An Efficient, Novel, and Sustainable IoT-Based Approach for Attendance Detection through RFID Module and IR Sensor

P Gopal Krihsna[1*], *Yerragudipadu* Subbarayudu[1], *K. Mythili* Rao[1], *V Jyoshna[1], Jumaid* Aman[2], *G.Vijendar* Reddy[1]

[1]Information Technology, Gokaraju Rangaraju Institute of Engineering and Technology, Hyderabad, Telangana
[2]School of Applied and Life Sciences ,Uttaranchal University ,Dehradun,248007,India

Abstract. The maintenance of student attendance at a facility is a challenging endeavor. The attendance is manually inputted, making it easily manipulatable. To effectively monitor and control student attendance in a setting, this research intends to build an intelligent attendance system with a sustainable approach to the problem. This study indicates employing RFID and IR sensors to automatically take attendance. Data can be viewed and stored in a real-time database using RFID (Radio Frequency Identification). The firebase database/google sheets are updated when the student's card is brought close to the RFID module. Additionally, an IR sensor is employed to keep track of the overall number of students entering and leaving the classroom. It would be useful to know how many students are in the class overall, and how many students are in the class overall would be displayed on the LCD outside the class. The outcomes of the research on student attendance will be communicated to the parents, and the number of students in attendance overall will be forwarded to the higher representatives of the institutions. The system alerts the user if there is any discrepancy between the number of RFID tags scanned and the total number of students present in the classroom. The teacher must manually rectify the attendance error after the disparity in the count reveals the proxy in attendance. Future expansion of this research may include the use of biometrics and face recognition to detect the proxy and open up the possibility for a more sustainable environment.

1 Introduction

In today's fast-paced world, managing attendance remains a critical challenge for various institutions and organizations. The traditional methods of attendance tracking, relying on manual processes and paper-based systems, are not only time-consuming but also prone to errors, leading to inefficiencies in record-keeping. Moreover, these conventional approaches

* Corresponding author: gopalakrishna@griet.ac.in

often lack real-time data accessibility, making it challenging for administrators and managers to make timely decisions based on attendance patterns. However, with the advent of the Internet of Things (IoT), the landscape of attendance tracking has witnessed a paradigm shift. IoT has emerged as a transformative technology, revolutionizing various domains, including attendance management. In this project, we present a cutting-edge IoT-based solution that harnesses the power of Radio Frequency Identification (RFID) technology and Infrared (IR) sensors to create an efficient and accurate attendance detection system. The primary objective of this project is to simplify attendance tracking processes in diverse settings, including educational institutions, corporate environments, conferences, and events[1]. By integrating RFID technology and IR sensors, the proposed system offers an innovative approach that can enhance administrative efficiency while ensuring real-time data accessibility, leading to optimized attendance management. FID Technology: At the core of this system lies RFID technology, a wireless communication method that enables the exchange of data between an RFID reader and RFID tags or cards. Each individual is assigned a unique RFID tag containing identification information. When individuals enter the vicinity of the RFID reader, their RFID tags are automatically scanned, and their unique IDs are captured. The process is seamless and requires minimal effort from the attendees, ensuring a smooth and efficient attendance tracking experience[2-3]. When attendees approach the vicinity of the RFID reader, the reader emits radio waves that power the RFID tags in their possession. This energizes the microchips on the RFID tags, allowing them to respond by transmitting their unique IDs back to the RFID reader. The RFID reader captures this transmitted data and links it to the corresponding individual's record in the attendance database. One of the key advantages of using RFID technology is the seamless and rapid nature of the attendance tracking process. As individuals pass through the range of the RFID reader, their RFID tags are automatically scanned, and their attendance is recorded within a matter of seconds. This automatic and contactless approach minimizes any disruptions to the attendees, creating a smooth and efficient attendance tracking experience[4-5].

Furthermore, RFID technology enhances the accuracy of attendance records compared to traditional methods. In manual systems, taking attendance often relies on roll-call procedures or paper-based lists, which are prone to human errors, such as misidentification or misrecording of names. RFID-based attendance tracking eliminates these errors, as the unique RFID tag associated with everyone ensures precise identification and accurate recording. Moreover, the RFID system can handle attendance tracking for multiple individuals simultaneously. In large gatherings, such as school assemblies or conferences, manual roll call can be extremely time-consuming and impractical. In contrast, the RFID-based system can efficiently handle a high number of attendees passing by the reader simultaneously, significantly reducing the time required to capture attendance data[6].

IR sensors operate based on the detection of heat emitted by individuals or objects within their field of view. These sensors can accurately detect the presence of individuals as they approach the RFID reader[7-8].Furthermore, the IR sensor integration enhances the system's overall reliability in attendance detection. In environments where lighting conditions may vary, such as dimly lit areas or outdoor settings during dusk, traditional optical sensors could face challenges in accurately detecting RFID tags. IR sensors, on the other hand, are less affected by ambient lighting, making them more reliable in various lighting conditions. By reducing the likelihood of false readings and improving the accuracy of attendance data, the integration of IR sensors bolsters the credibility of the attendance tracking system. Reliable attendance data provides administrators and managers with confidence in making data-driven decisions, whether it involves assessing student or employee engagement, analyzing

attendance trends, or optimizing resource allocation[9].The combined use of RFID technology and IR sensor integration further streamlines the attendance tracking process, ensuring that attendance data is collected efficiently and accurately without requiring any additional effort from the attendees. This seamless and non-disruptive approach promotes a better alternative by focusing on sustainable development by reducing the carbon emissions generated by the existing system and provides positive user experience for individuals in attendance, as they can move through the tracking point without encountering any delays or hassles[10].

2 Related work

IoT based Class Attendance Monitoring System using RFID and GSM by IoT. In this project, using Radio Frequency Identification (RFID) and Global System for Mobile (GSM) communication technologies, a new paradigm for tracking student attendance was developed using the Internet of Things (IoT). The hardware and software components of the proposed paradigm are based on the Internet of Things. The GSM module, RFID tags, and the EM-19 RFID reader are some of the components that make up the hardware. The software component uses Application Programming Interface (API) to quickly provide information to the registered mobile phone. The recommended approach efficiently notifies the right parents and guardians of a student's status, and even credentialed users with up-to-date credentials may access the server's database from anywhere at any time [10]. Development of Attendance Monitoring System using IoT:in this project the proposed automatic attendance monitoring system (AMS) in the current study makes use of IoT technologies, including RFID and hardware platforms. The proposed system's goals are to monitor instructors' punctuality and automatically check student attendance without involving a person. It will also alert students to any gaps in attendance. According to the findings, the suggested AMS is cost- and time-efficient, and it uses no electricity [11-14].
Automated Attendance-Checking System Using Bluetooth: In this article, they developed a Bluetooth-based system that automatically verifies attendance by monitoring the proximity of each student's mobile device to a Bluetooth beacon placed in a classroom throughout a class period. It implies that this method is straightforward, affordable, necessitates little from students and instructors, and improves the security of the attendance-checking procedure very much. A brief assessment at the end of each course and a real-time feedback mechanism for students are two innovative aspects of this system that give instructors richer data than just attendance numbers [14-16].The appropriate adjustments will be reflected in the student app and the attendance of the relevant topic will be automatically marked. This system will solve the proxy issue that currently exists The teacher will receive the understudy's QR code to record their attendance [18-20].

Utilizing RFID (Radio Frequency Identification) module and IR (Infrared) sensor technology, the goal of this project is to design and create an effective Attendance Detection System. The system should be able to track people’s attendance correctly and automatically in a variety of places, including offices, schools, universities, and events. Key Requirements: The system should be able to scan the RFID tags or cards that are given to each person and individually identify them. The RFID tag worn by each user should be identified by a special identification number.IR Sensor for presence Detection: The system must make use of IR sensors to find people within a given range while attempting to identify their presence. In order to achieve precise detection without any false positives or negatives, the IR sensors should be positioned carefully. The outcomes of the research on student attendance will be communicated to the parents and the number of students in attendance overall will be forwarded to the higher authorities. The system the user if there is any discrepancy between

the number of RFID tags actually scanned and the total number of students present in the classroom[21-24]. The teacher must manually rectify the attendance error after the disparity in the count reveals the proxy in the attendance.

3 System Architecture

A system's entire or partial structure is represented graphically in an architectural diagram. Above all, it helps engineers, designers, stakeholders, and everyone else involved in the project comprehend the organizational structure of a system or app. If anything, think of it as a blueprint for a building: You may view the entire building as well as numerous interior views and details, such as pipelines, walls, and floor layouts. The architecture proposed in this study covers the information collecting, transportation, processing, storage, and reporting in order to overcome the object connection difficulties and enable communication between humans and machines. time monitoring, analysis, and reporting of air quality, facilitating better understanding and management of air pollution. Hence promoting a sustainable environment.

The architecture proposed in this study covers the information collecting, transportation, processing, storage, and reporting in order to overcome the object connection difficulties and enable communication between humans and machines.

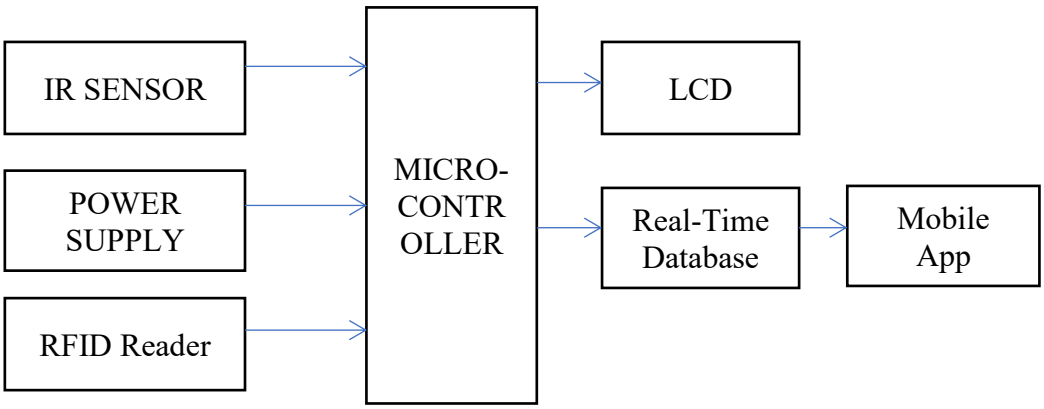


Fig 1. System Architecture

4 Methods and Material

RFID Module: An RFID (Radio Frequency Identification) reader works based on the principles of radio waves to read and capture data from RFID tags. The basic algorithm for an RFID reader can be summarized as follows. Initialize the RFID Reader: Power on the RFID reader and establish communication with the microcontroller or the system it is connected to. Configure the RFID Reader: Set up the necessary parameters, such as the communication protocol (e.g., ISO 14443A, ISO 15693), operating frequency, and power level for the RFID reader. Continuously Scan for Tags: Start scanning for nearby RFID tags continuously. Depending on the reader's capabilities, it can be set to operate in either active or passive mode. In passive mode, the reader waits for RFID tags to come into its range and respond to the reader's signals. In active mode, the reader periodically sends out signals to query nearby tags actively.

Antenna Activation: Activate the RFID reader's antenna to transmit radio waves to the tags within its range. Tag Detection: When an RFID tag comes into the reader's range and receives the reader's radio waves, it responds by transmitting its unique identification (ID) and other relevant data back to the reader. Data Reception:
Data Output: Depending on the application, the RFID reader can output the read data in various ways, such as displaying it on a screen, transmitting it to a central database, or triggering certain actions based on the read data. Handle Multiple Tags (Optional): If the reader is designed to handle multiple tags simultaneously, it should be able to distinguish and process data from multiple tags within its range. Error Handling: Implement error handling mechanisms to address issues like signal interference, tag collision, or read failures.Stop Scanning (Optional): Depending on the application, the scanning process may be continuous or triggered by certain events. If applicable, stop the scanning process when it's no longer needed. Terminate Reader (Optional): Properly shut down the RFID reader when it's not in use to conserve power and prevent unnecessary transmission.

IoT has diverse applications across various industries, including. Wearable: the core of IoT applications is simply wearable technology. Anything we can wear as an accessory or attach to our clothing is a variable. Because they provide useful information and maintain bodily condition management accessories, it gives the user access to personal data on his fitness, health, etc. Recently, a variety of wearable technology has been created Agriculture: IoT – based systems monitor soil conditions,automate irrigation ,and provide data driven insights for precision farming, leading to improved yields and resource utilization. Transportation: IoT is used for vehicle tracking, fleet management, and optimizing traffic flow, enhancing safety and efficiency. Health care: IoT devices and sensors enable remote patient monitoring real time tracking and efficient health care management.

5 Experiment Result and Discussions

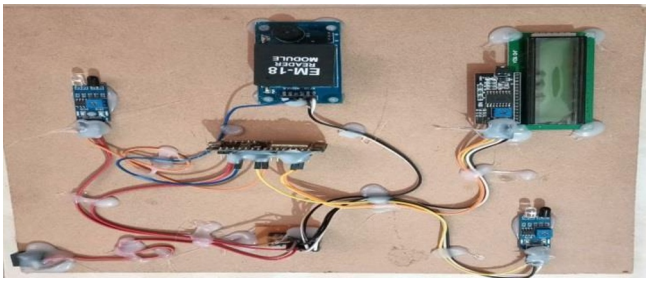


Fig:2 Circuit

The above figure consists of complete set with a RFID Module which is employing radio waves and scans the tag by placing the tag nearer to module and gives a beep sound when the tag is scanned ,a LCD which is 2x16 display which displays the count of the students in the class and IR sensor which increments or decrements by one when person comes in or goes out respectively.

5.1. Code Uploaded and compiled

The figur3e depicts after entering the student's information into the RFID tags, we will use a program to read the information from the card and send it to Google Sheets. It is the primary application used to transmit data to Google Spreadsheet. The MFRC522 library, which can be downloaded from the library manager and is necessary for the RFID reader module to function, needs to be installed. The program includes the Google spreadsheet's URL, where the pupils' data will be uploaded. In order to link the NODEMCU and RFID module to the Wi-Fi, we must provide the Wi-Fi SSID and Wi-Fi password in the program. Select NODEMCU from the board drop-down menu in the tools menu, then click the upload button to upload the code to NODEMCU. After launching the serial monitor with the code. The project will first establish a Wi-Fi connection. Now, set the RFID tag close to the RFID module so that it can be analysed. The time and date are uploaded to a Google spreadsheet along with the name that is contained in the tag. The status Code 302 indicates that the data was successfully sent to a Google Spreadsheet.

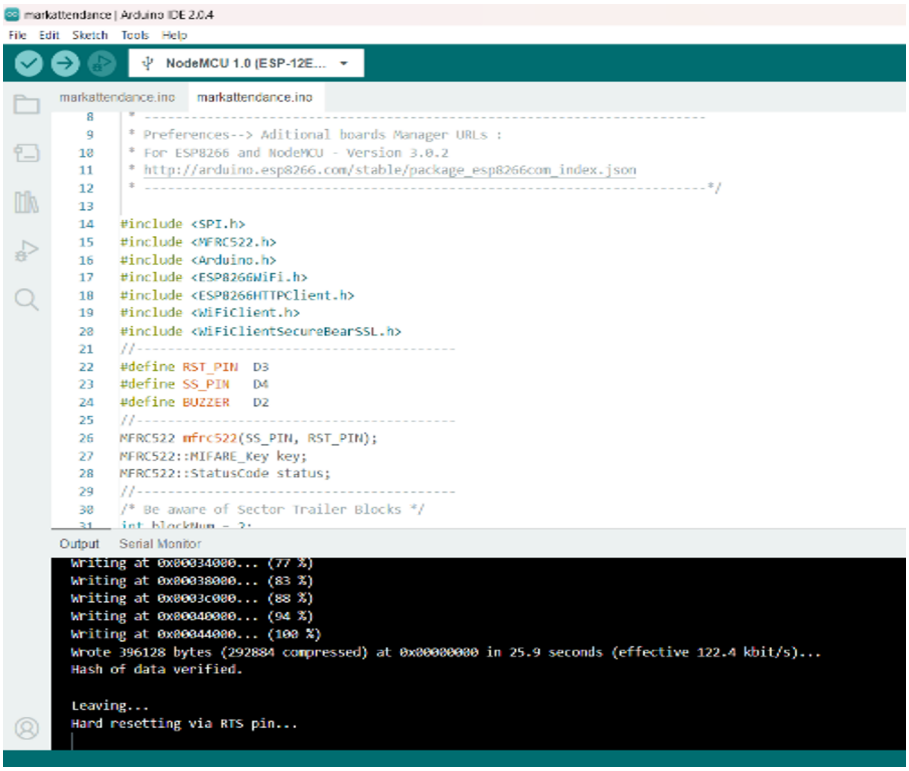
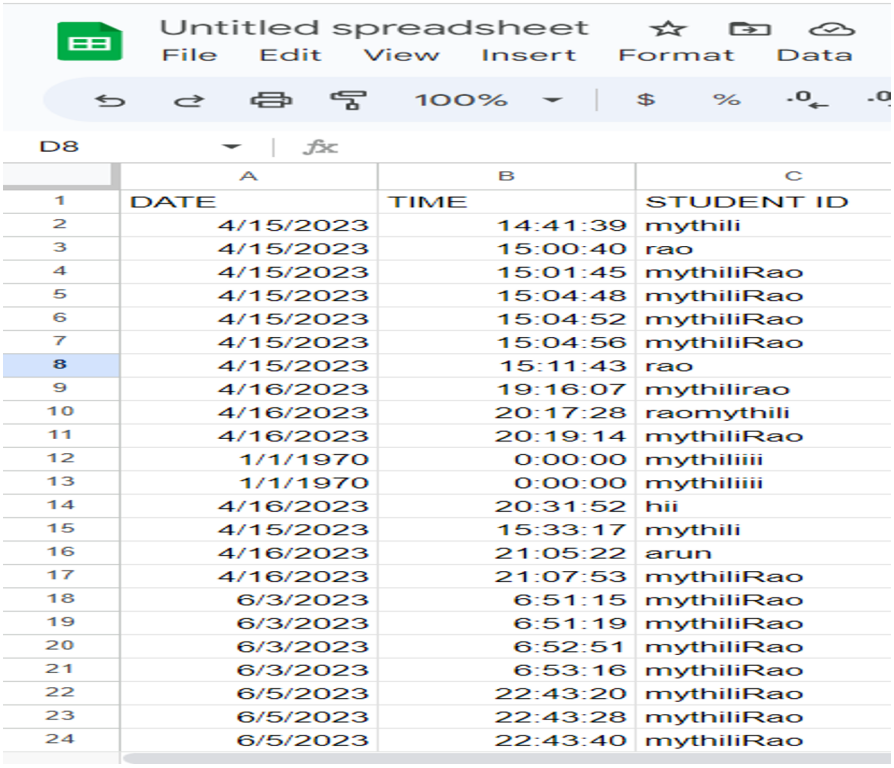


Fig3: compiled and uploaded code

Uploading Student Data Into Google Sheets:
The code needs to be compiled when the RFID scanner is connected to NODEMCU in accordance with the architectural diagram. The student's information that must be uploaded to the RFID tag is contained in the code. There can only be 16 characters in a name, and no blank spaces are permitted. After compilation, put the provided code into the board's

NODEMCU. 5. Now open the serial monitor in the IDE; a message and an RFID tag scan are seen. Move the card up against the RFID reader. The name "ah" is stored in the tag below where the card is detected. By doing so, we can save student information in various RFID. After that, a program is developed that reads the reader module data from the student card and sends the output it produces to Google Sheet



	A	B	C
1	DATE	TIME	STUDENT ID
2	4/15/2023	14:41:39	mythili
3	4/15/2023	15:00:40	rao
4	4/15/2023	15:01:45	mythiliRao
5	4/15/2023	15:04:48	mythiliRao
6	4/15/2023	15:04:52	mythiliRao
7	4/15/2023	15:04:56	mythiliRao
8	4/15/2023	15:11:43	rao
9	4/16/2023	19:16:07	mythilirao
10	4/16/2023	20:17:28	raomythili
11	4/16/2023	20:19:14	mythiliRao
12	1/1/1970	0:00:00	mythiliiii
13	1/1/1970	0:00:00	mythiliiii
14	4/16/2023	20:31:52	hii
15	4/15/2023	15:33:17	mythili
16	4/16/2023	21:05:22	arun
17	4/16/2023	21:07:53	mythiliRao
18	6/3/2023	6:51:15	mythiliRao
19	6/3/2023	6:51:19	mythiliRao
20	6/3/2023	6:52:51	mythiliRao
21	6/3/2023	6:53:16	mythiliRao
22	6/5/2023	22:43:20	mythiliRao
23	6/5/2023	22:43:28	mythiliRao
24	6/5/2023	22:43:40	mythiliRao

Fig:4 Google Spread Sheet

IR SENSOR SHOWING TOTAL COUNT OF THE STUDENTS:

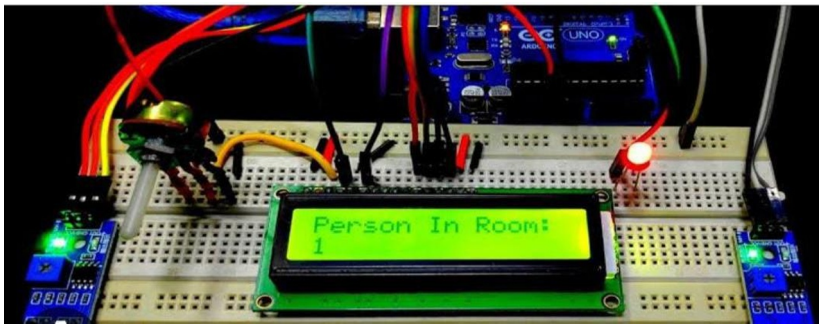


Fig5: LCD Display

Student detection with IR sensor
The student will be identified as they cross the IR sensor, and the number of students in the class will then automatically increase as a result. The count will not be increased if the sensor does not detect a student. The appliances will only operate based on the number of pupils; otherwise, they won't turn on. A IR sensor can be positioned at the entrance to the classroom to cross-check the attendance of pupils and maintain track of the students are displayed on an LCD display.As more students come into the classroom, the count on the LCD Screen grows.
During the testing phase, We conducted a formal testing method based on function processing and user requirements is called acceptance testing. It determines whether the software meets with the specifications provided by the user. A process akin to black box testing is used to test the system acceptability level with the necessary number of users. This is the software testing process' fourth and last stage.Users perform user acceptability testing (UAT), a type of testing, prior to accepting the finished product. UAT is normally carried out by the client (domain expert) to verify satisfaction and check whether the application is operating in accordance with given real-world business scenarios.In this testing, we prepare the test integration plan and the required frameworks. Decide on the type of integration testing approach, such as Bottom-Up, Top-Down, Sandwich testing, or Big Bang. Design test scenarios, cases, and scripts accordingly. Deploy the chosen modules together and execute the test cases. Track and fix the defects and re-test if necessary. Repeat the above steps until the complete system is tested.

6 Conclusion and Future Enhancement

In this study, the fundamental objective of a proxy-free RFID-based attendance system that uses IR sensors and counting logic has been successfully accomplished. This creative endeavour offers a substantially more practical technique of taking attendance than the conventional ones do. This system efficiently recognizes any efforts at proxy attendance and instantly notifies the necessary staff by integrating IR sensors and counting logic. This system's ease of use is one of its main benefits. People won't need to manually sign in or keep attendance records on paper if RFID technology is implemented because they can just carry an RFID-enabled card or tag. They automatically register their attendance as soon as they enter the specified area because the IR sensors recognize the RFID card's presence. As society gradually transitions to a contactless environment, RFID technology is growing and developing. This technology can also help us progress towards a sustainable environment through sustainable development by reducing carbon emissions. Even more so since, unlike

barcode scanners, RFID does not require that the tag be directed straight at the reader, as is the case with barcode scanners. Instead, even from a few feet distant from the reader, the user can still receive a scan. Additionally, to being cost-effective, RFID reduces the likelihood of mistakes and malpractice. Another thing to keep in mind is that, should the necessity arise, this system can be further improved by adding elements like a fingerprint scanner, face detection system, or iris scanner. Additionally, the use of this RFID-based system can be broadened to include a variety of tasks including library management and parking security management, among others.

7 References

1. K. Aravindhan, S. K. B. Sangeetha, K. Periyakaruppan, K. P. Keerthana, V. SanjayGiridhar and V. Shamaladevi "Design of Attendance Monitoring System Using RFID" 2021 7th International Conference on Advanced Computing and Communication Systems (ICACCS), Coimbatore, India, 2021.
2. S H V K Ashok , N DishniDivya , Fredrick Samuel , Prof. Dr. Uttam Mande" RFID Based Attendance System" International Journal for Research in Applied Science & Engineering Technology (IJRASET), Volume 10 Issue XII Dec 2022.
3. H. K. Nguyen and M. T. Chew, "RFID-based attendance management system," 2017 2nd Workshop on Recent Trends in Telecommunications Research (RTTR), Palmerston North, New Zealand, 2017, pp. 1-6, doi: 10.1109/RTTR.2017.7887874.
4. A. Jinushia R., S. Senthilkumar, S. Bhuvaneswari and E. Clapton, "Smart Monitoring System using RFID Technology," 2020 6th International Conference on Advanced Computing and Communication Systems (ICACCS), Coimbatore, India, 2020, pp. 1430-1433, doi: 10.1109/ICACCS48705.2020.9074448.
5. Darwin C. Mangca, "Enhanced Attendance Monitoring: Utilizing QR Code for Online Attendance with Laravel Framework and SMS Notification", International Journal of Advanced Research in Science, Communication and Technology, pp.237, 2023.
6. K Balakrishna, B R Ganesh Prasad, N D Dhanyashree, V Balaji, N M Krishna, "IoT based Class Attendance Monitoring System using RFID and GSM", 2021 IEEE International Conference on Mobile Networks and Wireless Communications (ICMNWC), pp.1-5, 2021.
7. L. Shi and Q. Li, "An attendance system design based on RFID technology," 2020 8th International Conference on Orange Technology (ICOT), Daegu, Korea (South), 2020, pp.
8. U. Koppikar, S. Hiremath, A. Shiralkar, A. Rajoor and V. P. Baligar, "IoT based Smart Attendance Monitoring System using RFID," 2019 1st International Conference on Advances in Information Technology (ICAIT), Chikmagalur, India, 2019, pp. 193-197, doi: 10.1109/ICAIT47043.2019.8987263.
9. S. N. Shah and A. Abuzneid, "IoT Based Smart Attendance System (SAS) Using RFID," 2019 IEEE Long Island Systems, Applications and Technology Conference (LISAT), Farmingdale, NY, USA, 2019.
10. P. Kovelan, N. Thisenthira and T. Kartheeswaran, "Automated Attendance Monitoring System Using IoT," 2019 International Conference on Advancements in Computing (ICAC), Malabe, Sri Lanka, 2019, pp.
11. Anurag Shrivastava, S. J. Suji Prasad, Ajay Reddy Yeruva, P. Mani, Pooja Nagpal, Abhay Chaturvedi, "IoT Based RFID Attendance Monitoring System of Students using Arduino ESP8266 & Adafruit.io on Defined Area", Cybernetics and Systems, pp.1, 2023.
12. A. A. Radhi and F. M. Al-Naima, "A proposed prototype design of a student attendance system based on a combined RFID -WSN technology," 3rd Smart Cities Symposium (SCS 2020), Online Conference, 2020, pp. 516-520, doi: 10.1049/icp.2021.0932.

13. A. Chomklin, L. N. Nongkhai and P. Padungpattanadis, "Class Attendance Recording using QR Code via Smartphone," 2019 4th International Conference on Information Technology (InCIT), Bangkok, Thailand, 2019, pp. 173-178, doi: 10.1109/INCIT.2019.8912099.
14. I. Meghana, J. D. N. V. L. Meghana and R. Jayaraman, "Smart Attendance Management System using Radio Frequency Identification," 2020 International Conference on Communication and Signal Processing (ICCSP), Chennai, India, 2020, pp. 1045-1049, doi: 10.1109/ICCSP48568.2020.9182167.
15. F. R. Basthomi et al., "Implementation of RFID Attendance System with Face Detection using Validation Viola-Jones and Local Binary Pattern Histogram Method," 2019 International Symposium on Electronics and Smart Devices (ISESD), Badung, Indonesia, 2019, pp. 1-6, doi: 10.1109/ISESD.2019.8909430.
16. Yerragudipadu subbarayudu , alladi Sureshbabu "Distributed Multimodal Aspective on Topic Model Using Sentiment Analysis for Recognition of Public Health Surveillance" Expert Clouds and Applications, 16 July 2021, DOI: https://doi.org/10.1007/978-981-16-2126-0_38
17. Yerragudipadu Subbarayudu , Adithi Soppadandi , Shreya Vyamasani and Supriya Bandanadam1, The Distributed Deep Learning Paradigms for Detection of Weeds from Crops in Indian Agricultural Farms, E3S Web of Conferences 391, 01057 (2023) https://doi.org/10.1051/e3sconf/202339101057 ICMED-ICMPC 2023.
18. Subbarayudu Yerragudipadu , Vijendar Reddy Gurram ,Navya Sri Rayapudi , Bhavana Bingi , Likhitha Gollapalli1 and Ukritha peddapatlolla, An Efficient Novel Approach on Machine Learning Paradigmsfor Food Delivery Company through Demand Forecastıng in societal community, E3S Web of Conferences 391, 01089 (2023) https://doi.org/10.1051/e3sconf/202339101089 ICMED-ICMPC 2023.
19. Yerragudipadu Subbarayudu , G Vijendar Reddy , M Vamsi Krishna Raj , K Uday , MD Fasiuddin , and P Vishal, An efficient novel approach to E-commerce retail price optimization through machine learning, E3S Web of Conferences 391, 01104 (2023) https://doi.org/10.1051/e3sconf/202339101104 ICMED-ICMPC 2023.
20. Subbarayudu, Y., Sureshbabu, A. (2023). A distributed densely connected convolutional network approach for enhanced recognition of health-related topics: A societal analysis case study. Ingénierie des Systèmes d'Information, Vol. 28, No. 3, pp. 677-684. https://doi.org/10.18280/isi.280317
21. Prasanna Lakshmi, K., Reddy, C.R.K. A survey on different trends in Data Streams (2010) ICNIT 2010 - 2010 International Conference on Networking and Information Technology, art. no. 5508473, pp. 451-455.
22. Jeevan Nagendra Kumar, Y., Spandana, V., Vaishnavi, V.S., Neha, K., Devi, V.G.R.R. Supervised machine learning Approach for crop yield prediction in agriculture sector (2020) Proceedings of the 5th International Conference on Communication and Electronics Systems, ICCES 2020, art. no. 09137868, pp. 736-741.
23. Sankara Babu, B., Suneetha, A., Charles Babu, G., Jeevan Nagendra Kumar, Y., Karuna, G. Medical disease prediction using grey wolf optimization and auto encoder based recurrent neural network (2018) Periodicals of Engineering and Natural Sciences, 6 (1), pp. 229-240.
24. Nagaraja, A., Boregowda, U., Khatatneh, K., Vangipuram, R., Nuvvusetty, R., Sravan Kiran, V. Similarity Based Feature Transformation for Network Anomaly Detection (2020) IEEE Access, 8, art. no. 9006824, pp. 39184-39196.