Available online at www.qu.edu.iq/journalcm
JOURNAL OF AL-QADISIYAH FOR COMPUTER SCIENCE AND MATHEMATICS
ISSN:2521-3504(online) ISSN:2074-0204(print)

Quick Response Code for Controlling Web of Things

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ARTICLE INFO

Article history:
Received: 13 /11/2019
Rrevised form: 00 /00/0000
Accepted : 18 /12/2019
Available online: 13 /02/2020

Keywords:

Big data, IT companies, Energy Management, Confusion.

ABSTRACT

It is widely acknowledged that the current Internet of Things (IoT) ecosystem is highly fragmented. The Web of Things (WoT) aims to counter the fragmentation using the principles of Web, standardized metadata and APIs. QR i.e. "Quick Response" code is a 2D matrix code that is designed by keeping two points under consideration, i.e. it must store large amount of data as compared to 1D barcodes and it must be decoded at high speed using any handheld device like phones. QR code provides high data storage capacity, fast scanning, omnidirectional readability, and many other advantages including, error-correction (so that damaged code can also be read successfully) and different type of versions. Different varieties of QR code symbols like logo QR code, encrypted QR code, iQR Code are also available so that user can choose among them according to their need. The WoT relies exclusively on application level protocols and tools. Web protocols are a critical factor in the successful implementation of the WoT. However, one of the main issues is web latency that may significantly affect the real-time performance of IoT systems. Some pioneer open stages and models are likewise shown. The latest research results are painstakingly outlined. Moreover, numerous efficient examinations are made to give the understanding in the advancement and eventual fate of WoT. At last, we call attention to some open testing issues that will be confronted and handled by research network.

MSC :

DOI : 10.29304/jqcm.2020.12.1.657

1 . Introduction

Ubiquitous computing (ubicomp), that was widely researched for long time, is now undergoing thorough changes due to the fact that physical world devices (such as industrial machines and home appliances), are currently developing into smart devices due to the advancements in computing technologies. At the same time, the techniques used for communication purposes are also progressing rapidly. Accessing the internet will possible be done with such “smart things”, which will motivate the concepts of IoT [1]. The next major challenge and possibility to the internet is IoT. Internet is not going to be only network of computers anymore, yet it is going to possible include

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Communicated by Qusuay Hatim Egaar

trillions of smart devices with embedded systems. The extent of the present internet will be majorly increased via the IoT, which will provide novel challenges and design opportunities. The internet with the smart things can be majorly seen as constrained IP network which has limited packet size, intermittent connectivity and high degree of packet loss, also it is defined via extreme limits on throughput, available power, and specifically complexity which could be supported [2, 3]. A lot of current researches were initiated for addressing such problems, from technological to social features. Especially, a major focus area is the way of making full interoperability of interconnected devices achievable, for providing them with constant high smartness degree via allowing their autonomous behaviors and adaptations in the same time as ensuring security, privacy and trust [2].

Recently, it is very complicated to use single sentence for describing IoT. In the last decades, the concepts of such subject have been present even with considering that the term is fairly new; thus, no boundaries exist regarding what IoT represent or what it isn't. Yet, the main definition regarding IoT is majorly a world in which internet is exceeding the concept of multimedia pages' collection as it is now, yet it is extending to real-time, physical world through the use of countless of embedded devices

Now, the web is considered as the main communication's medium in the internet. At the same time, tiny web server technologies were examined for long time and recently different embedded tiny web servers have been provided [4]. To be more specific, a web service is considered to be of high importance in developing interoperable applications on the internet used today. The smart things with an embedded web server could be summarized as web services and effortlessly integrated into present web [5]. Unifying the physical world and the cyber world can be done via reusing the present standards and technologies of the web. Therefore, one study trend treats IoT as WoT, since the current technologies of the web could be adapted and reused for building novel services and applications with the use of smart things [4]. This is going to yield more flexibility, productivity and customization. Briefly, in dissimilar way from conventional perception related to IoT that provide an IP address to the devices we used daily and make these devices interconnected on Internet, WOT make the devices speak the same language, for the purpose of interoperating and communicating without restrictions on Web.

A view is depicted via the vision of WoT in which web services' collections could be discovered, composed, and executed. Therefore, enriching the extent of conventional web services via progressing the web from just services of cyber-world to physical world and cyber world services [6]. Also, WOT is considered as service's eco-system not just involved in adding extra services, yet it is more involved in arranging different types of services effectively, which will make services more intelligent and human-centric.

QR codes could be utilized for logging into the websites: QR codes are displayed in login page on the screen of the computer, the registered user will have the ability to log in the system when they scan the QR with their verified smartphones [7]. A smartphone that contact the server is the way to perform the authentication. In January 2012, Google have tested such method of login.[33] In the year 1994, Denso-Wave (Japanese company, subsidiary of Toyota) have introduced QR. At first, these codes have been considered as rapid approach for keeping track of the parts of vehicles, they are now widely used in some Asian nations such as Taiwan, South Korea, Japan, and China, also they are becoming widely applied in western nations day by day. [8] The data could be encoded in vertical and horizontal directions via the QR codes; therefore, they have the ability of encoding quite a few times more data than bar codes.

2. Overview of The Web Of Things

WoT can be considered as computing approach which describe a future in which the objects which are used daily will be totally integrated with Web. The main requirement of WoT is that "things" should have embedded computer system that allow communications with Web. These smart devices will have the ability of communicating with each other through the use of the present Web standards. Throughout the past decades, the smart device's communications were examined. A lot of standards and technologies were suggested with regard to such field. To make smart things interconnectable in a way that bits could be transferred between the devices is just considered to be the initial stage, extra efforts and anticipated for making the smart things interoperable in a way that they will become understandable with each other. It is highly important to have interoperability for building systems with a

lot of devices, particularly those devices from different manufacturers. A few of the major technologies related to interoperability issues will be reviewed as follows.

Universal Plug and Play (UPnP) can bed defined as networking protocols' suite that is developed from the concept of original PnP to the networked system context. It has been developed via UPnP forum2 majorly for the personal network devices for discovering each other's existence and also for establishing network connections. UPnP is considered to be on the basis of established standards and protocols, like WSDL, HTTPU, SOAP, UDP, TCP/IP, and so on. Now, the most used solution for the personal network's implementation is the UPnP. Yet, there are some disadvantages related to UPnP:

1) No authentication protocol has been suggested for UPnP. Any device has the ability of configuring the other personal network's devices, with no user control, which will result in serious security problem in the case when the smart thing is available on Internet

2) UPnP is considered to be not strictly standardized in the same way as certain UPnP devices are based un-standardized protocols like HTTPU, which will restrict its universal inter-connection one way or another.

3) UPnP cannot be used for certain resource-constrained devices due to the fact that it typically applies many heavy protocols (WSDL, SOAP, and so on) involving complex processing.

Instead, JXTA technologies are suggested as solutions for the peer-to-peer application designs, which will enable the inter-connections related to the heterogeneous devices in the same networks. Afterward, C language-based version, JXTAC has been suggested for embedding JXTA in the resource constrained devices[9]. Regrettably, the protocols of JXTA were not standardized, also they have not been extensively used for the embedded devices in industry. It was indicated that a web server could be developed in size of just a small number of KBs [9], [10], [11]. Integrating web server directly in many devices is possible. After that, such devices actively serve their functionality over Web. To use the scalable, open, free, and flexible Web as universal platform for integrating smart devices is better than all the other previously mentioned solutions with regard to security, flexibility, easiness and customization.

Such idea has been of high importance from industrial field and from the academic one, particularly after the recent emergence of IoT. Web browsers were provided in the majority of platforms, such as tablets, PDAs, computers, and phones, also they became the standard user interfaces for a lot of applications. With the existence of an internet connections, Web-enabled applications could be accessed from any location. Utilized to the embedded systems, the web technology could provide platform-independent interface in a way that the end-user is not obliged to install certain drivers and software for various devices. Furthermore, the developers are not obliged to tediously create various drivers and software targeting various platforms for one thing. One-for-all solutions is provided via the Web. Also, even though that the devices are now programmable, offering major possibilities for creating more powerful and advanced applications, advancement, particularly composition, related to the applications which run on top of the physical devices remains cumbersome procedure since it necessitates wide-ranging expert knowledge (for example certain API in certain programming language) related to the various physical devices. This will constrain the advancements of smart things-based services. Luckily, the present web technology (mashup), that formerly targeted for cyber-world web services could be reused the developments of applications with the use of physical smart things as they could be abstracted as web services. Through the reuse of present web technology, costs for total implementation time and the extra infrastructure could be reduced. Such technology could be promoting the advancements of IoT considerably.

fig1. World Wide Web

1.1 The Description of WoT Thing

TD has been based on a model of formal interaction and supporting a variety of models of messaging, which includes publishing/subscribing and requesting/responding. The pattern of interaction of TD includes characteristics, actions, and events [12]. Fundamentally, events can be considered as generic interactions in which distant end-points, IoT applications, or other Things exchange data. Properties can be defined as points of data of Things which may be written to (for actuators) and/or read (for sensors). Actions can be considered as invokable procedures which are basically associated with the controlling purposes in actuators. This type of the TDs are fundamentally kept in Thing Directory that is like the Resource Directory of the CoRE. Thing Directory offers a number of web services for registering, updating, (automatic) removing and discovering the TD [13]. SPARQL end-points could be exposed for allowing the mechanisms of semantic query and semantic based discovery. TDs are serialized with the use of the JSON-LD that ensures sufficient mechanism for semantics that are machine-understandable. The following is part of TD (Figure 2) a connected car has been created, which utilizes the mechanisms of WoT for sending data to the Cloud.

```
{
        "@context": [
                "http://w3c.github.io/wot/w3c-wot-td-context.jsonld",
                {
                        "actuator": "http://example.org/actuator#",
                        "sensor": "http://example.org/sensors#"
                }
        ],
        "@type": ["Thing"],
        "name": "BMW_X5",
        "base": "http://192.168.1.122:3000/",
        "interaction": [
                {
                        "@type": ["Property","sensor:gearPosition"],
                        "name": "gear",
                        "outputData": { "type": "string" },
                        "writable": false,
                        "link": [{
                                "href" : "north/sensor/gearPosition",
                                "mediaType": "application/json"
                        }]
                },
                {
                        "@type": ["Action","actuator:turnOn"],
                        "name": "turnOn",
                        "link": [{
                                "href" : "north/rear-left-window/turnon",
                                "mediaType": "application/json"
                        }]
                },
```

Figure 2. Example of the Description of the WoT Thing

1.2 Binding Templates of WoT

The TD of the WoT provides the ability of inter-operability in the description of the abilities of Things and the way of accessing those abilities. However, Things are a part of a variety of platforms of the IoT that are following (a) standards such as OCF, one M2M, or (b) proprietary technologies. In addition to that, those protocols could utilize different protocols and techniques of communication and for data exchange of the Thing. Binding Template of WoT simplifies the interaction of the applications of WoT with the platforms of IoT via inter-operable communication meta-data blue-prints. This type of templates has been created once for every platform of IoT and it's recorded and instantiated in every applicable TD. An application or Client of WoT, which consumes and discovers TDs have to be implementing related protocol binding (for example, between HTTP and LwM2M). The meta-data of communication (that belongs to TD) in this case comprises a platform of IoT, media type, transfer protocol, and parameters of security. It has been illustrated in Figure 3.

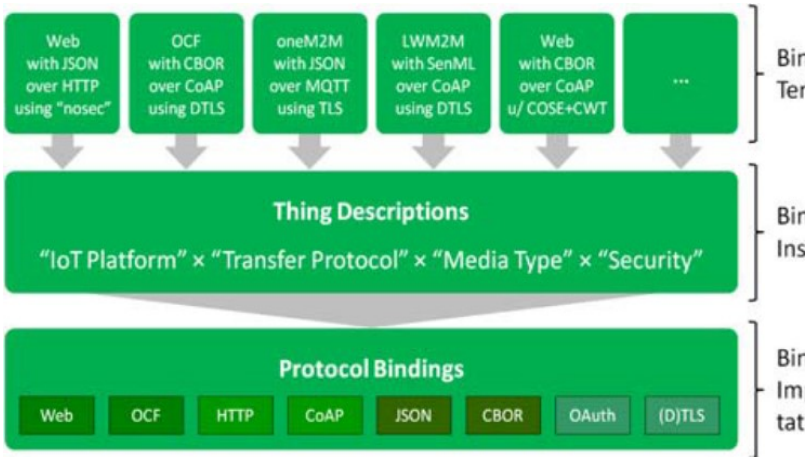

Fig. 3. WoT Binding Templates and Protocol Bindings.

1.3 Applications Examples on the WoT

According to technologies Web that have been explained earlier, relevant applications of WoT may be designed. Two examples of this type of applications have been proposed:

1.3.1 Shared calendar preserving privacy

Online Web calendars are one of the best examples of the commonly utilized applications of the Web2.0. Mostly, they have 2 strong points, which are: (a) being accessible by the users wherever their locations are and from any work-station, mobile, or PDA (b) they enable users sharing information concerning whether or not they are available[14]. None-the-less, online calendars still have problems related connectivity and privacy. Initially, they need storing private data on the servers of the Internet. in addition to that, they aren't accessible with no Internet access. Via the construction of an application of WoT on smart cards, combined with online Web applications, a simple solution has been proposed to both problems related to connectivity and privacy. Because of the mash-up, details on the private information may be managed and stored via smart cards in secured environments near users. The rest of the information is shared online. In addition to that, even without connection to the Internet, the calendar is accessible and can be altered with its owner. As soon as finding an access to the Internet, public information is updated from a sub-set of information in the smart card. Via putting calendar in a personal device, one of the most important strengths of Web calendar is enriched, which is the accessibility.

1.3.2 Personal contacts book

Private information concerning the contacts of the users are controlled and stored by smart cards, and can be accessed even without Internet connection. With the use of mash-up (as in Section 3), this application may be extended. For instance, through a simple script of the client-side, it is possible enriching the contents of the WWW through private data: when somebody's name in the contact book of a user appears in the page, they may get detailed (and also private) information of that contact via pointing on the name by the cursor of the mouse.

1.4 Overview of QR

A "QR code" is a trade-mark for a matrix barcode type (or 2-D barcode) initially, it has been designed in Japan for automotive industries. QR code has been developed in the year of 1994 by a subsidiary of Toyota, named as Denso Wave, for the sake of helping in the tracking of car parts during the production. The QR technology stayed actual for over 10 years, and has become popular recently as medium for the marketers for reaching users of smartphones. QR codes were utilized in inventory regulation, marketing, and manufacturing in Europe and in Japan for the past decade [15]. A typical QR code includes black modules (i.e. square dots) which are arranged on a white background in a squared grid that may be read by an imaging device (like a camera) and processed with the use of the error correction which is known as Reed–Solomon to the point where the image becomes possible to interpret appropriately. After that, the needed data are obtained from the patterns which exist in both horizontal components as well as vertical components of the image. At the same time as the design of a QR code could seem complicated, the creation of a "ready-to-use" QR code is simple with the use of free QR code generators that are available on-line [16]. Some QR code benefits for the customers compared to the conventional URL is that they're probably easier and faster to access the web-site, and they aren't susceptible to errors of typing. Due to the fact that the majority of the customers have their smart-phones with them when travelling, QR codes present the potential to conduct surveys on customer satisfaction at minimum cost, even though this isn't this tool's main application in the sector of the public transportation. There are presently 2 fundamental implementations of the QR codes, which are: e-ticketing[17, 18]. In addition to the real-time user information [18]. Passenger transport companies worldwide utilize QR codes rather than paper tickets, nearly every airline offers boarding passes on mobiles, and high-speed long-distance trains and some inter-urban bus companies utilize QR codes for ticketing applications. One more application of the QR codes in the sector of transportation is customer information. A wide range of companies of public transportation utilize GPS already for tracking vehicles, and that provides the ability for location-based services via web page connections. For instance, QR codes may be printed at shelters of bus stops, and that provides smart-phone travelers with the ability of directly accessing real time information on the departure of the bus for the stop (Figure4)[18].

Fig.4 QR code Scanning via a smart-phone

1.5 Proposal

QR codes are really useful and help us to complete tasks faster in Web of things field, QR code does not need any platform for redirection, but it has data within it. Once a QR code is generated, it are often used anytime, anywhere. The period of the QR codes is unlimited, so you do not need to worry about lifespan. Generate and then use. QR codes can be malicious. So, there area unit numerous security risks committed QR codes.

As this technology provides with protection and privacy and high speed, people within the system inside this system are in the form of a pyramid of the characters according to the powers granted to each person and according to its location in the system, So everyone has their own address page that includes and special addresses for that person in addition all these data is stored in his own QR. The proposed system shown in fig (5).

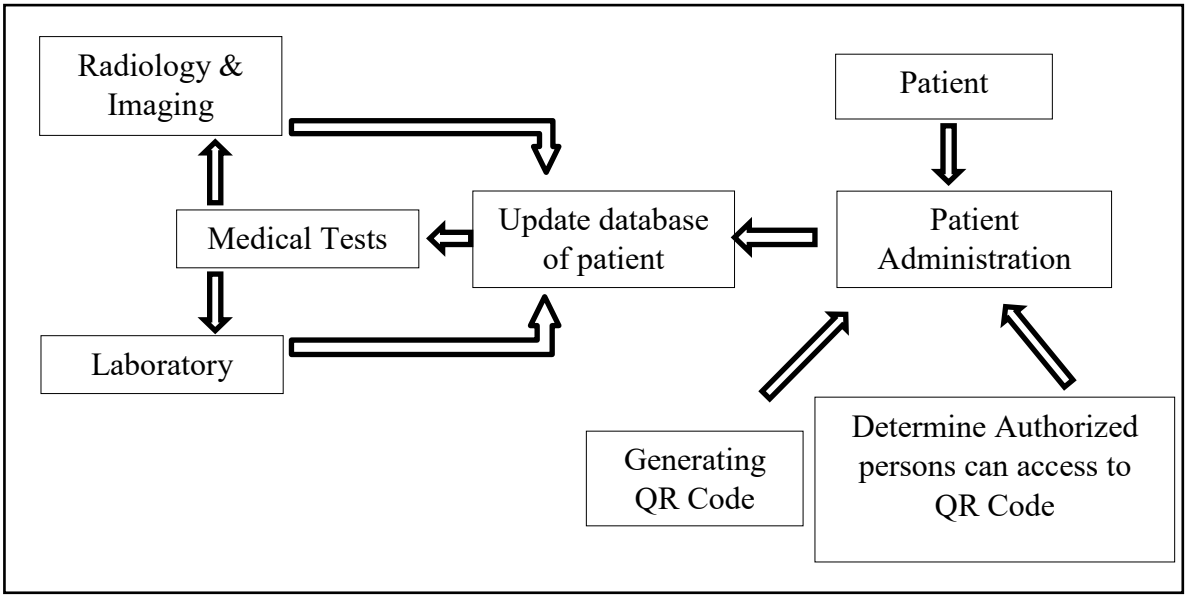

Fig (5). The Proposed System

QR code contain the URL page of the patient in the hospital system that contain all important information like:Name, Age, Gender, Other personal information.

Also, contain the important medical information that could help the doctor in diagnosis process like:

- Previous diseases of the patient.
- Hereditary diseases of the patient's family.
- The number of visits to the hospital and details of each visit
- Data on laboratory tests that were made.
- The duties related to the nurse towards the patient by informing the nurse of the tasks to be performed which the doctor has determined, by updating the patient's page data by the doctor and following up the latest updates by the nurses.
- The ward that the patient must be carried to it.

Thus, the doctor or nurse can know the patient's condition without question by reading his code and browsing his data through the web page.

Access to patient data is controlled from the system itself if the patient's doctor or the nurse change.

1.6 Conclusion

In this paper we have provided an overview of the current status of research in the area (web of things) as well as discussing possible future research topics. As this technology provides with protection and privacy and high speed, people within the system inside this system are in the form of a pyramid of the characters So everyone has their own address page that includes and special addresses for that person in addition all these data is stored in his own QR. Therefore, we'll use the Web of things in health field related to QR, that is employed as a way of authorizing and distinguishing the infected person rather than the name. The proposed system facilitates communication between the patient and the doctor or nurse and solves the problems resulting from misunderstanding between them and the patient. Monitor the patient's condition remotely by the doctor and monitor the tasks that nurses must perform in case they exceed the time to perform the task. Providing confidentiality of patient data where no one is aware of the privacy of the patient except authorized persons. Quick access to the patient information.

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