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# Design and implementation a network mobile application for plants shopping center using QR code

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| Article Info | ABSTRACT |
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| | During the revolution of developing mobile phone applications, they can be used in different fields like business, health, transportation, communications and tourism, and other uses. This paper presents QR based information management system for plants shopping centers. This system includes two main sides: mobile and server. The proposed application is used as a substitute for the human guide that each visitor needs in the plants shopping center. The complete information can be provided on any seedling displayed in the shop depending on the QR code technology. Each branch of the same enterprise includes sub-server that is linked to the main server using a private computer network. The server side contains information of all plants and all branches for such enterprise in the form of text and image in different languages. The proposed application facilitates the movement of the customer inside the place, the ease in preparing bills electronically that helps the visitor to save the time of queue to preparing the bill and paying. The proposed system is tested over different case studies to prove the efficiency in terms of information and selling management.<br><br> |

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## 1.    INTRODUCTION

Some institutions, such as exhibitions, libraries, shopping centers and museums, have achieved a large and increasing growth in the number of visitors. Because of the large increase in population density and the inquisitiveness of people in discovering the world, it is necessary to manage this large number of visitors in organizing their movement and requests in addition to providing information about the objects when the visitor needs to its, all of this requires appropriate, qualified and efficient guidance [1]. This problem was solved by providing a qualified human guide for such a task where he has extensive knowledge of the elements or services provided by the institution or the human guide may have several languages to communicate with different nationalities [2, 3]. It is difficult to find people with all these qualifications, in addition to the wages for being high. Because of that, there is a great need to establish a smart electronic guides system that provides complete information to customers anytime or anywhere he prefers. In addition, such systems work to improve the services and performance the institutions provide to customers, which leads to an increase in the number of visitors due to the customer's comfort within the organization and thus leads to an increase in profit [3, 4].

In this paper, the technique of QR codes is used to design an information management system that works as electronic guide system. QR codes are emergent to smartphones and greatly utilized to it in different fields and the ability to connect to the Internet. This leads to many different fields to search for an increase in

capacity storage or use security applications to hide information. All these made the QR codes more attractive than barcodes in terms of data quantity of about ten of the traditional barcodes can be encoded in just one QR code. Moreover, in the QR codes can encode different types of data such as SMS, URL, plain text and contact information [5].

## 2.   RELATED WORKS

As mentioned above, the electronic information management systems were considered by numerous researchers in last few years. Different opinions and ideas were introduced throughout the presented research work. In [6], the authors suggested a method to facilitate the process of adding privacy to patients' medical images, without compromising the confidentiality of the patient's medical data. The QR codes were used to include information that could be used to individualize the patient. The original image did not differ greatly from the image to be shared. After the QR code was read, some information about the patient was sent. Thereafter, patient information was retrieved using inverse functions. In [7] an electronic attendance system for students was presented to develop and design to be used in vocational schools. The focus was on developing an application using QR code technology. So, the proposed system enabled teachers to accelerate the process of taking attendance for students and thus would provide a good teaching time for students. In addition, this system helps students avoid negative effect that may result from a lack of class attendance and which lead to their being punished at the end of the semester by officials.

Maner [8] suggested the augmented reality system designed and implemented for Android mobile phones. The system works in extra high-voltage substations to ensure the correct and safe operation of switches and emphasize the status in real-time from SCADA the sub-station. It was based on a web application to manage it and an Android system for the mobile device. In this system, the QR codes were used as tags that were generated in an efficient way for the specific identification of each switch of the sub-station. In [9], the authors introduced a mobile application for automatic guidance to visitors that can be used in many institutions such as tourism, commercial, health or education. It worked as an automatic guide, as it provided information about the elements displayed inside the institution to customers without the need for a human guide that accompanies the visitor constantly. Information was provided to customers in this application in two formats, voice and text, to be appropriate in the places of use, in addition to this application supports several languages to suit the visitor's nationality. The system was implemented using the QR codes and Raspberry Pi 3, as an integrated electronic and automatic guidance system.

At the other side, in [10] a data retrieval system using (Near Field Communication) NFC technology was presented. The system was designed and implemented to transfer and read stored data from the device storage panel that locate at the recycle bin. In the past, data was collected from storage devices manually through the use of an SD Card, and then data was sent to the regional workstation to be uploaded to the data center. In the proposed system, the device creates an NFC connection automatically with the Recycle Bin panel. Jagodi [11] suggested a system for identifying objects based on the Android system for mobile devices, where the technique of QR codes was used for the identification of each object. This system has been progressed to help, simplify and facilitate the identification of a diverse number of items in an inventory. In [12], authors suggested a new structure to improve work of the health care system using mobile devices that rely on the Android operating system, Bluetooth and NFC interfaces. The medical errors were reduced using secure medical signs (SMS), storing electronic health records in the Secure Health Card, based on the NFC tags.

He [13] presented the electronic ticketing system, mainly relying on the QR code technology. The system consisted of several layers: layer for physical devices, a layer for the Android operating system, a layer for image capture and network processing, a special layer for decoding QR codes and the last layer for user interfaces. The advantages of this system were characterized by the use of electronic tickets instead of paper tickets, saving money, reduce of consuming time in the manual reservation. In [14] O. Al Hammadi *et.al*, suggested a system for indoor guidance to visitors using mobile phones and based on the Android operating system. It helped visitors inside buildings (shopping centers, schools, hospitals, museums, galleries or offices) to navigate easily. The system also provided many useful features using the latest software, including calculating the shortest paths, facial recognition, finding the closest toilet, giving opinions to manage the building, donating, reserving a parking site in addition to that system provided in both Arabic and English language. In [15], the authors proposed a traceability system, summarizing, and presenting observational data on smart farms. The internet of things has been presented in the research using environmental data that were detected on the smart farm using sensors deployed at the farm. The QR codes technology was used to provide customers with information related to the quality of the process of planting or caring for plants before purchasing an agricultural product, which gives the customer confidence in the product.

In this paper, the proposed system is designed according to the ideas of [9, 11, 14, 15], which provides information on each item displayed within any institution such as commercial, tourism, education, etc. The proposed system relies on the QR codes technology to retrieve the information, an AppServ server, TP-Link router works as an access point, a local server, and a main server that acts as a substitute for the local server if error happens and the mobile phone applications that install on the visitor's mobile phone.

## 3.    THE PROPOSED SYSTEM CONSTRUCTION
The proposed information management system includes different sides and componenets. Thus, it is divided into sub-sections for easing the reading flow.

### 3.1.  System structure
The proposed system is built using different types of hardware and software components and all elements are linked with each other to make the system correctly work. Figure 1 illustrates the process of connected devices.
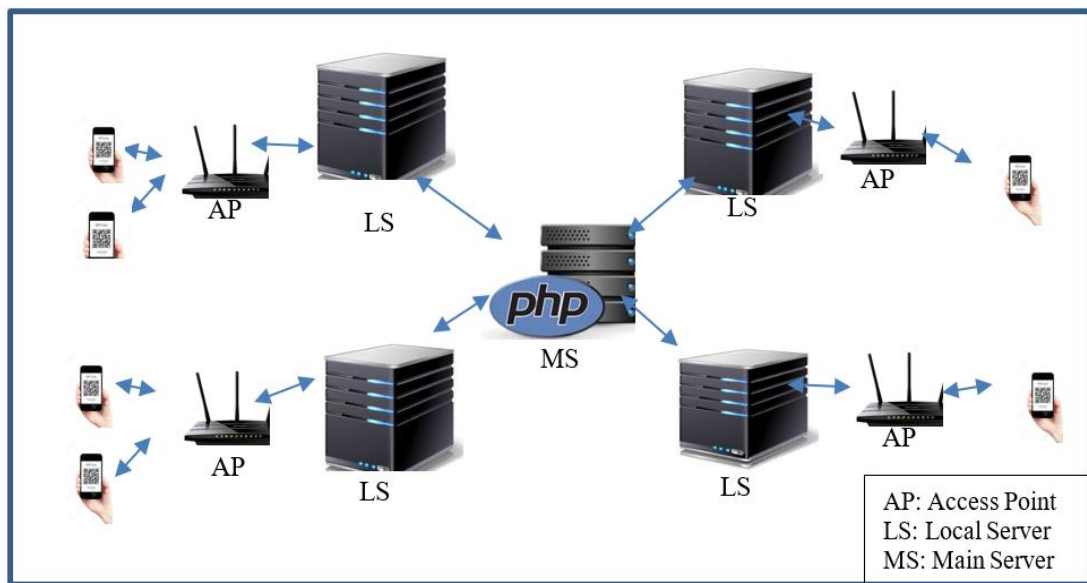


Figure 1. Proposed system structure

a.  *QR codes* are a two-dimensional barcode matrix, which have the ability to encode different types and large of data more than the one-dimensional barcode. The data included in the QR codes can be read by using smartphones equipped with a camera [16-18].
b.  *Mobile application* is designed and created for the visitor's mobile phone that works on the Android operating system using Android Studio IDE 3.4.1 (Integrated development environment) [19]. The application works to decode the QR codes by directing the camera of the mobile phone to the code where the request is sent to the server, and then text and image information is received from the server as a response to be displayed on the visitor's phone screen.
c.  *Local server (LS)* is provided with an AppServ software to save data about all the items displayed inside the station. In addition, it can also save information about the visitors. The records stored on the server can be accessed by the system administrator for several purposes such as updating the system data from adding, deleting or updating the item.
d.  *Main server (MS)* it employs a cloud to store data for all  stations, works as a backup if the data in the local server has an error or inform the visitor about the stations that provide the desired items through the search process.
e.  *TP-LINK router (AP)* is used to connect all cient's devices (mobile phones , tablets ,etc) with the local server, and connect the local server to the main server. This is necessary in the implementation of this proposed system in order to provide wide coverage of the Wi-Fi network.

## 3.2. Protocols used in the prposed system

It is highly important to keep the proposed system according to standards. This can be achieved by employing different protocols to manage the cross-layer categories of the proposed system.

a. *TCP* abbreviation to (Transmission Control protocol) is a point to point and connection-oriented protocol [20].

b. *HTTP* is abbreviation to (Hypertext Transfer Protocol) that is mainly utilized to access data on the World Wide Web (WWW), where documents in WWW can transferred by using HTTP [21, 22].

c. *DHCP* is an abbreviation to (Dynamic Host Configuration Protocol) is a connectionless, client and server protocol. It uses UDP for its proper functioning. it was designed to a unique IP address to each client that available on the network [23].

## 3.3. The proposed algorithms

Different algorithms are proposed for implementing the proposed system in efficient way. These algorithms are described in details as follows.

### 3.3.1. Proposed system management algorithm

Figure 2 shows the flowchart of the proposed system management algorithm that is used by admin to administrating the data of the proposed system. Web pages for the proposed system programed by using PHP language that contained in the AppServ package [24]. In this work, a plant shop center was taken as a case study to check if wanted result is achieved.

Each user must have an account to login or register in the system. In the case when a new station is opened, the system automatically creates a new database in the local and main server after making a connection to the main server, and then can register a new user. Figure 3 the flowchart illustrates the login and registration algorithm in the proposed system.
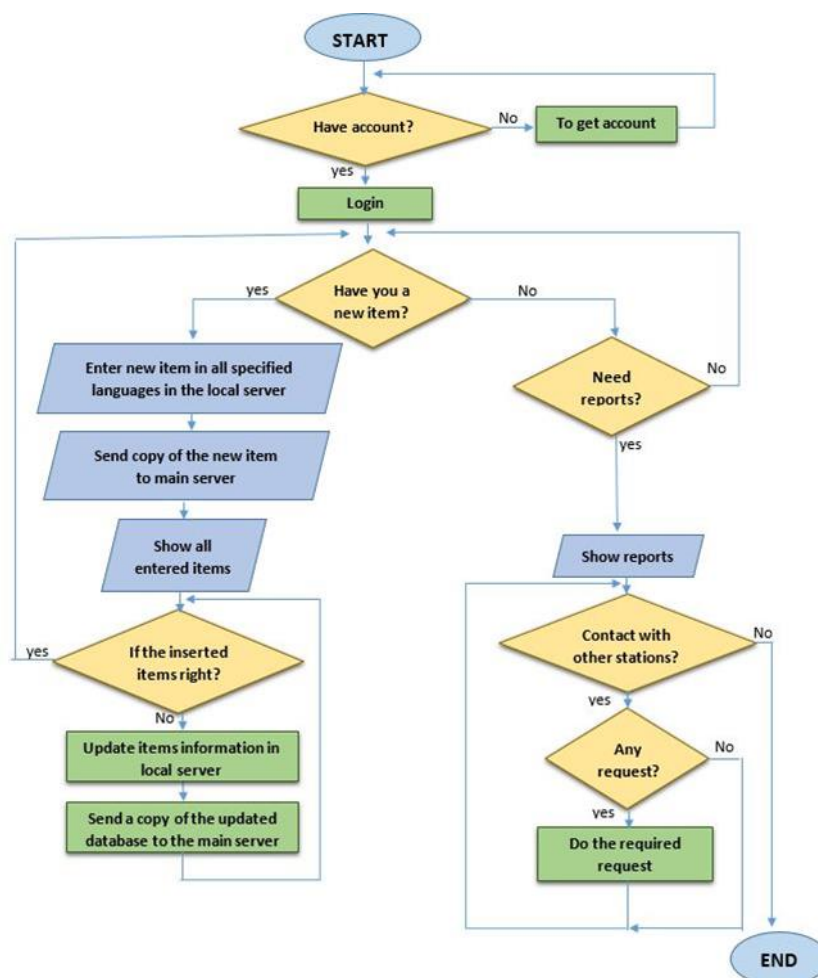
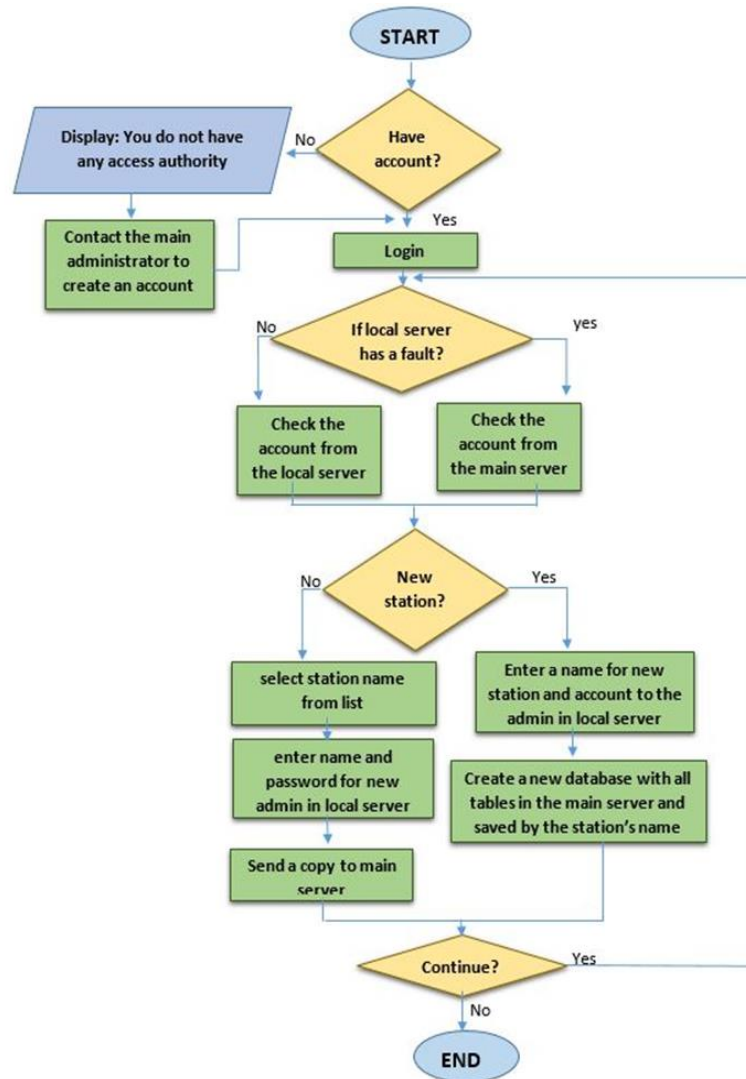Figure 2. Flowchart of the proposed system admin activities

Figure 3. Flowchart of the proposed system: admin login and registration algorithm

### 3.3.2. Proposed mobile application algorithm

To make the mobile application works correctly, each item offered at the plant shop center has a tag. In the proposed system a QR code tag is used that contains a tag ID to a specific plant. IDs with all information that related to the plant is stored at the server (main and local). For example, Noaman flower and Colony plants presented in the shop, the first step in the system generates QR code to each specific plant. Then, the visitors direct the mobile phone to the QR tag to get information if the local server works correctly, the information retrieve from it. Otherwise, the main server works instead of the local server in a transparency manner from the visitors to make the mobile application parse the retrieved information must convert to JSON format [25]. Table 1 clarifies these operations.

The offered plants in the shop are stored in local server and replica of it saved in the main server. Figure 4 and Figure 5 show databases for items in the local and main server. When the visitor enters the plant's shop, he/she must connect his/her mobile to the Wi-Fi that is available in the shop by reading QR code tag which is assigned to the network access, and then he/she must follow the following steps:
a. Run the mobile application and choose one of the presented languages such as (Arabic, English, etc.).
b. QR code that hangs to each item is scanned by the visitor's mobile phone to get detail information about the presented plant based on the information that included in the QR tag. When the information getting from QR is sent to the server, the only relevant information is sent as a response from the server and then its display on the screen of the visitor's mobile. If the local server busy or have some fault the main server responses to the client's request.

c.  If the visitor intends buying sapling, the visitor can add plants and wanted quantity to the cart until tour end, then can show all contents of the cart with the total price for purchases. The customer can delete items from the cart or adds another item as he like. The proposed application supports optional delivery service when the customer desires it. After the login process, if the customer chooses the delivery service, the requested destination address must be entered. So, the total price is computed as the delivery cost plus purchase cost.

d.  The purchase report for the visitor is prepared after the end of the tour and presses on the Send button. It is very important to prepare reports for the institution's statistics purposes, for example, the best-selling plants, calculating profits for a particular month, and other statistics.

e.  Exit from tour or take another tour and read more QR code.

Figure 6 and Figure 7 shows the flowchart for proposed system algorithms used by visitors at the plants' shop. Java programing language is used to design mobile applications by using Android Studio 3.4.1 IDE adopted in the mobile phone application on the ease of use and interactive interfaces.

Table 1. Generating QR tag for offered plants

| Offered plant name | Identification number (ID) | QR code Tags | JSON format |
|---|---|---|---|
| Noaman | 16 |  16 | {"id":"16","p_name":"noaman", "p_since_name":"saga noman","p_contry":"indonisa", "p_wather":"","p_type1":"", "p_type2":"","p_price":"2", "p_detail":"hujhkljl", "image":"Tulips.jpg", "station_num":"mansor1", "plant_num":"33"} |
| Colony | 27 |  27 | {"id":"27","p_name":"Colony", "p_since_name":"Brugmansia", "p_contry":"South america","p_wather":"", "p_type1":"Lightbulb", "p_type2":"Decorative plant", "p_price":"25$",…} |
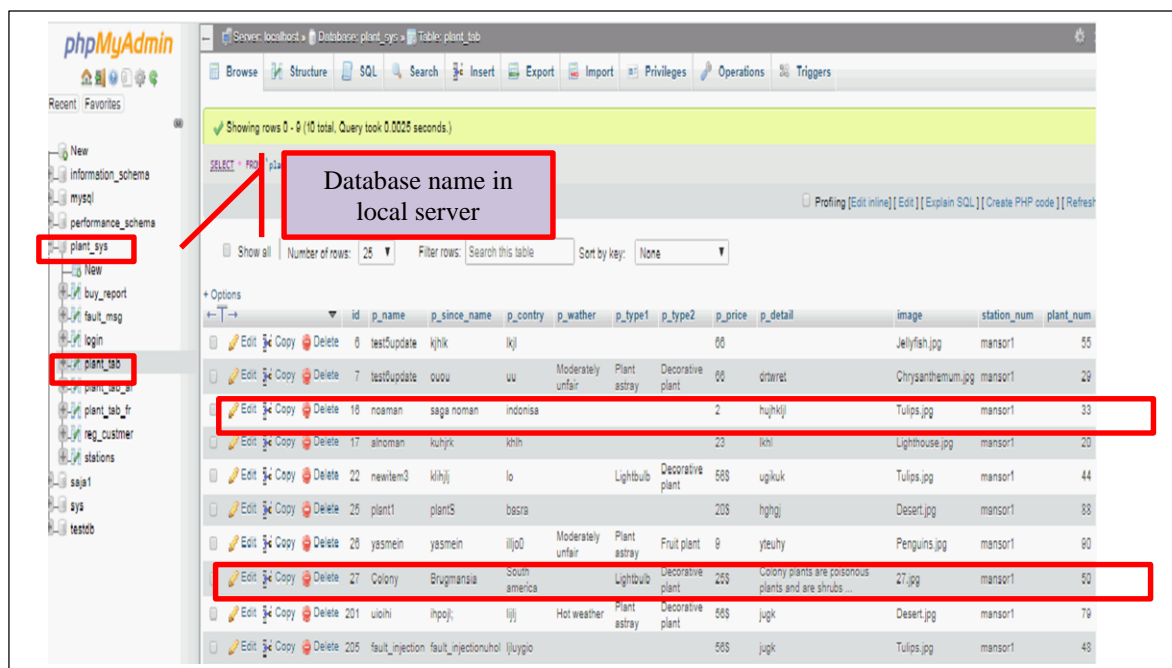


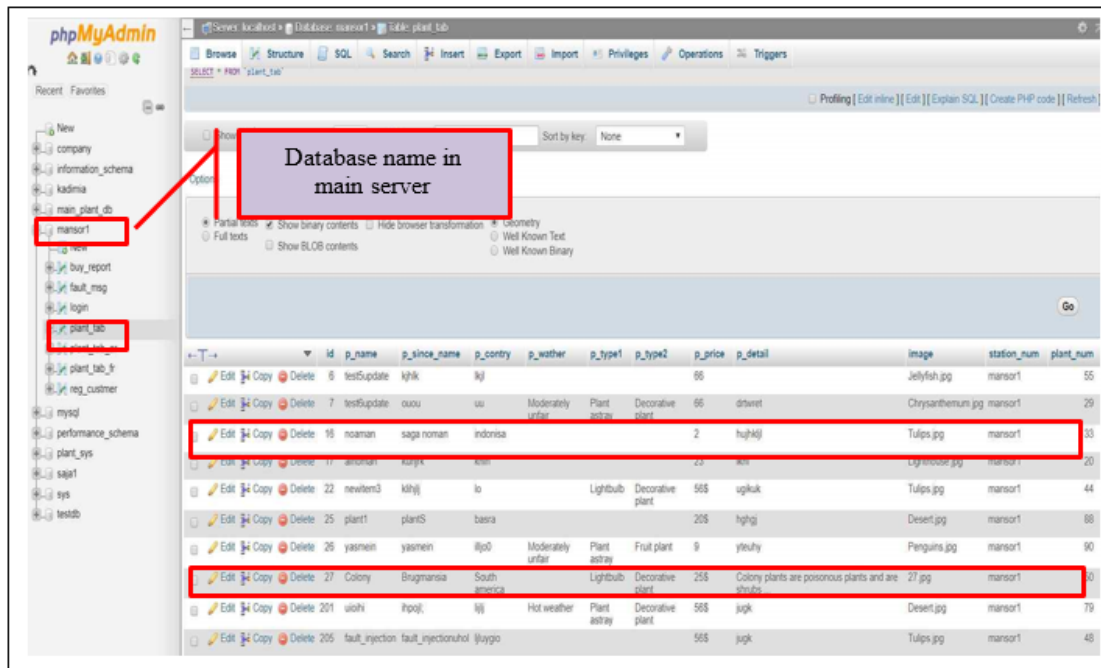Figure 4. Plants' database at local server
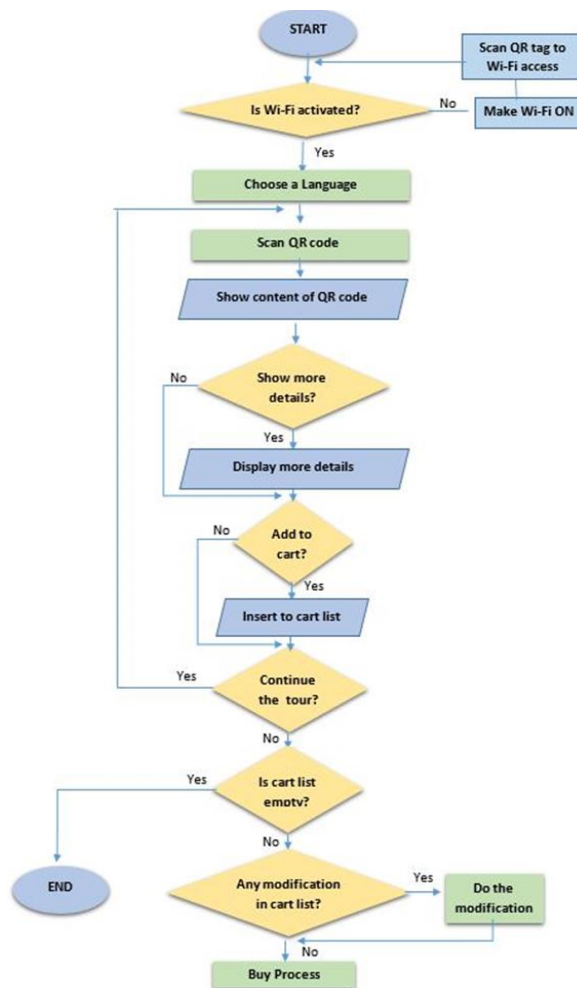
Figure 5. Plants' database at main server



Figure 6. Flowchart of the mobile application algorithm to scan tag and show information
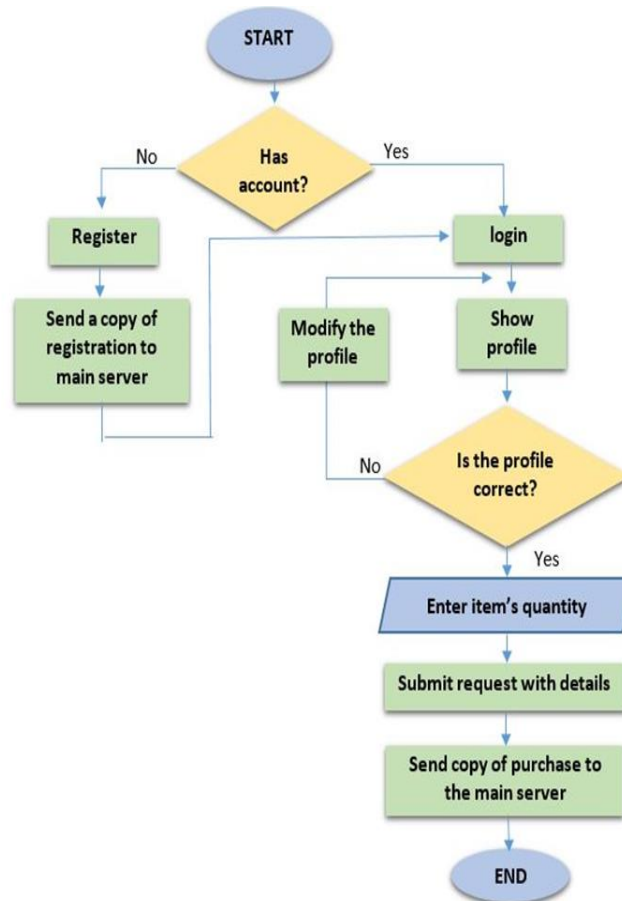
Figure 7. Flowchart of the mobile application algorithms of the buy process

## 4.     RESULTS AND DISCUSSION
In order to test the proposed system, a simple prototype that requires some of hardware and software components was designed and implemented:
-   *Hardware Components*: one TP-LINK router as access point, HP laptop as the main server, Dell laptop as a local server and smartphone Galaxy S8 as client's device.
-   *Software Components*: AppServ package for programing that include (MySql, PHP and Apache), Android Studio platform 3.4.1 version with many of libraries so that the implementation in Gridle file for example (Volley:1.1.1, picasso.2.5.2, etc).

At the server side, when entering the system by the administrator he/she must have a username and password. The administrator after login can do CRUD to each item in the shop and manage it. Figure 8 illustrates these processes.

To perform the mobile application at the mobile side, firstly the user should connect the mobile device to the plant's shop center network by scanning the log in QR code. Then, the user chooses the language he preferred. After that, the visitor is able to scan any QR code tag and retrieved the information quickly and easily based on embedded ID's in the tag. Figure 9 explains these steps.

If the local server is busy or offline, the main server is work in transparency manner from the customer and retrieve the required information to the visitor quickly. When the visitor wants to search for the specific plant, the proposed application provides search services about its or searching a specific the address of any station which can provide that plants. This information relies on databases stored in the main server.

The registration in the system depends on the MAC address of the visitor's mobile phone. The buying process can be done by choosing the Buy button only or adding multi-items to the list. The payment can be performed by choosing Add Cart icon. The buying list can be modified easily by deleting any item from the cart using the Del Cart icon. When he presses on the Eye icon, all cart content presented with the total prices. Figure 10 explains the processing of buying plants, login and registration.
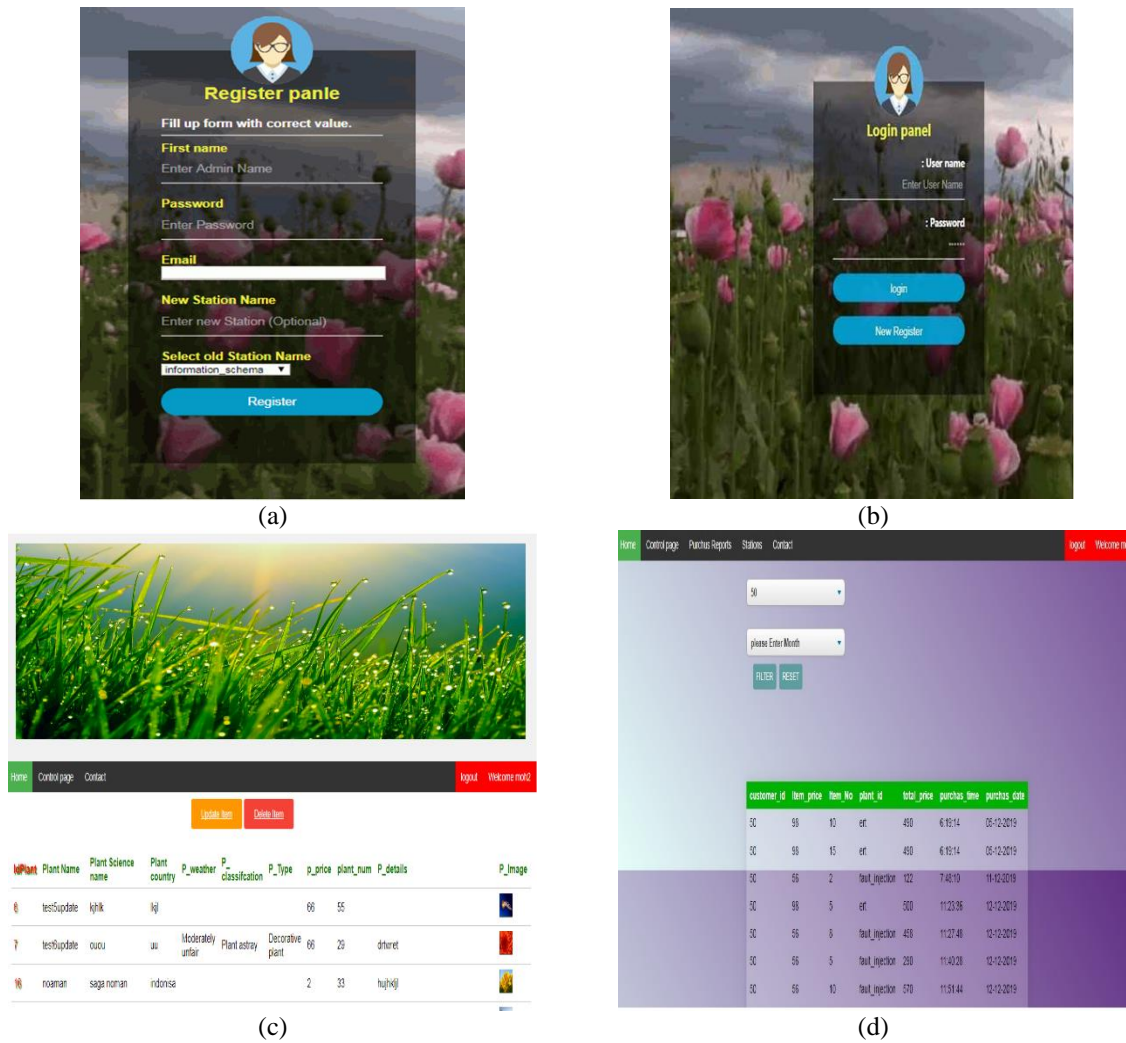
(a)


(b)


(c)


(d)

Figure 8. Administrator pages, (a) Registration a new admin, (b) Admin login,
(c) CURD opration by admin on the system database, (d) Report to an admin about visitor tour
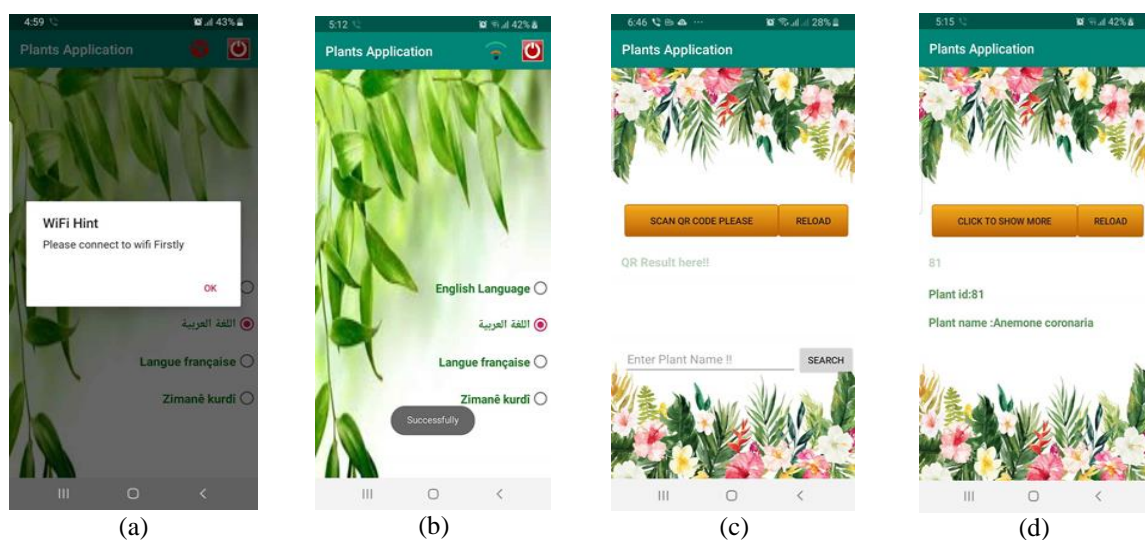

(a)


(b)


(c)


(d)

Figure 9. Scan QR code process from the visitor's mobile, (a) Connect to the farm Wi-Fi,
(b) Chose language, (c) Scan QR code tag, (d) Retrieve information to visitor mobile screen
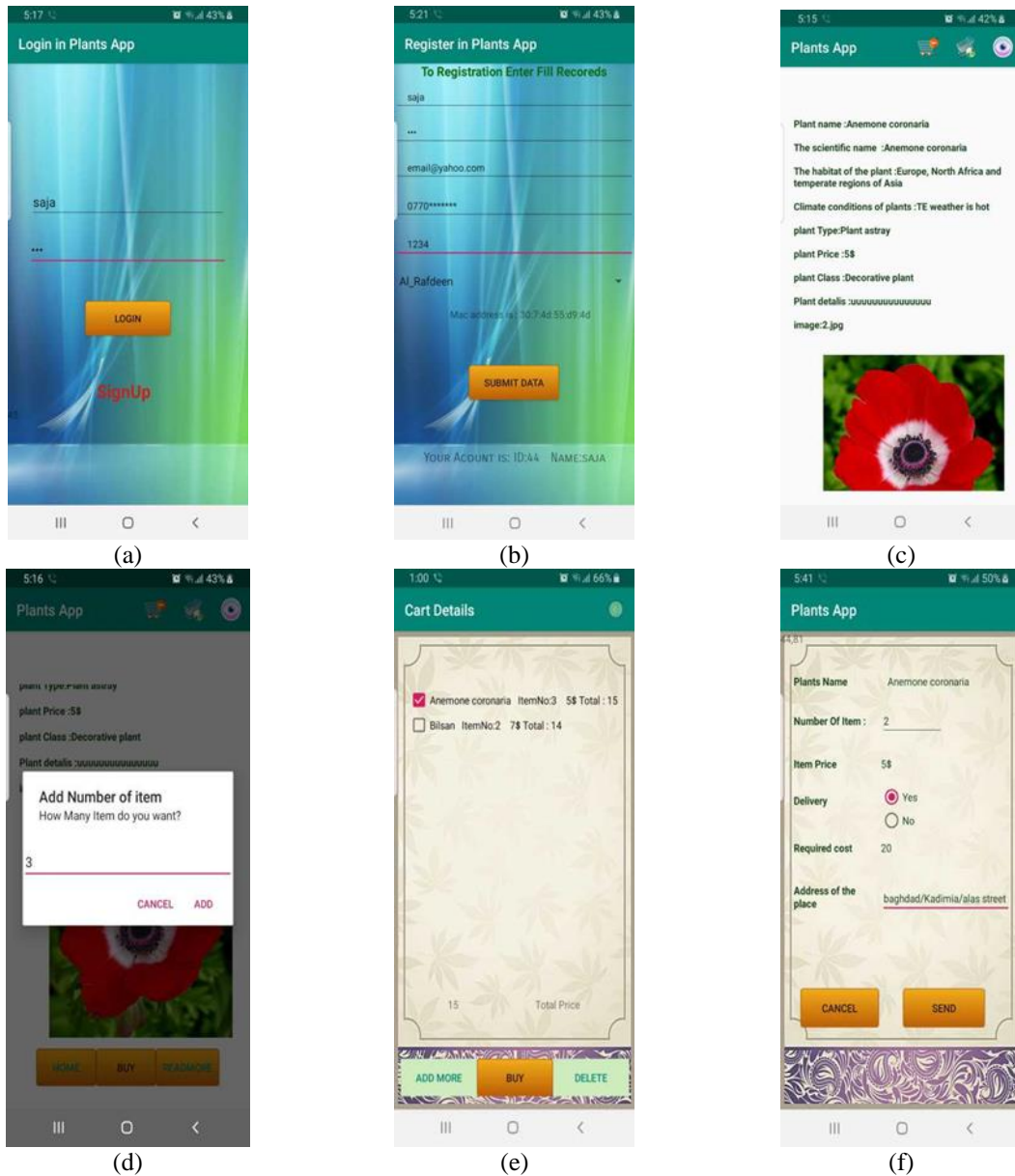
Figure 10. Login and buy items process, (a) Visitor login, (b) Visitor registration, (c) Showing details about the plant, (d) Enter number of plants to cart, (e) Cart's content, (f) Choosing delivery service

## 5.    CONCLUSION

An information management system for planet's enterprises was proposed based on QR codes. It includes two main sides: server side and mobile side. At the mobile side, an Android mobile application was introduced to design an electronic guide system. In the server side, the database was stored and managed as well as the required network. The main goal of the proposed system was to manage the information system including retrieving text and image information about the plants for all visitors. In addition, it provided an electronic purchase and payment service in case the customer desires it, which saves the visitor time from being lost in the queue to wait for his role in the payment. Moreover, the dummy shopping cart was used as a substitute for the physical cart to help the customer to move within the plants' mall easily and also helps the visitor to purchase plants of different sizes and weights without taking the trouble to transfer them to the cashier for payment. The proposed system was designed with mainly relying on the QR codes technique, mobile applications (Android system), local server, master server and router. The main server in the proposed system acts as a substitute for the local server in case of failures and stores a backup copy of the database of each local server in the enterprise. The proposed system was tested throughout different case studies and proved its performance and efficiency.

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