

Sustainable IT: A Realisation Survey Among Academic Institutions of Iraq

Ali J. Abboud¹, Omar S. Saleh²

¹University of Diyala\College of Engineering, Baghdad, Iraq

²Ministry of Higher Education and Scientific Research, Baghdad, Iraq

Abstract: Sustainability is the capacity to endure [1]. It has started to spread among different domains and disciplines of our life. Information Technology (IT) industry is one of these important fields that need sustainability to save huge amounts of energy and costs consumed by employed computers and communication technologies. We conducted a survey to figure out the knowledge of students and staff in our academic universities about sustainable IT or green computing. Our survey results indicate that (75%) of participants have connected sustainable IT to the environment friendly technologies and they are optimistic about future of them. Also, we found that most people in our universities lack sufficient knowledge about sustainable IT and cloud technologies. Therefore, there is a necessity for more efforts and educational programs to make such knowledge and services available in our academic institutions.

Keywords:Sustainability; Green Computing ;Survey ; Power Consumption.

I. INTRODUCTION

People live in the world with different kinds of constraints. Power consumption in the IT industry is one of the most constrained resources [2]. Sustainable IT or green IT is the process of knowing and exercising affordable environmentally computing technologies actively such that reduces consumed energy in constrained surroundings. In other words, it means according to the San Murugesan notes is "designing, manufacturing, using, and disposing of computers, servers, and associated subsystems such as monitors, printers, storage devices, and networking and communications systems efficiently and effectively with minimal or no impact on the environment" [2]. The connotation of green IT has begun prevalence rapidly among institutions, companies and acquiring widespread. Albeit this popularity of sustainable technologies, the economic requirements including rising electrical power consumption and its cost are the main incentives behind this interest [3].

The needs of the business in the world to analyze, collect, transmit, track and store huge volumes of data by several computer applications provided by IT industry increases economic requirements significantly and simultaneously impact environment and embark energy costs [4]. For example, scientific and engineering applications need very fast secure execution of enormous amount of complex computations that eventually consume huge amount of energy [13, 14, 15, 16, 17, 18, 19, 20]; hence such high performance applications produce high electricity bills. Furthermore, high consumed power applications result in boosting temperature of computing systems largely and this eventually will affect system reliability and availability [5].

Cloud computing is an emerging computing paradigm that provides an important approach to solve the problem of scarce resources such as electrical energy and capabilities. Cloud computing can be defined as [6]: "Cloud computing 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) that can be rapidly provisioned and released with minimal management effort or service provider interaction". In this paper, we conducted a survey among several academic institutions in Iraq with aim to discover the knowledge and practice of students and the staff about the sustainable IT. The remainder of this paper is organized as follows. In Sect. II, we present existing work in the area of sustainable or green IT. In Sect. III, we explain in details our proposed methodology to conduct questionnaire. In Sect. IV, we present our survey results and their analysis. We conclude in Sect. V.

II. EXISTING WORK

The origin of sustainable computing dates back to 1987. At this time, the basic concepts of sustainable development were reported in the world commission of environment and development. This authorization was established by general environmentalists, economists, social activists and the international community [7]. The important conscious of this community is that the effective solutions to reduce the energy consumption of computer systems can be achieved by using green or sustainable computing. In addition to previous advantage, the sustainable computing can be employed to operational efficiency, increase recycling efficiency and reduce emissions. To sum up, such kind of revenues of green IT will help to achieve the environmental protection and energy conservation.

Sustainable computing are required in computer systems for both hardware and software subsystems. In everyone, there are several aspects need to be sustained. For example, in software subsystem, sustainability can be used to save energy, reduce storage space, enhance the program efficiency, improve computing models including cloud computing, distributed computing and high performance computing. However for hardware subsystem, sustainability is adopted to reduce the energy consumption, increase economic efficiency, emissions footprint and recycling technology [8]. Green computing concepts become popular and it would be a suitable approach to solve constraint resources and environment problems. Especially green computing enables people, computer systems and environment exist in better harmony. All of these characteristics would help to achieve the goals of energy-saving, environment-protection and cost-saving [8]. Eventually, we can say that sustainable computing or IT is the computer system that adopts earlier technologies and achieves the appropriate purpose.

Energy consumption in the world becomes more and more important issue. Computing is one of the most influencing factors of energy consumption; US Environmental Protection Agency has been reported that data center in US consumed about 60 billion kWh in 2006, this value of consumption represents 1.5 percent of the total US electricity consumption and that would be over 8 percent of the total US electricity consumption in 2020. The main point that has been noted in that report was the value of electricity consumption for the data centers but did not include that by other computing facilities. Therefore, enhancing the effective utilization rate of the energy in computing was the main issue that has to be searched to avoid lots of energy wastes.

The energy issue in servers and data centers is discussed in various publications that showed the urgent demands for sustainable computing. A study in 2008 by McKinsey showed that the utilization ratio of servers rarely exceeded 6%, which is a source of low energy efficiency [9]. Also, a study in 2008 by IDC showed that the rate of electricity consumption of the data centers in Asia-Pacific region had been increased annually 23%; this value was quite higher than the global average annual rate of 16.7%. Another study was conducted by [10] showed that estimation of electricity consumption in data centers in China was around 36.4 billion kWh, this value of consumption represents 1% of the total Chinese electricity consumption. The study indicates that electricity consumption would continue to increase rapidly. More research articles provide enough evidences on the urgent demands for sustainable computing.

III. PROPOSED METHODOLOGY

The main aim of our research is to discover the familiarity and practice of people in the universities (i.e. students and staff) towards sustainable IT. We selected such kind of population to avoid factors that might limit the researcher's gathering of data. Such these factors are time, accessibility and expense factors. In addition to the earlier mentioned main objective, we need also to find out whether the green IT is an essential requirement in the future of Iraq. To achieve these objectives, there is necessity to use robust methodology that includes all possible steps to guide us to achieve the proper answer for the research question [11]. Having this aim in our mind would help to identify the suitable methodology of research. There are several methods that can be utilized to collect data such as documents, interviews, questionnaires and observations [12]. However, selecting a suitable data collection method is next step to be done after identifying sample space of this research. Hence, the quantitative paradigm was utilized as a suitable methodology for the current research. In this direction, a questionnaire was designed and distributed among several academic institutions in order to figure out the awareness of people towards sustainable information and communication technologies. It was chosen for its advantages including a series of questions to gather information from respondents. Several considerations were regarded in designing this questionnaire. First, it reviewed by several experts to valid the suitability our questions. In addition, the appearance of the questionnaire and the sequence of questions were made easy to facilitate the task of response on participants.

Students and staff of three universities (college of engineering in the University of Diyala, Bilad Alrafidin University College and college of engineering in the University of Baghdad) were surveyed. The population size was very large and

it was impossible to ask all students about their awareness. Therefore, a sample of this population is taken to obtain our results. Since the target population is very huge, the questionnaire sampling was quite troublesome. So the sample frame was made to cover these three universities. There are two ways to conduct research in order to obtain the sample. First way is using email and Facebook messages through online link, while the second way is by distributing the questions physically among students and staff. Both ways are used in our research. Questionnaire was distributed among Two hundred Seventy Three (273) respondents during the data collection period. The questionnaire was open for the duration of three weeks before the analysis took place. The response rate of the survey was 164 from 273 (i.e. this value represents 60% of all people who received the questionnaire and participated). This survey contains the following sections of questions:

1. A demographic questions.
2. Computer and information technology knowledge and use questions.
3. Sustainable IT practicing in the university questions.

IV. SURVEY RESULTS AND ANALYSIS

In this section, we present an analysis of the participant's responses for IT sustainability questionnaire. The questions of the last two sections of this survey are selected to be analyzed because those sections represent the core of our realization survey. The first section includes only general demographic questions, hence excluded from this analysis. We discuss and analyze most questions sequentially from the last two sections as follows:

- We asked participant kind of operating system they run on their computer as in the following phrase: **"What Operating system do you use in the computer labs"**. We found as shown below in Fig.1 that majority of participants are using Windows 7 operating system and few people use oldest XP Windows and newest one Windows 8. Using Windows 7 instead of Windows 8 is a normal trend of usage albeit both operating systems use power management policies. However, Windows 8 use less power than Windows 7, keeping computer running longer. Especially for laptops and mobile devices save their energy and make battery life longer.

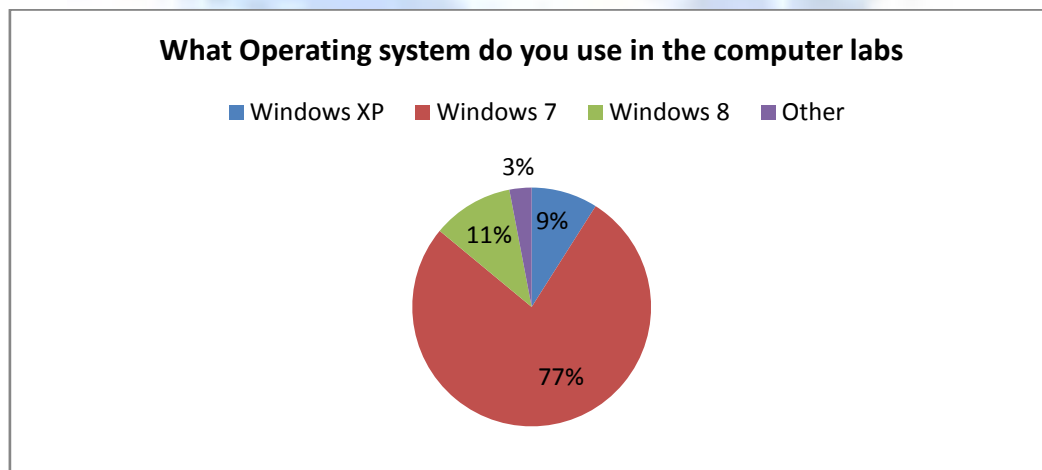


Figure 1. Results of operating systems question.

- **"Are the lab computers keep running always even when you finished class"** was one of the questions that listed on the survey. The aim of this question was to figure out the knowledge of the participants about reducing the consumed energy in the university or institution. We found that most respondents agree on shutting down computers and other lab equipments after finishing work as shown in Fig.2. Actually, this finding give us indication that the staff of labs have good education and knoweldge about energy saving by shutting down all computers and equipments. However, students do not have such knowledge and practice about reducing and saving electrical power.

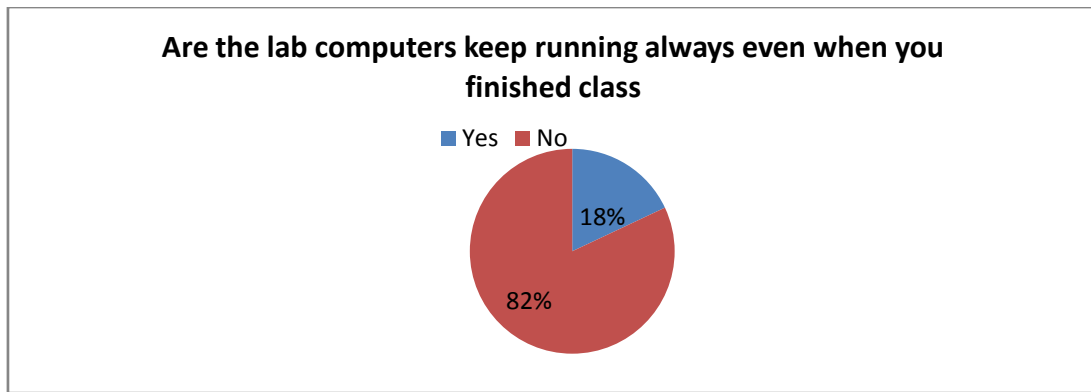


Figure 2. Results of lab computers keep runningquestion.

• **"Ever suffered an electrical cut when you had any class"** was one of the questions that listed on the survey. We found from the response to this question that there is consious among participants on frequent cuts of electricity during class. This is expected result because Iraq is suffering deficiency in the electricity power.

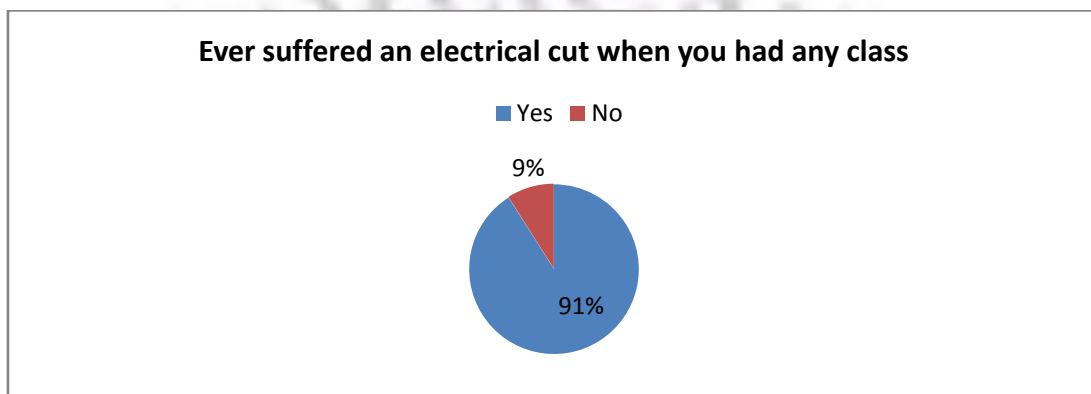


Figure 3. Results of ever suffered an electrical cutquestion.

• **"Advice the necessary steps to reduce consumed energy in the university"** was one of the questions that listed on the survey. This question is used to check the practice and knowledge of the participants about reducing the consumed energy in the university or institution. The responses showed that 76% of the participants did not know any step of how to reduce the consumed energy in the university while 24% of the participant advice various steps to reduce the consumed energy as shown in Fig.4. The suggested solutions are almost similar. We can conclude the response on this question is that most participants did not know any step to reduce the energy consumption. Hence; this is a critical issue should be considered.

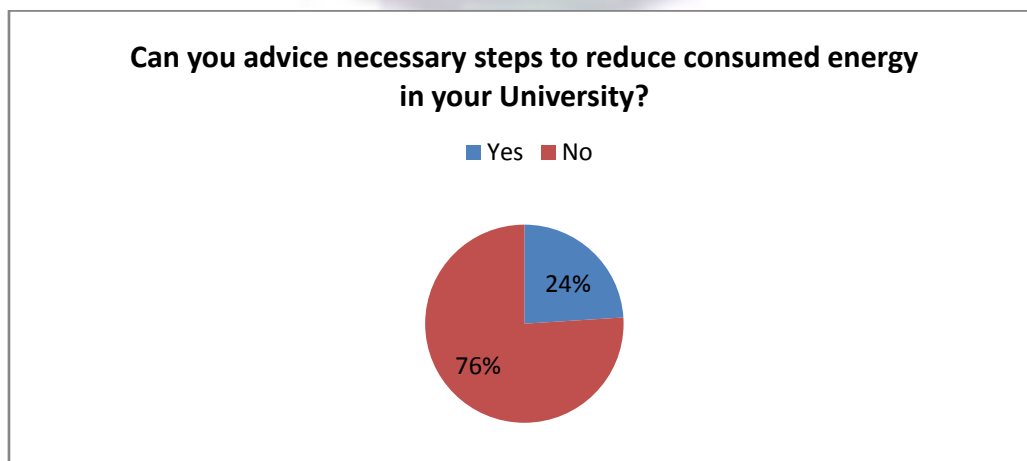


Figure 4. Results of Advice the necessary steps to reduce consumed energy in the university question.

- **"Have you ever heard about sustainable computing"** was another question listed in the survey; this question aimed to find out the awareness of the participants about the latest technologies. The responses showed that 74% of the participants have not ever heard about sustainable computing while 26% have heard about it as shown in Fig.5. The answers reflect that the participants are not keeping in touch with latest technologies. Therefore, there is real necessity to spread sustainability knowledge among students in our universities.

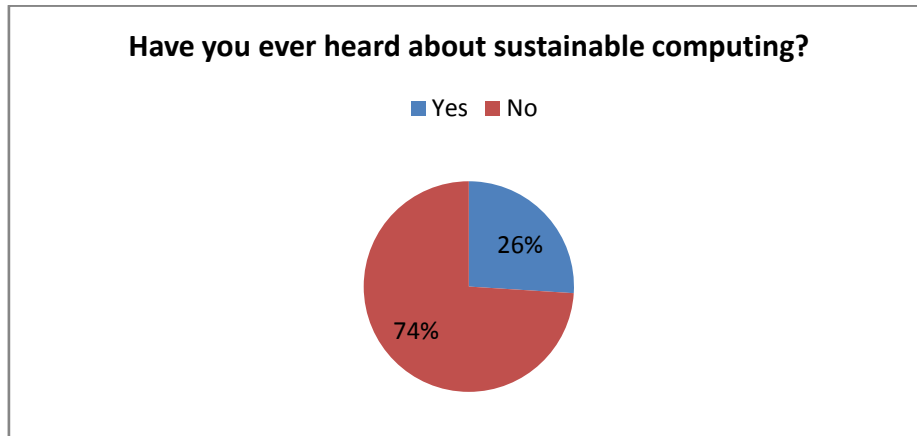


Figure 5. Results of have you ever heard about sustainable computing question.

- **"Do you know any sustainable Cloud IT practice in the University"** was one of important questions in the survey list. The purpose of this question to figure out whether there is any sustainable Cloud IT practice in our academic institutions. We noticed that 93% of the respondent's universities do not practice green Cloud IT services while 7% of them have some green Cloud IT practices as shown in Fig.6. The earlier observation indicates that our universities do not have basic requirements such as computer networks infrastructure to practice such advanced techniques.

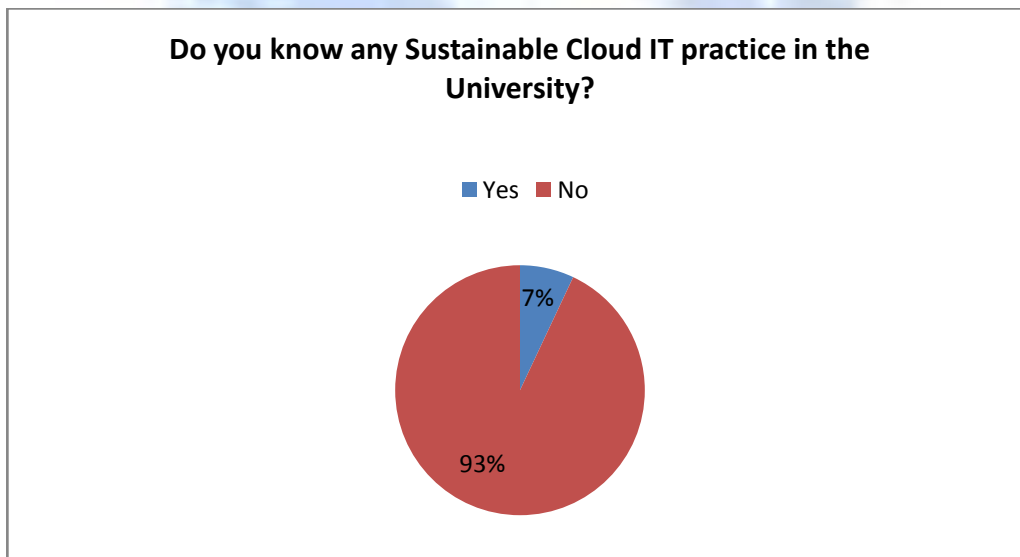


Figure 6. Results of Do you know any Green Cloud IT practice in the University question.

- **"Do you know any sustainable Cloud IT practice in the University"** was also one of important questions in the survey list. The purpose of this question to discover the opinion of students and staff toward the future of sustainable Cloud IT in our academic institutions. We noticed that 75% of the participant's responses are positive about future of green Cloud IT services while 23% of them have negative attitudes toward future of green Cloud IT practices as shown in Fig.7. The previous observation indicates that our universities can be developed by preparing all necessary requirements such as computer networks infrastructures and IT experts to practice such advanced services in our universities.

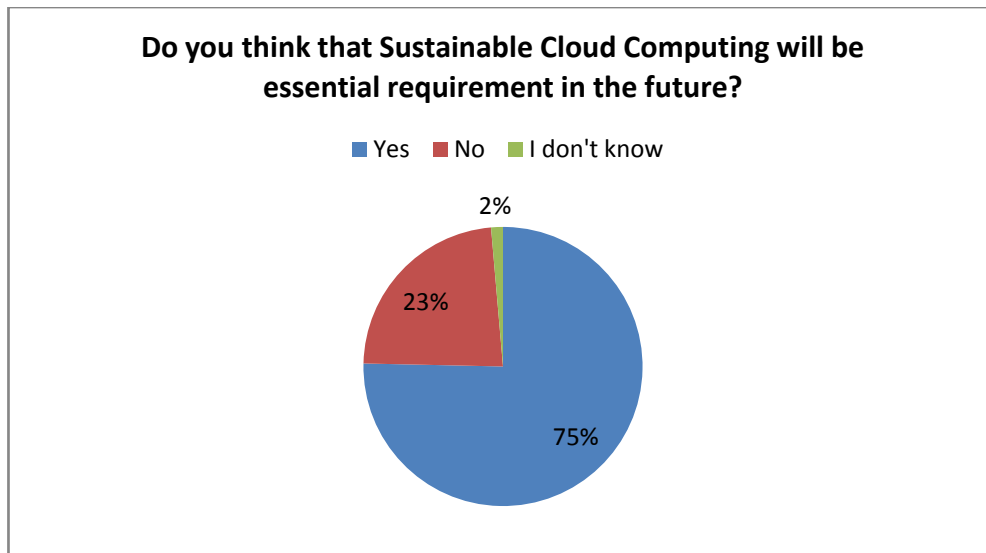


Figure 7. Results of Do you know any sustainable Cloud IT practice in the University question.

V. CONCLUSIONS AND RECOMMENDATIONS

We have conducted a realization survey among several academic universities in Iraq. The objectives of this research were: (1) To determine whether people are using information and communication technologies in their universities (2) To specify the knowledge and practice of people for sustainable IT techniques in their institutions (3) To know the attitude of people about the future of sustainable techniques in our universities. We concluded from this survey that many people do not have any knowledge about sustainable IT techniques. Also, our universities should make the sustainable cloud IT services available to students and staff by building wide computer networks infrastructures. In addition, we have noticed that there is necessity to educate people in our universities how save energy by following certain rules. These rules could be developing programs, training people how to use recent energy efficient technologies, increase awareness of student about importance of electrical power especially our country pass through difficult circumstances, etc. To sum up, this research represents initial step in the right direction to increase the awareness of people about importance of sustainable IT and communication technologies in our life and we hope that officials in our country help our academic institutions to achieve sustainable environment in Iraq.

ACKNOWLEDGMENT

1. The authors would like to thank all people from college of engineering in the University of Diyala, Bilad Alrafidin University College and college of engineering in the University of Baghdad who participated in this survey.
2. We also would like to thank virtual Iraqi library for providing us with all necessary references.

References

- [1]. Scott Cato, M. , "Green Economics". London: Earthscan, pp. 36–37. ISBN 978-1-84407-571-3,(2009). .
- [2]. Kazandjieva, Maria, et al. "Measuring and Analyzing the Energy Use of Enterprise Computing Systems." Sustainable Computing: Informatics and Systems (2013).
- [3]. Curry, Edward, et al. "Developing an sustainable IT capability: lessons from Intel's journey." MIS Quarterly Executive 11.2 (2012): 61-74.
- [4]. Garg, Saurabh Kumar, and Rajkumar Buyya. "Green cloud computing and environmental sustainability." Harnessing Green IT: Principles and Practices(2020): 315-340.
- [5]. Wang, Lizhe, et al. "Special issue on energy-aware computing and communications" ,Cluster Computing 16:1 (2013).
- [6]. Mell, P. and Grance, T., "The NIST Definition of Cloud computing", National Institute of Standards and Technology,(2009).
- [7]. Guo Bing, Shen Yan, and Shao ZL, "The Redefinition and Some Discussion of Green Computing" Chinese Journal of Computers, vol.32, Dec., pp. 2311-2319, (2009).
- [8]. Xiaodan Zhang, Lin Gong, and Jun Li, "Research on Green Computing Evaluation System and method" in Proc. Industrial Electronics and Applications (ICIEA), pp.1177-1182,(2012).

- [9]. Kaplan, J., Forrest, W., and Kindler, N.: "Revolutionizing data center energy efficiency." Technical report, McKinsey & Company, (2008).
- [10]. Luyang Wang and Tao Wang "Green Computing Wanted: Electricity Consumptions in the IT industry and by Household Computers in Five Major Chinese Cities" in Proc. Green Computing and Communications (GreenCom), pp.226-229,(2011).
- [11]. Kothari, C. R., "Research Methodology", 2nd ed. New Age International Publishers, (2004).
- [12]. Mahmud, Z., Handbook of research Methodology: A simplified version,(2009).
- [13]. A.J. Abboud, H. Sellahewa and S.A. Jassim, "Image quality approach for adaptive face recognition", in Proc. Mobile Multimedia / Image Processing, Security and Applications, SPIE, vol.7351, pp. 1-10,(2009).
- [14]. S. A. Jassim, H. Al-Assam, A. J. Abboud, and H. Sellahewa. Analysis of Relative Entropy, Accuracy, and Quality of Face Biometric. Pattern Recognition for IT security Workshop, (2010).
- [15]. Hisham Al-Assam, Ali Abboud, Harin Sellahewa, and Sabah Jassim. "Exploiting relative entropy and quality analysis in cumulative partial biometric fusion." In Transactions on Data Hiding and Multimedia Security VIII, pp. 1-18. Springer Berlin Heidelberg, (2012).
- [16]. A.J. Abboud and Sabah A. Jassim. "Biometric templates selection and update using quality measures." In SPIE Defense, Security, and Sensing, pp. 840609-840609. International Society for Optics and Photonics, (2012).
- [17]. A. J. Abboud and Sabah A. Jassim. "Image quality guided approach for adaptive modelling of biometric intra-class variations." In SPIE Defense, Security, and Sensing, pp. 77080L-77080L. International Society for Optics and Photonics, (2010).
- [18]. Al-Assam, H., Ali Abboud, and Sabah Jassim. "Hidden assumption of face recognition evaluation under different quality conditions." In Information Society (i-Society), 2011 International Conference on, pp. 27-32. IEEE, (2011).
- [19]. Al-Assam, Hisham, Ali Abboud, and Sabah Jassim. "Exploiting Samples Quality in Evaluating and Improving Performance of Biometric Systems." , International Journal of Digital Society (IJDS), Volume 2, Issue 2, June (2011).
- [20]. A.J. Abboud and Sabah A. Jassim. "Incremental fusion of partial biometric information." In SPIE Defense, Security, and Sensing, pp. 84060K-84060K. International Society for Optics and Photonics, (2012).

