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Face Recognition Attendance System, Smart Learning, College Enquiry Using AI Chat-Bot

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ABSTRACT

Artificial Intelligence (AI) involves the development of machines capable of emulating human-like intelligence. Chatbots serve the purpose of facilitating conversations between humans and machines. These bots are equipped with knowledge to interpret sentences and autonomously generate responses to address queries. Typically, chatbots maintain stateful services, retaining previous commands to offer continued functionality. When integrated with popular web services, chatbot technology can be securely utilized by a broader audience. This paper explores prevalent trends and practices in AI, challenging some existing principles and proposing an alternative theory that delves into machine intelligence, shedding light on the future of intelligent systems.Authentication poses a significant challenge in computer-based communication systems. Human face recognition, a crucial facet of biometric verification, finds extensive applications in video monitoring, human-computer interaction, door access control, and network security. This paper introduces a Student Attendance System integrated with facial recognition technology employing the Personal Component Analysis (PCA) algorithm. The system automatically records student attendance within classroom settings, enabling faculty members to conveniently access student information through a log documenting clock-in and clock-out times.Our study aims to establish and validate a comprehensive set of design principles applicable for educators in creating AI-driven agents. Employing a design science research approach, we derive requirements from students and educators. Our findings suggest that implementing these design principles and corresponding artifacts significantly enhance learning outcomes. This work aims to formulate an emerging design theory for developing Smart Personal Assistants functioning as learning tutors.The college inquiry chatbots are constructed using artificial algorithms that analyze user queries and comprehend their messages. The system responds to user input, enabling inquiries about various college-related activities remotely without physical presence. By leveraging artificial intelligence, the system effectively addresses student queries through a user-friendly Graphical User Interface, simulating a human-like interaction. Comprising a core and interface accessing the core via MySQL, these chatbots incorporate natural language processing technologies for parsing, tokenizing, stemming, and content filtering.

Keywords: Smart personal assistant, intelligent tutoring system, design science research, quasi field experiment, education, Face recognition system, automatic attendance, authentication, bio-metric, PCA.

I. INTRODUCTION

The core objective of this project revolves around an advanced chat-bot system tailored for academic purposes. This system streamlines various academic activities including admission inquiries, fee structures, scholarship details, departmental timetables, and necessary document details. By leveraging this chat-bot system, students can promptly resolve their queries with efficiency and speed.

As facial recognition technology continues to advance, it stands out as a leading biometric solution due to its user-friendly nature, requiring minimal effort compared to other biometric options. Its applications span across three primary domains: time attendance and employee management, visitor management systems, and authorization and access control systems.

Traditionally, manual recording of student attendance using sheets distributed by faculty members is a time-consuming process. Furthermore, verifying each student's presence in a large classroom environment across different branches is a challenging task. This paper focuses on showcasing how facial recognition technology can effectively automate the attendance process, accurately registering enrolled individuals' presence in specific venues. Additionally, the proposed system maintains a comprehensive log file, ensuring the record-keeping of entries aligns with a universal system time.

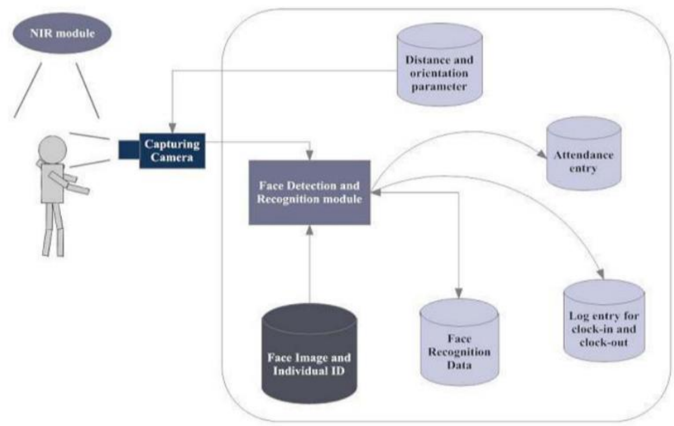

Fig 1. Architecture of the system

Chat-bot for college management system project will be developed using artificial intelligence algorithms that will analyse user's queries. This system will be a web application that will provide answers to the analysed queries of the user.

Users will just have to select the category for queries and then ask the query to the bot that will be used for answering it. Artificial intelligence will be used to answer the user's queries. The user will get the appropriate answers to their queries. The answers will be given using artificial intelligence algorithms. Users won't have to go personally to the college for inquiry.

The User must just register to the system and has to login to the system. After login user can access the various helping pages. There will be various helping pages through which the user can chat by asking queries related to college activities. The system will reply to the user with the help of an effective graphical user interface (GUI). The user can query about college-related activities with the help of this web application. College-related activities such as annual day, sports day, Intake, and other cultural activities. It will help the students/user to be updated about the college activities.

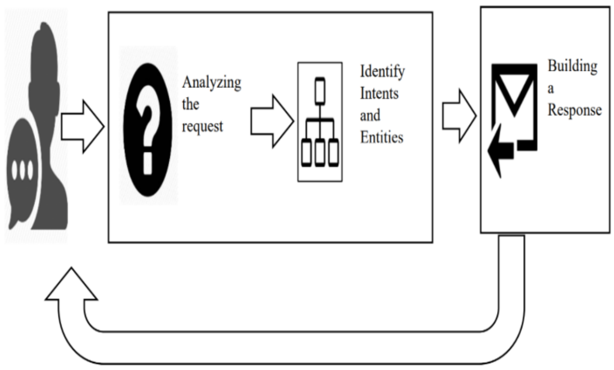

Fig 2. How Chatbot Works

Consequently, we address the following research questions regarding smart teaching or learning:

How can Smart Personal Assistants be designed as learning tutors to improve student's learning outcomes?

Our design science research project is grounded on a constructivist view of learning. In specific, we use the ICAP-framework as our kernel theory. To answer our research questions, we present two cycles of a design science research (DSR) approach. In our first cycle, we derive requirements for SPAs as learning tutors from literature and conduct interviews with educators and students. Based on that, we formulate an initial set of design principles for SPAs as learning tutors. In our second cycle, we refine the design principles and build our first instantiation of a SPA and evaluate it with the help of a quasi-field experiment in an everyday learning environment. The third cycle will be the subject of future research. The goal of the completed research project is to create a set of design principles resulting in a nascent design theory allowing educators to create SPAs for their learning environments. The remainder of this paper is structured as follows. The ICAP-Framework defines cognitive engagement activities based on students' overt behaviours and proposes that engagement behaviours can be categorized and differentiated into one of four modes: Interactive, Constructive, Active, and Passive.

Smart Personal Assistants as Learning Tutors:

Software Personal Assistants (SPAs) are intelligent agents designed to automate and simplify various daily tasks through voice-based interactions with users. Providers of SPAs offer robust ecosystems equipped with natural interfaces, empowering users to create and share their own skills, thereby enhancing the overall value of SPA platforms. Unlike traditional user assistance systems, SPAs excel in delivering heightened interaction and intelligence. They possess the capability to respond to user commands and proactively assist users through intricate tasks.

In the realm of education, the utilization of computer tutoring systems is a familiar concept. Despite their proven effectiveness in enhancing learning outcomes, the widespread adoption of current Intelligent Tutoring Systems (ITS) remains limited due to the substantial technological expertise and development time required. Conversely, SPA providers like Amazon offer accessible toolkits supplemented with extensive blueprints and tutorials, enabling users to develop SPA skills with minimal technological expertise and time investment.

ICAP – Framework as Kernel Theory: -

The ICAP framework proposed by Chi and Wylie (2014) is based on a constructivist view of learning. It explains the process of effective learning by classifying observable student behaviours into four modes: Interactive, Constructive, Active, Passive and predicts that these modes will be ordered by effectiveness: interactive > constructive > active> passive. Educators have long recognized that although students can learn from receiving information passively, they learn much better actively. Learning actively requires students to engage cognitively and meaningfully with the tasks they are doing. Each mode of the ICAP framework corresponds to different types of behaviours and knowledge-change processes predicting different learning outcomes.

For example, when watching a video, students can watch it without doing anything else. Students can also manipulate the tape by pausing, playing, fast-forwarding, and rewinding. A constructive behaviour would be self-explaining the concepts in the video. The most effective interactive student behaviour would be if students discuss the content and its justifications with a peer or tutor. The ICAP-Framework serves as a basis for the development of the design principles. It explains the mechanism why SPAs might be able to increase students' learning outcomes by changing their knowledge processes when interacting with SPAs compared to non-interactive learning materials. Properly designed SPAs as learning tutors have the capabilities to bring students from a passive to an interactive learning mode.

II. METHODOLOGY

2.1. Face Recognition-Attendance System:

The proposed system has been implemented with the help of three basic steps:

A. Detect and extract face images and save the face information in an XML file for future references.

B. Learn and train the face image and calculate the eigen value and eigenvector of that image.

C. Recognise and match face images with existing face images information stored in the XML file.

Fig 3. Methodology Used

A. Face Detection and Extract

At first, openCAM_CB() is called to open the camera for image capture. Next, the frontal face is extracted from the video frame by calling the function ExtractFace(). The ExtractFace() function uses the OpenCV HaarCascade method to load the haarcascade_ frontalface_alt_tree.xml as the classifier. The classifier outputs a "1" if the region is likely to show the object (i.e., face), and "0" otherwise. To search for the object in the whole image one can move the search window across the image and check every location using the classifier. The classifier is designed in such a manner that it can be easily "resized" to be able to find the objects of interest at different sizes, which is more efficient than resizing the image itself.

So, to find an object of unknown size in the image the scan procedure is done several times at different scales. After the face is detected, it is clipped into a Greyscale image of 50x50 pixels.

B.Learn and Train Face Images

Learn() function which performs the PCA algorithm on the training set. The learn() function implementation is done in four steps:

1. Load the training data.

2. Do PCA on it to find a subspace.

3. Project the training faces onto the PCA subspace.

4. Save all the training information.

1. Eigenvalues
2. Eigenvectors
3. The average training face image
4. Projected face image
5. Person ID numbers

The PCA subspace is calculated by calling the built-in OpenCV function for doing PCA, cvCalcEigen Objects(). The remainder of doPCA() creates the output variables that will hold the PCA results when cvCalcEigenObjects() returns.

To do PCA, the dataset must first be "centred." For our face images, this means finding the average image in which each pixel contains the average value for that pixel across all face images in the training set. The dataset is centred by subtracting the average face's pixel values from each training image. It happens inside cvCalcEigenObjects().

But we need to hold onto the average image, as it will be needed later to project the data for that purpose it is needed to allocate memory for the average image and the image is a floating-point image. Now we have found a subspace using PCA, we can convert the training images to points in this subspace. This step is called "projecting" the training image. The OpenCV function for this step is called cvEigenDecomposite(). Then all the data for the learned face representation is saved as an XML file using OpenCV's built-in persistence functions.

C.Recognise and Identification

Recognize() function, which implements the recognition phase of the Eigenface program. It has just three steps. Two of them - loading the face images and projecting them onto the subspace - are already familiar. The call to loadFaceImgArray() loads the face images, listed in the train.txt, into the faceImgArr and stores the ground truth for the personal ID number in personNumTruthMat. Here, the number of face images is stored in the local variable, n TestFaces.

We also need to load the global variable n TrainFaces as well as most of the other training data - nEigens, EigenVectArr, pAvgTrainImg, and so on. The functionloadTrainingData() does that for us. OpenCV locates and loads each data value in the XML file by name.

After all the data are loaded, the final step in the recognition phase is to project each test image onto the PCA subspace and locate the closest projected training image. The call to cvEigenDecomposite(), projects the test image, is similar to the face-projection code in the learn() function.

As before, we pass it the number of eigenvalues (nEigens), and the array of eigenvectors (eigenVectArr). This time, however, we pass a test image, instead of a training image, as the first parameter. The output from cvEigenDecomposite() is stored in a local variable -

projectedTestFace. Because there's no need to store the projected test image, we used a C array for projectedTestFace, rather than an OpenCV matrix.

The findNearestNeighbor() function computes the distance from the projected test image to each projected training example. The distance basis here is "Squared Euclidean Distance." To calculate the Euclidean distance between two points, we need to add up the squared distance in each dimension, and then take the square root of that sum. Here, we take the sum, but skip the square root step. The result is the same, because the neighbour with the smallest distance also has the smallest squared distance, so we can save some computation time by comparing squared values.

2.2. Smart Learning or Teaching:

We rely on Hevner's (2007) three-cycle design science research approach to structure the research process:

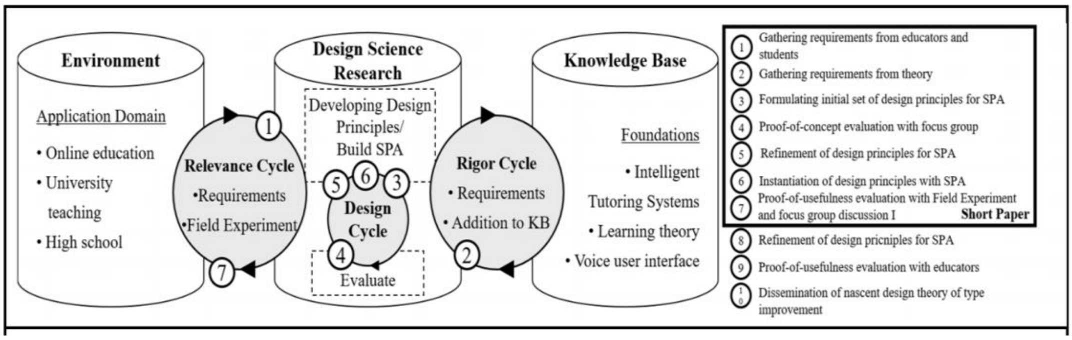

Fig 4. Block diagram of three-cycle design science research approach to structure the research process

In **step 1**, we initiate the relevance cycle by gathering requirements from educator and student interviews.

In **step 2**, we initiate the rigor cycle where we gather requirements from three different theoretical perspectives.

In **step 3**, we initiate the design cycle by formulating the initial set of design principles for SPAs as learning tutors.

In **step 4**, we conduct a first proof-of-concept evaluation with the help of a student focus group discussion. The objective of this evaluation is to make sure that we capture the most important requirements and logically translate them into design principles (Sonnenberg and Vom Brocke 2012).

In **steps 5** and **6,** we refine the design principles and create our first instantiation of design principles.

<u>Step 1: Gathering Requirements from Students and Educators</u>

Table 1. Sample Characteristics

Interviewees	Characteristics
Students	**Age:** 21.35, **level of education:** 5 x high school, 10 x bachelor, 5 x master, **nationality:** 8 x Swiss, 11 x German, 1 x Italian, **gender:** 8 women, 12 men
Educators	**Teaching experience:** 5 to 25 years, **type of school:** 1 x high school teacher, 2 x bachelor lecturer, 1 x master lecturer, **experience with different learning environments**: 1 x online, 1 x mass lecture, 2 x small classes

Table 2. User-Stories and Requirements from Students and Educators

User Stories (Students)	Requirements from Practice (RP)
USS1: As a *student*, I want the SPA to give me immediate and detailed feedback on my responses.	**RP1:** The SPA should actively process and evaluate the students' responses.
USS2: As a *student*, I want the SPA to reply as fast as a human in a conversation.	**RP2:** The SPA platform should provide a fast hardware and software architecture.
USS3: As a *student*, I want to be able to use the SPA at any time, at any place.	**RP3:** The SPA should be available anytime.
USS4: As a student, I want to access the SPA via voice similar to smartphone assistants (e.g., Google's Assistant or Apple's Siri).	**RP4:** The SPA should include voice in- and output.
User Stories (Educators)	
USE1: As an *educator*, I want to design SPAs by myself without needing a lot of technological knowledge.	**RP5:** The SPA platform should allow educators to develop SPAs on their own.
USE2: As an *educator*, I want that the SPA can be used on different devices (e.g., smartphones, tablets, laptops).	**RP6:** The SPA should be accessible via different devices.
USE3: As an *educator*, I want to use the SPA for different learning goals and tasks.	**RP7:** The SPA should be adaptable to different tasks in an efficient and uncomplicated way.
USE4: As an *educator*, I want to spend little or no money on developing SPAs for my courses.	**RP8:** The development costs of SPAs should be low.

<u>Step 2: Gathering Requirements from Theory</u>

Table 3. Requirements from Theory

Perspectives	Exemplary Paper	Requirements from Theory (RT)
Educational	**ICAP-Framework** (Chi and Wylie, 2014)	**RT1:** The SPA should include a proactive and reactive interaction model, where the SPA and the learner both make a contribution.
	Scaffolding (Kim and Hannafin 2011)	**RT2:** The SPA should provide different kinds of scaffolds during task completion.
Technical	**Personification** (Woolf et al. 2008)	**RT3:** The SPA should include personification attributes.
	Error handling (Guo and Goh 2015)	**RT4:** The SPA should resolve errors and dysfunctions so that the user can continue.
Voice User Interface	**Transparent Systems** (Xu et al. 2014)	**RT5:** The SPA should help the users to build an internal model of the functionality of the system.
	Engaging Response Structure (Pearl 2016)	**RT6:** The SPA should use an engaging response structure different to text interfaces.

Step 3: Formulating Design Principles based on Requirements

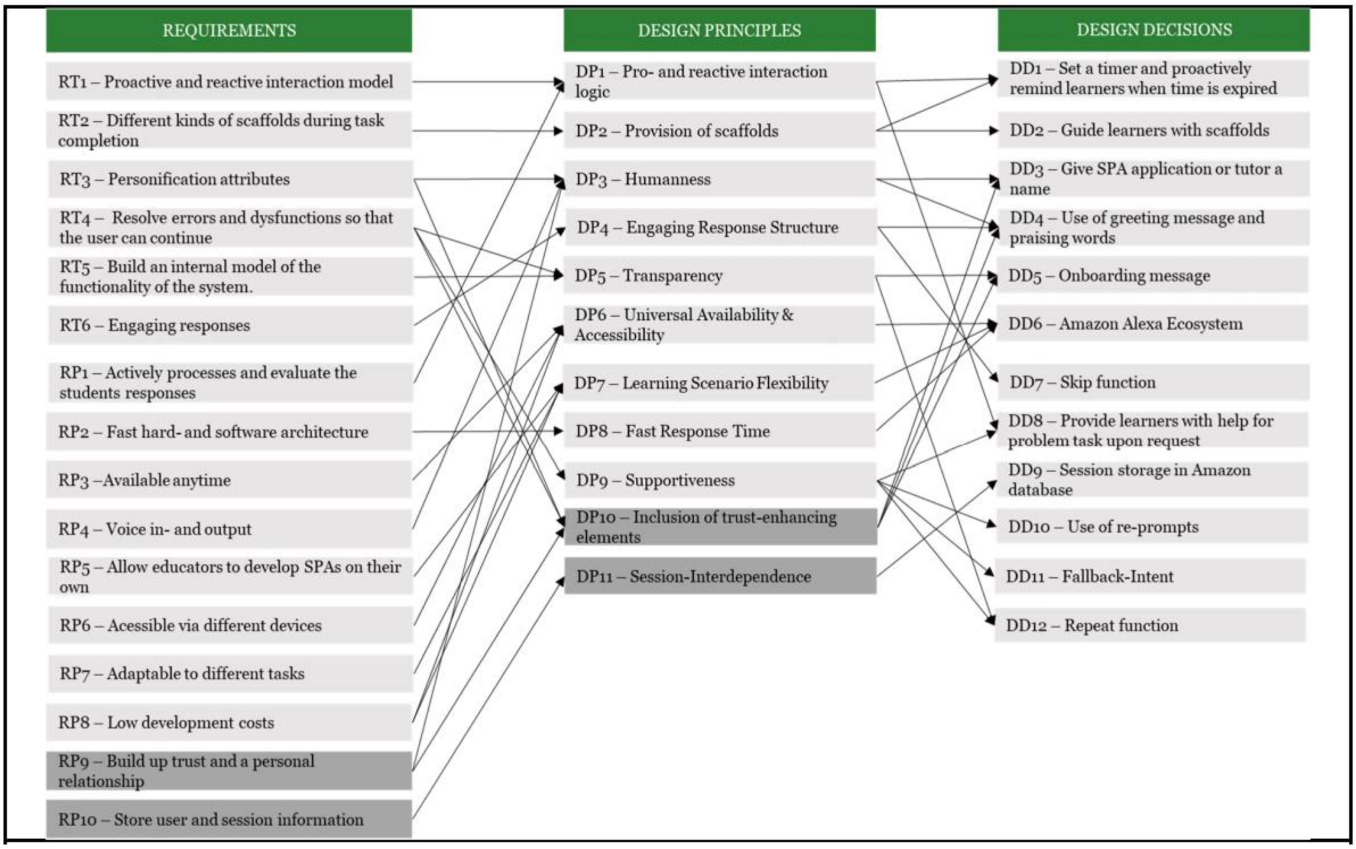

Fig 5. Requirements, Design, Principal and Design Decisions

2.3. College Enquiry

The proposed methodology makes use of both qualitative and quantitative perspectives and includes a broad array of approaches such as literature reviews, expert opinions, focus groups, and content validation.

The proposed system will have the following modules:

A. Online Enquiry: Students can enquire about facilities and queries related to exams, academics, fee structure, etc. Students can also ask questions related to placement activities.

B. Online Chatbot: The result can be shown in the form of images and card format or text format. The query will be answered based on questions asked and the language model built and also the response media created.

Users that want to enquire about the college at the time of admission or any competition held in the college can query the chat-bot.

Given below is the system architecture of this chat-bot:

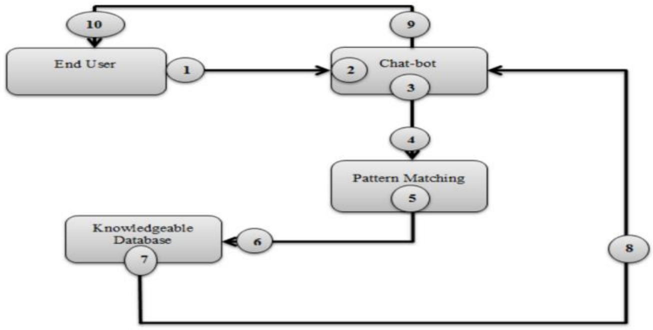

Fig 6. Architecture of chat bot

The basic algorithm that will be implemented for the working of this proposed system is as follows:

Step 1: Start.

Step 2: Get the input query from the user.

Step 3: The query is pre-processed. E.g., suppose there is this query "what are the project domains for CSE fourth-year major projects." So, we are going to remove these stop words like "are", "the" using pre-processing technique.

Step 4: Fetch the remaining keywords from the query.

Step 5: Match the fetched keywords with the keywords in the Knowledge base, and provide an appropriate response.

Step 6: Further the Database module is used to call proper services using entity information to find proper data.

Step 7: The keywords will be matched with the help of a keyword matching algorithm.

Step 8: It returns the query response to the bot.

Step 9: Chat-bot packages the data into a proper response for display by the client.

Step 10: Exit.

III. CONCLUSION

Face Recognition-Attendance System:

The system takes attendance of each student by continuous observation at the entry and exit points. The result of our preliminary experiment shows improved performance in the estimation of attendance compared to the traditional black and white attendance systems. Current work is focused on the face detection algorithms from images or video frames.

Our system can be used in a completely new dimension of face recognition application, mobile-based face recognition, which can be an aid for common people to know about any person being photographed by cell phone camera including proper authorization for accessing a centralized database.

Smart Learning or Teaching:

We contribute to the field of computer tutoring by providing prescriptive knowledge on how educators can design new forms of ITS (SPAs) to enrich the learning environments and improve student's learning outcomes. As SPAs will increasingly enter students' everyday lives, it is important to understand how SPAs can be used in education. Regarding practical implications, we exemplarily show educators how to build SPAs for their learning environments.

College Enquiry:

The goal of the system is to help the students to stay updated with their college activities. Artificial Intelligent is the fastest growing technology everywhere in the world, with the help of Artificial Intelligent and Knowledgeable databases. We can transform pattern matching and virtual assistance. This system is developing a chatbot based on an android system so with the combination of an Artificial Intelligent Knowledgeable database and virtual assistance. We can develop such a chatbot that will make conversion between human and machine and will satisfy the question raised by the user. The main motive of the project is to reduce the workload on the college's office staff and reduce the response time to a user's query.

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