



Artificial Intelligence based Computer Vision Analysis for Smart Education Interactive Visualization

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Abstract

The pedagogical of computer programming education is being enriched and improved through the interactive learning material. Visualization, modeling, and internet platforms for developing interactive visual skills are only a few examples of the types of specialized learning material currently accessible for use in a wide range of computing classes. There are some specific challenges related to the implementation of active learning, such as insufficient time for class, an increase in preparation, implementing students' engagement in extensive courses, and a lack of necessary materials, technology, or supplies. Computer vision is a subfield of AI that allows machines to learn from visual data (such as photos, movies, and other digital media) and then act on or offer solutions to problems. To enhance the efficiency of intelligent interactive learning and practice, this article incorporates a visual machine vision analytical framework under the guidance of Artificial intelligence to create a Machine-Vision-based Smart Education Assistance System (MV-SEAS). Visualization speeds up and simplifies regular communication by consolidating several forms of information into a single visual representation. This study discusses how visualizing information is crucial for students' initial knowledge acquisition and continued education and development. The seamless amalgamation of automated innovative education analyses and interactive visualizations is emphasized. The paper aimed to identify and characterize the technical challenges mentioned above must be surmounted to make it simpler for computer educators to discover, adopt, and tailor intelligent learning materials. The study concludes by proposing an MV-SEAS for storing, integrating, and disseminating smart educational data. It investigates whether it can be done using existing standards and guidelines. In the end, this essay combines trials to prove the effectiveness of the proposed smart education method. The findings demonstrate that interactive visualization of AI-assisted smart education may effectively combine subject experts' information with educators' experience to produce more powerful and easily intelligible machine intelligence.

Keywords: Smart education; visualization; Artificial Intelligence; Interactive learning; computer vision analysis.

1. Introduction:

With cutting-edge IT and forward-thinking pedagogical principles, smart classrooms can intelligently alter the learning environment, efficiently manage classrooms, resources, and students' particular needs, and keep

tabs on students and instructors while they work[1]. Using information education as a foundation, smart classrooms emphasize in-class instruction and collaborative activities between educators and their students. A smart classroom is linked to the Internet and may provide instantaneous feedback, intelligent analysis, and individualized recommendations compared to a regular classroom[2]. A smart educational environment offers an improved setting and technological backbone for in-depth classroom engagement and gives a unique educational experience for both instructors and students. The smart classroom system may count, process, and analyze the interactive data by providing more and deeper types of interactivity in the classroom, guiding students to engage in the interaction actively, and recording the data. Research in this field has grown popular because it enhances classroom instruction by providing answers and ideas for problems in the interaction between teachers and students[3,4].

Potential technological advancements will likely focus on Artificial Intelligence (AI), a broad field that emerged from the convergence of computer science, nanotechnology, pattern recognition, languages, and neurology. AI-assisted smart education creates a smart environment via cutting-edge information technology, bridges the gap between theory and practice, develops a curriculum tailored to the digital era, and leads directly into the working world[5,6]. The relational data of the polycrystalline formation of institutions, connections, and characteristics is obtained and stored by intelligent education that implements internet connectivity, graph computation, visual chart analytics, and other functions for understanding metadata interaction with the aid of AI technology[7]. Depending on the rich multi-source inconsistent services and information of the education system, the AI-assisted smart learning paradigm may represent the multi-level and multi-granular data lineages and cognitive activities of diverse subjects[8]. In the transition from the age of perception awareness into the period of intelligence quotient, an AI-assisted modern educational paradigm may combine the experts' classroom expertise and specialized knowledge to deliver decipherable and durable machine intelligence for smart education[9].

Computer vision is a subfield of AI that allows machines to learn from visual data (such as photos, movies, and other digital files) and then act on or offer solutions to problems. For example, autonomous cars would not exist without computer vision for object detection and classification, 3D mapping, and motion estimation[10]. Sensors and cameras in autonomous vehicles gather information about their environment, which is then processed by software. Computer vision is a branch of AI that focuses on making computers more perceptive to and knowledgeable about the world around them via images. Computer vision systems used to images allow machines to detect things and react accordingly by unlocking the phone upon recognizing a human face[11]. Examples of computer vision are segmenting an image, locating an object, identifying a look, locating an edge or a pattern, categorizing an image, and matching features. Scan and analyze video footage for signs of suspicious behavior like loitering, incursion, or strange occurrences using a computer vision system to ensure school safety. It aids in maintaining the security of the campus community by revealing possible dangers ahead of time[12]. Computer vision encompasses the processes of gathering, processing, analyzing, and understanding digital images, as well as extracting high-dimensional data from the real world to produce numerical or symbolic information, such as options. Facial recognition programs, which use computer vision to identify persons in photographs, rely heavily on this field of study. Images of faces may be analyzed by computer vision systems and compared to stored profiles of known faces[13].

People's hopes for online learning have shifted over the years from emphasizing accessibility and sharing to intellectualizing materials' quality and the instruction's efficacy. People have high hopes that Internet-based education will solve the problem of educational resource sharing, allowing students to access more relevant and high-quality educational materials and benefit from more effective instruction tailored to their needs[14,15]. Recent years have seen several successful initiatives by online education providers to boost educational productivity and quality via applications, including student-status reporting, voice-interactive instruction, and automatic assignment corrections[16]. For example, to detect whether or not a student is paying attention in class, has their hands up, is completing an activity, is listening, or has spoken, the face recognition-based student monitoring system will analyze their facial expressions[17]. With the help of an AI educational support system that effortlessly generates the appropriate learning summary for every student in response to shifts in the learning environment and the facial gestures of the students, the instructor can directly and precisely understand the differentiations in the multiple phases of the students throughout every step of the active learning life and afterward educate them depending on the visualization skills[18]. The main objectives of the paper are as follows:

- Establishing an interactive smart education system visualization based on artificial intelligence to analyze online teaching and learning effectiveness.

- Introducing the machine-vision analysis for enhancing the smart education interaction visualization of students and teachers based on AI.
- The MV-SEAS method allows for the study of intelligent education visualization that can be used to refine analyses of online learning and raise standards across the board.

The rest of the paper is as follows: section 2 with the previous related literature works, section 3 with a detailed discussion about the proposed work of MV-SEAS in smart education, section 4 with the results and its discussions, and section 5 with the conclusion of the paper.

2. Related work

In [19], the authors introduced a plan for a smart learning environment that makes use of graphical user interface (GUI) technologies for Internet of Things (IoT) wearables. The study analyzed the significance of GUI in IoT wearables for pedagogical technologies, particularly emphasizing the three most popular and effective IoT GUI technologies. The need for innovative classroom design at all educational levels continues to rise. The need for developing interactive GUI interfaces for superior education may be satisfied by integrating the most current and effective IoT technology tools into the many existing and new smart learning platforms. In addition, graphical User Interface (GUI) tools in Raspberry Pi and other development boards equipped with AI technology for use in different educational situations will be researched.

An artificial intelligence (AI) based Efficient Smart Learning Framework (AI-ESLF) has been proposed to handle the challenges of a smart learning environment, as stated in the literature [20]. This study's overarching goals are to (1) establish the state-of-the-art concept of the AI-applied smart learning environment, (2) analyze its essential needs, and (3) demonstrate, through case studies, how testing may be carried out in such an environment. The experimental results verify that the suggested system outperforms the state-of-the-art approaches in predicting students' learning behaviors.

Various neural network approaches linked to deep learning are compared. Furthermore, the authors of [21] introduced the CNN-BiLSTM method, a convolution neural network-Bidirectional Long Short-Term Memory hybrid, and we simulate its performance to ensure its effectiveness. The study focuses on using AI to visualize emotional expressions in a virtual classroom setting. Test results show that the CNN-BiLSTM method presented here achieves an accuracy of 98.75%, at least 3.15% higher than that of competing algorithms. Furthermore, the recognition rate is not less than 90%, and the Recall is at least 7.13 percentage points greater than competing algorithms. The enhanced CNN-BiLSTM algorithm can produce high-quality recognition results. It offers a valuable experimental reference for studies of emotion identification and graphical representation of emotions in a smart learning setting.

The authors of [22] argued that against the widespread use of the Internet and AI technologies in the classroom, the conventional model of instruction based on the expert teacher was undergoing a sea shift. The research examines data mining methods in a cloud setting to address the weak anti-interference in the dynamic compressing methodology used to dispersed point clouds. Using a time-series analysis paradigm of the big data communication process in a cloud computing environment, researchers first analyze the data organization, then rebuild its high-dimensional spatial structure. Reconstructing the phase space yields association rules that may be used as pheromones to guide data location mining and improve the data machine learning approach.

As data collection grows, IoT-based approaches are used to improve an app's intelligence and functionality, as the authors explain in [23]. Smart learning, which uses the IoT and Agent-based systems, has attracted the attention of many academics. The primary goal of a learning management system is to facilitate the acquisition of knowledge and the application of techniques, including the use of technological resources in a way that yields superior results for the educational process. Many technological advancements facilitate the dissemination of smart education. The article comprehensively assesses the use of AI in educational administration. Several AI platforms with a focus on the learning management sector were examined. Also covered are the needs of the AI and IoT-based Learning management system's implementation of the proposed architecture.

The research [24] explored the use of visualization technology in smart education administration. Its results suggested that such an approach might improve many aspects of school management, such as course contents, classroom environment, formative feedback, student participation, and personal security. Furthermore, with the advancement of education digitalization, big data, and cloud computing, administrators have more tools for administering schools. Furthermore, in light of the development of AI and the needs of education in the modern era, the said study suggests the idea of visual management to build a smart education management system that includes smart learning, smart mobility, smart management, smart assessment, smart investigation, and smart

provider. Finally, a plan is presented for enhancing the LMS's visual presentation. According to the study's findings, a conceptual model of an intelligent educational system was developed in the paper [25], which considers the latest trends in education and the specific demands of today's students who grew up with digital technologies. Information and Communication Technology (ICT) permeates practically every facet of daily life in our culture, with significant effects seen in classrooms. With the help of ICT, educators and students may use cutting-edge tools, speeding up the learning process. Through centralized administration and control, this model envisions a more effective, intelligent, and individualized learning environment based on numerous information and Big Data technologies.

The article [26] presents the viewpoint of strengthening the combination of objects and people, as well as the combination of theoretical study and teaching experiment, by visually analyzing the current issues in intelligence education via 422 publications in the previous decade. The smart education model has become an integral element of the educational environment, ushering in a new era of digitalization in the classroom. Furthermore, methods are proposed to improve author collaboration and foster more academic collaboration. As a final step, it will categorize the present status of smart education research in the country and the current situation of smart educational reform, providing a valuable reference point for the future advancement of intelligent learning. The paper's authors [27] used artificial intelligence and big data analytics to create a Video-based Effective Visualization Framework (VEVF). The authors use a machine learning strategy to categorize sports movies using spatial and temporal features. Our framework is based on convolutional neural networks that include temporal pooling layers. A common practice in professional team sports is to collect and analyze monitoring data on individual players with the goals of gauging tiredness and subsequent adaptation responses, assessing performance potential, and decreasing injury and sickness risk. AI-powered fitness products may build on the solid groundwork of data visualization technologies that emerged during the age of big data analytics (AI). From our experiments, the authors know that the proposed VEVF model is superior to the state-of-the-art models in terms of accuracy (98.7%), recall (94.5%), F1-score (97.9%), precision (96.7%), error rate (23.1%), performance (95.2%), and efficiency (96.1%).

The advancement of internet technology, machine intelligence, communication techniques, and other innovations and their use in smart education has sparked an investigation into intelligent teaching systems to allow personalized learning and collaborative learning. It will describe and analyze it from several perspectives, including those of learners, instructors, content developers, technological architects, and government officials. In addition to outstanding features like adaptive customization and enhanced feedback forms for visualizing education, a smart educational environment frequently provides features like user authentication, learner modeling, data accumulation, and support for learning analytics. This paper will examine the effects of offering these capabilities on the infrastructure required for smart educational material based on the MV-SEAS method.

3. Proposed framework:

The current focus of smart education is the intelligence learning support program, which employs techniques from artificial intelligence, knowledge bases, testing, and interaction to personalize the educational experience for each student. It creates a curriculum expert system that utilizes AI to improve education for the first time. Using a knowledge database, this intelligent education system is taking on the shape of a semantic network, building its instructional strategy on integrating previously separate ideas, facts, and procedures. The focus of customized online learning in the 20th decade has shifted from investigating the efficacy of intelligent tutors to exploring the potential of adaptive learning grounded on large datasets. First, students' expertise, learning capacity, behavioral preferences, and other data are mined and analyzed using information technology tools. Then the effective learning system will automatically arrange and adjust learning programs and resources to match each learner's unique requirements. The author suggests the MV-SEAS intelligent interactive networking education system in this study. The software features knowledge browsing, question answering, analysis, and various interactive online learning resources. Analyzing the user's practice data determines how they learn best and makes instantaneous adjustments to their answer volume and content to help them reach their goals. The system will explain the exercise results, and the user can see the relevant prompt information. User behavior is driven mostly by how well the product meets its needs. In contrast, the user's subjective experience is preoccupied with their satisfaction while using the product, and their comments consider the sense of accomplishment and pride they gained from using it. Additionally, the researchers created a complete framework of user engagement from the user and the technology, enabling researchers to comprehend and assess the individual components of the user experience.

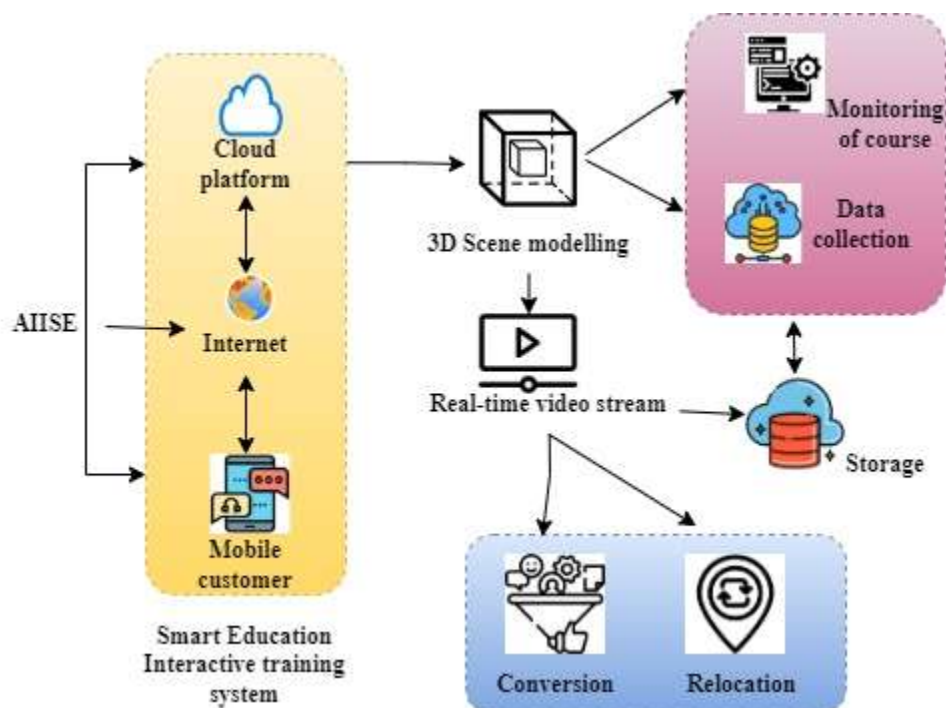


Figure 1: AI-assisted smart education interactive system

The ultimate goal of this system is to provide a cloud-based, Internet-connected, mobile-friendly platform for academic education that caters to users in virtual reality. Therefore, the following objectives should be realized through the architecture design: Scenario modeling in three dimensions, intelligent instruction with a physical controller, live video transmission, the mixed reality for mobile customers, and the use of devices in developing an AI with an instructional framework all feature prominently.

- **AIISE:**

The AI Server Interactive Education(AIISE) aims to provide a robust infrastructure for managing private AI servers, including the authentication of users, allocation of server resources, and administration. As seen in Figure 1, this system's stated goal is to provide infrastructure for the simultaneous gathering, monitoring, storage, and display of data throughout its transmission. A data center provides access to data processing, relocation, migration, and other device functionalities. The device setup includes AR, AI, a local cloud, decision-making, and an external interface. The system's functionality is divided into three sections: the Internet consumer on the phone, the cloud platform, and the Internet of Things platform. Various subsystems are responsible for each module. Adding visual perception modeling to the UI is a direct benefit.

- **3D modeling and Real-time video stream:**

Modeling in three dimensions, or 3D involves representing a surface or object in a virtual environment. It'll get into the specifics of 3D modeling software later on, but for now, know that it's used to create 3D models on computers. An item's dimensions, form, and surface texture may all be specified in 3D modeling. There is a place for 3D material in academic disciplines using artifacts, specimens, and anatomical structures. Style visualization, interface deformation analysis, and spectroscopic analysis are just a few examples of the novel ways in which 3D models expand our interaction with materials. In contrast to previously recorded and saved forms of streaming media, live streaming occurs while the video is sent over the Internet. Live streaming is becoming a common way to share content, such as TV shows, video games, and even social networking videos. Learners may regulate and control their cognitive load while video streaming in the classroom since they can choose their speed and determine how fast they study a subject. Therefore, media broadcasting entails the transmission of data, such as music or video, from a server to a user without interruption. Compressed video streams may be sent and played back in real-time via the internet. Data is transmitted constantly, and the material is played as it comes.

- **Monitoring of course and data collection:**

Knowledge of the degree to which a strategy for the education sector is being carried out can only be gained via careful monitoring and assessment. Educational ministries may benefit from collecting, monitoring, analyzing, and evaluating data to properly educate future decisions and planning. When instructors monitor, they go around the classroom to see how their students are doing. As a result, students are making strides in their coursework, and individualized instruction is being provided to those who need it. In my experience, the best educators: Establish routines to check in on and motivate pupils throughout the study. Intelligent applications of data generated or acquired in conventional educational settings to tailor teaching and enhance educational policy and practice. Methods of data collecting are used in educational research to amass information for further analysis and interpretation. Therefore, data gathering is a crucial study stage since it may considerably affect outcomes.

- **Conversion, relocation, and storage:**

Computers' ubiquity has allowed instantaneous communication between educators and their pupils via email. A student's progress may be more easily seen and audited using an online grading system. Furthermore, computers make access to social media possible, allowing for increased student-teacher communication, collaboration, and interaction opportunities. Computer vision may be useful in conventional classrooms for tracking student involvement as it is in online courses. Students' attention and focus may be gauged by analyzing their body language and eye movement. It has facilitated better two-way contact between educators and their students and between educators and their student's parents. It has also allowed teachers to tailor their classes to students' interests and learning styles in novel and exciting ways. Intelligence storage systems are more adaptable and agile in design. It can intelligently manage access permissions, reroute data in real-time, and automatically adjust data center temperature to achieve maximum efficiency. Artificial intelligence improves storage safety and dependability. With the Internet of Stuff network, users may interact with the virtual learning environment for topics in real-time, producing the same control impact as in the real world. This category includes the AI network's ability to manage resources, simulate scenarios, communicate with users, and render scenes. The user module contains users and their data, recording, tracking, and transferring. The AI network is also in charge of information gathering and keeping an eye on the virtual environment.

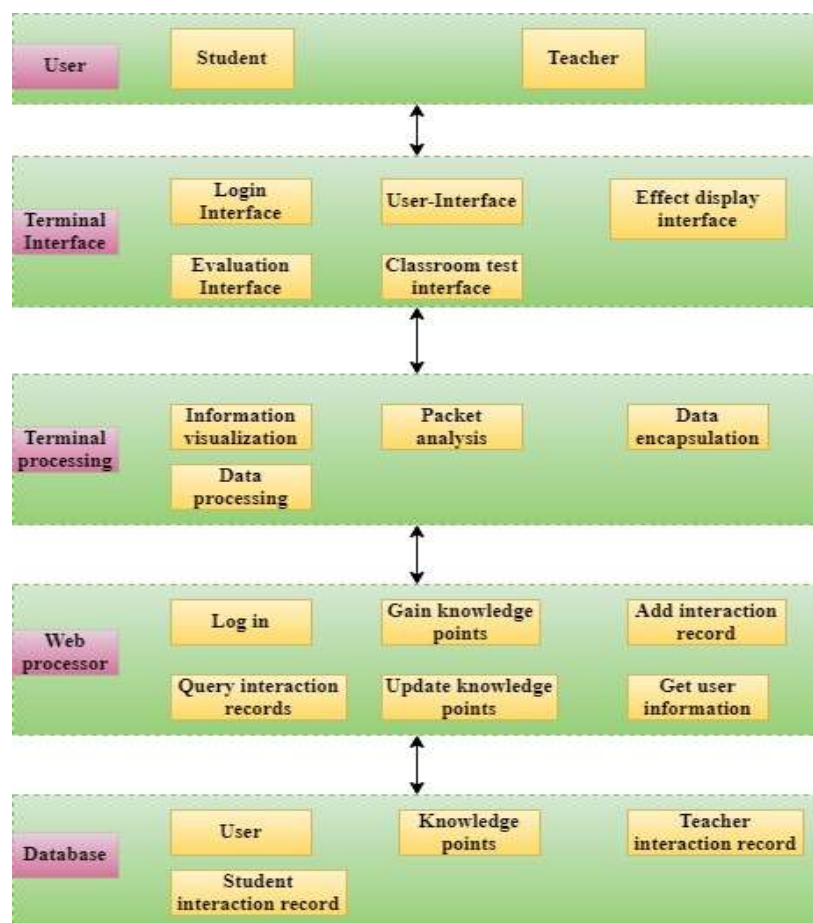


Figure 2: Utilization of visual computer vision analysis for interactive learning environments

As shown in Figure 2, the whole system of computer vision analysis in smart education is composed of five distinct layers: from the user to the databases through the web application, the graphical interface, the terminal processors, and the webservice.

- **Users' layer:**

Educators and learners are the two types of users that are described in the user layer. Both types of users access the system using unique interface layouts. A link between the user and terminal interface layers is established when a user successfully authenticates using their login interface and account password. Users will be sent to a different terminal page after entering their different account passwords.

- **Terminal Interface layer:**

The terminal interface layer defines the page where the user will interact with the mobile app. It may be broken down primarily into login interface, design element; effect identifies the most suitable, evaluation functionality, and classroom quiz functionality. To record information on the attributes of the user's interacting behavior, they must first press the interactive behavior patterns button in the user interface. The teacher and students may get insight into the changing classroom trends by seeing interaction patterns as each other develop in the affected areas in the form. Educators may assess their teaching effectiveness concerning the class as a whole, or they can choose a specific student to get feedback on their progress at any moment using the assessment interface. Additionally, when the session has ended, students can provide feedback to the instructor about the lesson's content. The quiz interface in the classroom allows instructors to choose questions for their students based on the concepts that will be assessed and display the question status once students have answered and submitted their responses.

- **Terminal Processing layer:**

The terminal processing layer's main purpose is to process information locally on the mobile device. Data processing and visualization are the essential components. Simply put, information visualization is the process by which a mobile device presents findings obtained by a server via the analysis of historical data employing graphical representations. The server and client utilize data encapsulation and data packet analysis to send and receive information. Information processing primarily checks for compatibility and prepares data for the user's dynamic action.

- **The Web Server Layer:**

The Web server layer's job is to handle user input and other data in an interactive system. Activities like signing in, earning experience points, and modifying and expanding upon dynamic data are at the heart of this. The data and requests received by the user interface are processed by this layer, which also creates a channel between the user and the database and transforms the action requested by the user into a suitable database transaction.

- **Database:**

The database layer stores all of the system's past data and allows users to perform queries at any time. Some examples of tables that represent their unique entity include user tables, integrated data sideboards, scoring tabular, and so on. In addition, the database holds essential information that keeps the whole system running smoothly.

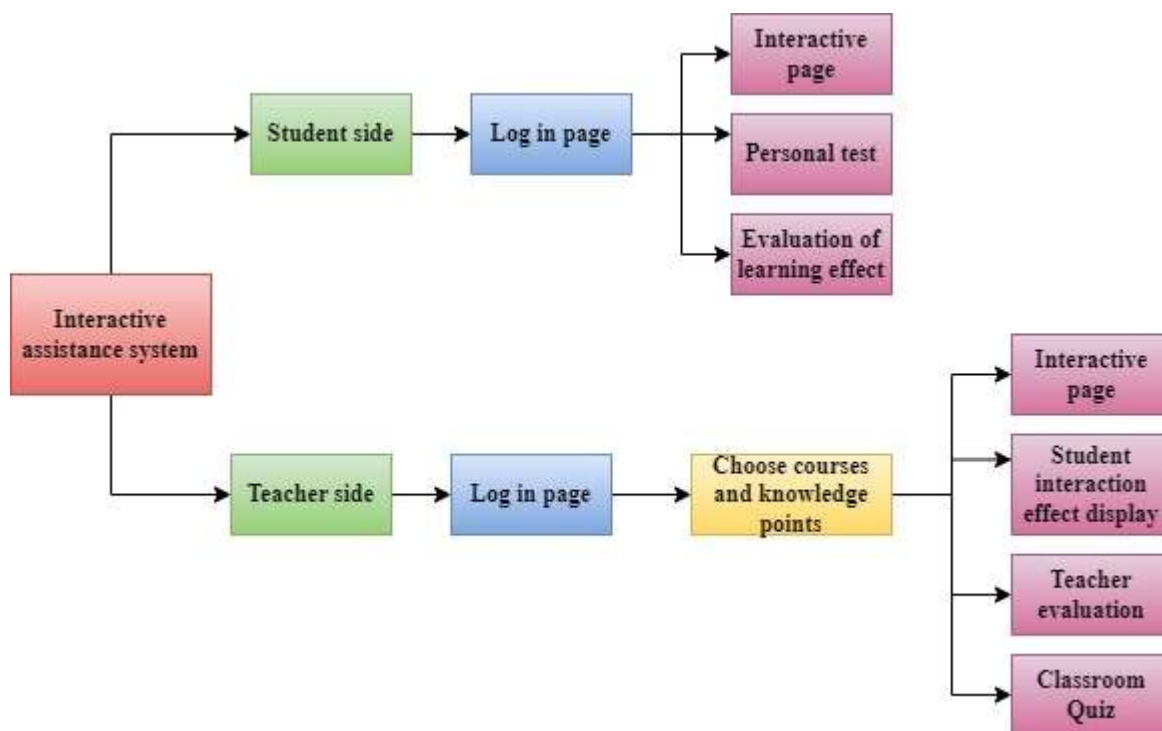


Figure 3: Smart interactive education visualization flow diagram

Figure 3 displays the sequence of the execution process. Both the educator and the learner have their interactive support system. The open-source computer vision architecture is the basis for the student's classroom identification system, which can recognize and record the user's face in real-time while stripping away any irrelevant picture backdrop information. The method for interactive visualization in computer vision is the foundation of this component. Micro-expressions of happiness, sadness, and surprise can all be detected and identified by this technique. The camera will take 30 pictures of the projected image, transmit the information to the detection task, and then show the findings on the screen. Visual calibration establishes a correspondence between the world in three dimensions and the picture on a two-dimensional screen. When applied to a two-

dimensional picture, the mapping reveals the precise position of the mechanism's movement. As the term suggests, there are three distinct kinds of visual calibration: the conventional approach, the self-calibration method, and the active-vision-based method.

With the help of an optimization problem, researchers can extract the right parameters from a model that've built based on the relationship between grid points and images; conventional calibration may achieve high processing accuracy by using a recognized calibration block as a guide. In the practical system, any camera may be used. Although any camera type may achieve great precision with the conventional approach, the procedure is time-consuming and needs calibration blocks. Visual positioning platforms are sensitive to changes in scene, stance, and optical characteristics, necessitating periodic calibration. Calibration blocks are inconvenient and time-consuming to use repeatedly. The self-calibration technique is adaptable since it does not need a calibration block to calibrate using the feature information of various scene photos, but it is not very sturdy. With some prior knowledge of motion, active vision self-calibration may be used as a visual calibration technique. The linear solution of the model parameters is made possible by the motion data, and the model's resilience is improved. Calculating the target's position in the picture yields the exact location of the moving platform, and all calculations are performed in the image's coordinate system. Given the great accuracy of the pixel array and the fact that camera manufacturers have somewhat different internal characteristics, the actual computations focus mostly on exterior pose faults rather than camera internal ones. To operate the camera using the pulse from the camera, the picture's position would need to be converted into the pulse value, or the pulse counterpart of the pixel would need to be calculated.

3.1 Formulation of Smart education using AI-machine vision:

Techniques for Gathering Data:

Data processing, quasi-information, and data structures are the three primary data sources for the smart education system. By establishing that the individual position sequences to be labeled is D , and the axis positioner is S , one may convert the acquired data together into a state sequence where $Q(i, j)$ has the highest possible value. If both D and S are random variables, D receives the values i , and S receives the values j , then the transition probability for analyzing the student behavior in a virtual environment is given in equation 1:

$$Q(i, j) = \frac{\log[\sum_{x,y} i_x j_y (i_{x-1} j_{x-1}) i_x j_x]}{\sum_{x=1}^a n_x i j} \quad (1)$$

Inputs i_1, i_2, \dots, i_a are listed below, with each i_x coming from either an external source or a neuron further up the hierarchy, and the weight values n_x for each input and output pair i_x and j_x , is shown below. After the input data has been weighted and added together, the function for calculating the camera's axis position values(r) is applied to it, and the following equation 2 is performed:

$$s(r) = Q(\rho \sum_{x=1}^a f_x i_x, \lambda \sum_{x=1}^a f_x j_x) \quad (2)$$

In equation 3, f_x is the convolution kernels, ρ is the vector representation of the input matrix, and λ is the bias. One might think of the nodes and controlling behaviors that make up the classified decision-tree model as a degree of uncertainty in a random vector and the number of clusters it uses to categorize cases as its building blocks. The probability density function of a stochastic process that ensures the axis positions of a camera to capture student images with a limited number of values is given below in equation 3, assuming the variable is discrete:

$$T(i, j) = s_i(r) + s_j(r) \quad (3)$$

The resemblance engine is a simple and reliable method for gauging how well two users are acquainted. The different conception is to measure the separation between two users on the scatterplot and see whether they have a preference. The field of machine vision uses cameras to collect data about the environment via observation. The hardware and software then process the images and get the data ready for usage in various programs. Customized lenses are often used in the image-gathering process of machine vision technologies. The two cameras' physical dimensions must be aligned with the camera app's coordinate system. To calculate the included angle with minimal precision loss, one may split the distance in half along the axis of the camera position and orientation, as indicated in formulas 1, 2, and 3. Line scan cameras, area scan cameras, and 3D scan cameras are all examples of machine vision cameras. Machine vision solutions check for existence, locate

entities, identify them, spot errors, and take measurements. Across a wide range of fields, machine vision technologies may be used in a variety of useful ways.

$$B(i, j) = \sqrt{\sum_{x=1}^a s(x)(i_a - j_a)^2} \quad (4)$$

In equation 4, $B(i, j)$ is the user's point set in space, and $s(x)$ is the distance between points in the user's area. One different way to determine how users are connected is via significance assessment. The preceding calculation method is used for significance assessment when the pupils'score information is not normalized:

$$S(D) = \alpha \frac{M(DS) - M(D)M(S)}{\sqrt{M(D^2) - M(S^2)}\sqrt{M(D^2) + M(S^2)}} \quad (5)$$

In equation 5, the generic fuzzy inference network emphasizes coverage and the incorporation of other entities, where D and S are student attendance values, α is the correlation among students, and M is the logical expectations of the students. Its accuracy is not as great as the flexible industrial graph structure and is impacted by the scope difference.

Instruction in the use of online tools:

In this study, the authors account for the uncertainty of particular words when determining their similarity to others. They conclude that the highest value of the collaborative identification among individual entities of terms is the similarity between words truly describes the nearby resemblance of phrases. Given that P_1 contains a ideas $f_{11}, f_{12}, \dots, f_{1a}$ and P_2 has n concepts $f_{21}, f_{22}, \dots, f_{2n}$, the formula for determining the degree of similarity for visually captured student image position between P_1 and P_2 is given below in equation 6 as follows.

$$A(P_1, P_2) = \frac{1}{\alpha} \sum_{x=1}^a f_{1x}, f_{2x} \quad (6)$$

It is standard practice to utilize the function $A(P_1, P_2)$, whose calculation notion is focused on the proportion of the intersections and the combination of two sets to assess their degree of similarity in camera pixels. For the most part, the correlation stems from the observation that the marking seems smaller as the distance between a marker and the camera increases. To calculate how far away a marker is from the camera, look at how big the marker is. The reference marker placements and the preset marker sizes form a mapping connection. Indicators are then identified in the video sequence, and the operation procedure extracts their pixel dimensions. For example, the following equation 7 is for determining cosine similarity for acquiring the camera position:

$$\cos(A_1, A_2) = \frac{\gamma}{\sqrt{\sum_{x=1}^{A_1} f_{1x}^2 + \sum_{y=1}^{A_1} f_{1y}^2}} \quad (7)$$

Where A_1 and A_2 are two vector directions, a weight value γ is assigned to the name in the similarity computation. The connection vector narrows the choices to only those that pertain to the most crucial category. Combining the two sets of vector similarity yields the root mean square for capturing student images, which may be used in the following calculation procedure to determine the degree of similarity between two images, as shown in equation 8.

$$\sin(R_1, R_2) = \sqrt{\gamma \cos(v_{1a}, v_{2a})^2} \quad (8)$$

The value of the expression where R_1 and R_2 are two entities, v_{1a} representing the name and feature matrix, and v_{2a} representing the connection matrix, γ varies among entities of teachers. As a result, the process index provides a more objective and consistent way to compare the rates at which different fields of study mature. The process index of a captured student image in the moving window and its transmission time is calculated as shown in equation 9:

$$X(x) = \sum_{x=1}^a b \frac{\cos(A_{1x}, A_{2x})}{\sin(R_{1x}, R_{2x})} \quad (9)$$

The preprocessing stage is a technique of extracting spatial information using a moving window, and it is denoted by (X, b) , where X is the efficiency index and b is the length of time.

$$E_x = \sum_{x=1}^a \sum_{y=1}^a (i_{n+x}, j_{a+y}) \quad (10)$$

In equation 10, where E_x are the window's length and height n and m are the coordinates in the matrix that represent the sliding screen's local neighborhood, and x and y are the values of the moving window. It measures

the moving window that captures the student images for processing through visualization. The results of an intense, recurrent system may also be integrated into a different recurrent system to enable another task.

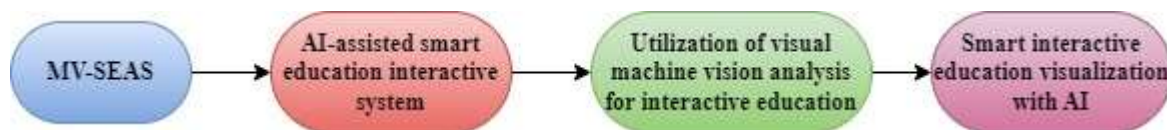


Figure.4 Conceptual framework of Interactive smart education visualization

The educational consequences of AI systems' more complicated autonomous control should not be lost on the systems themselves. Some academics argue that, before implementing sophisticated, intelligent systems, the educational concerns associated with them must be well thought through; educational concepts and norms must be included in AI systems. Agents built by AI should be able to learn from their surroundings like humans do, depending on their observations. Figure 4 shows the smart education visualization framework using artificial intelligence-assisted machine vision analysis.

Step 1: The conventional educational paradigm has come under fire for being inflexible and unsuited to the requirements of the modern world. The use of technology in education is now a global phenomenon, thanks to the proliferation of digital tools and the emergence of innovative approaches to teaching and learning. Space, location, time, technology, management, and interaction make a classroom. Therefore, it is feasible to create innovative pedagogical and technological educational settings. Students must have access to digital materials and be able to engage with learning systems from anywhere at any time. They also need the appropriate learning assistance, supporting tools, and learning ideas when needed and in the most effective way possible.

Step 2: The advancements and upgrades in machine-vision technology are becoming more dependable and improved due to the development of AI (Artificial Intelligence). Machine vision combined with AI allows for the in-depth study of an image's data, facilitating pattern recognition. It led to a major development in machine vision, allowing computers to control machinery by observing human facial expressions and movements. Through machine vision, a person's facial features, hands, arms, palms, and fingers may be tracked and analyzed for motions and expressions that can be used to command mechanical devices.

Step 3: The MV-SEAS model's major objective is to depict the evolution of AI-assisted smart education to describe and address the general principle of technological discovery in a specific topic with a higher degree of abstraction and more vivid and intuitive graphics. Because of this similarity between the discovery above mechanism and the knowledge piece about cohesion and dissociation based on network structure and information changes, the latter may describe the processes of scientific discovery. Next, the knowledge network has to be enhanced, and the semantic connections between its nodes should be fine-tuned. Given that every learner's status, learning progress, and knowledge level is unique and continually changing, dynamic prediction requires using Artificial Intelligence (AI) technology. In intelligent education, which is expanding quickly, knowledge-tracking technology is a potential new prediction tool. The learner's outer and explicit performance or sequence of actions may draw conclusions about the learner's internal and implicit knowledge and skill level. Effective educators realize that showing pupils how information is organized may help them build better knowledge organization systems.

4. Analysis and discussions:

In this research, the paper verifies and analyzes the operation of an intelligent education system built using visual machine-vision interaction. In addition, this article presents an MV-SEAS method for designing an operation that considers the practical requirements of intelligent education and the basic principles behind artificial intelligence technologies. This paper's MV-SEAS method relies on visual computer vision technology to recognize pupils in intelligent education, allowing educators to assess their progress and adjust lesson plans in realtime.

Dataset Description: It is becoming more common to create AI-driven technology to improve students' academic achievement and the quality of their education. AI-driven technology's efficacy is evaluated, as the responsibilities assigned to educators and the theoretical and practical contributions obtained from these interventions. The results of 48 studies showed that educational outcomes were more in line with AI system optimization, were primarily situated within a computer science viewpoint, and did not include instructors as active participants. Furthermore, few investigations proved to have any practical use beyond improving the AI

system's architecture, suggesting that most were purely theoretical. It addresses creating supplementary research designs for AI-powered tools before they can be effectively implemented in the classroom. The values were taken from [28-32].

i) Student behavior analysis based on MV-SEAS:

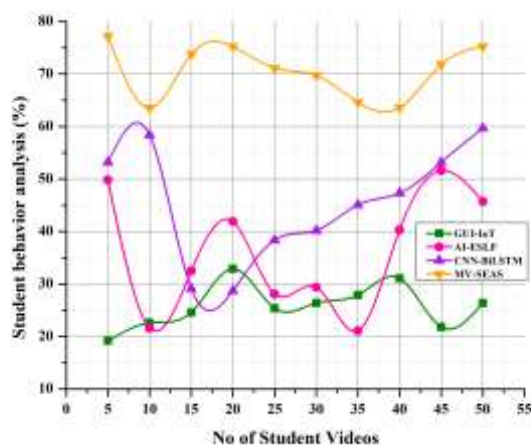


Figure 5: Student behavior analysis based on MV-SEAS

According to the results (shown in Figure 5), this paper takes the student videos as input captured during the class by their virtual teachers to analyze a student's behavior. Being late, leaving early, chatting/texting on mobile phones, talking loudly during lectures, sleeping, eating, cheating, plagiarising, going unprepared to class, and making snide comments are all characteristics of disruptive behaviors. AI's capacity to assess face attributes and compare them to a database considerably enhances the accuracy and efficiency of facial recognition by computers when used in conjunction with machine vision technology. Using a running count to keep track of incidents of potentially disruptive conduct in the smart classroom is one strategy for doing so. Analyzing student behavior is a process of systematic data collecting that aims to learn more about the causes and consequences of certain activities. Hence the suggested MV-SEAS outperforms the existing methods.

ii) Machine-vision-based facial emotion analysis with students:

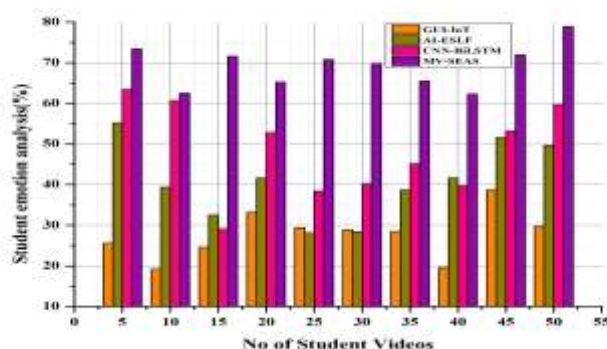


Figure 6: Machine-vision-based facial emotion analysis with students

According to figure 6, the video footage is given as input for evaluating the student emotions in the smart classroom that is captured in real-time. Turning on students' webcams during online lectures is one strategy for boosting participation. Machine vision in AI can understand and respond to students' emotions via speech, tone of voice, facial gestures, and movements. Teachers can get a sense of how their students feel and take a closer look at the atmosphere in class. It is one of the most convenient methods for presentation audits. Take into account, nevertheless, that this will greatly raise the students' bandwidth needs. Therefore the MV-SEAS method suggested in this paper gives better outcomes than the existing GUI-IoT, AI-ESLF, and CNN-BiLSTM methods.

iii) Error rate for image transmission of student data:

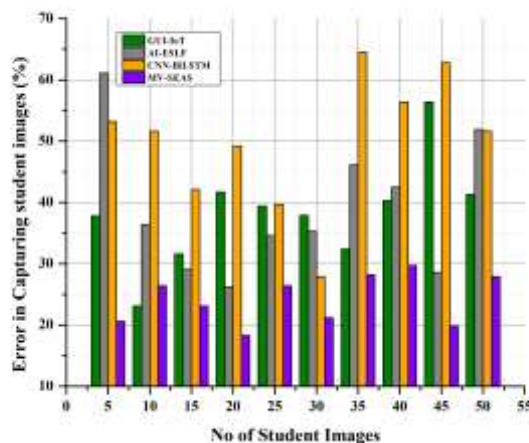


Figure 7: Error rate for image transmission of student data

Figure 7 shows that the total number of transmissions of a captured student's images utilized as input for the smart education interaction visual display is one of the two most important evaluations of a similarity model's efficiency. Thus, it assesses the normal discrepancy between simulated data and observed data. In addition, a measure is provided to assess the model's prediction performance. Therefore, it may be used since it has the same measurement system as the dependent variable. In this case, a lower error rate suggests a better match. Model prediction quality may be evaluated using the error ratio based on MV-SEAS. Bigger mistakes are given more weight in the averaging process. Since major errors need to be avoided, the error rate is illuminating under these circumstances. This number is usually understood to reflect the average discrepancy between actual data and predicted values.

iv) Performance of student activities based on MV-SEAS:

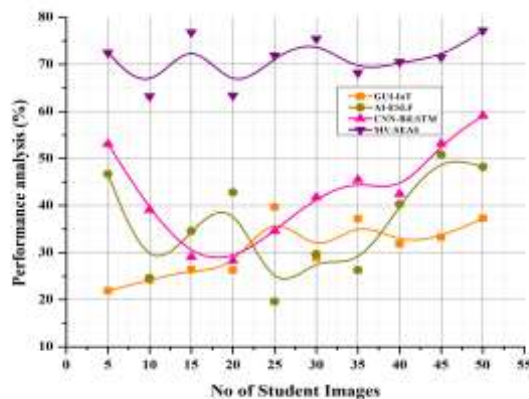


Figure 8: Performance of student activities based on MV-SEAS

Figure 8 shows that the variable measuring the time it takes students to learn visual content significantly influences their overall performance. Furthermore, student data with 3D images and its style is used in academic performance calculations and is analyzed in the context of the captured student's images in runtime. In this case, fewer longer accesses seem to help pupils more. Additionally, the student's online activities while using the site were highly related to their performance. Since the proposed strategy improves student performance, this article recommends it above the indicated MV-SEAS, which has a smaller impact. Performance was therefore enhanced with MV-SEAS over the previous system.

5. Conclusion

Smart education, as mentioned, represents a shift in how the world's educated populations see their schooling. The purpose of intelligent teaching is to enhance students' capacity for continuous learning. Contextual, individualized, and seamless learning is emphasized to foster the development of students' developing intellect and to aid in the acquisition of the skills necessary to solve problems in technologically advanced settings. Technological innovation and the modern social environment have created several challenges for smart education, such as pedagogical theory, innovative educational management, teacher learning governance, educational establishments, and instructional ideologies. Students in online classes may get real-world assistance with their studies using the MV-SEAS method's interactive data visualizations for learning. They may aid students in keeping tabs on and analyzing their performance processes and learning results, allowing them to make calculated moves toward improvement. Students' engagement with the course platform, their study of individual subjects, and their usage of course materials and other resources may all be gleaned via visual analytics. It includes data like how long students spend on individual videos or chapters of course materials, the sequence in which they study the materials provided, and the percentage of assignment completion. A teacher's ability to assess their pupils' learning performance and track their development over a semester is greatly aided by such data. When assessing a teacher's effectiveness in the classroom nowadays, it's not enough to look at test results or student surveys; evaluators also need to consider students' natural contributions to the education process. Consequently, a more accurate assessment of the student's focus is possible only via a multi-dimensional examination of their attention. Through machine vision analytics, this article provides educators with a foundation to build lesson plans based on the behavioral patterns of their students in smart education classrooms. Additionally, the paper develops the system's MV-SEAS framework structure and workflow to the core needs of education. In the end, a test is devised to see how well the system works. The results of the experimental investigation demonstrate the beneficial influence of the intelligent education system developed in this article. This paper delves further into the history of computer vision, how it operates, and how it identifies things. Furthermore, its function in interpersonal interactions is explored, along with its presentation of the area of application where it is involved. The discussion concludes with the current benefits and limits in the computer-vision field.

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