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Mobile DNUN: Danger Notification and User Navigation in Mobile Devices

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Abstract: In modern days, mobile applications are playing a key role in IT world which belongs to different desired fields like sports, entertainment, health and sciences, games, etc. This paper is to design a mobile application DNUN (Danger Notification and User Navigation) which associates with geolocation system to save and navigate to the location of an object for immediate/later use from anywhere on the earth. Also, DNUN notifies desired application's users when the location tracking of an object is lost. Notifying other contacts about the object location is through either broadcast or multicast communications.

Keywords: geolocation, location, navigation, ruby, mobile, social, rescue, danger

I. Introduction

Geolocation^[1, 2] is the process of identifying the geographical position of an object. Location-based service (LBS) is an information service providing multiple uses in social networks using information on the geographical location of the mobile device through the mobile networks. LBS is a common class of a computer program code that uses data location to develop different service features. "Smoke signal"^[3] is one of the old means that Ancient Chinese, Greeks, and Native Americans have used to communicate over long distances and for navigation through wide deserts and sea. In the past, navigation aids costed a lot as the ruler of Arabs made it a key economic power over several centuries. This eased travelling not only through small rivers but also in oceans. Arabs used magnetic compass so called "Kamal"^[4] in ships to decide directions while traveling. There are many different types of technologies to obtain the location information such as Global positioning System (GPS)^[5], IP Address, GSM/CDMA Cell IDs^[6], Wi-Fi and Bluetooth MAC Address^[7, 8], and User Input.

Finding the location of someone is a challenging task when his physical position is lost. It is quite difficult to restore the location of an object such as a car parked in a parking lot if one forgets its location. Hence we come up with a mobile application DNUN (Danger Notification and User Navigation) to localize a human/object effectively. Recently, mobile applications are growing in quantity and quality, with the evolution of Yelp^[9] as one of the earliest communication technologies. Network providers like T-Mobile, Verizon wireless, AT&T, provide geolocation application service to be available on their devices. Furthermore, the operating systems (OS) of these devices (iOS, Android, RIM, etc.) provided SDKs the possibility that allows software designers to develop various applications. This led to have an

obvious evolution in location-based services especially in developing different applications such as Foursquare, Yelp, Glympse, etc.

II. Methodology

DNUN Application starts with the login page, where the user is provided with multiple options including log-in, sign up and forgot password. Hence, the user will be redirected to the home page of the application. To enable better security, the user is supported with all the emergency notifications in the home page designed for DNUN. User would be able to add/delete/update his/her contacts and they can track the user's location who is in danger within Google Maps using Geo-finder APIs. User's contacts can track their paths and the total distance to rescue the user and hence navigate to that user. Another essential feature called finding an object is also provided to the user through using the Geo-finder APIs in Google Maps and can store the latitude/longitudinal positions of that object for a future use.

Process of software design starts with the analysis phase and ends at the product testing phase for further development. This design process specifies the possibility of application interaction with its environment and users. In the process of architectural design, developing the application might need to be based on particular design models including Data Flow Diagrams (DFD), Model-view-Controller (MVC), and UML (Unified Modeling Language). The DFD is sometimes known as a bubble chart where it can be implemented in a graphical representation. It can be used in various stages from the input data to the system, different processing elements executed on these data and information, to the output data produced by the system^[10]. DNUN application, that serves the user requests with a response, is associated with a database. The database stores the user data saved such as his contacts and the danger notifications. Depending on the user request, the application communicates with the database.

The UML is known by software designers and it is used for object modeling, documenting class diagrams, and other diagrams.

Native apps are coded using the Android SDKs and iOS. Mobile web apps are accessed using Internet browsers such as Safari on iOS and Chrome on Android. Projects such as Apache Cordova^[11], contributed to build apps with the aid of web technologies that are compiled into a wrapper creating a hybrid app such as DNUN.

Developing mobile application also comes with Ruby on Rails system^[12, 13], which we have used as a backend processing along with PostgreSQL database. Ruby on rails is an open source web application framework coded in Ruby. It employs the MVC pattern to organize application programming. Ruby creates DNUN with all required resources and available library's called as Ruby Gems. Ruby Gems are well-built so the developing of the mobile application such as DNUN with a ruby on rails is efficient and easier than other web application framework.

A Class diagram shows the set of classes, interfaces, and collaborations and their relationships in the DNUN. The class diagram is the key building block of object oriented modelling. We mainly use it for detailed modelling translating the models into programming code of our app. The main classes of the DNUN application are:

EmergencyDetail: This class gives user an option to save some of his contacts so that he can send a danger notification to them through e-mail if he is in danger. This class has the attributes such as name, email, phone_no_1, phone_no_2 and methods such as addContact() to add a new contact, updateContact() to update previously added contacts, deleteContact() to delete the selected contact and showContacts() to view the list of all contacts added by the User.

User: This class represents the User of the application. Each object of this class will have the association with all the other classes. The user will have attributes such as first_name, last_name, contact_number, email, password etc., and methods such as addUser() to create a new user, addPassword() to create a secure password for the newly created user, createSession() to maintain the sessions of the users once they login into the application, and destroySession() to destroy the session once they are logged out of the application class.

DangerNotification: This class does the work of creating a danger notification and sending it to one or more selected contacts through e-mailing. This class has the attributes such as user_id, receiver_id, message, address, latitude, longitude. Also other methods such as addNotification() to create a new notification, updateNotification() to update an added notification, deleteNotification() to delete a selected notification, showNotifications() to view the list of all the notifications for the user, navigate() to navigate to a location in the notification, sendNotification() to send a notification to one or more contacts through e-mail.

MyLocation: This class is useful to save the user locations. This is associated to the User class. This class has the attributes such as user_id, name, desc (description), latitude, longitude to represent the location. Methods such as addLocation() is to add new location which is the current location, updateLocation() is to update the previously added locations, deleteLocation() is to delete a saved location, showLocations() is to show the list of all locations that are saved by the user and navigate() to navigate from the current location to the selected saved location.

In the following sections, we focus on both DangerNotification and MyLocation as the two primary features provided by the DNUN application.

A. DangerNotification page:

Danger notification is one of the main relevant features of the DNUN application which allows the user to send his current location with just a single click of a button. The user can send a danger notification to one or more added contacts registered in the phase of EmergencyDetail. Danger notification can be sent through either multicast or broadcast communications. When the user clicks send, Geolocation will track his current position and send the notification along with an email to other users who are supposed to respond to the help request.

When an individual is in danger, his location will be detected and displayed in the Google Map. He/she would be able then to send a Danger Notification as shown in Figure 1.

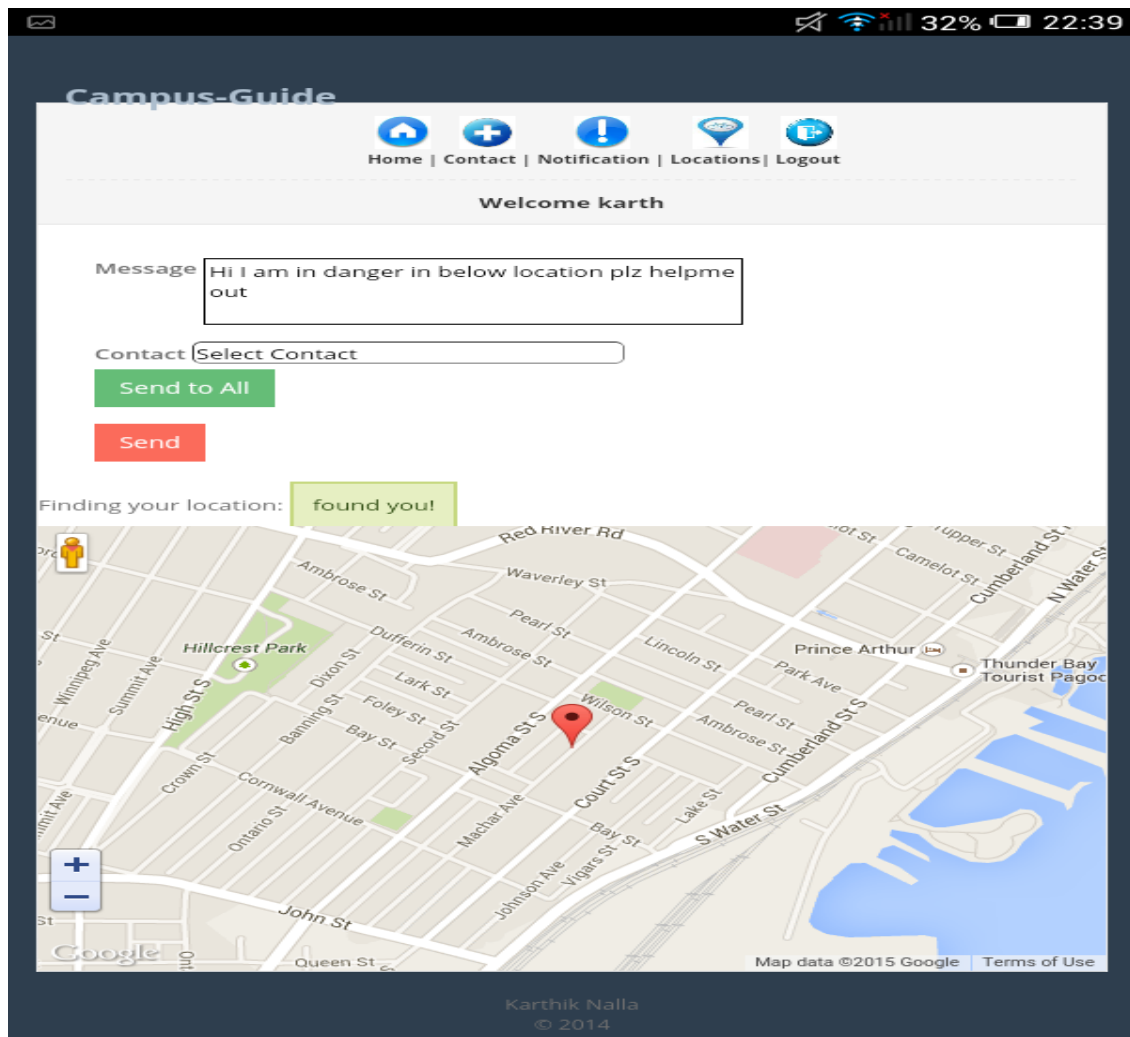


Fig 1 Create Danger Notifications

The user can send the Danger Notification either through broadcast or multicast communications as is shown in figure 2. User can tick separate selected contacts (multicast) or all of them (broadcast). Once the user clicks Send button, an e-mail will be sent to the intended person(s) notifying that there is one user/friend in danger. The email is accompanied by the exact location of the user in danger.

B. MyLocation Page:

Object positioning is the second function in the DNUN application which allows a user to store the location of a particular object and hence having an option of saving that location for later navigation. Whenever needed, the user can find that object with just a single click of button using Google Maps.

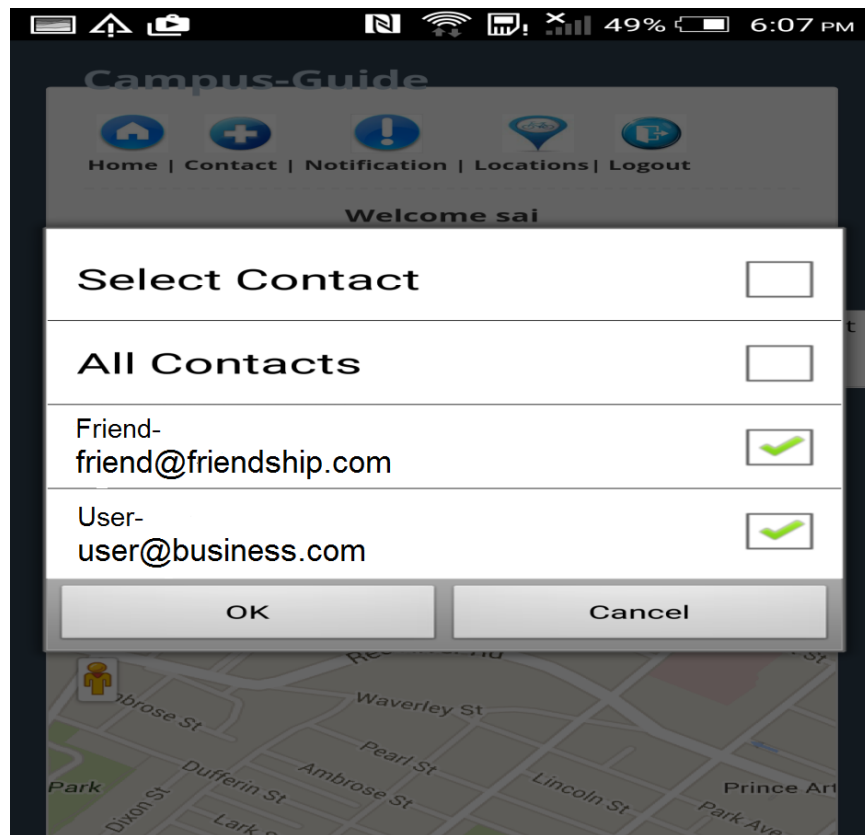


Fig 2 Send Notifications

User can add his current location or an object position such as a vehicle in a parking lot. Figure 3 depicts the feature of adding locations page of the application. This allows adding and storing one or more locations of objects. User clicks on Add Location button to store his current location or of an object. The user's current location is determined and a page is displayed which enables him to save his location with fields: "Name the Location" which allows the user to have a name for the location of the stored object, and "Note for your Location" which allows the user to have notes on the object and its location. Later, when the user needs to retrieve the object location, he/she clicks View Map which allows DNUN to open the location in Google Maps as shown in figure 4.

User may be located later somewhere and needs to be navigated to his saved location or object. When the User clicks Navigate in figure 4, the Map will show the route along with the navigation directions similarly as in the Google Map directions.

III. Discussion and Analysis

It's well-known that smartphones have altered our daily life most likely in a positive way. Geolocation is one of the most beneficial units of the smartphone technology these days. Most of the smartphones come nowadays with hardware/software geolocation components allowing for location tracking of the device. *Location* is a technology used to assist the GPS component in device locating with different operating systems such as Android and iOS. Geolocation

technologies are getting importance in the wireless products for many reasons, mainly the US FCC mandate requiring all wireless cellular carriers to be able to provide the location of emergency 911 callers to a *public safety answering point* (PSAP). However, geolocation technology has proved to be significant for both military and commercial applications in general beyond emergency location^[14] and this in turn is the motivation to propose our DNUN application. The use of wireless devices such as cell phones, PDAs, and laptops has become the enabler of viable location-based services and applications that need position location information. Examples of selected commercial location-based services that DNUN can be used include locating patients in a timely fashion in hospitals, locating individuals for personal and residential applications, concierge and location-aware services (e.g. locating the nearest coffee shop, those people newly located to a city to find their stored location such as library, vehicle in a wide parking lot as in malls and universities (where hundreds of similar vehicles are parking), classrooms (for newly enrolled students), and providing information about exhibits in museums based on the customer's location), etc. In the military and public sectors, enabling soldiers, policemen, and fire fighters with knowledge of their location and the location of other personnel, victims, individuals in dangers, etc, proves to be invaluable. The GPS has been the most significant and successful positioning technique in outdoor area and it is generally understood that GPS receiver is an inexpensive common place gadget^[13].

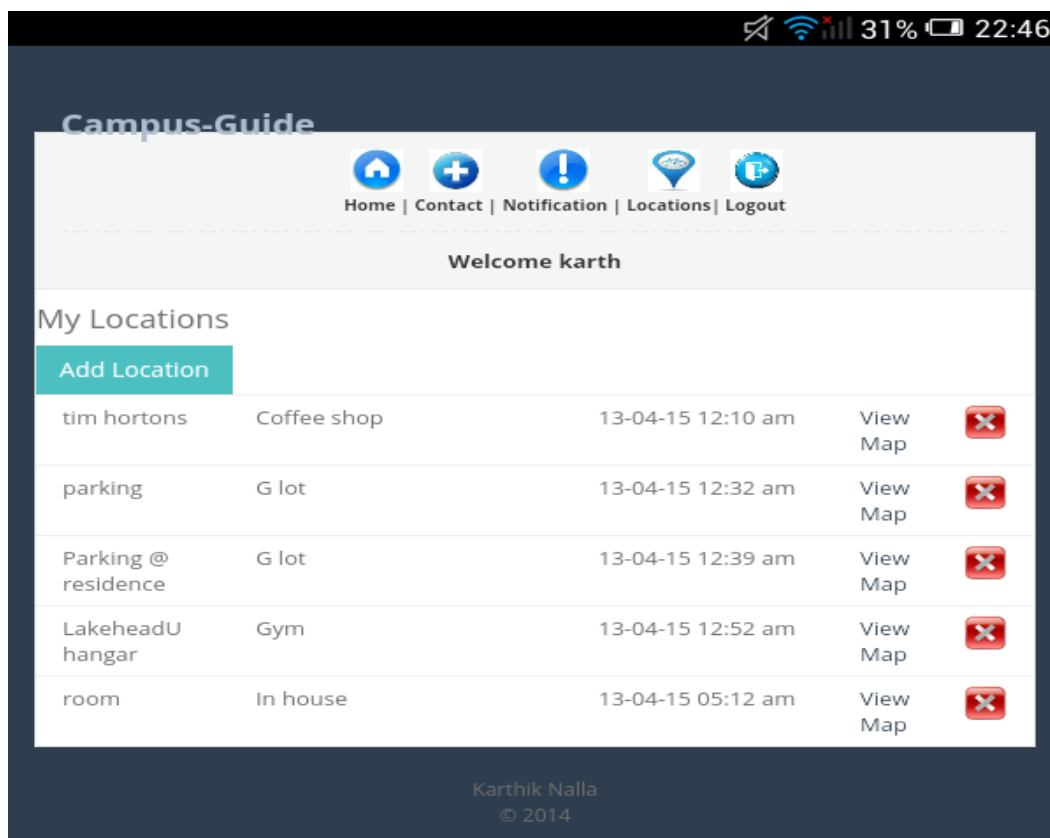


Fig. 3 Mylocations page

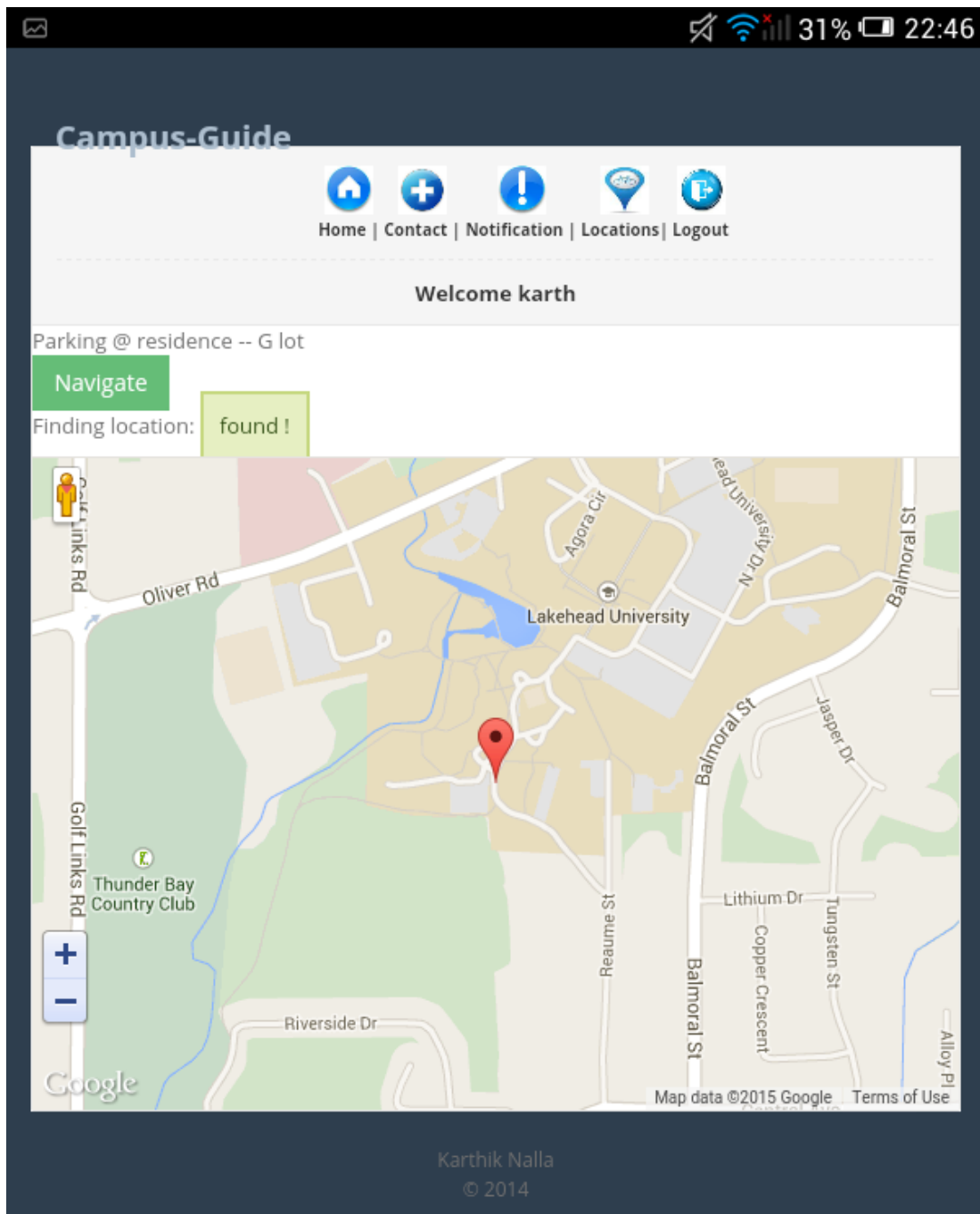


Fig 4 Open location in Map page

One of the key features of DNUN is the capability to allow the individual in danger to send his notification to more than one helper through the selected contacts (multicast communication) or to all his contacts (broadcast communication) depending on the case and need. This enables more flexibility to the individual to have even a slight moving within the area of danger as more than one helper can respond within a wider range of the danger zone. Consequently, as having several contacts for a person as it would be obviously useful in such danger case where not many rescuers are available at any given time and, therefore, at least some out of the many persons

may react to the help request. Those rescuers who are geographically closer to the danger location would respond quicker than the others. On the other hand, rescuers who are far away from the danger location may contact, by for example phone, email, and pager, those not even in the notification list and/or those in the notification list but may be away from their email. If the individual moves greatly from his current location, he may need to send a location update notification. However, to minimize the effort for a person in danger as he/she might be in panic, DNUN may be paired with mobile app such as *GPS Phone Tracker Pro* and *Mobile Location Tracker*, on Google Play, in the background for location tracking in case that the individual moves from his current location. Having a function to help users to filter informed people by location or even skills is an option that can be added to DNUN.

Conclusion

In this paper, we presented a design for a new mobile application DNUN intended to rescue a user through sending an email with a danger notification to intended contacts. These contacts can be added/updated/deleted by DNUN as a social network of the user. Consequently, DNUN provides an integration of mobile sensors and social network as a rescue plan that can be used in several military and commercial applications. Combining with social media, geographic location and Map system as mobile DNUN an additional application for smartphone users is provided. In doing this, DNUN uses Google Map to localize the user and enables him to store his current location or an object position, in his mobile device, needed for sending the danger notification and for a later use as well. As a result, DNUN provides another function that is to navigate the user to the previously saved location from anywhere.

This kind of software solution eliminates the cost of hardware installation. DNUN is able to successfully incorporate all the requirements specified for creating a mobile application using Apache Cordova and ruby on rails.

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Hosam Bio: Hosam El-Ocla received the M.Sc. degree in the Electrical Engineering Department of Cairo University in 1996 and the Ph.D. degree from Kyushu University in 2001. He joined Lakehead University in 2001 as an Assistant Professor and has been an Associate Professor since 2007. His research interests include computer communications and networks. He was invited for research visits to Manchester University (2007) and Ariake National College of Technology (2009). Dr. El-Ocla is a technical committee member on telecommunications of (IASTED) (2005–2008), and technical committee member on Antennas, Radar, and Wave Propagation of IASTED (2012–2018). In addition, he is a senior member of IEEE.