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Student Behaviour Monitoring System

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Abstract: ***"Automated learning analytics is quickly becoming a divisive issue in the educational community, needing efficient methods to monitor student development and provide feedback to teachers. Because of recent advancements in optical sensors and computer vision algorithms, autonomous monitoring of students' behaviors and emotional states is now possible at all academic levels, from university to pre-school. The purpose of this study was to create an automated system that would allow teachers to document and summarize student behaviors in the classroom in order to gather data for decision-making. A report is then sent to the facilities after the system has recorded the full session and determined whether the students are paying attention in the classroom."***

Keywords: Automated learning analytics, optical sensors, Computer Vision

I. INTRODUCTION

As a part of this research, we are taking into consideration a variety of factors that will be useful in determining how pupils behave in the classroom. These features consist of: One of these components is the evaluation of the head position; more specifically, the head position will be evaluated, and the behavior will be chosen in accordance with the assessment's conclusions. If a student is not looking directly ahead, it is possible to infer that he or she is not very interested in the subject matter being covered in that specific class. The opposite is also true. This is the key idea that underpins the entire notion and serves as its foundation. The assessment of the gaze is the third factor at play in this scenario. What if the student appears to be staring in the desired direction but is actually looking somewhere else? Head position cannot be the determining factor because the student can fool the camera, thus we must additionally include the student's gaze if we want to do an accurate analysis. Another important factor to take into account is the act of labelling the items. The level of interest a student has in the subject at hand will not be high enough for him to be able to understand what is happening in the classroom if, for example, he is talking on the phone about something else while his attention is diverted from the current issue. The most important factors that have been shown to have an impact on how a student behaves towards their teachers are summarized in this paragraph. However, there are a ton of other factors that might also affect how the game turns out.

II. LITERATURE SURVEY

It is now easier to efficiently gather and process information thanks to the use of newly created technology in the field of education. Thanks to technological advancements, on which teachers primarily rely, teachers can now view the information that the student will be entering into the camera. There are many reasons why students can leave class, including weariness with the material or the availability of more interesting activities, such playing computer games. (Kamille Pilar) In order to instill in their students a set of acceptable behaviours and expectations for suitable conduct, effective teachers put considerable effort into designing, preparing, and perfecting the daily activities that take place in their classrooms. When school routines are utilised and carried out in the appropriate manner, the institution is improved in terms of both its structure and its ability to foster an atmosphere in which both children and adults can pursue the organisational goal of fostering student learning in a manner that is both safer and more structured. When students breach the code of conduct and need to be redirected, teachers are sometimes forced to take a hard stance toward rectifying the behaviour of the students. This is because it is necessary for the kids to be redirected.

Charlotte Danielson states that "teachers who function at the competent and exceptional levels in Domain 2 demonstrate real care for the needs and talents of their students both inside and outside of the classroom Students believe their professors are responsible adults who believe in their ability to learn, care about them personally, and are reliable resources of support for the students' academic aspirations. (Addison). This edition of the Research Digest summarises numerous significant research discoveries that offer potential answers to issues like the ones below: How important is effective behaviour management for efficient teaching and learning? Does those who are being managed academically perform better as a result of effective management of their behaviour as students?

You can discover descriptions of approaches that are specifically relevant to classroom instruction throughout the digest. Scopus, the British Education Index, ERIC, Education Research A couple of the databases and bibliographic resources that were searched to create this research summary are Complete and the Australian Education Index. We will review some study findings that throw light on the value of effective behaviour management to teaching and learning in the first section of this article. The management of productive conduct will then be discussed from a variety of angles. A section that focuses on various studies on contextual influences in students' behaviour follows an account of recent research on the impact of the set of practises known as restorative justice practises.

An compulsive pattern of information seeking and information using habits that take precedence over other important activities is one definition of technology addiction [12]. Negative effects on a person's psychological, behavioural, and cognitive functioning are the hallmarks of technology addiction.

The growth of mobile internet-enabled gadgets, such as smartphones, causes students to spend more time browsing the internet rather than studying, which has a negative effect on their academic performance [5].

Compared to residents of developing and less developed countries, a significantly higher percentage of individuals in wealthier countries utilise the internet. In contrast to developed countries like Japan, the United States of America, and Denmark, emerging countries like India and Brazil only have internet penetration rates of 34.8% and 66.44%, respectively [6]. One aspect that has contributed to an increase in the average amount of time spent online that is significantly higher than what was anticipated is the general public's unquenchable curiosity in the results of recently introduced technological developments [7]. People in wealthy countries use the internet substantially more frequently than citizens of developing and less developed nations. Emerging nations like India and Brazil only have internet penetration rates of 34.8% and 66.44%, respectively, compared to industrialised nations like Japan, the United States of America, and Denmark [6]. The general public's insatiable interest in the outcomes of recently introduced technical innovations is one factor that has contributed to an increase in the average amount of time spent online that is substantially higher than what was predicted [7].

III. POSITIONING

A. *Problem Statement*

There are numerous factors that can influence an individual's level of academic performance. Numerous variables, including but not limited to professors, educational plans, learning environments, study times, academic architecture, institutional climate, and monetary considerations, may have an impact on students' levels of academic achievement. Study skills, study attitude, and motivation, according to H.K. Ning and K. Downing, are crucial components of students' study habits and have a significant impact on their overall learning outcomes. These components of students' study habits include motivation, study attitude, and study abilities. The ways that students approach their studies are influenced by how they view their classrooms and other learning environments. This suggests that if teachers are aware of their students' negative attitudes, they can make more suitable adjustments to enhance the learning settings for their students. This specifically suggests that teachers have the power to enhance the conditions in which their students learn. It is feasible for the teacher to keep an eye on the pupils' behavior in the classroom by watching them and asking them questions, but this task could be challenging in a class with lots of kids. Technology that can help teachers and other professionals get information on student conduct without requiring a lot of manual labor would be beneficial. Data collecting on student behavior could be aided by this kind of equipment. Because to recent advancements in the field of computer vision, it is no longer difficult to watch and evaluate the behaviour of students in real time while they are present in a classroom environment. This was previously thought to be physically impossible. The researchers Il-Hyun Jo and colleagues believe that having a systematised understanding of the educational requirements of each learner is essential; as a result, they collected, analysed, and systematised the data provided by learners in order to develop individualized teaching strategies and content.

B. *Product Position Statement*

IV. PROJECT OVERVIEW

A. *Objectives*

The goal of this project was to create a platform that could automatically aid teachers and other educational staff in keeping track of student behaviour. Our main focus was on the objectives of the students' real-time observation. The system functions in the role of a decision-making process assistant. The discovery and transmission of strategic data to the decision-makers may occur automatically.

A comprehensive system that permits the recording of ongoing statistics, student behaviour, and data visualisation was successfully built. We discussed the specifics of the research and experiments and demonstrated how model techniques might be combined to address the issue of monitoring students' behaviour.

V. PROJECT SCOPE

The location of the camera will not be a concern because it will use the laptop's built-in camera, which is already set up and ready to use. The location of the camera will be in direct alignment with the camera since the built-in camera in the laptop will be pointed in the user's face.

The data will be analyzed even if the learner is distracted while in class because the camera will still record it and incorporate it into the logic. A concise profile of the student's classroom behaviour will be created considering additional factors, such as object recognition.

VI. METHODOLOGY

In a manner very similar to Ngo et al. since their system also takes automated attendance, the student behaviour monitoring system is directly connected to the camera network and academic portal to retrieve the precise schedule and decrease the extent of the student recognition. It does not alter or interfere with the data that is being retrieved from these systems. The system's distilled diagram is shown in Figure 1. The recorder, recorder controller, task repository, task assignment manager, worker, report, and web server are its seven primary parts. Video footage from the camera is recorded by the recorder (also known as a media recorder). The recorder controller is responsible for allocating the recording duties. Given that video recording is a manual process, this entails deciding which recorder will capture footage from which camera. Meanwhile, The task repository is where the recorded films and their associated metadata (such as the class featured in the video, a list of the students, camera settings, etc.) are kept. The task assignment manager's job is to allocate jobs to workers and automatically retrieve schedules. The task assignment manager assigns tasks to the worker, which includes the data analysis module (or AI core), and the worker is responsible for processing those tasks and writing the findings to the report database. The web server manages recording and visualizes data from the report database. The AI module, which resides inside the module worker and may be separated into four stages (data retrieval, frame processing, summarize, and output to the database), can be viewed as the system's "soul."

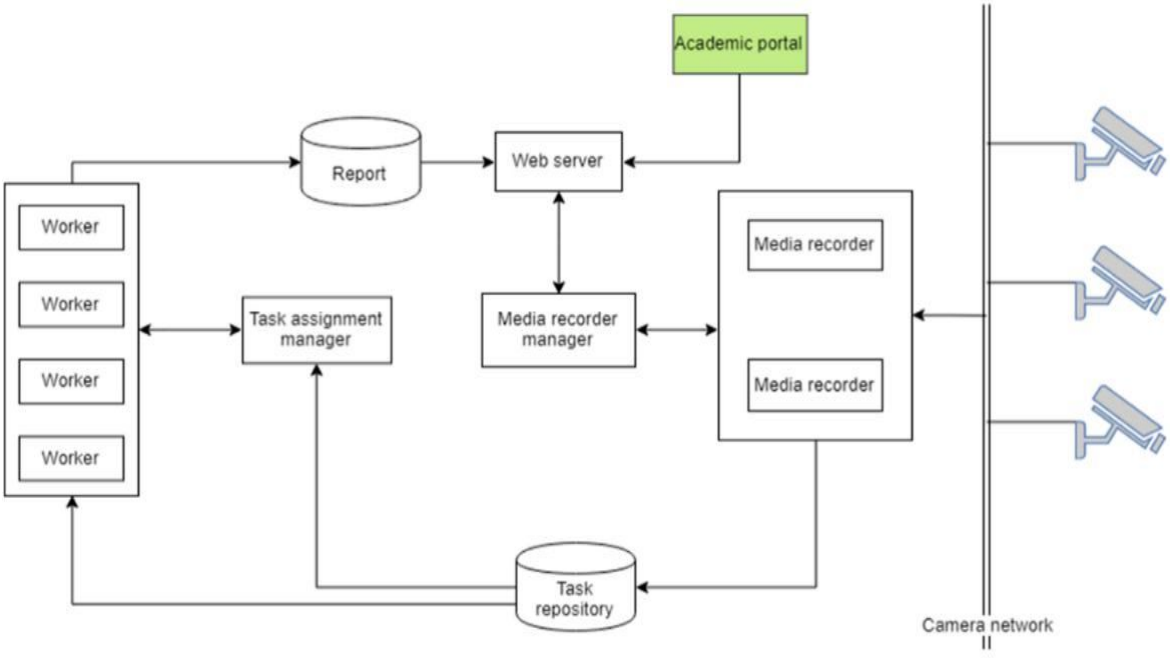

FIG 1. This figure shows an overview of the system that contains seven components: recorder, recorder controller, task repository, task assignment manager, worker, and report and web serve.

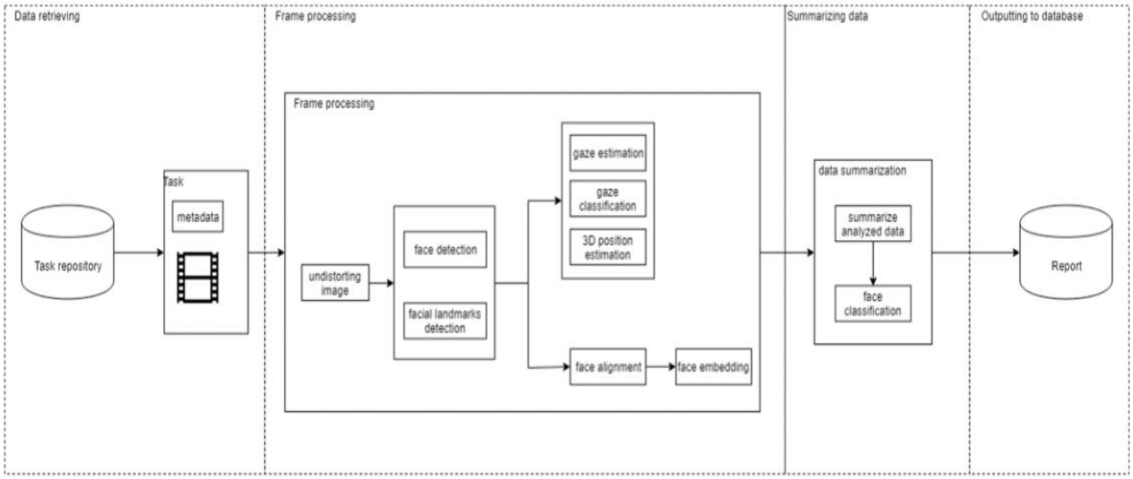

FIG 2. The worker's AI module pipeline contains four stages: data retrieving, frame processing, summarizing data, and output to the database

VII. MODULES IDENTIFIED

The approach that has been suggested gives particular attention to the elements referred to as attributes. This package includes features including the estimation of gaze, estimation of the optical heart rate, and facial identification. The phase that matters the most in our study is the process of extracting features. primarily because the characteristics that have been gathered will be used to interpret the results.

A. The Ability to Identify Someone by Their Face

The Viola and Jones Algorithm, often known as the haar-cascade approach, is presently used in the face identification process. Jones and Viola created this algorithm. The user's face is identified as the major focus of the first phase of the procedure at the beginning of the workflow for the proposed system. The initial stage will be to find every face and record its precise location before determining its traits.

B. Estimating Gaze

Once the face has been located, the next step is to estimate the direction that a specific person is looking in addition to estimating the percentage of interest that person is paying towards the ongoing class.

C. It Is Possible To Ascertain The Objects' Identities

The analysis and determination of a particular student's level of interest in a subject is necessary to guarantee the functioning of a few features. One of them is the measurement of a person's heart rate. The method that has been suggested measures a student's heart rate while they are listening to a lecture in order to gauge their level of interest in the content being presented.

D. Option D for Head Position Detection

In this scenario, the camera will oversee obtaining data on the user's head position, and the analysis's findings will be presented to the user as questions. The user could be questioned about their direction of gaze, for instance, if they are gazing straight ahead, down, left, or right.

E. The student's level of concentration

The needed steps were completed, the face was located, and the necessary features—including a determination of the subject's gaze and the monitoring of the subject's heart rate—were retrieved. The measure will be calculated using the characteristics that were identified during the preliminary steps. These labels are going to be changed within a spreadsheet that was created using Excel.

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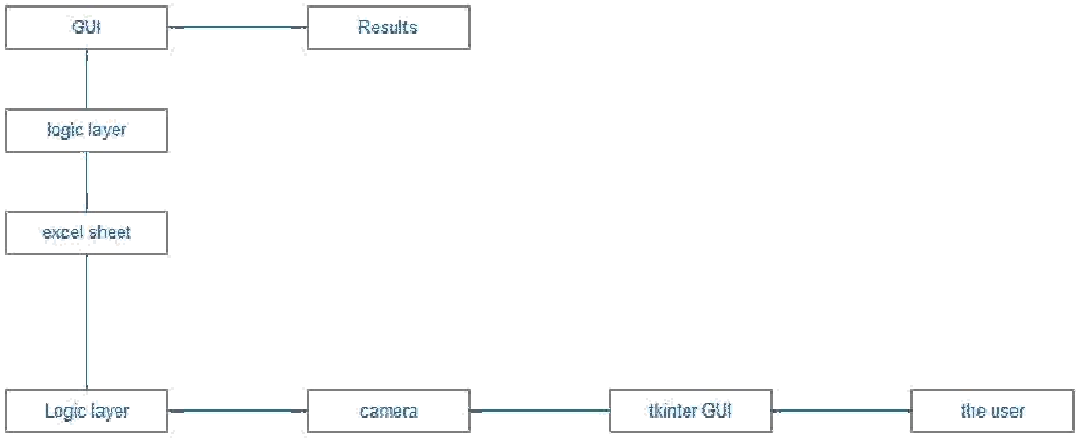
VIII. PROJECT IMPLEMENTATION

A. Architectural Design

1) High Level Design (Architectural)



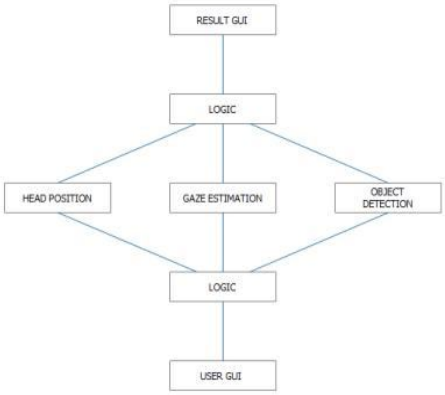
The high-level design demonstrates that the tkinter User Interface is the point at which the user interacts with the system. The user's face is captured by the camera, which also determines the user's head position, an evaluation of his gaze, and whether he is holding any objects, such as a phone. It also determines if the user is gazing straight into the camera or not. The logic layers will identify and detect any items that the user is holding, process the information, and then display the findings if there are any. The results won't be shown if the user isn't holding anything.

2) Low Level Design

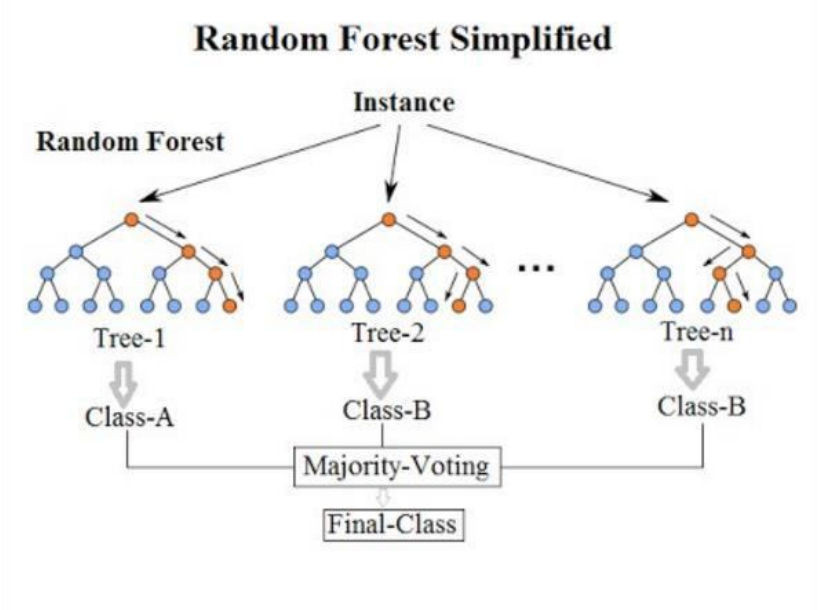
The user interface is situated here; it oversees gathering input, and this logical level is in charge of processing it. Logical level here is the module description design. The other modules include those that can recognize objects, estimate gaze, and detect head position. When these three factors are considered jointly, it will be simple to determine if the kid is acting appropriately or whether he still needs to progress in this area. Once more, the interface displays the findings of the analysis of the student's performance and the identification of areas in which they may do better.

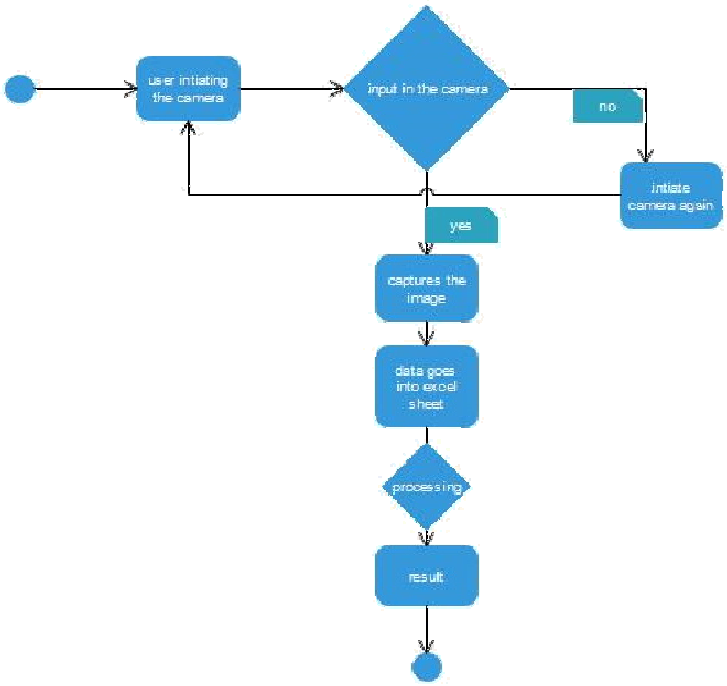
B. Class Diagram

C. Entity Relationship Model



D. Sequence Diagram





Once the camera has been opened following the user's press of the shutter button, the user is in charge of providing the inputs. Every time the user forgets to click the shutter button, the analytical process is resumed from the beginning, and pictures are only taken when the user is present. This data is entered into the excel sheet in front of the camera, where processing takes place, where findings are produced, where the user may examine them, and where the activity concludes here in this place.

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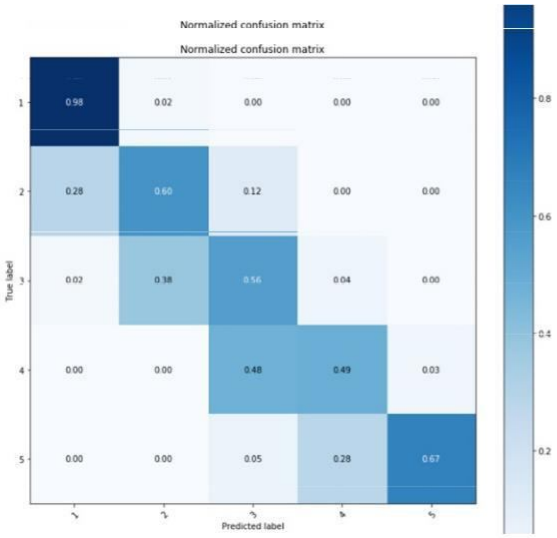
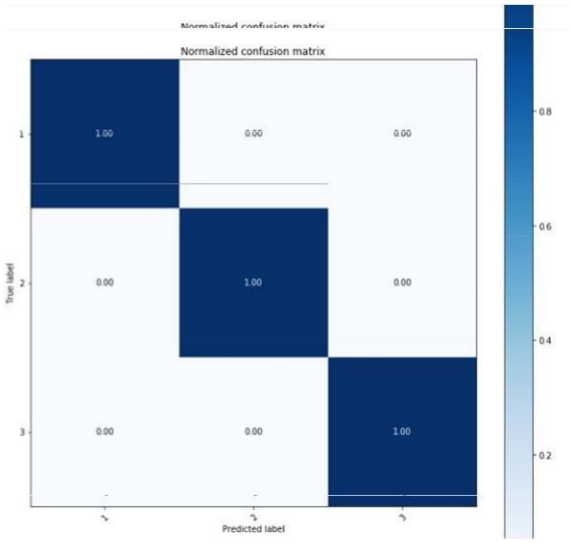
E. Description of Technology Used

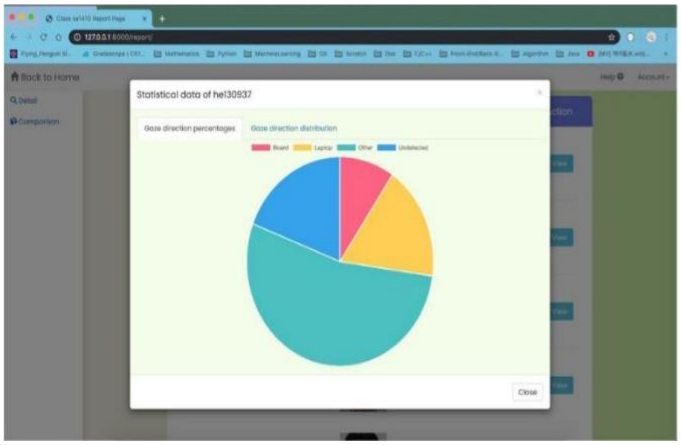
IX. FINDINGS / RESULTS OF ANALYSIS

and gaze. The student ID needs to be identified first and foremost. The student IDs continue to play a significant role in this situation. The monitored data about people's behaviors will eventually be associated with them after all student IDs have been discovered and recognized. The dataset's whole set of data is used to evaluate student ID identification. F1-scores are required due to the unbalanced nature of the data. Also shown is a matrix of perplexity. The other columns and rows display the outcomes of the relevant student IDs, while the first column and row indicate the term "unknown." The evaluation of row and column follows. The MAE (mean absolute error) is used to analyze the row and column. Additionally, confusion matrices are built for those estimations; the parameter ranges are matched with the vertical and horizontal values of the matrices. In order to determine if pupils are paying attention to the board or slides, computers, or other objects, the gaze performs the system's most important function. For teachers to examine attentional behaviors during the study session, the summarized statistics of gaze might be displayed. In order to estimate gaze, retrained models are used. As a result, the dataset is split into training and testing sets, with 7556 rows of the latter being used for assessment. The outcome of gaze estimation is also assessed using the F1-score. In addition, we obtain an F1-score of 82.81% using our summarization approach and 72% without.

The F1-score can reach 99.23% if we manually name the unknown set of sequences that the summarization algorithm generates, a process known as "semi-assist" labelling. We utilized our programmed in the actual world rather than under ideal circumstances, and the results of this facial recognition are almost identical to the results of the arc face. Behaviour detection and facial recognition appear to have nothing in common. Tracking a specific student's behaviour, nevertheless, is crucial. It offers several granularity levels for decision support system construction.







X. CONCLUSIONS

The goal of this project was to create a platform that could automatically aid teachers and other educational staff in keeping track of student behaviour. Our focus was on the objectives of the students' real-time observation. The system functions in the role of a decision-making process assistant. The discovery and transmission of strategic data to the decision-makers may occur automatically. A comprehensive system that permits the recording of ongoing statistics, student conduct, and data visualisation was successfully built. We discussed the specifics of the research and experiments and demonstrated how model techniques might be used to address the issue of monitoring students' conduct. Because the problem of monitoring student conduct is bound up with a large number of stringent and stringent criteria, there is a necessity for more inquiry. The lack of the ability to monitor other potentially important information, such as emotions, is the first restriction we face. Additional techniques of behaviour detection, such as facial characteristics, body stance, and so on, are extremely suited for the further enhancement of the system. [Case in point:] [Case in point:] Another matter that we wish to investigate in greater depth is the degree of connection that exists between the actions of students and, as a result, the results they achieve. Because it provides a foundation for more research into those relationships as they apply to a variety of settings, this method may very well be put to use. It has been commented that non-technical users may struggle to understand the graphs that we present on our website application. We are doing a quest for new relevant data visualisation tools.
In addition to that, this architecture calls for a very expensive processing system. This is frequently one of the obstacles that must be overcome before manufacturing can begin. We want to build a much better platform so that we can cut down on the costs of usage and maintenance.

XI. PROJECT LIMITATIONS AND FUTURE ENHANCEMENTS

The disadvantage of the current approach is that, regardless of whether a student is looking straight ahead or has their head held straight, we cannot be certain that they will behave positively in the classroom. Since the current system lacks object identification, if additional elements are added, the model will not be able to carry out the logic because there will be additional elements that have not yet been added. This is due to the lack of object identification in the current system. Because the existing system does not offer object identification,
Technology for facial recognition and body-motion detection is used in the processes of taking attendance and doing behaviour analysis. The computer vision system's data collection module is made up of cameras positioned thoughtfully throughout the classroom. The purpose of these cameras is to gather data. If the camera is not positioned correctly, the behaviour predicted by the model might turn out to be wrong**.**

A. The Optical Heart Rate Can Be Detected By

The analysis and determination of a particular student's level of interest in a subject is necessary to guarantee the functioning of several aspects. One of them is the measurement of a person's heart rate. The technique that has been suggested measures a student's heart rate while they are sporting a Fitbit watch in order to gauge their level of interest in the material being conveyed. In addition to the assessment of a student's search location, this function is offered. This will be a fantastic addition to the model because it takes heart rate into account, which is important for understanding what the person is feeling and predicting the reaction.

B. Good GUI

Users may only read the findings and work on themselves independently until this problem is fixed because the graphical user interface (GUI) is currently not connected to the administrator console. On the other hand, we might be able to add a new module to the administrative interface in the near future that will analyze the results and provide the students the best opportunity to grow.
Increasing the object detection's accuracy using the following methods:
In the case that any void actions are committed, providing more detailed information would be helpful since it will enable the higher authorities to be notified if necessary. Including this information will allow for the same to be filled with the higher authorities.

C. A Stronger Feeling That You Are Connected

When there is a greater degree of connectivity between the administration, the professors, and the students, as well as an ease with which they can communicate with one another, the results will be more accurate, and when there is a greater degree of ability on the part of the student to identify areas in which they are lacking and to make improvements in those areas, the more accurate the results will be.

D. One Camera Use

If we utilize only one camera and design logic in such a manner that it can record the correct gaze estimation and head position, it will be amazing since there will only be one piece of hardware to operate, which can be changed or repaired if required, and it will be cost-effective. If we utilise a single camera and design the circuitry such that it can accurately record head position and gaze estimate, both things will be doable.

Furthermore, since admin will handle it, there will not be any issues with authority, unlike when using a laptop camera, where there may be quality issues in addition to other issues if each person uses a laptop camera.

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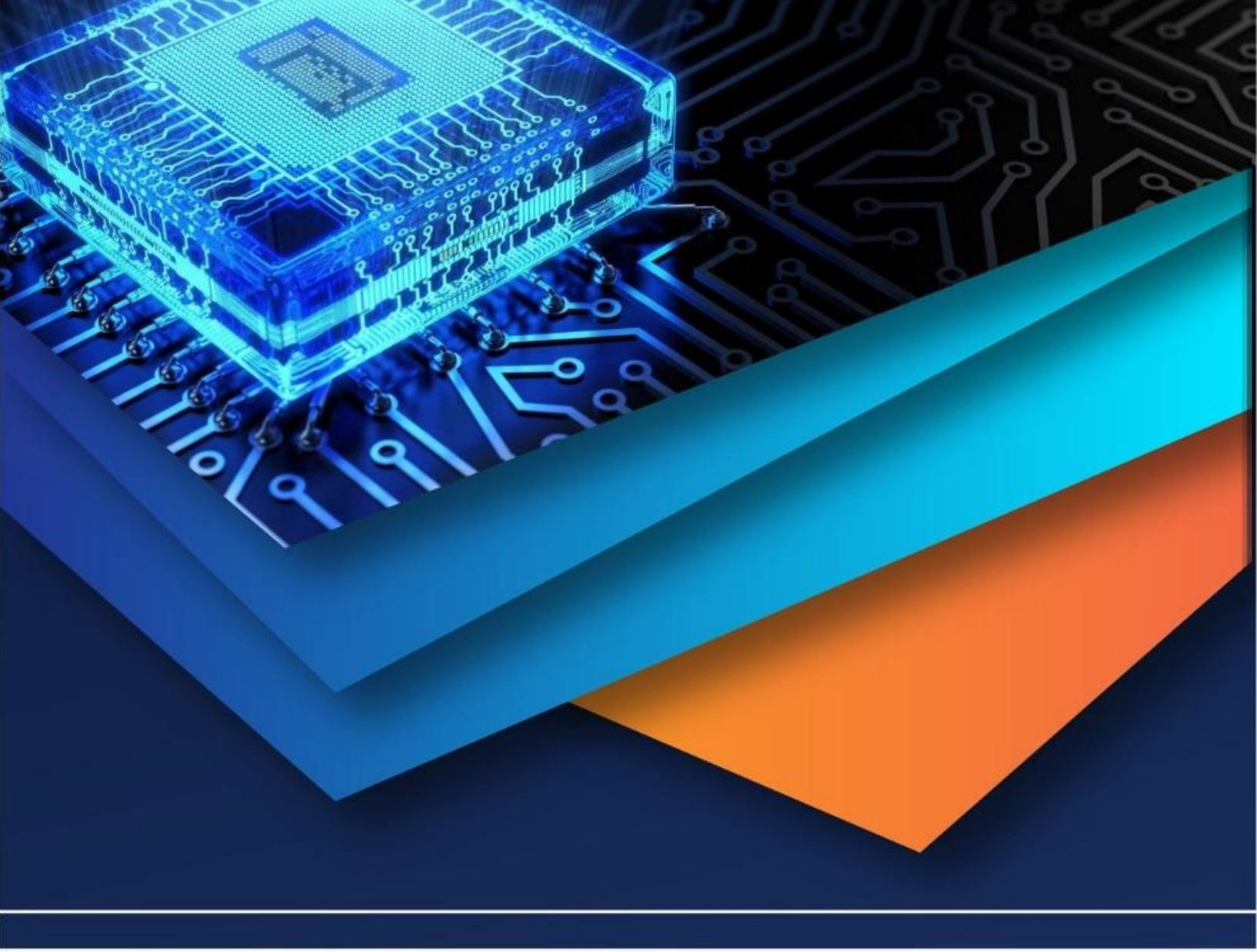

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