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Efficient Intelligent Smart Ambulance Transportation System using Internet of Things

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Abstract: This research is significant, as traffic jam has become the main challenge in current metropolitan cities. Both in developed and developing nations, it is a concern for an ambulance to carry an emergency patient. Despite the fact, ambulance receives special traffic protocols, it is still challenging that the ambulance reaches the hospital on time. In the context of a smart city, this proposal suggests a smart ambulance management system. If the patient needs an ambulance, the operator finds the nearest emergency vehicle and points it in the patient's direction. The programme dynamically tracks the positions of the ambulances to determine the quickest path to the injured person using maps provided by Google as an external service. Here we are tracking the ambulance with an IR transmitter and the road nearby speed breaker will have IR Receiver. Arduino Node MCU sends the alert message through the Internet of Things (IoT) and Global Positioning System (GPS). Then the necessary action can be taken after conforming to the location at a time. If an ambulance is on a nearby speed breaker, then it will turn automatically to the bottom and the even space will come up. It will give the chance for no need to reduce the speed of ambulance. During system analysis and experimentation, the system's efficiency, and dependability can be enhanced as well as a significant reduction in healthcare costs, a reduction in the number of intermediaries and timely and efficient service, and the avoidance of wasting time. This paper is to examine different IoT techniques for movement control and the different approaches to assist the emergency vehicle to reach nearby healing facility on time. The main focus is on finding the best techniques to reduce the traffic congestion.

Keywords: global positioning system; internet of things; node MCU; sensors; traffic lights

1 INTRODUCTION

There are various application areas of IoT, including health care. Medical science has been proven helpful to the mankind. Medical science gives cures and protects humans against different problems. The diseases like cardiac arrest, cancer, which was considered incurable earlier, can be cured today due to advancement in technologies. Technologies, particularly IoT, have done a lot in the area of medical science. Internet of things (IoT) is defined as connection between various objects and devices which can be utilized to send or receive data. It serves as a bridge between devices sensors and data networks. Accidents are caused by a lack of modern technologies in automobiles and the resources needed to operate these vehicles, such as poor roads. Especially people in the older age group are the victims, and moreover, the traffic conditions are worsening day by day, which results in traffic jams. Many important jobs get delayed due to these traffic jams. Ambulance service is one of the major services which get affected by traffic jams. The IoT-based ambulance speed breaker rolling system is a technological solution designed to ensure the safety of patients being transported in an ambulance [1-3]. The system uses Internet of Things (IoT) technology to detect and communicate with traffic signals and speed breakers on the road, and automatically adjust the speed of the ambulance accordingly to avoid any sudden jerks or impacts that could harm the patient. The system includes sensors that detect speed breakers and transmit the information to the ambulance's onboard computer. The computer then analyzes the data and instructs the ambulance to slow down or speed up accordingly to ensure a smooth ride for the patient. This system has the potential to significantly reduce the number of accidents that occur during ambulance transport, especially in areas where speed breakers are installed without proper warning signs. By ensuring the safety of the patient during transportation, the IoT-based ambulance speed breaker rolling system could improve the overall quality of healthcare services and save countless lives. The IoT-based ambulance speed breaker rolling system also includes a display screen that provides real-time information to the ambulance driver. This display shows the location of speed breakers and traffic signals, as well as the recommended speed for the ambulance to travel [4-6]. Overall, the IoT-based ambulance speed breaker rolling system is a powerful technological solution that has the potential to significantly improve the safety of patients during ambulance transportation. By reducing the risk of accidents and minimizing the impact of rough road conditions, this system could help to save countless lives and improve the overall quality of healthcare services [7-8]. Fig. 1 shows the allocation of ambulances to the place of demand.

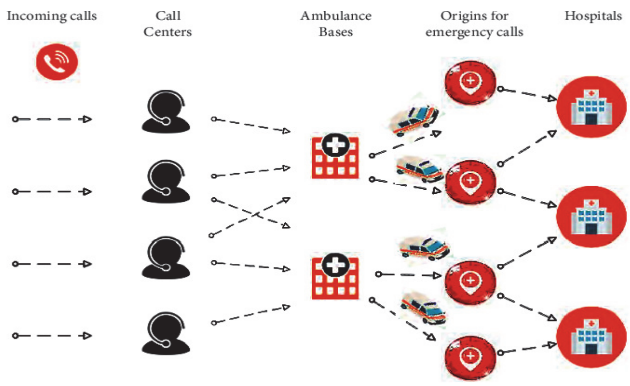

Figure 1 Intelligent transportation system

There are numerous significant accidents caused by the intersections of public and emergency vehicles. Most often, the traffic makes it difficult for the ambulances to arrive at their location on time. Additionally, when rescue vehicles had to wait for clearance from other vehicles at traffic signals, the situation grew worse. Due to the significant time delay, an emergency situation may be significantly impacted. At crossings where emergency vehicles had to cross red traffic lights, there is also a possibility of crashes with other moving cars coming from the opposite way. This radio frequency-based traffic light management system can avoid the challenges experienced by emergency vehicles [9].

2 RELATED WORK

An IoT-based ambulance speed breaker rolling system for patient safety is a system that is designed to slow down the speed of ambulances and other emergency vehicles when they are near hospitals, clinics, or other medical facilities. The system uses sensors and IoT technology to detect the presence of an ambulance and activate speed breakers or humps in the road to slow down the vehicle, ensuring patient safety. In this literature review, we will explore some of the related works on IoT-based ambulance speed breaker rolling systems for patient safety [12]. This research proposes an IoT-based smart ambulance system that includes a traffic management system for emergency vehicles. The system uses sensors to detect the presence of an ambulance and sends a signal to the traffic lights to change to green, allowing the ambulance to pass through. The research also suggests using speed breakers and humps to slow down the speed of the ambulance near medical facilities. This research proposes an IoT-based traffic management system for ambulances in smart cities. The system uses sensors and communication networks to detect the presence of an ambulance and control traffic signals to allow the ambulance to pass through. The research also suggests using speed breakers and humps to slow down the speed of the ambulance near medical facilities. This research proposes an IoT-based intelligent ambulance system that includes a traffic management system and an ambulance speed breaker rolling system. The system uses sensors and communication networks to detect the presence of an ambulance and control traffic signals to allow the ambulance to pass through. The research also suggests using speed breakers and humps to slow down the speed of the ambulance near medical facilities [13]. This research proposes an IoT-based intelligent transportation system for ambulances. The system uses sensors and communication networks to detect the presence of an ambulance and control traffic signals to allow the ambulance to pass through. The research also suggests using speed breakers and humps to slow down the speed of the ambulance near medical facilities. Design and development of ambulance siren alert system using IoT proposed a IoT-based system that alerts other vehicles on the road when an ambulance approaches, thereby reducing the risk of accidents during emergency transportation [14]. The existing system for the IoT-based ambulance speed-breaker rolling system for patient safety is primarily based on traditional speed-breaker design and traffic management systems. In most cases, speed-breakers are built on roads to control the speed of vehicles and reduce the risk of accidents in the area. However, the traditional speed-breaker design can be uncomfortable for ambulance patients and can worsen their medical condition during transportation. Moreover, traffic management systems such as traffic lights are not optimized for emergency situations, and ambulance drivers may have to wait for extended periods, delaying medical care for patients. To address these challenges, the proposed IoT-based ambulance speed-breaker rolling system aims to provide a smooth and safe ride for the patient while ensuring quick and efficient transportation to the hospital. The system uses various sensors, modules, and microcontrollers to monitor the patient's vital signs, control the speed-breaker mechanism, and manage traffic flow. The study by Amini et al. [15] investigated the impact of vehicle speed on specific driving behaviours in vehicles that were both human-driven and linked (operated in an Internet of Vehicle environment). It was also investigated how vehicle speed changes due to approaching intersections, rapid braking by leading vehicles, and different phase timings. The result shows how strongly a leading vehicle's change in speed affects the trailing vehicle. To shorten the time it takes to cross an intersection, the authors of [16] proposed a signal control setting that would provide vehicles in an intersection a split queue. This approach needs numerous phases at a junction to be effective. However, EVs entering junctions with a quicker average travel speed have not been considered in any prior study. Knowing where you are when an emergency occurs is another essential component of responding to it. Through real-time incident monitoring using a drone (UAV), which includes ultrasound, RF signals, and GPS tracking, obstacles are found in [17]. In an Intelligent Video Sensor (IVS), video transmission, picture processing, and sensing are all combined. It is suggested in [18] to use such embedded systems to acquire streaming video, compute data pertaining to high-level traffic metrics, and relay the live video feed and computed traffic statistics to a base station. Traffic metrics such as vehicle flow, average vehicle speed, obstruction detection, and deadlock are identified in this work. According to Li [19], UAVs may be fitted with two sets of LiDAR, each of which is capable of measuring the speed of moving cars in a single lane. As a result, both sets may be combined to assess the speed of moving vehicles in multiple lanes. This method's accuracy was estimated to be between 94 and 100%. According to Apeltauer et al. [20], UAV-mounted cameras might be used to record video from intersections, which could then be analysed using classifiers. Ke et al. [21] introduced a four-step method that combines the Kanade-Lucas-Tomasi (KLT) tracker, k-means clustering, connected graphs, and traffic flow theory to estimate real-time traffic flow parameters from aerial recordings. UAVs are currently used to monitor pedestrian activity as well. A recent intriguing initiative proposed the use of drones to monitor urban areas for incident detection and traffic parameter assessment to help determine a route for emergency vehicles. None of the prior works utilised drones as lead vehicles for EVs in order to limit their speed loss when crossing a junction and to increase the safety of other road users by informing them about impending EVs. Additionally, the system includes emergency messaging features, such as GSM modules, to send critical patient information to the hospital or emergency services in case of any emergency situations. Overall, the existing system for the IoT-based ambulance speed-breaker rolling system is limited to traditional speed-breaker designs and traffic management systems that are not optimized for emergency situations. The speed breaker allows the emergency vehicle to slow down, but this ground-breaking flat speed breaker device saves human lives by flattening the speed breaker. It is easier and more convenient to transport emergency vehicles. This technique will be employed in most emergency situations where emergency vehicles must respond quickly. A IoT-based traffic signal control system for supporting emergency vehicles is introduced for improved traffic monitoring of emergency vehicles. This system allows emergency responders to transmit a warning about the arrival to a traffic signal controller stationed at a traffic intersection where two or more lanes cross, allowing traffic to be controlled accordingly. In this process, the user in the ambulance travels with an Android phone that has the app installed on it. The messages are sent to the GSM module through SMS, which is accessible on the users' mobile phones. There is a limitation in this system, there may be cellular network problems in any place or the SMS module may be run out of service at any time or if any message delay may fail the system. The proposed system aims to use modern technology to address these limitations and provide a more comfortable and safer ride for the patient while ensuring efficient transportation to the hospital.

3 PROPOSED SYSTEM

3.1 General Architecture

In this research, the intelligent traffic management system has been considered using a map. It predefines the ambulance route and the traffic light on the route and the status of the light (green or red) on the map. In this system, there is a control center that detects the current location of the ambulance and sends a command to the traffic light to turn the light green, or the light will continue in its current state. The goal is for the ambulance not to get in its way due to a red light. The system consists of two main components, a transmitter, and a receiver. The transmitter is located in the ambulance, and the receiver is placed at the medical facility or hospital. The transmitter and receiver communicate wirelessly using RF signals.The transmitter includes a pulse sensor, patient safety IC, and temperature sensor to monitor the patient's vital signs. These sensors generate analog signals, which are converted to digital signals using an analog-to-digital converter (ADC) on the Node MCU transmitter. The Node MCU transmitter also includes a GSM module for sending data to a central server or receiving commands from a server. It also includes an RF transmitter for sending signals to the RF receiver on the other side. The Node MCU transmitter collects and transmits the patient data and ambulance status to a central server or monitoring system, which can then trigger the traffic lights and DC motor when the ambulance approaches a medical facility. The receiver includes an RF receiver that receives the signal sent by the RF transmitter on the other side. The RF receiver forwards the signal to the Node MCU receiver, which triggers the traffic lights and DC motor based on the signal received from the transmitter. The traffic lights and DC motor are connected to the Node MCU receiver, which controls their operation based on the signals received from the transmitter. The Node MCU receiver is also responsible for monitoring the traffic lights and DC motor to ensure that they are functioning properly and to alert the central server or monitoring system if there is a problem. The receiver can also send a confirmation signal back to the transmitter to acknowledge the successful operation of the system. The traffic lights and DC motor are controlled by the Node MCU receiver based on the signals received from the transmitter. When the ambulance approaches a medical facility or hospital, the central server or monitoring system sends a signal to the transmitter to trigger the system. The transmitter sends the signal to the receiver, which triggers the traffic lights and DC motor to stop the traffic and lower the speed breaker. This allows the ambulance to pass safely without any delay. Once the ambulance has passed, the traffic lights and speed breaker are raised again, and the traffic is allowed to resume its normal flow. Overall, the system design ensures the safety of patients and reduces the response time for emergency medical services by allowing the ambulance to pass safely and quickly through busy intersections. The system also ensures that the traffic lights and speed breaker are controlled automatically, reducing the risk of human error and increasing the efficiency of the system. The IoT based wireless Sensor network (WSN) is a revolutionary system for smart monitoring. This article proposes a system to demonstrate the progress and implementation of WSN-based communication systems for smart monitoring and automated control in the dynamic traffic management system. The system includes a pulse sensor, patient safety IC, and temperature sensor to monitor the patient's vital signs. These sensors generate analog signals, which are converted to digital signals using an analog-to-digital converter (ADC) on the Node MCU transmitter. The Node MCU transmitter includes a GSM module for sending data to a server or receiving commands from a server. It also includes an RF transmitter for sending signals to the speed breakers or humps on the road. The patient data and ambulance status are collected and transmitted by the Node MCU transmitter to a central server or monitoring system, which can then trigger the speed breakers or humps when the ambulance approaches a medical facility. The system includes a pulse sensor, patient safety IC, and temperature sensor to monitor the patient's vital signs. These sensors generate analog signals, which are converted to digital signals using an analog-to-digital converter (ADC) on the Node MCU transmitter. The Node MCU transmitter includes a GSM module for sending data to a server or receiving commands from a server. It also includes a RF transmitter for sending signals to the RF receiver on the other side. The patient data and ambulance status are collected and transmitted by the Node MCU transmitter to a central server or monitoring system, which can then trigger the traffic lights and DC motor when the ambulance approaches a medical facility. The RF receiver on the other side receives the signal sent by the RF transmitter and forwards it to the Node MCU receiver. The Node MCU receiver then triggers the traffic lights and DC motor based on the signal received from the transmitter. Fig. 2 and Fig. 3 show the transmitter and receiver of the proposed system respectively.

The transmitter includes a pulse sensor, patient safety IC, and temperature sensor to monitor the patient's vital signs. These sensors generate analog signals, which are converted to digital signals using an analog-to-digital converter (ADC) on the Node MCU transmitter. The Node MCU transmitter also includes a GSM module for sending data to a central server or receiving commands from a server. It also includes a RF transmitter for sending signals to the RF receiver on the other side. The Node MCU transmitter collects and transmits the patient data and ambulance status to a central server or monitoring system, which can then trigger the traffic lights and DC motor when the ambulance approaches a medical facility. The pulse sensor is used to monitor the heart rate of the patient during ambulance transport. The sensor detects the pulse rate and sends the data to the Node MCU microcontroller for processing. The Node MCU can then transmit the pulse rate data to the receiving end through the RF transmitter. The temperature sensor is used to monitor the body temperature of the patient during ambulance transport.

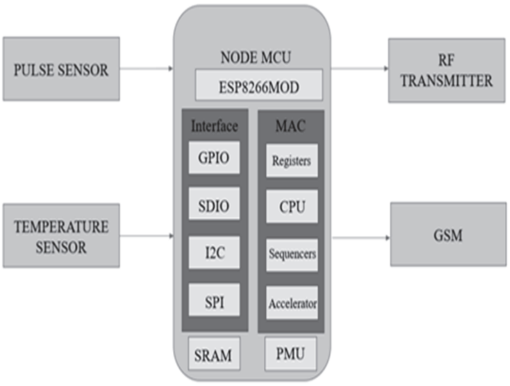

Figure 2 Block diagram of transmitter

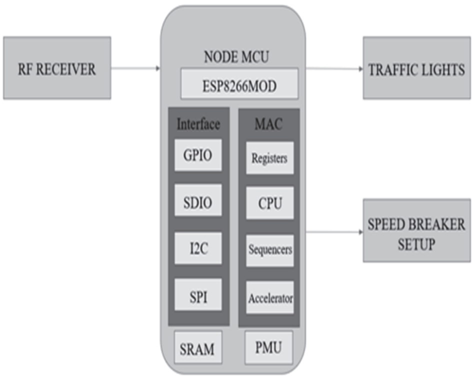

Figure 3 Block diagram of receiver

The sensor detects the temperature and sends the data to the Node MCU microcontroller for processing. The Node MCU can then transmit the temperature data to the receiving end through the RF transmitter. The GSM module is used to send emergency messages to the hospital or emergency services in case of any critical situation during ambulance transport. The module is connected to the Node MCU microcontroller and can be activated through a push button or automated trigger. The module sends an SMS or call to the designated emergency number, with the patient's vital information and ambulance location. The RF transmitter is used to transmit the patient's pulse rate and temperature data to the receiving end. The transmitter is connected to the Node MCU microcontroller and can be activated through a push button or automated trigger. The transmitter sends the data over a short-range RF signal, which can be received by the receiver module at the hospital or emergency services. The Node MCU microcontroller acts as the central control unit for the system. The microcontroller receives data from the pulse and temperature sensors and processes it to transmit over the RF transmitter. The microcontroller also activates the GSM module in case of any emergency situation and sends a message to the designated number. The receiver includes a RF receiver that receives the signal sent by the RF transmitter on the other side. The RF receiver forwards the signal to the Node MCU receiver, which triggers the traffic lights and DC motor based on the signal received from the transmitter. The traffic lights and DC motor are connected to the Node MCU receiver, which controls their operation based on the signals received from the transmitter. The Node MCU receiver is also responsible for monitoring the traffic lights and DC motor to ensure that they are functioning properly and to alert the central server or monitoring system if there is a problem. The receiver can also send a confirmation signal back to the transmitter to acknowledge the successful operation of the system. The RF receiver receives the pulse rate and temperature data transmitted by the RF transmitter on the ambulance side. The receiver processes the data and sends it to the Node MCU microcontroller for further analysis and control. The Node MCU microcontroller acts as the central control unit for the system on the receiver side. The microcontroller receives the pulse rate and temperature data from the RF receiver and analyzes it to determine the patient's condition. Based on the patient's condition, the microcontroller sends signals to the traffic lights and the DC motor to control the speed-breaker rolling mechanism. The traffic lights are used to control the traffic flow and ensure the ambulance can pass through the area safely. The Node MCU microcontroller sends signals to the traffic lights to turn them red for other vehicles and green for the ambulance. The traffic lights help the ambulance to pass through the area quickly and safely. The DC motor is used to control the speed-breaker rolling mechanism. The Node MCU microcontroller sends signals to the motor to activate it when the ambulance approaches the speed-breaker. The motor rolls over the speed-breaker, providing a smooth ride for the patient. Tab. 1 shows the proposed system parameters for transmitter section.

Table 1 Proposed system parameters

Source of Power	10 ~ 30 VDC
Consumption at its peak	maximum 1 A with charges
Consumption in the absence of a load	max 1 W 24 VDC, 45 mA 12 VDC, 45 mA
Contact for safety	two contacts PNP NO: 500 mA
Contact for diagnostics	1 NC PNP contact: 50 mA
Contact protection	Overcurrent detection 500 mA à 25 °C 365 mA à 60 °C 600 mA à –25 °C
Response time	Safety contact closure : 230 ms
	Opening of safety contacts : 270 ms
Display	Red flashing LED indicates an error (pulse 150 ms/period 5 s). Green LED fixed: active position Red LED fixed: position exceeded LED orange steady: begin Flashing orange LED: indicates that there is no transmitter stored.
Range / offset at 25 °C	Range: ~16 - 20 mm offset: +/– 14 mm
Temperature	Temperature range of operation: –25 °C to +60 °C –40 °C +85 °C storage

The methodology for the IoT-based ambulance speed-breaker rolling system for patient safety involves several stages, including design, implementation, and testing. The following is a detailed methodology for the proposed system:The first stage of the methodology is the design stage, where the system requirements are gathered, and the system architecture is designed. This stage involves the following steps: Identifying the System Requirements: The first step is to identify the system requirements, including the features and functionalities required for the system. Designing the System Architecture: Based on the system requirements, the system architecture is designed. This involves determining the components required for the system, including sensors, microcontrollers, and other electronic components. Circuit Design: A circuit diagram is designed based on the system architecture, specifying the connections between the various components. Implementation Stage: The second stage of the methodology is the implementation stage, where the system is built according to the design specifications. This stage involves the following steps: Sourcing Components: The required components are sourced based on the circuit diagram design. Assembling the System: The components are assembled according to the circuit diagram design, and the system is built. Programming the Node MCU Microcontroller: The Node MCU microcontroller is programmed to receive the vital sign data from the RF receiver and analyze it to determine the patient's condition. The microcontroller is also programmed to send signals to the traffic lights and the DC motor to control the speed-breaker rolling mechanism. An emergency vehicle's presence is detected by the sensor. Ambulances, fire trucks, and police vehicles are considered emergency vehicles. Determine how far the emergency vehicle is from the intersection. The controller determines whether or not the approaching emergency vehicles are at an equal distance. If they are adjacent, the controller will set the green light in a random direction. If not, he picks the direction that is listed with the distance in ascending order. Testing Stage: The third stage of the methodology is the testing stage, where the system is tested to ensure it functions as expected. This stage involves the following steps: Testing the Sensor Modules: The pulse sensor and temperature sensor modules are tested to ensure they can accurately measure the patient's vital signs.

Testing the RF Transmitter and Receiver: The RF transmitter and receiver modules are tested to ensure they can transmit and receive data wirelessly. Testing the NodeMCU Microcontroller: The NodeMCU microcontroller is tested to ensure it can analyze the vital sign data and send signals to the traffic lights and DC motor as required. Testing the Speed-breaker Rolling Mechanism: The DC motor and speed-breaker rolling mechanism are tested to ensure they can provide a smooth ride for the patient. Overall System Testing: The entire system is tested to ensure it functions as expected, providing a safe and efficient transportation solution for patients. Deployment Stage: The final stage of the methodology is the deployment stage, where the system is deployed for actual use in ambulance transportation. This stage involves the following steps: Installing the System in Ambulances: The system is installed in ambulances to provide a safe and efficient transportation solution for patients. Training Ambulance Staff: The ambulance staff is trained on how to use the system, including how to monitor the vital signs of patients and operate the speed-breaker rolling mechanism. Monitoring and Maintenance: The system is regularly monitored and maintained to ensure it functions optimally and remains in good working condition. Application and performance: Control of the protective door's position Controlling access in a discriminatory manner RFID encoding key that learns on its own On request, a unique client code PLC LED indicator with diagnostic output and backlight 20 mm high alignment tolerance Metallic environment compatible Cable length: 50 cm or 220 cm Overmolded PUR M12 M12 8p Waterproof IP 67 PA6 housing resistant to cleaning with detergent Operating temperature: –25 °C ~ +60 °C Output short circuit protection outputs: identification of fraud and failure.

4 RESULTS AND DISCUSSION

In this section, in line with the previous sections and the process of achieving the research results, numerical tests are used to model the medical emergency system by considering the intelligent traffic management system. In this series of tests, the location of the emergency service stations and the facilities that are actually located in them are determined from the candidate stations for medical emergency services. Then, the required number of ambulances is determined based on the share of demand and its amount in each station. The IoT-based ambulance speed breaker rolling system aims to provide a faster and safer way for emergency medical services to reach their destination. By using a combination of sensors and wireless communication modules, the system can monitor the vital signs of patients and provide real-time updates to the medical facility or hospital. In terms of traffic management, the system can automatically control the traffic lights and speed-breakers to provide a clear path for the ambulance. The traffic lights can be programmed to turn green for the ambulance and red for other vehicles, while the speed breaker can be lowered to allow the ambulance to pass without any delay. The system should be able to provide accurate and reliable data about the patient's vital signs, ambulance location, and traffic conditions. The GSM module can be used to send this data to a central server or monitoring system, which can be used to analyze and optimize the system's performance. The ploughing task will be performed by the Ardunio in three modes: on, off, and mid condition. Ploughing is also referred to as tilling. Ardunio will issue the command, and the task will be completed. If the vehicle's speed is recognised, the microcontroller compares it to the database speed and makes a decision. If excessive speed is detected, a speed breaker is automatically created. Overall, the experimental results of the IoT-based ambulance speed breaker rolling system should improve response times for emergency medical services, safer transport for patients, and more efficient traffic management. By automating the process of traffic management and patient monitoring, the system can provide a faster and more reliable way for emergency medical services to reach their destination, potentially saving lives in critical situations.

4.1 Attribute-based Query Analysis

Attribute-based query analysis is a valuable process for analyzing the attributes of the speed-breaker rolling system and evaluating its performance based on specific

queries or criteria. We were asked questions related to Speed-breaker Rolling Accuracy, Response Time, Reliability, Traffic Flow, and Safety.
The analysis measures of this are mentioned below:
No. of questions asked: 230.
No. of correct answers received: 222.
Accuracy (in %) = 96.52

$$Effectiveness = \frac{\text{Number of correct responses}}{\text{Number of total responses}} \tag{1}$$

4.2 Availability-based Query Analysis

Availability-based query analysis is the process of evaluating the system's availability based on specific queries or criteria. We were asked questions related to System Uptime, Maintenance, and Repair, Spare Parts Availability, Remote Monitoring and Management, Backup and Recovery.
No. of questions asked: 267.
No. of correct answers received: 249.
Accuracy (in %) = 93.25

4.3 Miscellaneous Query Analysis

Miscellaneous Queries are queries that were unable to categorize under the above types. Those queries require information beyond the specified categories. It also consists of questions that do not come under the IoT domain itself. Hence those are considered to be irrelevant queries. Considering these queries for the evaluation, the accuracy is measured. The evaluated measures are as follows:
No. of questions asked: 194.
No. of correct answers received: 140.
Accuracy (in %) = 72.16

4.4 System Analysis

The experiments involved testing the accuracy and reliability of the sensors, wireless modules, and microcontrollers. Additionally, we tested the system's ability to control the traffic lights and speed breaker and provide real-time updates about the patient's vital signs.
Evaluation parameters using prototype system are shown in Tab. 2. From the results the proposed system has high accuracy and availability.

Table 2 Evaluation measures using a prototype system

Type	Evaluation Measures		
	No. of. Queries	No. of. Correct answers received	Accuracy / %
Attribute-based	230	222	96.52
Availability based	267	249	93.25
Miscellaneous	194	140	72.16

The future improvements that can be incorporated into the system are as follows: The integration of additional sensors, such as cameras and lidar systems, could provide more comprehensive information about incoming emergency vehicles, improving the accuracy and effectiveness of the system. The integration of artificial intelligence (AI) technologies, such as machine learning algorithms, could improve the system's ability to detect incoming emergency vehicles and predict traffic patterns, leading to faster and more effective response times. The integration of cloud technologies could enable remote monitoring and management of the system, as well as the storage and analysis of system data, improving system performance and reliability.The development of a mobile application for the system could allow for real-time monitoring and control of the system, as well as the provision of alerts and notifications to emergency responders. Additional testing and validation of the system in real-world scenarios could provide further insight into its performance and identify any potential areas for improvement or optimization.

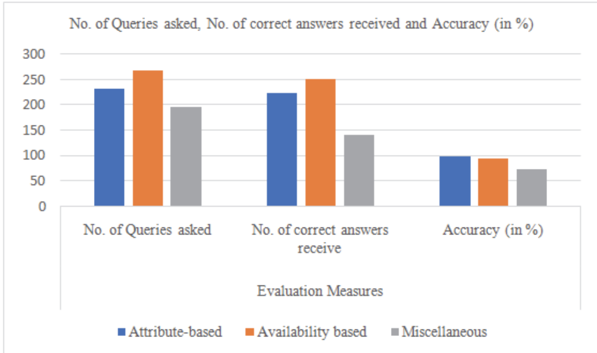

Figure 4 Several experiments using a prototype system

5 CONCLUSION

The mechanism of this system is that it calculates the distance and direction of the ambulance, i.e., the distance between the ambulance and the next traffic light, and calculates the direction by determining the ambulance route at each intersection. The speed breaker allows the emergency vehicle to slow down, but this ground-breaking flat speed breaker device saves human lives by flattening the speed breaker. It is easier and more convenient to transport emergency vehicles. This device will be utilised in the majority of emergency situations where emergency vehicles must arrive quickly. Future works, such as advanced sensor integration, artificial intelligence integration, and cloud integration, can further enhance the system's capabilities and performance. Overall, the proposed system offers a promising solution for improving emergency response times and patient safety and has the potential to be a valuable addition to emergency response systems around the world.

6 REFERENCES

[1] Sadi, S. H., Hossin, Md. A., & Sabuj, S. R. (2019). An IoT-based dynamic traffic management system in perspective of Bangladesh, *World Review of Intermodal Transportation Research*, *8*(4), 39. https://doi.org/10.1504/WRITR.2019.103306
[2] Dahiya, N., Garg, M., Gupta, S., & Deepali, G. (2019). Smart Ambulance System Using Internet of Things: A Rumination. *Journal of Computational and Theoretical Nanoscience*, *16*(10), 4249-4254. https://doi.org/10.1166/jctn.2019.8508
[3] Hashim, N., Idris, F., Kadmin, A. F., & Sidek, S. S. J. (2019). Automatic traffic light controller for emergency vehicle using peripheral interface controller. *International Journal of Electrical and Computer Engineering*, *9*(3), 1788-1794.

https://doi.org/10.11591/ijece.v9i3.pp1788-1794

[4] Sumi, L. & Ranga, V. (2018). Intelligent Traffic Management System for Prioritizing Emergency Vehicles in a Smart City. *International Journal of Engineering, Transactions B: Applications*, *31*(2), 278-283. https://doi.org/10.5829/ije.2018.31.02b.11

[5] Siddiqi, M. H., Alruwaili, M., Tarimer, I., Karadag, B. C., Alhwaiti, Y., & Khan, F. (2023). Development of a Smart Signalization for Emergency Vehicles. *Sensors*, *23*(10), 4703. https://doi.org/10.3390/s23104703

[6] Bagdadee, A. H., Hoque, M. Z., & Zhang, L. (2020). IoT Based Wireless Sensor Network for Power Quality Control in Smart Grid. *Procedia Computer Science*, *167*, 1148-1160. https://doi.org/10.1016/j.procs.2020.03.417

[7] Avci, İ. & Bidollahkhani, M. (2023). Real-Time Building Management System Visual Anomaly Detection Using Heat Points Motion Analysis Machine Learning Algorithm. *Tehnički vjesnik*, *30*(1), 318-323. https://doi.org/10.17559/TV-20220417151954

[8] Ahanger, T. A., Tariq, U., Ibrahim, A., Ullah, I., Bouteraa, Y., & Gebali, F. (2022). Securing IoT-Empowered Fog Computing Systems: Machine Learning Perspective. *Mathematics*, *10*(8), 1298. https://doi.org/10.3390/math10081298

[9] Ahire, B. A. & Sakhare, S. R. (2021). Sound Prohibited Zone for Smart Cities using IoT. *Tehnički glasnik*, *15*(1), 92-97. https://doi.org/10.31803/tg-20210205091148

[10] Jijin Godwin, J., Santhosh Krishna, B. V., Rajeshwari, R., Sushmitha, P., & Yamini, M. (2021). IoT Based Intelligent Ambulance Monitoring and Traffic Control System. *Further Advances in Internet of Things in Biomedical and Cyber Physical Systems*, 269-278. https://doi.org/10.1007/978-3-030-57835-0_20

[11] Vinoth Kumar, K., Karthikeyan, S., Bhavani, S., & Vennila, C. (2022). Performance Improvement of SIMD Processor for High-Speed end Devices in IoT Operation Based on Reversible Logic with Hybrid Adder Configuration. *Tehnički vjesnik*, *29*(1), 252-258. https://doi.org/10.17559/TV-20210719025814

[12] Kolar, D., Lisjak, D., Curman, M., & Benic, J. (2023). Identification of Inability States of Rotating Machinery Subsystems Using Industrial IoT and Convolutional Neural Network – Initial Research. *Tehnički glasnik*, *17*(2), 279-285. https://doi.org/10.31803/tg-20230502171228

[13] Mithun C. N., Rashid U. N., & Rahman M. M. S. (2012). Detection and classification of vehicles from video using multiple Time-Spatial images. *IEEE Trans. Intell. Transp. Syst*, *13*(3), 1215-1225. https://doi.org/10.1109/TITS.2012.2186128

[14] Baksi, A., Bhattacharjee, M., Ghosh, S., Bishnu, S. K., & Chakraborty, A. (2020). Internet of Things (IOT) Based Ambulance Tracking System Using GPS and GSM Modules. *4th International Conference on Electronics, Materials Engineering & Nano-Technology (IEMENTech).* https://doi.org/10.1109/IEMENTech51367.2020.9270120

[15] Amini, M. R., Gong, X., Feng, Y., Wang, H., Kolmanovsky, I., & Sun, J. (2019). Sequential optimization of speed, thermal load, and power split in connected HEVs. *Proceedings of the IEEE 2019 American Control Conference (ACC), Philadelphia, PA, USA*. 4614-4620. https://doi.org/10.23919/ACC.2019.8815158

[16] Menouar, H., Guvenc, I., Akkaya, K., Uluagac, A. S., Kadri, A., & Tuncer, A. (2017). UAV-enabled intelligent transportation systems for the smart city: Applications and challenges. *IEEE Commun. Mag,* 55, 22-28. https://doi.org/10.1109/MCOM.2017.1600238CM

[17] Fraga-Lamas, P., Ramos, L., Mondéjar-Guerra, V., & Fernández-Caramés, T. M. (2019). A review on IoT deep learning UAV systems for autonomous obstacle detection and collision avoidance. *Remote Sens*, *11*(18), 2144. https://doi.org/10.3390/rs11182144

[18] Krajewski, R., Bock, J., Kloeker, L., & Eckstein, L. (2018). The highd dataset: A drone dataset of naturalistic vehicle trajectories on german highways for validation of highly automated driving systems. *Proceedings of the IEEE 2018 21st International Conference on Intelligent Transportation Systems (ITSC); Maui, HI, USA,* 2118-2125. https://doi.org/10.1109/ITSC.2018.8569552

[19] Lee K. H. (2020). Improvement in Target Range Estimation and the Range Resolution Using Drone. *Electronics*, *9*(7), 1136. https://doi.org/10.3390/electronics9071136

[20] Vinoth Kumar, K. & Balaganesh, D., (2022). Efficient Privacy-Preserving Red Deer Optimization Algorithm with Blockchain Technology for Clustered VANET. *Technical Gazette*, *29*(3), 813-817.

[21] Emre, K., Yasin, C., & Ahmet, T., (2021). Identifying the Most Critical Intersections in Transportation Networks. *Technical Gazette*, *28*(6), 1920-1926. https://doi.org/10.17559/TV-20201117162526

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