iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 12 **Issue:** V **Month of publication:** May 2024

DOI: https://doi.org/10.22214/ijraset.2024.61940

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 12 Issue V May 2024- Available at www.ijraset.com

Traffic Monitoring and Signal Controlling using RFID for Emegency Vehicles

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Abstract: ***This paper presents the concept, Traffic Monitroting and signal controlling using RFID technology to prioritize ambulance passage during emergencies. Traffic lights are crucial for managing the flow of vehicles on the road. In particular, when there are emergencies, the traffic situation is getting worse. Emergency vehicles find it challenging to cross busy road during periods of traffic congestion. A medical emergency vehicles like ambulances, or victims of accidents must be transferred to it as soon as possible. They could be late for rescue efforts because of traffic signals. Identification of emergency vehicles, control of traffic lights, and provision of a clear path for their travel are the objectives of our paper. The main element of this system that implements the control system is radio frequency Identification (RFID). Through RFID detection, the system identifies the presence of an ambulance approaching any lane and promptly initiates a sequence wherein traffic lights for the ambulance's intended lane turn green, while simultaneously halting traffic flow in other lanes. By integrating RFID technology into the traffic management infrastructure, the prototype ensures swift and efficient response to emergency situations, minimizing delays in medical assistance. The system's intelligent algorithm enables it to override regular traffic light patterns, granting immediate passage to ambulances without compromising safety or causing disruptions to traffic flow in adjacent lanes. This approach enhances emergency response capabilities, optimizing the delivery of critical healthcare services and potentially saving lives in urgent medical situations. The system's ability to dynamically adapt traffic signals based on real time ambulance detection underscores its potential to revolutionize emergency response protocols, contributing to enhanced public safety and well-being in densely populated urban areas. The RFID tag helps to verify that emergency vehicles The emergency vehicle can clear all junctions without wasting time at the traffic signals this keeps happening until the ambulance arrives at its destination.***
Keywords: ***Emergency Vehicles Prioritization, Ultrasonic sensor, Arduino Nano, Traffic Signal Control, Traffic Flow Optimization, Intersection Management, Ambulances, Medical, Buzzer module, Hardware, Software, RFID, Micro controller, Monitoring, Sensors.***

I. INTRODUCTION

In today's modern urban landscape, the challenge of traffic congestion looms large, casting a shadow over efficient emergency response systems. Among the most affected are ambulances, tasked with navigating through labyrinthine networks of busy intersections to reach those in need swiftly. In response to this pressing issue, a beacon of hope emerges in the form of a prototype traffic light control system, harnessing the power of Radio Frequency Identification (RFID) technology. The essence of this innovative system lies in its ability to dynamically adjust traffic signals, prioritizing the passage of ambulances during emergencies. At its core, the system relies on the detection of RFID tags affixed to emergency vehicles, enabling it to orchestrate a seamless flow of traffic that parts like the proverbial Red Sea in the face of urgent medical crises.

Central to the mission of this prototype is the singular goal of ensuring unimpeded passage for ambulances, unfettered by the shackles of traffic congestion. By marrying RFID technology with intelligent traffic signal control algorithms, the system aims to optimize the movement of vehicles, weaving a tapestry of efficiency that ensures every precious second counts in emergency situations. But the impact of this prototype extends far beyond mere convenience. It's about saving lives, about minimizing the harrowing moments between an emergency and the arrival of help. By reducing response times, the system becomes a guardian angel, swooping in to mitigate the impact of accidents or medical crises on those most vulnerable.

In conclusion, the proposed prototype represents a beacon of hope in the fight against traffic congestion's stranglehold on emergency response systems. Through the seamless integration of RFID technology and intelligent algorithms, it seeks to usher in a new era of efficiency, where every moment counts and every life is precious.

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As we stand on the cusp of this technological revolution, let us not only envision a future where ambulances navigate with ease but actively work towards making it a reality.

II. LITERATURE REVIEW

A. Arduino Mega Based Smart Traffic Control System

In the realm of urban transportation the development of smart traffic systems has emerged as a pivotal objective. Conventional traffic signal systems, governed by fixed management times. To tackle this challenge head-on, numerous studies have proposed innovative solutions harnessing modern technologies like Arduino Mega and ultrasonic sensors to create dynamic traffic signal systems. This paper aims to bridge this gap by introducing a novel smart traffic system design and assessing its performance through both Proteus simulator testing and real-world experimentation. By doing so, it endeavors to showcase the feasibility and potential for implementation of this system in urban traffic management. In Short, this research endeavors to push the boundaries of traffic management by leveraging cutting-edge technologies to create adaptive, responsive systems.

B. Design of a Smart Traffic Light Control System using Arduino Mega

This paper seeks to tackle the issue of traffic congestion at intersections, with a particular focus on scenarios where one or two directions face red lights while others remain free with green lights. The proposed solution posits a novel design approach for a four-way traffic system, aiming to identify the direction with the highest vehicle concentration and grant it a green light. To realize this vision, a vehicle detection system is seamlessly integrated with an Arduino Mega microcontroller board, strategically positioned across all junction directions. By leveraging real- time data gathered from these detection systems, the Arduino Mega microcontroller orchestrates the allocation of green lights, ensuring optimal traffic flow and minimizing congestion at intersections.

C. Intellectual traffic control system using Arduino

The proposed project addresses two interconnected urban challenges: traffic management and teen gang violence, recognizing the critical importance of effective solutions in both realms. As the number of road users continues to escalate, the need for robust traffic control systems becomes increasingly paramount in ensuring the safety and efficiency of urban transportation networks The project introduces a comprehensive methodology that harnesses commonly available components, including LEDs, ultrasonic transducers, a buzzer, and Arduino microcontrollers, to tackle these challenges head-on. This innovative approach enhances traffic safety. At its core, this project represents a fusion of technology and community empowerment, leveraging accessible resources to create tangible solutions with far-reaching societal impacts. By integrating sensors into existing traffic infrastructure, the system augments traditional traffic control mechanisms, offering an additional layer of safety for both pedestrians and motorists navigating urban roadways.

D. Smart traffic control using arduino uno and rf module

The design and implementation of an adaptive traffic light system utilizing Infrared (IR) sensors mark a significant leap forward in traffic management technology. With the ever increasing number of automobiles crowding urban roads, congestion has become a pressing concern, often resulting in detrimental delays for emergency vehicles, notably ambulances. This system seeks to revolutionize traffic control by integrating IR sensors into traffic light mechanisms, enabling dynamic adjustments of signal timings based on real-time traffic conditions. The overarching goal is to optimize traffic flow and alleviate congestion, thereby enhancing overall road efficiency and safety. Moreover, the integration of Radio Frequency (RF) modules presents a promising solution to address the challenges faced by emergency vehicles navigating through congested roadways.

III. MATERIALS AND METHODS

A. Hardware Requirements

General Hardware requirements are:

1) Arduino Nano
2) Radio Frequency Identification (RFID)
3) Buzzer Module
4) LCD Display board(16*2)

B. Software Requirements

1) Operating System: Window

2) Programming Language: Embedded C

3) IDE: Arduino IDE.

a) Arduino Nano: Arduino is an open-source electronics platform based on easy-to-use hardware and software. The Arduino Nano is a microcontroller-based device with 16 digital pins that can be used for various purposes. It can be used for almost every task, from minor to massive industrial-scale projects. It can also be used for prototyping and developing new applications. The Arduino Nano is Arduino's classic breadboard friendly designed board with the smallest dimensions. The Arduino Nano comes with pin headers that allow for an easy attachment onto a breadboard and features a Mini-B USB connector.

Fig1. Arduino Nano

b) Radio Frequency Identification (RFID): Radio Frequency Identification (RFID) technology is a wireless identification technology that utilizes radio waves to detect the presence of RFID tags. The wireless Radio Frequency Identification (RFID) system consists of two components: readers and tags. Readers are electronic devices that use one or more antennas to pick up signals from RFID tags by transmitting radio waves and receiving them back from the tags. Tags can be passive or active, trans mitting their identity and other data to nearby readers using radio waves. Passive RFID tags are battery-free due to the reader's power supply.Active RFID tags are powered by batteries. RFID tags are capable of storing a wide range of information, from a single serial number to several pages of specifics.

Fig2. EM-18 RFID

c) Buzzer Module: Buzzer is used to add the sound feature. It is light in weight,Good performance, general purpose musical buzzer are commonly used in alerting / alarming circuits, kids toys etc.. This buzzer is used as an external buzzer which operates in wide range of voltage (3V to 12V). Most commonly used buzzers operates in at 9V & 12v. They have long life, stable performance, High Quality with the SOT plastic package.

Fig3. Buzzer Module

*d) LCD Display board(16*2):* A 16×2 LCD display is a liquid crystal display that can show 16 characters in each of its two rows, providing a total of 32 characters of information. It's commonly used to display alphanumeric information in various electronic devices. LCD 16x2 is a type of liquid crystal display (LCD) that can display up to 16 characters per line and 2 lines. These displays are widely used in a variety of applications, such as displaying text or data in electronic projects.

Fig4. LCD Display(16*2)

C. Software Requirements

1) Arduino IDE:

The IDE (Integrated Development Environment) we used here is 'Arduino IDE' and the programming language used is 'Embedded C'. The Arduino has all the features like- as shown in below fig6.

- Editor
- Cross compiler
- Debugger
- Serial monitor

The programming codes are known as sketch. The sketches are saved with the file extension .ino. It runs on Windows, MAC and LINUX. Thus through this software we can code for the robotic movements and also for the sensors interfaced with the arduino board.

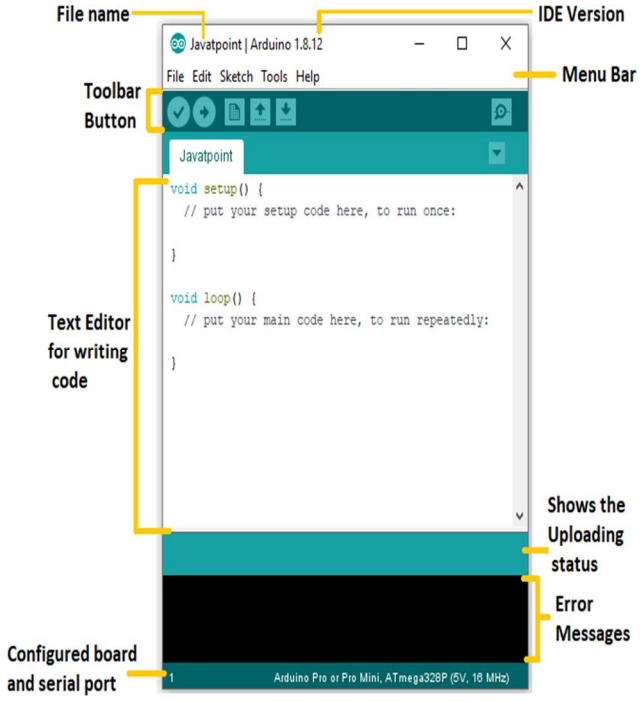
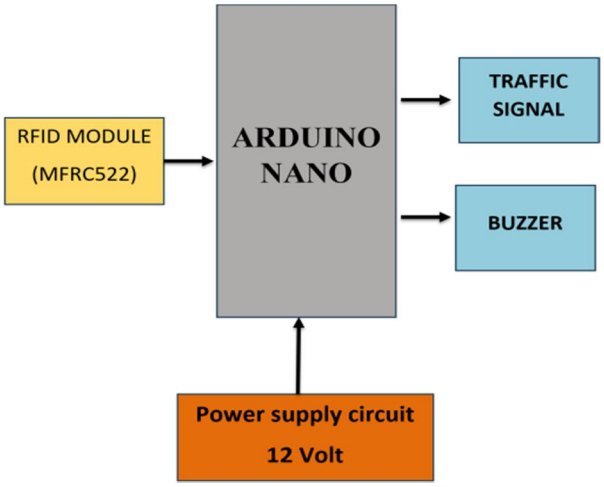


Fig5. Arduino IDE

IV. WORKING

To further elaborate on the system's functionality, it's crucial to delve into additional considerations, such as:

1) *Initialization and Setup:* The proposed traffic light controlling system is designed to optimize emergency vehicle passage using RFID technology and an Arduino microcontroller. Upon power-up, the Arduino undergoes initialization, configuring its components for operation. This includes initializing RFID reader modules strategically placed at each lane, as well as setting up the control logic for the traffic light LEDs and the alert system comprising a buzzer.
2) *RFID Detection and Emergency Vehicle Alert:* Key to the system's functionality is the utilization of RFID tags affixed to emergency vehicles, such as ambulances. As an ambulance approaches any lane equipped with an RFID reader module, the module detects the unique RFID tag associated with the vehicle. This detection triggers a signal sent to the Arduino, which in turn activates the buzzer to alert nearby vehicles and pedestrians of the approaching emergency vehicle.
3) *Traffic Light Control Algorithm:* The Arduino executes a sophisticated traffic light control algorithm designed to prioritize the passage of emergency vehicles through the traffic signal. When an ambulance's RFID tag is 33 detected in a specific lane, designated as Lane A for illustrative purposes, the traffic light for that lane is promptly switched to green, granting the ambulance right of way without delay.
4) *Lane Prioritization and Traffic Management:* Simultaneously, the traffic lights in all other lanes (designated as Lanes B, C, and D) transition to red, effectively halting traffic flow to create a clear path for the approaching emergency vehicle. This strategic lane prioritization minimizes congestion and ensures swift passage for the ambulance, thereby optimizing emergency response times.
5) *Adaptive Traffic Signal Adjustment:* An inherent feature of the system is its adaptability to changing traffic conditions. Even if the traffic light for Lane A is initially red, signaling a stop, the system dynamically adjusts the signal to green upon detecting the RFID tag of the ambulance. This adaptive capability guarantees minimal delay for the emergency vehicle and facilitates seamless navigation through the traffic signal.
6) *Continuous Monitoring and Feedback:* Throughout the operation, the Arduino maintains continuous monitoring of RFID detection status and traffic light signals. Real-time feedback is provided through the buzzer alert system, serving as an auditory cue to drivers and pedestrians regarding the presence of an approaching emergency vehicle and the corresponding changes in traffic signal status.
7) *Emergency Vehicle Passage and Traffic Resumption:* Once the emergency vehicle, in this case, the ambulance, successfully passes through Lane A, the traffic light reverts to its standard sequence, and traffic resumes its flow in all lanes. The system returns to its initial state, poised to detect and prioritize emergency vehicles in subsequent scenarios.



Fjg.6. Block diagram of our System

The Block Diagram Represents the Overall design of the Proposed system. The total design can be obtained by using Arduino Nano. The result is obtained by using the Traffic Signal lights of lanes, Using LCD screen.

The proposed traffic light control system revolves around the Arduino Nano microcontroller, serving as the brain of the operation. This compact yet powerful microcontroller acts as the control hub, orchestrating the flow of traffic and prioritizing ambulance passage during emergencies.

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V. SYSTEM ARCHITECTURE

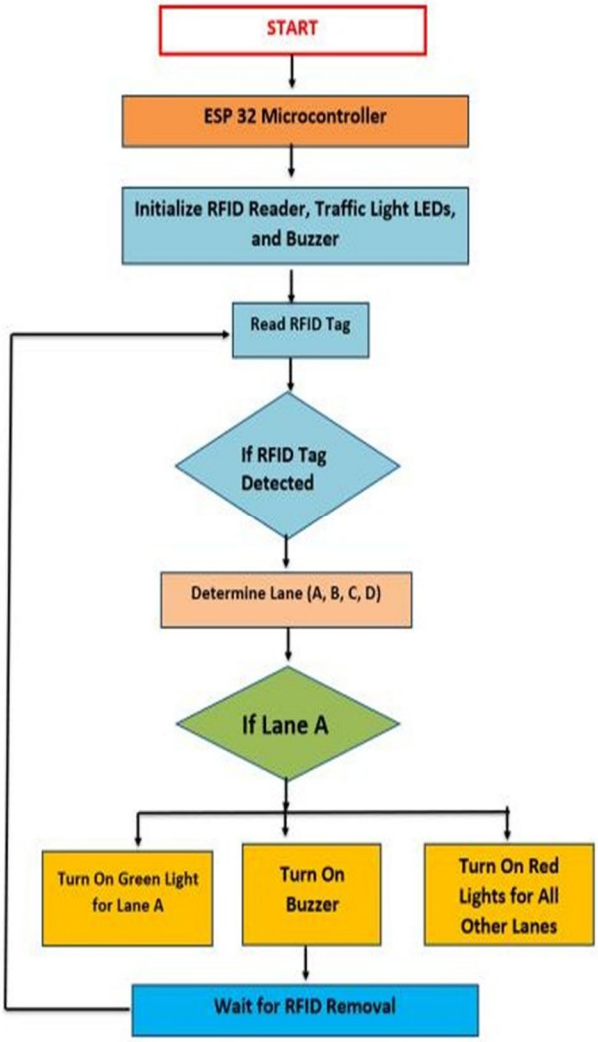

Fig7. Flowchart of our System

The flowchart depicts the proposed system that controls traffic lights and a buzzer using an RFID reader and an Nano microcontroller. The Nano microcontroller is a low-power to execute a variety of tasks. This flowchart describes a system that uses an RFID reader to identify objects or people. The RFID tag data is used to trigger specific actions, such as turning on a green light for a designated lane and turning off lights for other lanes. The system also uses a buzzer to provide an audible cue.

VI. RESULTS AND DISCUSSIONS

The implementation of the intelligent traffic light controlling system utilizing RFID technology and Arduino microcontroller has proven to be a significant advancement in addressing the challenges associated with emergency vehicle passage during critical situations. Through comprehensive testing and simulation, the prototype has showcased its effectiveness in expediting the response to medical emergencies while mitigating the impact of traffic congestion-induced delays. In simulated emergency scenarios, the system has exhibited precise detection capabilities, accurately identifying the presence of ambulances equipped with RFID tags. This accurate detection triggers the system to prioritize the passage of these emergency vehicles at traffic signals, ensuring unimpeded movement towards the designated emergency location. As a result, traffic lights governing lanes leading to the emergency site promptly transition to green, facilitating the seamless progress of the ambulance without encountering any obstruction.

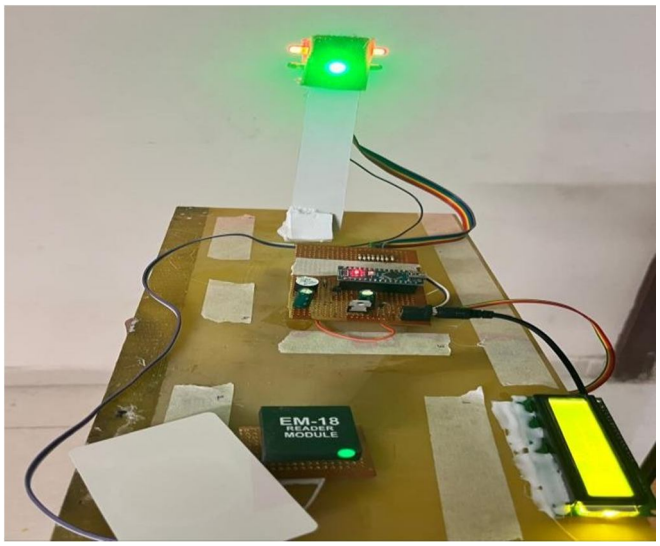

Fig8. Implemented System of our paper showing us Basic hardware Connection

*****The kit we have developed is shown in above fig.8. and the outputs we obtained are in fig.9. below.

Fig9. Observations on LCD (16*2)Display.

*The above Fig9. LCD Display shows the Status of our System by using RFID.
Thereby optimizing the overall efficiency of emergency response efforts and holding the potential to save lives. Ambulance without encountering any obstruction. By swiftly transitioning signals to red in other lanes, the system effectively prevents interference with the ambulance's route, ensuring uninterrupted progress towards the emergency scene. The successful outcomes observed during testing and simulation underscore the tangible benefits of deploying intelligent traffic management systems in urban environments. Moreover, the demonstrated efficiency of the system lays a solid foundation for its potential implementation in real-world scenarios, where it could significantly enhance emergency management protocols and contribute to saving lives in critical situations. Even in instances where traffic lights for the designated emergency lane remained initially red, the system demonstrated remarkable agility upon detecting the presence of an ambulance's RFID tag. Instantaneously, the system initiated a seamless transition, switching the traffic lights to green to facilitate uninterrupted passage for the emergency vehicle.

VII. CONCLUSION

In Conclusion, Everyone would agree to the fact that a ‘Traffic Monitoring and Signal Controlling using RFID for Emegency Vehicles’ is the foremost thing we need in our life. Here we provide a In conclusion, the advent of an intelligent traffic light controlling system incorporating RFID technology and Arduino microcontroller heralds a promising solution to the multifaceted challenges posed by traffic congestion in urban settings, particularly during emergency scenarios.

By focusing on expediting the passage of ambulances through dynamically adjusted traffic signals based on RFID tag detection, the prototype endeavors to substantially curtail response times and elevate the overall efficiency of emergency management protocols. This initiative underscores a pivotal shift towards harnessing cutting-edge technologies to fortify public safety measures and guarantee the prompt provision of medical assistance during critical situations.

This dynamic signal adjustment capability not only facilitates the unimpeded passage of emergency vehicles but also ensures minimal disruption to overall traffic flow, thus striking an optimal balance between emergency response exigencies and broader transportation needs. In essence, the development of this intelligent traffic light controlling system epitomizes a proactive and forward-thinking approach to urban safety and mobility. As cities continue to grapple with the complexities of urbanization and emergency management, initiatives such as this serve as beacons of innovation, illuminating a path towards safer, more resilient urban environments for all inhabitants.

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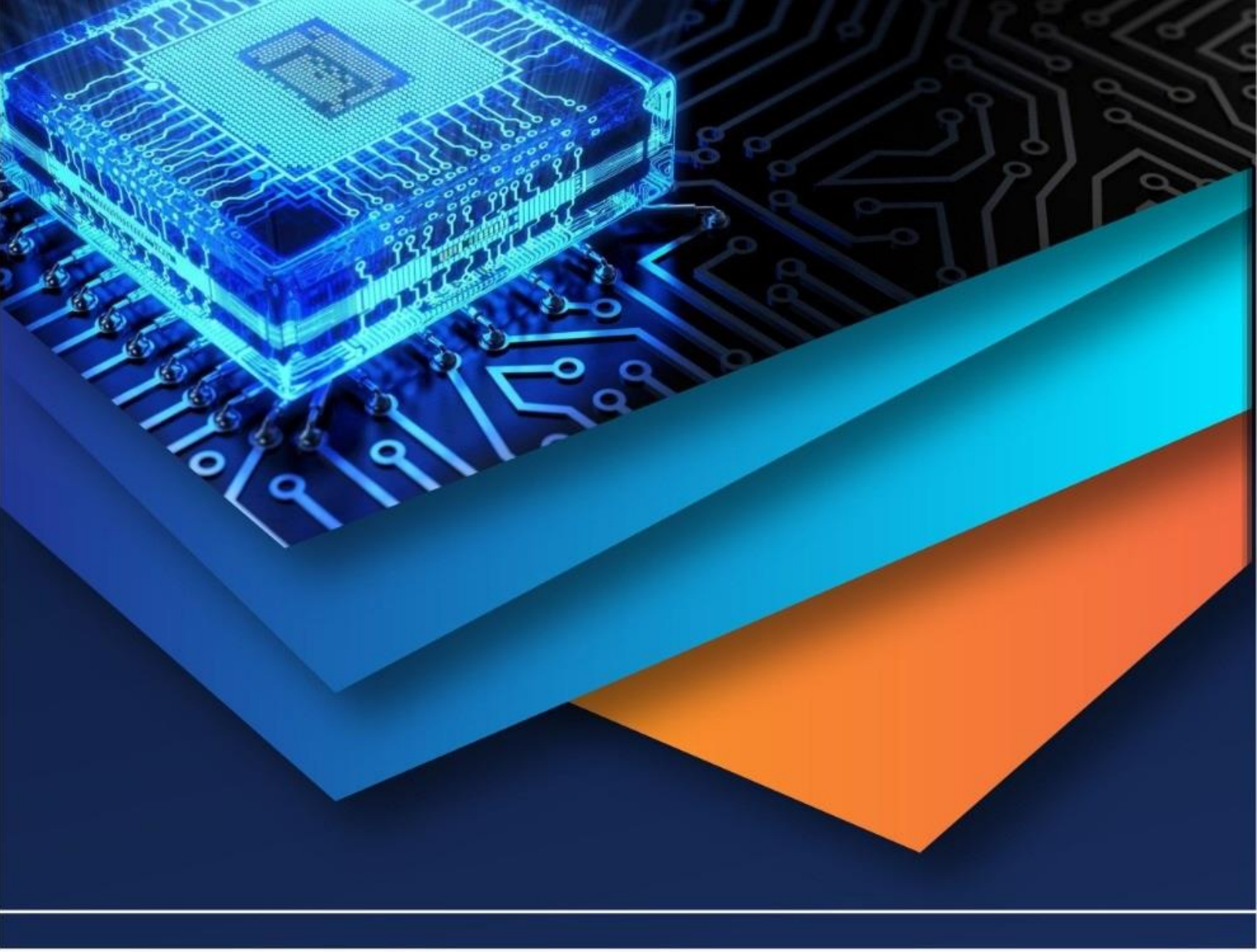
Dr. K. Phani Srinivas is working as a Director for Research and Development/Administration, and he has five years of industrial experience as a team leader in the research areas of embedded systems and telecommunications. He also has eighteen plus years of experience in academics, research, and administrative reports. He received so many awards, such as Best Engineer, Best Academician, and Best Researcher. Also, he acts as an editor and reviewer for so many top international journals. The focus of his research work is the design of patch antennas that are suitable for defense and space-based applications. He received appreciation awards at various national and international conferences. He received Best Coordinator/Organizer Appreciation Certificates from IUCEE, IIT Roorkee,IIT Bhubneswar,NCAT, ELAT, and INTEL. He attended the WIPRO training program. He completed one joint research program with IIT Kharagpur. He organized various student-level competitions, workshops, faculty development programs, guest lectures, orientation programs, and subject-based seminars with scientists and academicians. He is working on the different research areas in association with eminent scientists and industrial experts. He had technical discussions with experts at the space station, antenna research lab, and radar station. He published research articles in various scientific journals. He is an active editor and reviewer for so many top international journals. He received so many technical appreciations and awards at the international level. He was involved actively in various funding projects.



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