

**EduTrack**

**Student & Learning Ecosystem**

**Prepared To:**

Intelligent Systems Department

***Faculty of Computer and Data Science***

**Prepared By:**

Ahmed Gamal – 20221459969 Ziad Hany – 20221372971

Moataz Saieed – 20221465979 Rana Yasser – 20221466866

Rana Mostapha – 20221440972 Myar Hany – 20221376556

Mona Badr – 2103111

**Supervisor: Dr. Nancy Diaa**

**Fall 2024 – 2025**

Abstract

EduTrack is an advanced educational tracking and management system designed to optimize school operations and enhance overall effectiveness. EduTrack utilizes cutting-edge technologies such as the Internet of Things (IoT), artificial intelligence (AI), and mobile applications to improve student safety, classroom engagement, and academic outcomes while also providing comprehensive support to parents, teachers, and administrators through actionable insights.

As technology continues to advance, it is essential to incorporate these innovations into educational environments to meet the evolving needs of students, teachers, and administrators. EduTrack is committed to utilizing these advancements to create smart school educational institutions that embrace technology to improve every aspect of school operations. From real-time student transportation tracking and automated attendance recording to classroom engagement monitoring and predictive analytics for student success, EduTrack is designed to transform traditional educational environments into intelligent, connected ecosystems.

The system also integrates efficient inventory management and dynamic environmental adjustments within classrooms using IoT-enabled sensors, ensuring an optimized learning environment. With user-friendly mobile applications, Smart School ensures seamless communication and accessibility for all stakeholders, making it easier for students, parents, teachers, and administrators to engage with the system.

EduTrack is a comprehensive system designed to modernize educational management through cutting-edge technology. The following features are being implemented in the project to enhance school operations and improve the overall educational experience for all stakeholders

**IoT Integration:**

Using Arduino and Raspberry Pi devices, the system integrates sensors to monitor and adjust classroom conditions like temperature, lighting, and occupancy. This ensures an environment conducive to learning by automatically adjusting based on real-time data.

**AI and Computer Vision:**

Advanced AI models such as YOLO (You Only Look Once) are employed for real-time emotion detection and engagement monitoring in classrooms, while face recognition technology is used for automated attendance recording, enhancing security and efficiency.

**GPS and Student Tracking:**

Through GPS technology and the Google Maps API, EduTrack provides real-time bus tracking and records student attendance during transportation. This feature adds an extra layer of safety, ensuring students are always accounted for.

**Mobile Application Development:**

A cross-platform mobile application is being developed using Flutter, offering a user-friendly interface for students, parents, teachers, and administrators. The app includes features like real-time updates on academic progress, notifications, and tools for quiz creation and performance analytics.

**Cloud-Based Data Management:**

A centralized cloud system stores and manages data related to attendance, academic performance, and inventory. Automated alerts notify stakeholders of issues like repeated absences or low inventory, streamlining school operations and decision-making.

**Programming and Technology Stack:**

Programming Languages: Python for backend operations (AI integration and data handling), dart (flutter as framework )for mobile app development.

IoT Devices: Arduino and Raspberry Pi for classroom sensor deployment.

AI Tools: YOLO for emotion detection and engagement analysis, Face Embedding for automated attendance using facial recognition.

GPS Integration: Google Maps API for real-time bus tracking.

Through these innovations, EduTrack aims to transform traditional educational settings into intelligent, connected ecosystems, enhancing safety, engagement, and operational efficiency for students, parents, teachers, and administrators alike., engagement, and efficiency for students, parents, teachers, and administrators.

**Table of Contents**

[1. Introduction 3](#_Toc186674302)

[1.1 Concerns in School Transportation Safety 3](#_Toc186674303)

[1.2. Attendance Tracking Systems 3](#_Toc186674304)

[1.3. Monitoring Student Concentration and Engagement 4](#_Toc186674305)

[1.4. Classroom Resource Management and Environmental Optimization 4](#_Toc186674306)

[2. Smart Classrooms: 4](#_Toc186674307)

[3. The proposed: EduTrack System 5](#_Toc186674308)

[3.1 Objectives of EduTrack 5](#_Toc186674309)

[3.2 Components of the EduTrack System 6](#_Toc186674310)

[3.3 Technologies Used in EduTrack 6](#_Toc186674311)

[3.4 Future Potential 6](#_Toc186674312)

[2. Computer Vision 7](#_Toc186674313)

[3. Internet Of Things 7](#_Toc186674314)

[4. Mobile Application Development 7](#_Toc186674315)

[5. Administration Website 7](#_Toc186674316)

[References 8](#_Toc186674317)

Chapter 1

# 1. Introduction

Education plays a crucial role in shaping the future of individuals and society. However, traditional schools often face significant challenges that hinder the efficiency of educational processes and the overall learning experience. Issues such as outdated attendance systems, ineffective engagement monitoring, and limited resource management which negatively impact both students and teachers. Furthermore, ensuring student safety and maintaining open communication among parents, teachers, and administrators remain persistent challenges.

To better understand the challenges facing traditional schools, it is essential to explore each issue in depth, highlighting their impact on the educational experience and identifying areas for improvement

### 1.1 Concerns in School Transportation Safety

Parents continue to have serious concerns about student safety, especially about school transportation. Even though there are around **500,000** school buses that run every day in the US alone, many parents are concerned about their kids' safety when they get to school. According to surveys, **52%** of parents rank bus safety as their top priority, greatly surpassing all other considerations. However, **64%** of respondents concur that technological developments are urgently needed, and less than half of respondents think their school bus system is safe, effective, or ecologically friendly. Furthermore, **55%** of parents doubt bus drivers' competency and dependability. Additionally, **67%** of parents think they ought to be able to track their child's school bus in real time, just like they can track a delivery. The lack of live tracking and other technological features makes it difficult for parents to feel reassured about their children's safety during their journey.

### 1.2. Attendance Tracking Systems

Attendance tracking in schools is a time-consuming process that relies heavily on manual methods, often leading to errors and inefficiencies. Teachers spend valuable instructional time marking attendance, which not only delays the start of lessons but also opens the door to exploitation. Many students take advantage of the system by asking friends to mark them present or skipping school buses, relying on peers to cover for their absences. Such behavior undermines the integrity of attendance records and disrupts classroom dynamics. Additionally, 37% of public-school teachers report that student tardiness and class skipping interfere with their teaching, further highlighting the need for a more reliable and efficient attendance system. This issue significantly impacts the educational level, as frequent absences and classroom disruptions result in knowledge gaps, reduced academic performance, and lower overall achievement among students.

### 1.3. Monitoring Student Concentration and Engagement

Monitoring students' concentration levels during lessons is a challenging task for teachers, making it difficult to assess engagement and adapt their teaching methods effectively. Without reliable tools to measure focus, teachers struggle to identify students who may be disengaged or falling behind. This lack of insight hinders their ability to adjust lesson delivery in real-time, ultimately impacting the overall learning experience. Moreover, students who fail to concentrate can experience a decline in academic performance, reduced retention of information, which further widening the achievement gap. Additionally, **32%** of public school teachers agreed that student misbehavior interfered with their teaching, further compounding the challenge of maintaining engagement. A system that can accurately measure and track classroom engagement is essential to address these challenges and of course help in supporting a more dynamic and responsive teaching approach.

### 1.4. Classroom Resource Management and Environmental Optimization

The management of classroom resources and environmental factors is a persistent challenge for teachers, affecting both the learning experience and classroom efficiency. Teachers often struggle to track the availability and condition of supplies such as markers, whiteboards, and other materials, leading to disruptions during lessons. Additionally, environmental factors such as lighting and temperature are often not optimized for student comfort, which can impact engagement and focus. There is also a lack of real-time monitoring, which makes it difficult to address issues promptly, such as running out of supplies or uncomfortable classroom conditions.

Traditional methods of inventory management and environmental control are manual, time-consuming, and prone to human error. Teachers may not always notice when supplies are low, or environmental conditions are unsuitable, resulting in inefficiencies and disruptions. Moreover, managing these elements in a dynamic classroom with varying numbers of students and changing conditions can be overwhelming without automated systems.

## 2. Smart Classrooms:

The classroom is a very important part of learning. It is where students gain knowledge and study different subjects, starting from a young age until they reach college. According to the OECD Library, people in countries like the United States, Canada, and the United Kingdom spend about **7,634 hours** in school during their primary and lower secondary years. This means that around **9 years** of a person’s life are spent learning in schools and classrooms.

Smart Classrooms are classrooms that use various digital technologies to give students a better learning experience. Today, many classrooms are already equipped with tools like Smart Boards, Internet access, PCs, Digital Cameras, and many other devices.

Smart Classrooms make it easier for students to understand lessons and improve the way knowledge is shared. It’s not just the students who benefit from Smart Classrooms; teachers also use these tools to improve their teaching. With the help of these digital technologies, teachers can change and adapt their teaching methods to make lessons more interactive and engaging.

Nowadays, a wide variety of technologies are being used in Smart Classrooms to improve the way students learn. These technologies include Interactive Smart Boards, Projectors, Tablets, Laptops, the Internet, and many others. Their main purpose is to make it easier for teachers to deliver lessons and for students to understand the material more effectively. These tools help create a more interactive and engaging learning environment, which makes education more fun and efficient.

In addition to these tools, new and advanced technologies like Artificial Intelligence (AI), the Internet of Things (IoT), big data analytics, and Machine Learning are becoming more popular. These emerging technologies are expected to completely transform education in the future, bringing new opportunities for personalized learning and smarter teaching methods. This means that the way students learn today might look very different from how the next generation will experience education.

## 3. The proposed: EduTrack System

The EduTrack System is our innovative approach to addressing the challenges faced in traditional educational settings. By leveraging advanced artificial intelligence and modern digital technologies, EduTrack aims to revolutionize the way education is managed and experienced, ensuring efficiency, safety, and engagement for all stakeholders.

EduTrack is designed to provide comprehensive solutions for schools by integrating smart technologies to enhance classroom environments, simplify administrative tasks, and improve communication between students, parents, teachers, and administrators. This project aims to bridge the gap between the limitations of conventional education systems and the potential of intelligent education system .

### 3.1 Objectives of EduTrack

EduTrack is developed to achieve the following objectives:

1. **Enhancing Safety:** Implementing real-time tracking systems for school buses and improving school transportation safety for students.
2. **Streamlining Attendance Management:** Introducing AI-powered automated attendance tracking systems to ensure accuracy and save valuable teaching time.
3. **Improving Engagement Monitoring:** Providing tools to track and analyze student concentration levels and engagement during lessons to create a more dynamic and interactive learning experience.
4. **Optimizing Resource Management:** Automating classroom inventory and environmental management to improve efficiency and maintain optimal learning conditions.

### 3.2 Components of the EduTrack System

EduTrack integrates multiple components tailored to futter different user needs such as:

1. AI-Powered Insights: Analytics tools for tracking student performance, predicting learning outcomes, and identifying areas for improvement.
2. Attendance Tracking: Automated attendance systems that use advanced identification technologies to ensure accuracy and minimize manual errors.
3. Engagement Monitoring: Tools to assess and report on student focus and participation, enabling teachers to adapt their teaching strategies in real time.
4. Resource Optimization: Smart systems for tracking classroom supplies and environmental conditions, ensuring a smooth and efficient learning process.
5. Communication Enhancements: Platforms for seamless communication among students, parents, and school staff, fostering collaboration and transparency.

### 3.3 Technologies Used in EduTrack

EduTrack to perform all the mentioned requirements, edutrack incorporates cutting-edge technologies like :

Artificial Intelligence (AI): For personalized learning paths, predictive analytics, and smart grading.

Internet of Things (IoT): For real-time monitoring of classroom environments and bus tracking.

Big Data Analytics: For deep insights into student performance and institutional effectiveness.

Machine Learning (ML): For automated grading, performance trend analysis, and adaptive learning recommendations.

Cloud Integration: To enable centralized management of data and seamless access to resources.

### 3.4 Future Potential

EduTrack will not only addresses the current challenges in education but also will paves the way for future advancements. With continuous improvements and the integration of emerging technologies, EduTrack has the potential to redefine the educational landscape by providing smarter, more efficient, and highly personalized learning experiences for the next generation.

Chapter 2

# 2. Computer Vision

# 3. Internet Of Things

# 4. Mobile Application Development

# 5. Administration Website

# References

<https://nces.ed.gov/programs/coe/indicator/a11>

<https://www.ridezum.com/school-bus-safety-2022/>

[3] Y. J. Kambala and R. Mathe, “Importance of Smart Classroom: A Study”, *The Jour Multi Res*, vol. 2, no. 1, Nov. 2022.

<https://www.oecd-ilibrary.org/docserver/eag-2007-25-en.pdf?expires=1734476417&id=id&accname=guest&checksum=C7576AB473726ABAB6A840E9C4AA2E63>

[5] Dr. Anil Kumar, Dr Meenakshi Rani, Dr. Dharini Raje Sisodia, Dr. Yusuf Perwej, Ashutosh C Kakde, and Fayzieva Makhbuba Rakhimjonovna, “Transforming Education Through Iot And AI Opportunities And Challenges”, kuey, vol. 30, no. 5, pp. 11610–11622, May 2024.