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Research Paper

IOT: Towards an Effective Technical Model for Facial Recognition Using Machine Learning Techniques and Raspberry Pi 4 Model B Platforms with Python Language

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Abstract:

Internet of Things technologies has played a significant role in developing the world and providing the best services to get the best possible results. Due to the importance of the increased demand for them, computers have become very important because they provide high-resolution technologies. Today, computers have become compared to humans in many things. These have made great progress in face recognition; the computer has high accuracy in recognizing and recognizing faces, through high technologies. With the help of programming factors that have become a wonderful thing with the results they provide, the most important advantage for Internet of Things technologies is that they give results and recognize the face in a better way than humans, where if a person sees the face, perhaps at another time he will not recognize it, but the computer stores the face in a base Private data to be recognized at any time he wants and this is what distinguishes him. In this paper, we presented a technical model for facial recognition consisting of two experiments. In the first experiment, we used the Raspberry Pi 4 Model B platform. In addition to other contents, Micro SD card, power supply, and monitoring wire HDMI, mouse, and keyboard, as these were connected programmatically. We also used a second experiment using supervised machine learning techniques, We were able to improve its performance, and we obtained accuracy equal to 98.27%. This technology also provides me with the recognition of all faces without exception.
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Keywords: Facial Recognition, Raspberry Pi 4 Model B, Internet of things (IoT), Ensemble, Machine learning technologies.

1. Introduction:

Internet of things technologies has become one of the best technologies to provide the most outstanding services to humans. Today, the world of the Internet of Things is a big world to invent new things. Today we have many projects in every life. The prototype was created by combining the face recognition and IoT part, with IoT everything IoT has become a good business with these technologies. The most important challenge in this paper is the security problem and the data problems that have been removed, as many images suffer from missing some images, lack of knowledge, and low quality. Among the most important technologies that we will apply in our research are facial recognition technology and machine learning techniques. It is an innovative method that helps us and is useful for many applications, as today we need in all government and city departments and institutions for such technologies that facilitate his work and many things, due to the spread of many security applications, facial recognition technology is very important to develop security operations and make them more reliable. The facial recognition system has many, many potential security applications, including crowd and airport monitoring, home security, improving interaction and harmony between the human world and the computer world, as well as forensic detection, forensic medicine, and other proven applications. very Influential. Since this feature knows more than biometric characters, the most important challenge in this research is to address security problems that need many things to be good and work well and address data loss. This is what prompted many researchers to research and write many papers and provide high-resolution techniques, but all the work has not come to a solution that makes it safer. This is what prompted us to study this case and present the most important components to address this defect that hinders many businesses. This project and the proposed model aim to provide a good integrated technical model for face identification and data quality improvement.

In 2018, the authors presented a computer-based technical model for identifying aces through the use of the Raspberry Pi platform where their goal was to deploy a network consisting of several computers where the systems contain a high-resolution camera to capture.The bestpictures of people, their analysis, and detection. They used the mage algorithm processing algorithms for face recognition and face determination and recognition. His model gave good results, as they proved that their system work as a safety system in public places, parks, stadiums, institutions, malls, etc. For this, IoT techniques have become important techniques to show many negative results and work on many projects where it is considered. They did a good job because they demonstrated face recognition through their technical (*Wazwaz, Herbawi, Teeti, & Hmeed, 2018*). Also, in 2019, the authors proposed a technical system consisting of two face recognition experiments using the Raspberry Pi platform. Recently, protection operations have become important in all areas, and protection methods require high technologies. The authors used machine learning methods for face detection in their first experiment, in their second experiment Comparison with the first, where they used the Haar-Cascade method. To compare the methods, they worked to identify the face and provide the necessary protection. They used a comparative analytical model to identify the face, and their techniques showed acceptable work with satisfactory results (*Singh, Ramya, Sushma, Roshini, & Pavithra, 2019*).In 2015, the authors proposed an efficient technology system, a smart home system that has two sections, a face recognition section and a voice recognition section. Their system provides a security camera that can detect a face and recognize a voice. Their system aims to implement a software code that recognizes the face. They also used it in their work, and to implement the technical model, they used the Raspberry Pi platform, and it gave good results, as they worked with the Python language and were able to recognize the face (*Hajari & Andurkar, 2015*).

The most important problem that we face in this research is the problems of security, as today many institutions, airports, homes, and many government departments need techniques that apply safety with high accuracy, as well as weakness and lack of quality, and the loss of data related to the data that we downloaded from the UCI website suffers from many problems this data. This study aims to address the two problems, the problem of security and the problem of data quality Where we implemented two experiments, the first experiment was the application of facial recognition technologies where we used Internet of Things technologies for face recognition where we used the Raspberry Pi 4 Model B platform in addition to other contents SD, HDMI monitoring power source, mouse, and keyboard, where they are connected software. We used the Python language for this technique. The first experiment gave impressive results, as my image was identified personally, and this proves that this technique is good for improving face recognition processes. We also applied a second experiment where we downloaded data for Cardiotocography data. This data suffers from many problems with loss with the data of poor data quality and extreme values; we applied the techniques of supervised machine learning ensemble with the application of pre-processing techniques to improve the images that we downloaded. We included this data in the Rapid Miner program and worked on it, and we obtained excellent results and reached the highest accuracy in this article with these the techniques reached 98.27, which proves that the proposed model is good.We proposed a technical model for face recognition, where we did two stages. In the first stage, we applied facial recognition techniques, Internet of things technologies, where we used Raspberry Pi 4 Model B platform in addition to other contents SD, HDMI monitoring power source, mouse, and keyboard and we connected these components to a computer and we applied the Python language, where we got good results and we got good results. In the second

stage, we applied machine learning techniques to the data of face, where we were able to identify the face as well as improve the quality of the data. The technical model proved to be good and effective to address the problems of security, its presence, and the loss of face data. Also, the proposed technical model proved that it is superior to its peers.This paper is organized as follows: Sect. 2 shows a summary of the related works followed by a description of data collection in Sect. 3. The proposed method is presented in Sect. 4 and evaluated by the experiment explained in Sect. 5. Finally, the paper presents a conclusion in Sec.

2. Related Work:

Several previous works on facial recognition have been suggested in the years 2015 to 2021. We summarize some important work here. It found that our work is superior to peers in terms of results and during the two experiments, where the highest accuracy in our article reached 98.27%. It proves that our proposal is superior to peers and predicts the best results.In 2016, the authors developed a tech system they call the Portable Fish Roofs Facial Recognition Music Box (FRJ). Raspberry Pi has also been used as a hardware-based platform due to its ease of handling and also cheap and inexpensive. This system uses the open-source OpenCV library to implement Fisher faces facial recognition techniques and algorithms. Simple DirectMedia uses Layer Library (SDL) to play audio files, which is considered FRJ is a cross-platform system that can be run on Windows and Linux operating systems, where the authors wrote the script in C++. The results showed the highest accuracy of face recognition, reaching 90%, and this value is considered good, but our proposal is far superior in terms of results (*Mo & Shaout, 2016*).The authors, in 2017, proposed a technical model for detecting the faces of guests, and any human face that a guest, friend, or anyone approaching their place is detected by using a proposal for a door lock system based on the Raspberry Pi platform. Surveillance cameras and keyboards are used to provide the system Alarm can notify the owner and recognize faces. It provides the possibility of facial recognition and identification, as the people who are authorized and have permission to access the doors, only can reach the door. The people who do not have the permit cannot reach the door, the system works by taking snapshots of the guest through a code and a pi camera placed in the doors In front of the door on the entry side, through the capture, a form is sent to the owner, and thus any destination is identified using the locked door (*Hussein & Al Mansoori, 2017*).*Rahul Sridhar and et al*., in 2018, studied and presented a high-accuracy technical model, given that there are many systems for detection and protection, but protection to be more receptive and more protective must be with methods that do not accept failure in the role of detection and protection, this is what makes these Researchers present research to develop an E-Bot system that enables interaction between a human class and a robot based on emotions detected from facial recognition. Where an application and a mobile device were developed to control the robot, direct messages, and chat. It explores the Google Cloud Vision API and the flexible and pre-trained facial expression algorithm. The results show that the E-Bot system presented by the authors can be applied to provide emotional care for people who live alone at home or in private settings. This robot, through which emotion was discovered, can predict the feelings of the user with high accuracy and gave excellent results. The highest accuracy in their article reached 80%, the precision criterion value reached 80%, the recall value reached 96%, the f1 criterion's value reached 87%, and the results they obtained are considered good and predict the best results (*Sridhar, Wang, McAllister, & Zheng, 2018*).In 2019, the authors proposed a technical model for implementing a facial recognition system for the blind using image processing. Raspberry Pi programmer. Data and records are fed into the device in the form of images. Image pre-processing is applied and then the captured input image is processed inside the raspberry pi using one of the supervised machine learning techniques and one of the classification techniques which is the KNN algorithm. Here, the visually impaired student will be able to easily identify the person or any object that is in front of him using the device. The results show that the proposed model gives good results and predicts the best results for face detection. The proposed device is designed in this way to improve the perception, interaction, and communication of blind students in schools, colleges, institutes, work, institutions, at home, and all places where it is located. This system eliminates the need for a large-sized computer because it uses a practical device that has high processing power and low cost, and this makes this system more successful than others. The results proved that the proposed model is good. The highest accuracy in their article reached 92.38%, the precision value reached 91%, the recall value reached 91.78%, and the value of the f1 criterion reached 91.78%. These values are considered good, but the current research has obtained results and accuracy higher than these values and has surpassed the peers (*Raja, Vivekanandan, Kiruthika, & Ayshwarya, 2019*).

Authors, in 2020, presented a technical model for face detection using the Effective Attitude Tracking Algorithm (EATA). The technology has made great progress, as some machine learning techniques have proven their effectiveness in the methods of machine learning and face detection. The most important goal of these authors is to confirm from the ancient and modern key locking system for face recognition based on OpenCV the most prominent findings of the authors were good results and were less expensive and also in terms of energy consumption, the results were good as they consumed less energy and the results were more efficient, and they were able to identify the face using this proposed model. Modern smart door locks are sensitive to errors and damages, which makes them less secure. Almost every smart door lock has a pass code entry or faces recognition outside the door leaving it vulnerable. It made these researchers search

for other techniques and suggest a platform to work on to improve safety and give more reliable results Where the highest accuracy reached by the authors reached 95.45% as well as the value of precision, reached 95.45% also the value of recall reached 95%, and the scale of the f1 criterion reached 95.45% (*Zhu & Cheng, 2020*). In 2021, the authors presented a technical model of a drone based on Raspberry P and Android. Android offers a wide range of critical applications and software for direct use by drones depending on the business context and application tracking of the technical model. The applications cover a large number of areas such as object recognition, facial recognition, counting of objects such as plates, people, etc. In addition, the proposed drone calculates the optimal paths, providing the transition from one place to another independently without the need for external control, as experiments were conducted on the criteria mentioned in their article and the results proved that the authors reached good results that give positive incentives to control the drone And give good results (*Benhadhria, Mansouri, Benkhlifa, Gharbi, & Jlili, 2021*).We studied many works and found that the best result was obtained in this research and through the application of machine learning techniques, the highest accuracy with ensemble techniques reached 98.27%. We also obtained good results by applying face recognition technology using the raspberry pi 4 model platforms. The platform with python language where my face has been personally identified. It proves that the proposed model is superior to its peers. The result we obtained was also compared with related works. In our article, it shows that the current authors' proposal outperforms all previous work.

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3. Data Collection:

Due to the escalating demand for safety methods, as well as the increasing number of pretense failures in some of the methods used, this prompted us to search for alternative methods to improve safety operations. We downloaded data from the UCI educational site for face, where the problems of this large data contain outliers and missing values and contain very low quality. This is what made our search and use pre-processing methods to improve its level, as this data consists of 45 records and 7 attributes, we presented a proposed model to overcome the two problems, the problem of better face recognition And the problem of missing and extreme data has given good desirable results.

4. Proposed Method:

The proposed model consists of two stages. In the first stage, we applied unsupervised machine learning methods that include both Bagging,Boosting,Voting,Stacking, Classification by Regression,Polynomial by Binomial Classification With pre-processing methods that include both replace nissing value and detect outlier ,We got good results to improve face data problems In the second experiment, we applied IOT techniques with raspberry pi We also programmed this work with python language to get good results and face recognition It has proven that this proposed model is good for building high foundations for safety and face recognition, as shown in the first table.

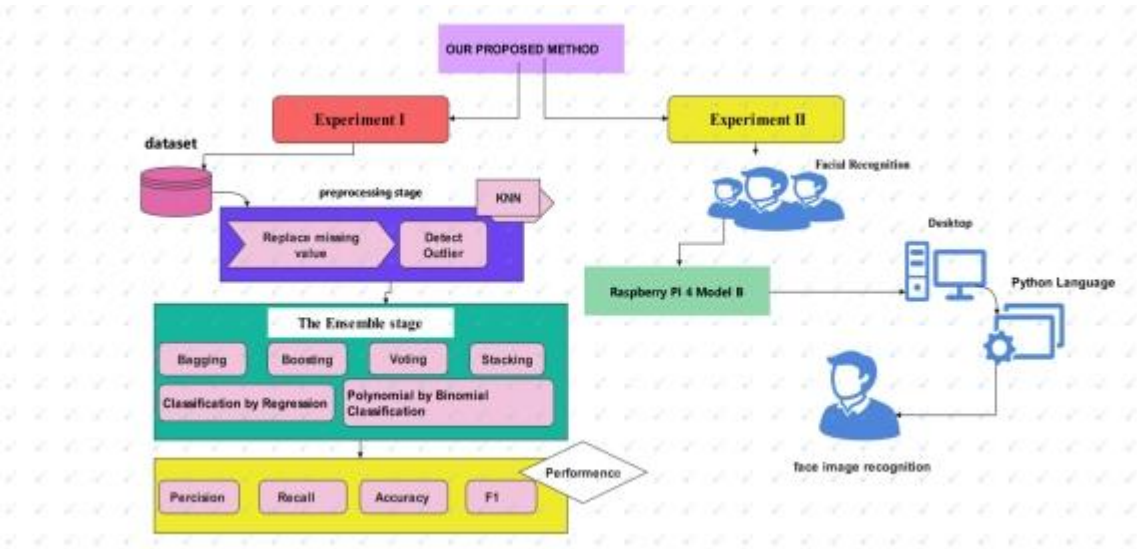

Fig 1: Our Work Methodology

3.1 Pre-processing stage for Missing values and Detect outliers:

At this case, we are working on the face data set that we downloaded from the UCI website Where this data suffers from many problems on missing data and low-quality data as well as there are extreme values that made us search and propose a technical model that solves the problems of face data, as we included this data in the Mail Miner program and worked on it, we applied to pre-process techniques that include both replace the missing value with mean and detect outlier Then we applied supervised machine learning techniques ensemble algorithms

which includes all of Bagging, Boosting, Voting, Stacking, Classification by Regression, Polynomial by Binomial Classification With pre-processingmethods. After applying these techniques, it was proven that the proposed model solves data problems and recognizes the face, and it is superior to its peers in terms of results.

3.2 **The Ensemble stage through ML techniques**:

At this stage, we have applied supervised machine learning techniques, where due to the importance of face data and the importance of security operations, it requires more research and work to get good values and better safety methods than the current methods. The educational site suffers from many problems. This data contains many missing values and stray values, and this makes the work and methods of security more dangerous and not secure because it will allow others to breach this safety. We have implemented machine learning techniques (Ensemble) that include Bagging, Boosting, Voting, Stacking, Classification by Regression, Polynomial by Binomial Classification With pre-processing techniques this made us obtain highly accurate and meaningful values, This article has an accuracy of 98.27%., As it has been proven that our proposal is good, it improves the problems of face data as well as face recognition, which made it outperform its peers.

3.2.1 **Bagging:**

It is considered one of the ensemble techniques, and it is one of the methods of machine learning under supervision. At this stage, we worked on the face data to improve its level. We included this data in the Rapid Miner program and applied this technology with preprocessing methods. The work area of this technology was divided into two parts, the training section, and the test department, where we gave the training department 60%, and we gave the testing department the lowest 40%, and this technique is good for predicting the best results, as we got good high values that predict the best results. Well done it will improve data performance and solve the problems of outliers and missing values**.**

3.2.2 **Boosting:**

Supervised machine learning methods are considered one of the most important ways to provide the best results. At this stage, we applied this technique, which is one of the types of ensemble techniques. We did work where we suggested that the training section will be 60% and the testing section will be 40%, to predict the best results we have applied this technology with pre-processing techniques, we got good results that improve data performance and overcome the problems of missing values and outliers. The highest accuracy in this technique has reached 98.27%, this result is good and outperforms its peers, as this confirms that the proposed model will solve face data problems and will recognize them**.**

3.2.3 **Voting:**

In the recent period, the demand for the application of techniques for face recognition and providing better safety than the methods used has increased. In this case, we have applied one of the methods of machine learning under the supervision and one of the types of ensemble techniques, which is the method of voting, where we divided our work into two stages, the first stage includes the education section with a percentage of 60 in the second section, the test section was 40%. We also applied pre-processing techniques. We obtained high-accuracy values, reaching the highest accuracy in this technique to 98.27%.Where this technique is good for improving and solving data problems, as well as predicting the best results, it outperforms our peers in terms of the result and the values we obtained.

3.2.4 **Stacking**:

At this stage, we applied one of the techniques of machine learning to the data set that we downloaded and worked on, as we included this data in the Rapid Miner program. We also divided the work into two stages, the education stage by 60%, and the testing stage up to 40%, we also applied this technology With three classification techniques namely decision tree, random forest, and KNN, We also obtained excellent results that improved the performance of the face data and recognized the face, as the highest value in this technology reached 96.70%. This assures us that our proposal is good and predicts the best results and will solve the problems of bad data.

3.2.5 **Classification by Regression**:

The regression categorization factor is nested and contains subtotals, as subtotals must contain a regression learner. That means, there has to be a factor to create a regression model where this method is a kind of supervised machine learning which one of the ensemble methods is where her work is divided into two parts, an education part, and a test part, the education part is 60% and the test part is 40%., This operator builds a classification model using the regression learner provided in its sub process,This technique gave good results, with the highest accuracy reaching 98.27%. These results are good for solving face data problems.

3.2.6 **Polynomial by Binomial Classification**:

The polynomial factor by the binomial classification factor is important and a factor that interferes with any sub-process, that is, it creates and sub-totals, that is, these sums are important to form a binomial model, this technique is one of the methods of

machine learning one of the sums of the ensemble, Where the work of this purification is divided into two parts, the education part by 60% and the test part by 40% so that we obtained excellent results, and the highest accuracy with this technology reached 98.27%, this result is good for predicting the best solutions and improving face data.

4. Facial recognition system with Raspberry PI:

Due to the importance of safety and its spread in recent times, where many ministries need Institutions and scientific departments are safe ways to protect their personal information. The researchers focused and worked on safety methods by recognizing the face by presenting them with many methods and techniques, but they did not get good results. Airports and medicine, in this paper, facial recognition technology using the Raspberry PI platform was used. Components were also used with this platform, such as Micro SD card, power supply, monitor, HDMI wire, mouse, and keyboard, we also did this work with Python, we got good results, I applied this on myself, and on my photo, it was shown in the program.

4.1 Face Recognition:

Facial recognition is a non-invasive method useful for many security applications, some government, and civil departments suffer from many problems in providing a good security method, this is what prompted us in this research to provide high-accuracy techniques for face recognition, which is a better safety method than others, which is more balanced and safer. Images, pre-processing, training images, testing, and others, as shown in Figure 1 below, are used to train the system and exercise until the system becomes more accurate and more welcome. In this paper, facial recognition technology using the Raspberry PI platform was used. Components were also used with this platform, such as Micro SD card, power supply, monitor, HDMI wire, mouse, and keyboard, we also did this work with Python, we got good results, I applied this on myself, and on my photo, it was shown in the program.

Fig 2: Merge images of more than one face to entertain them through training the system

4.1.2. To get this system up and running, and to train this system, we need the main components to run it in a real and imaginary way:

The application of face recognition techniques needs some components that are being worked on to recognize the face and practice it. Recently, face recognition techniques have become used in many countries, and this is what made some departments and some institutions rely on these safety methods, especially face recognition methods.We have proposed a technical model in this paper that recognizes the face and improves the performance of the face data, as some of the components that we need to implement this model are Raspberry pi 4 model B, Micro SD card, monitor, power supply, monitor, HDMI wire, mouse and keyboard, where these devices are important to implement this technology, where the course of our proposal is as follows: we control our work through the keyboard and mouse and then we put the Micro SD card To show the face and identify it and detect it with high accuracy, then connect the Raspberry pi 4 model B to a computer and perform this work with the Python language and it gave good results.

Fig 3: the components that we need for face recognition and detection

4.1.3. Training the system:

The most important ways to start running this system and start the face recognition feature of the Raspberry Pi are in the installation process and we recommend installing the original and activated version of Raspberry Pi OS through this platform I can connect it with the components of the Raspberry Pi and with the computer I can recognize the face and detect it, After installing this platform, you can directly train the system as if it were a subconscious mind, knowing and trained to recognize the face. The most important step is to connect the Raspberry Pi platform to a screen where the camera of the Pi is installed correctly and does not accept the error where the cable is in the direction of the correct slot, then open a list of Raspberry components Pi choose Interfaces and then set the enable Then train the system as shown in the drawing below, the most important steps that we applied on our computer, and here is the third figure that shows the Raspberry Pi configuration.

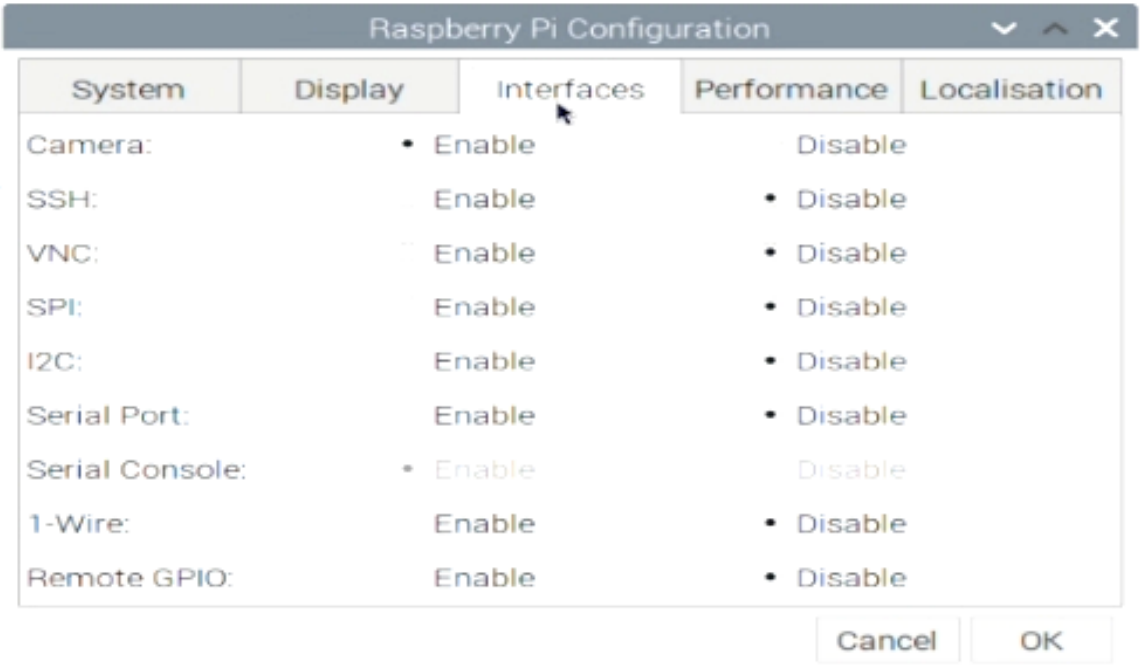

Fig 4: Raspberry Pi configuration

After completing this option, you can train the system well and excellently. There will be a folder with a name found in the |. Folder home/pi directory/facial recognition It is called headshots_picam.py Where a code will allow us to take some pictures of the Raspberry Pi Look at the picture below, the training process shows the system to facilitate the process of image recognition.

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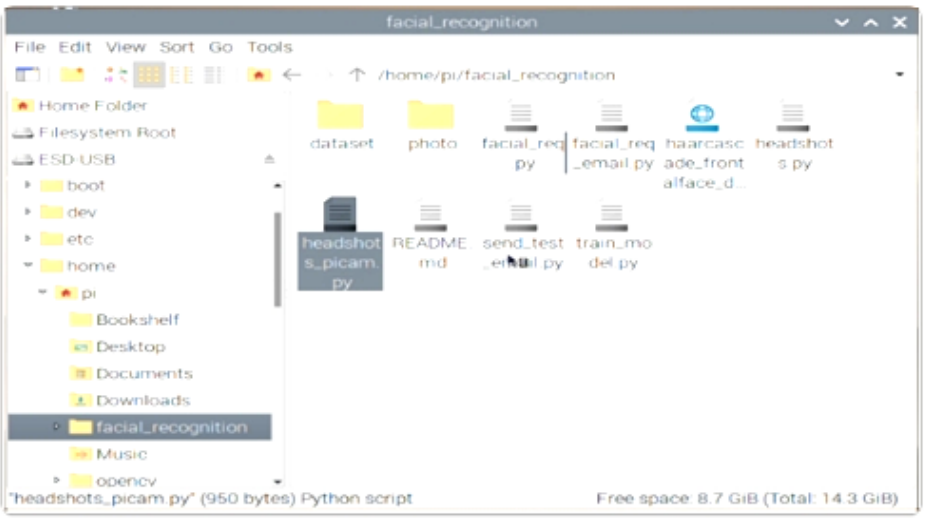

Fig 5: Indicates the location of the facial_recognition

After that, to carry out this work, we need to apply it in a program to show the face and make fun of it with the Python language, open the Python Script program and change the line of code with your name as shown in the picture. Script wherewith this step, we are moving in the right direction to implement the program programmatically.

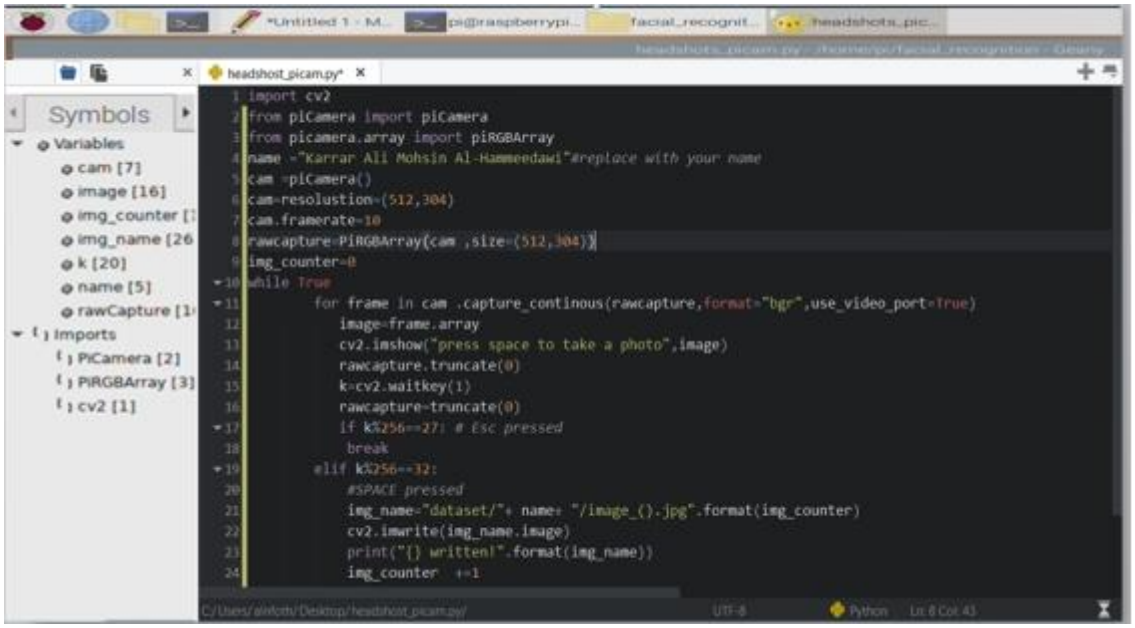

Fig6: Application of face recognition technology in Python

Code written in Python for face recognition:

1: import cv2
2: Begin
3: from piCamera import piCamera
4: from picamera.array import piRGBArray
5: name ="Karrar Ali Mohsin Al-Hammeedawi"#replace with your name
6: cam =piCamera()
7: cam=resolustion=(512,304)
8: cam.framerate=10
9: rawcapture=PiRGBArray(cam ,size=(512,304))
10: img_counter=0
11: while True
12: for frame in cam .capture_continous(rawcapture,format="bgr",use_video_port=True)
13: image=frame.array
14: cv2.imshow("press space to take a photo",image)
15: rawcapture.truncate(0)
16: k=cv2.waitkey(1)
17: rawcapture=truncate(0)
18: if k%256==27: # Esc pressed
19: break
20: elif k%256==32:
21: #SPACE pressed
22: img_name="dataset/"+ name+ "/image_().jpg".format(img_counter)
23: cv2.imwrite(img_name.image)
25: print("{} written!".format(img_name))
26: img_counter +=1
27: if k%256==27:
28: print("Escape hite, closing, ,")
29: end break
30: end cv2.destroyALLWindows()

To continue training the system and get a good result for face recognition, go again to the Python editor named headshots_picam.py, run the code, after that you will see a small window and a terminal window, you can use this to save the images directly, to continue training the system to recognize the face, click on Spacebar to take a picture, then Q to close the open window Just look at the picture below. I was able to identify my face with highaccuracy. This confirms that our work is good and has given good results that outperform its peers, as it has addressed

the two security problems and solved bad data problems.

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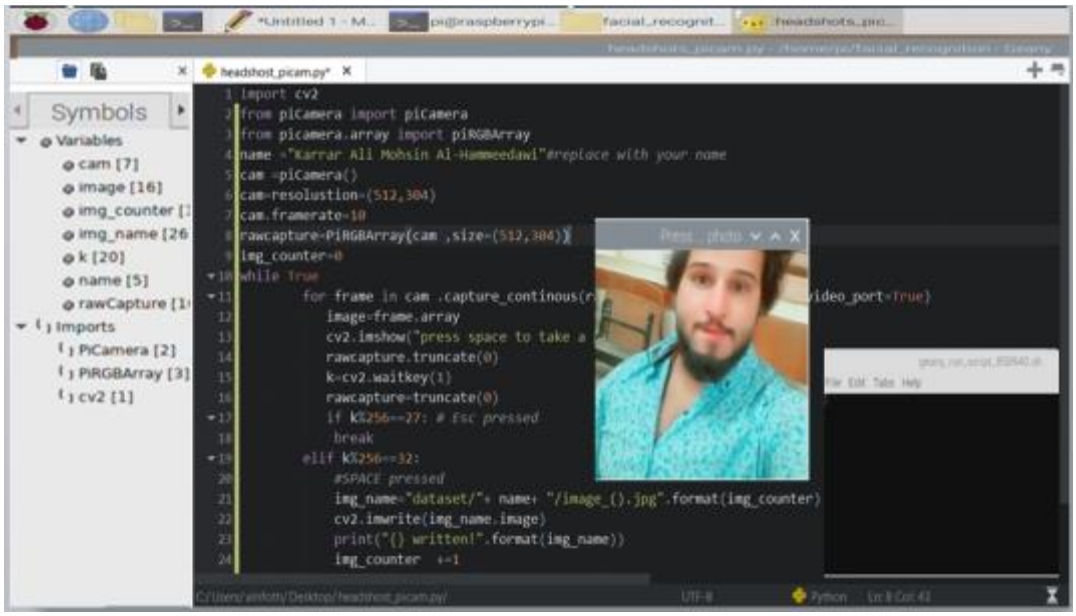

Fig.7: System training and face recognition Show the picture as shown

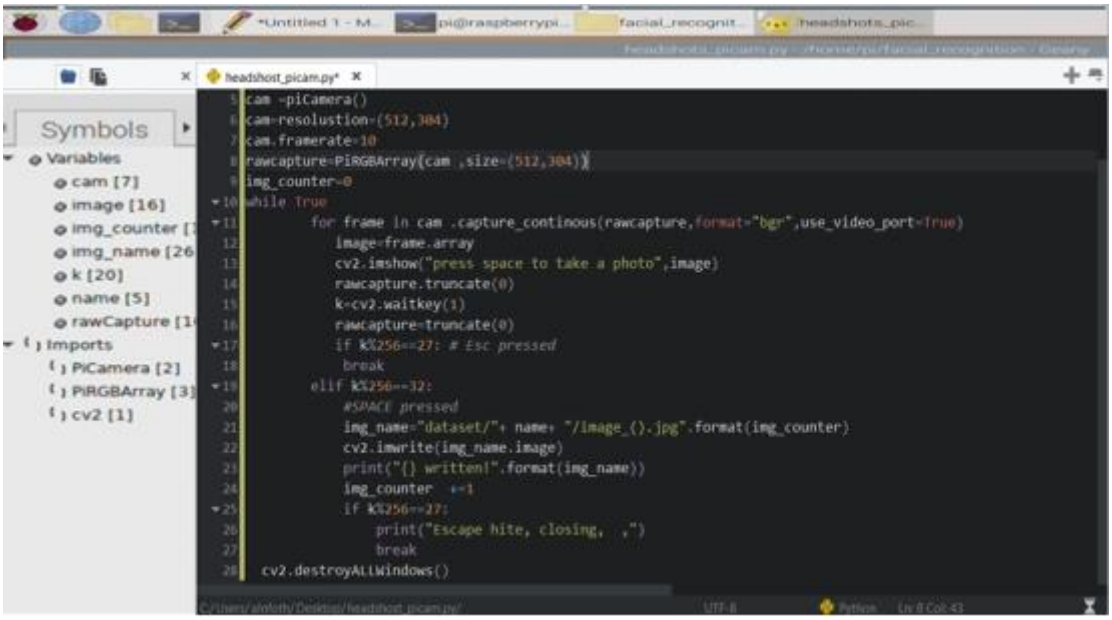

Fig.8: A graphic showing the completion of the system exercise and showing the complete code

Then, parsing all the images in the data groups folder is the Python code | train_model.py that was used Where this data will be analyzed and identified by this file, Then automatically, this data will be recognized and analyzed by simply pressing and running this code, then open a folder or open a terminal and then press the black console button in the upper left and type the pressure after each line through this process will give the system access to the destination and get to know him See as shown in the picture below the process of training the system to give the best result.

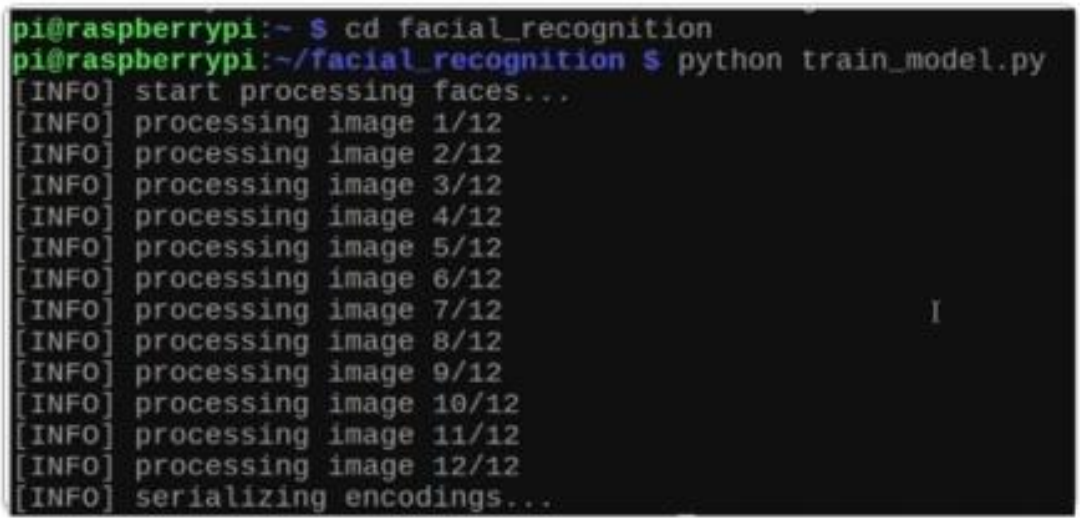

Fig 9: Training the system for face recognition

Next, you will see a small window containing a live webcam broadcast Raspberry Pi, point the camera at your face to recognize it, and then if you put a square yellow line on your face, the Raspberry Pi camera searches for faces and if it finds your face, it draws a yellow square around your face to show that its work has been completed and the recognition of The face area, as it will also determine and discover if this face is already known or just, it distinguishes between the faces and gives a result for each face that recognizes it. See the picture below, my picture is drawn around the face with a yellow square

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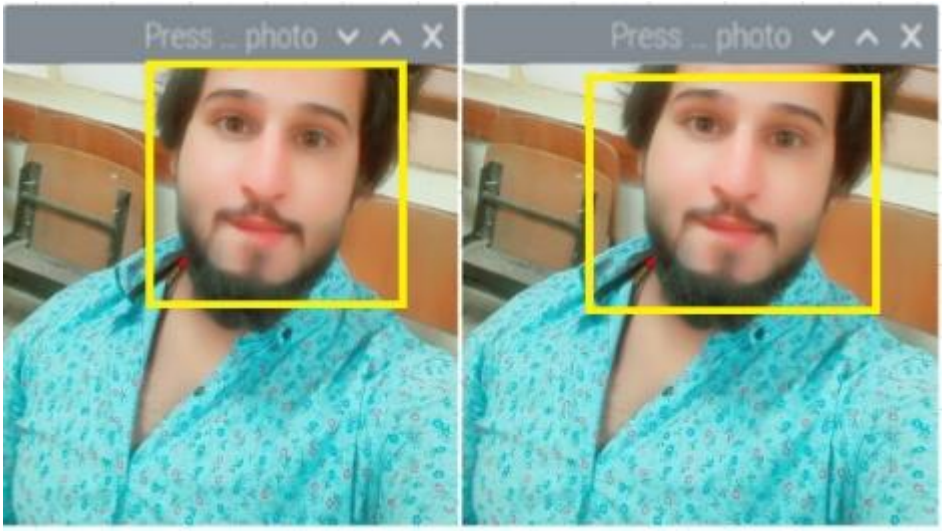

Fig10: Training the system to recognize the face and draw a yellow square around the face

We also identified another image to continue training the system and to clarify how it works. Due to the importance of protection methods, face recognition techniques have become important, this made us try in multiple ways to reach a good result, as providing such technology solves many problems, especially protection operations, which have become more dangerous to its owner. Then close the program, you will notice that you recognized your face and were able to see your face with this experience stored in the folder that you created in your name, See below, we get to know another picture.

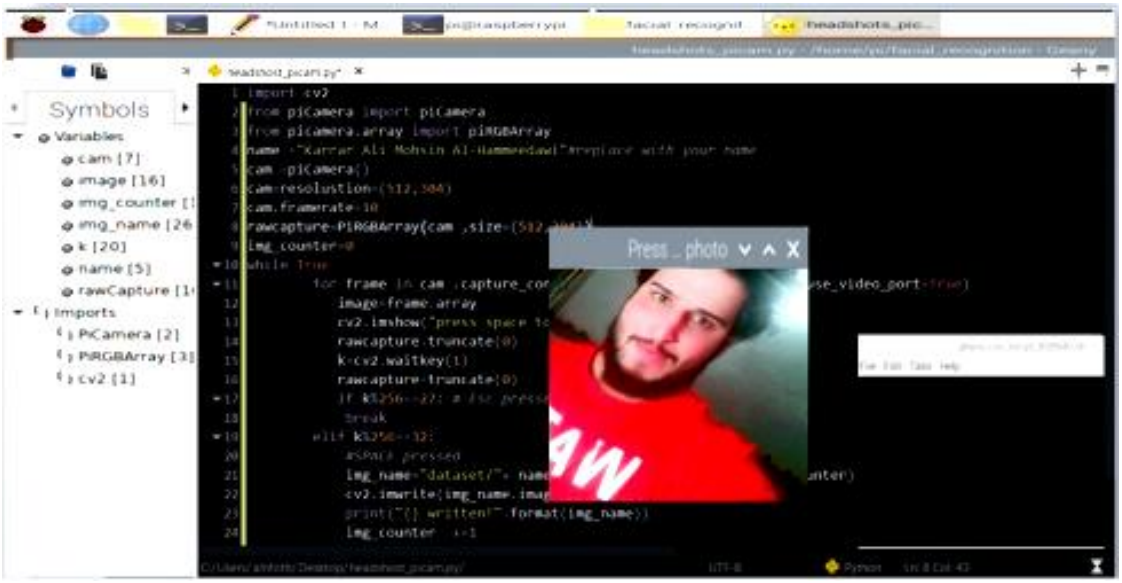

Fig.11: Demonstrates the process of recognizing a second image of a face

After that, we took another step, which is to train the system to take more than one picture at the same time and draw a yellow square around Wajh, but with another picture and a yellow colo it proved that the techniques used are high-accuracy techniques and gave excellent results and outperformed their peers.
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Through these techniques, we were able to solve security problems and solve data loss and poor quality problems. Look at the picture below that illustrates the process of identifying more than one image at the same time

Fig.12. System exercise to take more than one shot at the same time and put a yellow line around the face

We did another experiment, but with another editor, to implement these techniques and get to know other images. The safety methods have recently been considered a stop for everyone's attention, which prompted researchers and scientists to find the best alternative ways to compensate for the past losses in

the methods of safety and protection, we wrote the code in another editor and also the code with my case as shown below (*karrar ali mohsin al-hammedawi*) You can replace the name with your name, no problem, as we succeeded in this experiment as well, and we were able to identify another image.

Fig 13: Training the system with another editor

From then on we go to Python known as headshots_picam.py Run the code and this will open a window that can be used to save pictures of your face or pictures of a stranger Then press the space bar to take pictures, then press cancel by pressing the Q . key In recent times, computers have become better than humans in terms of safety, where if a person sees a face within a short period of time, he will forget that face, but the computer does not forget it, as it uses a database that recognizes the face at any time, as shown below in the picture, my face was recognized Personally and with a new image, this proves that the proposed and presented model is good for improving data quality and face recognition .

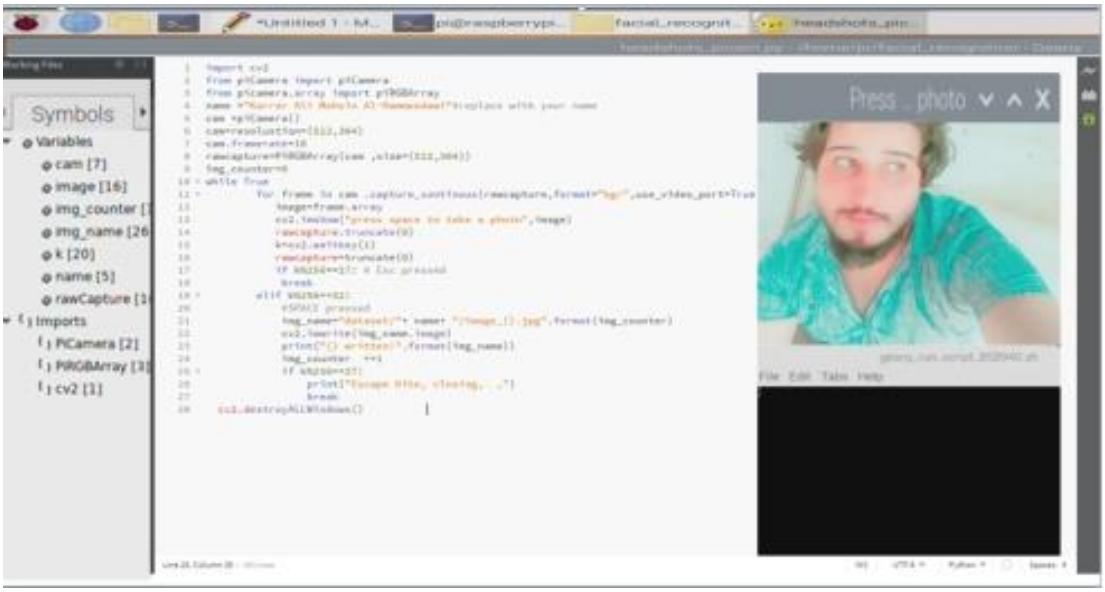

Fig 14: Training the system to show the face image and recognize it through the Python language

4.2 RASPBERRY PI BLOCK DIAGRAM:

One of the components we need to run the system really fast is to recognize the face and give good results Raspberry PI. It is a very small computer or a Micro computer that contains parts similar to the parts of a computer, for example, it contains a small RAM, small hard and other

parts. The main idea of this platform is that we learn programming using this device. We can also connect it to sensors and control the outside world.

Fig 15: Raspberry Pi 4 Model B

4.3 Internet of things (IoT):

Recently, information technology has become important and has become more advanced Internet of things technologies are good technologies because today everything has become the Internet of things, where the Internet of things is one of the most interesting concepts in recent years. Where one of the most important challenges faced by Internet of things technologies is to find the best ways and best solutions to all security problems in this paper has been implemented A technical model, as we used the raspbarry bi platform and implemented it with the Python language and through IoT technologies, where the proposed model gave great results and this distinguishes its work from the rest of the works. The proposed model with IoT technologies has proven superior to its peers.

Experiences and evaluation metrics and the result and discussion:

5.1 Experiences:

Experiment I:

In the first experiment, we downloaded the dataset of the face from the UCI website, this data suffers from many problems, for example**,**

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there are many missing values, outliers, and low-quality data in the image data, so we will enter this data into Rapid Miner and apply it Supervised machine learning algorithms, which are ensemble techniques such as Bagging, boosting, voting, stackingand classification by Regression and Polynomial by Binomial Classification with preprocessing technical, where the working area of the algorithms used were divided into 60% of the training section.By applying supervised machine learning techniques and preprocessing techniques to solve the problems of missing data and outliers, we obtained the highest accuracy that reached 98.27%, the precision criterion value reached 97.56%, the recall value reached 97.02%, and the f1 value reached 97.78%. Where these results are considered excellent for improving the quality of images and solving data problems, as shown in the first and second tables, the values obtained after calculating the mathematical equations of measurements within the Rapid Miner program, and we have reached good results and outperform their peers.

Table 1: The obtained results for solving missing values with Mean and outlier with K-NN in terms of precision and recall

Ensemble Method	***Positive Precision1,2***	**Negative Precision1,2**	***Positive Recall1,2***	**Negative Recall1,2**
Bagging	*98.08%,95.29%*	*98.80%,98.08%*	*92.05%,96.23*	*96.23,99.60%*
Boosting	*98.08%,95.29%*	*98.80%,98.08%*	*92.05%,96.23*	*96.23,99.60%*
Voting	*98.08%,95.29%*	*98.80%,98.08%*	*92.05%,96.23*	*96.23,99.60%*
Stacking	*87.64%,96.15*	*96.15,98.39%*	*88.64%,94.34%*	*94.43%,98.39%*
Polynomial by Binomial Classification	*98.08%,95.29%*	*98.80%,98.08%*	*92.05%,96.23*	*96.23,99.60%*
Classification byRegression	*98.08%,95.29%*	*98.80%,98.08%*	*92.05%,96.23*	*96.23,99.60%*

Table 2: The obtained results through ensembles with pre-processing in conjunction with KNN, DT and RF through Rapid Mine

Ensemble Method	*Precision*	*Recall*	*Accuracy*	*F1*
Bagging	*97.56%*	*97.02%*	*98.27%*	*97.78%*
Boosting	*97.56%*	*96.02%*	*98.27%*	*96.78%*
Voting	*97.56%*	*96.02%*	*98.27%*	*96.78%*
Stacking	*94.58%*	*93.95%*	*96.70%*	*94.95%*
Polynomial by Binomial Classification	*97.56%*	*96.02%*	*98.27%*	*96.78%*
Classification byRegression	*97.56%*	*96.02%*	*98.27%*	*96.78%*

According to the first and second tables, these values were obtained through the application of supervised machine learning techniques such as Bagging, boosting, voting, stacking and classification by Regression and Polynomial by Binomial Classification with preprocessing techniques within the Rapid Miner program, where we obtained the highest Measurements reached an accuracy that reached 98.27%, the precision criterion value reached 97.56%, the recall value reached 97.02%, and the f1 value reached 97.78%. Where these results are excellent compared to the previous works, and our work outperformed the previous works, and this proves that our proposal is an excellent proposal that gives good and good results, as the technical model was able to solve data problems and solve image quality problems, and this is what makes us excel over other than our work.

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Table 3: Confusion matrix with accuracy 98.27% performance vector with bagging

3	**1**	**2**	**NSP**	**True**
0	0	0	0	NSP
2	2	81	0	2
0	494	6	0	1
51	0	1	0	3

Table 4: Confusion matrix with accuracy 98.27% performance vector with Classification by Regression

3	**1**	**2**	**NSP**	**True**
0	0	0	0	NSP
2	2	81	0	2
0	494	6	0	1
51	0	1	0	3

Table.5. confusion matrix with Polynomial by Binomial Classification with accuracy 98.27%

3	**1**	**2**	**NSP**	**True**
0	0	0	0	NSP
2	2	81	0	2
0	494	6	0	1
51	0	1	0	3

According to the third, fourth, and fifth tables, the values in the table represent the values obtained with machine learning techniques. It was found that these results improve the quality of the data and give great hope for improving everything related to the data set.

Experiment II:

In the second experiment, after entering the data set for the face that suffers from many problems, the supervised machine learning techniques were applied that include ensemble techniques such as Bagging, boosting, voting, stacking, and classification by Regression and Polynomial by Binomial Classification with preprocessing techniques with Kappa The obtained results through ensembles with pre-processing in conjunction with KNN, DT, And RF through Rapid Mine, where high values were obtained. The highest values appeared in Tables VI and VII, reaching 97.56%,96.02%,0.953;96.78% with the following measurements according to the sequence Precision, Recall Kappa, F1. The proposed model will improve the image data, raise the quality of the data, and get rid of the missing values to be replaced by values according to the nearest neighbors, as well as solve the problems of outliers.

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Table 6: Kappa the obtained results for solving missing values with Mean and outlier With K-NN in terms of precision and recall

Ensemble Method	*Positive Precision1,2*	Negative Precision1,2	*Positive Recall1,2*	Negative Recall1,2
Bagging	*98.08%,95.29%*	*98.80%,98.08%*	*92.05%,96.23*	*96.23,99.60%*
Boosting	*98.08%,95.29%*	*98.80%,98.08%*	*92.05%,96.23*	*96.23,99.60%*
Voting	*98.08%,95.29%*	*98.80%,98.08%*	*92.05%,96.23*	*96.23,99.60%*
Stacking	*87.64%,96.15*	*96.15,98.39%*	*88.64%,94.34%*	*94.43%,98.39%*
Polynomial by Binomial Classification	*98.08%,95.29%*	*98.80%,98.08%*	*92.05%,96.23*	*96.23,99.60%*
Classification byRegression	*98.08%,95.29%*	*98.80%,98.08%*	*92.05%,96.23*	*96.23,99.60%*

Table 7: Kappa the obtained results through ensembles with pre-processing in conjunction with KNN, DTand RF through Rapid Mine

Ensemble Method	*Precision*	*Recall*	*Kappa*	*F1*
Bagging	*97.56%*	*96.02%*	*0.953*	*96.78%*
Boosting	*97.56%*	*96.02%*	*0.953*	*96.78%*
Voting	*97.56%*	*96.02%*	*0.953*	*96.78%*
Stacking	*94.58%*	*93.95%*	*0.910*	*94.95%*
Polynomial by Binomial Classification	*97.56%*	*96.02%*	*0.953*	*96.78%*
Classification byRegression	*97.56%*	*96.02%*	*0.953*	*96.78%*

According to the sixth and seventh tables, we have obtained very high values, and this makes our proposal predict the best results and solve data problems from missing values and low-quality images. The highest value in the two tables reached 97.56%. This confirms that the proposed model is good for prediction and face recognition using machine learning techniques.

Table 8: Confusion matrix with Bagging with kappa 0.953%

3	**1**	**2**	**NSP**	**True**
0	0	0	0	NSP
2	2	81	0	2
0	494	6	0	1
51	0	1	0	3

Table.9. Confusion matrix with kappa 0.953% performance vector with Polynomial by Binomial Classification

3	**1**	**2**	**NSP**	**True**
0	0	0	0	NSP
2	2	81	0	2
0	494	6	0	1
51	0	1	0	3

Table 10: Confusion matrix with Polynomial by Binomial Classification with kappa 0.953%

3	**1**	**2**	**NSP**	**True**
0	0	0	0	NSP
2	2	81	0	2
0	494	6	0	1
51	0	1	0	3

According to the eighth, ninth and tenth tables, after the inclusion of the facial data set, seven techniques were applied to classify the supervised data, where we also applied the preprocessing techniques and we obtained these values in the tables. As the eighth table shows confusion matrix with Bagging with kappa 0.953%, also the ninth table shows the values of confusion matrix with kappa 0.953% performance

vector with Polynomial by Binomial Classification. This confirms that the techniques used have given excellent results, also the tenth table shows confusion Matrix with Polynomial by Binomial Classification with kappa 0.953% Through this experiment, it has been shown to us that the proposed model outperforms its peers and predicts the best results and has improved data quality and face recognition.

Experiment III:

In the third experiment, we used high-precision techniques to achieve satisfactory results and provide more secure and more disciplined safety, as in the recent times many researchers were interested in providing the most prominent methods and the most prominent steps to achieve the best results for face detection and protection methods, this is what prompted us to search for alternative methods that work on Face detection and high-precision protection feature, where in his third experiment a Raspberry Pi technology scientific platform was used. The components needed by the system were used to implement face recognition, such as micro SD card, power supply, monitor, HDMI wire, mouse, keyboard, and we also did this work using python where all the components were connected with the computer and worked on them programmatically and this work was programmed With the Python language, my face has been recognized for more than one picture and more than one snapshot. This confirms that our work and our proposal is good and improves the methods of protection. It appeared in the program that the proposed model that we presented has proven that it is superior to its peers in terms of high results and values that are better than wonderful. This is what makes it give a very excellent prediction by recognizing the face. This makes us recognize the face and solve the data problems, so the most important thing in this proposal is that it recognizes the face and solves the data problems of the face images.

Evaluation Metrics:

To evaluation, accuracy, precision, recall, and f1 measures were applied. These measures were defined in Table 11.

Table 11: Evaluation parameters

Parameter	Equation
Accuracy	$(TP + TN) / (P + N)$
Precision	$(TP) / (TP + FP)$
Recall	TP / P
F-measure	$\frac{2 \times precision \times recall}{precision + recall}$

Result and Discussion:

In this article, the data mining tool, rapid miner 9th edition, was used to analyze and process data and solve data problems, after downloading the data for the problematic face images, we entered this data into rapid miner. We applied supervised machine learning techniques to solve data problems of missing values, low values, and outliers. We also applied to preprocess techniques to replace missing values, discover outliers, solve and replace them with good values with nearest neighbors. Ensemble techniques such as bagging, boosting, voting, stacking, and classification by regression and polynomial by binomial classification with technical preprocessing with the application of these techniques, we have obtained very high values. The highest measurements in our article and our first experiment reached the highest accuracy that reached 98.27%, the precision criterion value reached 97.56%, the recall value reached 97.02%, and the f1 value reached 97.78%. As shown in the first and second tables of the first experiment, where the most prominent results appear in the application of techniques within the rapid miner program. These measurements are very high and outperform their counterparts. They have been able to solve and overcome data problems. tables three, four, and five show the most important measurements, values , and results that were obtained after applying supervised machine learning techniques with preprocessing techniques within the rapid miner program. In the second experiment, we also entered the data that we downloaded from the autism spectrum disorder educational website into the rapid miner program. We have applied ensemble techniques such as bagging, boosting, voting, stacking, and classification by regression and polynomial by binomial classification with technical preprocessing. with the pre-treatment techniques, we have reached very high results as shown in table vi and vii, where the highest measurements with this experiment reached 97.56%, 96.02%, 0.953, 96.78% with the following measurements according to the sequence precision, recall kappa, f1. These values are more than good for improving data quality and face recognition. the eighth, ninth, and tenth tables show the most important results, values , and measurements that were obtained after applying the techniques in the second experiment within the rapid miner program. This confirms the success of our work and its presented paper is superior to its peers. We did a third experiment, which is the application of high-precision techniques to obtain good values in face

detection. Platforms, programs, and components were used to provide the third experiment and to present the model that can recognize the face. a technical model was presented that includes a scientific platform with raspberry pi technology. with the components that the system needs to implement facial recognition, such as micro sd card, power supply, monitor, hdmi wire, mouse, keyboard, we also did this work using python where these components were connected to the computer and we worked on them programmatically and this work was programmed in python, the experience was wonderful, as we trained the system and taught it to recognize the face and not be distracted by identifying the steps of the face. through the exercise of the system and the use of the python language, my face was identified and recognized personally and in more than one situation where my pictures were different and they were recognized. this is what makes the presented system to be a wonderful system as it was able to recognize the face, which makes it a proposed technical system that surpasses its peers in terms of accuracy of results, and this is what makes this proposed technical system gives impressive results that outweigh its peers.

Table 11 shows the most important criteria and their mathematical equations and the evaluation of the article will be by means of these measurements. Also, table 12 shows a comprehensive comparison between previous work and current work, where our work far outperformed the previous work in terms of accuracy. The highest accuracy that reached 98.27%, the precision criterion value reached 97.56%, the recall value reached 97.02%, and the f1 value reached 97.78%. As shown in the figure below, our work outperforms its peers.The first figure explains our work in detail with the proposed model, and explains the two experiments and the most important techniques used, that is, it is the entire research methodology.Figures from No. 2 to No. 15 show the most important components and results that were obtained from the application of the third experiment, which is how to identify the face.Through these forms, we have proven that our work is software work and is applied in an excellent manner and has given excellent results that outperform its peers in all respects. Figure 17 shows the comprehensive comparison between our current work and previous work. It has been shown through the figure and results that our work far outperforms the previous works. Figures 18 and 19 also show the best results that we obtained from applying supervised machine learning techniques. Figure 20 to 26 The most important results obtained after applying the techniques within the ROC program for the operations carried out within the program, and this confirms that our work outperforms all previous work.

Table 12: A comparison among the obtained results through ensembles with preprocessing and other works

	Precision	Recall	Accuracy	F1
Z. Zhu and Y. Cheng	95.45%	95%	95.45%	95.45%
R. Sridhar et al	80 %	96 %	80 %	87 %
S.Kanaga Suba Raja et al	91 %	91.78%	92.38%	91.78%
The best results of the current authors	*97.56%*	*97.02%*	*98.27%*	*97.78%*

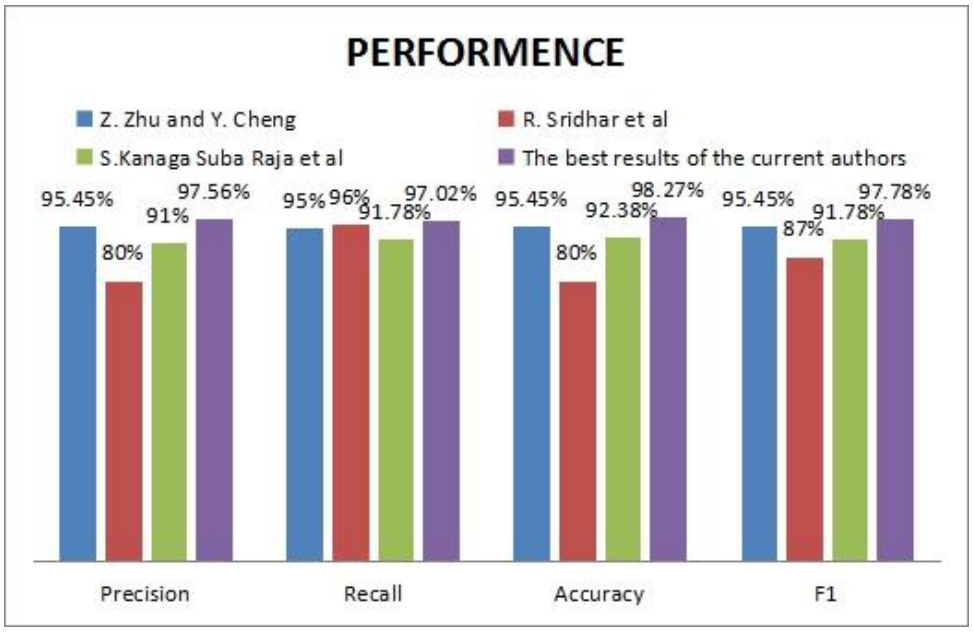

Fig16: A comparison among our best results and other works

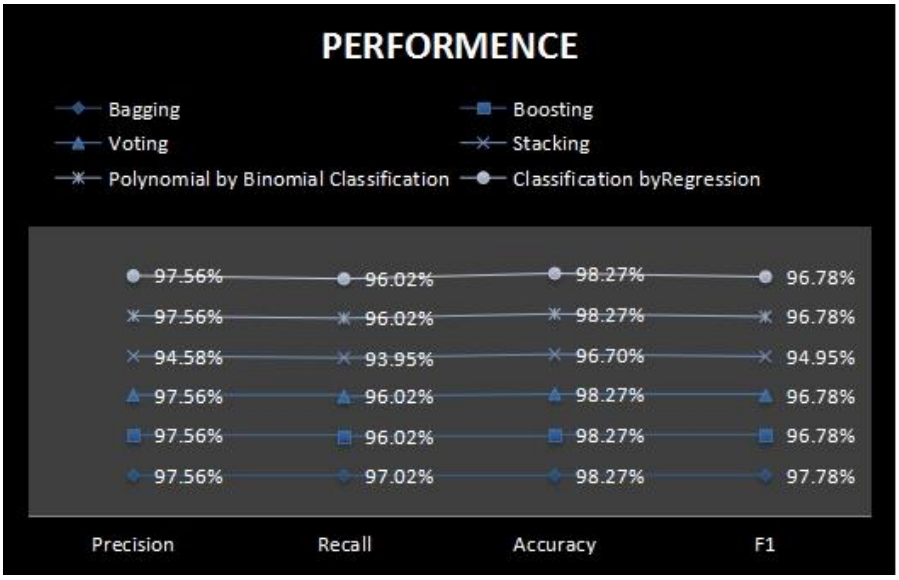

Fig 17: The best result in our work with ensemble techniques and pre-processing in conjunction with KNN, DTand RF through Rapid Mine

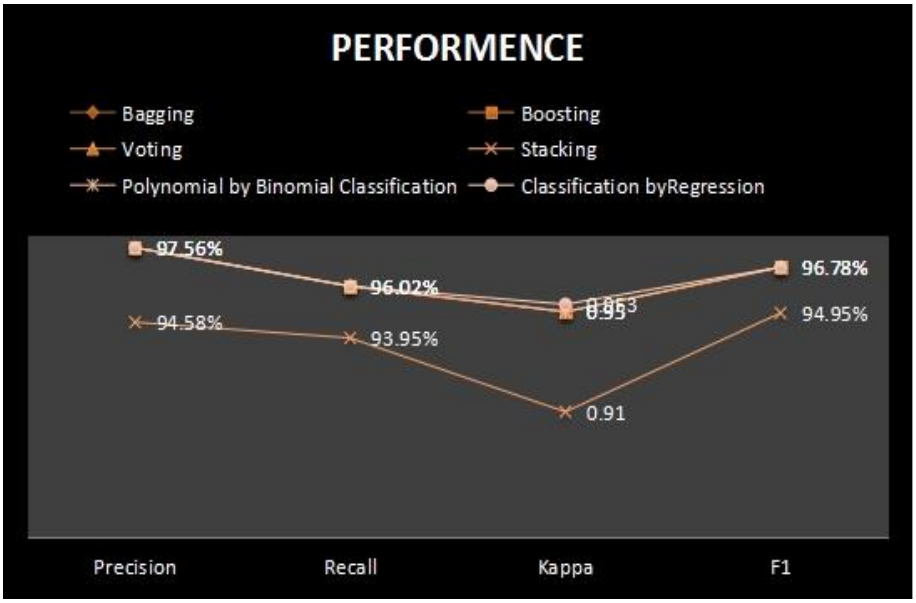

Fig 18: The best result in our work Kappathe obtained results through ensembles with pre-processing

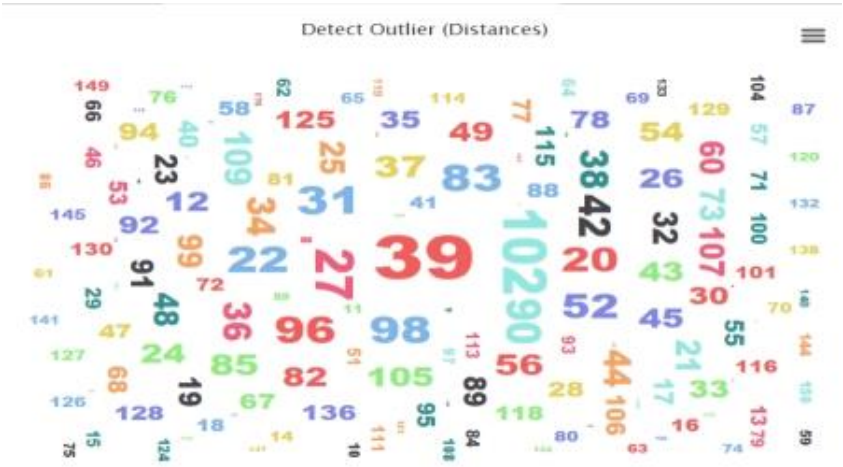

Fig 19: The ROC for wordcloud the bagging method

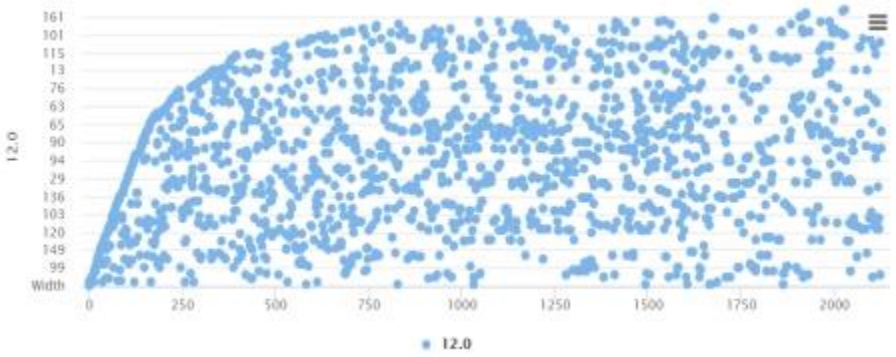

Fig 20: The ROC for Scater Bubble the boosting method

Fig 21: The ROC for word cloud the boosting method

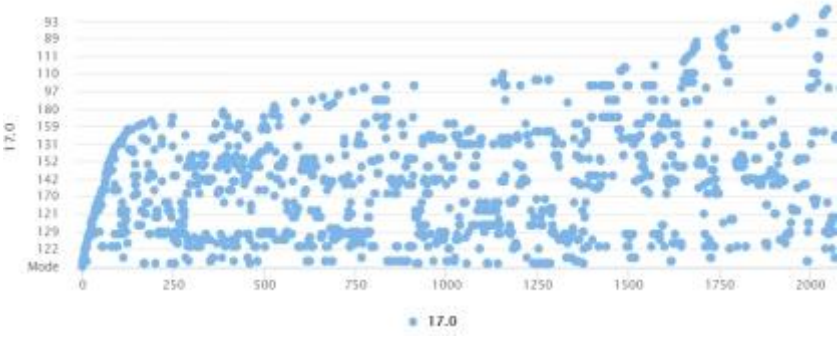

Fig 22: The ROC for Scater Bubble the voting method

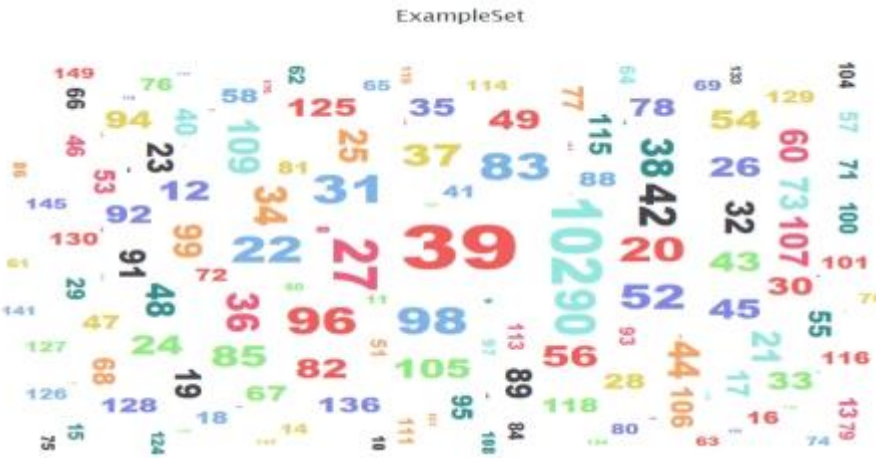

Fig 23: The ROC for word cloud the stacking method

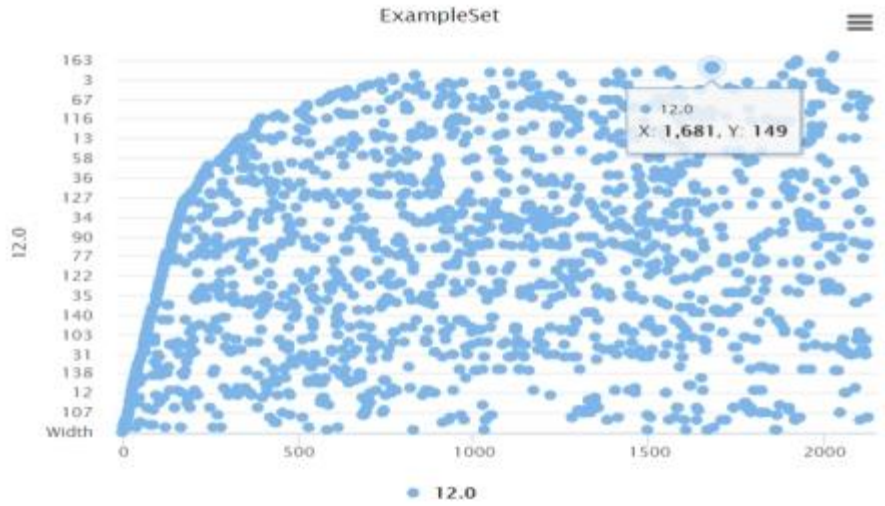

Fig 24: The ROC for Scater Bubble the voting method

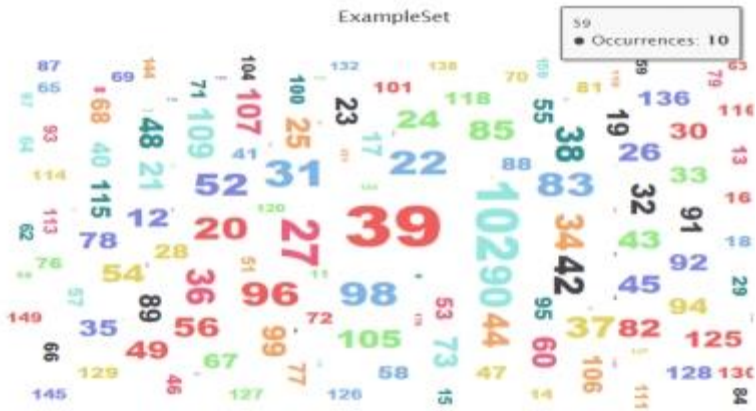

Fig 25: The ROC for word cloud the Polynomial by Binomial Classification method

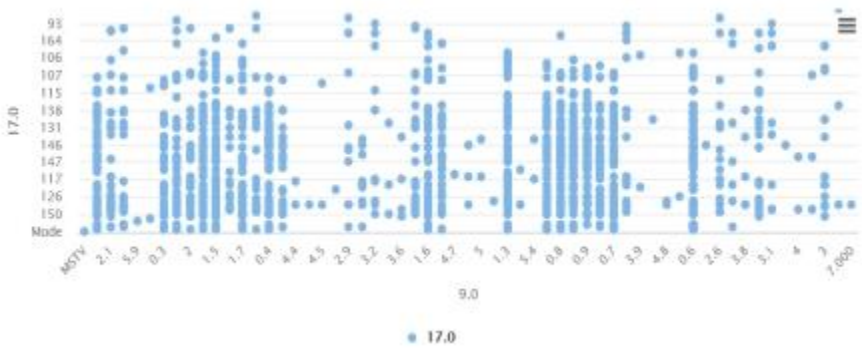

Fig. 26: The ROC for Scater Bubble the Classification by Regression method

Conclusion:

Due to the increasing demand for protection methods, face recognition technologies have become important techniques that meet the demands of all safety methods, as face recognition methods are technology capable of matching the human face from a digital image or video. It can work even without the user's knowledge, and it can also be useful for security-based applications and other applications based statistics the facial recognition feature is widely used in many applications, whether governmental or civil, such as criminal detection, airports, homes, etc. and this makes it a good technology for security. In this paper, a technical model has been proposed that overcomes the two problems of security and data problems two experiments were used, the first experiment was downloading the data set of the face, and it suffers from many problems, losing extreme values and values. Supervised machine learning techniques were used, which are ensemble techniques. We have implemented machine learning techniques that include bagging, boosting,

voting, stacking, classification by regression, polynomial by binomial classification with pre-processing where we obtained the following measurements as the highest values in the article precision equal to 97.56%, recall equal to 96.02%, accuracy equal to 98.27%, f1 equal to 96.78%. These values are considered good, and it has been proven that the proposed model is good, predicting the best results and solving data problems in the second experiment facial recognition technology was used using the raspberry pi platform. Components were also used with this platform, such as micro SD card, power supply, monitor, HDMI wire, mouse, and keyboard. We also did this work with python. It is shown in the program the proposed model has proven that it outperforms its peers in terms of high results and values that are better than wonderful. This makes us recognize the face and solve data problems. We will use an algorithm local binary pattern histogram algorithm with the OpenCV platform. We will aspire to achieve the best results with these algorithms. In next work, we will develop our work further.

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