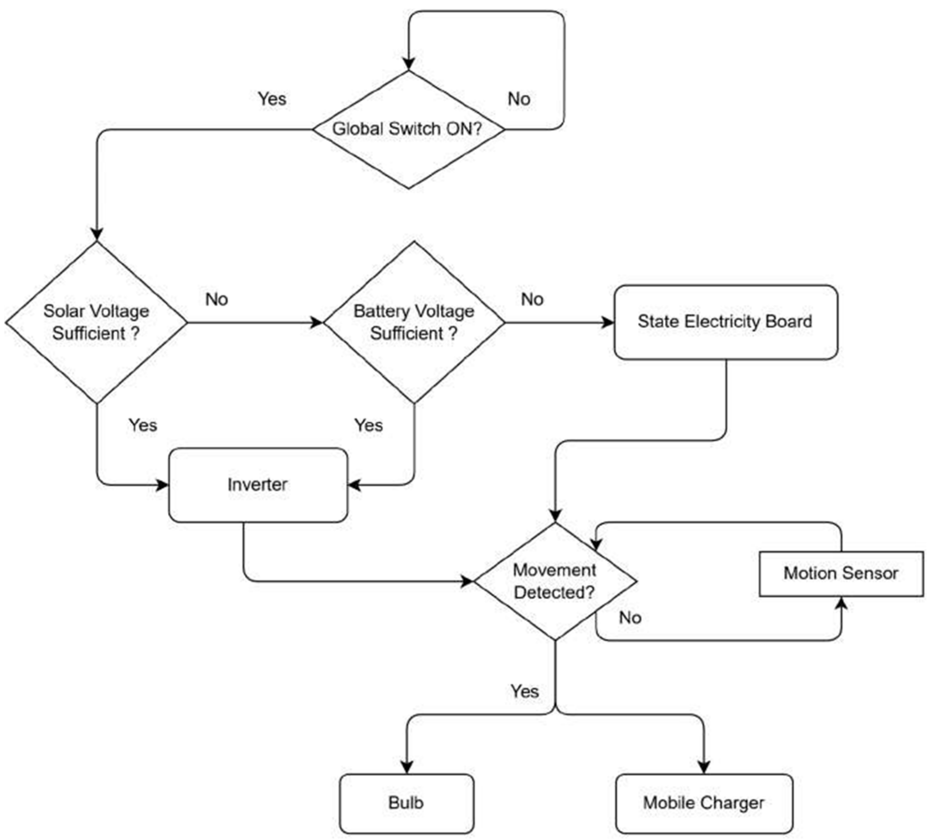

Fig. 7 Algorithm Flowchart

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At the beginning we check if the global switch is ON, the system will work only if it is ON. As ESP32 is dual core we take advantage of each core. One core runs Corridor Control Subsystem while the other core runs Energy Control Subsystem.

In the Energy Control Subsystem, we periodically check if energy provided by the Solar Panel is sufficient to drive the load, if it is not, then we move towards our battery where solar energy is stored. In case even Battery also does not have sufficient power we move towards conventional State Electricity Board power supply.

In the Corridor Control Subsystem, we periodically check if a person is detected by motion sensors. If the motion sensor detects a person, then the respective LED turns ON. And also, the mobile charging port is turned ON. As the person moves away, the LED and mobile charging port will automatically turn OFF.

Both of these subsystems run in parallel making efficient use of the dual core architecture of ESP32.

IV. EXPERIMENTAL RESULTS

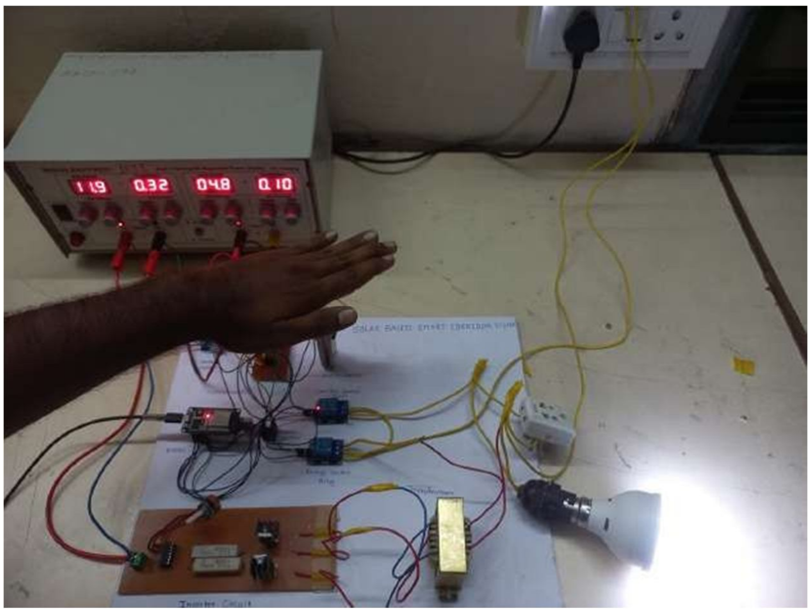

Fig. 8 Inverter ON, LED ON

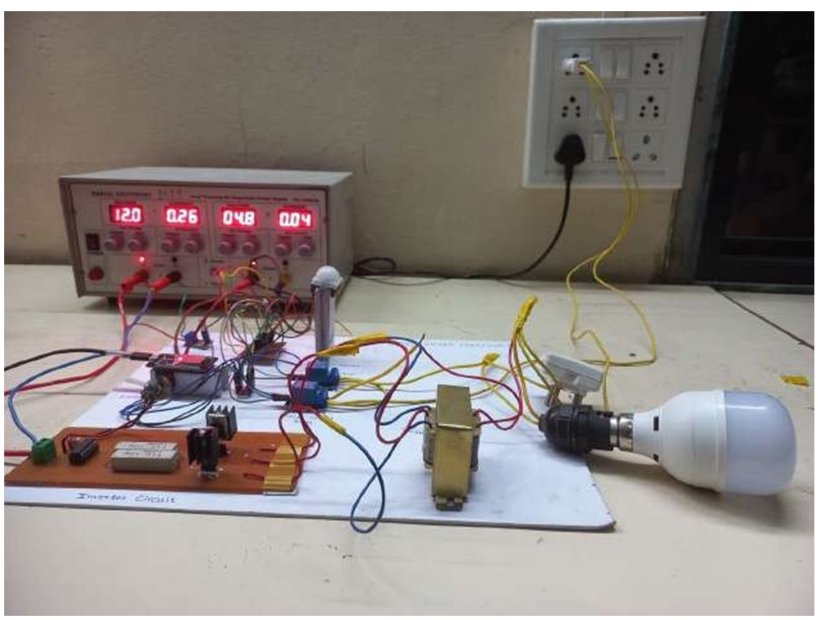

Fig. 9 Inverter ON, LED OFF

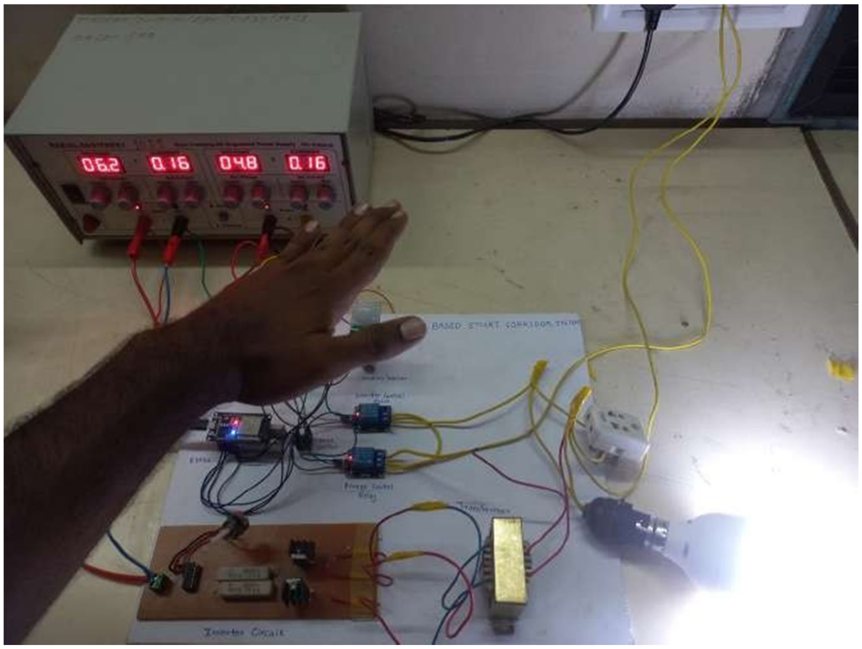

Fig. 10 MSEB ON, LED ON

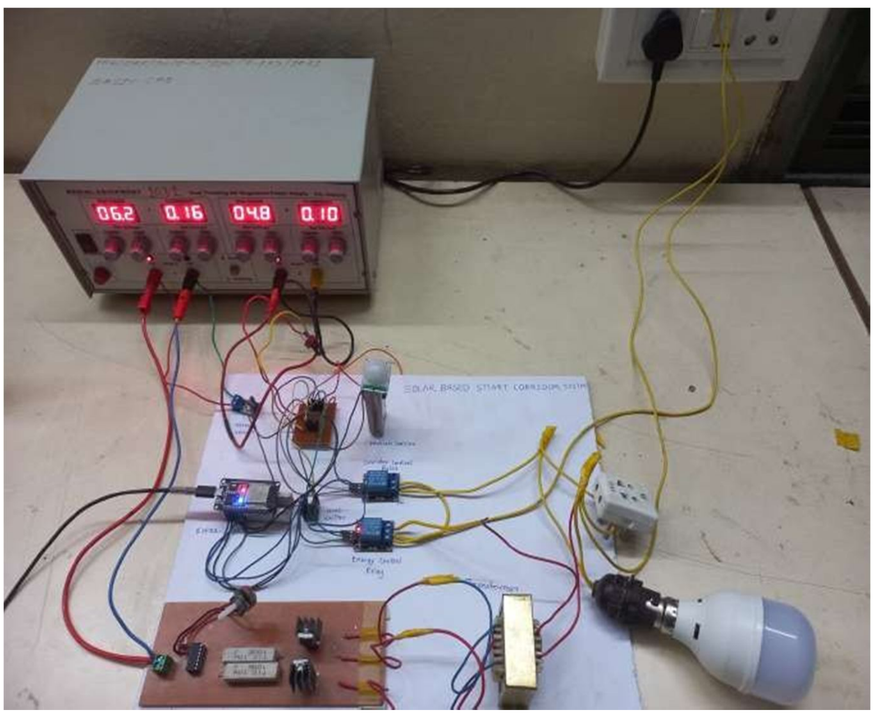

Fig. 11 MSEB ON, LED OFF

1) LED tubes powered by solar energy work on the sensors interfaced with the microcontroller. In protoFigure 11. MSEBON, LED OFF type consisting one motion sensor and one LED, The motion was detected by the motion sensor and the LED was turned on when the motion was detected. This control is achieved by the program in ESP32.
2) Failure of solar energy or storage batteries is resolved by using the relay which will power the LED and mobile charging ports through the supply from the state electricity board in case our system cannot deliver the necessary amount of energy.
3) The mobile charging ports with adapter outputs are provided in the corridor and the system is designed in such a way that if the person is present in the corridor then only the charging ports will be activated.

V. CONCLUSIONS

This paper describes the Solar Based Smart Corridor System. In this we have used ESP32 as a controller to integrate with sub-systems. Bi-directional Level shifter is used to change voltage from 3.3v to 5v and vice versa. PIR sensor is used as a motion sensor which is used to detect presence of a person. The system works on hybrid mode which is either solar energy through solar panel or battery or traditional state electricity power supply. System provides a smart lighting system as well as charging ports for mobile. System is controllable remotely with the help of a *Blynk* app through the wi-fi module on the ESP32. It will minimize human intervention.

VI. ACKNOWLEDGMENT

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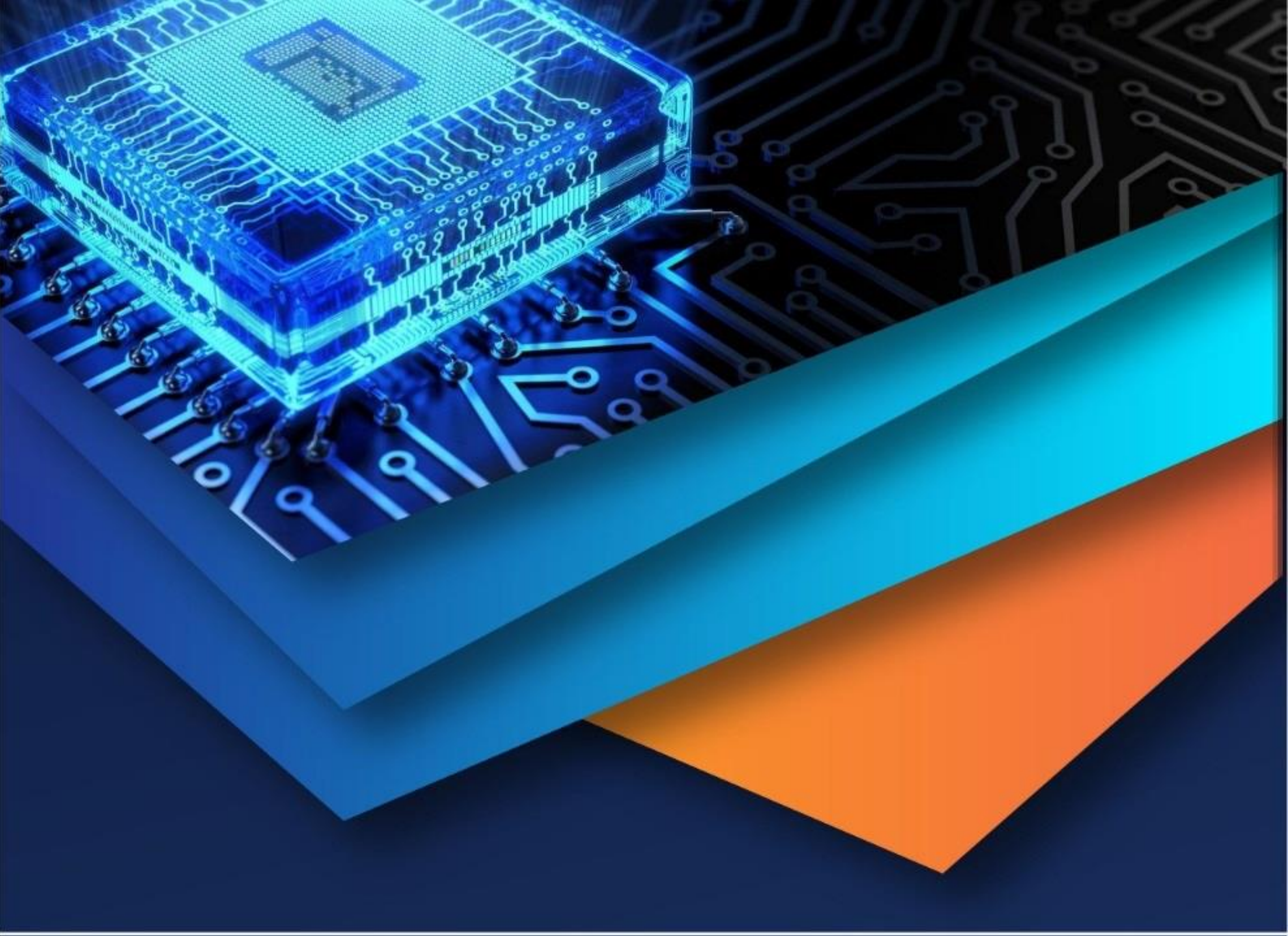

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