Contemporary Technologies for Promoting Safe Cities: The Case of Al-Salheya Compound in Iraq

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Received	Reviewed	Revised	Published
05.08.2023	14.08.2023	26.08.2023	31.08.2023

https://doi.org/10.61275/ISVSej-2023-10-08-18

Abstract

After the events of 9/11, the world's perception of security in the cities has changed. Management and security have become an important issue of contemporary cities. In fact, almost all cities of the world seek to have their cities safe from terrorism, and threats of vice. To reach this goal, the contemporary cities use modern techniques and technologies in various fields, installed by individuals, societies, as well as institutions. Installing security and civil technologies in public places and vital sites is one of the most important ways to improve safety, security, and civil control. The hardware, software, and qualified human element, with the presence of the latest auxiliary and supportive mechanisms, contribute significantly to achieving safety of the cities.

The research examines security technologies implemented in the Al-Salheya residential compound in Iraq to enhance safety of the city. It therefore carries out a comprehensive review of modern security technologies in contemporary cities.

It employs a qualitative approach as a research methodology. Data is collected from surveys, observation, questionnaires and interviews. It concludes a variety of security and civil technologies at the levels of monitoring, verification, reaction, central database, and support technologies compatible with the needs of Al-Salheya compound in Iraq.

Keywords: Safe city, Security technologies, Monitoring, Verification, Response, Database.

Introduction

The concept of technology has evolved in a way that reflects the development of various human and economic activities in parallel with the development of security, science, media, and the fields of technology and communications (Abdulmajeed, 2017).

All this have led to an unprecedented expansion in the development of technical systems that have contributed significantly to the rapid transition of the world from the industrial age to the information age in order to meet the new challenges facing contemporary cities. The increasing development in technologies has led to a parallel development in all human activities, including security technologies as advanced technologies used by the security or local authorities of cities in order to achieve the concept of a safe city (Al-Hilli & Al-Alwan, 2023).

One of the main challenges for any city is identifying and developing modern security technologies to support policymakers in determining the technologies and tools that can be adopted. The development of technologies contributes to adapting to the main challenges of the urban environment with the help of experts, professionals, decision-makers, and others. It requires a careful review of relevant research sources, as well as an analytical review of the available and approved technologies in many cities of the world (Abdulmajeed & Al-Alwan, 2017).

This research aims to develop and extract modern security technologies for the city of Baghdad and contribute to enhancing the safety of the city by reviewing techniques in general at the level of monitoring, verification, and response. It also extracts a list of technologies that meet the requirements of the Iraqi environment, specifically applicable to the Al-Salheya residential compound. Fig. 1 outlines the research approach.

Its objectives are as follows.

1. To reveal modern security technologies that contribute to enhancing the safety of the city by reviewing techniques in general at the level of monitoring, verification, and response
2. To extract a list of technologies that meet the requirements of the Iraqi environment, specifically applicable to the Al-Salheya residential compound. Fig.1 outlines the research approach.

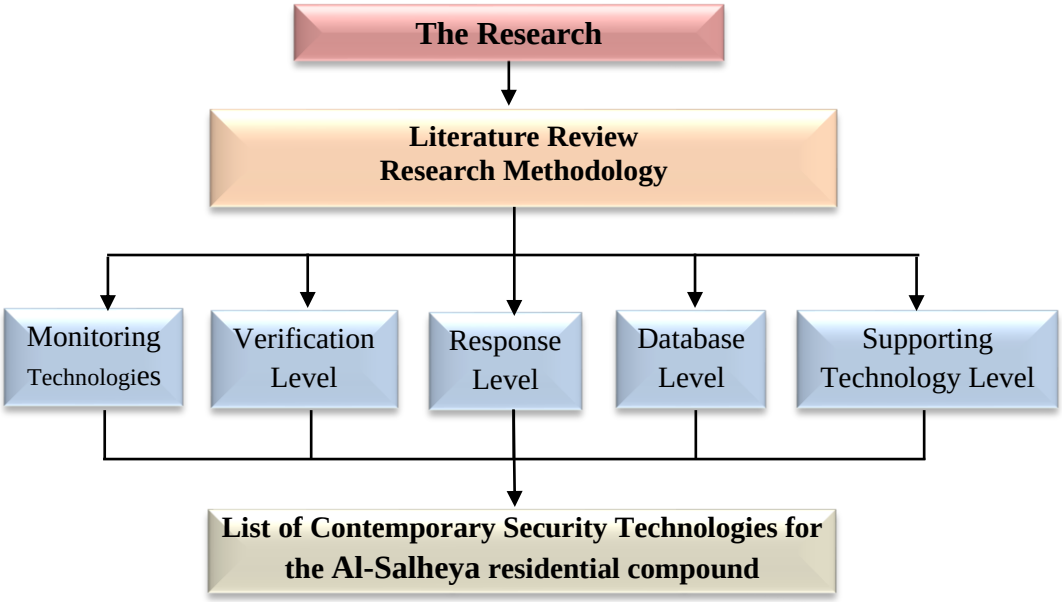


Fig. 1: The Research Approach
Source: Author

Review of Literature

This review examines the studies and company solutions on contemporary security technologies that have dealt with the concept of safe cities. According to Risdiana & Susanto (2019), the use of new technology provides a new way for the government to develop a city security system. That means that a "Safe city concept is one approach and as part of the live concept of the city focusing on the crime problem in urban areas" (Anuar & Aziz, 2012).In other words, 'Safe City' is an idea in a community that uses technology to help governments, communities and businesses reduce the possibility of crime and provide an environment where people feel safe and comfortable (Murray, 2017). Chidambaram & WIPRO Technology (2013) refer to the security technologies that used monitoring in the city such as 'video & analytical surveillance , collaborative monitoring, automatic number plate recognition – ANPR', as well as communication systems such as 'network connectivity, unified communication solution, data

center, application portfolio', and the mobility solution such as 'vehicle mounted camera, vehicle tracking system on GIS Maps', and finally the command and control center solution such as 'slandered operating procedures – SOPs and physical security information management – PSIM'. PWC technology (2016), explain that one of the most user-friendly technologies that can play a crucial role is the extensive use of closed-circuit television (CCTV) cameras, which play a vital part in ensuring day-to-day surveillance, crime prevention and monitoring of illegal or suspicious activities. In addition to close supervision, CCTV cameras allow post-incident analysis and collection of indisputable legal evidence. According to CableFree (2017), CableFree is deploying 'Wireless Safe City' solutions in many regions in the World for public safety, CCTV and security. The 'Wireless' concept is a necessary component for Safe Cities to connect diverse locations and mobile vehicles as a way to allow multiple agencies and applications to be served over low cost, resilient city infrastructure. CableFree wireless safe city solutions connect fixed, temporary and mobile CCTV cameras to enhance safety for public, services and first responders. Using CableFree's safe city wireless solutions users can provide real-time connections to 'CCTV cameras, police cars, port & customs authorities, emergency responders, buses, trains, and mass transit systems).

In developing the security technologies in a safe city Dahua Technology (2020) indicate that there are many security technologies in different aspects of cities such as the infrastructure, buildings, spaces, and movement paths etc. All these technologies support the concept of safe city. Hillman & McCalpin (2019) explain among the "solutions" that Huawei sells globally under this label are facial and license-plate recognition, social media monitoring, and other surveillance capabilities. According to Hikvision Technology (2021), security technology provides a full range of AI cloud products and solutions – from perception, storage, and computing, to data analysis, as well as comprehensive open interface. Huawei technology (2021) provide wide range of monitoring including 'CCTV, automatic number plate recognition, GIS etc.', and for verification include 'facial and license-plate recognition etc.'. Hikvision Technology (2022) indicates that the monitoring technologies for people and vehicle include 'video surveillance, GIS applications, alarm controls, command & dispatch, vehicle counting system, traffic event detection, and traffic flow report', and for people management include 'facial recognition, body characteristics and abnormal behavior, crowd density prediction etc.'. Dahua technology (2023) provide a wide portfolio of security-related products, ranging from monitoring technology include 'IPC, HDCVI camera, PTZ camera, thermal cameras' and for management provides display and control center. According to Murad (2023), the genetic security software is the best software used for the safe city.

The literature review reveals that the security and civil technologies used in cities are varied and are used according to the importance and need for the priority of the cities. Previous literature clarifies the type of technologies and the best solutions that are used in the cities to solve their problems. The research classifies these technologies into five basic elements (Monitoring, Verification, Response, Database, and Supportive Technology). Each of these elements has its own technologies that will be clarified in the following sections.

Research Methodology

This study reviews, explains and analyses the contemporary security technologies of safe cities. By conducting a qualitative research method, a new conceptual list for contemporary security technologies is proposed based on previous studies and company solutions together. Accordingly, data was collected from:

1. Contemporary research studies.
2. The best solutions that are used by international companies in the cities to solve their security problems.
3. Interviews with specialists in security technologies.
4. Official documents from Iraqi National Security Council and Iraqi Ministry of Interior.

Findings

The research found that the (Monitoring & Detection Technologies, Verification Technology, Reaction/Response Technology, Database Technology, and Supportive Technology) are suggested for safe city and it found that:

Monitoring & Detection Technologies

Monitoring & Detection technologies are divided into ground surveillance technologies and air surveillance technologies. Each section contains a set of technologies as shown in the Fig. 2.

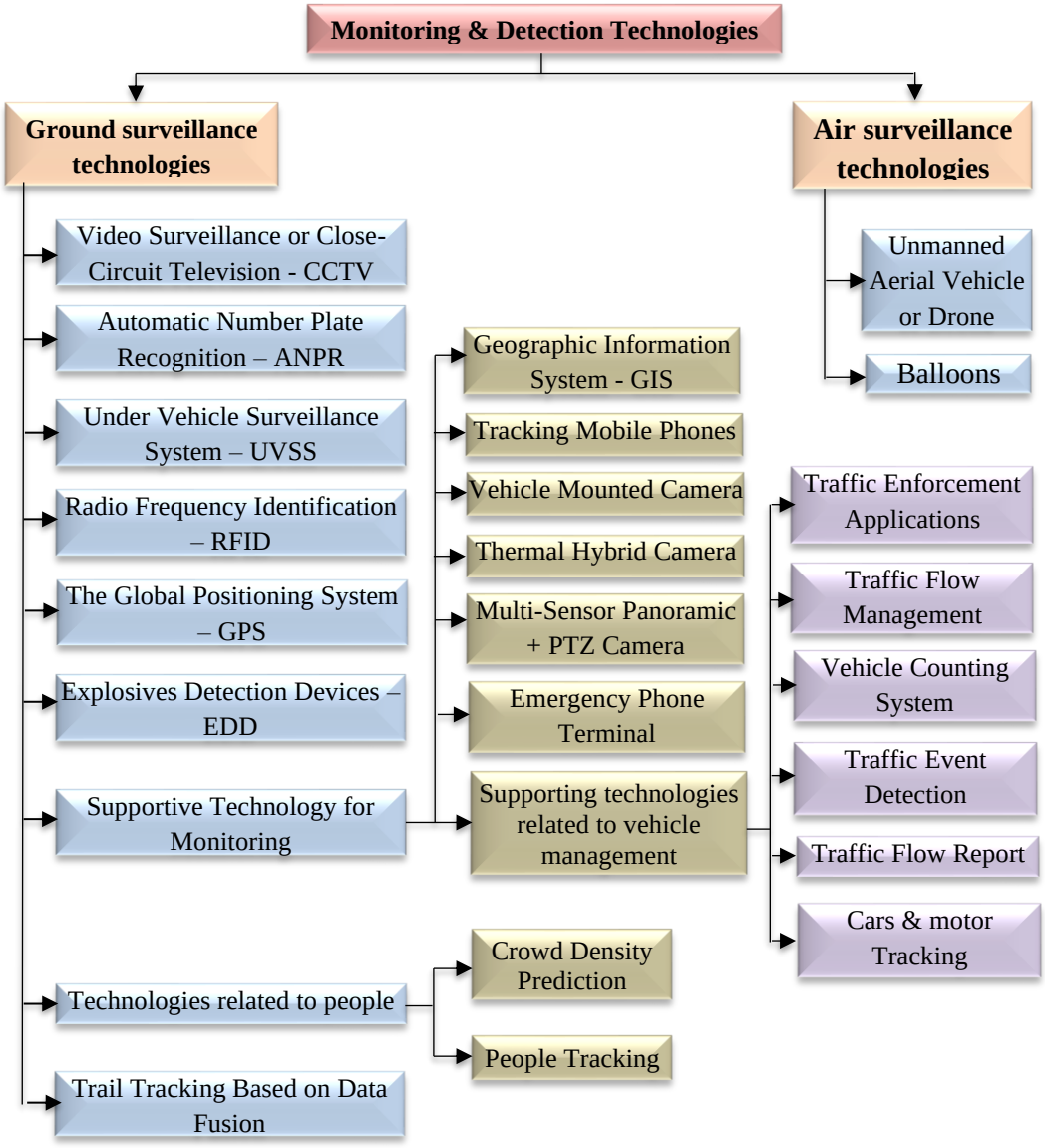


Fig. 2: Monitoring and Detection Technologies:
Source: Author

Ground surveillance technologies

1. Video Surveillance or Close-Circuit Television - CCTV

Al-Muhaimid (2014) explains CCTV as a system for visual and audio monitoring and recording of various events that take place in the monitored areas**.** Malmenbratt & Brooks (2015) explain that it is applied within a multitude of environments, where its features are perceived to have a proven application. Features present CCTV and its language as a tool

for deterrence, monitoring, reducing crimes, providing safety and evidence or supporting situational awareness**.** According to Al-Ahbabi & Al-Alwan (2023) these systems make the pedestrians and residents feels safe on the road and other areas. The basic components of a CCTV are cameras, a recorder and screens.

2. Automatic Number Plate Recognition – ANPR

Francis & Shaheen (2014) explain ANPR as the technology of automatic identification of cars by their numbers installed on their plates. This is important and fundamental. The automatic detection and recognition of vehicle plates is the key to the technology. These are useful for monitoring cars on the roads, detecting stolen cars, monitoring the entry and exit of vehicles from the cities, obtaining information about the owners of the vehicles and obtaining some information about the vehicles when needed. In addition, they are also useful for monitoring the parking of vehicles, controlling the maximum speeds as well as in preparing statistical studies such as studying traffic congestion in an area and others**.** The basic components of the (ANPR) system are: camera, computer system, software, and databases.

3. Under Vehicle Surveillance System – UVSS

According to Sukumar, Page and Koschan (2007), The UVSS is a system based on hardware and software for scanning and monitoring under vehicles. The Under Vehicle Scanning System (UVSS) uses high-resolution cameras to scan the vehicle's undercarriage which can display high-resolution images of the vehicle's undercarriage through intelligent algorithms**.**

Hikvision (2018) notes that the use of the UVSS system is the sole responsibility of the user. This system does not make any automatic detection prompts and it is the user's sole responsibility to monitor and respond according to their own assessment of the situation. The components of the UVSS system are: cameras, speed detection units, operating / trigger units, lighting, and computers**.**

4. Radio Frequency Identification – RFID

According to the Government of the Hong Kong Special Administrative Region (2008), RFID is an identification technology that tracks the movements of objects through a network of scanning devices using radio technology at a distance of several meters using radio signals to identify, track, sort and detect a variety of objects including people, vehicles, goods, etc. without the need for direct contact**.**

Sheilds et al. (2015) explain that the technology is an automatic identification based on a device called (RFID Tag)**.** Sheilds et al. (2015) explore the basic components of RFID. They consist of three main components: chips, tags, readers, and antennas which are collectively responsible for generating the radio waves**.**

5. The Global Positioning System – GPS

Olawale et al. (2015) explain GPS as a satellite-based radio navigation system developed and operated by the US Department of Defense. GPS provides accurate position, velocity and time (PVT) information to an unlimited number of suitably equipped land, sea, air and space users**.** It consists of three main sections: space segment, control segment, and user segment**.**

6. Explosives Detection Devices – EDD

According to the United Nations (2018), bombs and explosives are the main tools used to carry out acts of sabotage, destabilize security and tranquility, and endanger people's lives**.** Explosives are materials that are placed or manufactured in a manner that includes destructive, lethal, noxious, fiery, incendiary or toxic chemicals and are designed to destroy, incapacitate, harass or distract. These materials are usually derived from non-military

components. Those who manufacture IEDs are constantly changing their properties, the way they work, and link and deliver the explosives. Terrorist attacks occur in urban, peri-urban and rural areas against stationary and moving targets. The victims of attacks are overwhelmingly civilians**.**

Therefore, explosive detection devices are considered inspection devices to determine whether a person, vehicle, bag, etc. contains explosive materials or not. Explosives detection devices are used in airports and ports, to control borders, entrances to cities and buildings, etc. (Ong et al. (2017)**.** In general, explosive detection technologies can be divided into two categories: the first is mass detection and the second is trace detection. In the first category, explosive materials are detected directly, by displaying images by X-ray scanners or similar equipment. In the second category, which is trace detection, explosives are detected through chemical identification of the microscopic residues of explosive components **(**U.S. Department of Justice, 1999)**.**

7. Supportive Technologies for Monitoring

1.Geographic Information System - GIS

According to Halabi (2003), There is no longer a fixed definition of geographic information systems, due to the multiplicity of applied fields that depend on it, and also due to the different views on defining and classifying the applied goals of those systems. Some believe that the secret of the importance of geographic information systems lies in the electronic capabilities in programs and computer components. Other sees this in the ingenuity that has been reached in the methods of data processing**.**

Al-Taie (2013) explains that these systems are used in the study and analysis of various issues according to the requirements of the local administration of the city, such as documenting spatial or other data for the geographical location to be documented. The highest degree of spatial comparison and matching is achieved between a number of layers or maps on top of each other for a specific geographical area. This spatial information is derived from information documented by the field survey staff of the site**.** Blistan et al. (2015) provide five components of Geographic Information System (GIS) that consists of software, hardware, data, technical staff (specialists) and information production**.**

2.Tracking Mobile Phones

According to Victorian Law Reform Commission (2010), all mobile phones have an electronic serial number, which when combined with a phone number, makes the phone easily identifiable by the telecommunications service provider, allowing the phone to be tracked over time. GPS applications on mobile phones mean that the phones can also be used for location tracking and monitoring**.**

3. Vehicle Mounted Cameras

According to the Police Department, of the City of New York (2021), a vehicle should be equipped with basic Closed-circuit Television (CCTV) equipment, communication equipment and video display systems along with the seating capacity for operators (video display systems along). Mobile Video Van is fully operational and capable of capturing and streaming real-time videos of an incident**.**

4. Thermal Hybrid Camera

HIKVISION Technologies (2018) explain that most areas of the city face high risks at night due to the wide area and insufficient security patrols. This requires reliable area protection through full coverage, high-quality imaging in variable lighting conditions along with automatic intrusion detection. Thermal cameras illuminate objects day or night and in changing weather conditions by sensing the thermal radiation of the object, whether it is human, animal, vehicle, boat, etc. This allows security personnel and authorities to find suspects hiding in forests or among tree leaves, etc**.**

5. Multi-Sensor Panoramic + PTZ Cameras

According to Dahua Technology USA (2021), accidents often occur in crowded public squares, making it necessary for monitoring devices to photograph the entire area to ensure safety. However, due to limited resolution and field of view, conventional systems are ineffective when observing wide areas. Panoramic cameras are agile systems that are easy to operate and not bulky front installations blind from the scene**.**

6. Emergency Phone Terminals

According to Dahua Technology China (2017), High-traffic areas such as tourist attractions require rapid responses to incidents. Shorter response times can reduce loss of life and property and make people feel safer. This station provides emergency calls at hand and can talk audio and video with the provision of CCTV for monitoring and response.

7. Supporting technologies related to vehicle management

One of the main advantages of Safe City solutions is its ability to assist authorities in managing traffic and monitoring vehicles through:

(1) Traffic Enforcement Applications: - These applications are to ensure road safety and smooth travel. The system can, from analysis, detect violations and behaviour such as violating a red light, driving in the wrong direction, illegal lane change, illegal parking, speeding, failure to adhere to the seat belt, etc**. (**Saha, 2020).

(2) Traffic Flow Managements: It is the analysis of big traffic data and predicts traffic in advance to prevent traffic jams, as well as conducting effective signal control and direction such as traffic guidance, traffic signal control, and traffic event detection.

(3) Vehicle Counting Systems: Based on video streaming analysis technology, an operator can predict or take precautions to prevent accidents.

(4) Traffic Event Detections: The traffic control system is able to report the traffic flow, display the congestion situation to the observer or the public in real time, and effectively direct vehicles to avoid the crowded areas.

(5) Traffic Flow Reports: This system is able to generate traffic flow reports and display relevant data in various graphs such as real-time traffic flow, traffic flow comparison, and report on vehicle violations. **(**HIKVISION Technologies, 2021)**.**

(6) Cars & motor Tracking: According to George (2022), it is software that helps to identify and track vehicles and bikes in the event of any problem, threat, danger, or prior information of high importance, such as participation in operations (assassination, kidnapping, armed robbery, run-over, theft, harassment, fraud, etc.), as this software helps to identify and track a vehicle and the bike to know the path of movement and stopping places to help the competent authorities accurately diagnose the accused and arrest him/her or the network involved or associated with/her him to bring them to justice**.**

8. Technologies related to people

(1) Crowd Density Prediction: The crowd density analysis system is designed for large open areas such as public squares, stations, airports, etc. Through high-definition video stream analysis, the system is capable of calculating the population density within a particular area. If the density exceeds a pre-set limit, an action alert is issued **(**Sneha et al., 2018)**.**

(2) People Tracking: It is an advanced software that helps to diagnose and track people suspected or accused of criminal or electronic crimes, as this software helps to identify and track people to know the paths of movement and whereabouts in order to help the competent authorities to accurately diagnose people and arrest or arrest them. The network involved or associated with them to bring them to justice **(**HIKVISION Technologies, 2021)**.**

9. Trail Tracking Based on Data Fusion: - This application relies on the fusion of big data from multiple sources, such as vehicle data, human face data, and property data, body characteristics data (HIKVISION Technologies, 2021)**.**

Air surveillance technologies:

Air surveillance techniques are considered one of the important and vital technologies in a city. It consists of:

1. **Unmanned Aerial Vehicle or Drone**

   Also known as remotely operated aircraft, it is the best example of technological development **(**Singhal et al., 2018). These aircrafts do not need any pilot on board and can be operated independently or remotely controlled or pre-programmed for a route. Mostly, these planes carry surveillance or imaging cameras, or even missiles for military use. The greatest use of it is in military purposes such as surveillance and attacks, but its use in civil works is witnessed as well **(**Sivakumar et al., 20212)**.**

2. **Balloons**

   Critical infrastructures - such as electricity networks, power stations, and smart grids are increasingly monitored and controlled through computing and communication technologies. Surveillance and security technologies have traditionally been used in these contexts as a protection mechanism that maintains situational awareness and provides appropriate alerts. Surveillance is a cumbersome process because of the need to monitor a variety of objects, but it is absolutely necessary to promptly detect the occurrence of adverse events or conditions **(**Gouglidis et al., 2018).

Verification Technologies

It is a process that comes after the monitoring to verify the persons or vehicles and know the identity of them in a record time. There must be an accurate database of people (citizens, residents, and expatriates) in addition to vehicles for the verification process to be effective. Therefore, it is necessary to use specialized software to save the data of people represented by fingerprints, iris of the eye, facial features, features of the external appearance and other required information, and vehicles represented by types of cars, colours, models, ownerships, and other required information. There are multiple technologies to verify identity as in the following Fig. 3:

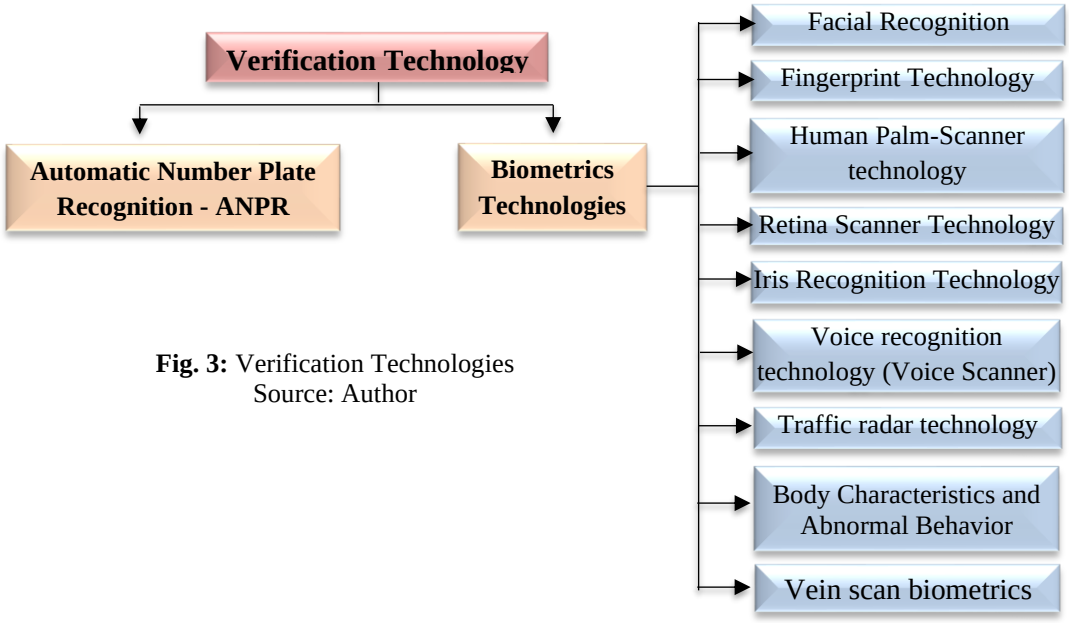


Fig. 3: Verification Technologies
Source: Author

1. **Automatic Number Plate Recognition - ANPR:** It has already been explained in the monitoring field in the paragraph above.
2. **Biometrics Technologies:** These technologies include:

   a. Facial Recognition: it works by calculating the extracted features of the face that is captured by a digital video camera. Then the image is compared with the previously analysed appearances and stored in a database. These databases contain a large number of depicted faces with their associated names and other identifiable and personal information (Mohammad, 2020)**.**

   b. Fingerprint Technology: After extensive studies, scientists and researchers in the science of biometrics have concluded that each person has biometric features and fingerprints that distinguish a person from others, based on physiological and behavioural characteristics, and this scientific mechanism is used for personal identification. Fingerprints, which have become internationally the best way to identify people, have been recognized by most of the legislation in the world as material evidence that does not bear doubt or interpretation **(**Hassan, 2017**).**

   c. Human Palm-Scanner technology: The technology of identifying a person through the palm of the hand is an important technique and is used to identify individuals by detecting the features and characteristics of the palm that contains about 10 000 information that the device analyses to determine the identity of its owner **(**Al-Wathani, 2014**).**

   d. Retina Scanner Technology: It depends on the pattern of blood vessels in the retina, as the blood vessels in the back of the eye have a unique pattern from eye to eye and from person to person. The retina is not directly visible and so a coherent infrared light source is necessary to illuminate the retina. Infrared energy is absorbed by the blood vessels in the retina faster than the surrounding tissues. Then the image of the retinal blood vessel pattern is analysed. The retinal scan cannot be falsified because it is currently impossible to model the human retina. The error rate for retinal examination is 1 in 10,000,000, compared to the error of fingerprint identification sometimes reaching 1 in 500 **(**Wayman, 2005**).**

   e. Iris Recognition Technology: The iris is the ring clearly visible on the front side of the eye that surrounds the pupil. It is a technique that identifies individuals by detecting the compositions of the iris of the eye that contain thousands of elements that can be measured, in addition to the impossibility of having identical iris between one individual and another (Zibran, 2009)**.**

   f. Voice Recognition Technology (Voice Scanner): Individuals can be identified by analysing their vocal patterns, which are produced when the vocal cords propel air. Voice tone technology relies on a method similar to the way facial features are used, but it records an audio signature that differs from person to person. Voice recognition should not be confused with a speech recognition system that attempts to predict the user's speech. These two terms are often confused **(**Jain, 2004**).**

   g. Traffic Radar Technology: It is a technology developed by experts from the US Department of Defence to identify people and determine their identities through the way they walk, by monitoring the different vibrations emanating from the movement of the feet, arms and torso while walking, and these movements cannot be similar in total between one person and another, and this radar can help identify individuals through their walking, without them noticing while passing the entry and exit corridors of the country (Abdulmajeed, 2017)**.**

   h. Body Characteristics and Abnormal Behaviour: Searching in the Video Analysis Server using multiple images with body characteristics. The real-time video analysis algorithm can model an individual's body characteristics using video streams from existing cameras. The back-end analysis server is also equipped with algorithms that can detect abnormal behaviour, such as sudden running, wandering, or intrusion through video streams **(**HIKVISION Technologies, 2021**).**

i: Vein scan biometrics: Vein scan biometrics technology identifies a person from the patterns of blood vessels in the back of the hand. This technology uses infrared light to detect patterns of blood vessels. Vein patterns are distinctive between twins and even between the same person's right and left hands. It is very stable, and does not change through one's life. Technology works even if the hand is not clean (Ashok, 2010).

Reaction/Response Technology:

According to George (2022), it comes after the process of monitoring and verifying the incident (whatever the incident is) and the suspected persons in order to deter threats and risks to the civilian population. The response is by issuing an alert of danger at the site of the event or indicating the occurrence of an accident (whatever it is) to take the necessary measures by the decision-maker or the police patrol responsible for protecting the area within a very short period of seconds. The special techniques used by an agent to react / respond are software that quickly determines the location of the accident, the type of accident, and the security agency responsible for the site and the party concerned with dealing with the accident. To send an alert message with the decision to move to deter the perpetrators and arrest them in a very short time, while giving an accurate map to the authority in charge of implementation to clarify the movement outlets and the possible routes to be taken by the violators, and to take precautionary measures to avoid similar incidents in the future.

In order to achieve the reaction process, appropriate technologies and appropriate software with effective communication must be available. (Al-Alwan & Shallal, 2012).

Database Technology

The data can be facts related to any object under consideration (Peterson, 2022). As for a database, it is a systematic and organized collection of stored data or information that can be accessed electronically and has an interrelationship with each other, and that is stored in a typical way, that is, without repetition. It supports electronic storage and data processing.

According to United Arab Emirates, Government of Ajman (2021), the most important thing that distinguishes it is that it is stored in a way that achieves a kind of independence and immunity against change from the programs that one uses, present or in the future. Databases make data management easy. Big Data can be addressed as it represents a set of data whose size exceeds the ability of any database system to perform the usual operations on it of recording, transferring, analysing and storing, so that it can be converted into information that can be used.

Supportive Technologies

It highlights the technology trends that are accelerating the evolution towards smarter and safer cities. This is done through as Fig. 4.

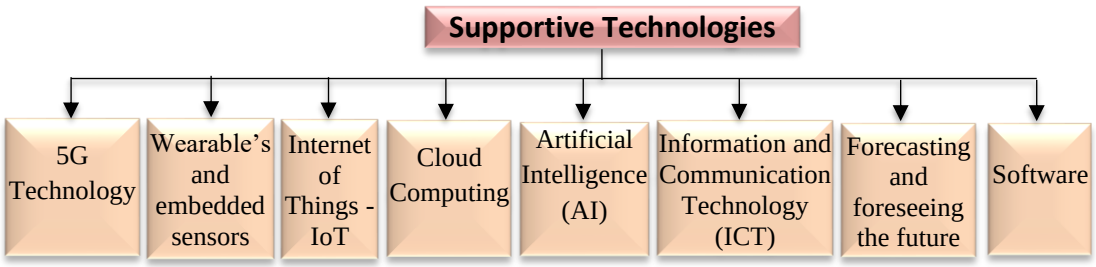


Fig. 4: Supporting Technologies
Source: Author

1. **5G Technology:** 5G-transformed networks operate at gigabit speeds and ultra-high-end computing to make cities run smoother, safer, and smarter with real-time data-backed insights. Compared to 4G networks, 5G switched networks offer 10 times lower latency, 50 times faster speed, and 1000 times greater capacity. 5G enables public safety use cases including incident detection and management, emergency response, sensor monitoring, and crowd management to be more effective and accurate (DELL Technology, 2019)**.**
2. **Wearables and Embedded Sensors**: Smart watches can help law enforcement, fire departments, and emergency medical teams stay mobile, going wherever emergencies take them. Real-time location, safety, and emergency data from the first responder to the dispatch centre can enable emergency personnel to be more effective in situations where mobile devices are not always practical (DELL Technology, 2019)**.**
3. **Internet of Things - IoT:** Today, the Internet is everywhere, it has touched almost every corner of the world, and it is affecting human life in unimaginable ways. The Internet of Things refers to a new kind of world where almost all the devices and appliances we use are connected with a network. We can use them collaboratively to achieve complex tasks that require a high degree of intelligence **(**Sethi and Sarangi, 2017)**.**
4. **Cloud Computing:** Governments and companies are increasingly storing data in massive off-site locations—known as the cloud—that can be accessed through a network, usually over the Internet. Cloud computing is a general-use technology that includes everything from turn-by-turn GPS mapping, social networking and email, file storage, and streaming content access. Essentially, cloud computing data centres act as the backbone of the Internet, instantly storing, communicating and transmitting information. As such, cloud computing is essential for the efficient operation of AI systems **(**Dedezade, 2018)**.**
5. **Artificial Intelligence (AI) technology**: it is rapidly spreading around the world. Astonishing developments continue to unfold, city officials are leveraging artificial intelligence to monitor traffic congestion and oversee smart energy metering. However, an increasing number of countries are deploying advanced AI monitoring tools to monitor, track and monitor citizens to achieve a range of security goals. As the use of artificial intelligence has become an important role in achieving many of the tasks and goals pursued by countries, including the security aspect. This involves predicting crimes and accidents before they occur, in addition to identifying hot spots and time periods in which accidents or crimes recur, and therefore, it has become possible to achieve a higher rate of prevention, or prevent the occurrence of these crimes, through the use of these systems that analyse data and provide them to the security authorities, and within its plans aimed at achieving a higher level of reducing crime and traffic accidents **(**Feldstein, 2019**).**
6. **Information and Communication Technology (ICT):** In order to deal with the rising trends of urbanization, smarter and more sustainable means must be found to manage urban complexities, reduce spending in urban areas, increase energy efficiency, improve the quality of life for urban residents, and promote the concept of security in the city. In this regard, modern technologies are used to enhance daily urban life in cities. Many cities integrate information and communication technologies (ICTs) with traditional infrastructures. It plays a critical and important role in cities, as it represents a platform for collecting information and data to contribute to improving understanding of how cities operate in terms of consuming resources and services and enhancing the concept of security. It can also be linked with the existing security and service systems, and this contributes to improving energy consumption efficiency, operating infrastructure in urban areas, flexible road and transportation networks, efficient water distribution systems, water and wastewater management, security, and other supporting services. Cities' security or service sensors have the potential to provide city stakeholders with access to real-time security, as well as geographic, economic, and environmental information about their cities **(**International Telecommunication Union, 2022**).**
7. **Forecasting and Foreseeing the Future:** - It plays a pivotal role in human life and it has become part of many areas involved in politics, economics, health, security, administration, military sciences, strategy, planning, policy-making and decision-making, etc.

It also has entered medicine, engineering and genetics. It is obligatory for whoever predicts the future of the city, whether it is threats, risks or general development, to be familiar with the possibilities of prediction and the methods of its techniques. Prediction is not speculation or astrology, but rather a scientific analysis that aims to predict what will happen in the future of the city based on the available information and analysis, and then predict the course of the event. The process of developing strategic plans for the city precedes the understanding of what may happen in the future **(**UK Government Office for Science, 2016**).**

8. Software: It is a group of important programs for monitoring, verification and response (reaction) systems, where in the monitoring phase, the software helps in transferring data and special information (image, video, sound, text, signal) to the decision-making authorities. Data is classified, stored and analysed in a practical manner. In the verification phase, the software assists in verifying the data sent with the database of the competent authority and calling it to interrupt it. In the response phase, software helps to instruct the patrols holding the land in the event area to take the appropriate action within a very short period to avoid a defect in the security or service system of the city. In the prediction phase, software relies on the huge data available in the operating room and the criminal or service system, where all the data about crimes, their types, geographical locations, and incoming communications are stored, as well as data related to the service side or aspects related to the city. Based on this stored data, the prediction software analyses all information and data accurately, and gives the security authorities coordinates of the next crime scene. It also determines the time during which crime increases in an area, and alerts the police to the need to provide security coverage, patrols, or cameras to prevent it from occurring **(**George, 2022**).**

Summary of the details of Security and Civil Technologies in Contemporary Cities

The Table 1 shows the extracted summary of security and civil technologies in contemporary cities.

Table 1: The summary of security and civil technologies in contemporary cities
Source: Author

N	Technologies types		Technologies Classified		Detailed components	
1	**Monitoring & Detection**	Ground Surveillance Technologies	Close-Circuit Television - CCTV	components of CCTV	Cameras	
					Recorder	
					Monitors	
			Automatic Number Plate Recognition – ANPR	components of ANPR	Databases	
					Camera	
					Computer System	
					Software	
			Under Vehicle Surveillance System – UVSS	components of UVSS	Cameras line scan	
					Speed Detection Module	
					Trigger Module	
					LED-based lighting	
					Computer	
			Radio Frequency Identification – RFID	components of RFID	RFID Tags	
					Reader	
					Antennas	
			The Global Positioning System – GPS	components of GPS	pace Segment or Satellite	
					control segment	
					Receiver Segment	
			Explosives Detection Devices – EDD	components of EDD	Natural	
					Industrial	trace detect
						bulk detect
			Supportive Technology for Monitoring	Geographic Information System - GIS	Components of GIS	Hardware,
						software
						data,

						technical staff (specialists) & information production
				Tracking Mobile Phones		
				Vehicle Mounted Camera		
				Thermal Hybrid Camera		
				PTZ - Multi-Sensor Panoramic + PTZ Camera		
				Emergency Phone Terminal		
				Supporting technologies related to vehicle management	Traffic Enforcement Applications	
					Traffic Flow Management	
					Vehicle Counting System	
					Traffic Event Detection	
					Traffic Flow Report	
					Cars & motor Tracking	
				Technologies related to people	Crowd Density Prediction	
					People Tracking	
				Trail Tracking Based on Data Fusion		
		Air surveillance technologies	Unmanned Aerial Vehicle or Drone			
			Balloon			
2	**Data Base**		components of Data Base		Hardware	
					Software	
					Data	
					Procedure	
					Database Access Language	
3	**Verification**		ANPR		It was discussed above	
			Biometric		Facial Recognition	
					Recognition Fingerprint	
					Human Palm-Scanner	
					Retina Scanner	
					Iris Recognition	
					Speaker Recognition Voice Scanner	
					Traffic fingerprint radar technology	
					Body Characteristics and Abnormal Behaviour	
					Vein scan biometric	
4	**Reaction/Response**		Software			
			communications			
5	**Supportive Technology**		5G Technology			
			Wearables and embedded sensors			
			Internet of Things			
			Cloud Computing			
			Artificial Intelligent			
			Information and Communication Technology - ICT			
			Forecasting and foreseeing the future			
			Software			

Application of the Security Systems

Case Study

1. Selection of the study Area

AL-Salheya Compound was chosen as a case study within the city of Baghdad to articulate and ascertain the use of these technologies (Fig. 5). It is the first integrated vertical project in Iraq. It consists of 34 residential towers, located in central Baghdad and near the green zone and the governmental buildings. The project includes 4 sectors (Yellow, Blue, Green, and Red) building, a commercial walkway in the center that runs along the project in addition to green spaces that permeate the project and the social and entertainment area. In addition to the residential buildings, the project also provides schools, restaurants, and many open parking spaces for residents. Figs 6 and 7.

2. **Reasons for the Selection of the Study Area**
    - It is located within a strategic location close to the centre of Baghdad and adjacent to the vital area known as the Green Zone, and the government buildings in the capital, Baghdad, which makes the site of vital importance.
    - The first vertical residential project implemented with a high density in the 80s.
    - Diversity of uses within the compound (residential, commercial, education).
    - Homogeneity in terms of the nature of the population.
    - It contains approximately 34 residential buildings at a height of 10 floors, and this reinforces the need for enhanced security. See Fig. 7.
    - It is exposed to the security threat.

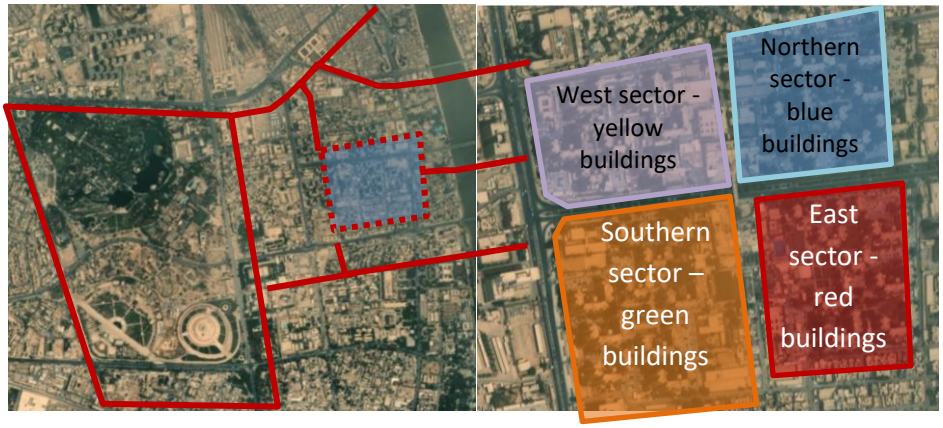
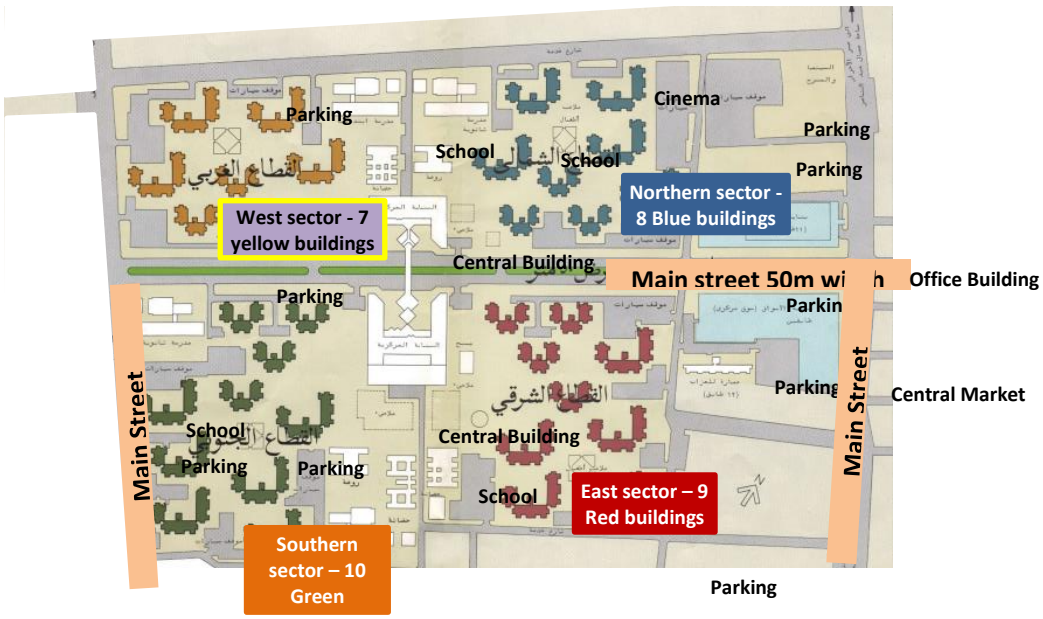


Fig 5: Al-Salheya Compound and the relationship with neighbours
Source: Author

Al-Salhiea Compound
The Main road

Fig 6: Thehe types of buildings in the Al-Salheya Compound
West sector
Northern sector
Southern sector
East sector
Source: Author



g. 7: Types of buildings and activities at the Al-Salheya Compound
Source: Author

The residential compound and its Security

The compound consists of 34 buildings of various heights, ranging from 5 to 10 floors. It includes a commercial central building, a cinema, public gardens, parking lots, schools, kindergartens and other service buildings as shown in the Fig. 7. The compound was exposed to security breaches, in addition to the weakness of the administration of the of the compound. The western sector, consisting of 7 buildings of different heights as shown in the Fig. 8, is selected and the rest of the sectors are neutralized .The site is analyzed, with vulnerabilities diagnosed.

Through checking the site and according to Iraqi National Security Council (2012) & George (2022), the type of technologies in the residential compound include:

1. In Monitoring & Detection -Ground Surveillance Technologies, the (CCTV, ANPR, UVSS, RFID, GPS, and Supportive Technology for Monitoring) are used.
2. Verification is used for people (citizens, residents, and expatriates) or vehicles or bicycles
3. In Reaction/Response, Software & communications are used.
4. In Data base, (Software, Data, Database Access Language) are used.
5. In supporting technology, (Wearable and Embedded, Internet of Things, Cloud Computing, Artificial Intelligence, Information and Communication Technology (ICT), and Threat Forecasting, Software) are used.

The research found that the compound lacks the necessary technologies to achieve monitoring, verification, and reaction and integration between them as shown in the Fig. 9. There is a general database of the people, vehicles, or bicycles and their locations within the compound. However, it is only a paper system. The extracted list of security systems was tested with the actual need for the compound to achieve integration between the systems.

In addition, the compound lacks the Monitoring & Detection - Ground Surveillance Technologies system like ANPR, UVSS, RFID, GPS, and Supportive Technology for Monitoring.

CCTV systems are found only in the apartments and not in the administrative office of the compound. Then verification technologies do not exist in the compound at all. Only security guard verification exists and not always. Therefore, the level of response after the process of verifying the identity of the people, vehicles, or bicycles is only by people reporting by phone. Moreover, supportive technologies such as wearables and embedded, Internet of Things, cloud computing, artificial intelligence, information and communication technology (ICT), threat forecasting, and software are not found in the compound too. Table 2.

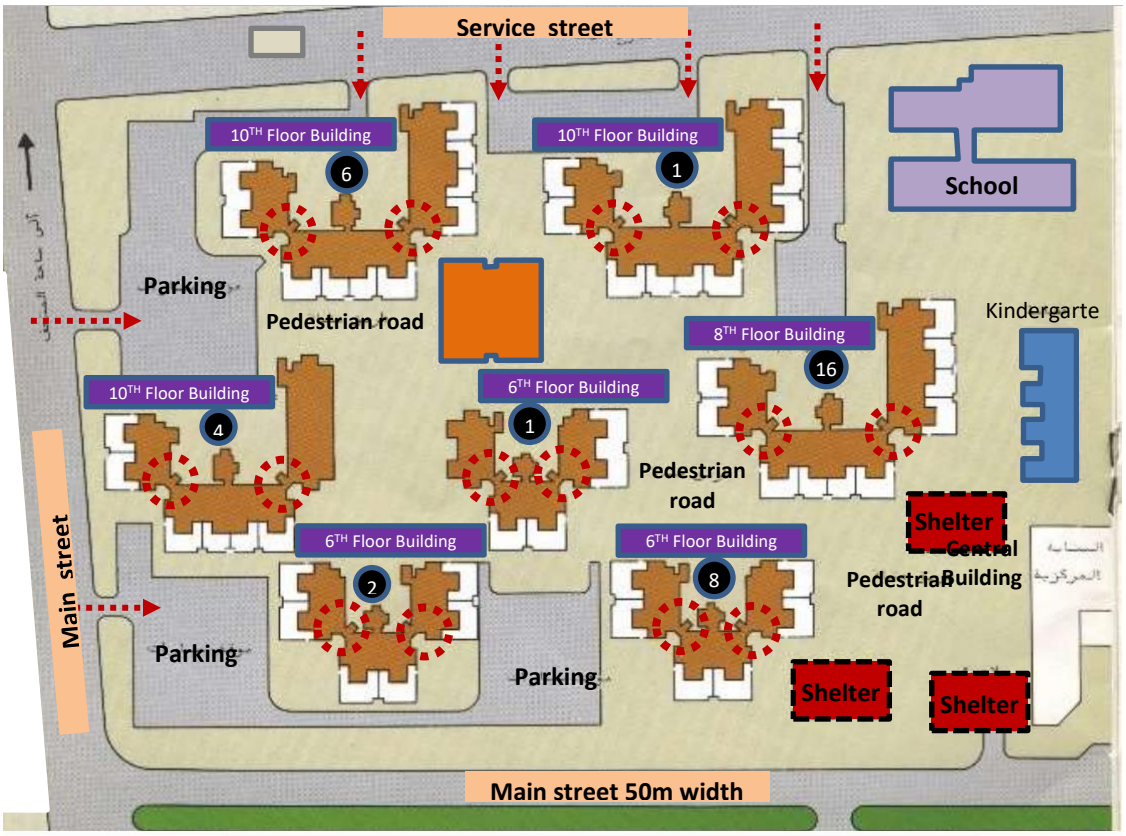


Fig. 8: The building and activities in the Al-Salheya Compound
Source: Author

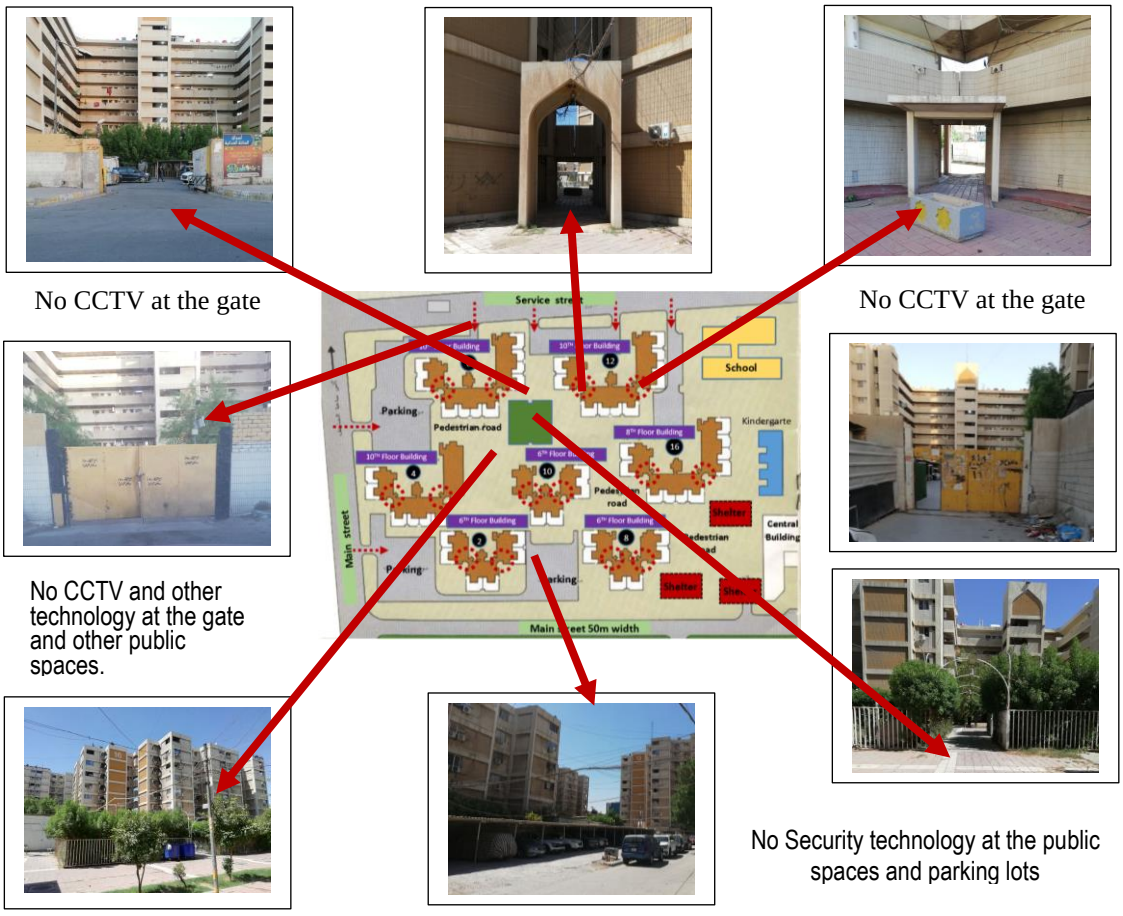


Fig. 9: Vulnerabilities diagnosed in the Al-Salheya Compound
Source: Author

Table 2: Checking the main the types of technologies that the compound needs.
Source: Author

N	The types of technology that the compound need		The location and level of application of the technologies	
			exist	Not exist
1	Monitoring & Detection - Ground Surveillance Technologies	CCTV	----------	The CCTV system are found only in the apartments not in the administrative office of the compound
		ANPR	----------	The ANPR system does not exist in the compound
		UVSS	----------	The UVSS system does not exist in the compound
		RFID	----------	The RFID system does not exist in the compound
		GPS		The GPS system does not exist in the compound
		Supportive Technology for Monitoring	----------	The Supportive Technology for Monitoring does not exist in the compound
2	Verification		----------	Verification technologies does not exist in the compound only security guard Verification and not always
3	Reaction/Response		----------	The level of response after the process of verifying the identity of the person, vehicle, or bicycle is only by people report by phone.
4	Data Base		----------	There is no electronic Data Base only paper system and the data for the person, vehicle, or bicycle are general not specific.
5	Supportive Technology		----------	Building a solid base and strong infrastructure within levels and stages, according to the requirements and available capabilities, and the budget allocated for the compound to build and use all the supportive technology that was referred to above. Wearable and Embedded, Internet of Things, Cloud Computing, Artificial Intelligence, Information and Communication Technology (ICT), Threat Forecasting, Software)

Conclusions

1. List of Security Features

By examining many documents, the research identified a variety of security and civil technologies at the levels of monitoring, verification, reaction, central database, and support technologies that are consistent with the Iraqi environment in general and the city

of Baghdad and the requirements of the Al-Salheya Compound in particular, as follows. The Table 3 shows the types of technology selected.

Table 3: The types of technologies that the compound need and the locations and levels of application of these technologies.

Source: Author

N	The types of technologies selected		The locations and levels of application of the technologies
1	**Data Base**		Build database (Big Data) in the compound; it could be used at the security and civil levels; it provides a huge database of data on the city in all its aspects (infrastructure, buildings, spaces, movement paths, people, and the environment) to help compound's administration to reach to the facts and solve the problems facing the compound, in the present and future.
2	**Monitoring & Detection - Ground Surveillance Technologies**	CCTV	Two types of cameras are to be used and placed on two levels: (1) The first level: put cameras at the entrances of the compound and its main and secondary exits, streets, main, secondary and secondary intersections, the entrance and exit of the building, the internal corridors of the compound and important sites. These cameras are to be placed to achieve the highest percentage of coverage of the site. These types of cameras transmit the images or the incidents in real time so that the security or civil authority (administrative and service) responsible for the site can determine the situation and take the appropriate decision according to the nature of the incident or situation. Cameras with high specifications and approved by specialized technical authorities are used to achieve the intended purpose. (2) The second level: Multi-Sensor Panoramic + PTZ Camera: To be used in public squares and major crowded intersections within the compound, which makes it necessary for monitoring devices to photograph the entire area to ensure safety. (3) Supportive technologies and software: The two levels reinforce the supportive software that enhances the work of the system and helps the responsible party to take the appropriate decision, including (anticipating crowd density, tracking people, etc.)
		ANPR	The ANPR is used in the compound and are placed as follow: (1) At the entrances and exits of the compound. It helps to know the exact details about the vehicle or the bike (such as (number, type, colour, model, belonging...etc.) as well as knowing the time of entry and exit of the vehicle to the compound and the period during which it can stay. This greatly assists the authorities responsible for security in the city in law enforcement procedures in terms of quickly tracking suspects, movement paths and stopping points. It is considered a strong complement and auxiliary that works in parallel with surveillance cameras and other security systems within the city, and achieving integration between them greatly helps the authorities responsible for the city to take the appropriate decision supported by evidence. (2) Supportive technologies and software: it enhances the functioning of the system and helps the responsible party to take the appropriate decision, including (vehicle cameras, traffic enforcement applications, traffic flow management, vehicle counting system, traffic event detection, traffic flow report, tracking vehicles and bicycles).

		UVSS	This system is used at the main and secondary entrances and exits of the compound. This system assists the security authorities responsible for security in the city by monitoring the bottom of vehicles to prevent the transport of explosives, blasting accidents, and smuggling of contraband. The system works with other systems and technologies inside the compound to enhance security
		RFID	The RFID is distributed at the entrances to the compound and the necks of the main streets and intersections to know the movement of vehicles and the times of entry and exit of each vehicle or bicycle, as it helps in tracking the vehicle or bicycle and help the relevant authorities the to detect them.
		GPS	This technology is used to locate people, vehicles, and bicycles, as well as belongings of interest. This system is linked through software developed on mobile phones and laptops as well as vehicles and bicycles to determine their locations. This technology helps the security and service agencies to locate locations for the purposes of security or service work. This technology reduces theft, smuggling and other incidents.
		Supportive Technology for Monitoring	In order to achieve integration and support the monitoring and detection system, there must be other technologies and software that enhance the work of the system in monitoring people, vehicles, bicycles, drones, etc., including (GIS, mobile phone tracking, emergency phone station, track tracking based on data integration)
3	**Verification**		Verification technologies are very important and complement the level of surveillance technologies, where the work of these technologies is to verify the identity of people (citizens, residents, and expatriates) or vehicles or bicycles. Immaterial in the compound. This is done by matching the data coming from the monitored technologies with the existing database through advanced software for matching among these technologies (ANPR, Biometrics)
4	**Reaction/Response**		The level of response after the process of verifying the identity of the person, vehicle, or bicycle is by instructing the nearest patrol or control to move towards the person, vehicle, bicycle, building, space, road, etc. The process of integration between the three systems (monitoring, verification, and response) is a major reason for the success of the technology system within the compound. In order for the response system to succeed, it is necessary to strengthen (alarm, communications, and support software).
5	**Supportive Technology**		Building a solid base and strong infrastructure within levels and stages, according to the requirements and available capabilities, and the budget allocated for the complex to build and use all the supportive technology that was referred to above. Wearable and Embedded, Internet of Things, Cloud Computing, Artificial Intelligence, Information and Communication Technology (ICT), Threat Forecasting, Software)

2. Conclusions related to implementation:

- There is no management and control centre in the complex
- Administrative operations in the complex are traditional

- Lack of technologies to be used in the compound at the (monitoring) level, with the lack of verification and response technologies.
- Surveillance cameras used in the compound are from the residents of the compound only, and there is no standardization in their use.
- The specifications of the cameras are to achieve the minimum level of surveillance and are not consistent with the requirements and controls of the Iraqi Ministry of Interior.
- Lack of data on the residents of the compound
- No supporting technologies are available.

3. It is recommended to:

- Update the residents' data and the visitor's data with building an integrated database for the compound.
- Encourage the residents to be active participants in the planning, design or service decisions of the residential compound.
- Conduct a periodic evaluation and assessment of equipment and software for security and civil technologies.
- Maintain periodically the equipment and software for the compound.
- Integration between the systems (monitoring, verification and response) in the compound, and one of them is complementary to the other.
-
- Update the hardware and software of the compound's monitoring centre.
- Predict the threats and risks that residents/visitors, infrastructure, building, spaces, and movement paths may be exposed to, at present and in the future.
- Analyse problems and finding effective and quick solutions to solve them.

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