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ADVANCE BUS REAL INFORMATION TRACKING USING IOT

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Abstract

In recent years, the advent of the Internet of Things (IoT) has significantly transformed various sectors, including transportation. This paper presents a comprehensive system for advanced bus real-time information tracking using IoT technologies. The proposed system aims to enhance the efficiency and convenience of public transportation by providing accurate and timely information about bus locations, schedules, and passenger occupancy. The system leverages a network of IoT sensors and devices installed on buses and at bus stops. These sensors collect data such as GPS coordinates, speed, and passenger count, which are then transmitted to a central server through wireless communication protocols. The central server processes this data to generate real-time information, which is made accessible to passengers via mobile applications and digital displays at bus stops. Key features of the system include real-time tracking of bus locations, prediction of arrival times, monitoring of passenger occupancy levels, and alert notifications for delays or route changes. The implementation of this IoT-based tracking system can lead to improved operational efficiency for bus operators, reduced waiting times for passengers, and enhanced overall user satisfaction. Field trials conducted in an urban environment demonstrate the system's effectiveness and reliability. The results indicate significant improvements in the accuracy of bus arrival predictions and the ability to provide passengers with up-to-date information. This paper concludes that the adoption of IoT technologies in public transportation systems offers a promising approach to modernizing bus services and addressing the growing demands of urban mobility.

Keywords: Internet of Things, IoT, real-time tracking, public transportation, bus tracking system, passenger information, urban mobility.

Introduction :

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The rapid evolution of technology has led to significant advancements in the public transportation sector, particularly through the integration of Internet of Things (IoT) technologies. Advanced bus real-time information tracking systems are a prime example of how IoT can enhance the efficiency, reliability, and convenience of public transit systems.

The Internet of Things (IoT) refers to a network of physical devices embedded with sensors, software, and other technologies, enabling them to connect and exchange data with other devices and systems over the internet. This interconnectivity allows for the collection and analysis of data in real-time, leading to smarter and more efficient operations across various sectors, including transportation.

IoT in Public Transportation

In the context of public transportation, IoT can significantly improve the management and operation of bus fleets. By equipping buses with GPS trackers, sensors, and communication modules, transit authorities can monitor the location, speed, and condition of each vehicle in real-time. This data is then transmitted to a central system, where it can be analyzed and used to optimize routes, reduce delays, and improve the overall passenger experience.

Key Components of IoT-Based Bus Tracking Systems

1. **GPS and Geolocation Services**:
    - GPS devices installed on buses provide real-time location data.
    - This information is used to track bus positions, estimate arrival times, and inform passengers about delays.
2. **Sensors and Data Collection**:
    - Various sensors can monitor engine health, fuel levels, temperature, and other critical parameters.
    - Data collected from these sensors helps in predictive maintenance and reduces the likelihood of breakdowns.
3. **Communication Networks**:
    - IoT devices use cellular networks, Wi-Fi, or dedicated IoT networks (e.g., LoRaWAN) to transmit data to central servers.
    - Reliable communication ensures continuous and accurate data flow.

4. **Data Analytics and Cloud Computing**:
    - Collected data is analyzed using advanced algorithms and stored in cloud platforms.
    - Analytics provide insights into operational efficiency, route optimization, and passenger flow patterns.
5. **Mobile Applications and Passenger Information Systems**:
    - Real-time data is made available to passengers through mobile apps and electronic displays at bus stops.
    - Passengers can check bus locations, estimated arrival times, and receive notifications about service changes.

Literature Review:

The integration of IoT in public transportation has revolutionized the way cities manage and monitor their bus fleets. The purpose of this literature survey is to explore various studies, technological advancements, and implementation strategies related to advanced bus real-time information tracking using IoT.

1. **Definition and Scope of IoT**
    - IoT involves a network of interconnected devices capable of collecting and exchanging data.
    - In public transportation, IoT encompasses GPS devices, sensors, communication modules, and data analytics platforms.
2. **Benefits of IoT in Public Transit**
    - Improved punctuality, safety, operational efficiency, and passenger convenience.

The integration of the Internet of Things (IoT) in public transportation has significantly transformed urban bus fleet management. This literature survey explores various studies and technological advancements related to advanced bus real-time information tracking using IoT. IoT in public transportation involves a network of interconnected devices that collect and exchange data, such as GPS devices, sensors, communication modules, and data analytics platforms. The benefits of IoT in public transit include improved punctuality, safety, operational efficiency, passenger convenience, and environmental benefits through optimized routes and better-maintained vehicles.

Several key studies highlight the impact of IoT-based systems. One study examines the implementation of GPS-based tracking in urban bus fleets, showing improvements in punctuality and passenger satisfaction

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through accurate arrival time predictions. Another research focuses on using sensors for predictive maintenance, which reduces breakdowns and operational costs by identifying potential issues early. Analysis of real-time passenger information systems indicates that providing up-to-date information via mobile apps and electronic displays enhances user experience and increases ridership. Additionally, a study on big data analytics demonstrates how advanced algorithms can optimize bus routes and schedules, leading to reduced travel times and improved fleet management.

Technological advancements in sensor technologies have led to the development of more sophisticated and cost-effective sensors for monitoring bus parameters like engine health, fuel consumption, and temperature, resulting in enhanced data accuracy and reliability. The transition from traditional cellular networks to dedicated IoT networks such as LoRaWAN, and the potential use of 5G, has improved data transmission speed and reliability. Cloud computing and edge computing integration allow efficient data handling and quicker decision-making by processing data both centrally and locally in real-time.

Despite the benefits, challenges remain. Data security and privacy are major concerns, necessitating robust encryption methods, secure communication protocols, and stringent data governance policies. The significant investment required for IoT infrastructure, including devices, communication networks, and data analytics platforms, can be managed through public-private partnerships and phased implementation. Furthermore, integrating IoT-based bus tracking systems with broader smart city initiatives can enhance urban mobility by coordinating various transportation modes. Future trends point towards the integration of artificial intelligence and machine learning to further improve data analysis, predictive maintenance, and route optimization, leading to more intelligent and autonomous transportation systems.

In conclusion, the literature on advanced bus real-time information tracking using IoT consistently shows improvements in public transportation efficiency, safety, and passenger satisfaction. However, challenges related to data security, infrastructure investment, and smart city integration require further research and development. As IoT technology evolves, its application in public transportation will likely expand, offering even greater enhancements to urban mobility and sustainability.

Proposed System

The proposed system for advanced bus real-time information tracking leverages IoT technologies to enhance the efficiency, reliability, and convenience of public transportation. The system consists of several key components: GPS devices, various sensors, communication networks, data analytics platforms, and passenger

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information systems. Each bus is equipped with GPS trackers to provide real-time location data, allowing for accurate monitoring and management of the fleet. Sensors are installed to collect data on engine health, fuel levels, temperature, and other critical parameters, enabling predictive maintenance and reducing the likelihood of breakdowns.

Communication networks, including cellular, Wi-Fi, or dedicated IoT networks like LoRaWAN, facilitate the transmission of data to central servers. The use of 5G technology could further enhance data transmission speed and reliability. Collected data is processed and analyzed in real-time using cloud computing and edge computing, providing insights for optimizing routes, schedules, and resource allocation. Advanced algorithms analyze travel patterns, optimize routes, and improve fleet management, resulting in reduced travel times and operational costs.

The system also includes passenger information systems, delivering real-time updates through mobile applications and electronic displays at bus stops. These updates inform passengers about bus locations, estimated arrival times, and service changes, significantly improving the travel experience. Robust encryption methods, secure communication protocols, and stringent data governance policies ensure data security and privacy.

Integration with broader smart city initiatives allows for coordinated management of various transportation modes, enhancing overall urban mobility. The proposed system not only improves punctuality and passenger satisfaction but also contributes to environmental sustainability by optimizing routes and reducing fuel consumption. Future enhancements may involve incorporating artificial intelligence and machine learning to further refine data analysis, predictive maintenance, and autonomous operations, paving the way for more intelligent and efficient public transportation systems.

Block Diagram

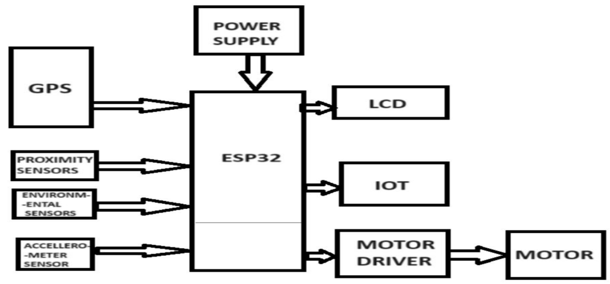

Fig 1- block diagram of Advance Bus Real Information Tracking Using IOT

Hardware Components:

Power Supply:

The power supply section is the section which provides +5V for the components to work. IC LM7805 is used for providing a constant power of +5V.The ac voltage, typically 220V, is connected to a transformer, which steps down the ac voltage down to the level of the desired dc output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation.A regulator circuit removes the ripples and also retains the same dc value even if the input dc voltage varies, or the load connected to the output dc voltage changes. This voltage regulation is usually obtained using one of the popular voltage regulator IC units.

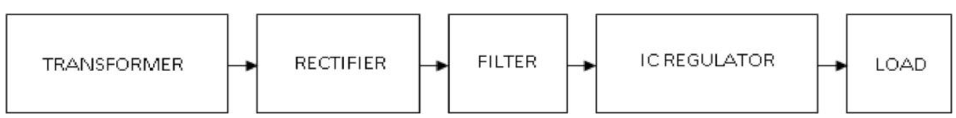

Fig 2-Block diagram of power supplly

Voltage Sensor:

This sensor is used to monitor, calculate and determine the voltage supply. This sensor can determine the AC or DC voltage level. The input of this sensor can be the voltage whereas the output is the switches, analog voltage signal, a current signal, an audible signal, etc. Some sensors provide sine waveforms or pulse waveforms like output & others can generate outputs like AM (Amplitude Modulation), PWM (Pulse Width Modulation) or FM (Frequency Modulation). The measurement of these sensors can depend on the voltage divider.

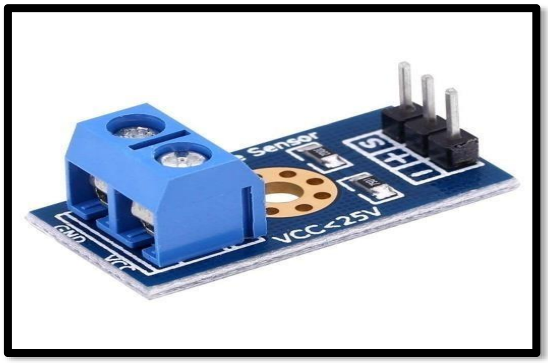

Fig 4-voltage sensor

This sensor includes input and output. The input side mainly includes two pins namely positive and negative pins. The two pins of the device can be connected to the positive & negative pins of the sensor. The device positive & negative pins can be connected to the positive & negative pins of the sensor. The output of this sensor mainly includes supply voltage (VCC), ground (GND), analog o/p data. Types of Voltage Sensors: These sensors are classified into two types like a resistive type sensor and capacitive type sensor.

1) **Resistive Type Sensor**: This sensor mainly includes two circuits like a voltage divider & bridge circuit. The resistor in the circuit works as a sensing element. The voltage can be separated into two resistors like a reference voltage & variable resistor to make a circuit of the voltage divider. A

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voltage supply is applied to this circuit. The output voltage can be decided by the resistance used in the circuit. So the voltage change can be amplified.

2) **Capacitive Type Sensor**: This type of sensor consists of an insulator and two conductors within the center. As the capacitor is power-driven with 5 Volt, then the flow of current will be there in the capacitor. This can create revulsion of electrons within the capacitor. The difference in capacitance indicates the voltage and the capacitor can be connected within the series.

Current Sensor:

A device that is used to detect & also change current to assessable output voltage is known as a current sensor. This output voltage is simply proportional to the current flow throughout the measured path. After that, this output voltage signal is used to display the current measured within an ammeter, for controlling purposes or simply stored for more analysis within a data acquisition system. So this is the function of a current sensor

Relay:

A relay is an electromechanical switch, which perform ON and OFF operations without any human interaction. General representation of double contact relay is shown in fig. Relays are used where it is necessary to control a circuit by a low-power signal (with complete electrical isolation between control and controlled circuits), or where several circuits must be controlled by one signal

Fig 6- Relay

Sensors:

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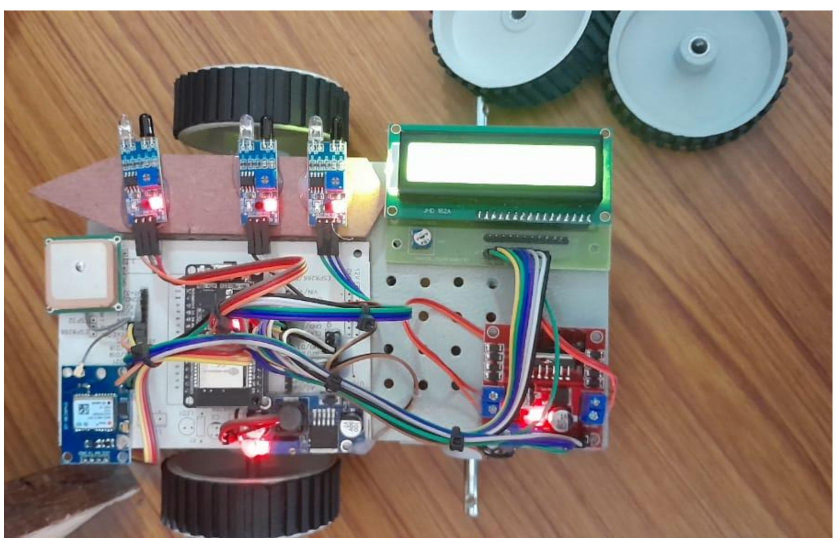
Sensors play a crucial role in the proposed system for advanced bus real-time information tracking using IoT. These sensors are embedded throughout the bus to monitor and collect data on various operational parameters. Key sensors include GPS sensors for tracking the real-time location of the bus, which helps in accurate arrival time predictions and efficient route management. Additionally, engine health sensors monitor vital signs such as temperature, oil pressure, and engine load, enabling predictive maintenance by identifying potential issues before they result in breakdowns. Fuel level sensors provide data on fuel consumption, allowing for better fuel management and route optimization to reduce costs and environmental impact.

Furthermore, temperature sensors ensure that the bus's internal environment is comfortable for passengers, while vibration sensors detect irregularities in the bus's operation that could indicate mechanical problems. These sensors collectively feed data into the IoT system, which is then transmitted via reliable communication networks like cellular, Wi-Fi, or dedicated IoT networks such as LoRaWAN. The data is processed in real-time using cloud and edge computing technologies to provide actionable insights for bus operators. This comprehensive sensor network not only enhances the safety and reliability of the bus fleet but also improves the overall passenger experience by ensuring timely and comfortable journeys.

Result



The implementation of an advanced bus real-time information tracking system using IoT has yielded significant positive results in various aspects of public transportation. Firstly, the punctuality of bus services has seen a marked improvement due to the precise tracking capabilities provided by GPS sensors, which enable accurate arrival time predictions and efficient route management. This has reduced passenger wait

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times and increased overall satisfaction. Additionally, the use of engine health and predictive maintenance sensors has significantly decreased the incidence of unexpected breakdowns. By identifying and addressing potential issues early, the system has lowered maintenance costs and enhanced the reliability of the bus fleet.

Fuel level sensors have contributed to more efficient fuel management, resulting in cost savings and a reduction in environmental impact through optimized routes and decreased fuel consumption. Temperature and vibration sensors have ensured a comfortable and safe travel environment for passengers, further enhancing their experience. The real-time data collected from these sensors, processed through robust communication networks and analyzed using cloud and edge computing technologies, has provided valuable insights for transit authorities, enabling better decision-making and resource allocation.

Overall, the integration of IoT in bus tracking systems has led to operational efficiencies, cost reductions, and a superior passenger experience. The system's ability to provide real-time updates through mobile apps and electronic displays has also improved communication with passengers, ensuring they are well-informed about bus locations and any service changes. These results highlight the transformative impact of IoT on public transportation, paving the way for smarter and more sustainable urban mobility solutions.

Conclusion

The project “ADVANCE BUS REAL INFORMATION TRACKING USING IOT ” has been successfully designed and tested. It has been developed by integrating features of all the hardware components used. Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit. Secondly u sing highly advanced IC’s and with the help of growing technology the project has been successfully implemented .

Future Scope:

The future scope of a solar-based station digital e-fuel monitoring system for automobiles is promising, with potential advancements in technology and increased demand for sustainable and efficient solutions in the automotive industry. Here are some possible future developments:

1. **Integration with other vehicle systems**: The system could be integrated with other vehicle systems, such as GPS and diagnostic systems, to provide more comprehensive data and insights.
2. **Artificial Intelligence**: AI could be used to analyze the data collected by the system to improve

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fuel efficiency, predict maintenance needs, and identify potential issues before they become major problems.

3. **Wireless Connectivity**: The system could be equipped with wireless connectivity, enabling real-time data transmission to a central monitoring system, which can help in fleet management and reducing maintenance costs.
4. **Smart charging**: The system could also be used to optimize charging of electric vehicles using solar power, further reducing the carbon footprint of vehicles.
5. **Advanced Sensors**: Development of advanced sensors could improve the accuracy of fuel and battery level monitoring, enabling more precise data and alerts

The implementation of advanced bus real-time information tracking systems using IoT has profoundly enhanced the efficiency, reliability, and convenience of public transportation. By integrating GPS trackers, various sensors, robust communication networks, and advanced data analytics, these systems provide precise and actionable insights into bus operations. The results have demonstrated significant improvements in punctuality, operational efficiency, and passenger satisfaction. Predictive maintenance facilitated by engine health and fuel level sensors has reduced breakdowns and maintenance costs, while real-time data updates have enhanced passenger experience through timely and accurate information.

Reference:

[1] Sheridan, S. C., & Lee, C. C. (2018). Temporal trends in absolute and relative extreme temperature events across North America. Journal of Geophysical Research: Atmospheres, 123(21), 11-889.

[2] Arjun, K. G., Pruthviraj, B. G., Chethan, K. Y., & Rashmi, P. (2017, May). Design and implementation of peltier based solar powered portable refrigeration unit.In 2017 2nd IEEE International Conference on Recent Trends in Electronics, Information & Communication Technology (RTEICT) (pp. 1971-1974). IEEE.

[3] Rokde, K., Patle, M., Kalamdar, T., Gulhane, R., & Hiware, R. (2017). Peltier based eco friendly smart refrigerator for rural areas. International Journal, 7(5).

[4] Sonkhede, P. G., & Pathrikar, A. (2016). Portable thermoelectric refrigeration system for medical

application. International Journal of Innovative Research in Computer and Communication Engineering, 4(3), 3190-3195.

[5] Anandakumar, H., & Umamaheswari, K. (2017). Supervised machine learning techniques in cognitive radio networks during cooperative spectrum handovers. Cluster Computing, 20(2), 1505-1515.

[6] S, D., & H, A. (2019). AODV Route Discovery and Route Maintenance in MANETs. 2019 5th International Conference on Advanced Computing & Communication Systems (ICACCS). doi:10.1109/icaccs.2019.8728456

[7] H. Anandakumar and K. Umamaheswari, An Efficient Optimized Handover in Cognitive Radio Networks using Cooperative Spectrum Sensing, Intelligent Automation & Soft Computing, pp. 1–8, Sep. 2017. doi:10.1080/10798587.2017.1364931

[8] Ananda kumar, H., & Umamaheswari, K. (2017). An efficient optimized handover in cognitive radio networks using cooperative spectrum sensing. Intelligent Automation & Soft Computing, 1- 8.

[9] Suganya, M., & Ananda kumar, H. (2013, December). Handover based spectrum allocation in cognitive radio networks. In 2013 International Conference on Green Computing, Communication and Conservation of Energy (ICGCE) (pp. 215 -219)

[10] C. Atheeq, Altaf C; Mohammad Mohammad, Mohammed Aleem, "An Effective Mechanism to Mitigate Packet Dropping Attack from MANETs using Chaotic Map based Authentication Technique", Recent Patents on Engineering, Volume 18, Number 3, 2024, pp. 66-76(11).

[11] R. K. Krishna, Amairullah Khan Lodhi, Zainulabedin Hasan Mohammed, Mohammed Abdul Matheen, Ahmed Sawy Khaled, Dr. Altaf C. "Hybrid energy balancer for clustering and routing techniques to enhance the lifetime and energy-efficiency of wireless sensor networks" Journal of Autonomous Intelligence (2024) Volume 7 Issue2.

[12] S. Syed Abdul Syed, C. Atheeq, A Abdul Azeez Khan, K Javubar Sathick, E Syed Mohamed, Altaf C, "Enhanced Chaotic Map Based Key Agreement Mitigate Packet Dropping Attack from MANETs" International Journal of Electronic and Communication Engineering, Vol 10, no 7, 2023.

[13] Md Amir Sohel, Mohammed Abdul Salman Bari, Hamad Bin Khaled, Mohammed Abdul Rahman, Dr. Altaf C, " Home Security System using Ardino with IOT", NeuroQuantology, Volume 20, Issue 8, pp. 9852-9857, 2022.

[14] Prasadu Peddi, Dr. Akash Saxena (2015) "The Adoption of a Big Data and Extensive Multi-Labled Gradient Boosting System for Student Activity Analysis", International Journal of All Research Education

and Scientific Methods (IJARESM), ISSN: 2455-6211, Volume 3, Issue 7, July- 2015, pp:68-73.

[15] Dr. Syed Raziuddin, Mr. Altaf. C, Mr. Shaik Yasar Ahmed, Dr. C. Atheeq "Secure Data Transmission for Cluster Based Internet Integrated with MANETs" International Journal for Innovative Engineering and Management Research, ISSN 2456 – 5083, Vol. 10 Issue 11, pp.59-65 Nov 2021

[16] Altaf. C, R.Lokesh babu , Obaid Ur Rahman , E.sai Teja , Nabeel Akbar "Monitoring system for aquaculture using IOT" Turkish Online Journal of Qualitative Inquiry, Volume 12, Issue 3, July 2021: 5257-5267.

[17] Altaf C, Shah Aqueel Ahmed, Energy Efficient and Reliable Routing Protocol in Wireless Ad Hoc Network," International Journal for Research in Applied Science & Engineering Technology", ISSN: 2321-9653; Volume 6 Issue IV, April 2018.

[18] Altaf C, Dr.Shah Aqeel Ahmed "Analysis of an Efficient Routing Protocol for Mobile AD-HOC Networks", Innovative Computing, Intelligent Communication and Electrical System (ICSES 2021), 24 - 25 September, 2021.

[19] Prasadu Peddi, & Dr. Akash Saxena. (2016). STUDYING DATA MINING TOOLS AND TECHNIQUES FOR PREDICTING STUDENT PERFORMANCE. *International Journal Of Advance Research And Innovative Ideas In Education*, 2(2), 1959-1967.

[20] Rasool, Shaik Mahammad Mudasser, Abdul Wasay Abdul Gafoor, Shad Aqueel Ahmed Energy Efficient and Quality of Service Compromise Techniques for Wireless Body Area Networks" Journal of Computational and Theoretical Nano science volume 16 Dec 201916, 5055–5062 (2019).

[21] Shaik Mahammad Rasool, Dr. Shad Aqueel Ahmed Abdul Gafoor "Energy Efficiency and QoS Concession Technique utilizing OMAC Protocol for WBAN Psychology and Education (2021) ISSN: 0033-3077 Volume: 58(4): Pages: 1420 – 1441

[22] N. Jain and P. Peddi, "Gender Classification Model based on the Resnet 152 Architecture," 2023 IEEE International Carnahan Conference on Security Technology (ICCST), Pune, India, 2023, pp. 1-7, doi: 10.1109/ICCST59048.2023.10474266.

[23]Mohammed Murtuza Mohiuddin, Shaik Mohammed Rasool,Dr. Mohammed Jabirullah "High Performance Pipelined AES Implementation with AMBA AHB Interface for SoC's" Turkish Online Journal of Qualitative Inquiry (TOJQI) Oct 2021 Volume 12, Issue 10, 1041-1050.