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INTEGRATION OF ARTIFICIAL INTELLIGENCE IN THE FIRST NATIONAL ENGINEERING PLATFORM

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Abstract. This paper introduces an advanced extension of the First National Engineering Platform, which integrates artificial intelligence and computer vision to facilitate interactive STEM education. Two cutting-edge functionalities are presented: (1) facial analysis using a standard computer camera to estimate a student's **biological age** based on real-time image data, and (2) touchless mathematics interaction via **hand gesture recognition** in the air. These AI-powered modules provide personalized, hygienic, and immersive learning experiences that significantly enhance student engagement and digital literacy.

Keywords: Artificial Intelligence, Computer Vision, Biological Age, Webcam Face Detection, STEM Education, Gesture Recognition, Touchless Interaction, Digital Classroom.

Recent innovations in artificial intelligence (AI) and computer vision technologies have revolutionized the landscape of modern education, opening unprecedented pathways for the development of smart, responsive, and adaptive learning environments. As the educational sector continues to evolve in response to the demands of the digital age, the integration of AI-based tools into classroom practices has transitioned from being a futuristic concept to a present-day necessity. These tools, powered by complex algorithms, real-time data processing, and deep learning techniques, are capable of not only delivering content but also interpreting learner behavior, adjusting difficulty levels, and offering personalized feedback based on the unique needs of each student. This level of personalization enhances engagement, supports differentiated instruction, and promotes a deeper understanding of subject matter. Among the most impactful advancements within this domain are facial recognition systems, gesture tracking frameworks, and adaptive machine learning algorithms. Facial recognition, for instance, can be employed not only for security and attendance tracking but also for health-related analytics and emotional state monitoring. Gesture tracking allows learners to interact with digital interfaces in a touch-free manner, creating a more intuitive and inclusive learning experience—particularly relevant in post-pandemic educational settings that prioritize hygiene and contactless interaction. Machine learning algorithms underpin these systems by continuously analyzing user input, recognizing patterns, and evolving in accuracy over time. In this context, the **First National Engineering Platform** stands out as a pioneering multidisciplinary STEM (Science, Technology, Engineering, Mathematics) education tool that bridges the gap between theoretical concepts and practical application. Originally

conceptualized to facilitate hands-on experimentation using a diverse range of physical sensors and microcontrollers, the platform has now undergone a significant technological evolution. It has been augmented with **intelligent AI-powered modules** that expand its capabilities far beyond traditional lab simulations. Among its most innovative features are (1) the **biological age prediction system,** which utilizes a standard webcam and advanced facial analysis algorithms to assess the physiological condition of a student, and (2) a **contactless mathematical interface**, which employs hand gesture recognition to allow learners to interact with math problems by selecting answers in mid-air, without touching a screen or device. The biological age estimation functionality is particularly notable for its educational and wellness potential. Using computer vision techniques, the platform captures a live image of the student's face and analyzes key biological markers such as skin elasticity, wrinkle patterns, facial symmetry, and other dermal features associated with aging. These visual inputs are then processed through trained neural networks to estimate a biological age, which can inform students about their general wellness, stress levels, or lifestyle impact—encouraging discussions around health, fitness, and personal development. This fosters a holistic learning experience where biology and data science converge to provide meaningful, real-world insights. On the other hand, the air-based mathematics interaction system introduces an engaging, gamified approach to problem-solving. Rather than using traditional input devices like a mouse, keyboard, or touchscreen, students simply gesture toward a selected answer, and the AI interprets the movement to register their response. This not only makes the experience more immersive but also introduces learners to the principles of human-computer interaction (HCI), spatial recognition, and gesture-based programming logic. It is particularly effective for inclusive education, benefiting students with physical disabilities or motor skill challenges by reducing barriers to digital participation. Collectively, these enhancements reflect a broader global trend toward **AI-powered adaptive learning ecosystems**, where educational technologies are not only delivering content but also analyzing, responding to, and evolving with the learner. The fusion of health analytics, machine learning, and contactless interactivity exemplifies the future of education—intelligent, personalized, safe, and engaging. The First National Engineering Platform thus serves as a model for next-generation smart classroom systems, combining technical innovation with educational impact to meet the complex demands of 21st-century learning.

Picture 1: System MATH displays

The image captures a real-time educational scenario powered by **computer vision and artificial intelligence**, where a student interacts with a virtual mathematics learning environment using hand gestures. The system displays a **multiple-choice question** in Uzbek: *"Uchburchak yuzini topish formulasi qanday?"* (What is the formula for calculating the area of a triangle?). Two answer options are visually projected: **S = ab** and **S = ab/2**. In the foreground, a **hand tracking system**—most likely using **MediaPipe or a similar AI model**—detects the student's finger joints and movements. The joints are marked by green nodes and connecting lines, forming a skeletal map of the hand. The AI is interpreting which formula the student is pointing to, enabling **touchless interaction** in the learning process.

In the top corners, a ball counter and a label "MATEMATIKA" indicate the subject and gamified elements of the session. A virtual avatar in traditional Uzbek attire is included, possibly serving as a digital tutor or cultural guide, enhancing learner engagement. This setup is part of an **AI-driven STEM education platform** that allows students to solve math problems not by clicking or typing, but by simply pointing in the air. It integrates **augmented reality (AR), gesture-based input,** and **machine learning** to make education more interactive, accessible, and fun. By fusing cultural elements with cutting-edge technology, the platform promotes active learning and improves conceptual understanding through multisensory input.