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Intelligent Traffic Light Control System

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Abstract: ***The "Intelligent traffic light control system " project introduces an innovative approach to traffic management, aiming to expedite emergency vehicle passage. Utilizing Zigbee and Radio-Frequency Identification (RFID) technology, this system assigns a unique RFID tag to each vehicle, enabling precise tracking and control at traffic junctions. The scenarios involving emergency vehicle clearance, the system's responsiveness shines. When an emergency vehicle clearance approaches, the system rapidly receives the signal from zigbee transmitter associated with it and promptly triggers a green signal at the traffic junction. This prioritization ensures that emergency vehicles can navigate the traffic with minimal delays, potentially saving lives. Another remarkable feature of the system is stolen vehicle detection capability. In the event that a vehicle with a specific RFID tag is reported as stolen, the system is programmed to take action. It sends immediate SMS notifications to relevant authorities, such as law enforcement or the vehicle owner. This proactive response enhances the chances of recovering stolen vehicles and contributes to overall security. The hardware components of this system include Arduino Uno. Arduino Uno serves as the central control unit, processing RFID data and executing signal adjustments, while the GSM module facilitates real-time communication, enabling SMS alerts and notifications. The " Intelligent traffic light control system " project exemplifies how RFID technology and zigbee technology can revolutionize traffic management. By incorporating data analysis and automation, this system offers a multifaceted solution to common traffic-related challenges.***

Keywords: Intelligent Traffic Control, Congestion Control, Ambulance Clearance, RFID Technology, Arduino Uno.

I. INTRODUCTION

India as highest population and it as rapid rise in economy. Urban traffic congestion represents challenge that significantly impacts economic efficiency, environmental sustainability, and it impacts the overall quality of urban life. This issue is aggravated by rapid urbanization, an increase in vehicle ownership, and lacks in existing road infrastructure and urban planning. The resultant effects are far-reaching, displaying having considerable extent delays, increased fuel consumption and stolen vehicle detection. Technologies like ZigBee Along with Encoder & Decoder, RFID technology and GSM Module is utilized among traffic management for the problems.It utilizes wireless technologies like RFID and Zigbee. RFID Technology utilizes radio frequency electromagnetic waves for carrying information among RFID tag and RFID reader.

They get operated in different frequency ranges across the area. ZigBee is a standards wireless technology and developed to enable low-cost,low power and it utilizes radio signal between any two devices. Data is transmitted from transmitter end and it gets received by receiver module at the receiver end. GSM Module is a device that connects to a mobile network using sim cards and allows communication through voice, sms and data.

Urban traffic congestion represents a multifaceted challenge that significantly impacts economic efficiency, environmental sustainability, and the overall quality of urban life. This pervasive issue is exacerbated by rapid urbanization, an increase in vehicle ownership, and inadequacies in existing road infrastructure and urban planning. The resultant effects are far-reaching, manifesting as extensive delays, increased fuel consumption, elevated stress among commuters, and a rise in greenhouse gas emissions and pollutants.

Within this complex scenario, the need for emergency vehicle prioritization emerges as a critical concern. Emergency response vehicles, crucial for public safety and health, often find their paths obstructed by congested traffic, leading to potentially life-threatening delays.

Traditional traffic management systems, characterized by fixed signal schedules, fail to accommodate the urgent requirements of these vehicles, underscoring the necessity for an intelligent traffic control mechanism capable of dynamically facilitating their movement. Concurrently, the challenge of stolen vehicle tracking presents a significant dilemma for law enforcement and vehicle owners. The efficiency of recovering stolen vehicles is critically dependent on the timeliness of the response, a task complicated by the sophisticated methods employed by criminals to evade detection. While technologies such as RFID and GMS offer promising solutions for real-time vehicle tracking.

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II. LITERATURE SURVEY

In [6], the authors proposed an intelligent traffic control system based on the design of a wireless sensor network in order to collect data at junctions and to know available parking spaces. In addition, the proposed system has innovative approach that allow drivers to view the traffic and the number of parking spaces available at destinations using an Android mobile application to avoid traffic jams and to take another alternative route to avoid congestion and to make it easier for drivers looking for a free parking space to av oid parking charges. This system integrates three smart systems connected to each other in order to connect citizens to a smart city application [6].

In [7], a new intelligent traffic control system is presented, which is based on the deployment of wireless sensor networks on roads, on traffic lights, and on specific places (such as hospitals and petrol pumps) in order to monitor road traffic in the city and find the s hortest route to the destination in terms of time and distance, avoiding traffic jams. This system employs intelligent cameras on the r oads to identify the vehicle numbers and send this information to the central system to monitor the cars in the city. The proposed sys tem uses more recent technologies which allow the interconnection of the various urban services between them by creating a smart c ity.

However, the deployment of smart cameras can be expensive and also less effective, especially when detecting the numbers of cars i n cases where there are visibility problems such as the reflection of light from car headlights, given that there are other cheaper and efficient solutions such as RFID technology which interacts with WSN networks and which allows vehicles to send this information to the central system in a sustainable and efficient way

The authors in [8] propose a system for monitoring road traffic based on mobile devices and Bluetooth beacons with low energy co nsumption. The vehicle detection offered by this system uses mobile devices (for example, smartphones) installed on the side of the road to measure the strength of the RSSI signal when receiving radio frequency frames emitted by Bluetooth beacons on the other ac ross the street.

Bluetooth beacons are installed along the road at different heights in order to identify and classify the type of vehicles traveling on t he road (cars or trucks). The RSSI values detected by mobile devices on each route as well as their positions are sent via a cellular n etwork or Wi-Fi communication to a server in order to measure the density of road congestion and monitor traffic on the roads. On t he other hand, Bluetooth technology can cause major synchronization problems and communication breakdowns between the BLE b eacon and the smartphone, which negatively affect the feasibility of the system, especially in the case of heavy traffic. So, an agent must be on-site to pair the two devices to resume communication.

The authors in [9] present a new intelligent traffic monitoring and traffic light control system based on wireless sensor networks. Th ese sensor nodes are installed along the roads constituting a road intersection.

The data captured by the sensors is sent to a two-traffic signal controller to assess the congestion conditions of traffic on each road a t an intersection and to predict the state of traffic jams. This system uses a self-organization protocol (Alg5) which creates a star top ology between the different nodes of the network.

However, the algorithm adopted by this system will create dark areas for certain nodes far from their associated central node which t hey will not be able to communicate with it and which will cause degradation in the quality and in the feasibility of this system. This solution makes it possible to dynamically manage the traffic lights according to the states of traffic congestion obtained in an interse ction and also makes it possible to optimize the synchronization phase of traffic light control in order to avoid traffic jams before its formation.

The intelligence of this system remains beyond the reach of drivers and citizens because they do not interact with the remote system and also do not connect to roads in real time.

The authors in [10] describe a new intelligent system of adaptive traffic light control based on the deployment of the wireless sensor network (WSN) in the roadways leading to an intersection. These nodes are magnetic sensors installed in the ground along all the pa ths that form an intersection. These sensors form a cluster-type network topology in which each node detects the presence of vehicle s and sends the data to the nearest head cluster to reach the base station. The data collected by the WSN is used by the base station b y running an algorithm to detect the rate of traffic congestion in each lane and dynamically control the traffic lights at the road inters ection.

In [11], use of Bluetooth ,the arrival of the emergency vehicle will be informed when it is too close to a particular junction that the re will be less time in order of seconds which is not useful in clearing of traffic signals. So there is a need to develop a new system which is cheaper as GPS and also more efficient than the Bluetooth. Thus using ZIGBEE module is the best way for system.

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III. METHODOLOGY

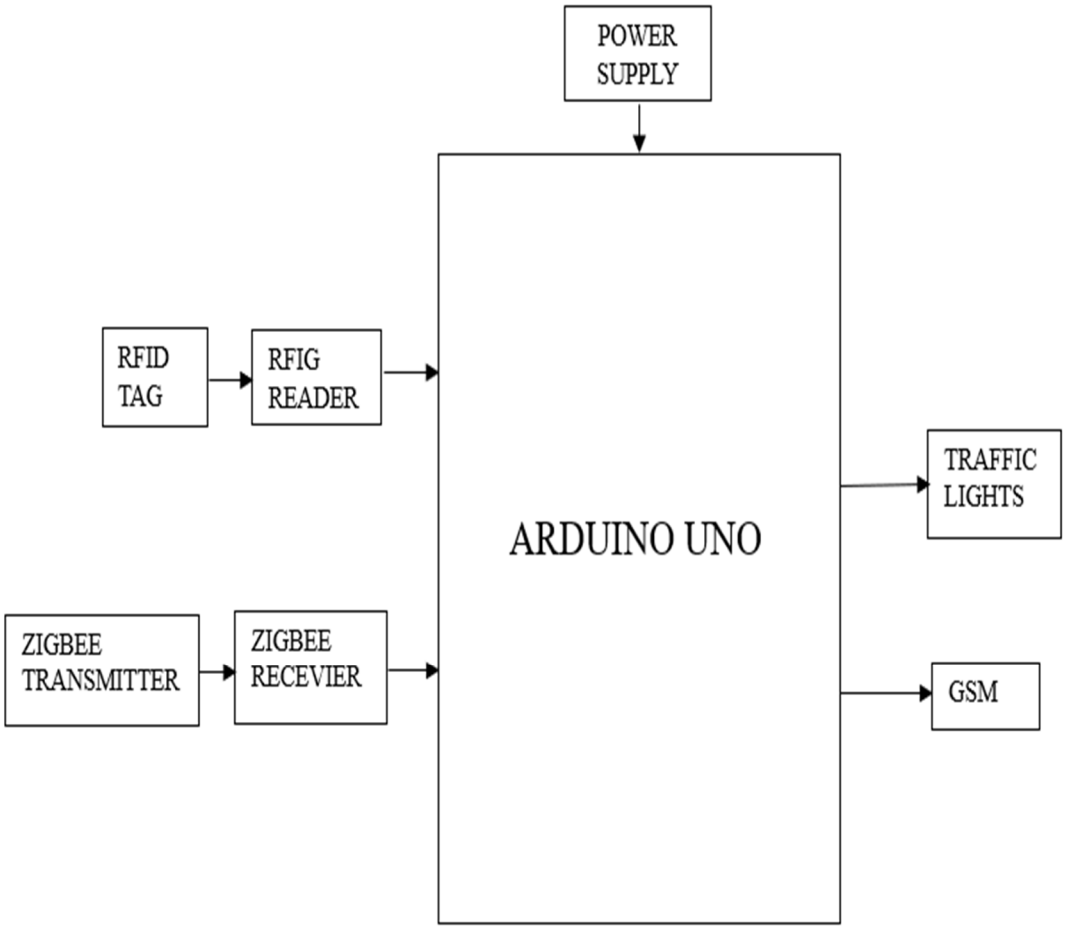

FIG 1: Block Diagram

A. Working Principle

Fig 1 is the block diagram of whole project ,here Emergency vehicle consists of zigbee transmitter it is used to provide green path . whenever emergency vehicle provides signal to zigbee receiver from zigbee transmitter connected to microcontroller it receives the signal. Stolen vehicle is detected when reader identifies the RFID tag of the vehicle, and send sms to the police control room. we use d RFID tag and RFID Reader. For stolen vehicle detection .where RFID Tags are places in the vehicle and RFID Readers are connec ted to Arduino uno placed at traffic signal. Stolen vehicle is detected when reader identifies the RFID tag of the vehicle, and send sm s to the police control room.

1) Emergency Vehicle Clearance

A 4-bit RF 433MHZ Transmitter Receiver is used for emergency vehicle clearance.Module dissociated as Transmitter and receiver. Transmitter acts as encoder and receiver acts as decoder.It utilizes zigbee technology and consists of microcontroller where transmitter is connected to emergency vehicles and receiver is connected to microcontroller at the junction.Whenever switch associated with Zigbee transmitter is pressed , it transmits the signal which contains unique id with security code through serial communication. Receiver utilizes zigbee technology and consists of microcontroller is connected to microcontroller at the junction.It receives the signal through serial communication and compares the security code with registered security code from databases. If flag is set then traffic signal dynamically turns on the green light for 30sec.

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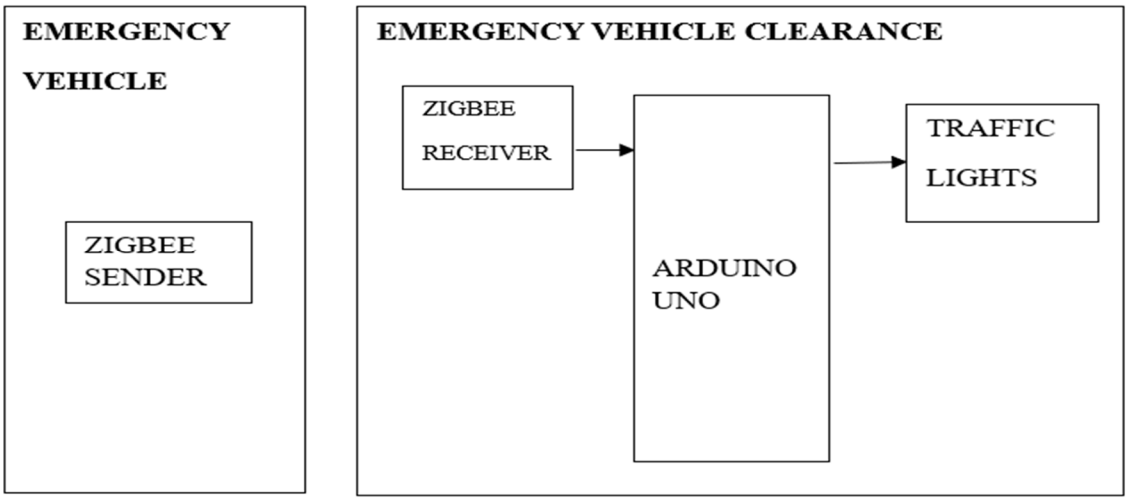

Fig 2. Block diagram for emergency vehicle clearance

2) Stolen Vehicle Detection

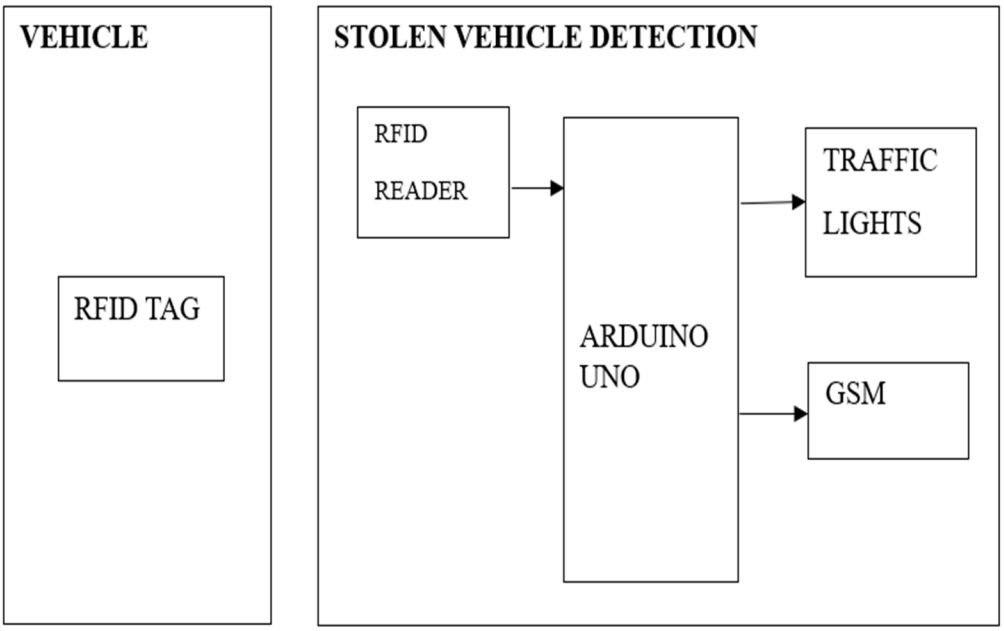

Fig 3.Block Diagram for stolen vehicle detection

RFID technology is utilized to detect theft vehicle. It consists of RFID tags, attacted to windshield of vehicle. RFID reader is used to read Rfid tag when it is brought in range. A fixed reader with frequency 125khz and range 20cm is used in project for testing purpose. When tag is brought into range, reader generates the electromagnetic field which gets transmitted to rfid tag. This causes electrons in tags moves across antenna to power the chip and sends the unique id associated with it to reader. Usually, every vehicle associated with rfid tag is read by the reader and it gets compared with the stolen databases. When the match is found it immediately blocks the traffic signals and sends sms to nearby police station and to registered user.

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IV. RESULTS

Here we have discussed about the present traffic system and providing green signals for the highly densed path comparing vehicles passing through the junctions to the regular timer using the RFID transmitter and receiver and by providing continuously green path for the ambulance and the traffic in the path of that ambulance is cleared.

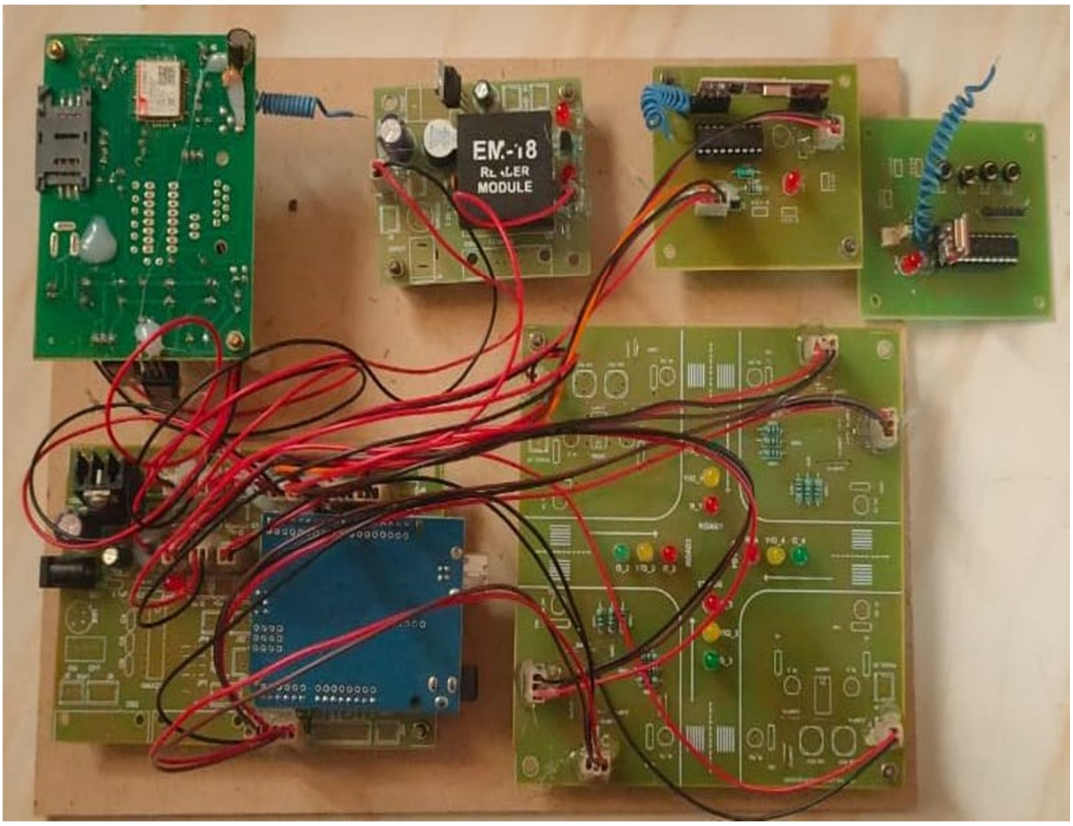

FIG 4:Overall Setup Of Our Project

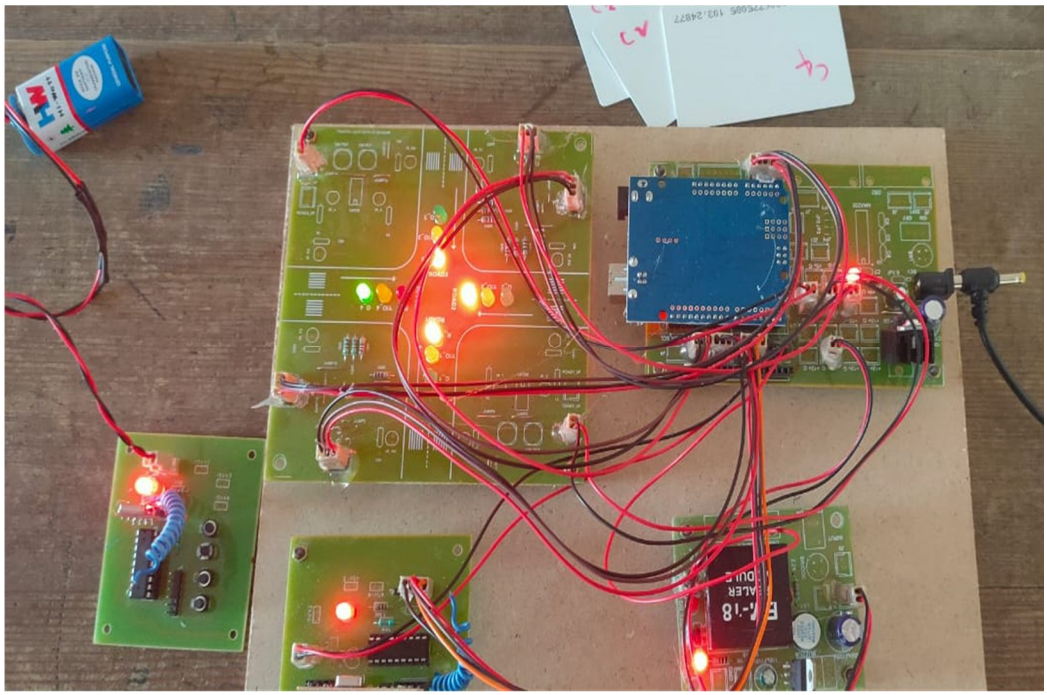

FIG 5: Emergency Vehicle Clearance

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The above fig 6 shows the emergency vehicle clearance depending upon RF 433 Mhz RF transmitter and receiver with Encoder & Decoder Boards, providing green signals for 30sec.

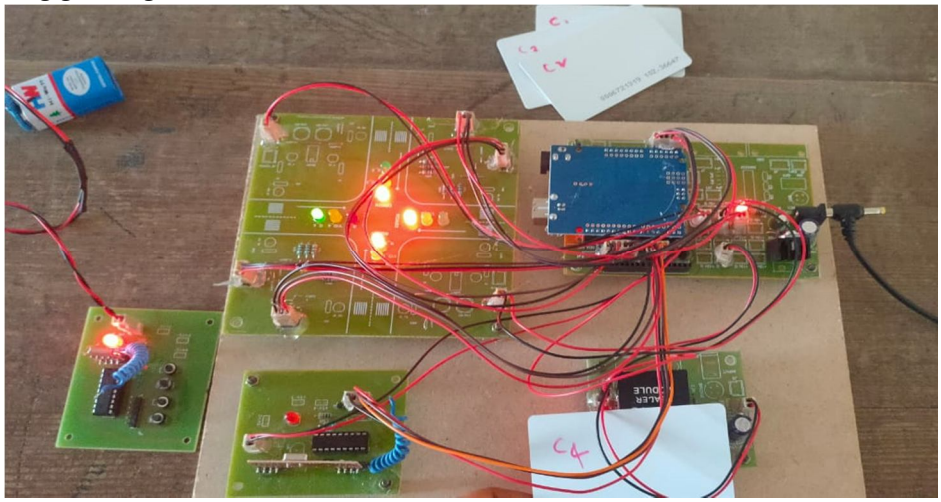

FIG 6:Stolen Vehicle Detected At Road 4

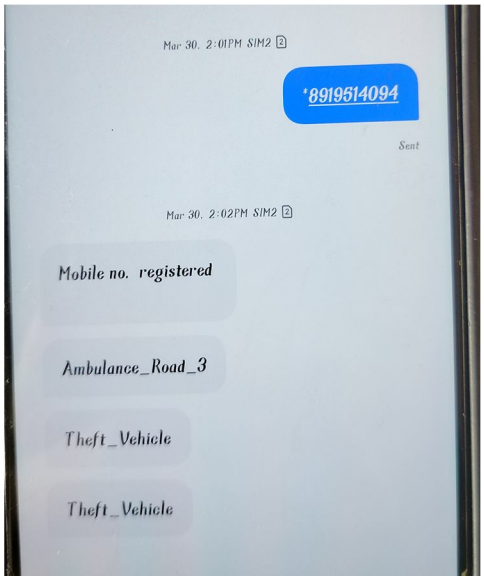

Fig 7: sms through gsm for stolen vehicle

A. Advantages

1) Reduced Traffic Congestion
2) Ambulance Clearance Priority
3) Real-time Monitoring and Control
4) Dynamic Adjustments
5) Reduced Emissions
6) Stolen Vehicle Detection

B. Applications

1) Urban Traffic Management
2) Smart Cities
3) Emergency Services Coordination
4) Public Safety and Accident Prevention
5) Transportation Planning and Policy

V. CONCLUSION

In conclusion, the Intelligent Traffic Control System is a proactive solution for addressing the complex challenges associated with urban traffic. Its continued development and integration with cutting-edge technologies will contribute to the creation of more sustainable, efficient, and livable cities in the years to come. With automatic traffic signal control based on the traffic density in the route, the manual effort on the part of the traffic policeman is saved. As the entire system is automated, it requires very less human intervention Emergency vehicles like ambulance, fire trucks, need to reach their destinations at the earliest. If they spend a lot of time in traffic jams, precious lives of many people may be in danger. With emergency vehicle clearance, the traffic signal turns to green as long as the emergency vehicle is waiting in the traffic junction. With stolen vehicle detection, the signal automatically turns to red, so that the police officer can take appropriate action, if he/she is present at the junction. Also SMS will be sent so that they can prepare to catch the stolen vehicle at the next possible junctions. The signal turns to red, only after the emergency vehicle passes through. The Intelligent Traffic Control System with congestion control, ambulance clearance, represents a significant step towards creating smarter and more efficient urban transportation systems. By leveraging advanced technologies such as artificial intelligence, machine learning, and real-time data analytics, the system addresses critical issues in traffic management, emergency response, and public safety.

VI. FUTURE ENHANCEMENT

The future scope of this system lies in its adaptability to emerging technologies and the evolving needs of urban environments. As technology continues to advance, integrating the system with autonomous vehicles, 5G communication, and environmental monitoring will further enhance its capabilities.

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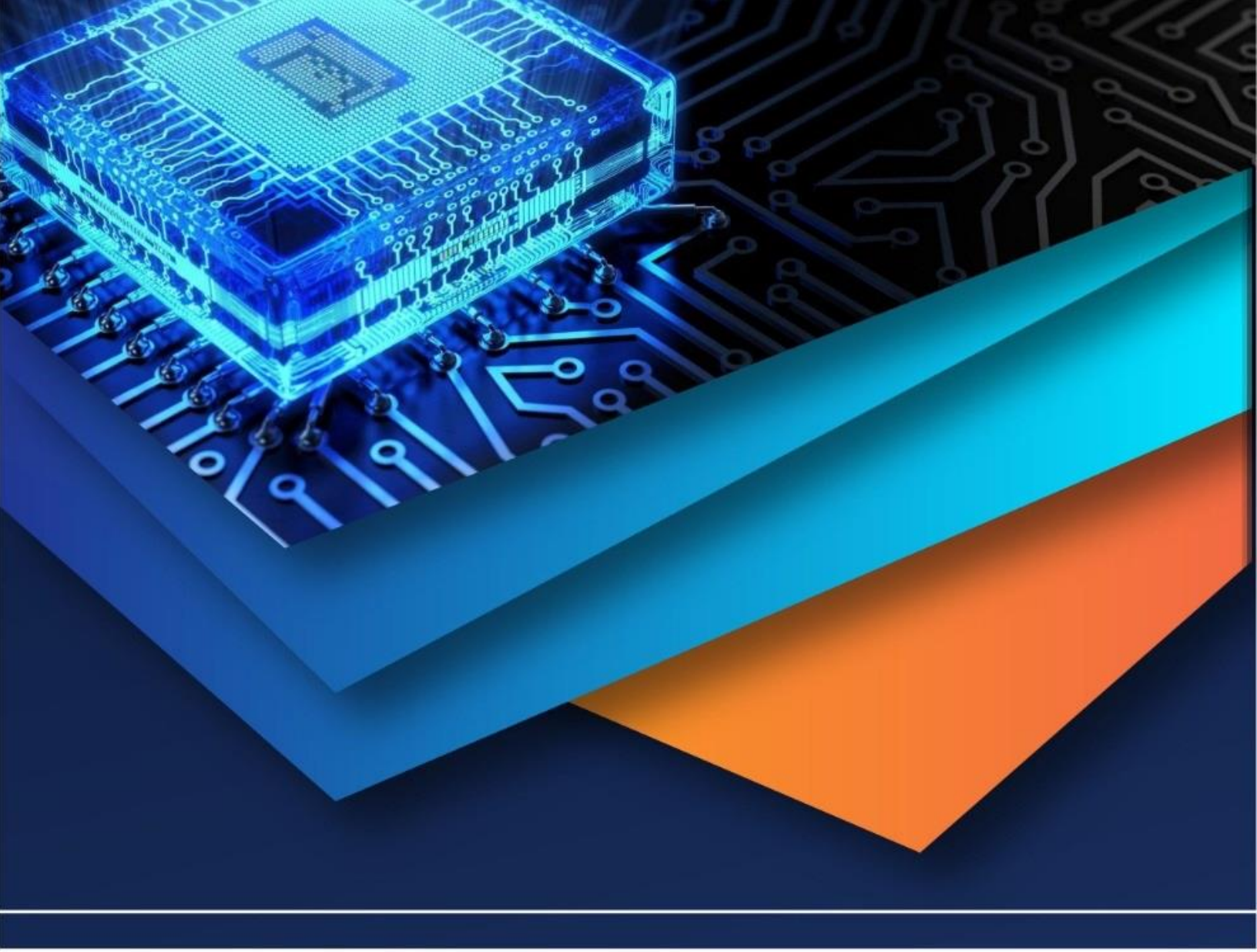

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