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ASSEMBLY OF INFORMATION TECHNOLOGY COMPONENTS IN ESTABLISHMENT OF FOOD/FEED QUALITY AND SAFETY CONTROL SYSTEM

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ABSTRACT

In a study to utilize modern **information technologies** in establishment of **food/feed safety** control system; a study was conducted using **mobile** monitoring devices such as smart phones, **car tracking** system, audio video **real-time broadcasting** device, **GIS** application, portable internet access device, **Wi-Fi** thermometers to designs a replied **quality control** inspection system which can be applied in food manufacturing stockholders including official inspection authorities.

Results obtained from application of the used modern information system and the mentioned quality control systems revealed that, by using these devices and inspection program (s), both the official bodies and the producers themselves can cooperate to improve the inspection/production activity to assure compliance of the end product with the **safety** guidelines and subsequently human/animal/**environmental safety**.

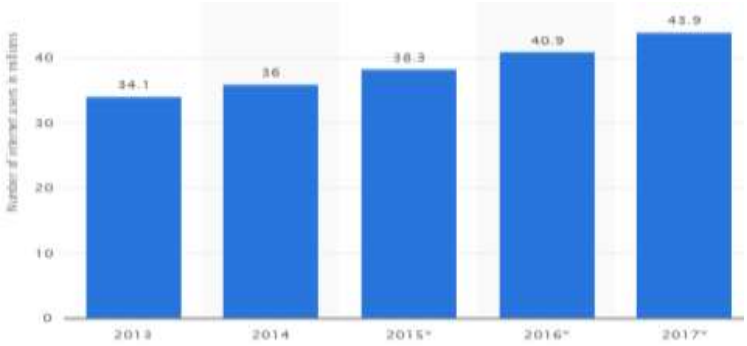
Key Words: Quality Control, Inspection, HACCAP, Luncheon, Feed, GIS, Car tracking, Audio Video broadcasting, Smart Phones, information system, Wi-Fi thermometers.

1. INTRODUCTION

Information **T**echnology (**IT**) is the language of this age, it is not possible currently to create any serious work methods without dependence on it, especially as it has created very advanced solutions not only in the field of databases and access them efficiently, but also very advanced applications have been developed in the field of **tracking** and **control** technologies for both humans and **vehicles**. Also, Internet has become the **lifeline** for both individuals, local and international bodies. The invention of the fourth generation of mobile **IT** systems (**4**G) at its enormous speeds which is at least **100 Mbit/s,** the fifth generation of mobile **IT** systems (**5G**) technology speed at least **1000 Mbit/s**, that will led to a great development in the field of voice and motion

broadcasting, which helps in the transformation from the phased of the traditional papers documentation of the events, to the modern phase of visual authentication on voice and motion, which is a very important addition in the field of inspection and control.

Number of internet users in Egypt grown in the last few years to a large extent they were about 34.1 million users in 2003 and reach about 43.9 million internet users in 2017, this growth shows that the use of information technology has become enormous and indispensable as shown in Graph (1).



Graph No. (1): Number of internet users in Egypt

In the age of great information technology and evolution of Internet, development of a digital system that uses these modern technologies in the formation of step by step monitoring approaches, maximize the benefits of such information and thus facilitate the task of achieving "**safety**" and "**quality**" of **food** and **feed**, especially when the system is supported by mobility technology like smart phones and Geographic Information System (**GIS**) like car tracking applications.

Therefore, monitoring process should be carried out with the latest possible technology and equipment which enable following and monitoring of any process in a real time beside the personal inspection by the official persons. Thus improving the inspection of the quality control approaches is a key factor to control all processes firmly which lead to increased efficiency of inspection quality and efficacy.

In view of the decision of the President of the Republic, which published in the Official Gazette of the State by the Law No. (1/2017) dated January 10, 2017, on the development of inspection and control of food, It emphasizes the application of HACCP and the application of modern methods of food inspection and inspection, Advanced data, the use of modern information technology (such as mobile technology, GIS and vehicle tracking systems...) in building an advanced technology inspection system is an effective application of advanced inspection and control systems.

With the knowledge that, food-borne diseases caused by infectious or toxic agents that enter the body by ingestion of contaminated food and/or water, cause health problem in many developed and developing countries**.** The main causative agents of food/feed poisoning are bacteria (66%) and viruses (4%).

The quality of food/feed is complementary to its safety, therefore, the concept of quality and safety is considered complementary to each other. Having a quality control approach and having a reliable tool for verification of its application is considered as crucial points to assure obtaining safe food/feed with the required parameters that comply with the international and/or national standards.

AIM OF THIS WORK:

- Development of **High Information Technology Quality Control Inspection** system
- Development of **GIS** module and car tracking system and integration of it with the developed system.
- Development of **Mobility Technology Module** for the whole system

MATERIALS AND METHODS

MOBILITY, GIS AND INFORMATION TECHNOLOGY TOOLS:

In order to implement technological evolution in the field of inspection and quality control of food and feed, the latest technology will be used to build and handle this system, following Figure shows the logical design of the materials of the suggested system followed by an explanation of all its components.

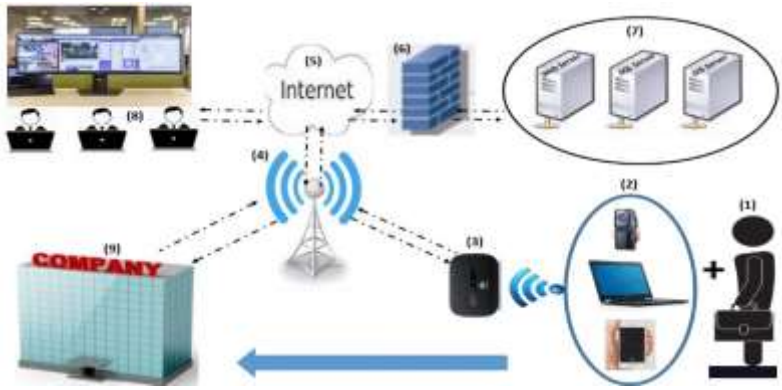


Figure No. (1): The logical design of the suggested system

The main factor in this system is the inspector who carries out the mission (as shown in No. 1), the inspector needs immediate information about the company or the factory (as shown in No. 9) that conducts the inspection and supervision, he also records any irregularities he found immediately on the system database.

In order of that, we must equip him with modern communication devices (as shown in No. 2), to connect to the system and interact with it, such as a smart phone through which to access the system and deal with, also to review the required data about the target factory, and a communicate with the operating room. Laptop or a tablet instead of the smart phone. A high-quality video camera with Internet connectivity to stream audio/video transmission to observers in the operating room (as shown in No. 8).

Because of this system is an interactive system and built on the "on-line transaction processing technique" for all business partners, the inspector must provide with a 4G high-speed My-Fi communication device (as shown in No. 3) so that he can enter all his tools (shown in No. 2) to get a suitable internet speed for sharing information and completing the process of transferring audio/video in a proper manner.

Because the My-Fi communication device (as shown in No. 3) works with a mobile SIM card, therefore requires contact with the mobile signal carrier "Cellure Network" (as shown in No. 4) and through it the Internet is connected (as shown in No. 5) to our system to exchange information "send and receive".

Applying professional methods of communication work, it is necessary to have a "firewall device" (as shown in Figure 6) as a way to secure and protect the system and acts as a gateway to and from the servers on which the various system applications are located (as shown in No. 7), such as Web server, application server, GIS server, serve ... etc ... On the other side, by using the same communication method to access the system through the Internet, the interviewers in the operating room can monitor all the mission process step by step "on line" and follow the inspector "live" and can give him any guidance if necessary (as shown in No. 8).

METHODS

INTERACTIVE WEBSITE:

Simply, such dynamic web pages have two main components; Style of the page and information. Style of the page is created using tools like HTML, CSS, JavaScript while the information is stored separately in a database. When a dynamic page loads in browser –it requests the database to furnish information depending upon user's input. When the page receives this information from database –the styling code gets applied on it and the resulting web page is displayed to the user as shown in the next fig.

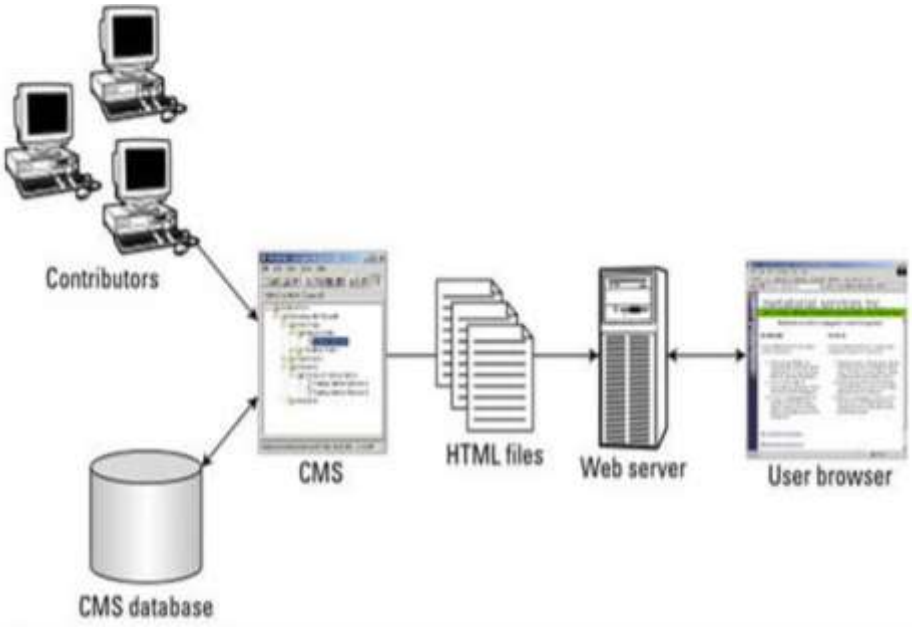


Figure No. (2): Logical Design of Interactive Website Architecture

Web Application Architecture is the main point in our interactive web site, as it's architecture is a framework that is comprised of the relationships and interactions between application components, such as middleware systems, user interfaces, and databases.

The general concept of Web Application Architecture is in line with the concept of a browser user who triggers an application that is capable of running in multiple websites[1].

In essence, Web Application Architectures can be defined with the depiction of this process:

- A user browses for a specific URL, which the browser locates and requests.
- Over the network, data is sent from the server to the browser, then executed by the browser so that it is able to display the requested page.
- The user views and interacts with the page.

Web Application Architecture includes all sub-components and external application interchanges for an entire software application.

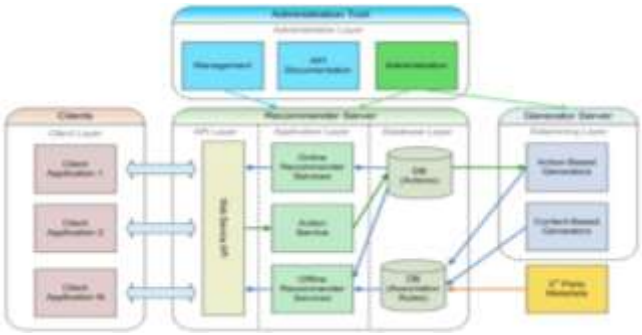


Figure No. (3): Web Application Architecture Diagram

The Figure is present Web Application architecture and its database Layer for the access of user Actions and item Association Rules, an Application Layer for Online and Offline Recommender Services, and an API Layer for various Web Services. Moreover, the Generator Server contains different (so called) Item Association Generators which create business rules that define a relation between two items.

Additionally, the architecture allows the import of Third-Party Metadata. Technically, a Client Application tracks user Actions and sends them to our Recommender Server via a Web Service call. Those Actions are then stored in the database. The design of our RS allows both online and offline recommendations. Online algorithms use Actions directly to compute Recommendations for the user, while time-consuming methods run as offline Generators that produce item associations which are then queried and post-filtered (with filtering methods, e.g. history filtering, duplicate filtering etc., using the present user Actions) to present meaningful Recommendations.

Additionally, Offline Recommender Services can make use of Third-Party Metadata provided as IAR. Recommendations are again provided to the Client Application via several Web Service methods.

The interactive website in the system is a specialized Internet site designed to serve this system and connects the participants involved in the work to be the system interface application.

The importance of the effective website is the major communication way between all parties participating in the work tasks, which plays the key role to allow the users of the system to access the database from anywhere and at any time to obtain the necessary data in an appropriate time.

The way to accesses the different system components like car tracking, manufacturing, quality control, monitoring, according to the users right and privileges, also to arranges and adopts the work flow processes, that allow each user of the system the direct access to his allowed job only.

It is the way to get data and information about the companies, factories, stores, etc… that are targeted to carry out the mission, for example, manufacturing licenses, registrations forms, licensed products manufactured data and company's contacts information.

CENTRALIZED DATABASE:

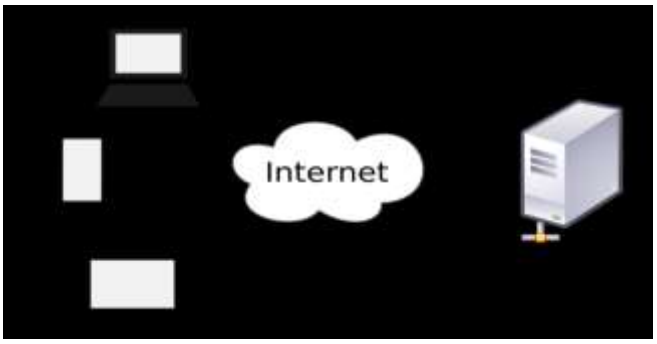


Figure No. (4): The logical design of centralized data base

Important to the centralized data base is the heart of the system as it contains the data of all the parties participating in the work cycle, such as the data of the companies and their branches and stores - photocopies of the company's documents - the registration data for the manufacturing of the products - the data of the required missions and their implementers. Also, it is the main way the inspectors can obtain the information necessary for them to perform their work at the same time and from anywhere.

by using the centralized database, the users can prepare the inspection minutes and the necessary reports about the mission online without any interference from anyone. All the differences that were recorded by the inspector are immediately identified and communicated to those responsible for the control, the operations room and the follow-up. This system built by using Microsoft SQL database server which is a relational database management system developed by Microsoft. As a database

server, it is a software with the primary function of storing and retrieving data as requested by other software applications—which may run either on the same computer or on another computer across a network (including the Internet).

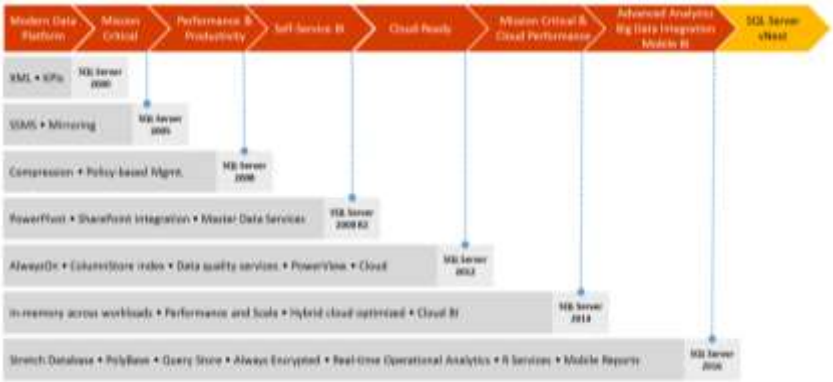


Figure No. (5): The evolution of SQL Server functionalities added across releases

The Real-time operational analytics SQL Server introduces real-time operational analytics the ability to run both analytics and transactional workloads on the same database tables concurrently.

CAR TRACKING SYSTEM:

Car Tracking System is a GPS device is installed in the vehicle dedicated to the mission. It is connected to a specified application thought the internet, that deals with actual maps to monitor the movements of the observers at the inspection mission at a rate of every five seconds. The following Figure is the Logical Design of the Car Tracking System.

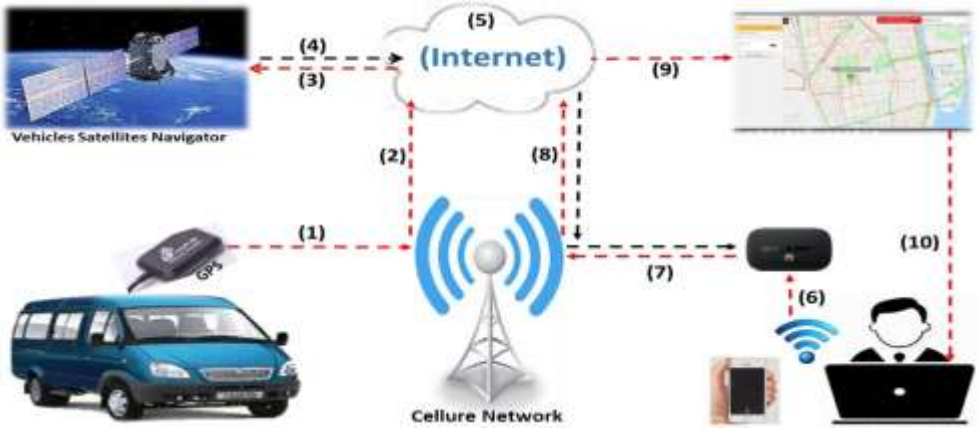


Figure No. (7): Car Tracking System Architecture

The Geographic Positioner System "GPS" device is installed in the car of the mission

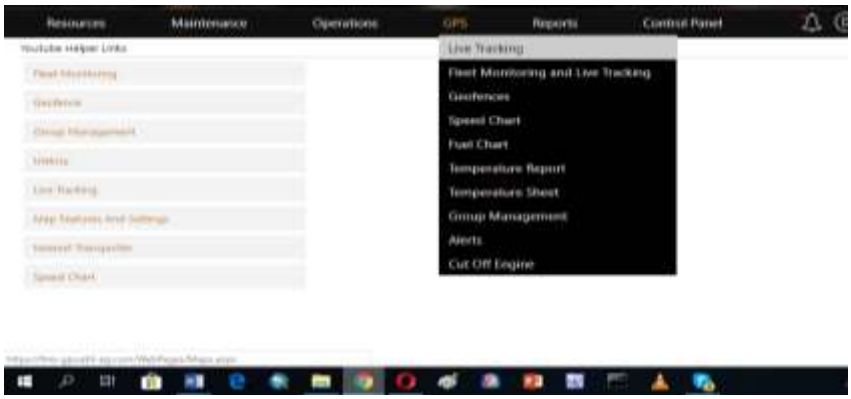
(as shown in No. 1.), so that it can be traced and determined. GPS works on a SIM Card, so the Cellure Network should be connected (as shown in No. 2) in order to track the vehicle's moving information to be modified and redirected every five seconds and record it in a geographic map. This is done by direct contact the GPS with "Vehicles Satellite Navigators" (as shown in No. 3-4.). Vehicles Satellite Navigators connect the internet (as shown in No. 5) so we can get the car moving information by accessing the internet from our mobiles or laptop using wi-fi connection (as shown in No. 6) by using a specific software.

The connection way to the user will be suitable using the Mi-Fi Device (as shown in No. 7) which also connect Cellure Network to connect the internet (as shown in No. 8), so the user can locate the car moving "Live" on the geographic map (as shown in No. 9) and receive it again at his mobile or computer by using the specific software (as shown in No. 10) .

In this system we did not develop the car tracking system itself, but we bay it from a specialized company in the field of care tracking, and we successfully linked it by our interactive web site.

Benefits from using Car Tracking System in the inspection process, that we can follow-up the move of the Missionaries car step by step, where the moving of the team is tracked and shown on maps showing the complete route such as the name of the area, the street name, the current speed of the car, the condition of the vehicle in case of moving or stopping and the period it stopped. The aim of this system is to follow the Mission line to ensure compliance.

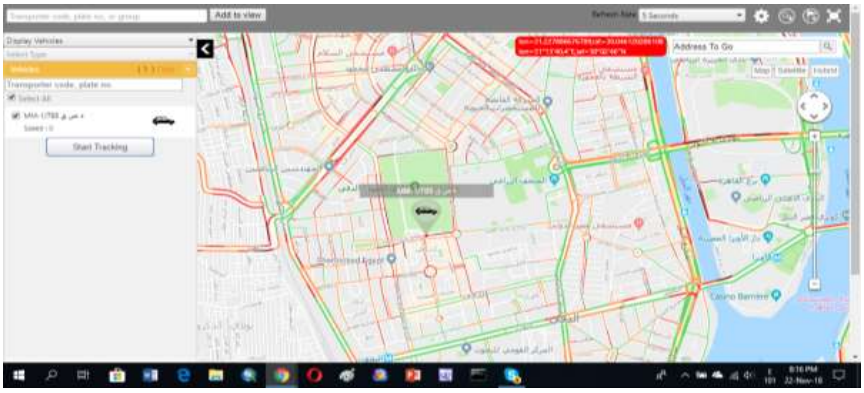
it's clarify them on an actual map of the event site with the possibility to analyze these movements moment by moment so we can record any irregularities on official routes, registration of the places visited by the Commissariat, pursuing the prescribed speed to ensure the safety of persons. It consists of may screen such as:



Screen No. (1): Main Application Screen

This is the main screen of the system, which allows the user to choose any job wants to follow it as the system is rich in functions and capabilities that are useful in the tracking of the inspections mission cars which is the most important functions to us is like (Cars Live Tracking– Speed Chart- Cut of engine- etc…).

Also through this screen we can extract different reports about the mission like (Cars Active Time Reports- Parking Time Report- Movement Activity Report- Active Detail Report –etc…).



Screen No. (2): Live Tracking Screen

This screen shows a geographical map of the sites where the car is located in, and is automatically updated the car status every five seconds. Also, the direction of the movement of the car is shown, and the position is clarified if it stops or moves, also the main street names or even the sub-sections where the vehicle is located.

The importance of this part of the system is the actual follow-up moment to the cars that perform tasks, and determine the time and place, the period in which they were stopped, in order to ensure that they are actually carried out, as well as to monitor the extent of the stability of the driver at legal speeds to maintain the safety of the inspectors themselves.

GEOGRAPHIC INFORMATION SYSTEM:

A geographic information system (GIS) is a framework for gathering, managing, and analyzing data. Rooted in the science of geography, GIS integrates many types of data. It analyzes spatial location and organizes layers of information into visualizations using maps and 3D scenes. With this unique capability, GIS reveals deeper insights into data, such as patterns, relationships, and situations—helping users make smarter decisions.

The following figure simply illustration the logical design of the concept of how GIS work with the maps to present it to the users.

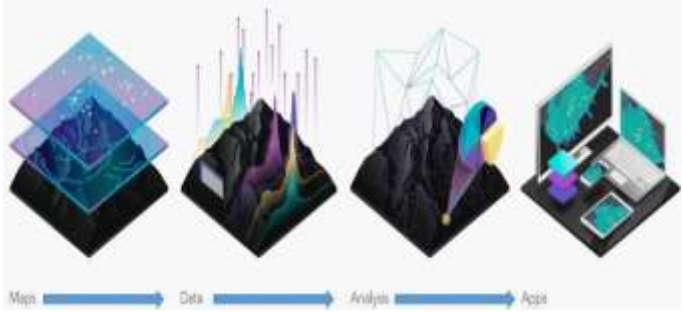


Figure No. (8): Logical Design to GIS

Maps are the geographic container for the data layers and analytics you want to work with. GIS maps are easily shared and embedded in apps, and accessible by virtually everyone, everywhere. GIS integrates many different kinds of data layers using spatial location. Most data have a geographic component. GIS data includes imagery, features, and base maps linked to spreadsheets and tables.

Spatial analysis lets you evaluate suitability and capability, estimate and predict, interpret and understand, and much more, lending new perspectives to your insight and decision-making. Apps provide focused user experiences for getting work done and bringing GIS to life for everyone. GIS apps work virtually everywhere: on your mobile phones, tablets, in web browsers, and on desktops.

REAL-TIME VIDEO STREAMING DEVICE:

Live Video Streaming is a process which constantly receives multimedia from an input source like IP Camera, mobile, surveillance camera, laptop etc. and displays it to the end-user using any streaming provider. The multimedia shared between the input and the output device is referred to as the Video Stream, below Logical design for LIVE VIDEO STREAMING workflow:

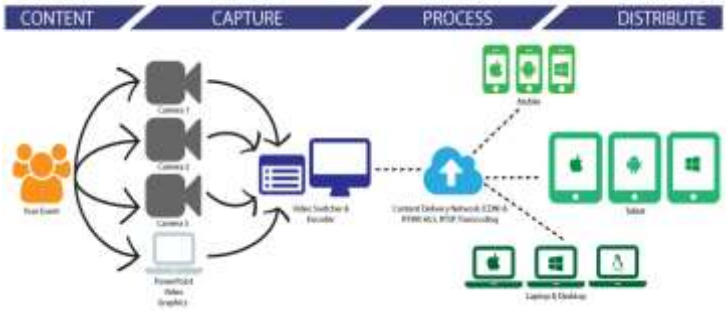


Figure No. (9): Logical design for LIVE VIDEO STREAMING workflow

This illustration shows the main elements of the video streaming process, which includes “Content” which is the video and audio required to be transferred, and are recorded by the “Capture” step which is made by video devices of different types and formats provided which has the ability to connect to the Internet and has its own IP address, And can process the switcher and encoder for the video files to convert it to the data format that can be handled in the Step of the “Process” dealing with audio/video and send to the Internet, then the process of the “Distribution” can be handled and received through specialized programs installed on the smart mobiles devices or computer connected to the Internet.

MOBILE INTERNET DEVICE:

A Mobile Internet Device (MID) is a multimedia-capable mobile device providing wireless Internet access. They are designed to provide entertainment, information and location-based services for personal or business use.

The next diagram shows the logical Design to the **Mobile Internet Device**, which no. (1) is the internet users whom have a smart phone or a computer, lab top tablet with a Wi-Fi connected to some Mobile Internet device as shown in No. (2)

which is work by a SIM card, therefor must connect by the Cellure Network as shown in No. (3) and the Cellure network connect to the internet to send and receive the data as shone in No. (4) .

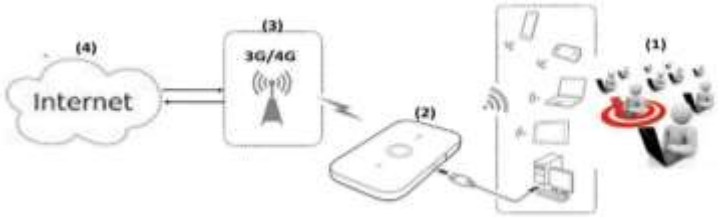


Figure No. (10): Logical Design of the Mobile Internet Device

In this system the Mobile Internet Device will be the way to make the work staff always connected to the Internet during the mission to be able to login on the system and call the necessary intents of his work, and also through the cameras are connected to the Internet so that the followers of the mission to follow the moment image and video and in addition to the introduction of any other tools needed by the team such as a mobile phone, Laptop, etc… and it must be characterized at high speed transfer so that you can transmit the sound and image clearly, so we used the (My-fi) device as a mobile internet connector with download speed up to 150.0 Mbps, upload Speed up to 50.0 Mbps, internal memory Up to 128MB, support both 3G and 4G networks, ability to connect up to 10 different devices at the same time.

CONTROL ROOM:

It is a place equipped with large screens, fast internet connections, computers and smart mobile phones, controlled by specialists in inspection and quality control, and its function is to follow up and direct the officials of the mission, and ensure the proper functioning and give the necessary orders to the team.

RESULT AND DISCUSSION

As **food safety** is considered as a very important target for healthy and life, ensuring the obtaining of safe food is a major demand for every person. Determining of the current situation concerning the safety parameters of available food to start a successful plan for controlling health hazards.

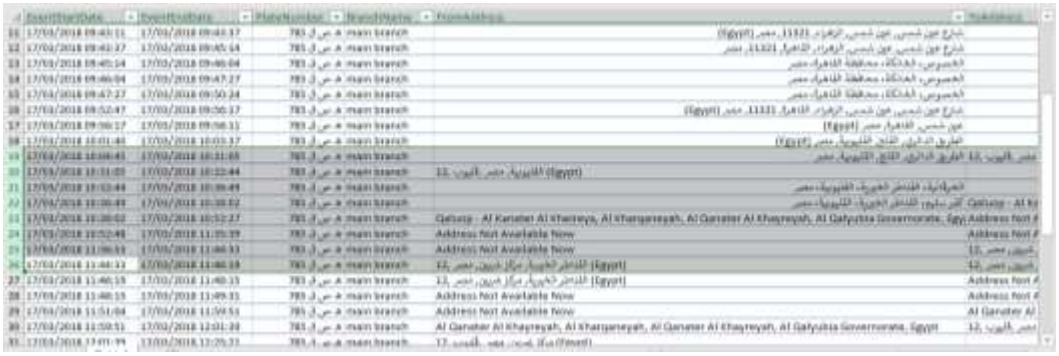
The **Safe food** starts from The **Safe Feed**. So inspection and control of manufacturing, storage and handling operations for **both FOOD/FEED** can not be separated.

So, making a survey on Inspections and control of both "**fattening Feeds" and "Luncheon Food"** factories and common outlets by using **proposed system, to get the required samples for official analysis, is very effective in control and inspection**.

In order to obtain the **samples** for which **laboratory tests** were conducted for the feed samples, several inspection and control tasks were carried out **using the proposed system** such as the mission for inspection of a feed factory on 17/3/2018. At 10:00 am, 10.04 minutes from the **MARG area**, the target was reached at **EL-Qanater**

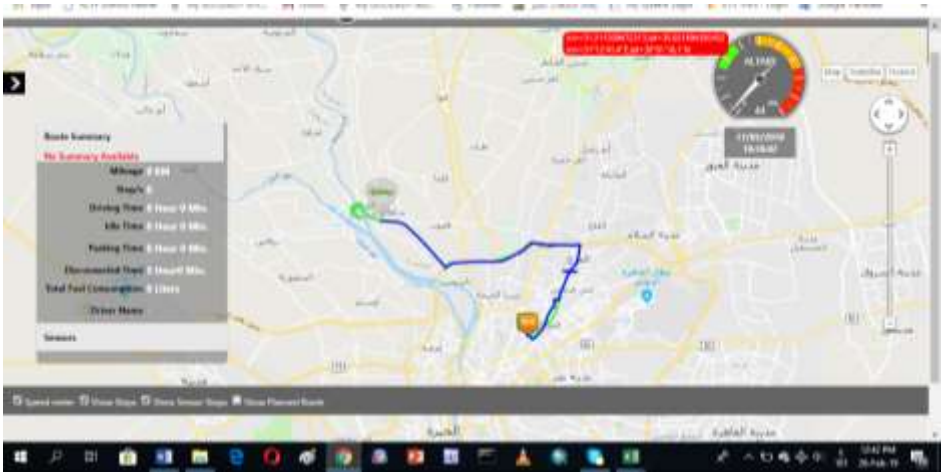
city at 11.34. As shown in the table for **vehicle tracking tool which used by the system operator**.

Which also shows the tracking of the car mission by the names of the areas passed by the car and the time of traffic very strict to ensure compliance with the official route of the mission, and also shows the duration of the car to confirm the logic of the implementation of the task as shown in screen (3).



Screen No. (3): Car Tracking table 1 screen

Also, by using the proposed GIS tools, which include a GIS application that allows instant tracking of the vehicles on actual location maps, we can directly track the actions of the mission to ensure that they are carried out, as shown in screen (4)



Screen No. (4): On-line Car Tracking GIS Map

At the time of the arrival of the staff of the site of the event they entered the system screens by mobile phone - (Laptop - Table) - and using the system steps, which were explained in the discussion the system at the beginning of the step review the factory data until the sampling and extraction of the final report.

The use of the proposed information system led to the clarification of the factory's violations to the Egyptian standard specifications in terms of cleanliness and storage conditions and the visual documentation of serious violations of the system, such as storage in a bad manner in exposed places as shown in Picture (2)

Picture No. (2): Storage in a bad manner in exposed places

As well as documentation vision of the dirtiness of cleanliness of the plant from the inside presence of tall significantly, causing the presence of insects and rodents, as shown in picture number (3).

Picture No. (3): Dirtiness of cleanliness of the plant

In addition, there was monitoring and documentation of serious violations inside the warehouses, such as the lack of any means of safety and the absence of wooden bases, in addition using the store as a parking garage workers, as shown in the picture (4).

Picture No. (4): Bad stores method

The proposed integrated digital content system used in this study composed of many factors which together tightened the monitoring system either official is or the in house are.

Interactive Website:

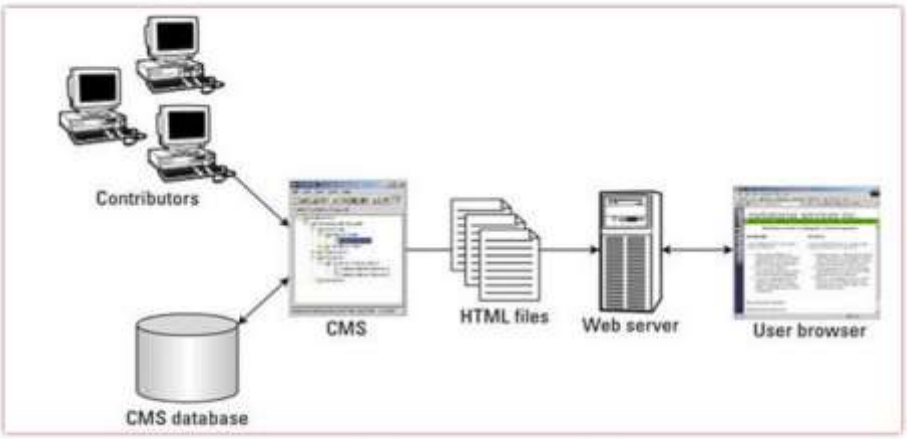


Figure No. (12): Logical Design of Interactive Website Architecture

Web Application Architecture is the main point in the interactive web site, as it's architecture is a framework that is comprised of the relationships and interactions between application components, such as middleware systems, user interfaces, and databases. The general concept of Web Application Architecture is in line with the concept of a browser user who triggers an application that is capable of running in multiple websites[2]. Web Application Architecture includes all sub-components and external application interchanges for an entire software application. The interactive website in the system is a specialized Internet site designed to serve this system and connects the participants involved in the work to be the system interface application.

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It is the way to get data and information about the companies, factories, stores, etc… that are targeted to carry out the mission, for example, manufacturing licenses, registrations forms, licensed products manufactured data and company's contacts information.

[2] **https://svitla.com/blog/web-application-architecture**

Through this website, the data of the missions are entered, and the current situation of companies whether the violations or the conformity. Based on this step, the official reports are produced, which can decide to close the company completely.

CENTRALIZED DATABASE:

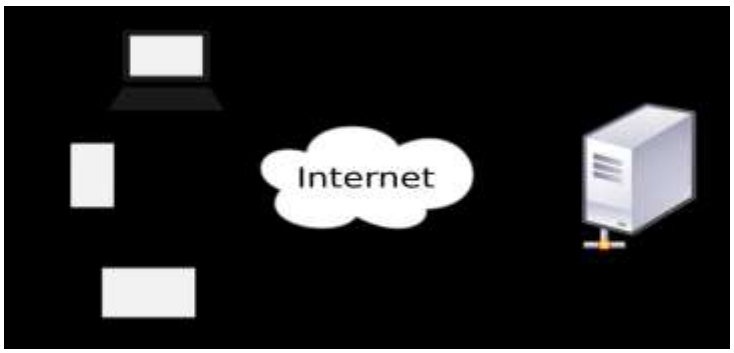


Figure No. (14): Centralized Database Logical Design

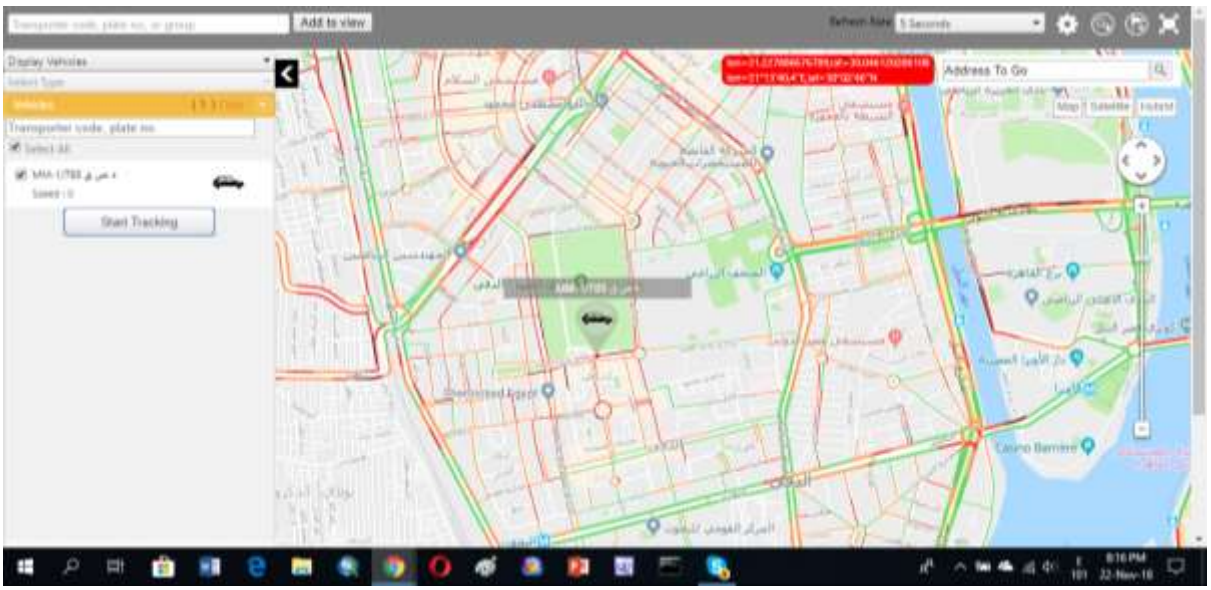
By using the centralized database, the users can prepare the inspection minutes and the necessary reports about the mission online without any interference from anyone. All the differences that were recorded by the inspector are immediately identified and communicated to those responsible for the control, the operations room and the follow-up.

The Real-time operational analytics SQL Server introduces real-time operational analytics the ability to run both analytics and transactional workloads on the same database tables concurrently.

CAR TRACKING SYSTEM:

Benefits from using Car Tracking System in the inspection process, that we can follow-up the move of the Missionaries car step by step, where the moving of the team is tracked and shown on maps showing the complete route such as the name of the area, the street name, the current speed of the car, the condition of the vehicle in case of moving or stopping and the period it stopped. The aim of this system is to follow the Mission line to ensure compliance.

This is the main screen of the system, which allows the user to choose any job wants to follow it as the system is rich in functions and capabilities that are useful in the tracking of the inspections mission cars which is the most important functions to us is like (Cars Live Tracking– Speed Chart- Cut of engine- etc…). Also through this screen we can extract different reports about the mission like (Cars Active Time Reports- Parking Time Report- Movement Activity Report- Active Detail Report – etc…).



Screen No. (5): Live Tracking Screen

This screen shows a geographical map of the sites where the car is located in, and is automatically updated the car status every five seconds. Also, the direction of the movement of the car is shown, and the position is clarified if it stops or moves, also the main street names or even the sub-sections where the vehicle is located.

The importance of this part of the system is the actual follow-up moment to the cars that perform tasks, and determine the time and place, the period in which they were stopped, in order to ensure that they are actually carried out, as well as to monitor the extent of the stability of the driver at legal speeds to maintain the safety of the inspectors themselves.

GEOGRAPHIC INFORMATION SYSTEM:

Arc GIS mapping and analytics software allows to visualize and analyze data in terms of its location on the map, also can enhance data with content from Esri's collection of global geographic information. Then, using ArcGIS to take accurate measurements, spot patterns, and identify relationships among features, also can plan efficient routes, perform profitable site selection, and model predictions to make better decisions.

ArcGIS, can easily collect, crowdsource, store, access, and share data efficiently and securely, integrate data stored in the systems and geo-enable any data from any source.

The Real-time function of ARC GIS empowers with location monitoring of any type of sensor or device accelerating response times, optimizing safety, and improving operational awareness across all assets and activities, whether in motion or at rest.

By using GIS application in this system we can locate and follow-up any threats or risks that may affect products, such as the appearance of mad cow disease, avian influenza, or infectious epidemics in areas close to the factories and production lines of a particular company, are recorded, the site is carefully mined, Warning warnings.

REAL-TIME VIDEO STREAMING DEVICE:

It's a small device with the ability to transmit audio and video with high definitions and broadcast directly by connecting to the Internet, and will be used by the staff of the mission, which of course has the immunity of judicial regulate to do so, the purpose of using this device is to record and direct transfer the events in the mission of the follow-up rooms to ensure neutrality professionalism and full functioning of the mission.

MOBILE INTERNET DEVICE:

In this system the Mobile Internet Device will be the way to make the work staff always connected to the Internet during the mission to be able to login on the system and call the necessary intents of his work, and also through the cameras are connected to the Internet so that the followers of the mission to follow the moment image and video and in addition to the introduction of any other tools needed by the team such as a mobile phone, Laptop, etc… and it must be characterized at high speed transfer so that you can transmit the sound and image clearly. In this system we used the (My-fi) as a mobile internet device with download Speed Up to 150.0 Mbps, Upload Speed: Up to 50.0 Mbps, internal memory Up to 128MB, support both 3G and 4G networks, ability to connect up to 10 different devices at the same time.

CONTROL ROOM:

It is a place equipped with large screens, fast internet lines, computers and mobile phones, controlled by specialists in inspection and quality control, and its function is to follow up and direct the officials of the mission, and ensure the proper functioning and give the necessary orders to the team.

CONCLUSION

- The use of information technology especially Mobility Devices greatly helps in monitoring the quality of performance of the tasks of inspection and control of both food and feed.
- Providing the inspectors with the necessary mobile technology connected to an advanced information system, which contributes to the control of the performance of work and control.
- The use of the proposed system leads to benefits that were not previously available. Such as vehicle tracking applications, on line data transaction, video and audio on line broadcasting, to adjust inspections and control.

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