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Design of IoT Enabled Grass Cutter Robo-Car

Mayur S. Shelke[1], Nikhilkumar P. Chichghare[2], Ankit M. Maske[3], Sneha M. Panware[4]
UG Students, Department of Mechanical Engineering, K.D.K.C.E., Nagpur, Maharashtra, India

Abstract: The IoT Enabled Grass Cutter Robo-Car project represents a transformative leap in the realm of lawn maintenance, merging cutting-edge robotics with the expansive capabilities of the Internet of Things (IoT). At its core, this project introduces a state-of-the-art Robo-Car, meticulously engineered to be remotely controlled through an Android application. The crux of the communication infrastructure is a web server, with the ESP8266 serving as the linchpin by receiving signals from the server. These signals orchestrate the nuanced operations of a L298N motor driver, steering the precise movement of 100 RPM motors, and a relay module that commands the activation of the grass cutter motor. With a vision to redefine the landscape of lawn care, this project stands as an exemplar of efficiency, convenience, and remote accessibility in the realm of smart agriculture.

I. INTRODUCTION

Traditional lawn maintenance has grappled with challenges stemming from manual exertion and time-intensive processes, hindering overall efficiency in the field. The advent of the IoT Enabled Grass Cutter Robo-Car marks a transformative leap forward, introducing a sophisticated solution that addresses the inherent limitations of traditional practices. Through the utilization of IoT technology, this innovative project not only enhances the effectiveness of grass-cutting operations but also mitigates the physical strain imposed on the workforce.

The primary objective is to usher in a new era of empowerment for users, granting them the ability to exercise remote oversight and control over the intricacies of grass-cutting operations.At the core of this technological marvel is the integration of IoT, which enables seamless communication between the Grass Cutter Robo-Car and an intuitive Android application.This integration allows users to remotely monitor and manage various aspects of the grass-cutting process, providing a level of control unprecedented in traditional lawn maintenance.

The Grass Cutter Robo-Car, equipped with state-of-the-art technology, becomes a reliable and efficient ally in the pursuit of maintaining lush lawns without the drawbacks of manual labor.

Efficiency gains are achieved by leveraging real-time data and analytics, optimizing the Grass Cutter Robo-Car's performance based on the specific needs of each lawn.

The project envisions a departure from the labor-intensive routines of traditional lawn care, ushering in a future where technology seamlessly integrates with nature. Users can enjoy the convenience of scheduling, monitoring, and adjusting grass-cutting operations through the user-friendly interface of the Android application. The Grass Cutter Robo-Car is designed to adapt to diverse lawn environments, ensuring a precise and tailored approach to grass maintenance.

This innovative solution not only enhances operational efficiency but also contributes to resource conservation by utilizing data-driven decision-making for optimal resource utilization. Through the integration of IoT, the project addresses environmental concerns by minimizing the ecological impact associated with traditional lawn maintenance practices. The Android application serves as a central hub, allowing users to receive real-time updates, set preferences, and even initiate grass-cutting operations from the comfort of their smartphones.

Remote oversight empowers users to make informed decisions, adjusting the Grass Cutter Robo-Car's course or operation parameters based on the real-time feedback received through the IoT platform. The paradigm shift introduced by this project extends beyond mere technological innovation; it signifies a commitment to redefining the relationship between humans and the maintenance of green spaces. By streamlining lawn care processes, the project aims to contribute to a more sustainable and environmentally conscious approach to landscaping. The Grass Cutter Robo-Car's intelligent algorithms ensure that it navigates obstacles, adjusts cutting patterns, and maximizes efficiency without human intervention. As the demand for efficient and eco-friendly lawn maintenance solutions grows, the IoT-enabled Grass Cutter Robo-Car emerges as a pioneering force in reshaping the landscape of traditional practices.

II. PROBLEM IDENTIFICATION

Manual grass-cutting practices face a myriad of challenges, including significant time investments, strenuous physical labour, and the requirement for direct human presence. These longstanding obstacles have historically hindered the scalability and effectiveness of traditional lawn maintenance, prompting the creation of the IoT-enabled Grass Cutter Robo-Car.

This innovative project, featuring a remotely controlled robotic solution, not only tackles the existing challenges but also introduces a scalable and highly efficient alternative to modernize lawn care practices. The impetus for this development lies in the recognition that the traditional methods are no longer sustainable in meeting the demands of contemporary lifestyles and landscaping needs. The Grass Cutter Robo-Car addresses the time-intensive nature of manual grass-cutting by leveraging automation and remote-control capabilities, eliminating the need for constant human supervision. Moreover, the project aims to redefine the landscape of lawn maintenance, offering a solution that is not only technologically advanced but also adaptable and responsive to the evolving requirements of efficient and scalable green space management.

III. PROBLEM FORMULATION

The articulation of the problem encapsulates a strategic response to the discerned challenges in conventional grass-cutting methodologies. A targeted approach is adopted with a clear emphasis on reducing manual labor, enabling remote operation through a user-friendly Android application, and providing a scalable solution for efficient lawn maintenance. This project is set on engineering a paradigm-shifting solution by addressing these key facets.

By framing the objectives within this comprehensive context, the IoT-enabled Grass Cutter Robo-Car aspires to redefine the benchmarks for efficiency and accessibility in grass-cutting operations. The focus on minimizing manual labor aligns with contemporary demands for automation and efficiency in landscaping practices.

The integration of remote operation through an Android application not only enhances user convenience but also aligns with the evolving landscape of smart technology. Ultimately, this project endeavors to establish a new standard in grass-cutting methodologies, incorporating advanced technologies to create a solution that is not only effective but also adaptable to the changing needs of lawn maintenance.

IV. LITERATURE REVIEW

A panoramic review of existing literature unveils a rich tapestry of IoT applications, particularly in the domains of agriculture and robotics.

While antecedent projects have adeptly demonstrated the potential of IoT in realms of remote control and automation, a conspicuous gap exists in literature regarding the amalgamation of IoT within the context of grass-cutting Robo-Cars.

This project, therefore, assumes the mantle of a trailblazer, poised to contribute substantively to the existing body of knowledge by bridging this scholarly void.

V. RESEARCH METHODOLOGY

The research methodology employed for this project reflects a meticulous and systematic approach, commencing with the discerning selection and integration of each component.

The core of this methodology revolves around the ESP8266 module, which is intricately programmed to interpret signals emanating from the designated web server.

By documenting the intricacies of challenges encountered during the development process, the research offers invaluable insights, shedding light on the iterative path traversed to implement effective and innovative solutions. This methodical and detail-oriented approach ensures a comprehensive understanding of the project's development, highlighting the significance of each component's selection and integration. The ESP8266 module, positioned at the project's epicenter, serves as a linchpin in deciphering signals and facilitating seamless communication with the web server, embodying the precision inherent in the research methodology. The documentation of challenges encountered not only provides a transparent account of the development journey but also contributes to the broader knowledge base, fostering continuous improvement and refinement in the field.

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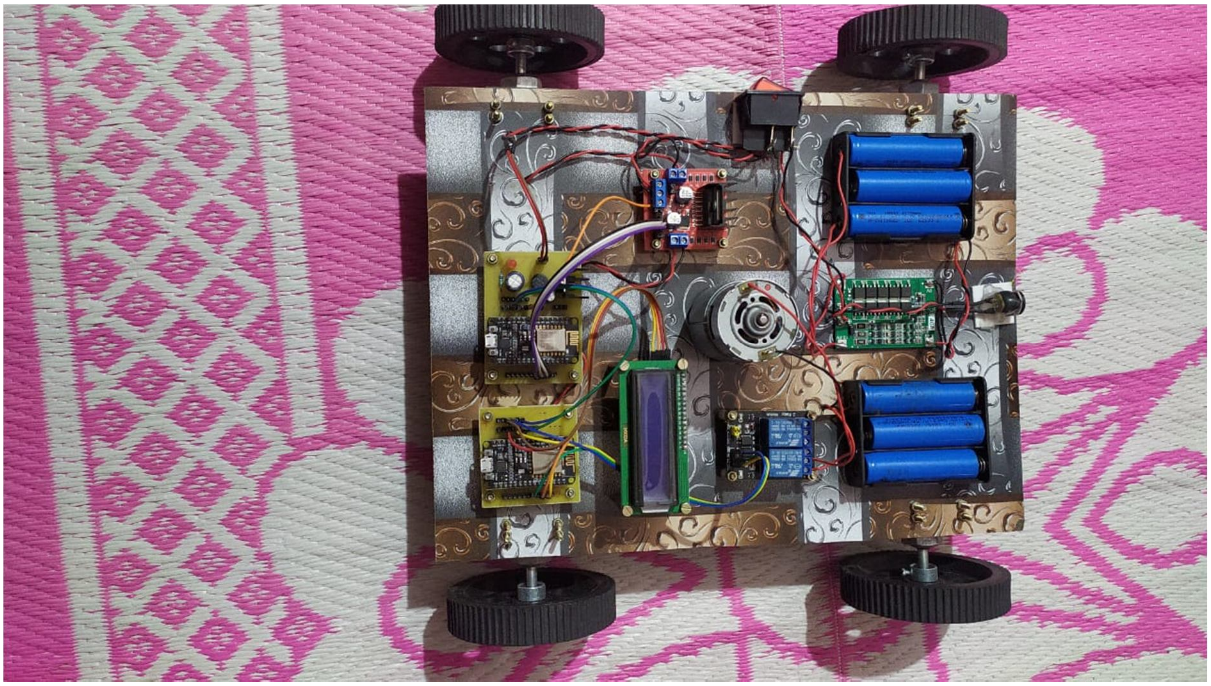
VI. CONSTRUCTION & WORKING



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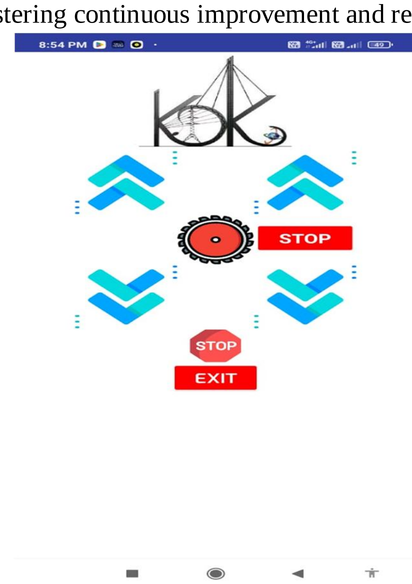

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VII. DESIGN: (ADD PROJECT PHOTOS)

The design considerations at the core of this project span a myriad of facets, commencing with the judicious selection of components. Each choice is grounded in a synthesis of functionality and compatibility, ensuring a harmonious integration within the holistic system.

The design process extends to the Android application, conceived as the user's gateway to seamless control, undergoing meticulous planning to provide an interface that is not only functional but also intuitive. Safety, recognized as a paramount concern, is intricately embedded within the design through the incorporation of an emergency stop functionality, guaranteeing the secure operation of the entire system.

At its essence, the design ethos is sculpted to deliver a user-centric, efficient, and safe lawn maintenance solution. This holistic approach ensures that every aspect, from component selection to user interface design and safety features, is carefully considered to create a comprehensive and well-balanced system that aligns with the project's overarching goals.

Calculations :

1. DC Motor Rated Voltage 100RPM= 12V, Rated Current = 0.3 AMH
3. DC battery lithium ion Rated Voltage = 12V, Ampere hour = 1.3 AMH
4. Number of Batteries in cell-: 6no.

DC Motor For Wheel : 70mm diameter, 40 width
Power of the motor = 3.6watts
Total power of motor for 4 wheels = 4*3.6
DC Motor For Cutter : 7555
DC motor for center = 12V, 1.3amps
Power required for cutter = 12*1.3apms = 15.6watts.
Total Power From The Battery :
Total power from battery = No. of batteries * volts * current
= 2*12*1.3
= 31.2watts.
Total Power From Motors :
Total power from the battery = 14.4 + 15.6 = 30watts
Total Power From Battery = Total Power From Motors :
31.2watts = 30watts
Total Time Taken To The Charge The Battery From
BMS 40AMP
Charge the battery from BMS 40amp panel = input supply adupter 12volt 2amp

A. NODE MCU ESP8266

1) Overview

NodeMcu Lua WiFi Development Board base on ESP-12E, a low cost wifi development board for you to DIY with NodeMCU platform. NodeMCU is an open source IoT platform. It includes firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module. The term "NodeMCU" by default refers to the firmware rather than the development kits. The firmware uses the Lua scripting language. It is based on the eLua project, and built on the Espressif Non-OS SDK for ESP8266. It uses many open source projects, such as lua-cjson and SPIFFS.

2) Features

- NodeMcu Lua ESP-12E WIFI Development Board
- Wireless 802.11 b/g/n standard
- Support STA / AP / STA + AP three operating modes
- Built-in TCP / IP protocol stack to support multiple TCP Client connections (5 MAX)
- D0 ~ D8, SD1 ~ SD3: used as GPIO, PWM, IIC, etc., port driver capability 15mA
- AD0: 1 channel ADC
- Input: 4.5V ~ 9V (10VMAX), USB-powered

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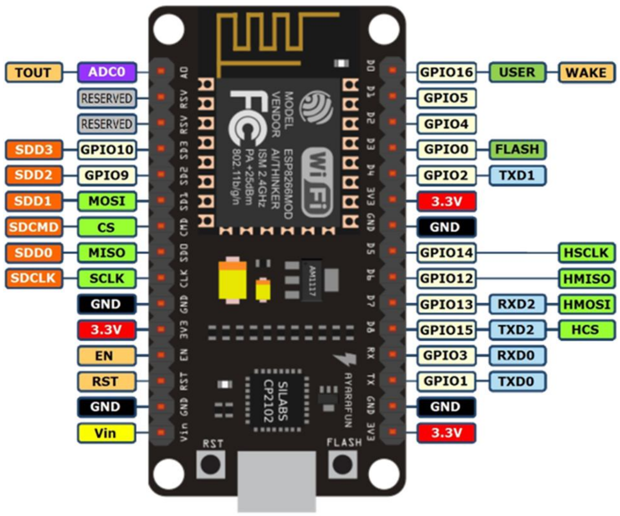
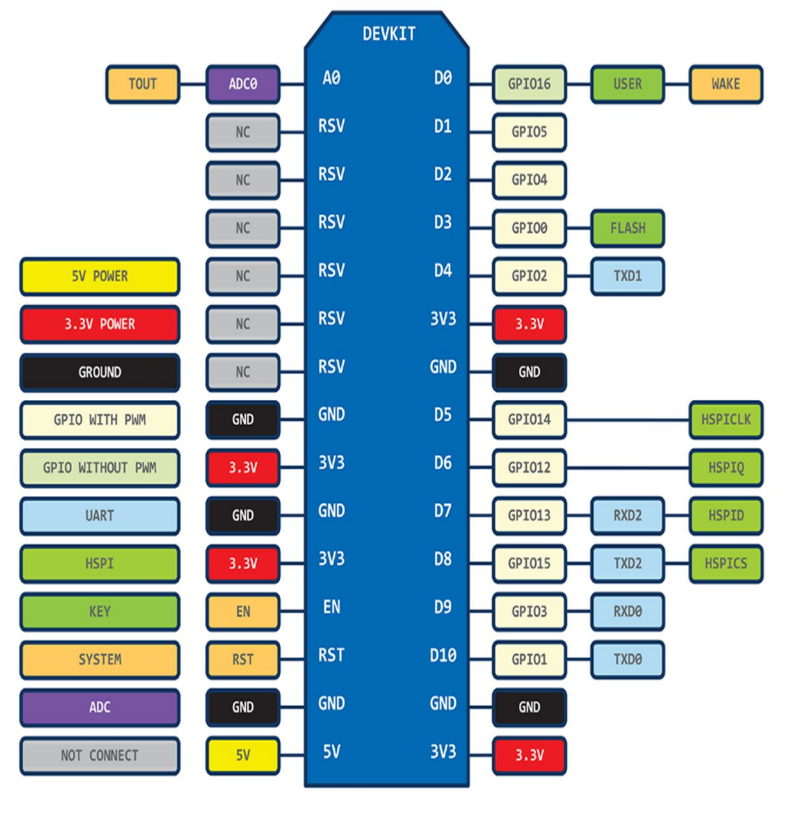
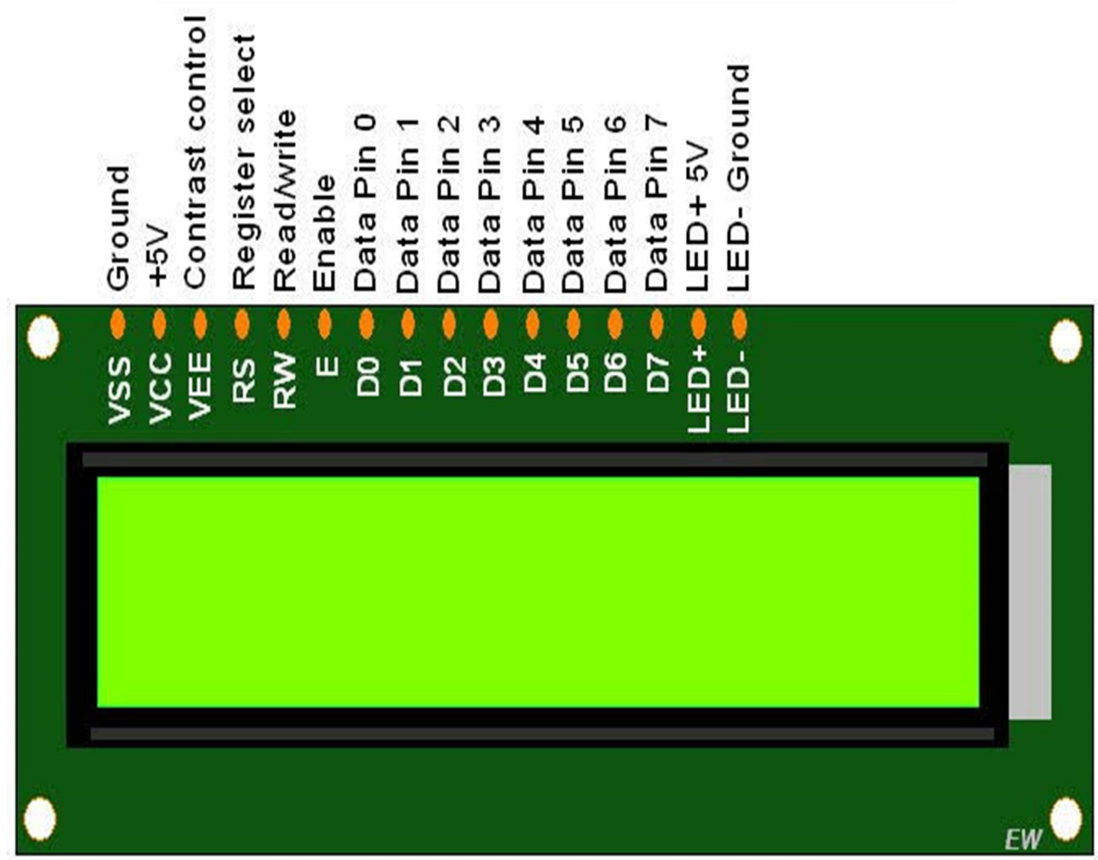
- Current: continuous transmission: ≈70mA (200mA MAX), Standby: <200uA
- Transfer rate:110-460800bps
- Support UART / GPIO data communication interface
- Remote firmware upgrade (OTA)
- Support Smart Link Smart Networking
- Working temperature: -40 ℃ ~ + 125 ℃
- Drive Type: Dual high-power H-bridge driver



While writing GPIO code on NodeMCU, you can't address them with actual GPIO Pin Numbers. There are different I/O Index numbers assigned to each GPIO Pin which is used for GPIO Pin addressing. Refer following table to check I/O Index of NodeMCU GPIO Pins –

GPIO Pin	I/O Index Number
GPIO0	3
GPIO1	10
GPIO2	4
GPIO3	9
GPIO4	2
GPIO5	1
GPIO6	N/A
GPIO7	N/A
GPIO8	N/A
GPIO9	11
GPIO10	12
GPIO11	N/A
GPIO12	6
GPIO13	7
GPIO14	5
GPIO15	8
GPIO16	0


DEVKIT
TOUT
ADC0
A0
D0
GPIO16
USER
WAKE
NC
RSV
D1
GPIO5
NC
RSV
D2
GPIO4
NC
RSV
D3
GPIO0
FLASH
5V POWER
NC
RSV
D4
GPIO2
TXD1
3.3V POWER
NC
RSV
3V3
3.3V
GROUND
NC
RSV
GND
GND
GPIO WITH PWM
GND
GND
D5
GPIO14
HSPICLK
GPIO WITHOUT PWM
3.3V
3V3
D6
GPIO12
HSPIQ
UART
GND
GND
D7
GPIO13
RXD2
HSPID
HSPI
3.3V
3V3
D8
GPIO15
TXD2
HSPICS
KEY
EN
EN
D9
GPIO3
RXD0
SYSTEM
RST
RST
D10
GPIO1
TXD0
ADC
GND
GND
GND
GND
NOT CONNECT
5V
5V
3V3
3.3V


Ground
+5V
Contrast control
Register select
Read/write
Enable
Data Pin 0
Data Pin 1
Data Pin 2
Data Pin 3
Data Pin 4
Data Pin 5
Data Pin 6
Data Pin 7
LED+ 5V
LED- Ground
VSS
VCC
VEE
RS
RW
E
D0
D1
D2
D3
D4
D5
D6
D7
LED+
LED-
EW

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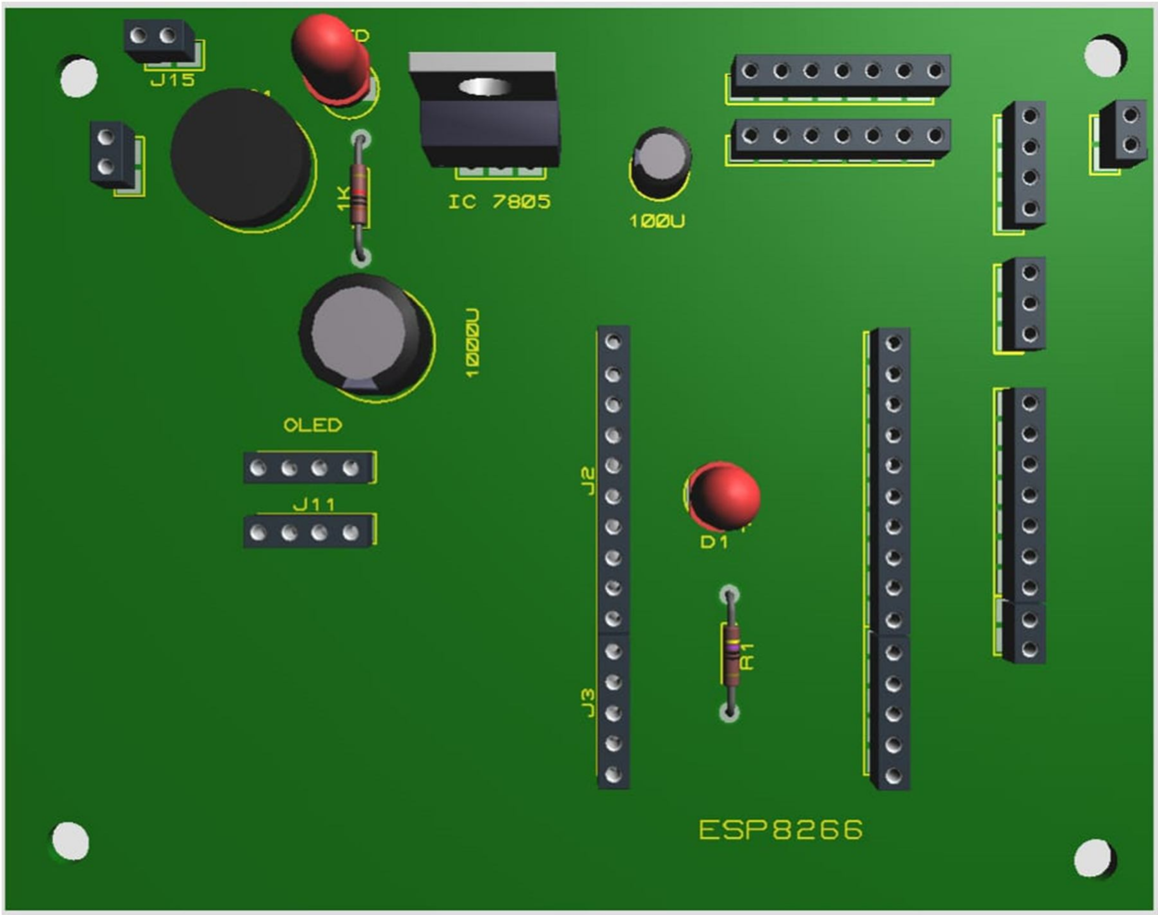

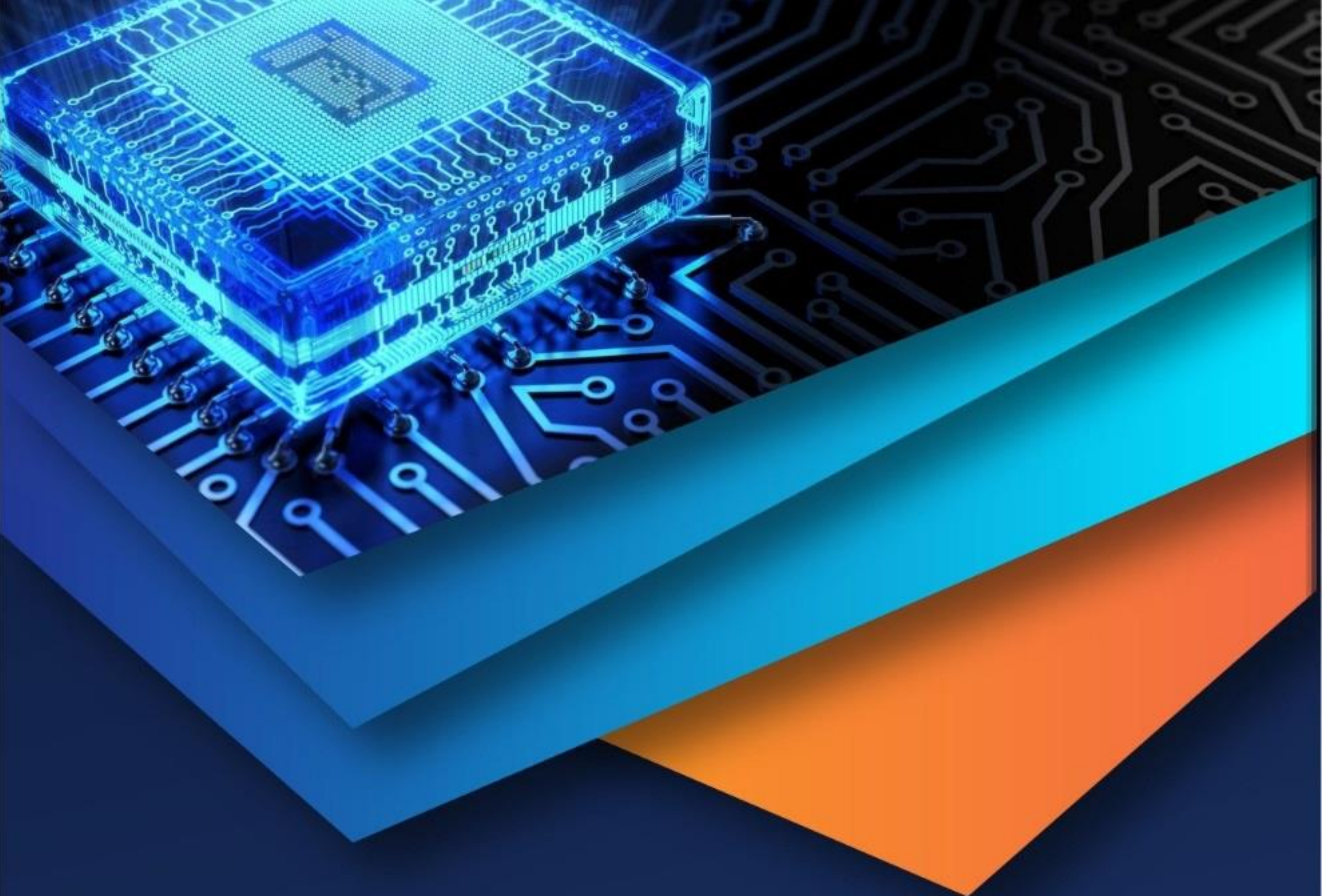

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