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An Intelligent Authorization System with Facial Recognition

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Abstract: ***Experimental results show that the recognition accuracy improves without increasing the false-positive rate even if the incremental learning proceeds. Face Recognition tasks can easily be implemented with an incremental learning approach. Many different facial recognition algorithms are freely available on the internet today, amongst all these, we selected the one giving us best accuracy (99.38%) and decided to make a meaningful system out of it, our goal is to prepare an internet-ready facial recognition system to be used to make a secure military base.***
Keywords: Artificial Intelligence, Authentication, Automata, Computer Vision, Face detection, Face Recognition, Machine Learning, Middleware, Neural Networks, Prediction Methods, Supervised Learning - (KNN, RNN, CNN), Security Management, Web Services

I. INTRODUCTION

What is a face? To human beings like us, a face is simply a pair of eyes, ears, lips,cheeks,a nose and a forehead. However, to explain to a computer what is a face, it is a completely new challenge. All that a computer can see is a grid of pixels.Also, a face is a 3 dimensional structure, while the pixels that a computer sees is comparable to a 2-dimensional array of pixels. Using pixels, it has to learn, understand and detect faces.

A. Problem

Security is the one fundamental aspect of the society that people are willing to pay for, no matter what the price. The Thai government has proposed a 2021 defence budget of THB223.4 billion (USD7.2 billion). Budgetary documents show that the figure represents a decline of 3.6% against the original 2020 military expenditure of THB231.7 billion. As we can see that a huge amount of money is spent every year by every country for its military budget. As technology keeps advancing and newer more advanced equipment comes at higher costs, we should work towards lowering the cost of managing military based systems.

B. Root Cause of the Problem

The main cause of this particular problem is that technologies are getting more advanced and more expensive, but the way money is spent on technology needs to be more smarter and more efficient. Our approach to tackle this problem is to implement a state of the art, easy to use facial detection system to make detection of intruders easy in a military base.

This type of a system would not make the duty of guards easier as they would not have to be on high alert at all times, but also automating this kind of a system can make the military base more efficient and can trigger intruder alerts faster than the traditional system of guards.

Being an international collaboration, we aim to use the combined minds of Indian and Thai students to come up with an optimal solution.

For The purpose of detecting faces in images, first the images are converted into grayscale and then, the computer searches for HAAR-like features. A Haar-like feature is represented by taking a rectangular part of an image and dividing that rectangle into multiple parts. They are often visualized as black and white adjacent rectangles.

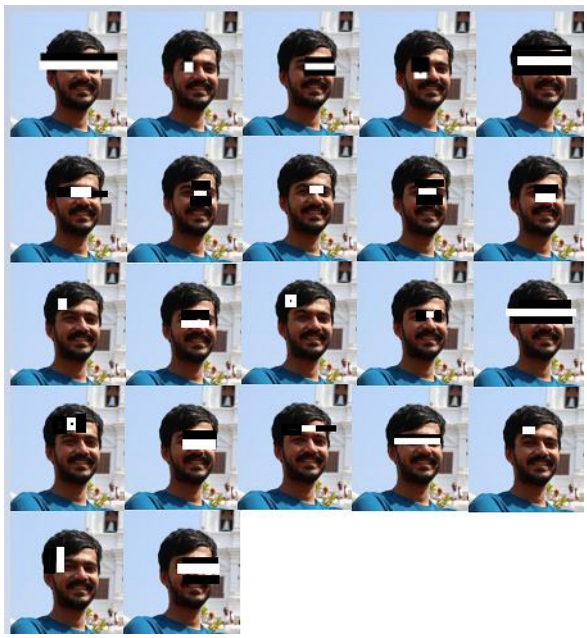

Fig- 1: An image showing haar like features detected on the picture of a face

How does Haar-cascade work? An image is scanned for particular variations of black and white that have a probability of being a specific feature of the face. And when such variations come together in a specific formation that represents the face, the classifier(The logical unit used to categorize items) returns back a probability that a face exists in a particular area of the image. If this probability crosses a specified threshold, then the code concludes that there is a face present in that area.

C. Contribution

1) We merged the domains of facial recognition and web development and created an easy to install secure system that can be installed in any military base/organization to make the system more secure against intruders instead of the traditional system with guards identifying and letting in people.

2) Our system can be easily installed in any institution throughout the world with the help of a few commands.

3) The goal of this project is to make this technology of industry standard so that it can be used on a large scale and cut down costs over the world.

II. PROJECT ARCHITECTURE

The goal of this project is to make this technology of industry standard so that it can be used on a large scale and cut down costs over the world.

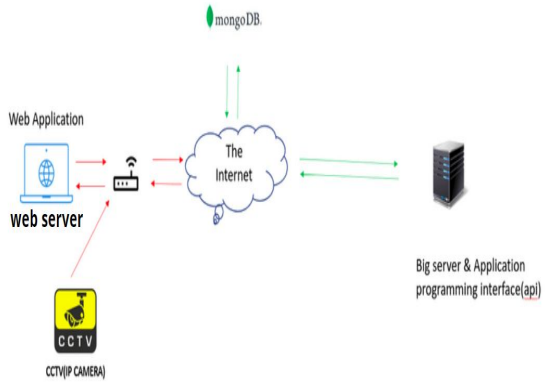

Fig- 2: Architecture of the project

A. The web application(nodeJS) sends the request to the big server(Ku University Server).
B. The big server approves it and stores the data in the backend(mongodb in our case).
C. Once the request is approved, with the help of the cctv camera we detect every person in a particular room.
D. The information of the person is collected and verified from the database and we get the result as whether a person is genuine or not
E. If he/she is genuine, then his/her name is printed, else he/she is marked as unknown.

III. IMPLEMENTATION

A. *Face Recognition Script*

The face recognition scripting language used in our case is python 3. We are using CCTV's located in some rooms of the Kasetsart University for detecting the faces. In order to train the models we used k nearest neighbor classification algorithm. We trained about 1000 models for getting a higher accuracy. The face detection and feature extraction is done with the help of Convolution neural network and the opencv libraries respectively.[3] Once the Face is detected on the cctv, we draw a bounding box around the detected person's face. If the person is detected correctly then his name is printed(if stored his information on the database), else we print unknown if we find any false positives.[6]

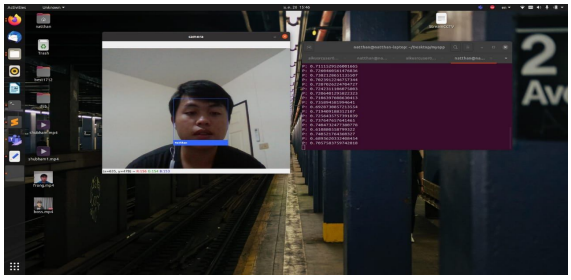

Fig-3: Python Script output of Face recognition without website

After the script was done locally we added it to our web application, so as to allow anyone at the university to access the application.

B. *Website Development*

We used NodeJS, ExpressJS and MongoDB as the backend of our website and designed it with handlebars and css. We implemented the login, register, admin, forgot password page and the main dashboard.[1,4,7].
We implemented a four level login system for the user where each level of user has their own functionalities assigned to them a follows

1) Guard->Can watch CCTV cameras.
2) Attendant->Has privileges of Guard and can add desired faces to the system.
3) Security executive->Has privileges of Attendant and can remove faces from the system.
4) Admin->Has privileges of Security Executive and can add/delete cameras as well as controls roles of the members in the system.

Users with higher authority can also Add new Cameras, Record footage from currently active cameras and save footage locally.

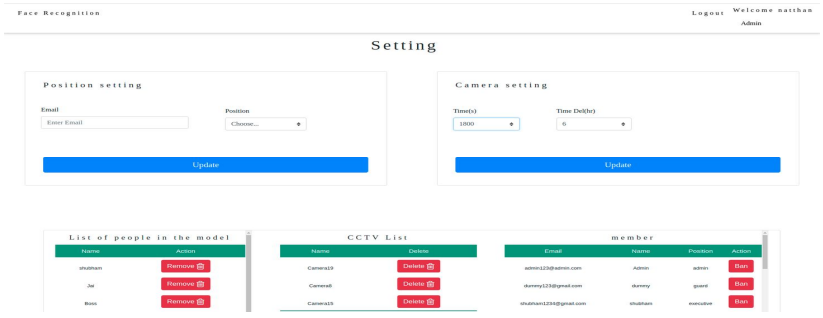

Fig- 4: The website has the functionality to add/remove cameras as per requirement

As far as the security is concerned, we implemented the json web token[9] along with cookies to authenticate the user(to test whether the user logged in is genuine). We also added a dotenv file[12] to keep our secret keys and credentials secured. We implemented [2]email validation(to check whether the user has entered a valid email address. And finally we refined our gui and other implementations, so as to make our web api more secure, user friendly and satisfying all basic customer needs.

We also made the website secure from directory traversal attacks, elevation of privilege attack and since the database does not use SQL, any type of SQL injection attack will not work on the website. All communication to and from the website goes in an encrypted form since we have implemented https protocol.

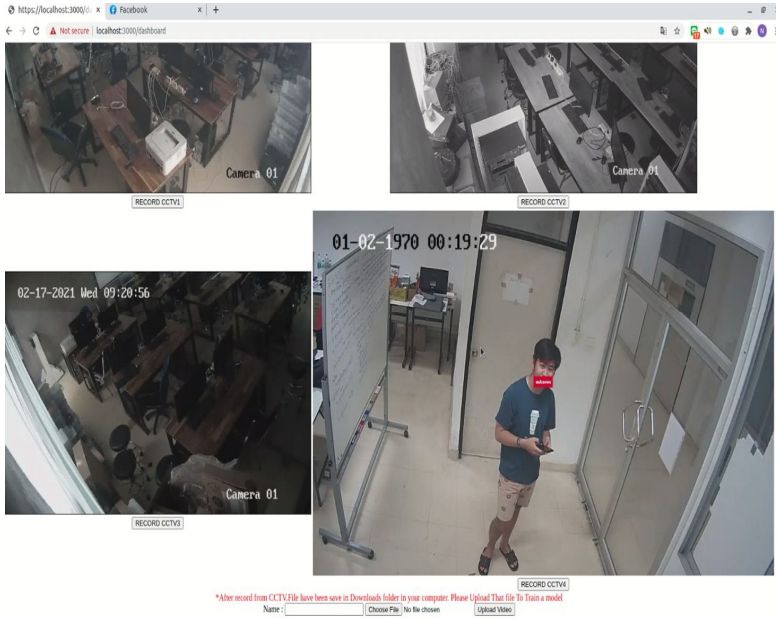

Fig- 5: Face Detection from the cctv of the Kasetsart University, on the website

IV. CHALLENGES FACED

The major challenge which we overcame was that the Indian students could not connect to the big server in Thailand in order to detect the faces from the university camera.

The second challenge was to secure our database credentials which were open for all from the source code, so we added the dotenv package which hides the credentials and stores it in the form of a secret key which is not visible even on github. We a;so faced some technical issues while implementing Multithreading to our code. Another issue that we faced was after running the script simultaneously for different cameras, we encountered a segmentation fault issue which was later resolved by optimizing the code and making it better.

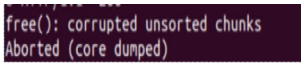

Fig- 6: Issues faced with the script

V. EVALUATION

We were able to train the model successfully , the faces were getting detected and also the person was recognized successfully. We were able to get an accuracy of 99.38% in the face recognition.

We created an easy to install face recognition system that any military or organization can use to improve their security.

VI. LIMITATIONS

In some cases where there wasn't sufficient lighting on face, or where there was debris on the camera like water or a cracked camera glass, we weren't able to detect the face or recognize the person even if he/she is present in the database.

Our system is also not equipped to automatically alert the Head of Security about an intruder, and will depend on a security guard to do the needful.

VII. LITERATURE SURVEY

Implementations performed done before us:

A. Face Recognition using Novel BMC-LBPH Methods:

In case of unconstrained environments like bad weather, Illumination variation and also low light, Face recognition still needs a lot of research.Radius and neighbor value are the two most important parameters in the LBPH algorithm. In the case of the LBPH algorithm, the neighbour value and the radius are the 2 most important parameters. In an unconstrained environment, to improve the FR accuracy, a novel LBPH based method , bilateral median convolutional-Local binary pattern histogram was proposed. First we convert the image into a grayscale image, which allows multiple-image manipulation process on the image and is also efficient. First we select a region around the face and detect it with any cascade classifier and remove any unnecessary object. To extract the features of face, the simple slice method is used to crop. After the face is cropped, bilateral filter is applied so as to reduce the noise and illumination variation of face image secondly, the median blur is used to smoothen the overall image; The robust features are produced by convolution filter
The accuracy which this algorithm gives is near about 90%.

B. Face Recognition using OpenCV and Haar Cascade[8] Method:

The CV2 library of OpenCV module is used for reading, writing of images and also to input video streams.
Haar Cascade is a machine learning based approach. In this the cascade function is trained from a lot of positive and negative images. It is then used to detect objects in other images. The accuracy is around 94%

C. Face Recognition using ANN:

In this proposed system, a Gabor feature based method[10] which eliminates the variations due to pose, lighting and features is used to increase the robustness of the face recognition system. For different scales and orientations of the Gabor filter, the input image is convoluted with gabor filters and from this convoluted image feature vectors were formulated using PCA followed by LDA. Using PCA, the high dimensionality of these feature vectors is reduced.The highest accuracy brought by this system is 98.6%.

D. Face Recognition using RNN[11]:

A recurrent neural network (RNN) is a class of artificial neural networks. Directed graphs can be formed from the connection between the nodes. Hence we can exhibit temporal dynamic behavior.
In case of facial recognition, using the recurrent neural network, we get a little low accuracy of 82% and a lot of false positives, as compared to other models.[5]

VIII. CONCLUSION AND FUTURE ADVANCEMENTS

We successfully completed the project with 99.4% of accuracy in face recognition and were successfully able to deploy it on the web server and also make the website secured.
But as no project is completely perfect, we always look forward to increasing accuracy, security of the web application. Along with improvements of the current system, we can also add a biometric system in the same web application to further improve security of the organization using our system.

IX. ACKNOWLEDGEMENT

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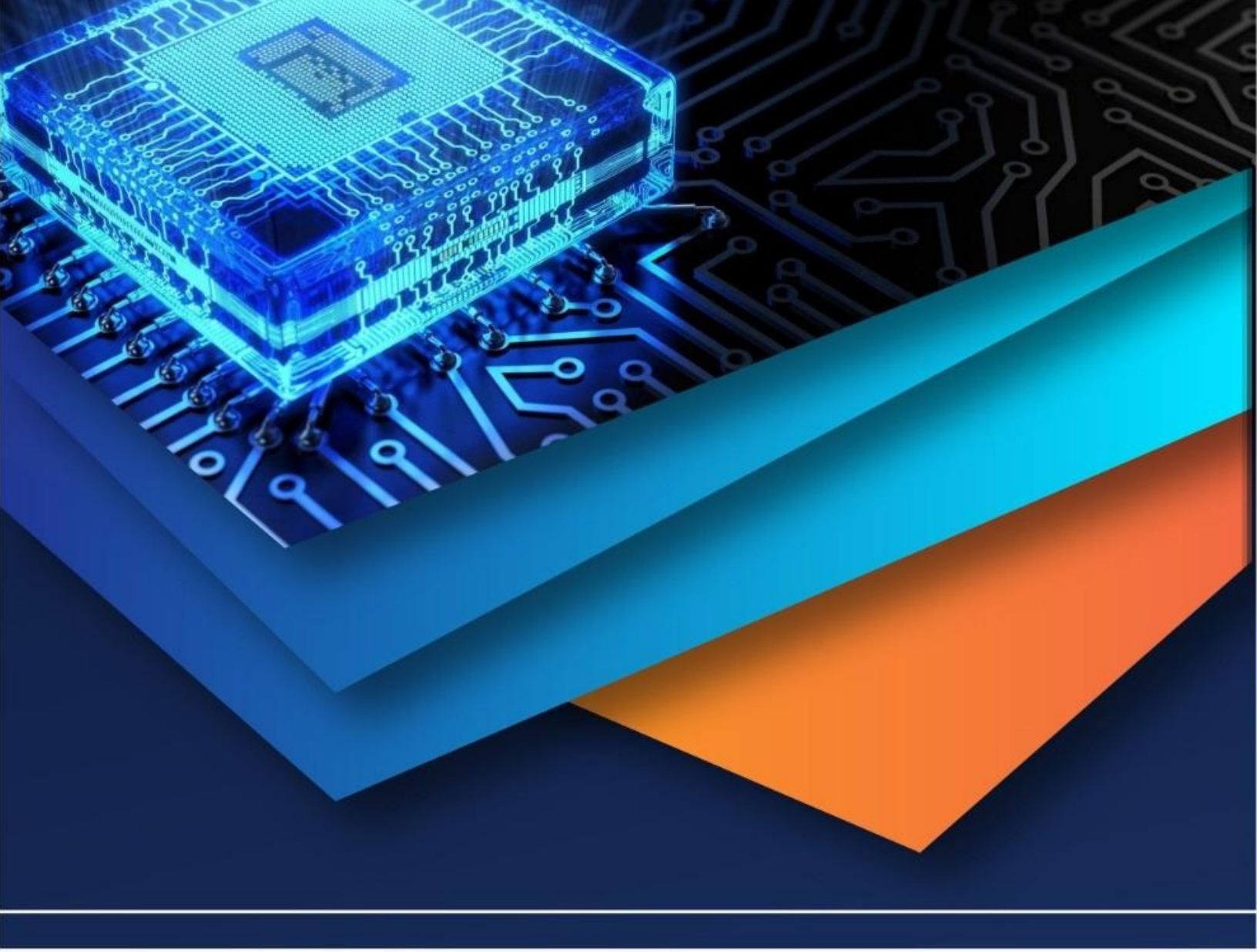

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