SAKARYA UNIVERSITY

INSTITUTE OF SCIENCE AND TECHNOLOGY

TRACKING A PERSON THROUGH THE CAMERA ON THE INTERNET AND DETERMINING THE LOCATION

M.Sc. THESIS

Zinah Shakir MAKKI

Computer and Information Engineering Department

Computer Engineering Program

JUNE 2022

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Thesis Advisor: Prof. Dr. Ahmet ZENGIN

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The thesis work titled “Tracking A Person Through the Camera on The Internet and Determining the Location” prepared by Zinah Shakir MAKKI was accepted by the following jury on 13/01/2023 by unanimously of votes as a MSc THESIS in Sakarya University Graduate School of Natural and Applied Sciences, Computer Engineering Department.

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Zinah Shakir MAKKI

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In the name of ALLAH, the Most Gracious, The Most Merciful, Praise be to ALLAH, who enabled us to do this work and facilitated the path of knowledge for us. I extend my thanks and gratitude to everyone who helped me to complete this research, my thanks and appreciation for the big scientific edifice Sakarya University, and my appreciation and gratitude for the incredible effort and support provided to me by my advisor Prof. Dr. Ahmet Zengin, to my dear father's soul, to the soul of my dear husband, to my dear mother, to my happiness my children, to my dear brothers, and to all my friends members, I dedicate this scientific research to you.

Zinah Shakir MAKKI

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ABBREVIATIONS

PCA	: Principal Component Analysis
CNN	: Convolutional Neural Networks
AI	: Artificial Intelligence
IBM	: International Business Machines
LSTM	: Long Short-Term Memory
RNNs	: Recurrent Neural Networks
TIMIT	: Corpus of Read Speech Dataset
MNIST	: Modified National Institute of Standards and Technology Database
FDNA	: Future Directions in Network Architecture
DNNs	: Deep Neural Networks
PCFG	: Probabilistic Context-Free Grammar
GNMT	: Glycine N-Methyltransferase
OpenCV	: Open-Source Computer Vision Library
GPS	: Global Positioning System
RFID	: Radio Frequency Identification
EPC	: Energy Performance Certificate
RTLS	: Real-Time Locating Solution
MOT	: Multi-Object Tracking
FR	: Face Recognition
LFW	: Labeled Faces in The Wild
SVM	: Support Vector Machine
ORC	: Organic Research Centre
LBP	: Lipopolysaccharide Binding Protein
CBIR	: Content-Based Image Retrieval
OOP	: Object-Oriented Programming

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TRACKING A PERSON THROUGH THE CAMERA ON THE INTERNET AND DETERMINING THE LOCATION

SUMMARY

In a smart environment, person tracking is a basic component of the computational perception of human activities. Tracking is frequently referred to as a service, and it has benefits and drawbacks like any other modern technology or technical service. Because it is often difficult to place a device in the case that a person is wanted for crimes, tracking people using GPS technology has become obsolete.

While researchers in the past five years focused on tracking people by implanting a GPS chip in the person, where all person's movements are tracked from one place to another, there is a lot of research regarding GPS technology.

The main objective of this proposed system is to provide a safe environment for tracking people through cameras and a trained model that helps this system track the wanted people and know their whereabouts easily and quickly.

A different mechanism was proposed as opposed to the previously used techniques in tracking people. The Tensor Flow model was used to intelligently train the model, which was developed using CNN techniques. This pre-programmed software recognizes wanted individuals and transmits their information and location to the system management. For tracking to work, the software must be attached to its camera. The system test is done in two steps, with the first stage taking place if the light at the camera is poor. With 50 photos, the system was trained, 24 images were detected, and the existing data was determined. In the second part, an experiment was conducted on the system in normal light using the same mechanism as in the first test. The system achieved a percentage of 100%, which means that all images were recognized. The coded program was also tested using the hash algorithm, where the accuracy scored 99, which is a good percentage.

In the future, we suggest that researchers focus on

1- Using facial recognition algorithms from all sides,

2- Using the cloud database to save the data and

3- Using thermal cameras instead of regular cameras.

İNTERNET ÜZERİNDEN KAMERA ARACILIĞIYLA BIR KİŞİNİN TAKİBİ VE KONUMUNUN BELİRLENMESİ

ÖZET

Akıllı bir ortamda kişi izleme, insan etkinliklerinin hesaplamalı algısının temel bir bileşenidir. İzleme genellikle bir hizmet olarak adlandırılır ve diğer modern teknolojiler veya teknik hizmetler gibi yararları ve sakıncaları vardır. Bir kişinin suçtan aranması durumunda uygun cihazı yerleştirmek çoğu zaman zor olduğundan, GPS teknolojisi kullanılarak kişilerin izlenmesi artık geçerliliğini yitirmiştir.

Son beş yıldır araştırmacılar, kişinin bir yerden bir yere tüm hareketlerinin takip edildiği GPS çipini kişilere takarak insanları takip etmeye odaklanırken, GPS teknolojisi ile ilgili çok fazla araştırma bulunmaktadır.

Önerilen bu sistemin temel amacı, kameralar aracılığıyla insanların izlenmesi için güvenli bir ortam ve bu sistemin aranan kişileri takip etmesine ve nerede olduklarını kolay ve hızlı bir şekilde bilmesine yardımcı olan eğitimli bir model geliştirmektir.

İnsan takibinde daha önce kullanılan tekniklerin aksine farklı bir mekanizma önerilmiştir. CNN teknikleri kullanılarak geliştirilen modeli akıllı bir şekilde eğitmek için Tensor Flow modeli kullanıldı. Geliştirilen yazılım, aranan kişileri tanır ve bilgilerini ve konumlarını sistem yönetimine iletir. İzlemenin çalışması için yazılımın kameraya kurulması gerekir. Sistem testi iki adımda yapılmıştır. Ilk aşama kameradaki ışık zayıf olduğu durumda test yapılıştır. 50 adet fotoğraf ile sistem eğitildi, 24 adet görüntü tespit edilerek mevcut veriler belirlendi. İkinci aşamada, ilk testte olduğu gibi aynı mekanizma kullanılarak sistem üzerinde normal ışıkta bir deney yapıldı. Sistem %100'lük bir başarıma ulaştı, bu da tüm görüntülerin tanındığı anlamına gelmektedir. Geliştirlen program, hash algoritması kullanılarak da test edildi ve başarım yüzde 99 olarak ölçülmüştür.

Gelecekte, araştırmacıların şu konulara odaklanmasını öneriyoruz:

- Yüz tanıma algoritmalarını her yönden kullanmak,
- Verileri kaydetmek için bulut veritabanını kullanma ve
- Normal kameralar yerine termal kameraların kullanılması.

Kamera tabanlı kişi takip sistemi, her biri farklı bir işlevi yerine getiren karmaşık teknolojilerle programlanıyor. Ancak entegre çalışırlar, bu nedenle tüm teknoloji doğru çalışmıyorsa iş doğru yapılmaz. Yüz tanıma teknolojisi öncekilerden daha doğru ve karmaşıktır. Aynı şekilde, tanıma teknolojisi için, bir kişinin fotoğrafı, veritabanındaki fotoğraflarla yavaş yavaş eşleşir. Ancak sadece yüzün şekline ve özelliklerine odaklanmaz, kişinin görüntüsü ile veri tabanındaki görüntü arasındaki yüz ifadelerindeki herhangi bir değişiklik çalışmayı geçersiz kılar. Bazı yüz tanıma teknolojileri, yüzün bir görüntüsünden özellikleri ayıklayarak yüz özelliklerini tanımlar; örneğin, bir teknoloji, yüzün boyutu ve konumu tarafından belirlenen, örneğin burun gibi yüz birimlerinin göreli konumunu ve boyutunu analiz eder. gözlerden uzaklığının yanı sıra gözler arasındaki boşluğu tanımlar.

Araştırmacı, çalışacak belirli teknikleri belirlerken, teknikleri karşılaştırarak ve iş için uygun teknolojiyi seçerek ciddi bir çalışma yapmalıdır. Önerilen bu sistemde,

TensorFlow modelini eğiterek yüzü tanımak için temel çalışma tekniklerini (CNN) tanımlıyoruz ve ayrıca sistemin güvenliğini artırmak için sistem içindeki verileri şifrelemek için hash algoritmasını kullanıyoruz.

İş dilde programlandı Python programlama diliÜst düzey, öğrenmesi kolay, açık kaynaklı ve genişletilebilir (OOP) nesne yönelimli bir programlama dilidir. Python, Blender dahil olmak üzere çeşitli programların performansını kontrol etmek için kullanılabilen bir programlama dilidir. Python, grafik arayüzlerle bağımsız programlar oluşturmak ve çevrimiçi uygulamalar dahil olmak üzere birçok disiplinde yaygın olarak kullanılan yorumlanabilir, uyarlanabilir bir dildir. Python, acemiler için basit uygulamalar ve genel olarak karmaşık projeler oluşturabilir. Bu dil, programlamaya yeni başlayanlar için sıklıkla tavsiye edilir çünkü öğrenmesi en kolay programlama dillerinden biridir.

Python, kapsamlı ve basit programlama becerileri nedeniyle şu anda en önemli dillerden biri olarak kabul ediliyor ve çeşitli programlama ofisleri için güvenli bir izleme sistemi sağlıyor.

. Kişi takip sistemi, kişilerin yüzlerinin fotoğraflarını çekerek kimliklerini belirlemek ve bunları sistemdeki veri tabanı ile eşleştirmek olarak tanımlanır. Günümüzde yaygın olarak kullanılan teknolojilerden biridir ve pek çok özelliği vardır ve bunların en önemlisi suç tespit sistemlerinde kişilerin kimliğinin tespit edilmesidir. Önerilen bu çalışmada, insanları tespit etmemize ve takip etmemize yardımcı olması için bu özelliği kullandık, sistemin pratik kısmını ve yüz tanımanın sanal sistemle deneyler yaparak ve örneğin standart bir kamerayla sistemi simüle ederek kaydedilen sonuçlarla nasıl çalıştığını inceleyeceğiz. bir dizüstü bilgisayar kamerası ve ana program. Son aşamada ise uygulama aşaması projenin başarısını belirleyen son aşamadır. Çünkü kameralar, güvenlik doğrulama cihazı gerektirdiğinden halka açık yerlere yerleştirilemez.

Google'ın 50 kişilik veri setinde çektiği bir dizi ünlü fotoğrafını sisteme göndererek sistemi somut olarak test ettik. Kişilerin bilgileri veri tabanına sunuldu ve resimleri tabana girildi ve laptoptaki kamera kullanılarak kamerada önlerine resimleri geçtik ve bu deney iki partiye ayrıldı, dim kullanıldı. Duyduğunuz anda ışık verin ve sonuçlar ortaya çıktı

Temel amacı, belirli bir alandaki insanların yüzlerini eşleştirme, ihlal edenleri tespit etme ve konumlarını gönderme tekniklerini kullanarak bir kişiyi takip etmektir. CNN algoritmaları, projenin ana amacına uyacak ve doğrulayacak şekilde bazı değişikliklerle kullanılmıştır. Aynı anda birden fazla kişinin keşfedilmesi gibi bazı özellikler projeye eklendi.

1. INTRODUCTION

1.1. Background of Research

Concerns regarding technologies that detect persons by matching faces have grown after DeepFake began to proliferate in 2019. Although this technology is found in many smartphones and computers, we will concentrate on the component that necessitates the analysis of millions of photos, which is more advanced and yields more accurate findings.

Person-recognition technologies match people's faces by analyzing images of the human face and then converting them into digital data according to the features in each face (such as distance between the eyes, length of the nose, the shape of the lip circumference, spacing of the ears, and width of the chin, among other things). The face is then matched with a copy of the device owner if it is an individual or with images in a database of faces in other sectors. This technology can be used to identify the face's owner or verify that he has the necessary authorization to visit the site or use a device. Depending on the degree of analysis performed by the system, this step can take milliseconds to a few seconds [1].

But why is this technology more widely used than other forms of recognition, such as fingerprints, voice tone, etc.? This is due to the ease with which face data, as opposed to an eye or a fingerprint, can be read from a distance, as well as the noise associated with tone-recognition of voice in public places and the ease with which these parameters, such as the user factor, can be changed. Among the possibilities are burned fingerprints, a cold, or the presence of a virus that caused an eye infection. Instead of requiring the criminal to be near a device to identify his fingerprint, eye, or tone of voice, it is simple to use this technology to watch pedestrians and instantly identify visitors, particularly in assault or theft.

Over the previous period in the last years, facial recognition in vital measurements and events, pattern recognition, and security monitoring devices played a crucial role. As for today, it is complicated and challenging to identify the person as well as the

property from thieves and recent fraud in some countries. The crimes that appear in the news daily, where there is credit card fraud, the penetration of computers and relevant data, and security threats faced by companies or governments, are increasing, quickly. The primary cause of failure and these security breaches is that authentication is done on a basis, not our biometric identity [2].

Facial recognition systems are likely to be configured to identify emotions. Many applications are technical and industrial, and facial matching is an important part of artificial intelligence, in contrast to tasks such as facial recognition. Facial recognition is also difficult, but data can be collected not with big but simple data to experiment with this system using clean basic reality stickers (see Figure 1.1). Usually, the metrics are objective (i.e., we know the identity) [3].

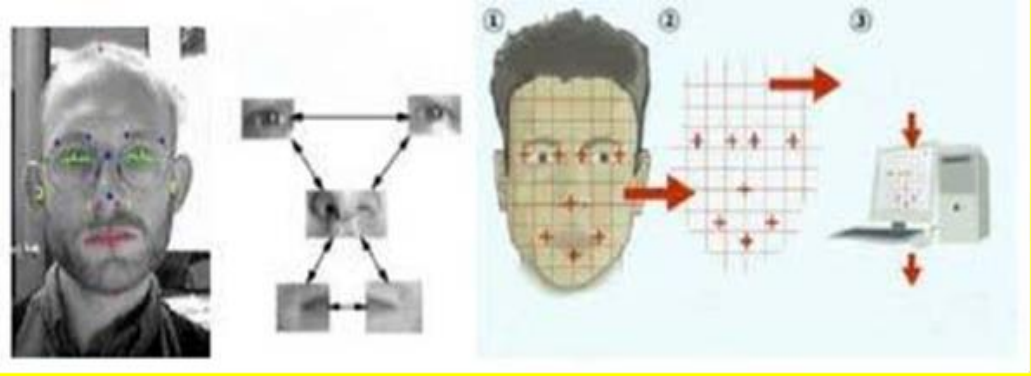

Figure 1.1. Person matching method [4].

In the last period of 2019, the first infections of the deadly Coronavirus appeared in China, causing disease in many Chinese citizens. Many researchers have conducted research to help reduce the spread of the virus, and many advertising campaigns have identified the virus to people worldwide. The World Health Organization published guidelines for disease prevention, and one of the necessary things to prevent is face masks, as China has held many people accountable for wearing masks. This thesis presents a proposal to use the face recognition feature to keep responsible people in violation of the general guidelines for preventing Coronavirus. We focused on face masks in the research. We used an algorithm for facial analysis by three essential points (eye, nose, and mouth). We will look at the next chapters and the method followed in detail.

1.2. Subject Area Description

Tracking people based on face detection techniques is one of the most important sciences of computer vision. Person tracking systems use several metrics and technologies to scan faces, including thermal imaging, 3D facial mapping, unique feature indexing (also called facial features), geometric analysis of facial features, mapping of distances between key facial features, as well as analyzing skin surface texture.

Person tracking technologies are part of biometrics, and other examples of this feature are fingerprint scanning technologies and iris scanning systems, which are emerging from artificial intelligence [5].

It can recognize and verify people by comparing and analyzing distinct patterns based on facial features and can help identify and distinguish human faces from an image. Facial recognition systems are used in various fields, although the most common application appears to be for security reasons. This trait has been exploited in our research to prevent disease.

Person tracking systems use different methods depending on the application and the manufacturer. However, it usually consists of several stages that record, process, analyze, and match the face to a database of different images. To identify and match facial image traits, these systems use computer vision intelligence, statistical analysis tools, and machine learning [6].

1.3. Problem Statement

In the past years, the need for person tracking based on face recognition technology has increased. Many institutions have used it in their applications and manufactured devices because it saves a lot of effort and time for humans to match faces. The Viola-Jones algorithm is used to detect the front. The modified Principal component analysis (PCA) algorithm is used to recognize faces from the images with some differences close to the actual time. The algorithm analyzes the main components of the face. This technique recognizes facial pictures before and after plastic surgery [7]. Many single-row laser scanners and video cameras are used [8]. A consecutive workbook consisting of heterogeneous feature classifiers has been applied to capture different photo properties: use two-step rankings, the first looking for coarse features and the second

for the more excellent features. The appliance engine is designed to detect the face with a useful area quickly. Hardware acceleration, including resizing, integrated image generator, filter correction console, workbooks, and face guide that can process one image in 101ms [9]. Facial recognition was also used in organizations of education to identify the faces of students and record their attendance. In the system, a modified algorithm from Viola-Jones was used to detect the front and a partial, alignment-free algorithm for identifying faces [10].

1.4. Scope of Research

The main objective of this thesis is to track a person using techniques for matching people's faces in a specific area, detecting violators, and sending their locations. CNN algorithms were used with some modifications to suit and verify the main objective of the project. Some properties have been added to the project, for example, discovering more than one person at the same time.

1.5. Significance of the Study

The recent development in technology and industrial revolutions in the world has become essential in our lives to use technology in the right way to benefit more, especially in the field of computer vision and artificial intelligence, especially machine learning and deep learning. The feature of tracking person systems and facial recognition in our time is an expression of the essential characteristics that must rely upon in applying some issues, including health, security, and education. In this thesis, a system was proposed to track persons in violation, get to know them, and send their locations to the authorities concerned with managing the system.

1.6. Thesis Plan

The rest of this thesis has been organized into five chapters briefly shown:

- Chapter Two: Literature Review and Theoretical Background.
- Chapter Three: System Architecture and Methodology.
- Chapter Four: Implementation and Results.
- Chapter Five: Conclusions.

2. LITERATURE REVIEW AND BACKGROUND

2.1. Introduction

In this chapter, it is devoted to discussing a historical overview of the tracking a person system. The main components of the project based on implementation will be addressed. Generally, tracking a person's system is common in several areas, such as computer vision, machine learning, and artificial intelligence. Sometimes it is used in many fields such as protection, surveillance, health systems, and crime detection system applied in several applications. This chapter will discuss the general vision of the thesis with the main fields and components and compare it with previous works.

2.2. Artificial Intelligence

Over the past years, computer capabilities and artificial intelligence-based person tracking systems have evolved rapidly. These technologies have reached a degree of precision that makes use of this technology for security uses, despite some observations about it. Scientists have developed a computer program with artificial intelligence that can detect false facial expressions, analyze fake smiles, and distinguish between different smiles [11].

The program works by identifying the person's face using a video recording, in which it identifies mouth, cheek, and eye movements. It then measures how these facial features move with the start of the smile and calculate the differences in mobility between videos displaying real and fake smiles [12].

The researchers analyzed the results of the program using two different data sets, one containing pictures of people expressing genuine smiles and the other containing pictures of fake smiles. They found that when comparing real and artificial expressions, there were significant differences in the way mouths and cheeks were moved. Many problems arise around this technology, starting with the recognition of artificial intelligence and its bias towards certain groups according to the background of scientists and programmers until the issue of privacy has been raised [13].

For example, this technology is spreading in China so much that it may change everything, from how to search for criminals to the daily interaction of people with banks, shops, and transportation services. People can push their faces through an application with a high degree of accuracy. Person tracking systems allow it to use for financial transactions and their use in daily life. Payment via the face is a new technology that appeared in the past years and was followed by the company Master Card, which launched last year a particular application that enables users to use this technology. This technology provides a very safe and comfortable way to pay, but it raises privacy concerns.

Face ++ is a one billion $ Chinese startup that can spot, compare, search for, and analyze faces under the title "Discover the Power of Artificial Intelligence" through an application launched in 2012 for this year to update (Face ++ Cognitive Services) using deep learning technology [14]. It is an artificial intelligence technology that is especially effective in image recognition because it makes the computer focus on facial features that enable people to be reliably recognized. Deep learning is a relatively new form of artificial intelligence that involves a network of sophisticated algorithms that loosely rely on the neural systems of the human brain. It is a compelling recognition pattern that uses a massive amount of data that enables computers to do things automatically, such as adding accurate colours to black and white images.

Figure 2.1 will show the main structure of artificial intelligence and what are its components and parts.

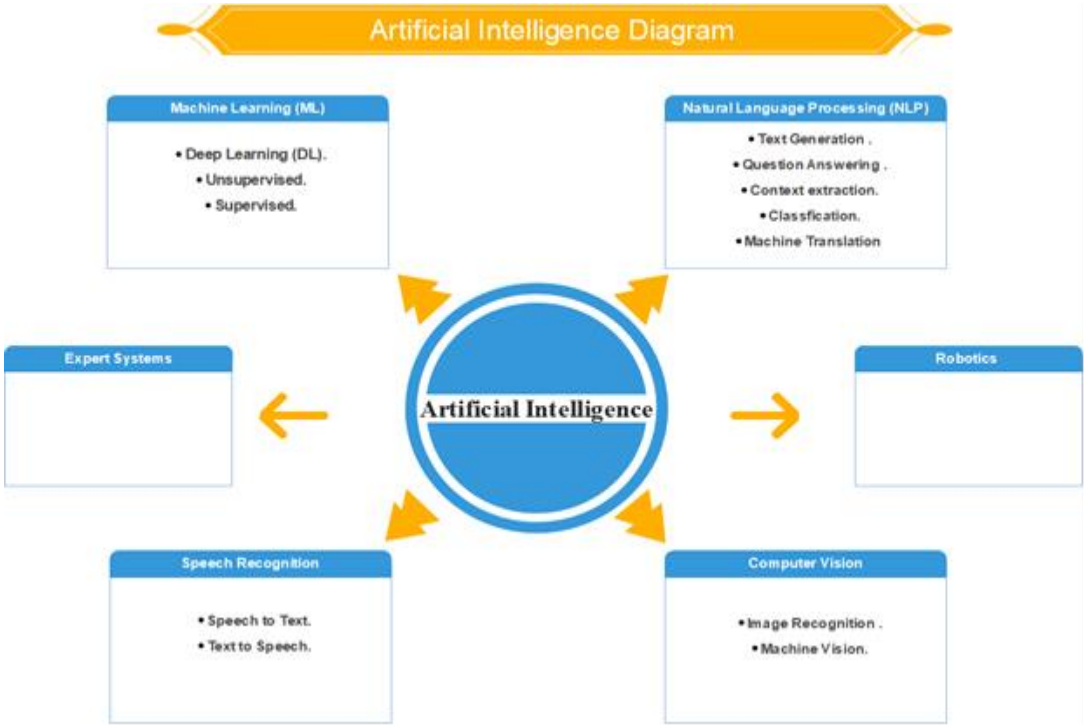

Figure 2.1. Main structure of artificial intelligence [11]

In Figure 2.1. the main branches of artificial intelligence are shown with their subfields. In the proposed system, we will explore the properties associated with machine learning (Deep learning) and computer vision. We will explain this linkage below.

2.2.1. Machine learning

The entire world's attention has recently focused on artificial intelligence. The most important dialogue has become the tables of discussion about what the world hopes to achieve from technological development and unprecedented progress, and that interest has not gone unnoticed. Many models have emerged that confirm that artificial intelligence has approached human knowledge competition, and we have observed this by developing self-driving cars, robot Sofia, and many others [12]. With one success following another, the area of interest known as machine learning and development to move towards more significant achievements in employing artificial intelligence has increased.

Machine Learning, referred to the acronym ML, is one of the branches exuding from artificial intelligence science (AI) based on computer programming in its different shapes to be able to perform assignments and execute orders endowed to it. ML is overcome the issues based on the information accessible and analyze it whereas

confining human mediation in coordinating it or totally truant it. It is essential that the term machine learning showed up at the instigator of the pioneer of artificial intelligence Arthur Samuel in 1959 inside the scope of the work of IBM research facilities. It is worth noticing that the machine, in this case, must depend on the examination of the information entered in development to meet the orders and errands required of it. Hence, the part of the component humanity is eventually negligible. The machine will have the obligation to form choices when needed and to decide what assignments must be executed, as this will unavoidably contribute to the completion of errands as rapidly as possible compared to the time humans consume complete tasks [13].

- The principle of machine learning

It could seem complicated, to begin with, approximately how to memorize a machine and how it can be done, but typically by no implies inconceivable. Numerous practical applications of artificial intelligence based on the rule of machine learning have shown up, among which the foremost celebrated is the Sofia robot [14]. As for the working rule, the calculations are the premise of the application of machine learning. These calculations comprise an arrangement of commands, information, and instructions vital to direct the machine or computer for how assignments ought to be performed [15]. As the calculations play the part of the plan within the gadget, since of the polarization of information, they are collected, analyzed, and at last, depending on the analyzed information to decide how the task ought to be carried out [16].

The calculations utilized in machine learning depend on a set of graphical models and choice devices such as the choice tree, natural language processing, and artificial neural systems to carry out the assignment of mechanizing. The analyzed information and handling hence propel the machine to create choices and carry out the capacities relegated to it with ease. It must be famous that the artificial neural systems utilized in machine learning play a noteworthy part comparable to the position of nerves and their frameworks within the human body and the human brain and beginning from the complex part played by calculations and instruments. The pressing requirement has developed to come up with what is known as deep learning [17].

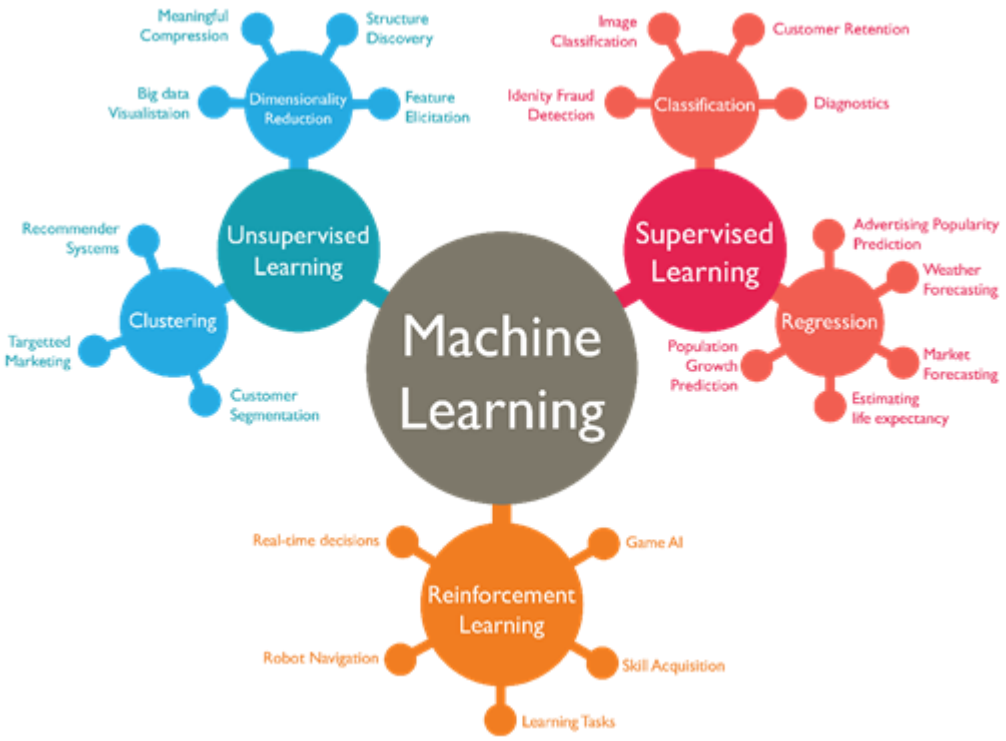

Figure 2.2. Machine Learning fields [18]

2.2.1.1. Deep learning

Deep learning falls under the umbrella of machine learning and may be a subset of artificial intelligence. A more direct definition: artificial intelligence incorporate innovation that reenacts human capabilities while learning machine learning algorithms and adapting to current events.

Deep Learning may be an unused field of inquiry that bargains with finding hypotheses and algorithms that permit a machine to memorize what it possesses by invigorating neurons within the human body. And one of the branches of science that bargains with artificial intelligence. Specialists contend that deep learning and artificial neural organizations are the same things, and the terms utilized are traded; like the neural systems in intellect, neurons (hubs) are interconnected by neural connections (connections) [19].

Deep learning is one of the branches of machine learning science; most of the in-depth learning inquiries centers on finding strategies for determining a tall degree of reflection by analyzing an endless information set utilizing direct and non-linear variable (see Figure 2.2.).

Discoveries in this range have demonstrated a critical, fast, and viable advances in numerous regions, counting facial recognation, speech recognation, computer vision, and natural language processing [20]. Figure 2.3. shows the deep learning pyramid.

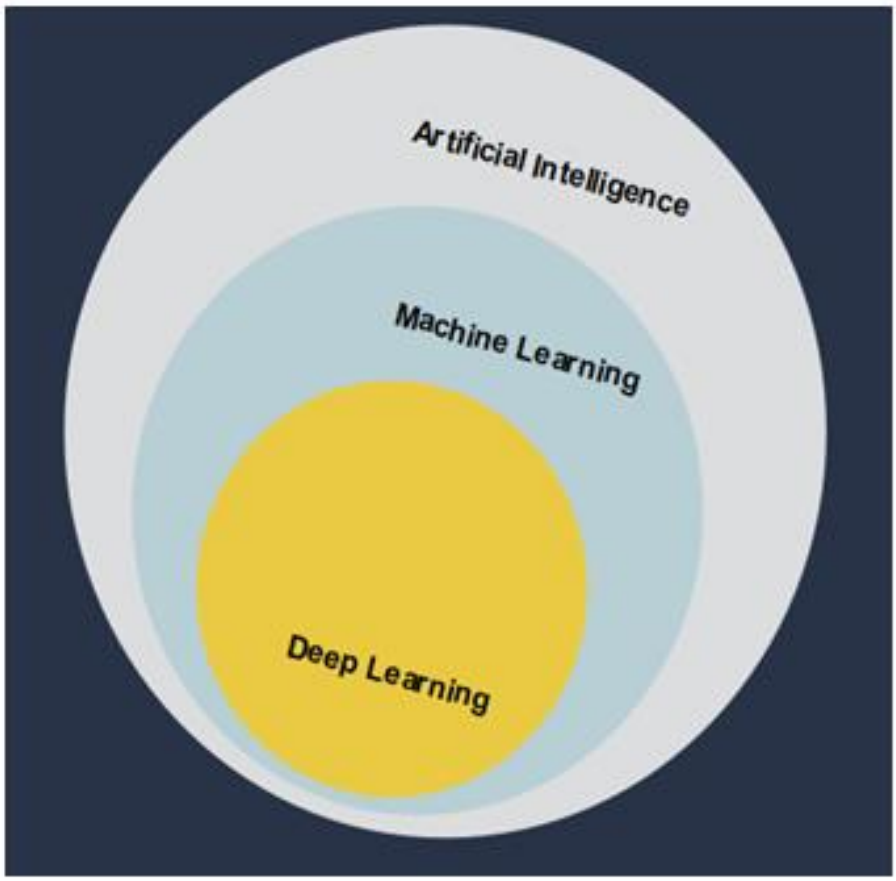

Figure 2.3. Deep Learning Pyramid [21]

Machine learning relies on giving the machine the ability to learn like a human being. At the same time, deep learning is concerned with simulating the human nervous system, and it is related to the neural network field.

Deep learning needs a large memory and powerful devices. Therefore, it relies heavily on big data. Many applications are currently being worked on using deep learning, including self-driving cars where the machine enables the identification of traffic lights, people, animals, and buildings. There are also medical applications in the detection of cancer and also used in audio response devices and to detect people in pictures [22]. Figure 2.4 below shows the difference between deep learning and neural networks.

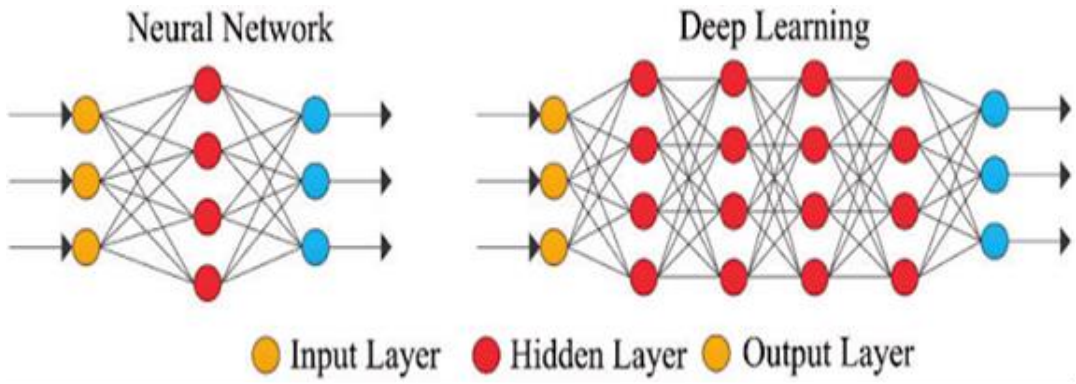

Figure 2.4. Difference Between Deep Learning and Neural Networks.

To be able to explain deep learning, we must first talk about the neural network. Neural nets like any mind in the world, the memory of the machine consists of neurons, and the neurons in the machine mind are partitioned into three layers, the input layer, the hidden layer, the output layer [23]. The first layer receives the input data collects it, and then sends it to the hidden layers, where it performs some mathematical operations for the inputs and then forwards it to the output layer that returns the data that was processed.

- The main idea

Any object can be described in many different ways. For example, an image can be configured on a vector basis for the brightness in each pixel or in a scattered manner based on the sum of the edges and regions that make up the image. Many other methods can be used to characterize this image [24].

Studies show that some of these methods are better than others in simplifying machine learning (such as noticing a face or expressions). One of the expected objectives of studying deep learning is to replace human-machine-defined learning with features produced by the machine itself using practical algorithms to derive functions in an automatic or semi-automatic manner.

Deep learning research relies heavily on discoveries in neuroscience, especially in the area of understanding the coding processes that the nervous system performs in determining the different relationships between stimuli and brain activities.

- Deep learning technology

William McCulloch and Walter Bates are the best places to begin learning about artificial intelligence and deep learning. They published the first computerized model of the neural network in 1943, in a logical account of similar ideas in neural activity.

Donald Hub published Behavior Regulation six years later, arguing that the connections between neurons increased with use. This fundamental concept has proven useful in comprehending human learning and training artificial neural networks [25].

Belmont Farley and Wesley Clark used research by McCulloch and Bates to run the first computerized simulation of an artificial neural network in 1954. These 128 neurons were trained to recognize basic models.

In the summer of 1956, computer scientists gathered to work on the hypothesis that every aspect of learning or any other aspect of intelligence can be accurately emulated when described with a purpose. The Dartmouth Conference is widely regarded as the birthplace of artificial intelligence [26].

The field of artificial intelligence grew after the Dartmouth conference. Frank Rosenblatt began researching a type of neural network known as “Persepetron" in 1957. He could transfer the Farley and Clark training methods from the two-layer network to multi-layer networks.

A single-layer neural network was created by Bernard, Hydro, and Markian Hof. Based on the previous particles, he named it Adalin, an acronym for Adaptive Longitudinal Elements. It is capable of predicting the most accurate information that may be received in a phone call.

Her next developed model, a multi-layer neural network named Madeleine, was echoed in phone calls, and is regarded as the first practical application of industrial neural networks.

These innovations continued during the sixties period, but funding, research, and developments slowed in the seventies. All the scientists' achievements failed to keep pace with the media boom and the government's expectations. What was called "Alointer" was gone during a period of tight funding, and the research work on the topic declined.

Beginning in 1986 AD, the research returned to the advancement for several years after "Geoff Hinton" published his article "Explanation of Learning in the Way of Generalizing Errors," which explains the method of learning with backward generalization. Despite this, the real renaissance did not occur until the middle of the second millennium. At present, deep learning and related matters are at their best, and some may exaggerate, describing the situation as a surge in the boom.

- The principle of deep learning work

Within the human brain, neurons get approximately 100,000 electrical signals from their partners, as each dynamic neuron can have a fortifying or inhibitory impact on those related to it. The fake organize is based on the same guideline as the signals travel between nerve cells with a slight contrast. Rather than utilizing the electrical flag, they organize works by labeling it with a particular weight. Neurons that get an expansive sum of information have a more critical effect on neighboring neurons. The final layer of cells reacts to these signals [27].

To know how deep learning works, let us take a concrete illustration of picture recognation. Envision that the neural net utilized to recognize pictures that contain at slightest one cat, to be able to do so, the calculation must be able to recognize between the distinctive sorts of cats and to recognize the cat precisely notwithstanding of the point in which it is captured. Within Figure 2.5 appears the how neural systems work.

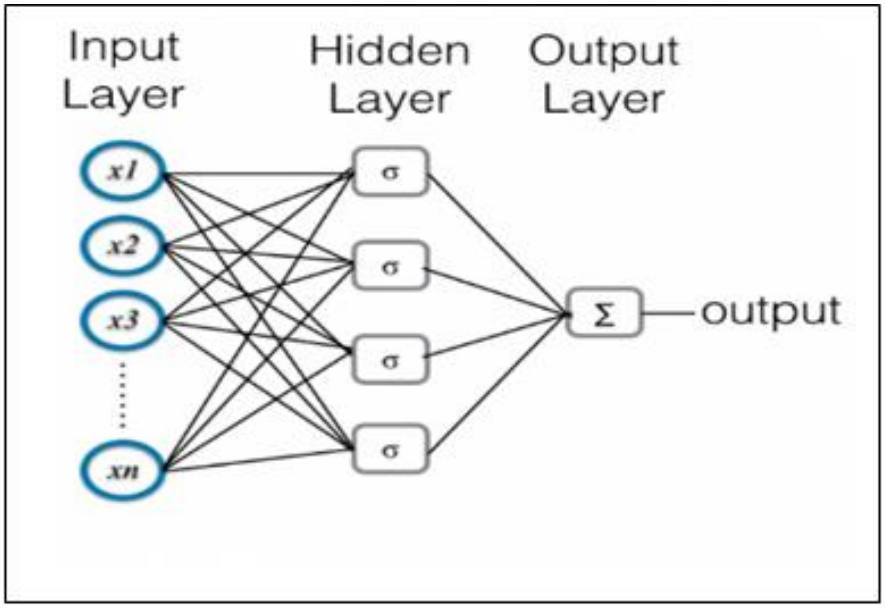

Figure 2.5. Principle Neural Networks Work

To realize this, the neural network must be prepared by collecting thousands of pictures of distinctive cats blended with pictures of other animals. These pictures will be changed over to information and exchanged to the organize where neurons stamp the different components of the show to a certain weight. At last, the final layer of neurons will collect different information and conclude whether the ultimate shape may be a cat or not [28].

The next stage is to compare the neural network of its response with the correct answers provided by humans. If they are identical, the network saves the process in memory for later use to identify cats. In the opposite case, the network will correct the error by adjusting the tagged weight of each element in the neuron. The process is repeated thousands of times so that the network can recognize the cat in the picture in all circumstances and bodies, and this technique is called supervised learning. Figure 2.6. shows the principle of deep learning work.

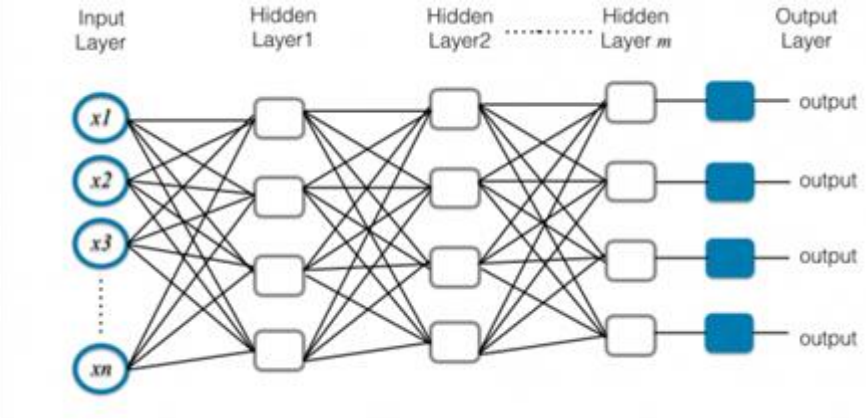

Figure 2.6. Principle of Deep Learning Work

On the other hand, there is another technique called unsupervised learning, which relies on unclassified data where neural networks have to recognize patterns within data sets to learn for themselves the most important and relevant elements.

- Deep learning applications

Deep learning has numerous applications depending on the diverse areas; for example, Facebook employments this innovation to distinguish companions consequently, and Apple employments it in its innovation, Face ID, to perceive faces. Whereas programs such as Skype and Google interpret could decipher verbal discussions in real-time, much appreciated to which the artificial intelligence Google AlphaGo was able to overcome the world winner within the amusement go [29].

Learning structures, such as deep neural systems, bypass neural systems, and deep confidence systems, have been utilized in applications such as computer vision, speech recognation, and natural language processing.

Deep learning mirrors the workings of the human brain. In this manner, the more we develop in understanding and knowing the calculation on which it is based, the higher the rate of innovation advancement using reverse engineering [30]. Underneath may be a brief outline of the foremost critical applications for deep learning.

a. Automatic speech recognition

Large-scale programmed speech recognation is the primary and most persuasive case for deep learning. Long Brief Term Memory (LSTM) repetitive neural arrange (RNNs) can learn exceptionally deep learning assignments that include several-second interims that contain discourse occasions isolated by thousands of partitioned time steps, with one step compared to almost ten milliseconds. LSTM whereas overlooking salary entries compete with conventional speech recognation apparatuses in a few cases and missions.

Starting victory in speech recognation was based on Texas Instruments/Massachusetts Organized of Innovation (TIMIT) based small-scale recognation assignments. The dataset contains 630 speakers of eight major lingo tongues of American English, with each speaker perusing 10 sentences. Its little estimate permits a wide assortment of setups. Most vitally, TIMIT's mission is to recognize the grouping of the phone, which, unlike the recognation of the group of words, grants frail bigram language models for the phone. This empowers the examination of perspectives of vocal modeling to recognize speech more effectively [25].

b. Image recognition

The Modified National Institute of Standards and Technology database (MNIST) is the foremost popular image rating collection because it could be a database information set. MNIST comprises written by hand numbers and incorporates 60,000 preparing cases and 10,000 test illustrations. As with TIMIT, its compact estimate permits clients to test different arrangements. A comprehensive list of comes about is accessible in this bunch.

We found that deep learning-based image recognation was extraordinary, more exactly comes about than of human contenders. This happened for the primary time in 2011.

Another case is the new Facial Misshapening Examination (FDNA) utilized to analyze human deformations related to a broad database of hereditary syndromes [25].

c. Visual arts processing

This is often closely related to the advance made in image recognation with the expanding application of deep learning methods to different errands of visual expressions. DNNs have illustrated their capacity to, for case, a) characterize the strategy utilized in portray and a given time, b) Neural Fashion Exchange - capture a particular work of art fashion and apply it outwardly to an irregular image or video, and c) make striking images based on arbitrary optical input areas.

d. Treating neural networks

Neural networks have been utilized to execute language standards since the early 2000s. LSTM has made a difference in the progress of machine interpretation and language demonstration. Other essential procedures in this range are negative inspecting and word implanting. The utilization of word incorporation as an RNN passage layer permits the organization to analyze sentences and expressions utilizing compelling vector rules. The language structure rules of vectors can be considered as probabilistic context-free language structures (PCFG) actualized by RNN. Iterative programmed encoders that are planned based on the words included by evaluating the likeness of sentences and finding rewording. Deep neural structures give the leading comes about for voting demographic parsing, estimation examination, data recovery, understanding of talked language, machine interpretation, learning almost composing fashion, categorizing writings, and more [31].

Later advancements generalized the word implanting to incorporate the sentence implanting. Google Decipher employments a broad long-term end-to-end memory arrangement. Google Neural Machine Interpretation (GNMT) employs machine interpretation based on Google Neural illustrations. Machine Interpretation, in which the framework learns from millions of illustrations. It interprets the entirely sentences at once, rather than pieces. Google Decipher bolsters more than a hundred languages. The arrangement stands for semantics and professions rather than fair sparing state interpretations to sentences. Google Interpret employs English as a middle person between most dialect sets.

e. Restore photos

Deep Learning has succeeded in forthcoming issues such as denoising, super-resolution, inpainting, and film colorization. These applications incorporate instructive strategies such as Shrivel field for compelling picture recuperation [32].

- Discovering financial fraud

Deep learning is tightly related to budgetary extortion and anti-money washing. Where framework empowers deep location of anti-money washing to find and recognize connections and likenesses between information, as well as learn how to distinguish peculiarities or categorize and estimate occasions. This issue can be measured by advancing and reinforcing both administered learning procedures, such as categorizing suspicious exchanges and unsupervised learning, for example, recognizing peculiarities.

2.2.2. Computer vision

Computer vision is a field consisting of several specialities, the most important of which are image processing and machine learning. Which is a branch of artificial intelligence, and computer vision aims to automatically process images to perform specific tasks, such as discovering, identifying, and identifying objects in the image. Although there is no real definition, it can simply be said that it is in the middle between image processing and artificial intelligence (including machine learning) (see Figure 2.7.)

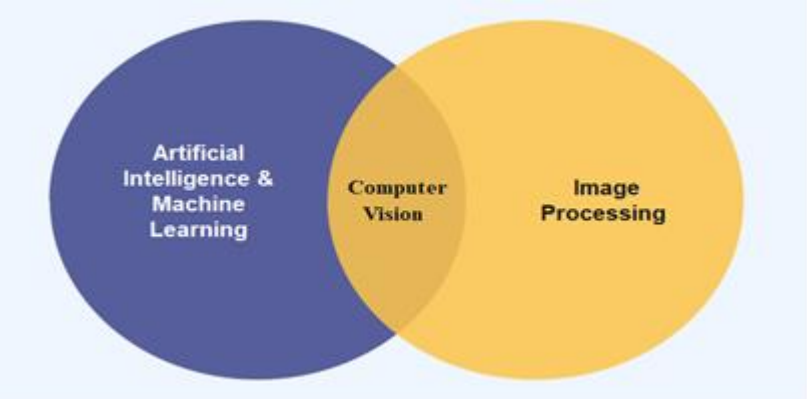

Figure 2.7. Place of Computer Vision

Although the domain name is new to some, you use it in one way or another in your personal daily life or at work. One of the widespread applications of computer vision

is to identify people by their distinctive features, such as fingerprint, face or iris, and this category of application is called Biometric systems. They are now used daily in mobile phones, arrival and departure systems. There is an urgent need in medical fields to analyze medical images, such as those taken using X-rays or magnetic resonance imaging [33]. These images are used to diagnose diseases, tumors, and fractures and to plan surgeries through high-resolution vision and internal views of organs. It benefits from analyzing images in factories in many tasks, such as checking quality and classifying products according to specific criteria such as size or color, inventory, and distribution by reading the addresses and symbols written on the packages. There are many areas other than the ones mentioned, such as the military, traffic, aircraft navigation systems, and recognition of printed writing and converting it into computer texts.

Photography via cameras is the only way to see a computer, whether photography or video, but the computer can see through many different means of reproducing reality. This is a strong point, as images can be captured through different wavelengths of the electromagnetic spectrum or by sounds or magnetic resonance. These images allow the properties of the photographed bodies to be presented in different ways that humans cannot see with their eyes. Visible light occupies a tiny portion of the electromagnetic spectrum [34].

We reviewed many algorithms in the field of computer vision to implement various tasks of image analysis and benefit from it, for example in some applications it is necessary to discover whether there is a specific body in the image (Detection). We may need to track this object during its movement (Tracking), and we sometimes need to crop it from the image by identifying the exact location of its boundaries to measure the properties of the detected objects (such as size and circumference). Among the most frequently used tasks is recognizing objects in the image (Recognition), or even the components of the image in general (Scene Labeling). Navigation systems, in their various forms, benefit from computer vision for orientation, navigation, and localization, such as those used in robots and autonomous cars, and also interfere with virtual reality and Augmented Reality applications [35].

With the spread of media coverage of artificial intelligence, a person sometimes thinks that a computer will match human capabilities. Still, the vast gap between machines and humans only becomes clear if we take computer vision alone, as the challenges

are many and complex. All the examples that mentioned belong to specific fields. When designing these algorithms, the area considers what is called prior knowledge, for example, when developing a medical application to handle magnetic resonance images. Whoever designs the algorithms knows the properties of the captured images and takes them into account [35]. The same applies to other systems, such as face or text recognition. Several achievements have been made recently, especially using deep learning algorithms that have benefited from the vast number of images available and the limitless potential to address them. However, there is still a long way to go to approach human vision. Technological leaps may occur that change the equation and expectations. The development of quantum computing can make tremendous leaps in the speed and ability to learn for devices. Then there remain the philosophical issues related to the nature of computing and comparing it with humans, and definitions related to understanding and perception.

- OpenCV: Open-Source Computer Vision Library

The Computer Vision Open Software Library aims primarily to improve computer vision, developed by Intel, and subsequently corrected by Willow Garge for Robotics and Itseez. The library is free under the open-source BSD license [36]. It can be used on most computer systems that support C and C ++. It focuses on real-time image processing.

The library supports all popular programming languages (C#, C++, Python, Java, C, Delphi). The OpenCV library include the following:

1. 2D and 3D tools for drawing,
2. Optical odometer,
3. Facial recognition system,
4. Motion diagnosis,
5. Computer human interaction,
6. Mobile robot,
7. Understanding the movement,
8. Selection an object,
9. Anthropomorphism,
10. The structure of the movement,
11. Traceability and

12. Augmented reality.

- Computer vision limits

Current computer vision frameworks do better than average work of categorizing pictures and localizing objects in pictures when they are prepared in sufficient cases. But deep learning calculations that back computer vision applications are consistent with pixel designs. They have no understanding of what is happening within the pictures.

Understanding the connections between individuals and things in visual information requires common sense and foundation information. Typically, why computer vision calculations utilized by social media systems can find exposed substance but frequently battle to discover the contrast between secure bareness (breastfeeding or Renaissance craftsmanship) and disallowed substance such as obscenity. Moreover, it is troublesome for these calculations to compare radical and narrative publicity from radical bunches.

People can take advantage of their broad information of the world to fill gaps when confronting a circumstance, they have not seen recently. Unlike people, computer vision calculations require exact directions on the sorts of things to find. Once their environment contains things that cut off from their preparing illustrations, they start to act in nonsensical ways, such as falling flat to identify crisis vehicles stopped in inaccessible areas [37].

The arrangement for these issues is to prepare AI calculations in increasing illustrations, with the trust that extra information will cover each circumstance that AI will confront. But as involvement appears, without situational mindfulness, there will continuously be corner cases - uncommon cases that overpower the AI calculation.

Numerous specialists accept that we are going as it accomplishes genuine computer vision when we make commonly artificial intelligence. AI can unravel issues in the same way that people utilize [38].

2.3. Person Tracking Systems

Multiple technical and electronic monitoring methods have expanded significantly because of the world's technological transformation, and it is projected that over the next decade, every person will be specifically tracked. Tracking is frequently referred

to as a service, and it like any other modern technology or technology service, has benefits and drawbacks. For example, people use gadgets to track their children or older people who have lost their memories, and some even track their pets, in addition to other uses such as tracking cars, to avoid thefts. Many experts feel that electronic tracking and the equipment that provides this service have become integrated into many aspects of our everyday lives. Tracking methods, whether hardware or electronic tracking, hurt the individual being tracked by invading their privacy. A smartphone tracking mechanism is based on locating objects by combining multiple technologies. The phones utilized information from the phone chip's signal transmission tower and data from GPS satellites.

Personal tracking is carried out by embedding a phone chip in a necklace worn around the neck of a person or a pet, and electronic personal tracking is carried out by worldwide technology corporations monitoring their subscribers' accounts. Experts advise people to take certain precautions to protect themselves from malicious tracking. According to an expert in information security and social networking sites. There are two types of tracking; the first is through devices, which the user cannot prevent because it requires expensive devices that are also prohibited across the vast majority of the Middle East.

Some are "time-delay" indicators, which means that data is collected after an object passes through a point, such as a barcode, throttle point, or gate. Others, such as GPS systems, are real-time or near-real-time depending on how frequently the data is refreshed. There are barcode systems that require a person to scan objects and barcode systems that identify items automatically (automatic RFID identification). The majority of tracking worlds are made up of independent hardware and software for various applications. That is, barcode systems are distinct from EPC systems, and GPS systems are distinct from active real-time identifying systems (RTLS). For example, in the warehouse, a passive RFID device will scan boxes when they are put onto a truck, and the truck will then be tracked. On a distinct system that uses GPS and has its own software and functions.

People monitoring is based on temporary (RFID tags) or permanent identifiers for people, such as personal identifiers (including biometric identifiers) or national identity numbers, as well as a mechanism for sampling their whereabouts, either on short timeframes such as through GPS. Or for the general public to track state

inhabitants or visitors. The reasons for doing so are numerous and range from public safety and security to mass control.

Personal tracking systems are useful in a variety of sectors because they reduce the time it takes to identify people and track their locations. We have integrated the tracking technology with the pain recognition technology in our suggested solution. Following people using cameras installed in public and private areas.

2.4. Face Recognition

Face recognition, also known as face detection, is one of the most important computer vision sciences. The subject is considered the foundation for face recognition because detection is the first step in achieving automatic face recognition, and that if it is revealed correctly positioning the face has become easier.

Face recognition is a computer technology that is used to recognize human faces in digital images. The importance of face detection or face recognition does not require physical communication with the user, and that the tools used are cameras that are already available.

Computers utilize the facial recognation framework to distinguish individuals by outline their facial highlights and to compare that data with the faces database. This innovation is broadly utilized until it gets to be a dependable instrument for examinations, distinguishing individuals and faces.

- Modern facial recognition systems

Present day face recognition frameworks depended on the three-dimensional design, where uncommon cameras take live three-dimensional pictures of the suspect. They utilize the most highlights of each face that don't alter essentially with time such as the eye depth, the shape of the nose, and the separate between the eyes. These highlights are a source of data for facial recognation frameworks, as the alter in lighting or the encompassing natural conditions don't influence these estimations. These frameworks can work in any lighting conditions, and indeed in the event that the individual isn't confronting the camera.

The utilization of profundity and the pivot of the face that is not influenced by a change in lighting could be a three-dimensional recognation of the face and computer program

frameworks. A three-dimensional innovation goes through an arrangement of steps to be able to recognize the face:

1) Detection: The step is to take a digital image with a 2D digital camera or even a video camera.
2) Alignment: After taking the picture, the system determines the position, size and direction of the head. And the three-dimensional system can do this step even if the image chosen for the person is a side image. Making an angle of 90 degrees with the camera lens, while the two-dimensional systems can not do this step unless the person is looking directly at the camera or in its direction. So it does not the angle between a person's face and the camera lens is more than 35 degrees.
3) Measurement: The system software calculates curves and aliasing on the face with precision up to parts of a millimeter. It transforms that information into a facial model.
4) Representation: In this step, the system translates the form and turns it into code. The code for each style is unique and consists of a set of numbers.
5) Matching: 3D picture is indistinguishable and put away within the framework database, the comparison between the pictures is made straightforwardly. But the challenge confronting these frameworks is that most of the pictures put away in databases are standard (two-dimensional) pictures. So how a live picture of an individual who moves his head before the camera and takes a three-dimensional picture with millions of two-dimensional pictures be compared to him can? That's why a modern innovation has advanced that employments the utilization of three distinctive focuses to distinguish and from these focuses speak to the exterior of the eye and interior the eye and the tip of the nose. These frameworks make exact estimations on the measurements between these focuses for the three-dimensional pictures and start to change over them into two-dimensional pictures through the application of complex numerical calculations. After the conversion preparing from this framework begins to create a comparison.
6) Verification or Identification: The image is compared and matched to the database images produced by the system in the previous step during the identification step. However, if the goal is to verify the result of the previous

step, the system compares the image to all images in the database, and the match results are displayed in percentages.

- Facial Recognition Applications

Recently, facial recognition technology had many applications, but it will mention the main applications of this technique.

1) Mobile platforms
2) Social media
3) Identity verification
4) Face ID

a. Prevalence in security services

Companies prepare deep learning calculations to recognize extortion discovery, decrease the requirement for conventional passwords, and move forward the capacity to recognize between the human face and the picture.

b. Healthcare

Machine learning is combined with computer vision to more precisely track persistent medicate utilization and administration methods.

- Difference Between Face Recognition and Face Detection

Face Detection**:** It points to discover faces (area and measure) within the picture and extricate it for utilization by the facial recognation algorithm.

Face Recognition: With facial pictures that have as of now been extricated, trimmed, resized, and as a rule changed over to dark shades, the facial recognation calculation can find the properties that best portray the image.

2.5. Face Recognition Algorithm

Face recognition is a method to detect the faces of people whose photos have been saved to the data set. Although other means of identification can be more accurate, face recognition has always been a significant focus of research because of its non-intrusive nature and because it is a secure method for personal identification.

2.6. Related Work

Real-time video surveillance systems are used in a wide range of settings, including public spaces, commercial buildings, and public infrastructure. People detection is a critical component of many video surveillance systems, including people identification, segmentation, and tracking. To recognize and track people, researchers have used a variety of image processing and AI-based technologies (including machine and deep learning). Still, they mostly use a front-view camera perspective.

Imran Ahmed demonstrated a method that employs an overhead camera viewpoint. SiamMask, a deep learning-based technique utilized in the system, is simple, adaptable, fast, and outperforms other real-time tracking systems. In order to track the target or person, the method incorporates the mask branch into the full convolutional duplex neural network. The person's video sequence is gathered first from an overhead perspective, and then additional training is carried out through learning transfer. Finally, a comparison to different tracking algorithms is made. The SiamMask algorithm produces excellent results [39].

According to John Krumm, it is constructed a workable people monitoring system that solves most real-world concerns. During live demos in the living room, they use two sets of color cameras to track various participants. Color photos are utilized to protect people's identities while stereo images are used to locate them. The system is fast enough to give the impression that the room is responding [40].

According to Mara José's research, he took advantage of the transfer of learning from a Multi-Object Tracking (MOT) domain of two photographs of a specific person to be identified and tracked. In both domains, he taught a unique deep triple structure. Six levels of translational learning were implemented and analyzed, demonstrating that transferring knowledge from one area to another improves re-identification performance significantly. The experimental results show that the proposed method is comparable to existing state-of-the-art procedures in terms of accuracy and robustness. These findings also show that, despite the data issue, deep learning may be used to do single-shot redefinition [41].

Weiyang addresses the problem of deep facial recognition (FR) under the Open Group Protocol. Where ideal facial features are expected to have a maximum distance within the layer of the minimum distance between categories under a suitably selected

measurement area, a few of the existing algorithms can achieve this standard effectively. An angular SoftMax loss (A-Softmax) was used that enabled convolutional neural networks (CNNs) to learn angular discriminant features. He also concludes a specific approximation of the ideal feature standard. Intensive analyzes and experiments appear on the so-called wild in the wild (LFW) and faces (YTF). As a result, a new approach to deep in face recognition was introduced. Specifically, it is beneficial to learn facial representation. Competitive results in many common facial standards outweigh our approach and its enormous potential [42].

Mustafa used Kernel Discriminant Analysis (KDA) and Support Vector Machine (SVM) facial recognition algorithms that applied kernel analysis to extract features from the input images. Also, this procedure was used in both Yale and ORL databases to evaluate the performance of the proposed system. Experimental results showed that the system has a high recognition rate with an accuracy of 95.25% in the Yale database and 96% on the ORL [43].

Priyan Malarvizhi has proposed an arrangement for most problems facing the daze within the category of exploring through the inner and outside situations that comprise different obstacles and recognation of an individual before them. Faces can be recognized utilizing neural learning methods including extraction and preparing modules. Pictures of companions and relatives are put away within the smartphone client database. Proposed unused picture recognation and route framework that gives precise and quick voice messages for individuals with visual troubles so they can move around rapidly. The framework applies to open air and indoor situations. An examination of the execution of the actualized framework appears that 75% of the dazzle discovered this framework supportive and gave a 90% exact result for face recognation [44].

According to Muhammad, the process of the real-time face recognition system is divided into three steps, feature extraction, clumping, detection and recognition. Each stage uses a different method, which is the local binary pattern (LBP), cumulative hierarchy (AHC), and Euclidean distance. CBIR, an image search technology based on the image feature, is applied as a search method. Based on experiments and test results, the recall and accuracy values were 65.32% and 64.93%, respectively [45].

Table 2.1. Comparison of previous works

Title	Year	Problem	Technique used	Result
"A real-time person tracking system based on SiamMask network for intelligent video surveillance"	2021	Video surveillance of people	Deep learning Algorithm SiamMask	The algorithm gave excellent results compared to other methods
“Multi-Camera Multi-Person Tracking for EasyLiving”	2000	Monitor people in the living room	Use the technology of two-color cameras and match photos	Suggest A Workable People Monitoring System That Solves Most Real-World Concerns.
"Transferring Learning from Multi-Person Tracking to Person Re-identification"	2019	Re-identification of the one-shot person (re-id)	The Transfer of Learning from A Multi-Object Tracking (MOT)	The Proposed Method Is Comparable to Existing State-Of-The-Art Procedures in Terms of Accuracy And Robustness
"SphereFace: Deep Hypersphere Embedding for Face Recognition"	2017	Deep face recognition (FR) problem under the open set protocol	LFW and YTF	Competitive results in many common facial standards outweigh our approach and its enormous potential.
"Face Recognition System Based on Kernel Discriminant Analysis, K-Nearest Neighbor and Support Vector Machine"	2018	Face Recognition	SVM and KNN	According to the experimental results, the system has a high recognition rate, with an accuracy of 95.25 percent in the Yale database and 96 percent on the ORL.
"Intelligent face recognition and navigation system using neural learning for smart security in Internet of Things"	2017	System for blind people	Genetic algorithm and RBF Kernel	System is completely helpful and provides a 90% accurate result for face recognition
"Multi-Object Face Recognition Using Content Based on Image Retrieval (CBIR)"	2017	Human face recognition in multi-object images,	LBP and AHC	Based on experiments and test results, the recall and accuracy values were 65.32% and 64.93%, respectively.

2.7. Summary

By reviewing the literature, we found several techniques and algorithms mentioned in the previous part of the Table 2.1. We chose CNN algorithms because they fit our work very well in terms of the accuracy of the analysis and the data used. Next chapter explains the main topics that branch off the proposed system, such as artificial intelligence, machine learning, hands-on learning, and computer vision. We also discussed the feature of the person-tracking and facial recognition system, the history of this technology, the practical technical applications used, and the working method of the person-tracking technology with the help of facial recognition technologies.

3. SYSTEM ARCHITECTURE AND METHODOLOGY

3.1. Introduction

The world has recently witnessed a wide development in technology, especially smart systems, including people tracking systems. In this chapter, we will explain the methodology used to implement the proposed system and the mechanism to achieve the desired goals. The proposed system connects many disciplines such as machine learning (deep learning), neural networks and computer vision.

3.2. Proposed System Architecture

Person tracking systems are among the systems that are of great importance in identifying or confirming a person naturally from a computerized image. There are two strategies for countering recognition. One is photo-based, and the other is video-based. There are more classifications for nowadays. A person tracking system based on face recognition technology in our case is a still image of a person; It can verify and identify one or more individuals using a stored database of people to be tracked. The framework for facial recognition consists of taking some initial steps: processing the information, highlighting extraction and classification. Information preprocessing includes activities such as standoff location, noise reduction, image resizing, scaling, etc.

The structure of a person tracking system based on face recognition technology consists of three components:

- Training a CNN model by placing a set of images of the people to be tracked,
- Image processing by reducing some of the noise on the images and
- Comparing the image taken in the camera and matching it with the database within the system.
- The functions of each part are described as follows:

3.2.1. CNN model training

One of the important steps in our work was Tensor Flow when we trained a model with the help of high techniques. It is an open-source library provided by Google to train models. The trained model can recognize the face by matching the images inside the base with video images through surveillance cameras and identifying the desired person.

3.2.2. Face extractor from photos or videos

The face feature extractor extracts critical facial features. We are developing a feature extraction method that works on color images without wearing glasses. The face feature extractor consists of three sequential modules: Face feature localization, feature point extraction, and face feature generation. First, select the main points - eyes, nose, mouth - from the image of the face. Second, the face extraction unit extracts the characteristic point and begins to analyze its compatibility with the existing base.

3.2.3. Classification of a person by face

Face matching includes a categorized and didactic algorithm. This component is responsible for identifying a person. By giving a new picture, the person tracking system detects the face detection first and puts it in place. Then the detected face image is passed to the face feature extractor, and the features are extracted with the help of algorithms used SVM algorithm to improve the image resolution (see Figure 3.1). The image will be matched and determined if the image is in the database.

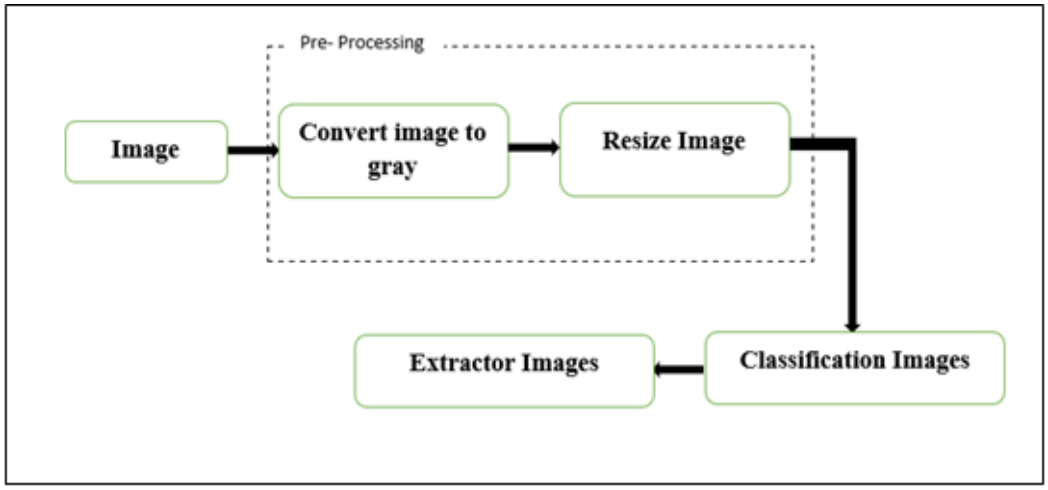

Figure 3.1. Proposed Person Tracking System Architecture

3.3. Research Design

When a researcher is working on a topic, she/he has goals to be achieved at the end of the work. In this proposed system, the main goal is to track certain people through the camera, identify them, send their location to the person in charge of the system, and work to determine their identities. At the outset of our work and before any of our work, we conducted a literature review of all previous research in the field of tracking systems to determine the strengths and weaknesses of the algorithms used and to determine which technology should be used to meet the primary purpose of the system. Also, the main components that we must use in work are discussed in detail in this chapter. Then the proposed system is designed according to the data available in the work environment. Figure 3.2 shows the methodology used for the work.

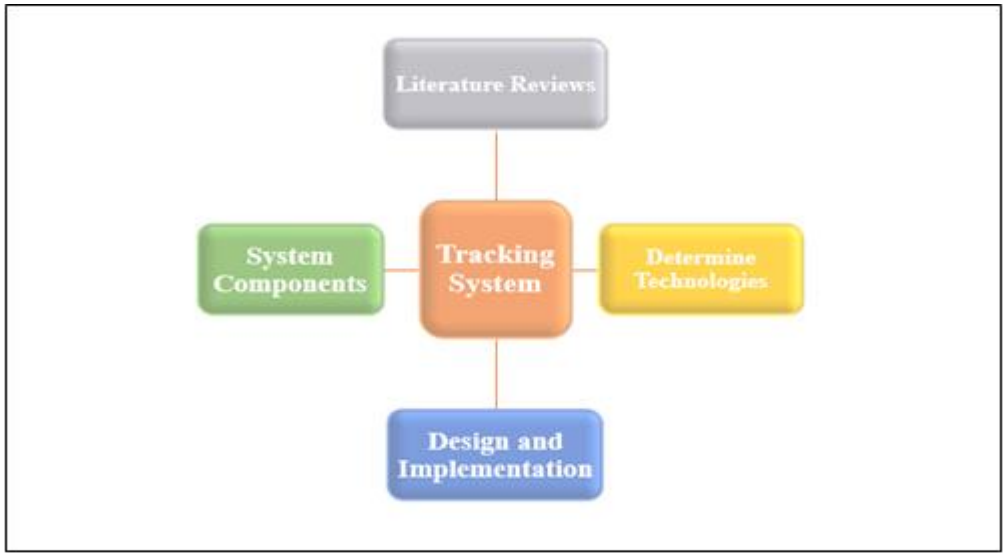

Figure 3.2. Methodology of Work

3.4. Proposed System

The proposed system helps to track certain persons in public or private places, governments, or private security companies. One of the main axes that the system works on is feeding the system by images of people to be tracked. The system also contains the encryption feature of the data inside by using the hash algorithm to encrypt the information entered into the system and make its confidentiality high. The system consists of three main parts namely input, processing and output as shown in Figure .3.3.

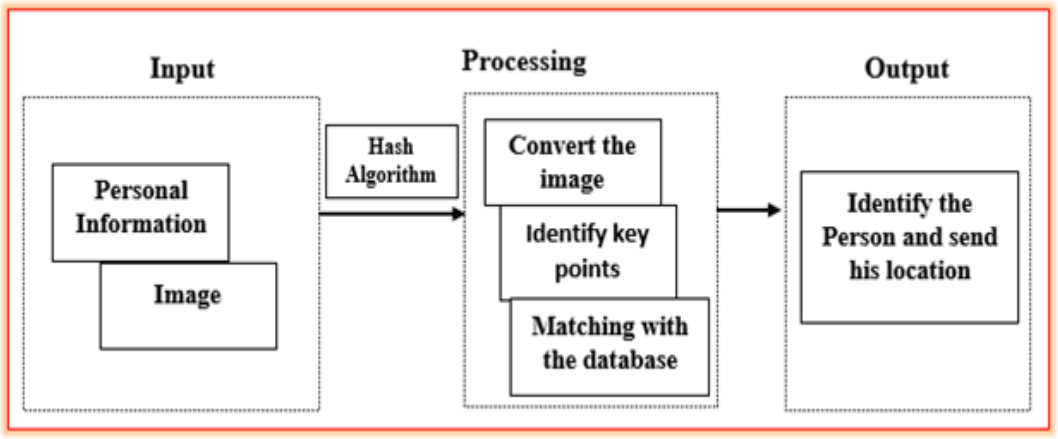

Figure 3.3. Proposed System Steps

3.5. The Main Components of the Proposed System

People tracking is a complicated system. According to our capabilities, we designed the proposed system using a computer camera to read faces and start the process of image analysis. System components are divided into two main parts, the physical and software parts of the system. Figure 3.4 represents the main outline of the system components.

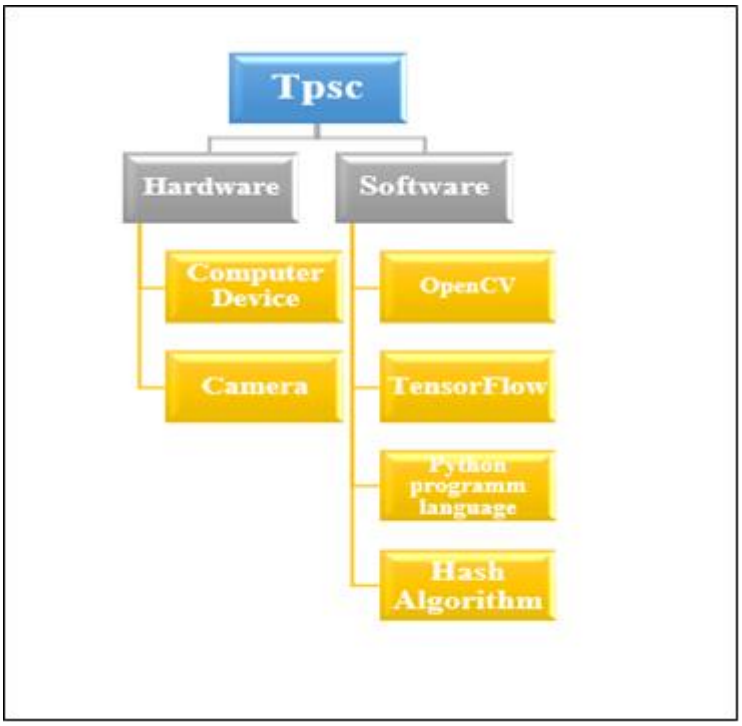

Figure 3.4. Components of system

We illustrated the main scheme of the system's components and divisions. We will explain each section with the benefit of using it in the system.

3.5.1. Hardware

By this section, we mean the physical parts used in the system to obtain the desired result, consisting of two parts.

- Computer Device

The computer is one of the indispensable significant units of the system, through which we connect the camera placed to the programmed application to detect the violators and recognize. Also, the computer can be described as the link between the system’s hardware and software components, through which all the hardware and software components are collected from an application, camera, and database.

- Camera

Most of the security cameras available today in the market have a high-resolution feature, as the camera is linked to the proposed system, which allows us to have a database that includes the people to be tracked. And when the camera observes a face, it determines whether it is inside a person in the database. In our proposed system and a basic stage of work, we tested a camera on a personal laptop.

3.5.2. Software

The software components are represented by the code, libraries, and algorithms that all combine to form an integrated application with the camera to track person systems. The coded application in the python language is a mixture of several libraries and algorithms that we will mention in detail.

- OpenCV

The Open Vision Computer Library (OpenCV) is a library of programming associations aiming to develop computer vision. Intel Corporation has a free software library under an open-source license. We can benefit from the OpenCV library, especially in medical, industrial, and artificial intelligence. OpenCV consists of several algorithms and softwares collected in a single frame. The objective of this framework is to provide solutions in Computer Vision. It can be used on all computer systems and focuses on real-time image processing.

Library contents (OpenCV)

- Core: A built-in module for characterizing fundamental data structures
- ImgProc: Image Processing Unit for Image Enhancement.
- Video: The video analysis unit that incorporates target movement estimates.
- Calib3d: The 2D image information analysis unit.
- Features2d: Responsible for detecting the target's known properties and separating it from the rest of the surrounding environment, such as geometric shapes.
- ObjectsDetect: Face detection.
- High-up: An easy-to-use interface for taking pictures and videos.
- CPU module: Utilizes the full computing power of the system by using the power of the video processing card.

OpenCV Library Applications

a. Facial recognition systems,
b. Gesture recognition systems,
c. Computer-human interaction,
d. Mobile android,
e. Get to know the target and
f. Motion chasing,

- TensorFlow

After completing the data entry, reprocessing the images, and preparing them for the image processing stage in our proposed model. Three image classifications will be based on the document where the model is trained to discover these cases and give accurate results help of CNN techniques. Below are the measures are taken to train the CNN model (Convolutional Neural Network).

- Step 1: Upload Dataset
- Step 2: The Input layer
- Step 3: Convolutional layer

Filter the feature map using the specified number of filters. To add non-linearity to the network, we need to employ a relay activation function after convolution. The first convolutional layer contains 18 filters, each with a 7x7 kernel and equal padding. Both

the output and input tensors have the same width and height with the same padding. To verify that the rows and columns are the exact sizes, the TPSC model will add zeros to them.

- Step 4: Pooling layer: Following the convention, the maximum facility will be downsampled. The goal is to limit the feature map's mobility to avoid overfitting and enhance computation speed. The traditional technique of max pooling divides feature maps into subfields and only keeps the maximum values. Following the convolutional, the pooling computation is the following stage. The data will be compressed due to the pooling computation. With a dimension of 3x3 and a stride of 2, we can utilize the module max pooling2d. As input, we use the previous layer. [batch size, 14, 14, and 15] are possible output sizes.
- Step 5: Convolutional layer and Pooling Layer: The output size of the second CNN is [batch size, 14, 14, 32], and it has precisely 32 filters. The output shape is [batch size, 14, 14, and 18], and the pooling layer's size is the same as before.
- Step 6: Dense layer: The fully connected layer must be defined. Before combining the feature map with the thick layer, it must be compressed. 1764 neurons will be connected by the thick layer. We can add a Relu activation function and will be able to do so. We add a 0.3 dropout regularization term, which means that 30% of the weights will be 0. Only during the training phase does a person drop out.
- Step 7: Logit Layer: Finally, we define the final layer with the model's forecast. The output shape is batch size 12 (the total number of photos in the layer), which is the same as the total number of images in the layer.
- Programming Language

The person tracking system is one of the features we have heard so much about and is included in most present-day equipment and program. This highlight contains a wide extend of applications, the foremost common of which are in security frameworks. It empowers gadgets to recognize the character of an individual or question as it were through their picture. So, what does it take to make an application or program with image recognition? You got to program employing a programming language that supports the execution of this include. Of course, a few languages can do this work. Underneath are the finest programming languages for picture recognition. One of the

programming languages utilized in programming person tracking system frameworks are (Matlab, Python, C, C ++, C#, etc.). After conducting research and studies, we used Python in the proposed system because it is one of the essential programming languages of our time.

- Python programming language

It is an object-oriented programming language that is high-level, easy to learn, open-source, and extendable (OOP). Python is a programming language that may be used to control the performance of various programs, including Blender. Python is an interpreted, adaptable language that is extensively used in many disciplines, including constructing independent programs with graphical interfaces and in online applications. Python can create simple applications for novices and complex projects in general. This language is frequently recommended for novices in programming because it is one of the easiest to learn programming languages.

Python is currently regarded as one of the most significant languages due to its extensive and simple programming skills, and it provides a secure tracking system for various programming offices.

- Algorithms

The camera-based person tracking system is programmed through complex technologies, each performing a different function. However, they work in integration, so the job is not done right if the entire technology is not working correctly. Face recognition technology is more accurate and complex than its predecessors. Likewise, for recognition technology, a person's photo slowly matches the photos in the database. However, it does not focus only on the shape and features of the face, but any change in facial expressions between the person’s image and the image in the database invalidates in work. Some facial recognition technologies identify facial features by extracting features from an image of the face, for example, one technology analyzes the relative position and size of face units, such as the nose, for example, determined by the size and location of the face as well as its distance from the eyes, and it defines the gap between the eyes.

In determining certain techniques to work, the researcher must do serious work comparing the techniques and selecting the appropriate technology for the job. In this proposed system, we define elementary working techniques (CNN) to recognize the

face by training the TensorFlow model and also use the hash algorithm to encrypt the data inside the system to increase its security of the system.

4. IMPLEMENTATION AND RESULT

4.1. Introduction

A person tracking system is defined as the identification of people by taking pictures of their faces and matching them with the database in the system. It is one of the technologies widely spread today, and it has many characteristics, the most important thing is the identification of people in crime detection systems. In this proposed study, we used this feature to help us discover and track people. In this chapter, we will review the practical part of the system and how facial recognition works with the results recorded through the virtual system experiment and the system simulation using a standard camera for example a laptop camera and the main program.

4.2. The Mechanism of the Proposed System

It is known that the tracking system or the people tracking system is a system through which certain people have committed a mistake or crime wanted by the security authorities. Through these systems, we can track people without their knowledge and any obstacles. While reviewing the previous literature related to our proposed system, we found several systems in the world, most of which use GPS technology. In our proposed system, we suggested using the camera to monitor some cases linked to an intelligent system that is prepared by CNN techniques with facial recognition techniques. The hash algorithm was used to encrypt data to increase the confidentiality of the system, as shown in the following Figure:

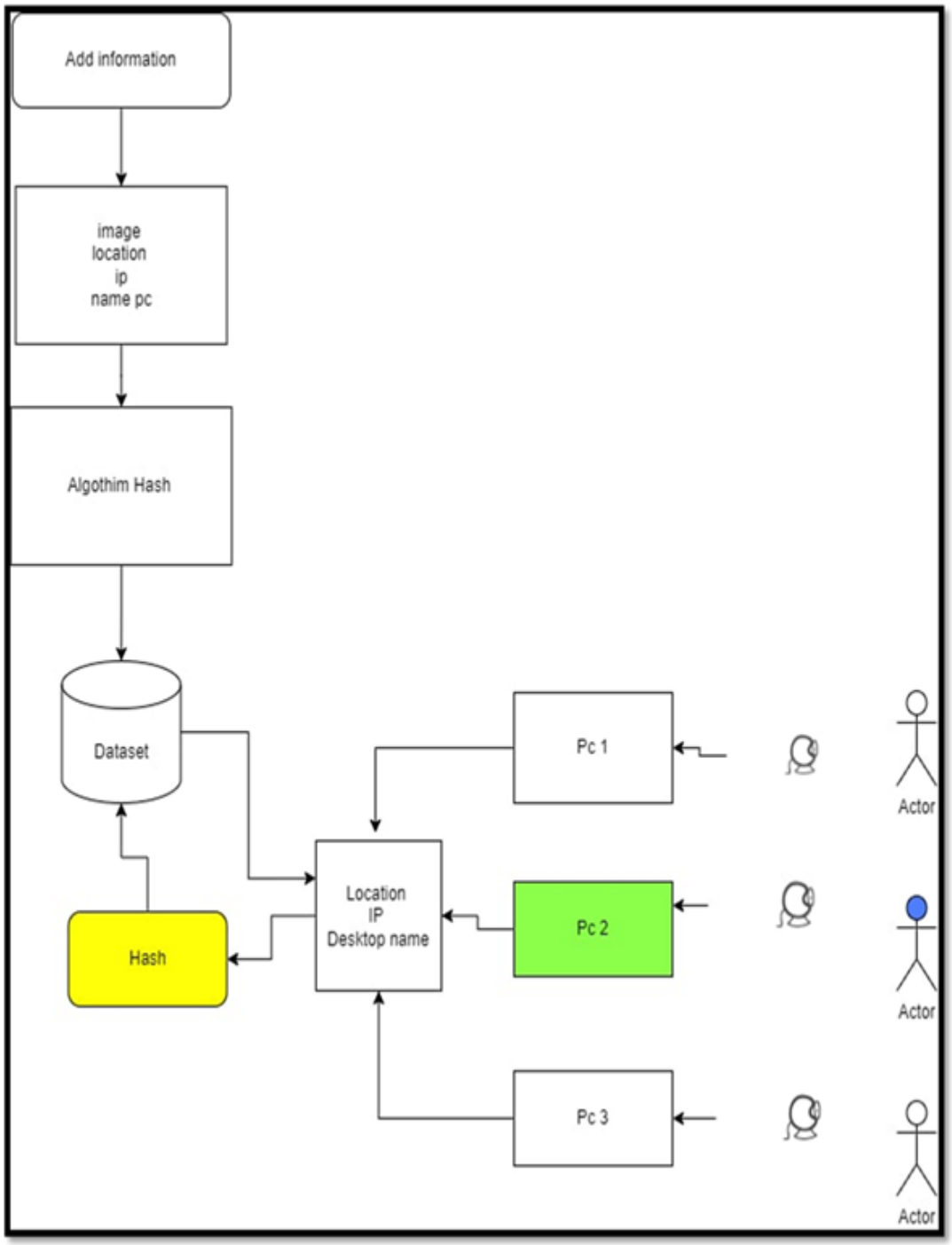

Figure 4.1. Main Diagram of Proposed System

Based on the Figure 4.1., the system is divided into two parts. The first is to enter information into the system, and the second is to track and identify the person and then send the information to the system. The process of entering data into the system, i.e., feeding the proposed form with images of the people to be tracked, is through the person authorized to administer the system. The image is uploaded with the name and the rest of the information. The system encrypts the entered data using the hash

algorithm and stores it in the database. Also, the process of identifying people through the camera is done. The information of the identified person is encrypted and sent to the database, after which the decryption is done, the data is matched and the result is returned to the system.

4.3. Component of Proposed System

The proposed system contains several main components linked together to form an integrated system through which specific people are tracked and their locations are determined. The system consists of two main parts, the physical parts and the software parts. We also explained that the hardware of the system is a surveillance camera that is placed in an external location and monitors people within the area covered by the camera. In the proposed system for the first experiment, we used a computer camera for the whole process. The computer on which the application is installed has excellent specifications for accelerating work within the application and synchronizing with the externally linked camera.

As for the programming parts, which are the application designed using the Python language, they consist of four parts, the first is the database and the second is the program part, which consists of several libraries and the training of the main model. The four sections will be explained in detail below.

4.3.1. Database design and diagram

It is a standard set of data related to each other which is used to support the system in an organized manner. The importance of databases is that they can be considered repositories. Project-specific data is saved within one specified time; users can access it easily. In our proposed system, we used rules of evidence for various purposes including:

1) The main administrator of the system can save data and give permissions to other users in the system.
2) Keep the people’s data to be tracked, including the data (the person's name, age, identity number, mobile phone number, gender, and the name of the governorate or region.
3) Identifying or identifying the person and sending his data from the place’s name and location.

Figure 4.2 shows the project database schema which consists of three tables.

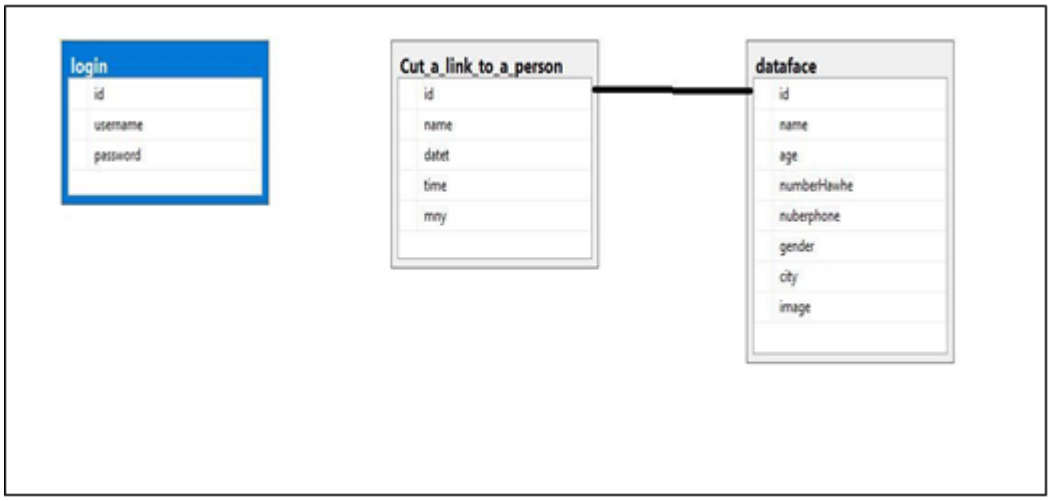

Figure 4.2. Database Diagram

4.3.2. Hashing algorithm encryption and description

In the first step, and as mentioned in this chapter above, data entry is the basic step in the system that takes place by the person responsible for the system. After entering, this data is encrypted and sent to the database.

Only the information of the requested person is taken, and the data is encrypted; the person is identified by the model, and the person's information is sent to the database, where the data is encrypted by the hash algorithm, the person's information, the name of the computer, the location of the person, and the IP address of the person as shown in the Figure 4.3.

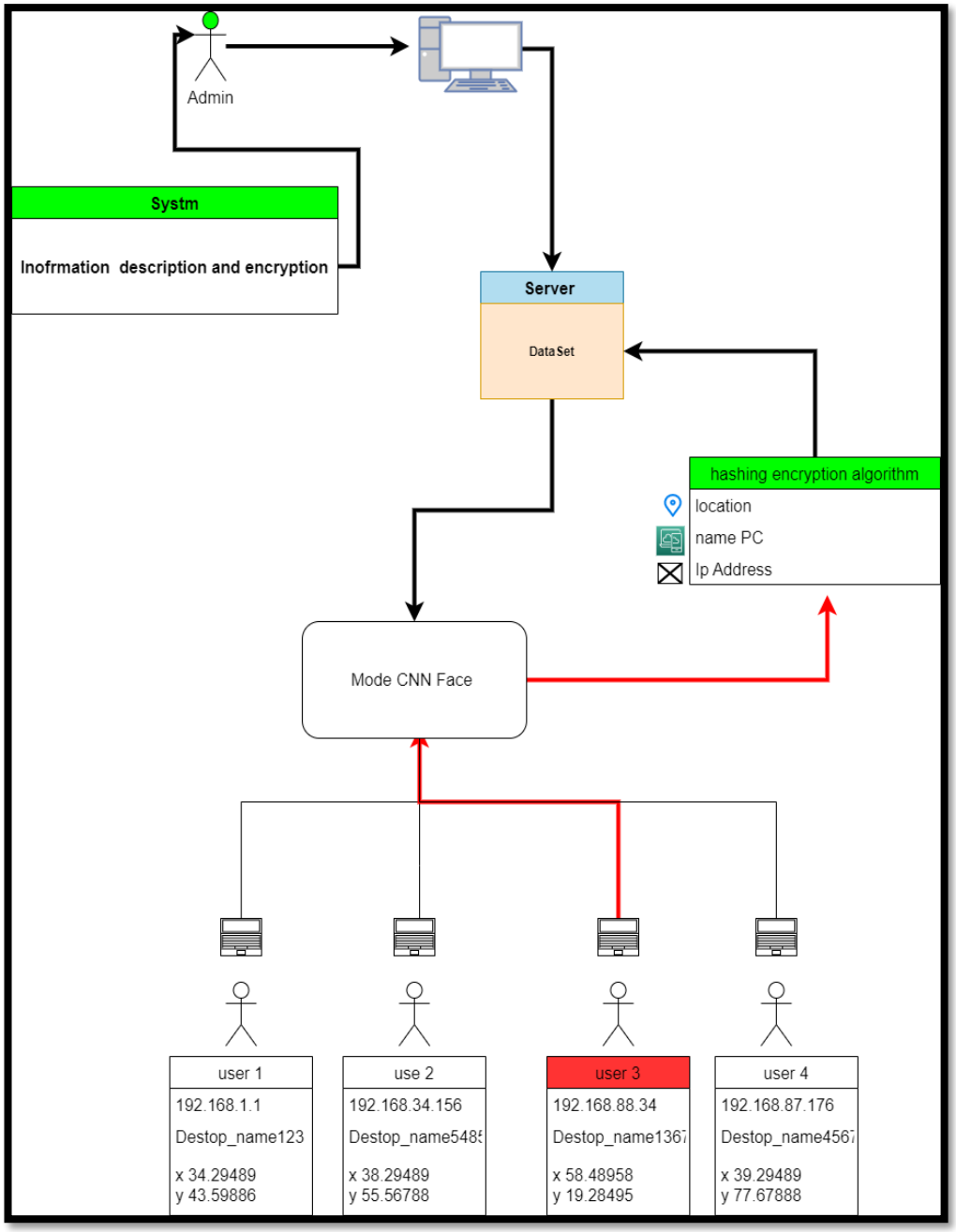

Figure 4.3. Encryption and Description Diagram

4.3.3. Training the proposed system

For the proposed system to be able to recognize all the people whose photos were stored in the system in the classification stage, it must be trained on all the photos of people. To classify the images, CNN and TensorFlow technologies are used. The categorical intercept function is used to evaluate the network. Training techniques start from preprocessing. It is important to pass the images through the convolutional neural network architecture in both directions (forward and backward direction) to reduce the

error between the actual label of the training sample and the expected output from the CNN model.

The training phase of CNN consists of the followings:

- Input: All images from the Training data
- Output: Training Model of person images that have been classified,
- Step 1: Read the training images (3040 images),
- Step 2: Call the steps to perform the data preprocessing (resize, convert to RGB, Normalization),
- Step 3: Call the steps in normalization to build the CNN model,
- Step 4: Set the number of training epochs and Batch size,
- Step 5: Start Train CNN model.

4.3.4. Application interfaces

It was previously mentioned that the system contains a program developed in the Python language that links the programming offices and the technologies of the system to achieve the goal for which it was designed. The main idea of the system is to track and identify wanted people and send their encounter addresses using a camera and model trained using CNN technologies. Cameras are distributed in certain places and linked to the system so that when a person passes through the camera, if his information is inside the system, he will be identified. The system will take a picture of it and compare it to the database if recognized. The person is required, and all his details will be sent to the site in the system. Thus, the project has achieved the main objective of tracking people easily and safely.

Below, each interface will be shown separately with an indication of how to use the interface, its components and its code as follows:

- Main Interface

The main interface of the system appears when the system is running. It contains the system information and the researcher's name with the supervisor. To open the system, we press start as shown in the following Figure 4.4.

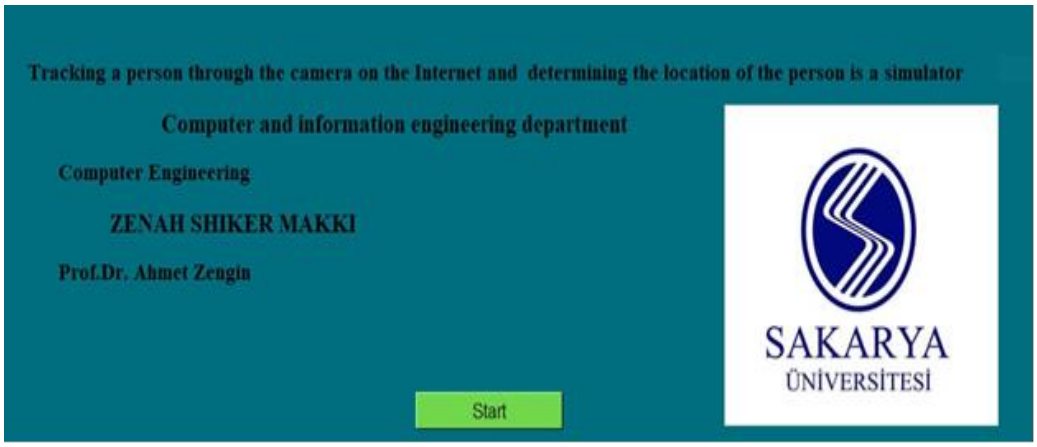

Figure 4.4. Main Interface of System

- Login Interface

Now, it will show the first interface that will appear when the system is running, which is the login interface (see Figure 4.5.).

Figure 4.5. Login Interface

Figure 4.5 is the login interface the second window of the system through which the user is allowed to enter and use the system. The goal of this diversion feature is to protect the data within the system from distortion, as each employee who uses the system has his username and password to log into the system and view the violators.

- System Interface

After entering the user through the login interface with his username and password, the interface will show you like in Figure 4.6. It is a user interface that contains several things that the system user can benefit from.

Figure 4.6. System Interface

The interface in Figure 4.6. is the system interface or the system home page that contains a title bar that includes the project logo, minimize, and maximize buttons, hide window, and close the application. It also consists of a side menu bar that includes a set of menus, such as adding person information or registering persons, turning on the camera to discover and monitor persons, persons tracked, adding an administrator and about the system. The display area, or the so-called display area, displays the contents of the previously mentioned sidebar.

- Register the Persons Information

The interface to add information is intended to attach or provide the database with details of people within the specified area. The goal of keeping the information in the system is to identify the offending people by comparing the images and fetching all the information about the person from the name and address to issue a penalty in the event of a violation. Figure 4.7. is the interface to add information.

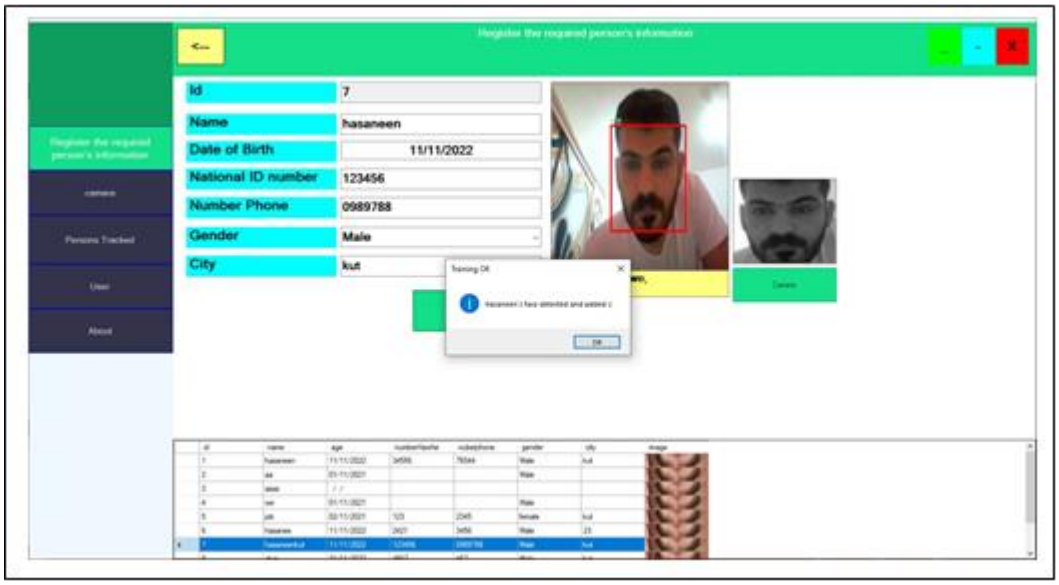

Figure 4.7. Add Information Interface

The interface for adding information contains a section dedicated to entering data such as name, birth, ID number, phone number, region, and gender. After entering this information, you must click on the camera button to open the camera connected to the system to take a picture of the person whose data we entered. The system takes the person's image and saves it in three shades of gray. Above the camera box, there are two boxes around the first in which the camera appears when the button is clicked, and the other table displays the captured image. After adding information through this interface, the data will be stored in an SQL database containing all the data available within the system. Below the added interface, the information previously added to the project database is displayed.

- Camera (Person Identification)

The interface to recognize a person through the camera is the second part of the system through which a person who appears in front of the camera is followed and their information is tracked. If a person appears in front of the camera and he is among the people to be tracked, a red box appears on the person's face and the person's name, in the meantime. The system takes the information of the person who has been identified and sends it to the system with the full address. Figure 4.8. shows the destination of the camera in the system.

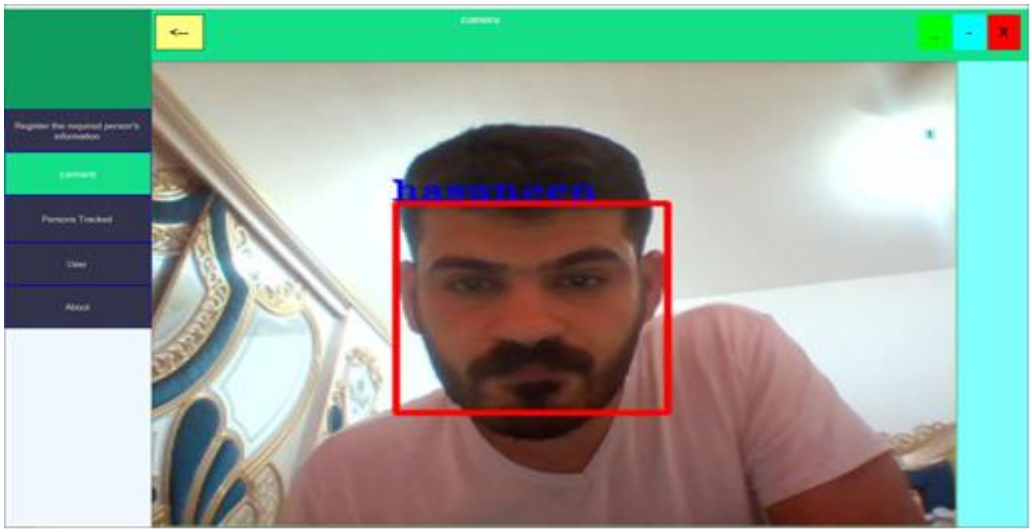

Figure 4.8. Camera (Person Identification) Interface

- Persons Tracked Interface

The interface of people who have been tracked and identified through the camera is an interface dedicated to displaying the wanted people who have been identified through the camera and comparing their images to the database with the mechanism followed by the trained model. So that the full details of the wanted person are known from the name and time of recognition, the name of the place and the address, it also contains a second part that includes fields to display the wanted persons who have been identified individually when a specific name is selected from the table. We can change the data and delete the data. As shown in Figure 4.9. there is also a button to print a full report of the recorded violations.

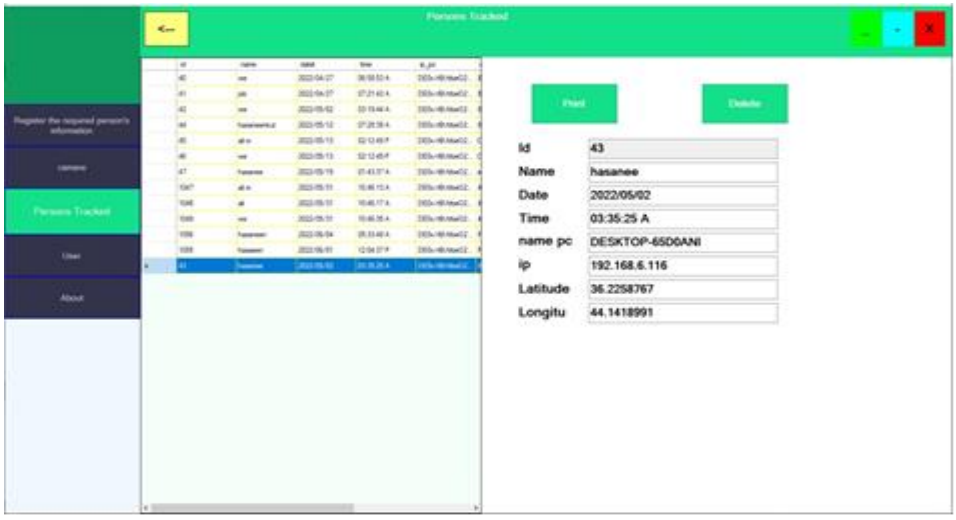

Figure 4.9. Persons Tracked Interface

A report can also be printed for the people being tracked through the print button in the interface above, as shown in the following Figure 4.10.

Persons Tracked

Date: 6/4/2022 12:00:00 AM

id	name	datet	time	ip_pc	name_pc	lat
40	we	2022/04/27	06:58:53 A	DE0vrBl/trbeO20CHEMFA==	8sxYyDMZ35odUYynioSYaQ==	N0jtC/myTdMVU9YzWPplMQ==
41	job	2022/04/27	07:21:43 A	DE0vrBl/trbeO20CHEMFA==	8sxYyDMZ35odUYynioSYaQ==	N0jtC/myTdMVU9YzWPplMQ==
42	we	2022/05/02	03:19:44 A	DE0vrBl/trbeO20CHEMFA==	8mz2hsOkbTjgHY/++pOVAw==	b1M3rGpVkjwZseCEyOFvUw==
44	hasaneenkut	2022/05/12	07:28:39 A	DE0vrBl/trbeO20CHEMFA==	8sxYyDMZ35odUYynioSYaQ==	b1M3rGpVkjwZseCEyOFvUw==
45	ali m	2022/05/13	02:12:49 P	DE0vrBl/trbeO20CHEMFA==	OTSiAhenRzdEa3+W7eGqSA==	b1M3rGpVkjwZseCEyOFvUw==
46	we	2022/05/13	02:12:49 P	DE0vrBl/trbeO20CHEMFA==	OTSiAhenRzdEa3+W7eGqSA==	b1M3rGpVkjwZseCEyOFvUw==
47	hasanee	2022/05/15	01:43:37 A	DE0vrBl/trbeO20CHEMFA==	e9hD7voBapm6a8uLkLBd6w==	b1M3rGpVkjwZseCEyOFvUw==
1047	ali m	2022/05/31	10:46:13 A	DE0vrBl/trbeO20CHEMFA==	4p6K1pbMCRRMqbUZJtEjCA==	b1M3rGpVkjwZseCEyOFvUw==
1048	ali	2022/05/31	10:46:17 A	DE0vrBl/trbeO20CHEMFA==	4p6K1pbMCRRMqbUZJtEjCA==	b1M3rGpVkjwZseCEyOFvUw==

Figure 4.10. Print Report Interface

- User Interface

The user interface is the interface through which we can give authorization to new users to enter the system by authorizing them to join (username and password). And also, through the user interface, we can know the number of people who use the system through the table in the interface. Also, it contains a second part through which you can add a new user and delete the authorization of a previous user, as shown in the Figure 4.11.

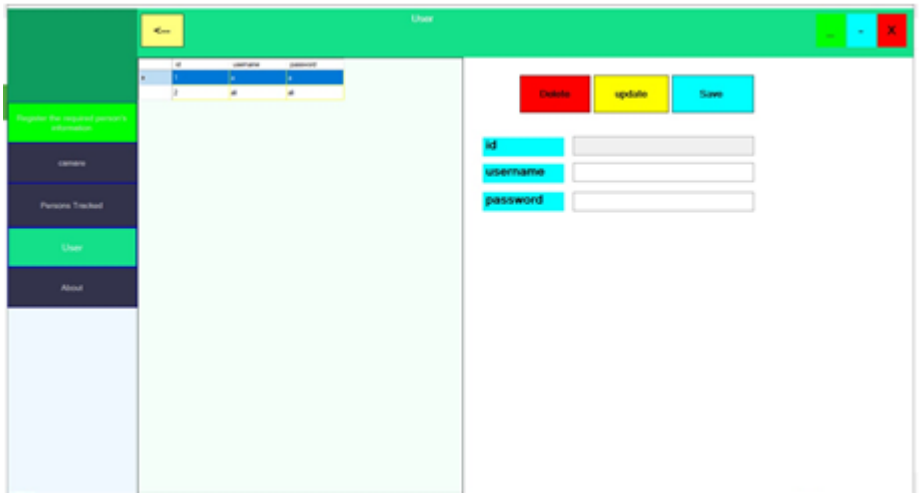

Figure 4.11. User Interface

- About interface

An interface on how we mentioned a brief overview of the principle of the proposed system and what is the policy of the Personnel Tracking System. Figure 4.12. shows the interface around.

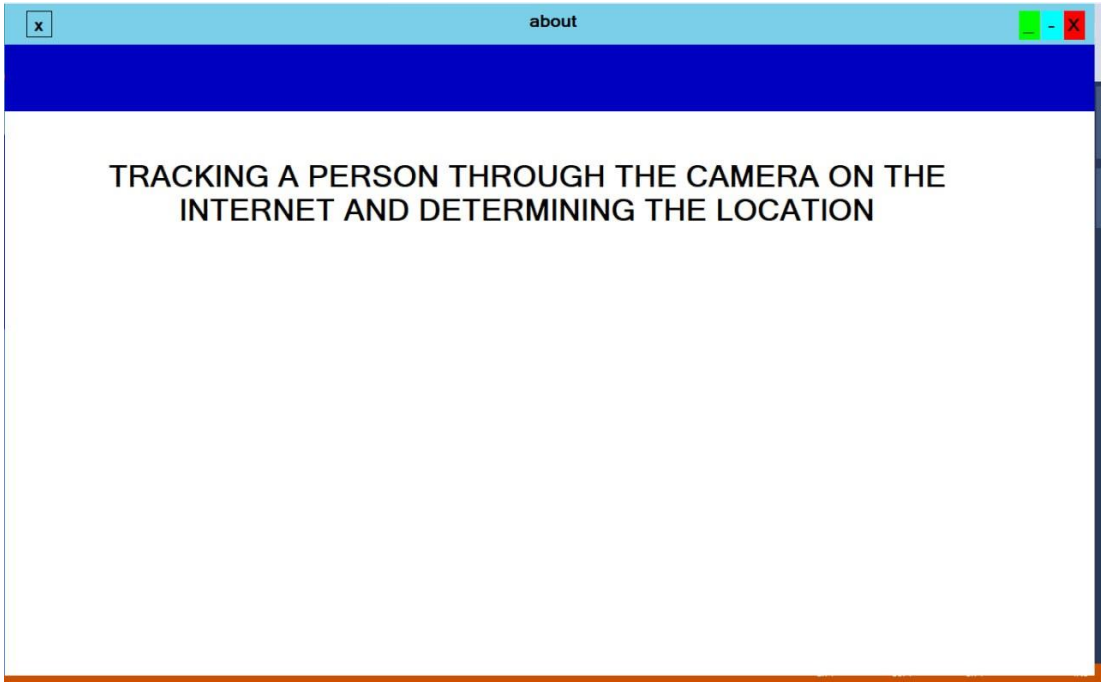

Figure 4.12. About Interface

4.4. Implementation and Result

The implementation phase is the final phase that determines the project's success. Because it is not possible to plant cameras in public places because this requires a security approval machine. We experimented with the system in a tangible way by providing the system with a set of photos taken by Google of their celebrities with data, which were identified, by 50 people. The database was supplied with people's information, and their photos were added inside the base, and we ran the program using the camera in the laptop, and we passed the pictures in front of the camera, and this experiment was done in two batches, the first using dim light, and the second using standard view, and the results were recorded as follows.

The process was complete in low light by the time 50 typical images were read into the system. In the experimental phase, where was identified 46 images; at this stage, the system achieved a result of 92% identifying the wanted persons.

The process was carried out in normal light with the exact mechanism followed previously, and 50 photos of people were identified. The system achieved 100% of the

goal of distinguishing the wanted people to be tracked by regular people—the ideal ratio.

Use the following formula to calculate the percentage achieved.

$$\text{Tracking rate} = \frac{\text{The number that has been recognized}}{\text{All number}} * 100$$

$$\text{Tracking rate} = \frac{46}{50} * 100 = 92\ \%$$

$$\text{Tracking rate} = \frac{50}{50} * 100 = 100\ \%$$

Based on the results achieved and when comparing them with the previous work mentioned in the second chapter and considering Mustafa and Priyan Malarvizhi have achieved results less than the results achieved in our proposed system. Researchers used different algorithms than the technology that was used in our system. Table 4.1. shows the accuracy of the results obtained from the system.

Table 4.1. Accuracy of the results

	precision	recall	f1-score	support
0	0.99	0.99	0.99	3800
accuracy			0.99	760
macro avg	0.99	0.98	0.99	760
weighted avg	0.99	0.99	0.99	760

5. CONCLUSION

Multiple technical and electronic monitoring methods have expanded greatly because of technological transformation in the world, and it is expected that within the next decade, every single person will be tracked precisely. Tracking is often referred to as a service, and like any other modern technology or technical assistance, it has advantages and disadvantages. Tracking people via GPS technology has become outdated because it is sometimes difficult to place a device if a person is wanted for crimes.

This proposed system presented a different mechanism than previously used tools in tracking people. The model was built using CNN techniques and trained intelligently by the Tensor Flow model. This trained form identifies the wanted persons and sends their information and reality to the system administrator. As Chapter Four mentions, the form must be connected to its camera for the tracking to occur. The system test is conducted in two stages; the first stage is in case the light is not good at the camera. The system was trained with 50 images, 24 images were identified, and the existing information was determined. In the other part, an experiment was conducted on the system in the usual light and with the exact mechanism used in the first test, and the system achieved a percentage of 100%; that is, all images were recognized. Algorithm was also tested using the hash algorithm, where the accuracy scored 99, and this percentage is considered acceptable.

In the future, we suggest that researchers focus on

1) Using face recognition algorithms from all sides,
2) Using the cloud to save the database,
3) Using thermal cameras instead of regular cameras.

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