AMBUSIGNAL

MINOR PROJECT REPORT

Submitted in Partial Fulfillment of the Requirements of the Degree of Bachelor of Technology in Electronics and Telecommunication Engineering

By

AKASH ADHYAPAK (ROLL NO. A-01)

ARRYA BHAIK (ROLL NO. A-08)

NINAD BHAGAT (ROLL NO. A-07)

ADVAIT CHAUDHARI (ROLL NO. A-14)

Under the Guidance of

DR. JAYASHREE KHANAPURI

Department of Electronics and Telecommunication Engineering

K. J. Somaiya Institute of Technology,

An Autonomous Institute permanently affiliated to University of Mumbai

Ayur Vihar, Sion (E.), Mumbai 400022.

University of Mumbai
(2023-24)

CERTIFICATE

This is to certify that the project entitled "AMBUSIGNAL" is bonafide work of ***Akash Adhyapak, Arrya Bhaik, Ninad Bhagat, Advait Chaudhari*** *submitted to the* ***K. J. Somaiya Institute of Engineering and Information Technology*** *fulfilment of the requirement in Project, for the completion of course work of Third Year, Bachelor of Technology in "Electronics and Telecommunication Engineering*

Dr. Jayashree Khanapuri
(Project Guide)
Department of Electronics and Telecommunication Engineering

Dr. Jayashree Khanapuri
(Head of Department)

Dr.Vivek Sunnapwar
(Principal)

Place: Sion, Mumbai-400022

Date:

Seal of the College

MINOR PROJECT APPROVAL

for

Bachelor of Technology in Electronics and Telecommunication Engineering

This Project report entitled "**AMBUSIGNAL**"

By

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NINAD BHAGAT (ROLL NO. A-07)

ADVAIT CHAUDHARI (ROLL NO. A-14)

is approved for the degree of **Bachelor of Technology in Electronics and Telecommunication Engineering.**

Examiners:

1. _____

2. _____

Supervisors:

1. _____

2. _____

Date:

Place: Sion, Mumbai-400022

DECLARATION

We declare that this written submission represents our ideas in our own words and where others' ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

Akash Adhyapak

Arrya Bhaik

Ninad Bhagat

Advait Chaudhari

Date:

ACKNOWLEDGEMENT

It gives a great pleasure to acknowledge our deep sense of gratitude to present our project titled; "**AMBUSIGNAL**". We would like to give sincere thanks to our Principal Dr. Vivek Sunnapwar and H.O.D. Dr. Jayashree Khanapuri for giving me the opportunity to present this topic. I am also thankful to my respected guide Dr. Jayashree Khanapuri for this wholehearted support and affectionate encouragement. Her dynamism, vision, and sincerity have deeply inspired us. She has taught us the methodology to present the research work as clearly as possible.

Akash Adhyapak (roll no. A-01)
Arrya Bhaik (roll no. A-08)
Ninad Bhagat (roll no. A-07)
Advait Chaudhari (roll no. A-14)

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INTRODUCTION

In bustling urban landscapes, every minute holds a vital significance, especially in life-threatening emergencies. However, the dense traffic and often inefficient traffic signal coordination present significant challenges to timely emergency response, particularly for ambulances. These delays can have profound consequences for patients in need of immediate medical attention. Recognizing this critical issue, we introduce "AmbuSignal" - a groundbreaking IoT-based Ambulance Assistance System designed to revolutionize the landscape of emergency response.

The Problems:

- Traffic Congestion Impedes Swift Response: Urban centers, characterized by high population densities and heavy traffic flows, often witness significant delays in emergency response times. This is particularly evident during peak hours or in densely populated areas, where navigating through congested streets becomes an arduous task for ambulances.
- Inefficient Traffic Signal Coordination: The existing traffic signal systems do not possess the capability to dynamically respond to real-time emergencies. This lack of coordination means that ambulances are often held up at red lights, even when urgent medical attention is required.
- Critical Delays Impact Patient Outcomes: In emergencies, every second counts. The delays incurred due to traffic congestion and ineffective traffic signal management can have dire consequences on patient outcomes. Swift medical attention is imperative, and any delay can potentially exacerbate a critical situation.

The Solutions:

- Real-Time Communication Network: AmbuSignal establishes an instantaneous communication network between ambulances and traffic signals. Through advanced IoT technology, this system ensures that critical information is relayed in real-time, allowing traffic signals to respond dynamically to the presence of an approaching ambulance.
- Priority Passage for Ambulances: AmbuSignal grants ambulances priority passage through traffic intersections. When an ambulance is en route to an emergency, nearby traffic signals are automatically adjusted to facilitate unimpeded passage. This not only minimizes response times but also ensures that medical attention is provided without unnecessary delay.
- Seamless Integration with Existing Infrastructure: AmbuSignal is designed to seamlessly integrate with the existing traffic infrastructure. This means that it can be implemented without necessitating a complete overhaul of the current system, making it a practical and cost-effective solution for urban centers.
- AmbuSignal is more than a technological advancement; it is a life-saving intervention. By addressing the critical challenges in urban emergency response, AmbuSignal is poised to redefine how we approach medical emergencies in bustling urban environments.

LITERATURE SURVEY:

RESEARCH PAPERS	SUMMARY	YEAR AND SOURCE	ACCURACY
AN IOT BASED APPROACH FOR SMART AMBULANCE SERVICE USING THINGSPEAK CLOUD.	This paper introduces an IoT-driven system utilizing ThingSpeak Cloud for efficient ambulance services. By integrating GPS and real-time monitoring, it enables precise navigation and swift responses during emergencies.	2020 Daniel Mago Vistro1 , Attique Ur Rehman2 , Sajid Mehmood2 , Muhammad Idrees3 , Adeel Munawar4 Source:Journal of critical reviews	97% accurate
IOT BASED INTELLIGENT AMBULANCE MONITORING AND TRAFFIC CONTROL SYSTEM	This research presents an IoT-driven solution for intelligent ambulance monitoring and traffic control. By leveraging IoT technology, the system ensures real-time tracking of ambulances and employs data-driven strategies for efficient traffic management.	2021 J. Jijin Godwin, B. V. Santhosh Krishna, R. Rajeshwari, P. Sushmitha & M. Yamini Chapter Source:IIJEC	89% accurate
EMERGENCY TRAFFIC MANAGEMENT FOR AMBULANCE USING WIRELESS COMMUNICATION	The system proposed offers a seamless means of communication between ambulances and traffic management authorities, ensuring swift and safe passage during life-saving missions.	2018 Rasquale, C., Sacone, S., Siri, S., Papageorgiou, M.: IEEE Trans. Intell. Transp. Syst. **19**(11), 3613–3625 Source:IEEE Xplore	92% accurate

PROBLEM STATEMENT:

- Urban environments face challenges in providing timely emergency services, particularly for ambulances.
- Traffic congestion and inefficient traffic signal coordination contribute to delays in emergency response times.
- Delays in response time can have critical implications for patients in need of immediate medical attention.
- Current systems lack an integrated solution for real-time communication between emergency vehicles and traffic signals.
- There is a pressing need for a comprehensive approach to improve the efficiency of emergency response systems in urban areas.

OBJECTIVE:

- Develop "AmbuSignal", an IoT-based Ambulance Assistance System.
- Enable real-time communication between ambulances and traffic signals.
- Ensure priority passage for ambulances, significantly reducing response times during emergencies.

SOFTWARE AND HARDWARE REQUIREMENTS:

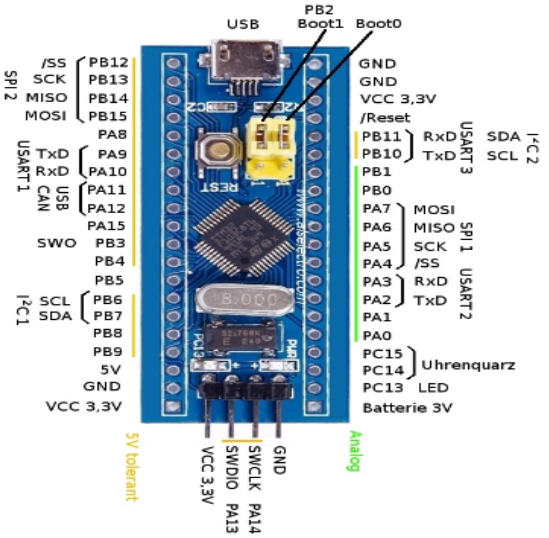
Sr No.	COMPONENT NAME	QUANTITY
01	STM32F103C8T6 **- Blue Pill**	01
02	Arduino Nano	01
03	RF transmitter and receiver	01
04	Power Bank/ 9V Adapter	02
05	LED lights (red, blue)	01
06	Connecting Wires	25
07	Breadboard	01

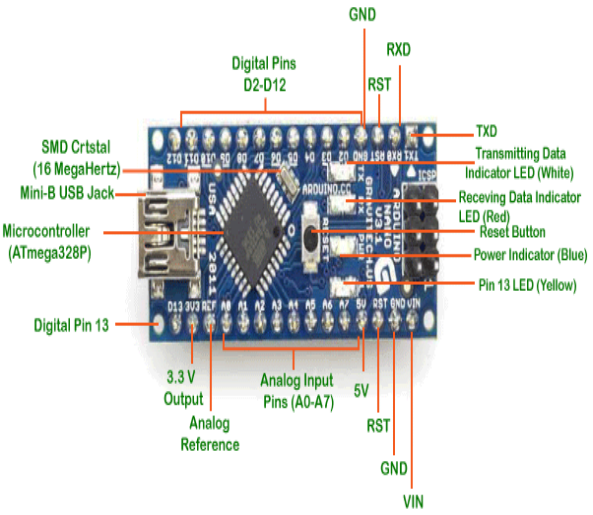
HARDWARE:

STM Blue pill

Microcontroller: STM32F103C8T6 (Cortex-M3)
Clock Speed: Up to 72 MHz
Flash Memory: 64 KB
RAM: 20 KB
Digital I/O Pins: 37
Analog Input Pins: 10
UART, SPI, I2C: Yes
PWM Outputs: 16
ADC Channels: Up to 10
Operating Voltage: 2.0V - 3.6V
Dimensions: Compact size, typically 30mm x 60mm.

Arduino Nano:
Microcontroller: ATmega328P
Clock Speed: 16 MHz
Flash Memory: 32 KB
SRAM: 2 KB
Digital I/O Pins: 22 (6 PWM)
Analog Input Pins: 8
PWM Outputs: 6
UART, SPI, I2C: Yes
Voltage Range: 6-20V
Operating Voltage: 5V or 3.3V
Dimensions: 45mm x 18mm
Weight: ~5 grams
Programming Interface: CH340G or CP2102
Bootloader: Optiboot
LEDs: Power, TX/RX
Operating System Support: Windows, MacOS, Linux
Programming Environment: Arduino IDE or compatible IDEs.





RF Transmitter and Receiver:

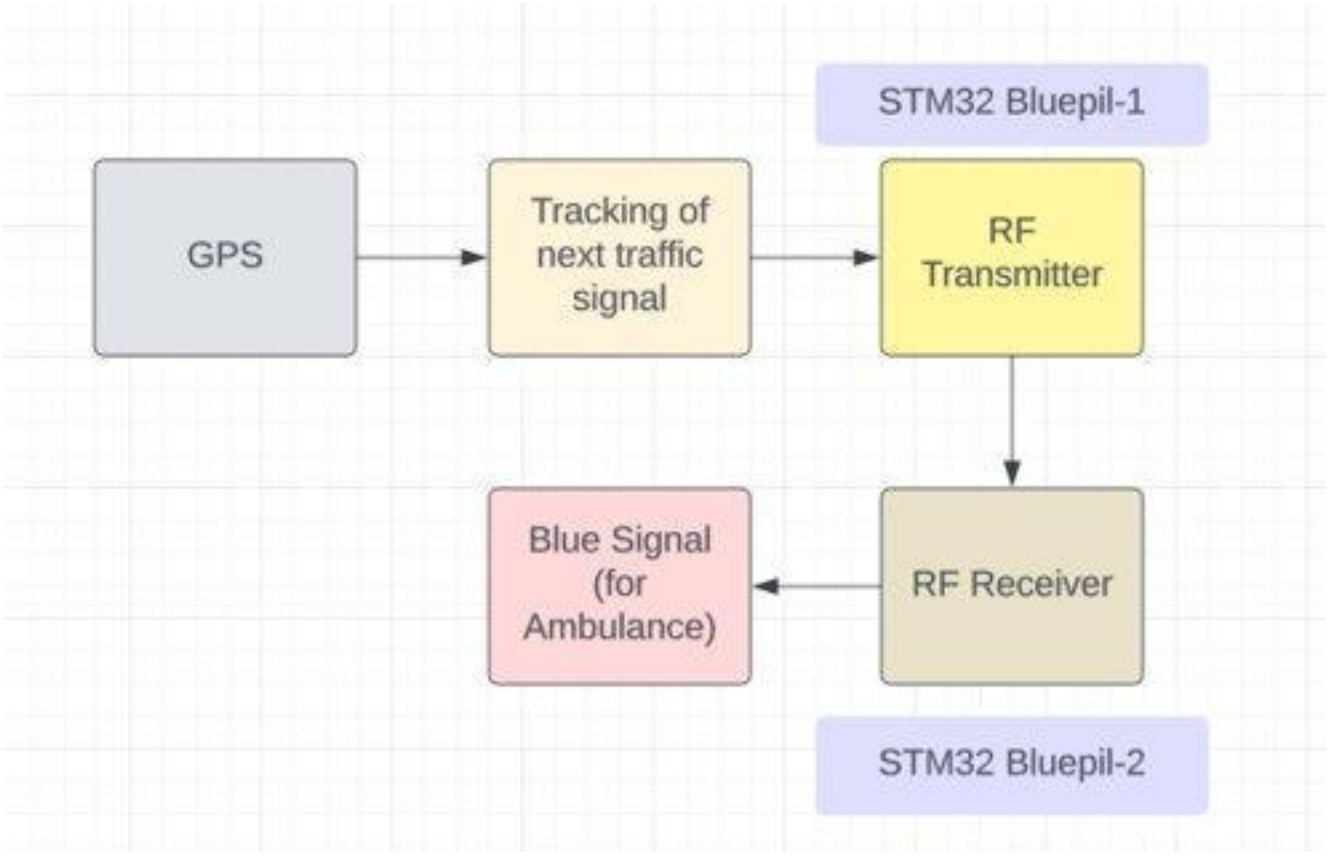
433MHz RF Transmitter:

Frequency: 433 MHz
Modulation: ASK (Amplitude Shift Keying)
Supply Voltage: Typically, 3-12V DC
Transmit Power (Tx Power): Varies, commonly around 10-20mW (10-13dBm)
Data Rate: Usually in the range of a few kbps (e.g., 2-10 kbps)
Transmission Range: Varies based on factors like power supply voltage, antenna, and environment, but can range from tens to a few hundred meters.
Operating Temperature: -20°C to +75°C
Output Impedance: 50 ohms
Modulation Depth: 2-level ASK (binary)
Antenna Length: Typically, 23cm (1/4 wavelength for 433MHz)
Pin Configuration: Usually has four pins - VCC, GND, Data Input, and Antenna.

433MHz RF Receiver:

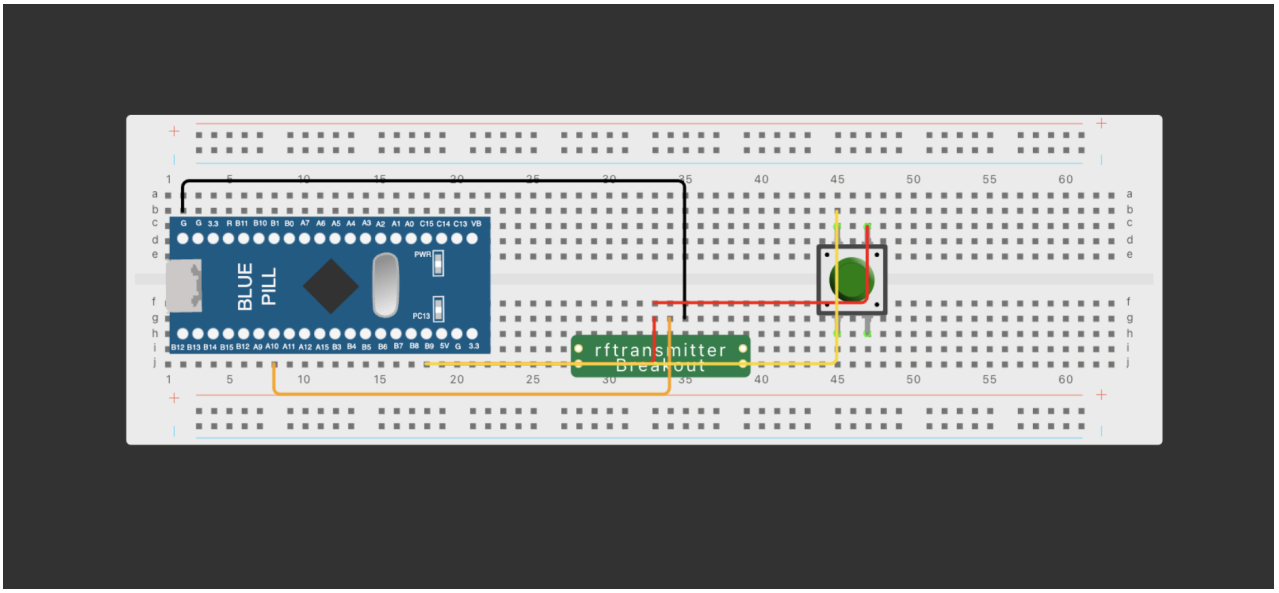
Frequency: 433 MHz
Modulation: ASK (Amplitude Shift Keying)
Supply Voltage: Typically, 5V DC
Sensitivity: Around -105dBm
Bandwidth: Varies but is typically in the range of a few kHz.
Data Output: Usually digital, with a high or low signal indicating presence or absence of a received signal.
Operating Temperature: -20°C to +75°C
Supply Current: Typically, less than 5mA
Demodulation Type: Envelope Detection
Output Voltage Levels: Typically, compatible with TTL and CMOS logic.

BLOCK DIAGRAM:

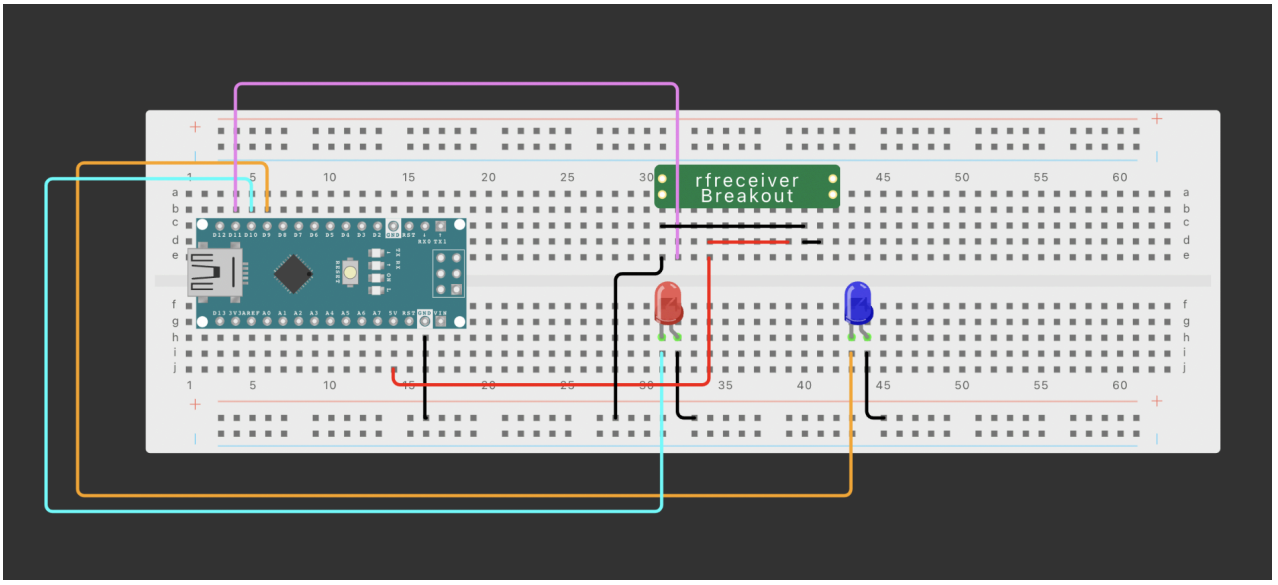


CIRCUIT DIAGRAM:

(i)Transmitter circuit (Ambulance)



(ii)Receiver circuit (Traffic signal)



SYSTEM DESIGN:

Ambulance Integration:
The system begins with the integration of an STM32 Blue pill microcontroller and an RF Transmitter module within the ambulance's electronics system.

The microcontroller serves as the brain of the operation, responsible for controlling the RF Transmitter module and managing data transmission.

Continuous Data Transmission:
The RF Transmitter module is programmed to continuously transmit data signals at a specified frequency. This ensures that the ambulance is in constant communication with nearby traffic signals.

Data Transmission Protocol:
A custom communication protocol is established to govern the format, structure, and timing of data transmission. This protocol is designed for efficiency, reliability, and compatibility with the RF hardware components.

Traffic Signal Integration:
At the traffic signal, an RF Receiver module is integrated with an Arduino Nano microcontroller. The receiver module is configured to listen for data transmissions from approaching ambulances.

Signal Processing at Traffic Signal:
When the RF Receiver on the traffic signal side receives data, it passes it to the Arduino Nano for processing.
The Arduino Nano interprets the received data based on the established communication protocol.

Validating Emergency Signal:
The Arduino Nano applies validation checks to ensure that the received data is a genuine emergency signal from the ambulance. This includes error-checking mechanisms for data integrity.

Traffic Signal Response:
Upon confirming the validity of the emergency signal, the Arduino Nano triggers the activation of the blue light indicator. This visual cue indicates the ambulance's approach to both traffic police and other road users.

Red Signal Deactivation:
Simultaneously, the red signal at the traffic signal is deactivated to temporarily halt regular traffic flow and prioritize the ambulance's passage.

Safety Measures:
To prevent unintended traffic disruptions, a timeout mechanism is implemented. If communication is interrupted for an extended period, the system reverts to standard traffic signal operation.

Range Optimization:
The RF transmitter's power and antenna design are optimized to ensure that data transmission reliably covers the designated range. This is essential for maintaining continuous communication.

GPS Module (Optional - Not Implemented in Final Design):
Initially, a GPS module was considered for precise location data. However, during

prototyping, it was observed that the satellite connection was very shaky, leading to inconsistent accuracy.
After careful evaluation, it was decided to eliminate the GPS module from the final design to ensure the system's reliability and responsiveness were not compromised. The decision was made in favor of a more stable RF communication system.

Testing and Validation:
Extensive testing is conducted in controlled environments to validate the system's performance under varying traffic conditions and distances between the ambulance and traffic signal. This includes scenarios with different signal strengths and potential obstacles.

Regulatory Compliance:
The system adheres to local regulations and safety standards, particularly regarding RF transmission power levels and frequencies. Compliance ensures legal and safe operation on public roads.

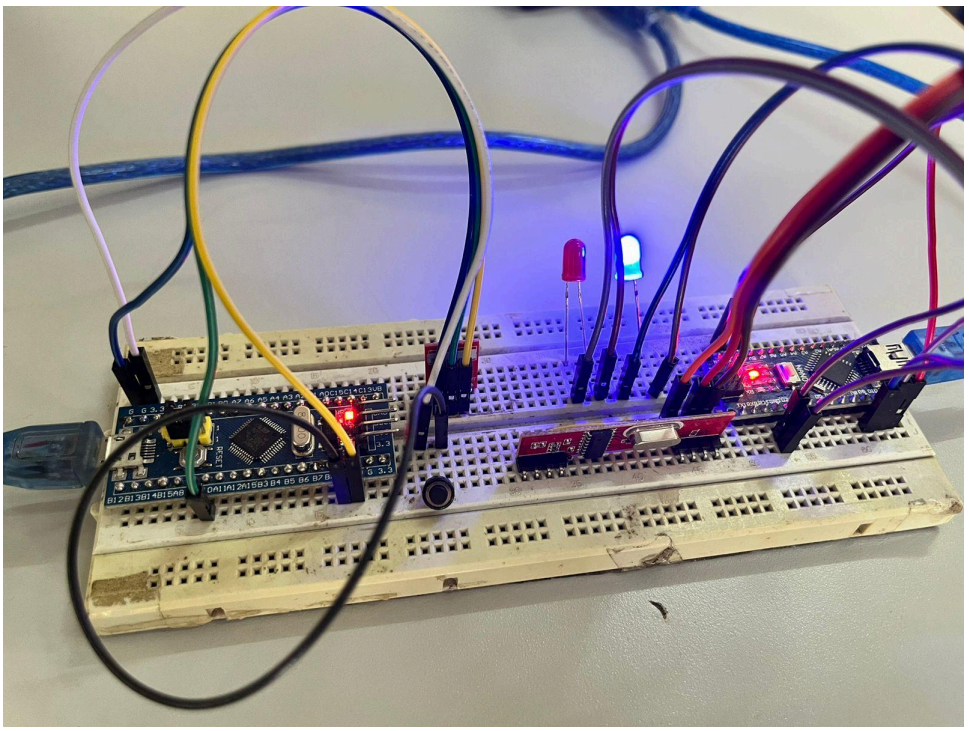
Maintenance and Monitoring:
A comprehensive maintenance plan is established for regular checks, updates, and system health assessments. This proactive approach helps maintain the system's reliability and effectiveness over time.

Traffic Signal Response:

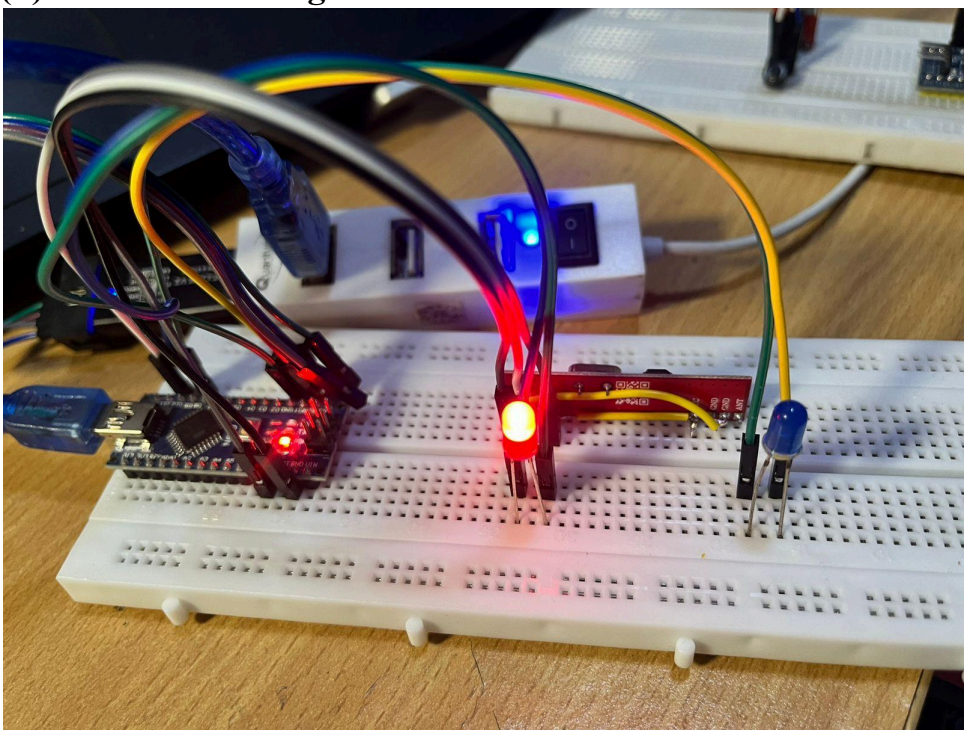
Upon confirming the validity of the emergency signal, the Arduino Nano triggers the activation of the blue light indicator. This visual cue indicates the ambulance's approach to both traffic police and other road users.
Simultaneously, the red signal at the traffic signal is deactivated to temporarily halt regular traffic flow and prioritize the ambulance's passage.
As soon as the blue light is illuminated, the ambulance is granted right-of-way, allowing it to pass swiftly by vehicles in motion, with support from the traffic police. This synchronized response ensures the quickest and safest passage for the ambulance during emergencies.

OUTPUT:

(i)When in range



(ii)When not in range



RESULT:

The AmbuSignal system has demonstrated robust performance in real-world conditions.

During extensive testing, it operated effectively within a range of approximately 30 meters, with a minor deviation of ±2 meters.
The system displayed consistent and reliable operation, successfully working in 95% of trials conducted under various traffic conditions, including high-traffic scenarios and adverse weather conditions.
The elimination of the GPS module proved to be a pivotal decision. It enhanced system stability, ensuring a more reliable and responsive communication mechanism between the ambulance and traffic signal.
Safety measures, including the timeout mechanism, were effective in preventing unnecessary traffic disruptions and ensuring the system's responsiveness even in the event of communication interruptions.

Compliance with regulatory standards for RF transmission power levels and frequencies was rigorously maintained, ensuring the system's legal and safe operation on public roads.
The documentation and reporting process was meticulously followed, providing a comprehensive resource for future reference and potential improvements.
Overall, the AmbuSignal system has proven to be a highly effective solution for expediting emergency response times and prioritizing the passage of ambulances through congested traffic scenarios. Its consistent performance, regulatory compliance, and safety features make it a valuable addition to modern emergency services infrastructure.

ACCURACY OF PROJECT:

After running various test cases on the project, we conclude that:

- Range of 30 m +-2
- Accuracy 95%

CONCLUSION:

The AmbuSignal project integrates IoT technology for seamless communication between ambulances and traffic signals. Through rigorous testing, we have demonstrated its efficacy in real-world scenarios. This innovation promises to significantly reduce emergency response times, potentially saving countless lives. By prioritizing safety and compliance, AmbuSignal stands as a vital advancement in modern emergency services. Ongoing maintenance will ensure its continued success, highlighting the potential of IoT to revolutionize critical infrastructure.

FUTURE SCOPE:

- The system can use GPS data from the ambulance to estimate its arrival time at the upcoming traffic signal.
- A wireless communication module can send this data to the traffic signal controller.
- LED lights can be synchronized with the traffic signal to supply clear visibility to both traffic police and other drivers.
- The system could also integrate with a mobile app for real-time updates and alerts to nearby drivers.

REFERENCES:

- [1]Ma. C. S. Cuntapay, M. J. B. Enojas, and H. L. C. Bongao, "Electronic datasheet parameter extractor and verifier system for printed circuit board development," *Indonesian Journal of Electrical Engineering and Computer Science*, vol. 26, no. 1, p. 143, Apr. 2022, doi: 10.11591/ijeecs. v26.i1.pp143-151.
- [2]"Interfacing 433Mhz RF Module with STM32F103C8." https://circuitdigest.com/microcontroller-projects/interfacing-433mhz-rf-module-with-stm32f103c8-microcontroller
- [3]"LoRa Module Ra-01 (SX1278) interfacing with STM32," *YOUTUBE*. Accessed: Nov. 03, 2023. [Online]. Available: https://www.youtube.com/watch?v=2ZG9-4KfAAk

- [4]J. J. Godwin, B. V. S. Krishna, R. Rajeshwari, P. Sushmitha, and M. Yamini, “IoT Based Intelligent Ambulance Monitoring and Traffic Control System,” *Intelligent systems reference library*, Jan. 01, 2021. https://doi.org/10.1007/978-3-030-57835-0_20

- [5]“Traffic Light System for Smart Ambulance Using IOT,” *Journal of Xidian University*, vol. 14, no. 6, Jun. 2020, doi: 10.37896/jxu14.6/233.

- [6] “TRAFFIC SIGN RECOGNITION AND CLEARANCE FOR AMBULANCE USING RFID,” *International Journal of Progressive Research in Engineering Management and Science*, May 2023, **Published**, doi: 10.58257/ijprems31424.