ST JOSEPH ENGINEERING COLLEGE MANGALURU
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The Department of Intelligent Computing and Business Systems

Course Level Problem Based Learning

Course Title: **Computer Vision**

Course Code: **22AIM71**

Semester: **Seventh Semester**

A CLPBL Project Report Titled

STUDENT ENGAGEMENT MONITORING

Submitted By

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Under the Guidance of

Dr Vijetha U
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29 November 2025

ST JOSEPH ENGINEERING COLLEGE
MANGALURU – 575 028

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CERTIFICATE OF COMPLETION

It is hereby certified that this CLPBL Project Report is a bonafide work carried out by the students listed below under my guidance in the Department of Intelligent Computing and Business Systems. This work has been completed towards the partial fulfilment of the course Computer Vision with course code 22AIM71, offered in the Seventh Semester.

It is further certified that the students have followed the Design Thinking framework throughout the execution of the project and have incorporated all the corrections/suggestions provided during the progress reviews and assessments. The project work has been evaluated and approved as it meets the requirements of CLPBL Implementation as mandated by the Department.

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DECLARATION

We, the undersigned students of the Department of **Intelligent Computing and Business Systems**, hereby declare that the project work entitled **"Student Engagement Monitoring"**, submitted in partial fulfilment of the requirements of the course **Computer Vision** with course code **22AIM71}**, in the **Seventh Semester**, is an original **Course Level Problem Based Learning (CLPBL)** project carried out by us.

We confirm that this project has been completed using the **Design Thinking framework** under the guidance of **Dr. Vijetha.U**. We also certify that the work reported in this document has not been previously submitted to any institution or organization for any academic award, degree, or certification. We abide by the academic integrity and ethical standards of the Department and the Institution, and accept that any violation, if discovered later, may lead to appropriate action.

Students' Signatures:

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Date: 29 November 2025

Place: Mangaluru

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We are immensely thankful to the Head of the Department, **Dr. Harivinod.N**, for providing the necessary support and a conducive learning environment.

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ABSTRACT

This Course Level Problem Based Learning (CLPBL) project focused on the problem of declining student engagement during classroom sessions, especially in environments where distraction, low motivation, and irregular participation affect learning outcomes. Using the Design Thinking framework, the team first explored the issue through interviews, observations, and secondary research to understand how students often lose attention, struggle to remain active, and hesitate to participate due to fear, social pressure, or lack of interest. From these insights, the team defined the need for a simple and structured method to monitor classroom engagement and encourage consistent participation. Through ideation and brainstorming, various approaches were considered, and a prototype engagement-monitoring system was developed. The solution included mechanisms to record student attentiveness, track activity levels, and provide periodic feedback to both teachers and learners. Iterative refinement based on user feedback helped make the system more practical, user-friendly, and aligned with real classroom needs. The project demonstrated how student engagement can be effectively supported by combining thoughtful observation, technology-driven tracking, and feedback-based improvement. Overall, the project highlighted the importance of understanding learner challenges and applying user-centered problem solving to create meaningful educational tools.

Keywords:

Student Engagement, Classroom Monitoring, Design Thinking, Learning Behavior, Educational Tools, Feedback System

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Chapter – 1: Problem Description

Student engagement plays a crucial role in determining how effectively learners absorb, retain, and apply knowledge during classroom sessions. However, in many educational settings, maintaining consistent engagement has become increasingly challenging. Students often lose focus due to distractions, lack of motivation, reduced interest in the subject, or external pressures. This disengagement leads to lower academic performance, reduced participation, minimal interaction with teachers, and an overall decline in the quality of the learning experience.

The problem primarily affects students, who struggle to stay attentive and involved, and teachers, who find it difficult to assess real-time engagement levels or identify learners who need support. In typical classroom environments—both physical and online—teachers rely heavily on subjective observation, which does not always provide accurate or continuous insights into student attentiveness. As a result, instructors may be unaware when students are confused, distracted, or not participating, leading to gaps in understanding that accumulate over time.

This issue is especially important because effective engagement is directly linked to improved academic outcomes, enhanced focus, and stronger conceptual understanding. In modern classrooms where digital distractions are common and class sizes are large, monitoring engagement manually becomes even more difficult. Therefore, there is a clear need to understand how engagement fluctuates during lessons and how students respond to teaching methods, activities, and classroom dynamics.

This chapter highlights the significance of the engagement problem and establishes the context within which the project was undertaken, without introducing any proposed solutions.

Chapter – 2: Key Findings of Secondary Research

The secondary research conducted for this project focused on understanding the factors that influence student engagement, the challenges faced in maintaining attention during classes, and the current tools or methods used to monitor and improve engagement. Articles, educational reports, academic journals, and reputable websites consistently highlighted that student engagement is a multidimensional concept influenced by behavioral, emotional, and cognitive factors. Research showed that a significant percentage of students experience distractions due to mobile phones, lack of interest, poor classroom environment, and teaching methods that do not cater to diverse learning styles.

Existing studies emphasized that disengagement often goes unnoticed because teachers rely on subjective observation, which becomes difficult in larger classrooms. Reports indicated that more than 50% of students lose focus within the first 15–20 minutes of a lecture, and engagement drops sharply when sessions are monotonous or overly theoretical. Furthermore, the shift toward digital and hybrid learning environments has increased the need for structured engagement-tracking mechanisms, as online platforms make it even harder for teachers to monitor attentiveness.

Several products and tools currently available—such as classroom response systems, learning management systems with activity logs, and AI-based facial-expression monitoring—offer partial support but are either too complex, require expensive infrastructure, or fail to provide real-time, actionable insights. Secondary research also revealed a strong opportunity for solutions that are simple, low-cost, easy to use, and capable of giving continuous feedback to both learners and teachers.

Overall, the research highlighted the growing importance of engagement monitoring and the lack of accessible tools designed specifically for everyday classroom use, reinforcing the need for a practical and student-friendly solution.

Chapter – 3: Key Findings of Primary Research

Primary research for this project involved directly interacting with students and teachers through interviews, short surveys, and informal discussions to understand real classroom challenges related to engagement. The responses showed that a significant number of students found it difficult to stay attentive throughout lectures, especially when the sessions were long or theory-heavy. Many admitted that they often got distracted by mobile phones, conversations, or lack of interest in certain subjects. Some students also shared that they hesitate to clarify doubts due to fear of judgment or shyness, which further reduces their participation.

Teachers provided valuable insights, expressing that it was difficult to accurately assess who was engaged and who was not, particularly in larger classes. They mentioned that some students appear attentive but are mentally disconnected, while others stay quiet even when they need help. Teachers also highlighted that they lacked simple tools or structured methods to track engagement trends over time. This made it challenging to modify teaching strategies based on students' attentiveness or involvement.

From these observations, several user needs emerged: students wanted more interactive sessions, timely feedback, and a system that encouraged active participation without embarrassing them. Teachers needed a reliable way to monitor engagement in real time, identify disengaged learners quickly, and receive insights to improve their teaching approach.

Chapter – 4: Problem Definition

Based on the insights gathered from both primary and secondary research, it became evident that the most critical issue in classroom learning is the **lack of a consistent and reliable method to monitor student engagement in real time**. Students frequently lose focus due to distractions, low motivation, or difficulty understanding concepts, yet these disengagement moments often go unnoticed by teachers. Traditional classroom monitoring relies heavily on visual observation, which is subjective, inconsistent, and difficult to manage in large or active classrooms. As a result, teachers struggle to identify disengaged learners, provide timely support, or adjust teaching strategies to maintain attention and improve learning outcomes.

Students, on the other hand, expressed that they often feel hesitant to participate, overwhelmed during long lectures, or disconnected when teaching styles do not match their learning preferences. They need a system that helps them stay attentive without drawing negative attention or putting pressure on them. Teachers require a simple, practical, and unbiased tool that gives them visibility into the engagement patterns of the entire class.

Therefore, the refined problem can be stated as:

“How might we create a simple, accessible, and effective way to monitor and understand student engagement in real time so that teachers can respond promptly, support learners better, and improve classroom learning outcomes?”

This problem definition formed the foundation for ideation and guided the development of a meaningful, user-centered engagement monitoring solution.

Chapter – 5: Project Objectives

The primary objective of this CLPBL project was to design a simple and effective method for monitoring student engagement in real time, based on the insights gathered from both students and teachers. To achieve this, the project focused on the following specific and measurable objectives:

1. Identify the key factors influencing student engagement through surveys, interviews, and classroom observations, ensuring a clear understanding of user needs and pain points.

2. Develop a structured method for tracking engagement levels that is practical for use in regular classroom settings and does not require complex technology or extensive training for teachers.

3. Create a basic prototype or model that demonstrates how student attentiveness and participation can be monitored consistently and objectively.

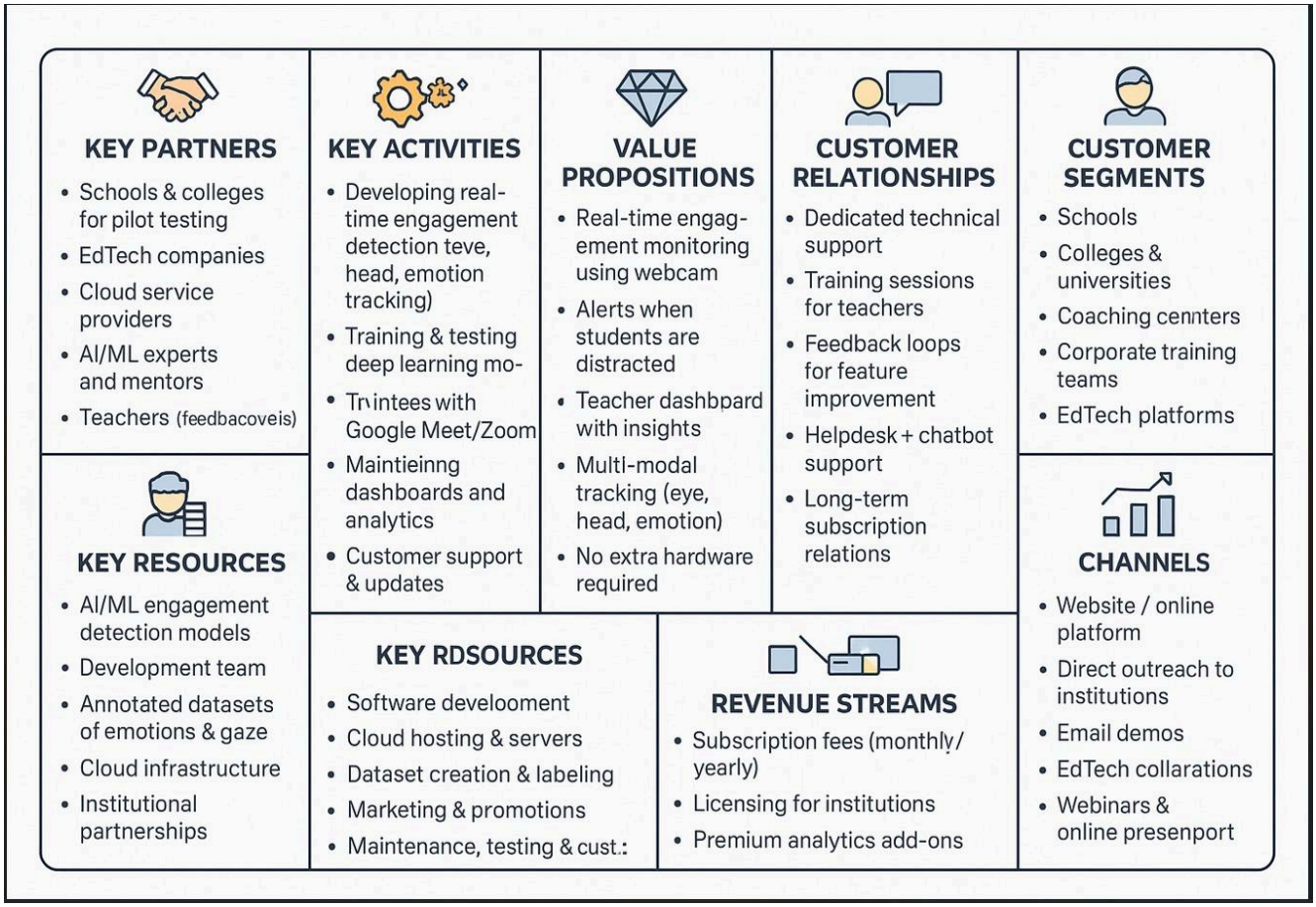
4. Enable teachers to gain insights into engagement trends, helping them recognize disengaged learners and make timely adjustments in their teaching approach.

5. Encourage students to become more self-aware of their engagement levels by incorporating simple feedback mechanisms that promote active participation.

6. Ensure that the proposed solution is user-friendly, low-cost, and easily implementable, making it suitable for everyday classroom use without disrupting the teaching process.

These objectives were designed to guide the project toward developing a meaningful, user-centered engagement monitoring system that addresses real classroom challenges and enhances the overall learning experience.

Chapter – 6: Business Model Canvas



7. SWOT Analysis

STRENGTHS	**WEAKNESS**
• Provides real-time visibility into student engagement levels. • Helps teachers identify disengaged learners quickly. • Simple, user-friendly, and low-cost compared to complex digital systems. • Encourages active participation and self-awareness among students. • Can be adapted to different classroom sizes and teaching styles.	• May require teachers to adapt to a new monitoring method. • Limited accuracy if students intentionally alter behavior. • Depends on consistent usage to observe engagement trends. • Basic prototypes may lack automation without further development.

OPPORTUNITIES	**THREATS**
Growing demand for tools that improve learning outcomes. • Can be integrated with digital classrooms and LMS platforms. • Potential for advanced analytics and AI-based engagement prediction. • Useful for institutions aiming for outcome-based education	Competing ed-tech solutions may offer more advanced features. • Resistance from students who dislike monitoring systems. • Data handling concerns if digital tracking is implemented. • Limited adoption in institutions with traditional teaching cultures.

Chapter – 8: Description of Work

This project involved designing and developing a Student Engagement Monitoring System that automatically detects student presence and attentiveness using facial and eye detection techniques. The system was built using the Design Thinking framework, which guided the team through stages of ideation, prototyping, and iterative improvement. The final solution used a combination of Python scripts, Haar Cascade classifiers, and a web-based dashboard to provide real-time engagement information to teachers.

8.1 Ideation and Design

The ideation phase began by discussing how teachers currently face challenges in identifying disengaged students, especially during long lectures or when managing large classrooms. After exploring several concepts, such as mobile applications, manual feedback tools, and gesture-based tracking, the team concluded that an automated, camera-based monitoring system would be the most objective and efficient approach.

Sketches were prepared to outline how the system would capture a student's face through a webcam, process the video feed, determine eye openness/engagement, and send the result to a central dashboard. The architecture was designed as a client–server model:

- Student Client: Captures video, performs face/eye detection, sends data.
- Server: Receives updates from multiple clients, processes engagement status.
- Dashboard: Displays real-time engagement for teachers.

The decision to use Haar Cascade classifiers was made due to their low computational demand and suitability for real-time detection.

8.2 Prototyping / Simulation

The prototype was implemented using Python and OpenCV. The following key files formed the basis of the solution:

- `student_client.py` – Captures webcam frames, detects the face and eyes, determines whether the student is attentive, and sends the engagement status to the server.
- `haarcascade_frontalface_default.xml` and `haarcascade_eye.xml` – Pre-trained Haar Cascade models used to detect face and eye regions.
- `server.py` – Acts as a central communicator, receiving engagement data from multiple clients and updating the dashboard.
- `dashboard.html` – A simple HTML dashboard that visualizes student engagement in real time.

During prototyping, the team simulated multiple student clients by running the script on separate systems/instances. The dashboard displayed each student's status as "Engaged" or "Not Engaged" depending on the detection results.

This prototype validated that facial and eye detection could be used to estimate engagement effectively in a controlled environment.

8.3 Testing

Testing involved running the system in classroom-like conditions to evaluate accuracy, responsiveness, and ease of use. The following parameters were tested:

- Face Detection Accuracy: Ability to detect faces under different lighting conditions.

- Eye Detection Accuracy: Consistency of eye state detection when the student blinked, looked away, or moved slightly.

- Real-Time Performance: Speed of transmission between client and server.

- Dashboard Responsiveness: Whether changes in engagement were reflected immediately.

Test Results:

The system performed well in moderately lit environments, with high accuracy in detecting faces and eyes. Teachers appreciated the dashboard's simplicity and found it useful in identifying disengaged students. Some challenges were observed in cases of poor lighting or when students wore spectacles, as eye detection occasionally missed frames.

Improvements Made:

Based on testing feedback, thresholds for eye detection were fine-tuned, the dashboard layout was made clearer, and comments were added to the code for readability. Future enhancements were also identified, such as adding EAR-based detection, improving lighting robustness, and expanding the dashboard.

Chapter – 9: Conclusion

This project successfully demonstrated the development of a Student Engagement Monitoring System using facial and eye detection techniques integrated with a client–server architecture. By applying the Design Thinking framework, the team was able to clearly understand user challenges, explore practical ideas, and build a functional prototype aligned with classroom needs. The system used Haar Cascade classifiers to detect faces and eyes in real time, allowing the client application to estimate whether a student was attentive. Engagement data was transmitted to a central server and visualized through a simple web-based dashboard that provided teachers with immediate insights.

Testing showed that the solution is effective under normal lighting conditions and can reliably monitor student presence and attentiveness. Teachers found the dashboard intuitive, while students appreciated that the system operated unobtrusively without interrupting the learning process. Although some limitations were noted, such as sensitivity to lighting variations and difficulties detecting eyes behind spectacles, the project lays a strong foundation for further enhancement.

Overall, this CLPBL project demonstrated how computer vision and basic automation can support better classroom management and improve real-time engagement tracking. The work highlights the potential of technology-driven solutions in education and provides a valuable starting point for future developments such as enhanced attention metrics, improved detection models, and integration with learning analytics platforms.

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