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Attendance Recording System for Educational platform using face recognition based on PCA, ANN and chaos

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Abstract - *There are many electronic educational platforms that allow students to attend, receive information and exchange it with the electronic class students. In the current situation the need for these platforms has increased because the world is facing the Covid-19 epidemic. But most of these platforms lack a student attendance registration system. Inthis paper an attendance system has been proposed, based on Face recognition using a modified back-propagation neural network algorithmwhit Logistic map. Test the proposed system on (50) volunteers, were the results for (FAR =0.02), (FRR =0.326), (FER =0) and accuracy =93.4%*

Keyword: Attendance Recording System, face recognition, PCA, ANN, chaos.

I. Introduction

COVID-19 pandemic has contributed to restricting many behaviors, practices and policies across the world. Whereas, education is the sector that has been most affected by this epidemic. Which led to the closure of institutions in most countries of the world, schools and universities to reduce the spread of COVID-19 pandemic and because educational institutions are more crowded [1] thus, they are the most vulnerable to infection with this virus. That is why the countries of the world sought to search for solutions to complete the academic and educational path of pupils and students, and they found only a basic mechanism, namely e-learning platforms, and here began to talk about this type, although it is not new, but must stop at a fundamental point, which is defining what distance education is, which is an exchange of cognitive and educational activities between the teacher or the source, whether it is an institution or a body, and the recipient, whether it is a student, researcher or trainee, through a predetermined course and according to a timetable.[2]

In the process of classroom teaching activities, the phenomenon of absenteeism becomes more serious, and it is difficult to ensure the degree of effective participation of students' interaction and the influence of teaching. Therefore, teachers often require students to participate in teaching activities in the mandatory requirements by registering learners' attendance. In addition, course attendance registration information is also part of the regular grading, and promotes the transition from summary assessment to process evaluation. [3]There are many previous works, of which we mention:

MIN and etal ,[4] proposed a method for registering attendance that is controlled by the site. Where they have developed a mobile application called Master C. This enables the users to register to the proposed system via a smartphone. When the teacher opens the signature function at a certain time in the classroom where students can send their information and location coordinates through the Master C application. The functions of the proposed system consist of three units, namely, attendance registration, attendance data recording, and attendance submission. As for the system test, attendance was registered in nine subjects, and the final results have achieved an efficiency of 99.51%

Eze Peter U and etal [5] have proposed a system for attendance recording, fingerprinting and remote monitoring, for employees and students in educational institutions, as this system contains a real-time monitoring interface that enables managers to follow students or employees from remote locations during check-in or out. Through results, the system has taken a second for the purpose of verification instead of the 20second in the manual method, as the system takes 7.3 When registering 71 astudent.

Nilesh D and etal[6] have proposed an automated attendance system using face recognition that would take students' attendance periodically during the semester As this system reduces the effort and time that are spent in the attendance process. This system consists of a high-definition surveillance camera to record videos during the semester. Through this video, the attendance of students is determined and also contains an attendance report according to the needs of the supervisors. Where the results have shown that the more students in the frame, the greater is the false detection rate. When testing the proposed system on 10 students, the false detection rate was 1%, and when the number was 40, the false detection rate was 3%

This study proposes a system for recording student attendance for an educational platform, where attendance has been recorded using the face recognition. For which two algorithms have been used, which are: (PCA for feather extraction and Dimensional reduction) and (neural network modified with chaos). Through, the results that have been obtained, it has been noticed that the proposed approach has given better results compared to it in the case before modification.

II. Logistic map

Logistic map can be defined as a simple non-linear function it is defined in equation:

$$x_{n+1} = r x_n (1 - x_n) \dots \dots \dots \dots \dots (1)$$

Where $cho_i = x_{n+1}$ (2)

Where x1 is the initial condition and r is a parameter, whit $0 \leq x_n \geq 1$.[7].

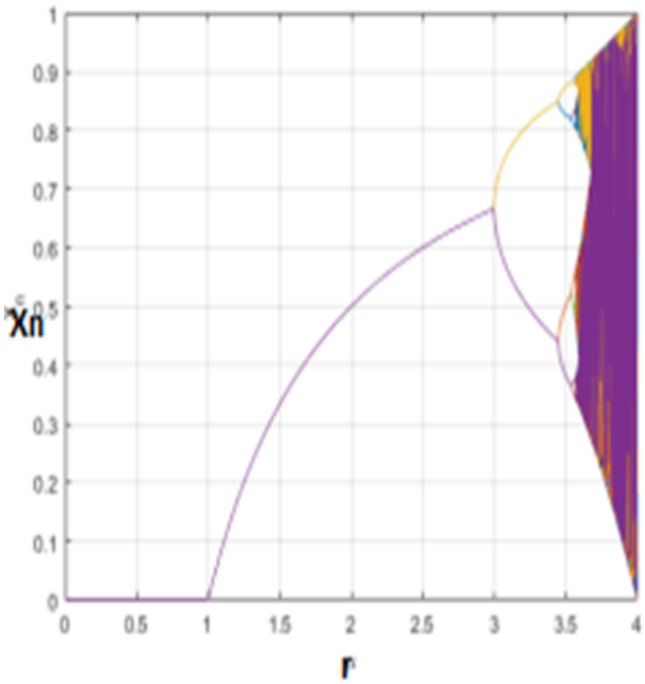

Figure (1). Logistic map behavior [8]

III. Modification neural network

The back-propagation neural network is a multilayered, feed-forward neural network and has been by far considered as the most extensively used. It is also considered one of the simplest and most general methods that are used for supervised training of multilayered neural networks. Back propagation works by internally adjusting the weight values and approximating the non-linear relationship between input and output. It can be applied to inputs that are entered into the training impairment (i.e. the predictive abilities). For speeding the learning process up, by changing the weight to continue in the same direction in bigger steps, due to the fact that it avoids the learning process from staying in local minimum. The chaos generates random numbers whose value ranges from 0 to 1. It has been noted through the modification that weremade to the algorithm, better results have been reached in terms of the speed and efficiency of work.

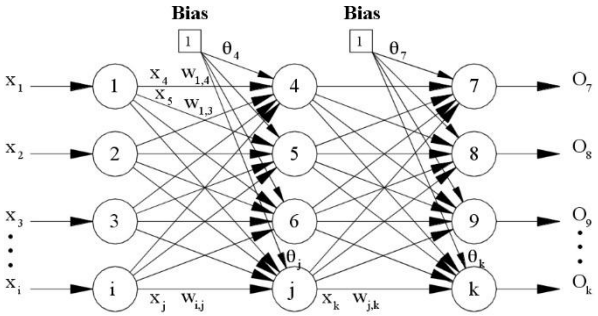

Figure (2) Back-propagation Neural Network with one hidden layer [9]

When an input layer is fed by a certain pattern to the hidden layer, the formula calculates :

$$Net_j = \sum w_{i,j} x_j + \theta_j \quad (3)$$

Error Calculations and Weight Adjustments

$$\Delta_k = t_k - O_k \quad (4)$$

actual activation value of the output node, k, is O_K, and the expected target output for node k is t_K

$$\delta_k = \Delta_k O_k (1 - O_k) \quad (5)$$

where the O_k(1-O_k) term is the derivative of the Sigmoid function.

The formulas that has been used to modify weight, wj,k, between output node, k, and j node is:

$$\Delta w_{j,k} = I_r \delta_k x_k cho_i \quad (6)$$

$$w_{j,k} = w_{j,k} + \Delta w_{j,k} \quad (7)$$

The following equation is used to calculate the error function, E, for all patterns.

$$E = \tfrac{1}{2} \sum (\sum (t_k - O_k)^2) \quad (8)$$

IV. PCA algorithm

The Principal Component Analysis, or PCA, is a dimensionality-reduction method that is often used to reduce the dimensionality of large data sets, as the process is carried outfor reducinga large group of data to a smaller group as it contains the most important information in the large group, naturally at the expense of the accuracy. [10] however, the idea in reducing the dimensionality is to trade off a little subtlety for simplicity. Because smaller data sets are easier to explore and visualize and make data analysis much easier and faster for machine learning algorithms without addressing external variables.[11]

An image (m) matrix is converted into a group from a vectors

Training set v= $[v_1\ v_2 \dots \dots . v_m]$ (9)

The mean face (¥) is the arithmetic average vector as given by:

$$¥ = \frac{1}{m} \sum_{i=1}^{m} v_i \quad (10)$$

The deviation vector for each image Φi is given by:

$$\Phi_i = v_i - ¥ \qquad were\ i = 1,2 \dots \dots m \quad (11)$$

The covariance matrix preserves destination features and removes common features. Then Eigen faces are computed by find the Covariance matrix C of the training image vectors as:

$$C=A.A^t \quad (12)$$

Due to the large dimension of matrix C, matrix L of size ($M_t\ X\ M_t$) has been considered, which gives the same effect with reduced dimensionality.

The Eigen vectors of C (Matrix U) can be obtained by using the Eigen vectors of L (Matrix VV) asgiven by:

$$U_i = AVV_i \quad (13)$$

The Eigen faces are:
Eigenface = [U1, U2, U3,.... UM] (14)

V. proposed system

The proposed student attendance system consists of two interfaces, the teacher interface and the user interface through which student attendance can be enrolled when recognizing the face using the camera, at a specific time when the lecture is given. However, the proposed system consists of three stages.

A. Enrollment stage

At this stage, the student is enrolled in the system by pressing the registration button, he writes his name, then takes four different pictures to be saved in the database, then a message appears, confirming the registration status.

B. Activation stage Enable student button to register attendance

At this stage, the teacher will activate the registration button so that students can register their attendance within a time period determined by the teacher and after the time expires, the activation is cancelled. It should be noted that this is done during the time of the lecture.

C. Attendance registration stage

Student attendance is taken by face recognition. The teacher activates the registration feature within a specified time that the administrator controls so that students can record their attendance, when the student presses this option, it open the camera and takes a picture of the face, then face detection is done. Then the saved face detection image is transferred to a matrix, either in the phase of extracting the destination characteristics. PCA algorithm has been utilized, which in turn reduced the dimensions and transformedimportant characteristics to a vector which is saved in the database. As for the recognition process, a modified neural network has been used with the chaotic to face recognition, results have been given and then sent in the form of a symbolic string containing the name of the student and his presence status to the teacher's side or the administrator that is kept in the database. Figure (3) shows the architecture of the proposed system.

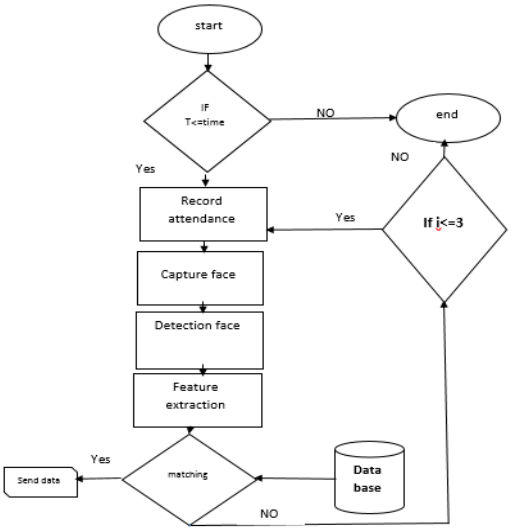

Figure (3) The flowchartof the proposed system

D. Algorithm of proposed System

Step1: start

Step2: if T < Time (Within the specified time to attend)

Else End.

Step3: capture image face

Step4: face detection& Feature extraction using PCA.

Step5: face matching using ANN.

Step6: if face match then send data

else if face Mismatch

if i<=3 goto step 3

else End

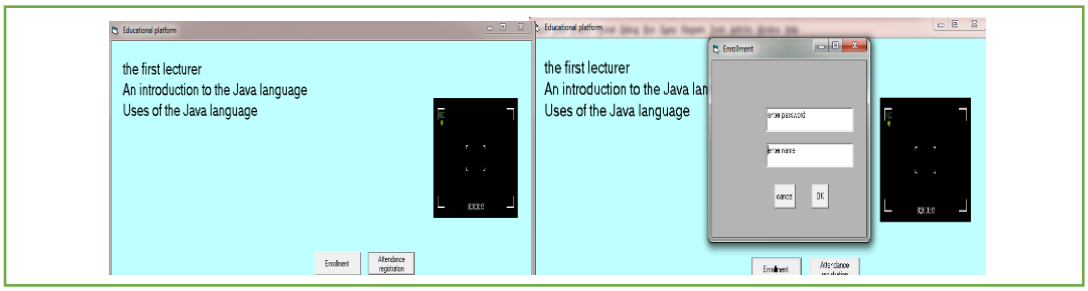

Figure (4) Interfaces of attendance system

VI. Experimental results

In order to evaluate the proposed destination based attendance system (and modified neural network), the tests were conducted using the smartphone as well as the laptop. The system was tested on 50 volunteers each one of which has 4 different pictures, where the volunteers were divided to 5 groups as follows (10, 20, 30, 40, 50), then some parameters have been calculated, such as: the false rejection rate (FRR),false acceptance rate(FAR), the accuracy of the system (RR), and the time it took for treatment before modification and after modification. The equations below calculate the results that suggested attendance system in test trials as shown in Table1, Table2.

$$FRR = \frac{number\ of\ failed\ attempts\ by\ authorized\ students}{all\ attempts} \quad (14)$$

$$FAR = \frac{number\ of\ effective\ authentications\ by\ rogue}{all\ attempts} \quad (15)$$

$$FER = \frac{number\ of\ students\ who\ fail\ in\ \ enrollment}{all\ attempts} \quad (16)$$

$$RR = 100 - (\quad (17)$$

Table1 Calculated results after modification (NN) for the proposed attendance system

The number of volunteers	Recognition rate	FRR	FAR	FER	Recognition Time
10	90%	0.100	0	0	22ms
20	95%	0.050	0	0	53ms
30	93%	0.066	0	0	100ms
40	95%	0.050	0.1	0	130ms
50	94%	0.060	0	0	173ms
	93.4%	0.326	0.02	0	

Table2 Calculated results before modification (NN) of the proposed attendance system

The number of volunteers	Recognition rate	FRR	FAR	FER	Recognition Time
10	80%	0.200	0.100	0	2ms4
20	85%	0.150	0.066	0	73ms

30	90%	0.100	0.050	0.06	120ms
40	90%	0.100	0.050	0	160ms
50	94%	0.060	0.120	0	201ms
average	87.8%	0.012	0.386	0.06	119.2ms

VII. Conclusions

Teachers can implement attendance records and statistics easily and flexibly through the attendance registration system. The time of attendance enrollment can be controlled and this meets the needs of various educational applications and different kinds of the curricular learning contents without growing the workload of teachers, through the results we reached by comparing them with the results before modification and after modification. proposed system It provides flexibility, efficiency and can be used in many areas of education.

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