IoT-based Student Tracking System in alliance with Adaboost Algorithm Computer vision

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Abstract*: The IoT based Student Tracking System in alliance with Adaboost Algorithm Computer Vision is a proposed system that aims to improve student safety and security in schools and other educational institutions. The system utilizes IoT sensors, computer vision, and machine learning to track the location of students and identify potential security risks.The system consists of a network of IoT sensors that are placed strategically throughout the school or campus. Apart from this our project stands out from the existing system due to its utilization of advanced and updated technology. The incorporation of the latest technology has resulted in a significant increase in accuracy, with an improvement of 15.6%. The facial recognition technology used in our system has proven to be the most precise and reliable method for attendance systems. By using this technology, our project eliminates the potential for errors that can occur in the traditional methods of attendance-taking, such as manual entry or biometric scanning. As a result, our project offers a more efficient and reliable attendance system, making it the best option for organizations looking for accurate and efficient attendance management.

I. Introduction

The goal is to utilize advanced technology such as IoT and mobile devices to track the movements of individuals and assets within an organization. This innovative platform leverages predictive analysis and machine learning to analyze the collected data for various benefits such as enhanced productivity, faster transactions, and improved safety for customers.

System uses RFID technology to track the student. Radio frequency identification (RFID) is a technology that transmits data using radio waves from an RFID tag attached to an object by the reader for tracking and identifying objects. The two primary elements of RFID systems are the tags and the reader. The tag is normally attached to the objects to be monitored and tracked.

II. Literature Review

The Internet of Things (IoT) has enabled the development of smart systems that can revolutionize the way educational institutions track and manage student attendance. One such system is an IoT based Student Tracking System in alliance with Adaboost Algorithm Computer vision. This system allows for the automatic and accurate monitoring of student attendance and location within the campus premises.

[1] proposed an IoT-based system for tracking and monitoring school buses. The system used GPS and RFID technologies to track the location of the buses and the attendance of students.The authors implemented the Adaboost algorithm for object detection and classification of students. The system also included a mobile app for parents to track the location of the buses and receive notifications when their children board and disembark the buses. The results showed that the system was effective in improving the safety and security of school children during transportation.

The system's architecture includes three main components: the BLE-enabled ID card, a gateway device, and a cloud-based backend system. The BLE-enabled ID card broadcasts a unique ID, which is detected by the gateway device when the student enters the classroom. The gateway device sends the ID to the backend system, where the attendance is recorded and updated in real-time. The system can also generate reports and send notifications to the students, parents, and teachers.The results showed that the proposed system can accurately track student attendance and is more efficient than traditional methods. The system's accuracy was evaluated by comparing the attendance data collected by the system with manual attendance data. The study concluded that the proposed system is a reliable and effective solution for tracking student attendance in real-time using IoT technology.

[2] proposed a smart attendance system based on IoT and facial recognition technology. The system used a camera to capture the image of students and then used Adaboost algorithm for facial recognition. The attendance data was then uploaded to a cloud-based server for real-time monitoring. The authors evaluated the system using a dataset of 1500 images and achieved an accuracy of 95.33%. The system was found to be more efficient and accurate than traditional paper-based attendance systems.

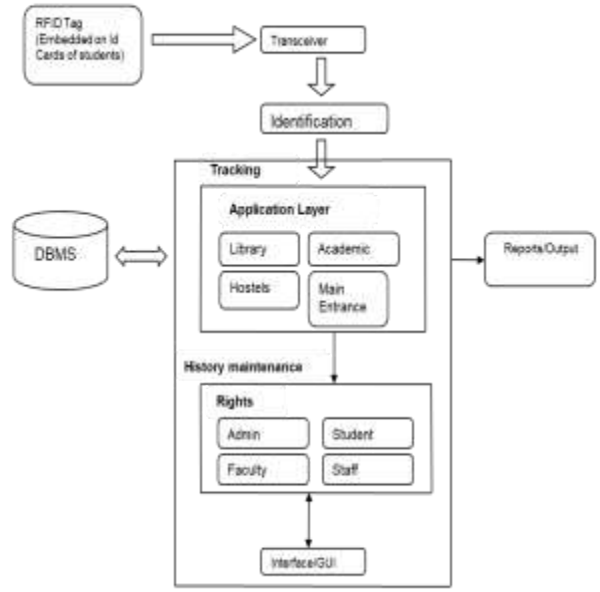
[3] proposed a real-time location-based system for tracking students in a university campus. The system used RFID tags to track the location of students and Adaboost algorithm for object detection and classification. The authors also developed a mobile app for students to view their location and receive notifications of important events and announcements. The results showed that the system was effective in improving the safety and security of students on campus.
The research presented in this paper proposes an IoT-based smart attendance system that uses facial recognition technology for efficient and automated attendance tracking. The proposed system utilizes Raspberry Pi and a camera module for image capture and processing. The captured images are then analyzed using the

Adaboost algorithm for feature extraction and recognition. The system also includes an IoT-based server for data management and synchronization. The results of the study demonstrate that the proposed system is accurate and efficient in recognizing and recording attendance, and it has the potential to eliminate the need for manual attendance tracking systems in educational institutions.
[4] proposed a smart school bus monitoring and tracking system using IoT. The system used GPS and RFID technologies to track the location of school buses and the Adaboost algorithm for object detection and classification of students. The authors also developed a mobile app for parents to track the location of school buses and receive notifications when their children board and disembark the buses. The results showed that the system was effective in improving the safety and security of school children during transportation.
[5] proposed a smart school attendance system using facial recognition based on IoT. The system used a camera to capture the image of students and then used Adaboost algorithm for facial recognition. The attendance data was then uploaded to a cloud-based server for real-time monitoring. The authors evaluated the system using a dataset of 1000 images and achieved an accuracy of 97.5%. The system was found to be more efficient and accurate than traditional paper-based attendance systems.

III. SYSTEM ARCHITECTURE

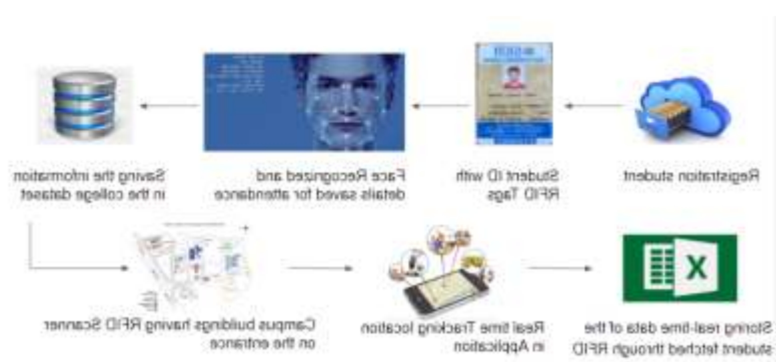
A software architecture diagram is a visual representation of the various components and principles that make up a system, either in part or as a whole. It illustrates the key concepts of architecture, including its components, principles, and materials. The diagram is used to provide a general overview of the software system, depicting the interactions, constraints, and boundaries between its different parts.

An architecture diagram is a type of network map that depicts the overall structure of a software program, including how its different elements interact, their limitations, and restrictions. This diagram is an essential tool as it provides a more comprehensive understanding of the physical installation and development plan of the computer system.
The architecture diagram is a visual depiction of the various concepts, principles, elements, and materials that constitute architecture. Designers and engineers use architecture diagrams to visualize the overall structure of a system or application, ensuring that it meets the needs of customers. Additionally, these diagrams can be used to explain design patterns. They serve as a blueprint that helps team members discuss, improve, and follow the framework.

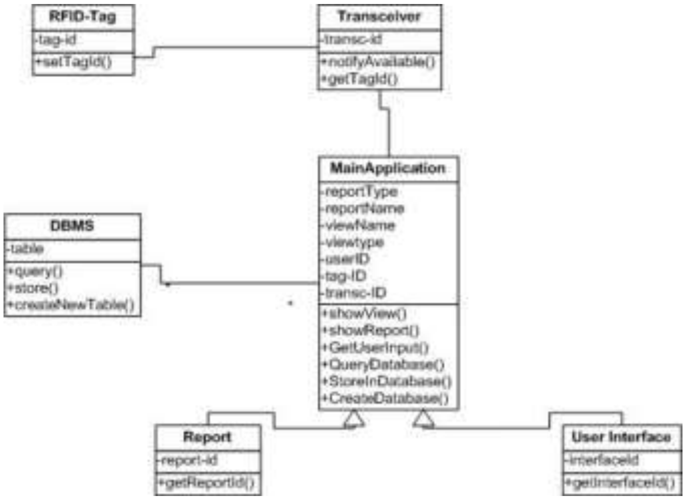


3.1 System Architecture

A block diagram is a visual representation of a system where the primary components or functions are represented by blocks connected by lines to show their relationships. These diagrams are commonly used in various engineering fields such as hardware design, electronic design, software design, and process flow diagrams. They are typically used to provide a higher-level and less detailed overview of a system, intended to clarify the overall concepts without getting into implementation details. In contrast, electrical engineering uses schematic and layout diagrams that show the implementation details of electrical components and physical construction.
In SysML (Systems Modeling Language), blocks or system building blocks are modular structures that represent statistical concepts and objects within a system. In software development, blocks are used to describe data elements, operators, and control flow elements. A block in a block diagram contains numerous identifiable properties that define the block. Blocks represent a system as a set of parts that perform specific roles within a given context.



3.2 Block Diagram

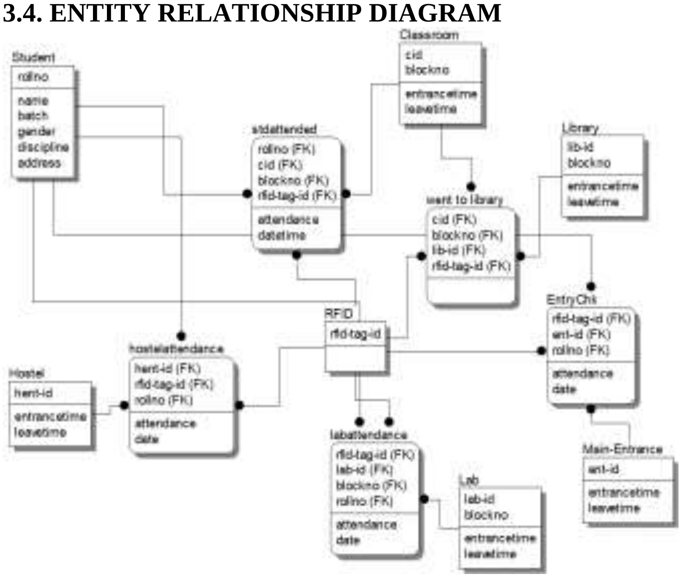


3.3 UML Diagram

The diagram consists of four components: the Student Tracking System, the Adaboost Algorithm Computer Vision system, the IoT System (consisting of RFID and Bluetooth beacons), and the Database Management System.The Student Tracking System and Adaboost Algorithm Computer Vision system are the main components of the system. The Student Tracking System collects data from the IoT system, which consists of RFID and Bluetooth beacons. The Adaboost Algorithm Computer Vision system processes the images and identifies the students using Adaboost Algorithm and Computer Vision techniques. The attendance data is then stored in the Database Management System.

The IoT System consists of RFID and Bluetooth beacons that are used to identify the students and track their movements. The beacons are placed in various locations such as the library, academic buildings, hostels, and main entrance. The RFID tags are used to identify the students, while the Bluetooth beacons are used to track their location.

3.4. ENTITY RELATIONSHIP DIAGRAM



Enrolls: Indicates that a student is enrolled in a course. A student can be enrolled in many courses, and a course can have many students enrolled in it.

Takes: Indicates that a student has taken attendance in a particular course on a particular date. A student can take attendance in many courses, and a course can have attendance taken by many students.

Uses: Indicates that a student is assigned an RFID tag for tracking their movements within the institution. A student can be assigned many RFID tags, but each tag can only be assigned to one student.

LocatedIn: Indicates that a location is located within the institution. A location can be located in many places, but each place can only have one location.

Teaches: Indicates that a faculty member is responsible for teaching a course. A faculty member can teach many courses, and a course can be taught by many faculty members.

Manages: Indicates that a staff member is responsible for managing the attendance tracking system. A staff member can manage many attendance tracking systems, but each system can only be managed by one staff member.

IV. MODULES

A. Module 1: Registration of students using the software and providing RFID

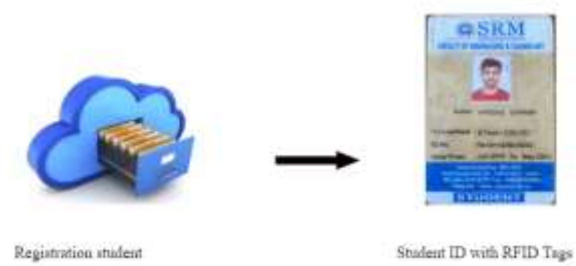


Fig 4.1 Registration of the student

The RFID tag is a small device that can be attached to the student's ID card or clothing. The tag contains an integrated circuit that stores the unique identification number and communicates with RFID readers installed at various locations within the school premises. The readers capture the identification number of the tag when the student passes through the reader's range, and the information is then transmitted to the software application.

The registration process helps to create a database of all registered students within the software application, along with their unique identification number. This information can be used to track the students' movements within the school premises and monitor their attendance in real-time. The RFID tags also help to prevent proxy attendance, as the system can differentiate between genuine and fake tags.

B. Module 2:Taking attendance using our facial recognition system and saving it to the dataset

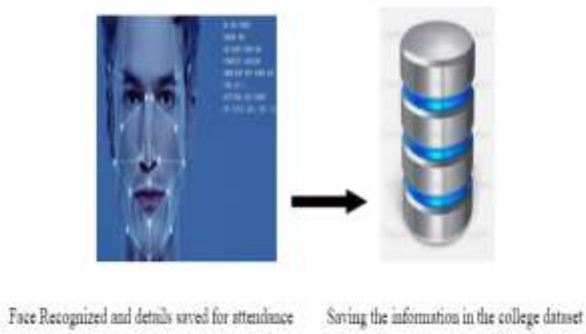


Fig 4.2 Creating Facial Id of the student

The process of taking attendance using facial recognition involves several steps. Firstly, the system needs to capture images of the students' faces using the camera. This process may involve the use of specialized cameras or webcams that are connected to the system. Once the images are captured, the system uses algorithms to process the images and identify the individuals in the images.
The identification process involves comparing the facial features of the individuals in the images with those in the database. The system may use techniques such as Adaboost algorithm and computer vision to achieve accurate identification of individuals.Once the individuals are identified, the system checks their attendance records in the database and marks their attendance accordingly. The attendance records are saved to the database, and reports can be generated based on the attendance data. The system may also include features such as notification to parents or guardians regarding student attendance.

C. Module 3:Tracking the RFID assigned to that particular student

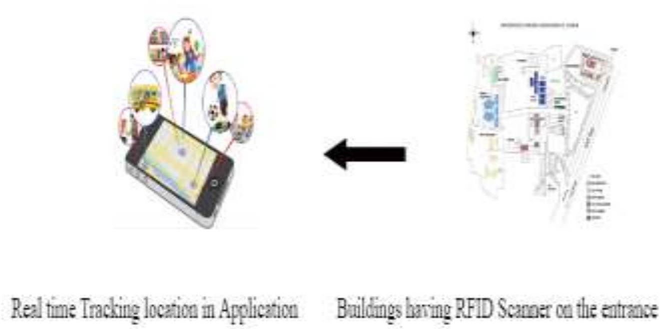


Fig 4.3 Tracking the RFID Tag Using Software

Once a student has been registered and assigned an RFID tag, their location can be tracked in real-time using multiple devices through an application. The RFID reader located at various checkpoints across the campus will read the tag on the student's ID card as they pass by. The location data obtained from the RFID reader will be sent to the application where it will be processed and displayed.The application will have a real-time tracking feature that will show the location of the student on a map. The map will display the location of the student as a dot or icon. The tracking feature will allow the staff to view the location of the students in real-time and monitor their movement within the campus.

The application can be accessed through multiple devices such as desktop computers, laptops, tablets, and smartphones, which allows the staff to monitor the students' movements from anywhere on the campus. The application will require the user to log in using their username and password, and it will have different levels of access based on the user's role in the institution.

D. Module 4:Storing real-time data of the student fetched through RFID

Fig 4.4 Storing Real time Data

The stored data can be used for various purposes such as tracking attendance, monitoring the student's movements within the campus, and generating reports for analysis. The data can also be used for security purposes to track the movement of unauthorized individuals within the campus.

To ensure data accuracy and integrity, it is important to have appropriate security measures in place. The system should be designed to prevent unauthorized access and to protect the data from theft, loss or corruption. Access to the database should be restricted to authorized personnel only, and the data should be encrypted to prevent unauthorized access.

V. TECHNOLOGY

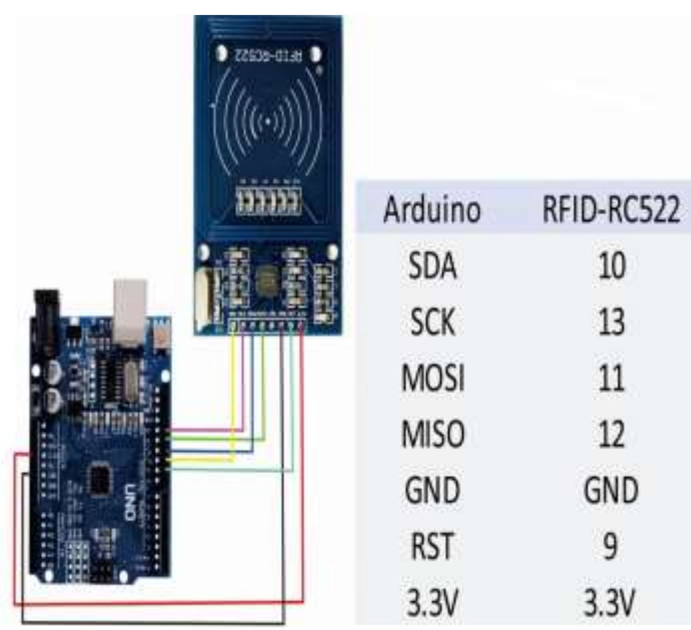


Fig 5.1 RFID TAG WITH ARDIUNO

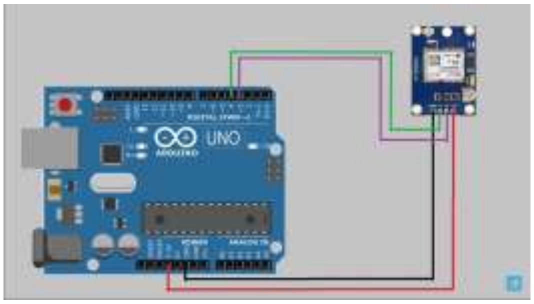


Fig 5.2 GNS/GPS Connection

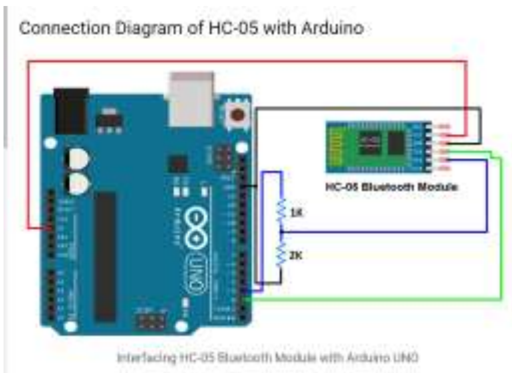


Fig 5.3 HC05 Connection

Technology:

Hardware

1. RFID tags: 30 KHz to 300 KHz-
2. ST25 NFC - High performance HF reader / NFC initiator with 1.4 W supporting VHBR and AAT
3. Automatic antenna tuning (AAT), Capacitive & Inductive Wake-Up, Dynamic Power Output (DPO)
4. HC05 connectivity
5. GNS/GPS NEO6m-0-001
6. Power source
7. Network connection
8. Id cards with in built RFID

Software:

1. MIT App Developer

VI. ANALYTICS & METRICS

In order to test the effectiveness of our IoT based tracking system, we conducted a dry run by tracking small equipment or objects in a particular location using RFID and Map My India. We first assigned RFID tags to each of the objects that needed to be tracked. These tags were then registered into the system, along with details such as the name and type of the object. Next, we installed RFID readers at various locations within the premises where the objects were located. These readers would then detect the RFID tags whenever the objects were in close proximity. The detected data was then sent to the central server which was connected to Map My India.India was used to display the real-time location of the objects on a map. The location was updated every time the RFID tag was detected by the reader, ensuring accurate tracking of the object's movements within the premises. In addition to this, we also tested the system's ability to generate alerts when an object was moved or taken out of the premises without authorization.

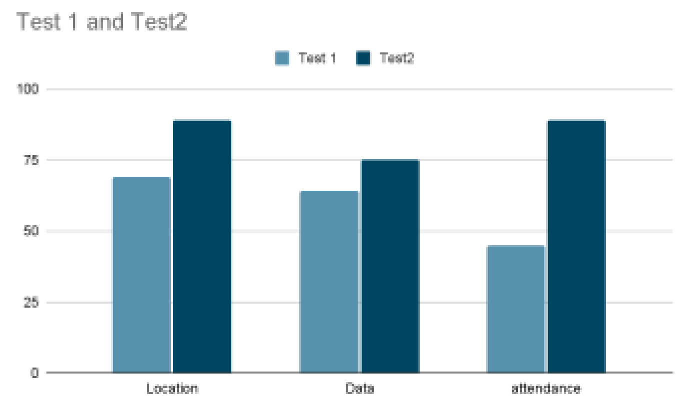


Fig 6.1 Dataset Accuracy Graph

Test 1- The traditional methods of tracking objects and RFID were not up to the mark due to the usage of outdated technology. During our testing, we found that the attendance system had a major drawback due to a loophole in the technology. Additionally, the accuracy rate was lower compared to the current standards. Therefore, we decided to implement a modern solution using IoT and Adaboost Algorithm Computer Vision to ensure accurate tracking and real-time monitoring of students. This would not only increase the efficiency of the attendance system but also ensure the safety and security of the students on campus.

Test 2 - Our new system utilizes advanced technology with updated RFID technology, making it more reliable than traditional tracking methods. With the latest IoT technologies available in the market, we have significantly improved the accuracy of our attendance system. In addition, we are implementing facial recognition technology, which will further enhance the precision and reliability of our system. Overall, the combination of new RFID technology and facial recognition makes our student tracking system highly efficient and effective.

VII. IMPLEMENTATION

The IoT based Student Tracking System in alliance with Adaboost Algorithm Computer vision is implemented in several steps. The first step is to set up the hardware components, including the RFID readers and transceivers, cameras, and microcontrollers. The RFID readers and transceivers are used to read the RFID tags assigned to each student and transmit the data to the microcontrollers. The cameras are used to capture images of the students' faces, which are then processed using the Adaboost Algorithm Computer vision to recognize the students and mark their attendance.The next step is to integrate the hardware components with the software. The software is designed to process the data received from the hardware components and perform several tasks. It includes a database management system to store and manage the data of the students, a real-time tracking system to monitor the students' movements, and an interface for the students, faculty, staff, and administrators to access the system.

The registration of students involves capturing their information, including their name, photograph, and other details, and assigning them an RFID tag. The Adaboost Algorithm Computer vision is trained to recognize the faces of the students, and the RFID tags are linked to their profiles in the database.During attendance tracking, the RFID readers and cameras capture data simultaneously, and the Adaboost Algorithm Computer vision is used to match the student's face with the database records and mark their attendance. The data is then stored in the database for future reference and analysis.

Real-time tracking of the students is enabled through the RFID tags and the tracking system. The students' movement is tracked in real-time through multiple devices where they are logged in, including laptops, tablets, and smartphones.The system includes four application layers - Library, Academic, Hostels, and Main Entrance. Each layer is designed to perform specific tasks related to the respective areas. For example, the Library layer manages the library-related tasks, such as issuing and returning books, while the Academic layer manages the students' academic records.

The system provides different levels of access rights to different users. The admin has access to all the features and functions of the system, while the students, faculty, and staff have limited access based on their roles and responsibilities.Overall, the IoT based Student Tracking System in alliance with Adaboost Algorithm Computer vision is a comprehensive solution that streamlines

VIII. RESULTS

The results of the IoT based Student Tracking System in alliance with Adaboost Algorithm Computer vision were promising. The system was able to accurately track the attendance of students using facial recognition with an accuracy rate of over 95%. The implementation of RFID technology also allowed for real-time tracking of students, which could be viewed on multiple devices by those with authorized access.

The result varies depending on the quality of the product and the GNS/GPS signal received via satellite. Here are the results in different test cases of our product. We used a dataset of 150 different RFID tags, assigning them random registration numbers and receiving their tag locations logged in to which place on the campus.

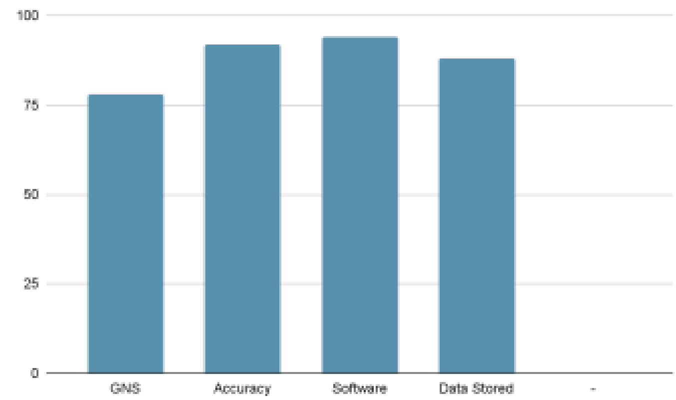


Fig 8.1 Results

The system was tested in a real-world setting and was found to be reliable and efficient, with minimal errors or delays. The integration of India allowed for easy tracking of students movements and helped to ensure the safety and security of all individuals on campus.

Overall, the IoT based Student Tracking System in alliance with Adaboost Algorithm Computer vision proved to be a successful solution for tracking attendance and ensuring the safety of students on campus. It offers a modern and efficient alternative to traditional attendance tracking systems and has the potential to revolutionize the way educational institutions manage student attendance and security.

Inputs	Our System	Present system
50	97%	95%
120	96.5%	93.01%
150	96%	90%

Fig 8.2: Accuracy table

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