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The acceptance of Moodle Mobile in Smartphones

- Case Study – Al-Andalus University

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Article info	Abstract

Nowadays with the rapid developments in web and mobile computing technologies, students have the ability to use digital learning objects to draw upon a rich variety of resources that can make education more effective. Moodle (Modular Object-Oriented Dynamic Learning Environment) is known as a Course Management System (CMS). The aim of this research is to study the students and university staff" acceptance of applying the Moodle in smartphones. It was field survey on the Al-Andalus University in Yemen. The data were collected and analysed using SPSS. After analysing the survey results and questionnaire study, we found that the sample has a strong acceptance (77.7%) for the use of Moodle Mobile in smartphones.

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1. Introduction

Deployment of 3G/4G mobile technology is speeding up; research activities on mobile platforms for supporting mobile learning have emerged in the academic community. Sometimes students cannot approach to classrooms because of some issues, which can decrease the study quality in these specific areas. Therefore, M-learning should be applied for supporting student access to virtual-laboratory - environments at any times from anywhere by simply using their own computers, laptops, smartphones, or any other electronic equipment [1].

Learning Management System (LMS) based on a computer connected to the Internet, that make it possible for students to learn more by obtaining course materials, sending assignments, taking quizzes, communicating with their teachers and fellow learners. For teachers, the LMS assists by allowing them to create, make available, manage, customise and modify a range of digital content and learning objects, to reuse that content and track their students' learning. On the other side (the university), the LMS enables it to expand its student number though delivering courses to students around the world. Since the advent of the Internet, various technologies have been used to enhance learning [2].

Mobile learning provides students with greater customization and mobility compared to traditional learning. On its side, ubiquitous learning seeks that students can acquire knowledge at any time and place. Some mobile devices such iPad, Tablet smartphone have been used by most of the students in the university. It is recommended to use smartphones for supporting students in learning as well as the universities staff. Most higher education institutions use a Learning Management System (LMS) to handle its needs of learning and teaching processes. Some institutions adopted commercial systems and some open source systems [3].

Smartphone is a communication tool whose ability is getting closer to the use of notebook, although now the most popular activities performed on smartphones is accessing social media. The most frequent activities of smartphone users are social media, group discussion, youtube, browsing, games, download, e-commerce, and entertainment news. However, e-learning and other learning applications are the shortest activities of all activities, whether through smartphones or notebooks. Social learning concepts, micro-content, and informal learning are the result of the mobile learning [4].

Smartphones are used worldwide due to their enhanced features, such as computing power, high storage capacity, attractive interface and Wi-Fi connectivity and upload capabilities. These are personal, portable and being increasingly used to assist students' learning that creates new educational opportunities for university students. Social media, on the other hand, has emerged in the last decade as a dominant feature of the technology landscape, especially for our current generation of digital-native students [5].

A smartphone is able to do a wide variety of functions since it is at its core, a simplified handheld computer device. A smartphone can allow a user to increase their overall productivity, make your life more convenient, stay in touch with friends and family [6].

Moodle (Modular Object-Oriented Dynamic Learning Environment) is known as a Course Management System (CMS). It is used all over the world (193 countries) by more of 400,000 registered users. Moodle is an open source software e-learning platform. It does not provide a formal model for future development [7]. Moodle is LMS written in php. Most important part of Moodle is the Course. Courses are the spaces on Moodle where teachers add learning materials for their students. Courses are created by admins, course creators or managers. Teachers can then add the content and re-organize them according to their own needs [8]. Furthermore, Moodle is a learning platform designed to provide educators, administrators and learners with a single robust, secure and integrated system to create personalised learning environments. Any discussion about Moodle should begin with a brief introduction to open source software (OSS)

and the OSS community. OSS is a collective name for software code that is freely available and distributed. In contrast to proprietary or commercial software, anyone may copy, modify, and share open source code without paying royalties or fees [9]. Moodle Mobile is the official mobile application for Moodle. With the Moodle Mobile app, you can learn wherever you are, whenever you want, with these app features: [10].

•Easily access course content - browse the content of your courses, even when offline

•Connect with course participants - quickly find and contact other people in your courses.

•Keep up to date - receive instant notifications of messages and other events.

•Submit assignments - Upload images, audio, videos and other files from your mobile device.

•Track your progress - View your grades, check completion progress in courses.

•Complete activities anywhere, anytime - attempt quizzes, post in forums, play SCORM packages, edit wiki pages and more - both on and off-line.

Currently there are two methods, which can be used by users to access Moodle from a mobile device [11]:

1-Browser-based: the main advantage is immediate access without any additional changes to the system,   however it can cause interface-related issues and requires an constant internet connection.

2-Using a native application: can offer the same security as an authenticated browser connection and a custom interface designed for mobile devices' screens.

The first version of the new Moodle Mobile app was recently released on Google Play (for Android) and Apple iTunes (for iOS) [12]. The new app has been designed as a platform with the following strengths:

• Secure.

•Can work offline.

•Faster and more convenient Moodle operations.

•Support notifications on all platforms (coming soon).

•Can be branded by any Moodle site easily using CSS.

A number of applications developed, have approached the mobility accepted of a LMS (Learning Management System) for a more pragmatic point of view [11].

1) MDroid : (Moodle for Android) offers support for: Authentication, course and file listing, forum access, parallel file download and offline mode. As strong points, it offers a simple user interface and all the common functionalities found on the web.

2) mTouch: is the first native Moodle application for the iOS mobile platform. It does not require any changes on the server side and offers the standard functionalities: course visualization, forum usage, calendar events, chat, grade viewing, wiki access and quiz solving.

3) mBot: is an Android targeted application that allows multiple users on the same device. The user can instantly access its course and activities by their usage relevance and unlike the previous applications mBot it is free.

In this paper we have analyzed, from both learning and technological perspectives, the development of learning applications using smartphone. We have considered M-learning architectures as a way to extend traditional virtual class with Moodel Mobile. While it is clear that the smartphone devices can meet all learning styles, and we imagine that it will support the best learning methods for instructors as well as students become more comfortable with smartphone devices and their characteristics. If used efficiently, smartphones can help in the creation of an attractive learning environment.

The aim of this paper is to determine how students and University staff accepted the application of Moodle in smartphones as an instructional medium. The importance of education using smartphones will support students' capabilities in education and give them the opportunity and access to the innovations in order to reach a high level of excellence and creativity

2. RELATED WORK

Haytham studied and evaluated the Learning Management System of TUBerlin, Information System for Instructors and Students (ISIS), that

has been adopted since 2006, their focus was on three characteristics of ISO-9126, which are usability, functionality, and reliability of ISIS. [3]

Khan investigated how students at university use smartphones with respect to engagement and interaction in various learning activities. It studied how students engage with learning tasks and what social interactions occur when they are trying to achieve their academic goals.

Also, the tools/software that supports their academic goals in different learning settings or activities will be considered. This paper showed the background of the research to promote engineering students' learning curve. [5]

Zamfirache followed the design and development of a mobile application and a web service designed as an extension to the Moodle course management system, with mobile-specific functionality, such as the offline mode, notifications, and attendance based on location. [11]

Mihajlov made a usability evaluation of standard modules in Moodle, one of the leading open source learning management systems. With this research, they obtained significant results and information's for administrators, teachers and students on how to improve effective usage of this system.

More importantly, it opens up fresh possibilities for implementing pedagogical innovations in an environment where students are expected to function as active, independent, self-reflected and collaborative participants. [12]

Brand tested the efficacy of a blended learning iteration with iPad tablet computers, an e-textbook and Blackboard's Mobile Learn application connected with a learning management system (LMS). Mobile learning was embedded into the pedagogical design of an undergraduate subject run in two semesters with 135 students.

Results suggested that students were positive about mobile learning, but they were unconvinced that it made a difference to their learning. Performance variables demonstrated that age and self-managed learning attitudes were important covariates with academic success, and mobile learning per se was important but not indepen-

dent from curriculum design and student engagement. [13]

Fatos analysed, from both learning and technological perspectives, the development of learning applications using mobile devices.

To this end, proxy and proxy less architectures are considered as a way to extend traditional virtual campuses with mobile clients. The objective is twofold: to access learning materials and to support learning activities. A prototype of a Virtual Campus is developed using MLE-Moodle –the Mobile Learning module of Moodle. The proposed Virtual Campus enables mobile clients to perform online learning activities and is a step towards achieving the "anytime, anywhere" paradigm. [14]

Al-Kindi tried to explore students' skill levels of LMS (Moodle) and their knowledge of online tools or technologies and then looked for a correlation between smartphone usage and using of online tools and Moodle in learning.

The study conducted among 173 students in the Department of Information Studies (DIS) in Oman, using online survey.

The study concluded that students prefer to use smartphone for accessing these tools rather than using it to access LMSs, while a positive correlation was found between the use of these tools and smartphones, but there was no correlation between smartphones and using LMSs. [15]

3. Research Methodology

The descriptive survey method was adopted in conducting this study. The descriptive analysis was used in analysing the data of the study.

The means, standard deviations, t-test, analysis of variance in analysing data were used (SPSS).

The data of this study was gathered by means of a paper, pencil survey and through internet.

The aim of this questionnaire is to find out the Acceptance for applying the Moodle in smartphones. The questionnaire was based on five scale options: Strongly agree, Not sure, Disagree, Strongly disagree.

The questionnaire contained the necessary data for the study that was sent to all participants and consisted of two sections.

3.1. Research Question and Aim

The aim of this research is to find out the answer to 'Do the students and University Staff accept applying the Moodle using their smartphones'

3.2. Questionnaire Analysis

SECTION 1: Personal information of the respondents to the questionnaire   .

• What is Gender?

• What is their type phone?

• What is your level of education?

SECTION 2: Acceptance for applying the Moodle in smartphones.

A. The Community and the Sample

The targeted Samples were students, teacher and academics. The number of questionnaires that were distributed randomly was 60 questionnaires to Al Andalus University in Sana'a

B. The Characteristics of Respondents

Aims to know the answers to Section A and characteristics of Personal information of the respondent to the questionnaire, and to provide descriptive statistics for personal data.

1. Variable Gender

Shown in Figure 1 that the majority of respondents were females forming (66.2%).
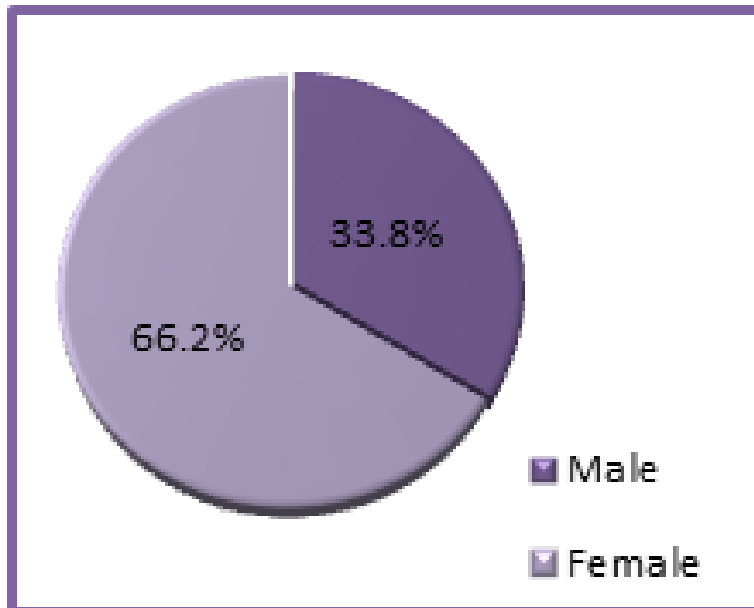
Fig1: Variable Gender

2. Variable Type Phone

Clear from Figure 2 that the majority of the sample had SmartPhones (62.8%), followed by (Normal Telephone) by (31.1%).

Finally 6.1% used no phones (Nothing).
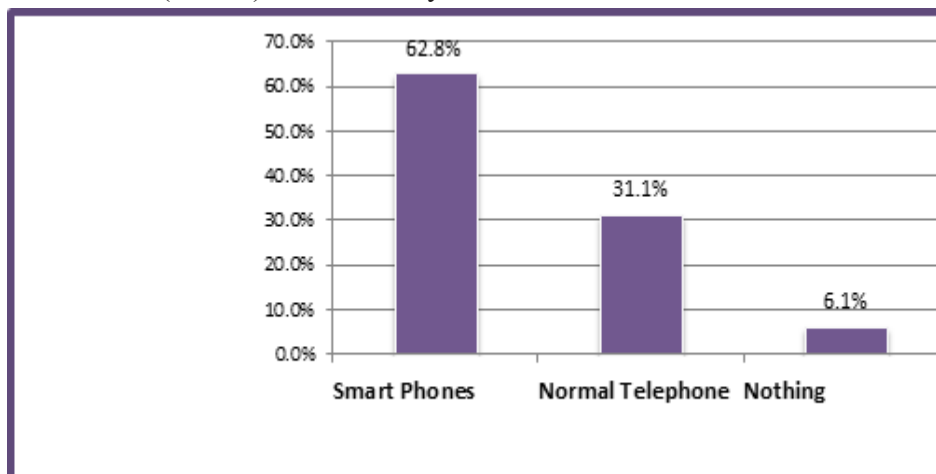
Fig2: Variable of Type Phone.

3. Variable Current Job

Clear from Figure 3 that the majority (Current Job) of the sample were (Student) rate (50.0%), (Administrative Officer) rate (26.4%), followed by Teacher (16.9%), Manager by 4.7%, and Other (0.7%) .
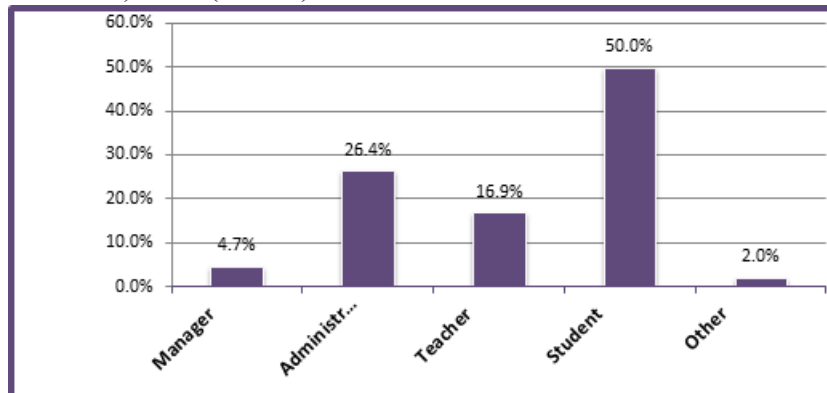
Fig.3: Variable of Current Job.

4. Results and Discussion

The element 1 to 15 of the questionnaire reflect acceptance for applying the Moodle in smartphones in learning.

1-I support the idea of applying the Moodle in smartphones.

2-Smartphones help to motivate the student to deal with the program Moodle

3-The program will be more near the student and the teacher from the computer.

4-Smartphones Moodle achieves the objectives better.

5-Technical qualities in smartphones do not support model.

6-Gives an opportunity for the student and for the teacher to deal with the Moodle better.

7-The teacher and the student can get to the Moodle at any time and in any place.

8-The small screen of the smartphones of constraints in the use of the Moodle in Mobile.

9-I do not want to use the Moodle in smartphones.

10-The application is not available in all kinds of phones and by following the process used to be limited.

11-The program will become more interactive between teacher and student when used with smartphones.

12-The enormous potential of Moodle does not commensurate with the potential of smartphones.

13-The lack of flexibility to deal with all the Moodle services in smartphones.

14-Gives students a chance to connect with the teachers more.

15-Will help the characteristics and advantages of smartphones to spread the program Moodle.
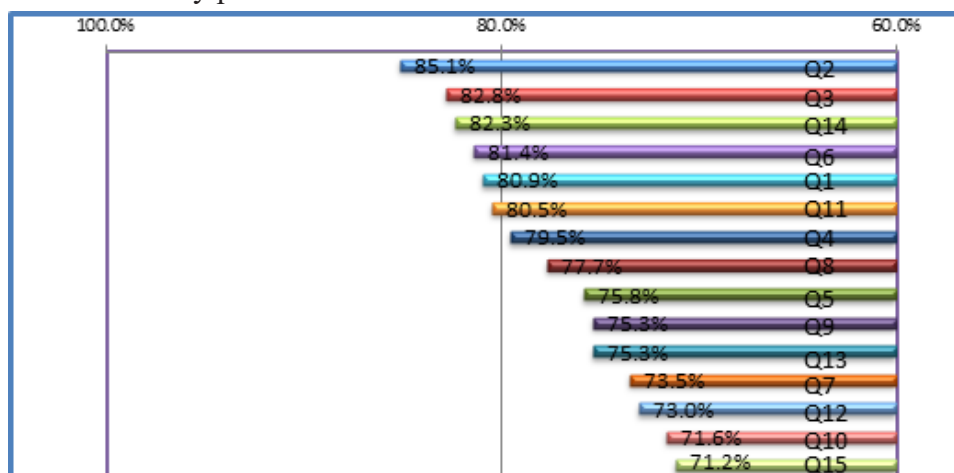
Fig.4: Smartphones help to motivate the student to deal with the program Moodle
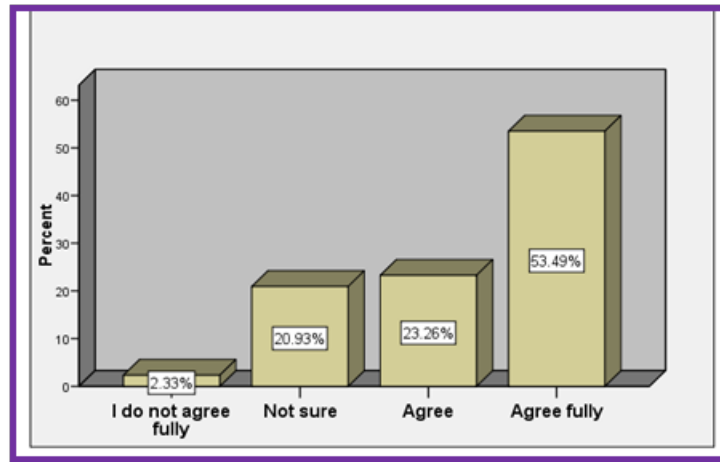
Fig.5: Mean of the questionnaire indicators.

As shown in Figure 5, Q2 (Smartphones help to motivate the student to deal with the Moodle). The result of the analysis of the questionnaire found that 53.49 % of the respondents agree full, and 23.26% agree; with 20.93% of the respondent not sure; and 2.33% of the responded do not agree fully.

The data gathered from the respondents are pre-sented in Table 1, which demonstrates the percentages of the descriptive statistics for Acceptance for applying the Moodle in smartphones measured by a Likert scale.

A Likert scale is a psychometric scale commonly used in questionnaires, and is the most widely used scale in survey research.

Q. No	I do not agree fully		I do not agree		Not sure		agree		Agree fully		Total	
	Count	%	Count	%	Count	%	Count	%	Count	%	Count	%
Q1	7	6.1	18	12.2	16	10.8	56	37.8	49	33.1	148	100.0
Q2	3	2.0	5	3.4	12	8.1	62	41.9	66	44.6	148	100.0
Q3	1	.7	9	6.1	20	13.5	61	41.2	57	38.5	148	100.0
Q4	26	17.6	73	49.3	23	15.5	15	10.1	11	7.4	148	100.0
Q5	0	.0	5	3.4	23	15.5	62	41.9	58	39.2	148	100.0
Q6	0	.0	9	6.1	29	19.6	56	37.8	54	36.5	148	100.0
Q7	22	14.9	73	49.3	29	19.6	10	6.8	14	9.5	148	100.0
Q8	8	5.4	49	33.1	43	29.1	33	22.3	15	10.1	148	100.0
Q9	3	2.0	5	3.4	18	12.2	68	45.9	54	36.5	148	100.0
Q 10	0	.0	1	.7	5	3.4	39	26.4	103	69.6	148	100.0
Q 11	0	.0	2	1.4	9	6.1	28	18.9	109	73.6	148	100.0
Q 12	7	4.7	32	21.6	30	20.3	48	32.4	31	20.9	148	100.0
Q 13	2	1.4	26	17.6	16	10.8	52	35.1	52	35.1	148	100.0
Q 14	22	14.9	57	38.5	27	18.2	25	16.9	17	11.5	148	100.0

Table1: Descriptive statistics for the questionnaire indicators.

5. Conclusions

The study showed how the use Moodle mobile could be improved by the introduction of M-learning. The M-learning themes offer a potential for enhancing the student's performance and experience within this particular course, but also in a wider context of higher education. In this paper we have considered how to integrate the function Moodle Mobile to support the educational experience. Teacher can record their lectures using smartphones, and allow students to access it in the future.

Further studies are required to be conducted on the effect of other variables in the use of smartphones in education.

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Article

The Effect of User Interface on Retaining New Users from Moving Away to Similar Service (Personal Cloud Storages – User experience (UX))

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Article info	Abstract
	In Information Technology, the User Interface (UI) is everything designed in an information device with which a person may interact. The user interface has been developed during many years from a very simple user interface to intelligent user interface. Information Technology played an effective role in these developments. The environment of the systems has expanded greatly, and the Internet has become a suitable environment for them. The means of social communication and electronic commerce, along with electronic marketing, e-payment, and others, which included users who cannot be interviewed and not limited to specific categories because they are in different geographical locations and have different experiences, cultures, possibilities and ages. This is a challenge for the user interface's designer to design interfaces that accommodate this vast diversity of users. In this paper, we are going to spot the light on the importance of the user interface in keeping new users continuity with the cloud services. Our experiments have been applied to a number of the new users of the personal cloud storage (Google Drive and Dropbox). The result showed that ease and the feedback are the most important principles to keep the users interested in the service.

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1. Introduction

User Interface Design (UID) is the design of user interfaces for machines and software, such as computers, home appliances, mobile devices, e-services and other electronic devices, with the focus on maximizing usability and the user experience [1]. It focuses on knowing what users might need to do and ensuring that the interface has elements that are easy to access, understand, and use to facilitate those actions [2]. The goal of UID is to make the user's interaction as simple and efficient as possible, in terms of accomplishing user goals [1], as well as to make it self-explanatory, efficient, and enjoyable (user-friendly) to operate a machine in the way that produces the desired result. This generally means that the user needs to provide minimal input to achieve the desired output, and also that the machine minimizes undesired outputs to the user [1].

Information systems research has long recognized that cultural differences can inhibit the successful use of information technology and its user acceptance [3] [4] [5]. The differences have mostly been analyzed on a national or an organizational level of culture, both of which are often closely intertwined.

In the question of the user interface for systems on the website, the cultural differences are more various. A website is much more than a group of pages connected by links. It is a space where different people such as a company's employees or individual's web users meet through the user interfaces to communicate and affect each other. That interaction creates a global experience for tasks to be done. The web designer should ensure that experience is as good as it can possibly be [6]. On the other hand, web user interface is the interaction between a user and software running on a web server. Web 2.0 refers to World Wide Web websites that emphasize user-generated content, usability (ease of use, even by non-experts), and inter-operability for end users [7]. A Web 2.0 website may allow users to interact and collaborate with each other in a social media dialogue as creators of user-generated content in a virtual community.

The main rule in designing user interface is to know the end user well [2]. It was a very important and critical task for success user interface. These users are company employees, managers, stockholders, and recently customers have been allowed to interact with the system. Nowadays with the services on the cloud, the users are located all around the world with different experience, knowledge, culture, and view. This makes designing user interface more difficult and challenging.

1.1. Development of Architecture of User's Interface

1.1.1. Traditional User's interface

Almost all software programs have a graphical user interface (GUI). Meaning that the program includes graphical controls, which the end user can select using a mouse or keyboard. Traditional user's interface is classified into three models [8]:-

1-Presentation.
2-Dialogue.
3-Application.

which include other models such as explicit models of the user, discourse and domain, input analysis and output generation, and mechanisms to manage the interaction, such as focusing and interpreting imprecise, ambiguous, and/or inaccurate input, controlling the dialog progression, or tailoring presentation output to the current situation.

1.1.2. Intelligent User's Interfaces

Artificial Intelligence (AI) in user interface has many contributions with intelligent interfaces, including the use of representation of knowledge for model based on UI development. It illustrates basic areas of intelligent interface:

•Analysis of input
•Generation" planning or realization".
•Modeling of the user.

Intelligent User's Interfaces (IUIs) are human-machine interfaces that aim to improve the efficiency, effectiveness, and naturalness of human-machine interaction by representing, reasoning, and acting on models of the user, domain, task, discourse, and media (e.g., graphics, natural language, gesture)"[8]. The intelligent user's interface can attract users by content, values, and techniques of working of the interface, so that, the designers should focus on content. Making this successful requires artificial intelligent tech-

niques some of them are complex and other are simple [9]. Any intelligent system can perform the task of representation and simple algorithms in useful performance. The Architecture of Intelligent User's Interfaces (IUI) [8] has the following components:

•Input processing.
•Machine analysis.
•Interaction management
•Application interface.
•Application interface and people.
•Representation and interface.

Most researchers attempting to enhance the interface by following opportunities with the use of complex inferential machine, that machine does not deliver great value [9]. Overall, researchers can make plans by focusing on better UI design with taking into consideration the possibility of joining simple automation procedures into functions of UI.

1.1.3. Personal Cloud Storage

Personal Cloud Storage is a part of a wider definition called 'Cloud Computing'. Cloud computing as defined by the National Institute of Standards and Technology, is "a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) [10] [11].

Dropbox and Google drive are two of the most important personal cloud storage [10]. Dropbox gives users the capability of sharing entire folders with other Dropbox account users, which allows updates to be viewable by all collaborators. It has many advantages such as primarily in its ease of use, very intuitive interface and recovers deleted files in Dropbox easier than some other options [12]. Google Drive has built☐in document editor so that programs such as Microsoft Word are not required to be installed on the computer in order to edit the document. Also, allows comments to be left on any files stored [13]. Both storages have many users all around the world. As of March 2017, Google Drive has 800 million active users Compared to 500 million registered users for Dropbox in the same year [14] [15]. In this paper, we are going to focus on the user interface in both of them. Their advantages and disadvan-

tages are out of the paper's scope.

2. Literature Review

The aim of Maybury's study [8] is to present the importance of intelligent user interface (IUI). The authors gave the outline of the theoretical foundation of IUI.

IUI becomes an important part of a different field that has the ability to implement many functions that meet needs of users according to the requirements and can improve the quality of interaction between users and system. Intelligent user interface always tries to achieve users' goals such as more effective interaction, efficient interaction and more interaction that is natural. The most benefits from IUI are reduced time, cost and expertise to develop the interface. The authors stressed that the motivation of IUI The authors stressed that the motivation of IUI is mention to the available materials on corporates, natural and global information networks is guiding that companies to looking for effective, natural interface to help companies to achieve their goals and support access to people information and applications.

The authors also said that the first interface named command line interface has advanced from initial it. This was the first generation, the second generation of the interface was called graphic user interface (GUI). The third generation is the intelligent interface that provides a number of additional benefits for different type users like adaptivity, task assistance, sensitivity, and context. [8]. Molina's work (2004) [16] was about model-based user interface development (MB-UID). The quality of traditional user interfaces was depending on a strong factor on the experience of the designers and their skills in the platform and development tools [16]. On the other hand, developing UIs of web interfaces, global systems, and wireless have extra concerns that establish a challenge per system. Molina summarized some problems of MB-UID using the Novak's rule:
"Automatic Programming is defined as the synthesis of a program from a specification. If automatic programming is to be useful, the specification must be smaller and easier to write than the program would be if written in a conventional programming language"
These problems were maintainability, scalabili-

ty, round trip problems, integration with artists' designs, lack of standards, lack of robust code generators, lack of integration with business logic, and lack of commercial tools supporting the methods. In the same time, there are some advantages for using MB-UID from Molina point of view, some of them are: higher abstraction level, better productivity, better quality, fewer errors, providing a precise engineering process, multiple device support, and less Time to Market. He concluded his study that new generation tools should address the previously quoted problems to overpass the Novak's rule. Ease of use is crucial to make work perceived as a non-time-consuming task.

Tanahashi and his co-researchers [17] presented in their paper a sketch of an interface design for an online visualization service. The general theory of cloud computing suggests that visualization, which is both data and computing intensive, is a perfect cloud computing application [17]. To make such a service is attractive to a wider audiences, its user interface must be simple and easy to use for both inexpert and expert users. Tanahashi and his co-authors saw that an interface supports visualization processes mainly directed by browsing and assessing existing visualizations in terms of images and videos will be very appealing to, in particular, inexpert users. In other words, the aim is to maximize the utilization of the rich visualization data on the web. Without losing generality, they considered volume data visualization applications for their interface design.They also discussed issues in organizing online visualization data and constructing and managing an execution cloud.

They expected such utilization of the cloud would become more common in the coming generation of web applications. Finally, they have identified a number of key components that are crucial to the strong realization of a usable system: a simple and intuitive interface, an efficient data indexing system, a suggestive visualization system allowing the user to refine its previous results in a relevant fashion, an efficient implementation of visualization techniques [17].

The aim of Sonia's study [18] was to address the security of system or network to find out how they affect the design interface in security man-

agement system. Software security assurance is a process that helps design and implements software that protects the data and resources contained in and controlled by that software. The software is itself a resource and thus must be afforded appropriate security [19]. Sonia and his co-authors presented in their paper four different approaches in security management system. The first approach was usable security; they suggested certain guidelines that the users should: be aware of security task, figure how to successfully perform those tasks, not make dangerous errors, be comfortable with the interface to continue using it, be able to tell when their task has been completed and have sufficient feedback to accurately determine the current state of the system. The Second approach was ecological interface design framework for designing complex socio-technical systems. The third approach was the Social Navigation; this was based on the human tendency to use cues from other people in order to make decisions about our own behavior. People use the social navigation on a daily basis. The last approach was Persuasive Technology; a new area of human-computer interaction. Considering these four approaches to interface design, the authors proposed the following initial set of design guidelines for security management interfaces: Administrators should reliably be made aware of the security tasks; should be able to figure out how to successfully perform those tasks; should be able to tell when their task has been completed; should have feedback to accurately determine the current state of the system and the consequences of their actions; should be able to return to a previous system state if a security decision has unintended consequences; should be able to form an accurate and meaningful mental model of the system they are protecting, should be able to easily examine the system from different levels of encapsulation in order to gain an overall perspective and be able to effectively diagnose specific problems. The interface should facilitate interpretation and diagnosis of potential security threats, able to easily seek advice and take advantage of community knowledge to make security decisions and the interface should encourage administrators to address critical issues in a timely fashion. They concluded their study that end-user

is the main concern for the field of usable security.

The aim of the Doina's study [7] is to emphasize the connection between cloud computing and Web 2.0. Doina and his co-authors presented in their paper the advantages, challenges, and issue related to cloud computing. Cloud computing is a new method to add capabilities to a computer on the fly, without licensing new software, investing in new hardware or infrastructure, or training new personnel. The services are accessible anywhere in the world, with the cloud appearing as a single point of access for all the computing needs of the consumer. The authors presented the advantages of cloud computing such as price, simplicity, reliability, flexibility, focus, and collaboration. The issues related to cloud computing were privacy and security, emergencies, standards, legality, mentality, and pricing theory. They concluded that web 2.0 is the result of applying web technologies to the web, in which the user has final control over visual presentation and user interaction. Cloud computing is currently gaining popularity as an inexpensive way of providing storage and software [7].

2.1. User Interface Design Principles

"To design is much more than simply to assemble, to order, or even to edit; it is to add value and meaning, to illuminate, to simplify, to clarify, to modify, to dignify, to dramatize, to persuade, and perhaps even to amuse." - Paul Rand.

Sensenbach stressed in his study [20] that changing the design thinking to larger systems, rather than one-off screens, can be hugely transformative in how the designer approach new projects. The most important principles of user interface design are [21]

Clarity: Clarity is the first and most important job of an interface. It means people must be able to recognize what it is, care about why they would use it, understand what the interface is helping them interact with, predict what will happen when they use it, and then successfully interact with it. Clarity motivates confidence and leads to further use.

Interfaces exist to enable interaction: The act of designing interfaces is not Art. Interfaces are not monuments unto themselves. Interfaces do a job

and their effectiveness can be measured. The best interfaces can encourage, suggest, confuse, and strengthen the user's relationship with the world.

Conserve attention at all costs: Attention is valuable. It is not only when the users are happier, but also when the results are better. When use is the primary goal, attention becomes essential. Conserve it at all costs.

Keep users in control: Humans are most comfortable when they feel in control of themselves and their environment. The users should be kept in control by regularly surfacing system status, by describing causation and by giving insight into what to expect at every turn.

Direct manipulation is best: Design an interface with as little a footprint as possible, recognizing as much as possible natural human signs. Ideally, the interface is so slight that the user has a feeling of direct manipulation with the object of their focus.

One primary action per screen: It is recommended that every screen has been design should support a single action of real value to the person using it. This makes it easier to learn, easier to use, and easier to add to or build on when necessary.

Keep secondary actions secondary: Screens with a single primary action can have multiple secondary actions but they need to be kept secondary. The secondary actions should be kept secondary by making them lighter weight visually or shown after the primary action has been achieved.

Provide a natural next step: Very few interactions are meant to be the last. The next step for each interaction a person has with the interface should be designed carefully.

The appearance follows behavior: Humans are most comfortable with things that behave the way they expect. When someone or something behaves consistently with their expectations, they feel like we have a good relationship with it.

Consistency matters: Elements that behave the same should look the same. In an effort to be consistent novice designers often obscure important differences by using the same visual treatment (often to re-use code) when different visual treatment is appropriate.

Strong visual hierarchies work best: A strong visual hierarchy is achieved when there is a clear viewing order to the visual elements on a screen.

Weak visual hierarchies give little clue about where to rest one's stare and end up feeling cluttered and confusing. In environments of great change, it is hard to maintain a strong visual hierarchy because visual weight is relative.

Smart organization reduces cognitive load: ''Simplicity, smart organization of screen elements can make the many appear as the few'' (John Maeda). This helps people understand the interface easier and more quickly.

The highlight, do not determine, with color: The color of physical things changes as light changes. As in the physical world, where color is a many-shaded thing, color should not determine much of an interface.

Progressive disclosure: Show only what is necessary on each screen. If people are making a choice, show enough information to allow them make a choice, then dive into details on a subsequent screen.

Help people inline: In ideal interfaces, help is not necessary because the interface is learnable and usable. Asking people to go to help and find an answer to their question puts the responsibility on them to know what they need.

A crucial moment: the zero state: The first time experience with an interface is critical, yet often overlooked by designers. In order to best help the users get up to speed with the designs, it is best to design for the zero state, the state in which nothing has yet occurred.

Great design is invisible: An interesting property of great design is that it usually goes unnoticed by the people who use it. One reason for this is that if the design is successful the user can focus on their own goals and not the interface. When they complete their goal they are satisfied and do not need to reflect on the situation.

Build on other design disciplines: Visual and graphic design, layout, copywriting, information architecture and visualization, all of these disciplines are part of interface design. They can be touched upon or specialized in. Do not get into field conflicts or look down on other disciplines: take from them the aspects that help you do your work and push on.

Interfaces exist to be used: As in most design disciplines, interface design is successful when people are using it. It is not enough for an interface

to satisfy the ego of its designer, it must be used. From Tanahshi there are others principles [17].

Searching: this is achieved in a convention manner e.g insert any request into a search box or choose any items through indexed categories. Smart users select all the properties.

Suggestive Visualization: the initial searching provides users with existing visualization. The system then computes a new set of Visualisations that the user may prefer. Some visualization may include changes to the dataset, the function of transfer and viewpoint.

Iterative Interaction: there are two types of basic interaction in system: the first type is called direct change visualization parameters, it consider a common type of interaction with application of visualization, and the second type is choosing visualization from supporting collection of visualization.

In addition, Niall Mruphy set two main principles [22].

Directed interfaces: Some designed interfaces suggest a direction. The users have some options to break out the sequence but the question gives suggestion to the users to go the next appropriate action to provide the answer.

Compatibility: this principle has three levels; the first one is a compatibility between what user experts and what users get. The second one is compatibility between different products of the same type. The last one is between devices and its surrounding and the device with which it has to be cooperate

According to Larry Constantine and Lucy Lockwood [23] the principles of user interface design are intended to improve the quality of user interface design. Such as:

The structure principle: Design should organize the user interface purposefully in meaningful and useful ways based on clear, consistent models that are apparent and recognizable to users, putting related things together and separating unrelated things, differentiating dissimilar things and making similar things resemble one another. The structure principle is concerned with overall user interface architecture.

The simplicity principle: The design should make simple and common tasks easy, communicating clearly and simply in the user's own language,

and providing good shortcuts that are meaningfully related to longer procedures.

The visibility principle: The design should make all needed options and materials for a given task visible without distracting the user with extraneous or redundant information. Good designs do not overwhelm users with alternatives or confuse with unneeded information.

The feedback principle: The design should keep users informed of actions or interpretations, changes of state or condition, and errors or exceptions that are relevant and of interest to the user through clear, concise, and unambiguous language familiar to users.

The tolerance principle: The design should be flexible and tolerant, reducing the cost of mistakes and misuse by allowing undoing and redoing, while also preventing errors wherever possible by tolerating varied inputs and sequences and by interpreting all reasonable actions.

The reuse principle: The design should reuse internal and external components and behaviors, maintaining consistency with purpose rather than merely arbitrary consistency, thus reducing the need for users to rethink and remember.

2.2. The criteria for designing cloud computing

Cloud computing is considered as one of the most important favoured technology. It has the ability which can help users to achieve their needs. It is able to treat a number of issues related to users' needs [24]. "The open source cloud computing is a flexible paradigm which has reached heights by facilitating a large number of users with unlimited services."[25].

To design storages like Google drive and Dropbox should include high-quality criteria to achieve the goals. That criteria are considered important to accept and deal with them such as flexibility, scalability, ease of use, scalability, reliability, broad network access of infrastructure, location independence, reliability improves, economies of scale and cost-effectiveness [26] [24]. Another important criteria is the security criteria; It focuses on security-related capabilities which must be trusted [Kaur].

Cloud UI Design Mistakes to Avoid

Great user interface design for cloud applications is harder than it looks [27]. Some of the mistakes that designers should avoid are:

•Focus on good look but it makes the product harder for the real pro to use. Beauty is only skin deep, even with UI skins.

•Continuous auto save: it is nice, but with products that have some administrative complexity a simplistic auto-save is a guaranteed disaster.

•It is so easy: it should not be so easy to lose the main function.

•None of that Big System Complexity: UIs that make it easy for the novice user often make it easy to generate complete chaos.

Google Drive and Dropbox Personal Cloud Storage

Dropbox and Google Drive are two comparable cloud storage services. A lot has used more than one device these days; tools like Dropbox and Google Drive can come in hands for sharing files across multiple devices. We can compare them in several principles: [28]

Storage Space: Dropbox offers 2 GB of storage for free while Google Drive offers 5GB for free.

Desktop Client: Both Drive and Dropbox offer very similar desktop clients. Both allow the users to see and access all of their files in a desktop folder. If users want more flexibility with their files, they need to go with Dropbox.

Web Client: Google Drive features a suite of apps including Docs, Spreadsheets, PicMonkey for editing images, and DocuSign for collecting and sharing signatures. Google Drive also comes with Google's powerful search tools. Users can specifically search through presentations, documents, spreadsheets, private files, shared items, and more. Drive's search taps into Google's Optical Character Recognition service and Images, making it possible to scan and search documents for text and images.

Support: Google Drive supports up to 30 different file types, all of which the users can open directly within their Web browser. Other than their standard text, audio, and video files, Google Drive also supports AutoDesk, Adobe Illustrator and Photoshop files. On the other hand, Dropbox does support many file types including PDFs, documents, video, photos, Photoshop files, and music. They can be viewed in the browser, but the users can't edit them online. Google Drive, for its ability to open and edit any type of file

online.

Sharing Features: Both Google Drive and Dropbox are pretty good when it comes to sharing. A key difference: Drive only allows uses to share through its Web app, while Dropbox offers sharing directly from its desktop app.

Compatibility: Both services are available on iOS, Windows, Mac, and Android devices. But Dropbox has a slight upper-hand, as it's also compatible on Linux and Blackberry. But Google is working on developing Drive for Linux.

Security: Google Drive links to the Gmail account, the users can enable two-step authentication. Dropbox offers a similar two-step verification feature, where the users must submit their password in addition to a six-digit security code in order to sign in.

2.3. Summary of Literature Review

To sum up the most important principles of user interface, we will go through those that have been emphasized in the literature review:

The first group regarding the usage; the important principles include ease of use, must be simple and easy to use for both inexpert and expert users, inform users when their task has been completed with sufficient feedback, and aware them that end-user is the main concern for the field of usable security.

The second group regarding the learning; the important principles include providing the user with final control over his task, encourage, suggest, confuse, and strengthen the user's relationship with the world, easier to learn, and easier to add to or build on when necessary especially when the users will not be trained to use these systems.

 The third group regarding behaviour; the important principles include very few interactions, humans are most comfortable with things that behave the way they expect, elements that behave the same should look the same. Finally, Simplicity, smart organization of screen, show only what is necessary on each screen, what user experts should be what users get, keep users informed, and reducing the cost of mistakes. Although, both of the personal cloud storage are similar in their facilities, the first time experience with a user interface is critical' as well as, 'the clarity motivates confidence and leads to further use'. These

are the facts that our paper attempt to ensure them regarding the new user.

3. Research Methodology

3.1. The Methodology

We will use the qualitative methodology to investigate and analyze the user interface for both of personal cloud storage - Google Drive, and Dropbox- to find out what is the most important interface principles that encourage the new user to continue discovering and using the personal cloud storage. We will achieve that goal by doing experiments on a number of users who have not tried these stores yet, and ask them to perform the basic functions and record their opinions of dealing with the interfaces and where they prefer to stay in and know the reasons behind this choice. This methodology is using the User experience (UX). The main tasks in the personal cloud storage that the new user has to achieve in his/her first time in these storages are

1.[Upload]: Upload files, directories, photos, to the storage.

2.[Access]: Access to the files, directories, photos, from the storage from anywhere.

3.[Share]: Share files, directories, photos, to the storage, with anyone.

4.[Receive]: Receive files, directories, photos from the others to the storage.

5.[Editing]: Editing files in the storage.

3.2. Research Sample

The research sample consists of a random group of participants who have not yet used personal cloud storage. Fifteen of them are from the, Institute Of Statistical Studies and Research Cairo University, fifteen of whom are from the Agricultural Bank in Yemen and the last fifteen are from the Yemenia University. The sample varied in terms of general characteristics of age, gender, educational level, computer experience. Although these characteristics were not the subject of study in this research, however, researchers sought to diversify the sample to obtain their overall opinion without being influenced by specific characteristics.

3.2. Research Tools

The researchers studied the covered-up user interface design's criteria, identified the most important criteria for the design of the user inter-

face, and examined the personal cloud storage. The researchers then identified the most important tasks that the new user is supposed to start with, and use experiments to ask the participants to accomplish these tasks, record their reactions, deal with the personal cloud storage, determine which storage they prefer to continue and why?.

3.3. Research Objective

When the designer starts designing the user interface for the particular information system, he has three advantages. First, he can understand the users' requirements very well by interviewing them. The second advantage is that there will be training for the users to use the system and understand the user interface. Finally, the users are forced to use the system, so they will do the best to understand it. In the cloud computing systems, where there are multiple options in everyone's way, the situation is somehow different. The designer cannot interview the users or know their characteristics. Moreover, there is no training for the system face as well as they are not forced to use the system. If the system is not clear, the user can just give it up and switch to another system with similar functions. The objective that we are trying to address is how to keep the new user in the system. The new users (visitor) have to discover everything in personal cloud storage by themselves to move from visitor to client. They like to know how to use the storage efficiently in short time. If the user interface is not clear and easy to use, some of them will switch to another storage because there are many in the cloud.

3.4. Aim of Research

With all the offers available in the user's hand, the designer of the user interface of the services on the cloud should be careful to build the user interface to a large degree of gravity and ease in order to keep their new users and do not let them move to similar services. The aim of this study is to find out the most important user interface design principles that encourage the new user to continue with understanding the facilities of the cloud services, for example, personal cloud storage.

3.5. Research Significance

It is important for the designer to ensure that the new users will continue using the service. Our research importance comes from the importance of keeping new customers in the service and not loses them especially that nowadays there are many options offering similar products. The research seeks to highlight the importance of retaining the new customer and not leaving it to competed service that may pose a serious risk to the survival of the system. Our research is based on the personal cloud storage, however the results can be applied to a similar system or product on the web.

4. Results and Analysis

Each author has tested a number of new users who have never used personal cloud storage before. They were selected from the various background, age, gender, and education. Total of 45 new users have been tested. The 45 new users have been tested to do the main tasks of the personal cloud storage, for example, uploading a file and image, sharing and receiving files with other users, and editing a file on the storage for both Google Drive and Dropbox. Their feedback, questions and comments were recorded.
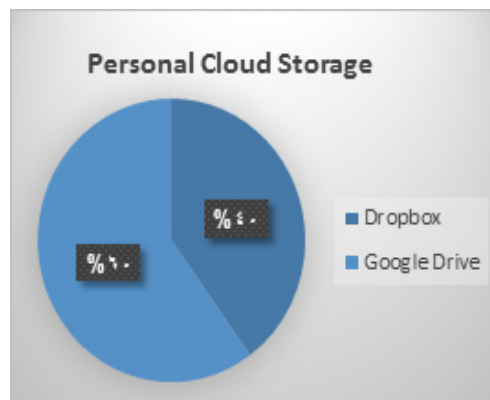

Fig.1. result of the experiments on Google Drive and Dropbox

Figure no. 1 shows the result of the experiments to check what is the new users' preference to use from, Dropbox or Google Drive. The result showed that the 60% of the new users who have been tested (they have not tried these storages yet) prefer Google Drive while 40% prefer Dropbox. That means most of the new users preferred Google Drive and less of them preferred Dropbox. To sum up that, it is clear from the experiments that the majority of new users prefer to use Google Drive. They said that Google Drive has good quality design and it is easy to use according to their opinion. They also like to have feedback while they are doing their tasks to keep them in control and know what is going on.

5. Conclusion

We can sum up that it is both important and difficult to keep the already existing service users rather than to gain new ones. Our experiment investigated why users prefer a personal cloud storage more than the other. However, the results showed that the new user (visitor) always seeks the ease of use and the simple way to achieve its tasks. We can confirm that users usually focus on achieving their tasks in an easy way more than how the design of the user interface looks like. At the end, we can ensure that this result can be applied to any other service on the cloud; where there are many similar options available for the users. We have to emphasize on the fact that keeping the new users gives a good indicator to how successful the service is. On the other hand, losing users "users leaving" displays a warning that there is something wrong.

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Article

The Role of E-government in Combating Corruption in the Public Sector in Yemen

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Article info

Abstract

Corruption is generally considered to be one of the most significant impediments to economic development and good governance; while E-government is considered as a tool to promote transparency and reduce corruption. It is more than true, especially in the least developed countries; Countries that have invested more in e-government have also seen more reduction in the levels of corruption. Clearly, there was a need for strengthening research on e-government as a tool for combating corruption, which at present is largely a-theoretical and descriptive. This research focused on different projects of e-government in Yemen and that might be helpful to reduce corruption. The statistical analysis used a modified Klitgaard corruption model, which included factors of intervention of middlemen in addition to monopoly power, the discretion of officials and the absence of transparency. The purpose of this research was to study the direction and significance of the relationship between e-government and combating corruption in the public sector in Yemen. The results of this research revealed that the use of ICT in the form of e-government can make important headway to reduce corruption. Also, the results of this research support the hypotheses that e-government limits both positively and significantly monopoly power, discretion, and intervention of middlemen, as well as increases transparency.

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1. Introduction:

Combating corruption is one of the most important challenges facing countries around the world. In this decade, countries, both developed and developing, are vulnerable to corruption. Also, corruption has become a threat to the general objectives of the governmental development, disruption of its programs, plans, projects, and helps the aggravation of the economic crises.

Recent researches in information and communication technology (ICT) have given hope to the idea that new technologies in the form of e-government practices can be used to combat corruption in the public sector. Indeed, different studies[1],[2],[3],[4] show that different e-government projects that are initiated in countries have one thing, in which all the projects succeeded, that is elimination or combating of corruption to a great extent.

In general, the need to have better transparency and to combat corruption is not restricted to the Western Countries; it is more urgently required in developing countries.

Yemen is considered as one of the developing countries, and it has failed to combat corruption despite its efforts in this area. Corruption in Yemen has increased remarkably between 2005 and 2015 based on Transparency International rank countries[5].

The public sector in Yemen suffers from many f-orms of corruption which became a big problem rooted in all departments and govern- ment bodies in Yemen. [6] In recent years, many countries have considered administrative reform as a crucial step towards strengthening their economy and better management of their social development.[7].

Yemen, however, as one of the least developed countries seeks to improve its e-government development index which is 0.22 in 2016.[8] The aim of this research is to examine the role of e-government in combating corruption in the public sector in Yemen, and to investigate if e-government reduces significantly monopoly power, discretionary authority, and middlemen's intervention, as well as increases transparency.

1.1. Background of the problem

Although several laws, rules, prosecution and recovery of public properties have been made through years, but corruption is still growing rapidly. Most Yemeni have the view that the fight against corruption is sometime selective, while others believe that some people can involve in corruption without being noticed [9]. However, public officials often intentionally cause some of the delays in various public offices because they expect citizens offer bribes in order to fast-tract the services.

In view of the above listed and other related reasons, it is necessary to research for other approaches of fighting corruption. One of such measures is the adoption of Information Communication Technology (ICT). Generally, ICT in controlling corruption operates by shining a bright light on institutional processes. ICT enhances transparence, while offering opportunities for easier access to public records.[10]

The researches of the role of e-government in combating corruption in Yemen are still new. In fact, most of the researches on the role e-government in combating corruption focused on samples from some countries such as India[11][12].

Also, a common recommendation in corruption and ICTs studies is that the next step in this kind of research should examine if there is a positive effect of e-government on corruption [1],[2],[3],[4]. Hence, the present research is an attempt to explore answers to the following core question:

"What is the role of E-government in Combating Corruption in the Public   Sector in Yemen?"

2. Literature Review

2.1 E-Governance :A Way to reduce corruption

E-government may offer a weapon against corruption. Recent innovations in information and communication technology (ICT) and scholars have given hope to the idea that new technologies in the form of e-government systems can be used to combat corruption in the public sector. Combating corruption considered to the extent that increased transparency, accountability and

predictability (of rules and procedures) are made priorities.

In addition, the findings from the study presented by Shim & Eom (2008) suggested that ICT has a strong potential to reduce corruption through the promotion of "good governance and enhancing relationships between government employees and citizens".

Besides all these cost-efficiency benefits that Communication and ICT can provide to governments, it is believed that e-government can strengthen good governance and decrease corruption levels through increased transparency and accountability and[13].

2.2 Drivers of Corruption

Studies argue that illicit behavior flourishes when public servants have a monopoly power over citizens, when agents have great discretion, and when accountability of agents to the principal is weak [14] [15]. So, as many researchers did, the researcher adopted the drivers of corruption that are mentioned by [16],[17] which is summarized in the following functional equation:

Corruption = Monopoly Power + Discretion – Transparency (in governance)".

But, in line with the forms of corruption in Yemen, the researcher adds one variable, Middlemen's Intervention to the equation, which is considered the most important driver based on different studies. Middlemen's Intervention is defined as the direct interacti-on between officials and citizens. [18].

2.3 E-government Practices in Yemen

Yemeni government has many attempts to apply the concept of e-government. Some ministries and government bodies have adopted e-government practices to build technological computer systems that are working to help various institutions to do their work efficiently and effectively, and to perform numerous functions of help desk and doing accounting tasks[19]. The government has successful attempts to adopt e-government project such as E-gate for application and admission for the Yemeni universities project (electronic registration for students at universities) that has been implemented by Ministry of Higher Education and Scientific Research[20]. In addition, Procurement Management Informa-

tion System (PMIS) project was initiated by the Higher Authority for Bids and Offers Control. They managed to launch an interactive website of draft laws and regulations and allowed the public and civil society organizations to submit comments[21].

Furthermore, Yemen Civil Service Modernization Project has started reforms to rationalize government employment and limit ghost workers by Yemen Civil Service Ministry.

The main objective of this project is to reduce corruption in registration procedure in the civil service. The project struggled as a result of strong bureaucratic resistance; and absence of institutional building to carry out a complex multifaceted reform program. Before this project became operational, the Yemeni government, at the Crossroads Report, was described; "the government's patronage system involves 'employing' thousands of Yemenis in government positions, they have more than one wage with no performance or duties", and the Yemeni government had not had an accurate survey of Yemen's workers [22].

Furthermore, the USAID report stated that The Civil Service Modernization Program created the first civil service survey, which initially found that between 473,000 employees in civil service, 15,000-30,000 were either having double –job or so-called" double- dippers" (those who receive more than one government salary) or 'ghost employees (those who did not perform any duties) . [9]

2.4 Related studies

For the present discussion, literature addressing the e-government and its role in combating corruption is organized along two dimensions: first, studies which take a micro view and focus on the description and outcome of specific e-government projects; and second, studies which do not focus on any particular e-government project, but take a macro view of the outcomes of e-government in a country/state.

First: the linkage between e-government and corruption at country/state level has been addressed by relatively few studies, and these are discussed individually.

The case study presented by [11] reported a sig-

nificant effect of e-government on corruption in Estonia, and focused on four factors could be the most effective way to reduce corruption through e-government. These factors are increased transparency, better accountability, disappearance of the "middlemen" and bridging the gap between public workers and citizens. The results reported by [23] in Kuwait suggested that the transition to e-government limits the intervention of individuals in the public sector in Kuwait. Thus it reduces many kinds of corruption related to individual emotion through favoritism, nepotism and bribery. Additionally, this study showed that the presence of e-government can be seen as one of the tools that can help reducing the discretion of government officials. Furthermore, the results reported by[24] are supported of a positive connection between e-government and reduction in corruption in Fiji and Ethiopia. This study, using a structured questionnaire, explored the perceived role of e-government in reducing corruption amongst 800 respondents each from Fiji and Ethiopia. This study also noted that while e-government is important to anti-corruption, it also has its limits because many ICT projects fail because of the insufficient planning capacity and political instability. In order to overcome these challenges, the researchers mentioned that successful implementation requires matching the right technologies with capable and progressive reformers and government systems.

Second: the linkage between e-government and corruption at specific e-government projects; it has been addressed by relatively few studies, and these are discussed individually. The case study of Punjab presented by[11] explored the five e-governance projects in Punjab that really decreased the level of corruption in different states in India. The findings of this study suggested that the services of government should be available Online to help reduce corruption. If services are available Online, procedures will be streamlined and will take less time. There will be also no need to pay extra money for speeding up the process. The results suggested also that e-government must be firmly embedded in the existing government processes and must be supported both politically and technically by the governments. The study presented by [4] explained one particular case in South-Korea. They tried to examine the OPEN (Online Procedures Enhancement for civil applications) system of the Seoul Metropolitan Government. The findings brought out that implementing OPEN was the most effective tool to reduce corruption, and the strong leadership was crucial for its success. They also brought out that e-government eliminates discretion from the equation by removing intermediary services and allowing citizens to conduct transactions themselves.

3. Objectives and Methodology

The objective of this study is to investigate the relationship between e-government practices and the following major drivers of corruption:

Monopoly of power, discretionary authority, middlemen's intervention, transparency Fig 1. The study hypothesizes that e-government practices are positively related to corruption reduction.
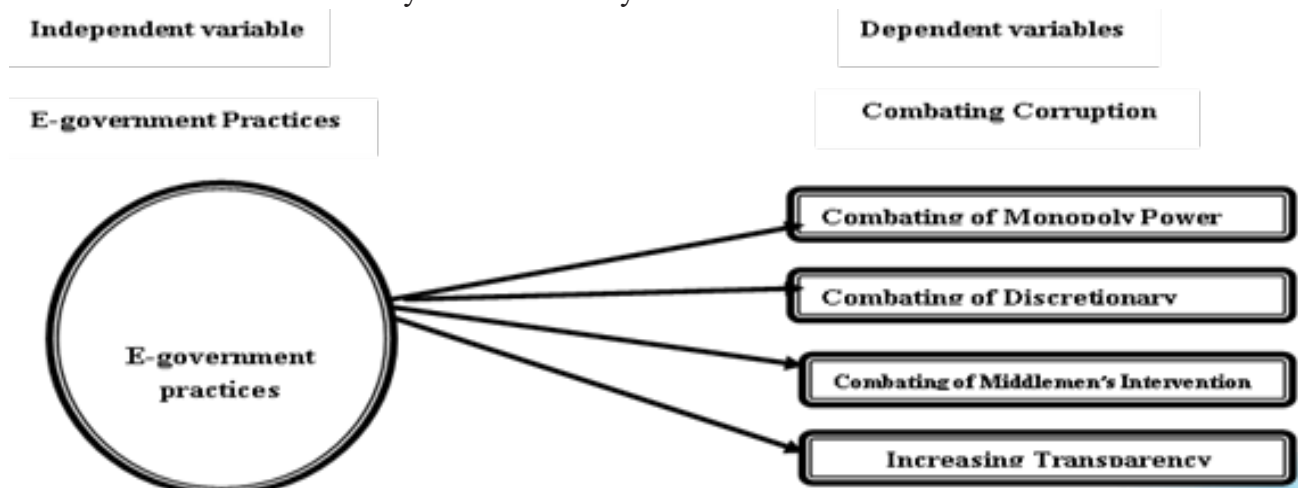

Fig1. Research mode

We adopted the drivers of corruption that are mentioned by [14] which is summarized in the following functional equation:

Corruption = Monopoly Power + Discretion + Middlemen's Intervention– Transparency

The purpose of this model was studying the direction and significance of the relationship between e-government and combating corruption (monopoly power, discretion, middlemen's intervention, and transparency) in the public sector in Yemen

The monopoly power is defined as having control or access to material or human resources, as well as control procedures that allow third parties to fulfill the mandate of the government [25].

 While discretion defined as the presence of ability or power to freely make some choices in an unconstrained manner.[26].

 Middlemen's Intervention is defined as the direct interaction between officials and citizens [18].

 Finally, transparency refers to the public avail-ability and increased flow of timely, comprehensive, relevant, high quality and reliable information concerning government activities [27].

• **The Study Sample**

   The study sample included 370 employees who are working in organizations that were carefully chosen for this research based on the extent of using the ICT, or e-government practices.

The organizations chosen are as follow: Ministry of Finance, Ministry of communication & Information Technology, National Information Center, Ministry of Civil Service, Customs authority, Ministry of Higher Education and Scientific Research, The Higher authority for Bids and Offers Control, The authority for Bids and Offers, and Taxes authority. 261 respondents returned the questionnaire.

Respondents were selected using stratified random sampling technique. Table 1 presents the demographic profile of the 261 respondents (N=261) selected for the study.

Demographic profile			
		Frequency	Percent
Gender	Male	192	73.6%
	Female	69	26.4%
	Total	261	100.0%
Academic Qualification	Secondary School	5	1.9%
	Diploma	24	9.2%
	Bachelor	181	69.3%
	Master	50	19.2%
	PHD	1	0.4%
	Total	261	100.0%
Position	Employee	108	41.4%
	Director	73	28.0%
	Manager	59	22.6%
	General manager	21	8.0%
	Total	261	100.0%

Table 1: the demographic profile of the 261 respondents

•**Study Tool**

We prepared the study tool, a questionnaire, to collect the necessary data on the subject of the study. The questionnaire used 5 -point likert scale (A five-point Likert Scale rating from 1 to 5 where 1= Strongly Disagree,2=Disagree, 3=No View, 4=Agree, 5 =Strongly Agree).

The questionnaires were divided into different sections for easy reading and completion, and were accompanied by a short, simple and informative cover letter that informs respondents about the aims and importance of the research. The questionnaire was written carefully using clear language to encourage participants to provide honest and unbiased information, and emphasize the privacy and confidentiality measures are in place.

The questionnaire included 43 items (12 items concerned on the availability of ICT in the public sector organization ,8 items concerned on the role of e-government in combating of monopoly power, 10 items concerned on the role of e-government in combating of discretionary authority, 4 items related to the role of e-government in combating of middlemen's intervention, and 9 items related to the role of e-government in increasing transparency), besides the personal and organization's information.

The study used the following research hypotheses:

•**Hypothesis** 1: Higher level of e-government practices is significantly associated with higher level in combating monopoly of power in public sector organizations

•**Hypothesis** 2: Higher level of e-government practices is significantly associated with higher level in combating discretionary authority in public sector organizations.

•**Hypothesis** 3: Higher level of e-government practices is significantly associated with higher level in combating middlemen's intervention in public sector organizations

•**Hypothesis** 4: Higher levels of e-government practices is significantly associated with higher level in increasing transparency in public sector organizations

The reliability of this questionnaire was assessed using Cronbach's Alpha (Which was reliable - Cronbach's Alpha =92.2%).

To test the Validity of the questionnaire it was presented to a group of administrators and PhD legal professionals at the Sana'a University (Faculty of commerce).

The questionnaire was modified accordingly.

4. Results and Discussion

•**Testing normality**

Normality of the distribution is the underlying assumption for most statistical tests.

As a consequence, all the variables in the current research (E-government, combating of Monopoly Power, combating of Discretionary authority, combating of Middlemen's intervention, and increasing Transparency) were tested for normality of distribution of the score of measures to ensure that this fundamental assumption was met before proceeding with inferential examination to prove the proposed hypothesis.

Statistics in term of skewness and kurtosis for the five variables were illustrated in Table 2.

The data is considered to be normally distributed when the skewness value is between +/- 3. And for the kurtosis the value must be between +/- 10 to meet the normality assumption. (Cohen, Cohen, West & Aiken, 2003)[28]

Descriptive					
	E-government	Combating of Monopoly Power	Combating of Discretionary authority	Combating of middleman's Intervention	Increasing Transparency
Mean	3.4662	3.2088	3.2130	3.1149	3.5185
Std. Deviation	0.58978	.75055	0.756906	.93114	0.70334
Skewness	-.142	-.020	.195	.977	-.840

Std. Error of Skewness	.151	.151	.151	.151	.151
Kurtosis	-.419	-.304	-.513	6.228	.919
Std. Error of Kurtosis	.300	.300	.300	.300	.300

Table 2 Skewness and Kurtosis Analysis of first part of questionnaire

•Hypothesis Testing

The results of hypothesis testing are as follows:

Hypothesis 1: Higher level of e-government practices is significantly associated with higher level in combating of monopoly of power in public sector organizations.

As mentioned in Table 3, this relationship was investigated by running Pearson's Correlation test. The result demonstrated a medium positive and significant relationship between e-government and combating of monopoly power (r = .360 **, p=.000 < 0.001).

Accordingly, it could be inferred that government organizations who scored high in e-government would report a high level in combating of monopoly power.

Therefore, Hypothesis 1 was supported.

Correlations			
		E-government	Combating of Monopoly Power
E-government		1	.360**
	Sig. (2-tailed)		.000
	N	261	261
**. Correlation is significant at the 0.01 level (2-tailed).			

Table 3 Correlation analysis for combating of Monopoly Power level and E-government level

Hypothesis 2: Higher level of e-government practices is significantly associated with higher level in combating of discretionary authority in public sector organizations.

This relationship was investigated by running Pearson's correlation test.

The Result demonstrated a medium positive and significant relationship between e-government and combating of discretionary authority (r = .302**, p=.000 < 0.001).

Accordingly, it could be inferred that organizations who scored high in E-government would report a high level in combating of discretionary authority. Therefore, Hypothesis 2 was supported. Table 4 provides correlation analysis between the factors under study.

Correlations			
		E-government	Combating of Discretionary authority
E-government	Pearson Correlation	1	.302**
	Sig. (2-tailed)		.000
	N	261	261
**. Correlation is significant at the 0.01 level (2-tailed).			

Table 4 Correlation analysis for combating of Discretionary authority and E-government

Hypothesis 3: Higher level of e-government practices is significantly associated with higher level in combating of middlemen's intervention in public sector organizations.

The results revealed a medium positive relationship between e-government and combating of middlemen's intervention (r = 0.297**, p=.000 < .001).

Consequently, public organizations which perceived a higher level of e-government also were likely to develop a higher level of combating of middlemen's intervention.

Correlation			
		E-government	Combating of middleman's Intervention
E-government	Pearson Correlation	1	.297**
	Sig. (2-tailed)		.000
	N	261	261
**. Correlation is significant at the 0.01 level (2-tailed).			

Table 5 Correlation analysis for combating of Middlemen's intervention and E-government

Hypothesis 4: Higher level of e-government practices is significantly associated with higher level of increased transparency in the public sector organizations.

This hypothesis suggested a direct relationship between e-government and increased transparency.

The correlation was examined by running Pearson's correlation coefficient. There was a statistically significant (p=.000 < 0.005) but rather weak

Therefore, Hypothesis 3 was accepted. Table 5 provides correlation analysis between the factors under study.

positive correlation (r =. 144*) between increasing transparency and e-government.

Thus, e-government increases significantly transparency in the public sector organizations. Table 6 provides correlation analysis between the factors under study.

Accordingly, it could be inferred that organizations who scored high in e-government would report a high level in transparency. Hence, Hypothesis 4 was accepted.

Correlations			
		E-government	Transparency
E-government	Pearson Correlation	1	.144*
	Sig. (2-tailed)		.000
	N	261	261
*. Correlation is significant at the 0.05 level (2-tailed).			

Table 6 Correlation analysis for increasing Transparency and E-government

5. The Conclusion

This paper does not seek to identify whether there is corruption in the government sector of the State of Yemen, but to identify if there is a relationship between e-government and combating corruption in the public sector in Yemen. Corruption is the main problem all over the world that cannot be ignored. Corruption in many ways resembles viruses, whose survival mechanisms are so robust that containing or eliminating them, proves an extra-ordinarily challenging task.

  Combating corruption in countries across the globe has proven very difficult, regardless of var-

ious administrative reforms.

E-government has shown promise in this regard, and in many instances, it has eliminated or at least reduced corruption in public services delivery. E-government, however, does not guarantee the end of corruption.

Officials who master technology-empowered processes can find new opportunities for rent-seeking. Such circumstances, fighting corruption should be part of the e-government vision. If fighting corruption is included in the government's vision, the next key question is when to announce the anti-corruption goal to the public.

  If fighting corruption is publicly announced as a

major part of the e-government agenda, it could help build coalitions and public pressure for anti-corruption results. Also, the awareness is necessary; the public should be made aware of all the government policies and online services. The media also would play a great role in this regard. The conditions required for successful e-government as an anti-corruption tool in Yemen are: the commitment of higher leaders, the legal environment, and the growing ICT sector. Without these factors, it would be impossible to create the comprehensive e-government services.

Finally, this work proved that the use of ICT in the form of e-government can make important headway to reduce corruption. Also, the results of this research supported the hypotheses that e-government limits positively and significantly monopoly power, discretion, and intervention of middlemen, as well as increases transparency.

6. Recommendations

Building upon the results achieved, this research offers number of recommendations for government, organizations, and managers.

• It is highly recommended to work closely with ICT specialists to ensure that the design of the ICT system is coordinated with other reform processes.

Sometimes, ICT may even provide an opportunity for more corruption. Securing the ICT system is important to prevent corruption by those who know how to manipulate the ICT system.

•Installing a controlling system that relies on a computer system to follow up the work of individuals by using algorithms to track, control, and save every process that has been done to the public.

If decisions and transactions will be documented and easily tracked to individual officials, officials will think twice before committing a corrupt behavior.

•Each department should establish complaints and inquiries handling regime through organization's websites that fits its and customers' needs. Complaint channels should be clearly advertised to both the public and staff.

The improvement in the complaint handling regime would increase the public's confidence and trust in the system, it may result in reduction of corruption.

•Bridging the digital divide. Even if the government information is available in all government sites, and the citizen does not have access to technology or field to use the same capabilities, ways of combating corruption will be futile. Therefore, government should give citizens convenient access to government information and services from everywhere anytime, via multiple channels

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Article

Development Challenges Of The Internet Of Things In Yemen

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Article info

Abstract

The Internet of Things (IoT) promises to offer a revolutionary, fully connected "smart" world. Yet the challenges associated with IoT need to be considered and addressed for the benefit of individuals, society, and the economy to be realized.

This paper presents development challenges of the IoT in Yemen such as availability of internet at everywhere and at reasonable cost, shortage of IPv4 addresses and transition to IPv6, power supply for sensors, acceptability among the society, and finally security and privacy protection. Solutions to these challenges were devised.

The data for this study was collected through an online questionnaire that was focusing on the Yemeni specialists in the field of computer and information technology to determine their degree of agreement on challenges and solutions. The results showed that the degree of agreement was high. Based on our results the challenges and solutions were arranged according to the respondents' point of view.

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1.Introduction

IoT is a new step in technological progress, new stage for the development of the Internet [1], and provides great opportunities to be connected with the virtual world.

'IoT allows people and things to be connected anytime, anyplace with anything and anyone, ideally using any path/network and any service'. [2]

IoT enhances the collection, analysis, and distribution of data, which can be transformed into all kinds of receivers.

The main reasons behind this interest of IoT are the capabilities that it offers.

It promises to create the world around us where everything will be connected to each other via Internet and with minimum human intervention [1].

In recent time, an enormous amount of research, and development works are carried out in different parts of the world to make IoT feasible. The main application domains for the IoT are illustrated in Figure 1.
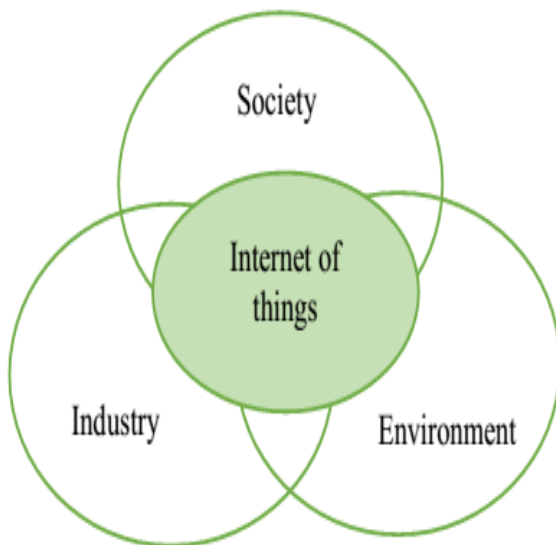

Fig1. Internet of things application domains

Cisco estimates that IoT will consist of 50 billion devices connected to the Internet by 2020 [3].

The aim of IoT is to make our daily life easier and smarter and to be applied in all areas of life; such as industry, environmental monitoring, healthcare, military, and management of cities. Imagine the world where billions of objects can communicate and share information. Data reg-

ularly collected, analyzed and used to initiate action, providing intelligence for planning, management, and decision-making. This is the world of the IoT, however, in Yemen, its scope develops slowly.

The development of IoT is a step-by-step process, IPv6 address space to make it possible to connect unlimited number of devices with Internet [2].

There are many difficulties in the field of IoT such as the problem of insufficient security, the less-protection of personal information, the complexity of communication, the variety of protocols, the lack of common standards, issues of power supply of connected devices, and the acceptability among the society [3], [4].

The broad scope of IoT challenges will not be unique to industrialized countries, but also developing regions will need to respond and realize the potential benefits of IoT.

In addition, the unique needs and challenges of the implementation in underdeveloped regions will need to be addressed, including infrastructure readiness, technical skill requirements, and policy resources.

This paper presents the most important challenges facing the IoT in Yemen currently; the main challenges of IoT in Yemen can be summarized as availability of internet at everywhere and at reasonable cost, shortage of IPv4 addresses and transition to IPv6, Power supply for sensors, acceptability among the society, security and privacy protection.

2. The Main Development Challenges of IoT in Yemen Currently

2.1. Availability of Internet at Everywhere and at Reasonable Cost

The success of the IoT depends on the availability of the Internet and its spread everywhere [5]. In addition, the Internet should be available with a reasonable cost; and this problem may not be very easy to be solved in Yemen.

According to Internet Live Stats - Internet Usage & Social Media Statistics [6] the number of Internet users in Yemen is still limited with reference to the population as not to exceed 25% of the total population. Over 75% of the population in Yemen is still unable to use internet (Figure 2).
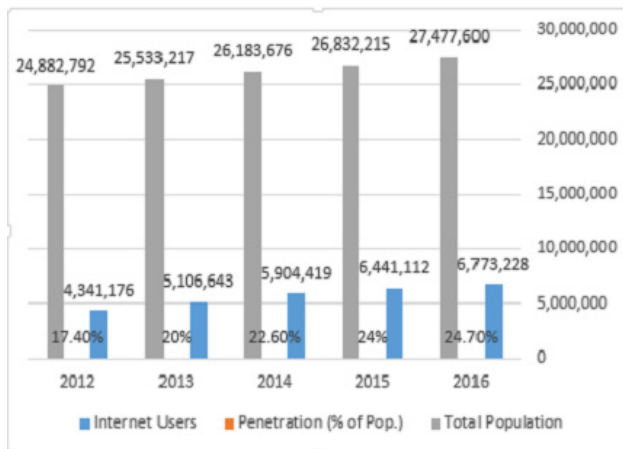
Fig2. Internet users and population statistics in Yemen

In order to make internet available, there is a need for huge investment in providing infrastructure and resources.

2.2. Shortage of IPv4 Addresses, and Transition to IPv6

Currently in Yemen, using the internet protocol (IPv4), IPv4 uses 32-bit (4-byte) addresses, IPv4 has only 4.3 billion (232) possible IP-addresses, IPv4 has been completely depleted by Feb 2011 [7]. Now in Yemen, the providers are using Network Address Translation (NAT) as a solution to IPv4 shortage.

Some hosts implement a level of security regarding how many connections should be accepted from another host and they do not respond if the defined number of requests has been reached. Hosts may decide that there is a load on them created by robots, and would take measures to protect from such actions like completely block the IP-address, or increase the intensity of the show captcha.

The quality of access to the Internet for users will be worse, and can break certain applications, or make these applications more difficult to run. [8]

The development of IoT requires many new sensors with new unique IP-addresses, NAT mechanisms limits the direct accessibility to IoT devices, so transition to the IPv6 is very necessary. IPv6 uses 128-bit (16-byte) addresses, so the new address space supports approximately 340 undecillion (2128) addresses [9].

Currently, the Ministry of Communications and Information Technology is working for the transition to IPv6 [10]. IPv6 simplifies network management by using automatic configuration. Also,

it provides new features enabling an easier configuration of devices, data streaming compliance, improved security, and effective peer-to-peer connections avoiding NAT barriers [7], [9].

IPv6 has been designed to provide secure communications for users and mobility for all devices.

In areas of network protocol security, IPv6 contains addressing and security control information, i.e., IPSec to route packets through the Internet. While in IPv4, IPSec is optional.

With IPv6, IPSec support is integrated into the protocol design and connections can be secured when communicating with other IPv6 devices.

IPSec provides data confidentiality, data integrity and data authentication at the network layer. It offers various security services at the IP layer and above.

IPv6 is the most suitable technology for the IoT, since it offers scalability, flexibility, tested, extended, ubiquitous, open, and end-to-end connectivity [7].

Most sensor networks use wireless communications networks such as IPv6 Low Power Wireless Personal Area Networks (6LoWPAN) [11], Bluetooth, Wi-Fi, WiMAX, 3G and 4G networks, and a satellite network (e.g., GPS).

Sensor networks in IoT use communication protocols based on IP (e.g., IPv6).

"IPv6-based solutions are key enablers for the success of the IoT interoperability, acceptance and integration" [7].

6LoWPAN is a key component in order to realize the IP-based integration of constrained devices.

It is used in a multitude of projects, exploring a wide range of use cases such as smart buildings, smart environments, smart cities, etc.

In all cases, constrained devices forming 6LoW-PAN networks are used to collect information from the real world and this information is used to generate intelligence and make the world around us smarter [12].

6LoWPAN is a communication standard that allows the low-power devices to communicate and exchange data via IPv6 [13].

There are many benefits of using IP-based connectivity to form the sensor access network [13]:

-IP connects easily to other IP networks without the need for translation gateways or proxies.

-IP networks allow the use of existing network infrastructure.

-IP is open and free, with standards, process and documents available to anyone.

6LoWPAN works on the IPv6 protocol suite based on IEEE 802.15.4 standard. Hence, it has the characteristics of low-cost, low-rate and low-power deployment.

2.3. Power Supply for Sensors

Power consumption has the greatest challenge for sensors.

Today, sensors need to be able to sustain longer battery lifespan, especially in cases such as outdoor deployments, to shorten hardware maintenance and to prevent breakdown of communication.

The most important factors for IoT power sources are [14]:

•Wireless, and smart self-charring capability.

•Environment friendly and cost-effective materials.

•Flexible shape and small size.

•Enhancement in energy and power density.

•Longer lifetime.

Sensors must operate fully autonomously, as well as continuously in order to fulfill the highly benefit of IoT potentials. Batteries use to supply the necessary energy required for sensor signal processing and communication.

There is a need to use new types of rechargeable batteries which are environment friendly.

The rechargeable batteries will need to be charged from different renewable energy sources; wind and solar energy.

The choice of wind energy may not be limited for sensor nodes due to its initial investment and availability of wind.

The development of new, efficient, and compact batteries, as well as new energy generation devices or energy harvesting will be the main power source for IoT devices [15].

"Energy harvesting technologies [16] use power generating elements such as solar cells, piezoelectric elements, and thermoelectric elements to convert light, vibration, and heat energy into electricity, then use that electricity efficiently." These technologies will help in the growth of the IoT.

2.4. Acceptability among the Society

Through interviews conducted by the researchers, it turned out most consumers are not ready to use the IoT technology because they do not have enough knowledge about it.

Most companies in Yemen consider that the technology is not mature, the infrastructure of companies is not adequate, and IoT implementation may be expensive.

There are also many concerns related to security and privacy [17], some applications handle sensitive information about people, such as their location and movements, or their health and purchasing preferences.

The researchers believe that trust in and acceptance of IoT will depend on the protection it provides to people's privacy, and the levels of security it guarantees to systems and processes.

2.5. Security and Privacy Protection

IoT raises important questions and introduces new challenges for the security of systems, processes and the privacy of individuals.

Privacy should be protected at the device, in storage during communication and in the processing which helps to protect the sensitive information.

To assure data confidentiality during the transmission of data, the most common approach is encryption.

To secure the information exchange in the IoT, existing encryption technology needs to be carefully reviewed [18]. The encryption algorithms need to be faster and less energy consuming.

Security at both the device and network is critical to the operation of IoT.

This does not require the search for a solution that does not yet exist or proposing a revolutionary approach to security, but rather an evolution of measures that have proven successful in IT networks, adapted to the challenges of IoT and to the constraints of connected devices.

For privacy the situation is more serious, the heterogeneity and mobility of 'things' in the IoT will add complexity to the situation.

Moreover, privacy-preserving technology is still in early stages.

In the future, new standards and technologies should address security and privacy features for users, network, data and applications.

3. Methodology

The data for this study was collected through an Online questionnaire that was focusing on the Yemeni specialists in the field of computer and information technology.

The questionnaire was grouped thematically into different subsections: personal data, development challenges of the IoT in Yemen, and proposed solutions to overcome the challenges successfully.

3 point Likert scale is used to measure the respondent's degree of agreement or disagreement with each statement.

The used scale is (Agree digitally represented by 3, Neutral digitally represented by 2, and Disagree digitally represented by 1).

The survey was conducted in Arabic language, but the questionnaire was translated for the analysis into English.

Our respondents were specialists in the field of computer and information technology.

57 respondents participated in the survey; more than (60 %) of the respondents were master and PhD holders. The analyzed sample consisted of 57 respondents.

3.1 Research Goals

The research aims are:

1.Determine the main development challenges of the IoT in Yemen currently.

2.Identify the solutions to overcome these challenges successfully.

3. Ordering the challenges and solutions according to the respondents' point of view.

4. Results and analysis

The data were collected via a questionnaire. It was quantitatively analyzed using the Statistical Package for the Social Sciences (SPSS) software. The data preparation process ensured that the data set have no missing values and they didn't distort significantly by the different opinions of specific groups.

Outline and statistical results of the questionnaire have been identified as interesting by:

1.determining if the scale is reliable.

2.ordering the challenges and proposed solutions according to their means (showing the top results)

3.determining whether the sample mean is statistically different from a midpoint.

4.conducting significance tests at 95% confidence level.

4.1 Reliability

Cronbach's alpha is the most common measure of internal consistency ("reliability").

It is most commonly used when using multiple Likert questions in a survey/questionnaire that form a scale and in order to determine if the scale is reliable [19].

Cronbach alpha values must meet the minimum accepted criteria i.e above 0.6 in order to confirm the consistency and reliability.

The Reliability Statistics table that provides the actual value for Cronbach's alpha is shown in the table below:

Cronbach's Alpha	Cronbach's Alpha Based on Standardized items	N of Items
.621	.641	12

Table 1. Reliability Statistics

The value of the Cronbach's alpha is 0.62, which indicates acceptable level of internal consistency for scale.

4.2 Descriptive statistics

The statistics of development challenges of the IoT in Yemen currently are shown in table 2.

	N	Mean		Std Deviation
	Statistics	Statistics	Std Error	Statistics
Availability of internet Everywhere and at Reasonable Cost	57	2.877	.0564	.4255
Power Supply for sensor	57	2.649	.0729	.5507
Acceptability among the Society	57	2.526	.0906	.6841
Shortage of IPV4 addresses	57	2.474	.0906	..6841
Transition from IPV4 to IPV6	57	2.404	.0997	.7526
Security and Privacy	57	2.386	.1055	.7963
Valid N(listwise)	57			

Table 2. The statistics of development challenges of the IoT in Yemen currently

The challenges were ordered according to their mean as illustrated in figure 3.
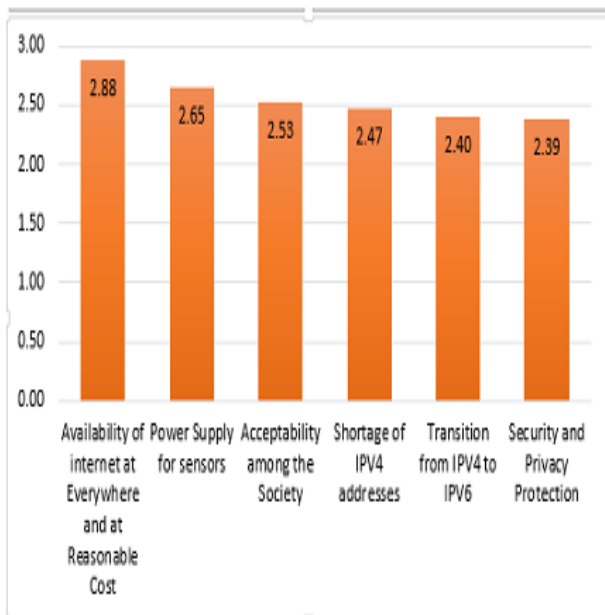
Fig 3. Ordering the challenges according to their mean

The statistics of proposed solutions to overcome the challenges successfully are shown in table 3.

	N	Mean		Std Deviation
	Statistics	Statistics	Std Error	Statistics
Investment and providing the necessary resources to improve the telecommunications infrastructure and opening the area of competition	57	2.992	.0175	.1325
Awareness of the field of information security in society	57	2.912	.0378	.2854
Using new types of rechargeable batteries friendly to environment	57	2.860	.0527	.3981
increase the level of technical skills in society	57	2.860	.0464	.3504
Transition from IPV4 to IPV6	57	2.807	.0527	.3981
Awareness of the importance and benefits of the IoT	57	2.754	.0675	.5099
Valid N(listwise)	57			

Table3.   The   statistics   of   proposed   solu-

tions   to   overcome   the   challenges   successfully
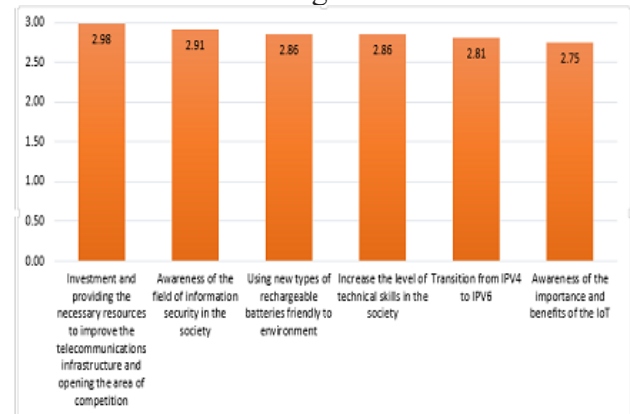 The solutions were ordered according to their mean as illustrated in figure 4.

Fig4. Ordering the solutions according to their mean

4.3 One sample T test

The one sample T test is used to test the statistical difference between "the mean of the challenges and solutions", and "the midpoint" (the midpoint = 2).

The null hypothesis (H0) and alternative hypothesis (H1) of the one sample T test can be expressed as:

H0: μ = x (the mean of the challenges and solutions is equal to the midpoint).

H1: $\mu \neq$ x (the mean of the challenges and solutions is not equal to the midpoint).

Where μ is the midpoint, and x is mean of the challenges and solutions.

The data should include one continuous, numeric variable (represented in a column) that will be used in the analysis.

The variable 'means_of_C_S' used which a continuous variable representing means of the challenges and proposed solutions.

The 'means_of_C_S' exhibit a range of values from 2.39 to 2.98.

The result of the one-sample statistics and one-sample test is shown in table 4 and table 5.

	N	Mean	Std.Deviation	Std. Error Mean
means_of_C_S	12	2.7076	.21124	.06098

Table 4. One-sample statistics

	TestValue=2					
	t	of	Sig(2-tailed	Mean Difference	95% Confidence internal of Difference	
					Lower	Upper
means_of_C_S	11.604	11	.000	.70758	.5734	.8418

Table 5. One-sample test

Since p < 0.001, we rejected the null hypothesis i.e the mean of the challenges and solutions is equal to the midpoint and conclude that the mean of the challenges and solutions is significantly different from the midpoint.

The mean of the challenges and solutions is about 0.71 greater than the midpoint.

5. Discussion

It is clear from the results of this work that the degree of agreement is great; both for the development challenges of the IoT in Yemen, and for the proposed solutions to overcome them. The challenges and proposed solutions to overcome them can be summarized in the following table (table 6).

Challenge	Overcome by
Availability of internet at everywhere and at reasonable cost.	Investment and providing the necessary resources to improve the telecommunications infrastructure and opening the area of competition.
Transition from IPV4 to IPV6	
Power supply for sensors	Using new types of rechargeable batteries which are environment friendly.
Shortage of IPV4 addresses	Transition from IPV4 to IPV6
Security and privacy protection.	Awareness of the field of information security in the society
Acceptability among the society - -	-Awareness of the importance and benefits of the IoT. -Awareness of the field of information security in the society. -Increase the level of technical skills in the society.

Table 6. The challenges and the proposed solutions

Challenge Overcome by Availability of internet at everywhere and at reasonable cost.Investment and providing the necessary resources to improve the telecommunications infrastructure and opening the area of competition.
Transition from IPV4 to IPV6

Power supply for sensors Using new types of rechargeable batteries which are environment friendly.
Shortage of IPV4 addresses Transition from IPV4 to IPV6
Security and privacy protection. Awareness of the field of information security in the society
Acceptability among the society   -
Awareness of the importance and benefits of the IoT.
-Awareness of the field of information security in the society.
-Increase the level of technical skills in the society.

The following challenges: power supply for sensors, and security and privacy protection are common for all countries.

The acceptability among the society for the IoT depends on the security and privacy protection.

6. Conclusion

This paper presented, the IoT as a technology that will change the world to make it smarter. The main aim of research is to identify the development challenges of the IoT in Yemen currently, and propose solutions to overcome them successfully. The empirical study aims to assess the degree of agreement of Yemeni specialists in the field of computer and information technology about these challenges and proposed solutions, and to consider whether there are other challenges and solutions from their point of view. The results showed that the degree of agreement was great, it is about 90%. The degree of agreement mean of the challenges and solutions is about 0.71 greater than the midpoint.

Challenges and solutions were arranged according to the respondents' point of view. The statistical analysis confirmed that the assessment instrument was reliable.

The transition from IPv4 to IPv6 is very important step for development the IoT in Yemen now. Security and privacy protection are very important topics for research in the field of IoT.

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