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Acceptance of IoT Learning Among University Students at Pakistan

Humaiz Shaikh[1], Zulfikar Ahmed Maher[2], Ali Raza[3], Muhammad Yaqoob Koondhar[4], Saajid Hussain[5], Asadullah Shah[6]
[1,6]Kulliyyah of Information and Communication Technology, International Islamic University Malaysia, Malaysia, humaiz_shaikh@hotmail.com, asadullah@iium.edu.my
[2,4]Information Technology Centre, Sindh Agriculture University Tandojam, Pakistan, zamahar@gmail.com, yaqoobkoondhar@sau.edu.pk
[3,5]Department of Information Technology, University of Sufism and Modern Sciences, Pakistan, alirazarang@gmail.com, sunny_sau@hotmail.com

ABSTRACT

The Internet of Things abbreviated as an IoT is considered the most recent innovative and fastest-developing field that is to be applied in all aspects of life, in particular higher education. It has sparked interest as well as challenges among academics; the current research will concentrate on acceptance and adoption of IoT in the higher educational institutions of Pakistan. IoT supports educators in environment of learning and can have an impact on how we interact, connect, and work. In this study, we will look at two different aspects. The first one is how to teach students, and secondly how IoT can be used in educational institutions to enhance learning. This study looks at the factors that affect acceptance of IoT and use in an academic setting in Pakistan's higher education institutions. The current research establishes foundation for a comprehensive framework based on trusted technology and social psychology models, such as the Use of Technology 2 and Unified Theory of Acceptance (UTAUT2). The method proposed in this study is network analysis method to observe users' actions in relation to several IoT applications in higher education. An in-depth analysis and consideration of key deliverables which have a major impact on the Internet of Things (IoT) adoption in Pakistani educational institutions of higher level, revealed that only a few applications are heavily used in comparison to all other applications. This research lays the groundwork for developed countries to grow adoption and IoT technologies use in higher education, which will support both students and faculty.

Key words : IoT; Smart Learning; Higher Education Institutions (HEI's); UTAUT2 Model.

1. INTRODUCTION

In higher education, IoT enables physical objects to communicate with controllers and sensors in order to spread information not involving humans [1]. It has provided a new approach to education and an atmosphere in which people can learn. In higher education, a number of initiatives focused on IoT applications have been introduced. It is expected that the Internet of Things will be expected to be a game-changer in future by uniting students and teachers under a common technological umbrella, making education more appealing, quantifiable,flexible and meeting the needs of the twenty-first century. IoT is assumed to play a possible role in educational transformation at all the levels, from school to college, and to university. This innovation will help everybody from the student to the teacher, the classroom to the college grounds [2]. IoT can be described as a system connecting processes, data and people providing administrators and educators with actionable information [3]. It has never been considered to use this approach before but the implementation of systems based on IoT has brought transformation in the educational system and the ordinary human involvement. At higher educational level, Pakistan has also embraced information and communication technology with a range of different projects that includes internet, digital library connectivity, computer laboratories, and use of multimedia in the classroom. Furthermore, m-learning, p-learning, and e-learning though distance learning has been used for years, however, the most recent method, which employs intelligent-based systems known as IoT, has yet to be implemented in Pakistan's higher education institutions. The developed world, on the other hand, has already adopted IoT and is enjoying greater benefits. In education, Pakistan recognizes the value of IoT as well. Consequently, this research aims to look into the possible applications, challenges, and benefits of IoT.

2.PROBLEM STATMENT

IoT enables institutes to radically change how they operate and improves students' learning capabilities in a variety of ways and at any level. If effective implementation by lecturers, students, and assisting officers; Pakistan's universities have a large platform and various educational institutions.Further progress is needed for institutions. The IoT systems outcome, applications, software and facilities can be influenced by researchers, academics, and students [4]. IoT is increasingly evolving and becoming an undeniably emerging topic that is generating awareness and concern around the world [5]. There are numerous indications regarding the change the IoT will bring in a various divisions and education institutions, especially universities. Educational institutions now are able to implement IoT-based development models, that will ultimately create a workforce that, in future, will cater to service industry for IoT, while also it is taken into account the TIPPSS risk standard, that stands for Trust, Identity,

Privacy, Protection, Safety, and Security in IoT context [4]. This study will look into the potential for IoT acceptance among Pakistani students in HEI's. The UTAUT2 model is regarded as a measuring device for this reason. This research is expected to reveal methods that Pakistani higher education institutions may use to benefit from the Internet of Things (IoT) in educational Institutions at higher level

IoT should fully represent the higher education learning and various justification components reflecting the intent within higher education scope later. Higher education is characterized as a self-directed learning experience that includes ethical, scholarly, aesthetic and physical components. The Internet of Things is linked to a series of events in relation to the higher education and its practice, as seen in the figure no. 1

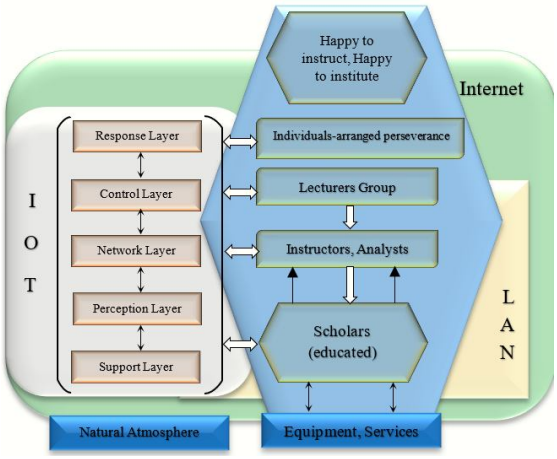

Figure. 1. IoT Judgement Relationship Design

IoT under Higher education system is seen affirming degree of learners' satisfaction, teachers, and institutions, that is the part of the similar scope of education and learning; where for students sense of achievement is accomplished from learning perspective and educators are satisfied with the mechanism of teaching process. IoT encompasses LAN and current services for the general public that are part of the educational system [6]. The perception layer, network layer, application layer, and IoT layer, as well as additional layers such as the response layer and base layer, appear as a five-layer structure. The alleged "support layer" refers to virtual and physical element of digitization process, which is a primary guide, and the advent of IoT; IoT would not exist without this relation. The evaluation status response value to the IoT configuration, with the intention of making adjustments and alterations, is expressed by the Response Layer.“ The “response level” corresponds to the control of academicians, i.e., level of orderly solidarity required to understand their “knowledge pool” as well as the data and ultimately control it [6]. According to previous research, IoT technology has a critical role in building knowledge that transcends boundaries and cultures [8][9][10][11][12]. Since the Internet of Things is a very dynamic intermediate medium of communication, it is defined as constant and existing between people who participate in the learning process; these learners collaborate for developing novel ideas. A learner understands his society and culture outside borders using technology such as video conferencing or chat group techniques[7][8][9][10][11]. Nevertheless, this exposure is limited to lowbrow details (e.g., traditions) and highbrow factual awareness (e.g., arts and literature) leaving a void in cross-cultural comprehension. A significant number of academics have stressed the need to transform the fact-based "content-competence" model in order to apply a deep learning mechanism [13]. In an immense area, IoT will put two main components into traditional E-learning. Insight and article correspondence are two of them. The capability of smart operators that provide robotized dynamic operational system is to convince a consumer to connect to a PC application [14]. Although IoT is providing virtual access for students from all geological locations, however, it is also presenting some challenges in terms of communication, concerted effort, and "face to face" partnerships between teachers and students. The solution is to use smart pieces of instruction in environment of learning [19][20], and IoT proves to be the most limitless provider of interactive understanding mediators. Furthermore, in the IoT ecosystem, the likelihood of cooperation between specialists (virtual and physical objects) is expected in abnormal state of probability.

3.FRAMEWORK

In this study, the proposed theoretical model incorporates UTATUT2 [15][16][17] in current research in IoT acceptance and usage-based confidence issues, which include privacy risk (PR) and security risk (SR). The primary aim of UTAUT2 is to create baseline to explain IoT acceptance in higher education using proven technology frameworks. IoT applications, regardless of the similarities with other technologies, are digital physical structures that can elicit distinct cognitive and enthusiastic users' responses. As a result, gaining widespread technological acceptance is important. The decision of UTAUT2 as TAM was motivated by reality that it develops a cohesive perspective of the technology adoption approach and the matter of fact that it was specifically created for applications that are designed with sense of market with an underlying constructs that are consumer-related [18][16]. IoT's acceptance and its use in higher academic institutes are among UTAUT's experiences. Use Conduct (UB), Behavioral Intentions (BI), Success Expectancy (PE), effort Expectancy (EE), Social Impact (SI), Hedonic Motivation (HM), Promoting Conditions (FC), Price Value (PV), Privacy (PR), Confidence (TR), Work Significance (JR), and Compatibility are all words used to explain how people act (COMP). Since IoT is a modern technology, only a few research directions have linked it to IoT usage [19][16]. As a result, at this stage of IoT adoption, we do not expect "habit" to be a factor in higher education institution acceptance, and therefore we do not include it in our model.

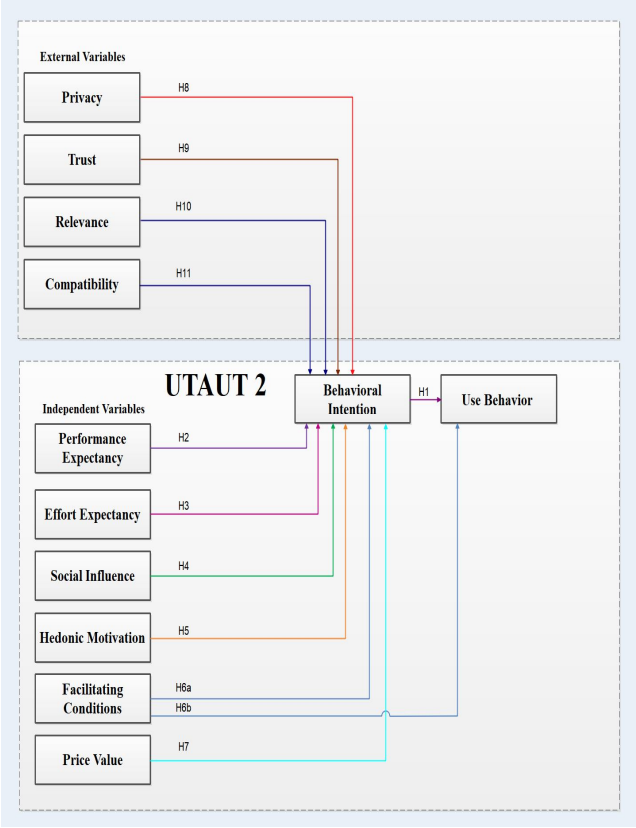

Figure. 2. Proposed Research Framework

A. User Behavior

Use behavior can be described as the true representation of a user's behavioral nature as it relates to the structured use of technology. It's the frequency at which a person's intention toward actions is calculated in relation to the use of technology [17], [20].

B. Behavioral Intention

Almost every psychological theory supports the connection between BI and actual usage [20], [21]. The degree to which a person has made deliberate plans to perform or not perform a specific future action is known as BI [17]. (17) According to Venkatesh et al., BI is a variable that predicts the acceptance of a new technology. Earlier theorists, such as [21], who founded the theory of planned actions, claimed that BI is a motivator for new technology adoption.

H1: Behavioral Intention will have positive effect on IoT use in HEI's.

C. Performance Expectancy

Performance Expectancy refers to an individual's belief that implementing IoT technology can motivate them to improve the gain in their job performance [17][15]. The value of the Internet of Things is subjective and is defined by how the consumer wants to interact with the IoT. Many do not respect or see any advantages from physical hardware environment view IoT as wasteful and even harmful. As a result, users' aspirations for the precious respect of acknowledging IoT capabilities would have an effect on translation to Pakistan's higher education institutions. [22] [number 23] [page 24] As a result, proposed hypothesis is:

H2: Performance Expectancy will affect positively on the adoption of the IoT in HEI's of Pakistan.

D. Effort Expectancy

Effort Expectancy tests how simple a device is to run [17][15]. The ease of using remote IoT system learning surveillance and control helps to minimize travel and movement effort, which is one of the main goals of IoT. Most IoT devices have user-friendly, intuitive, and collaborative interfaces and control systems [25]. As a result, the non-IoT device would almost certainly be a key factor in IoT acceptance decisions. As a result, following hypothesis is put forth:

H3: Effort Expectancy will affect positively on the adoption of the IoT in HEI's of Pakistan.

E. Social Influence

The degree to which users perceive that a significant individual thinks an IS should be used is measured by SI [17]. IoT technologies are expected to impact not only users but also students in universities, and we hope that in future users of IoT will be aware of IoT viewpoints[16]. Thus, the following hypothesis is proposed:

H4: Social Influence will affect positively on the adoption of the IoT in HEI's of Pakistan.

F. Hedonic Motivation

HM encapsulates the user's happiness and enjoyment as a result of using a particular technology [15]. Along with the effect of the Internet of Things (IoT) adoption, HM is linked to constructive weight [26]. As a result, it is expected that HM will allow a user impact in higher education against IoT and will be a key component in IoT acceptance. Hence, following hypothesis is put forth:

H5: Hedonic Motivation will affect positively on the adoption of the IoT in HEI's of Pakistan.

G. Facilitating Conditions

FI applies to resources that can be utilized to make IoT more accessible to consumers and to facilitate the usage [27][21]. If everybody has fair access to FC, consumers would be more likely to use specific technologies [23][28][29]. As a result, we give the following hypothesis: Thus, the following hypothesis is proposed:

H6a: Facilitating Conditions will affect positively on the adoption of the IoT in HEI's of Pakistan.

H6b: Facilitating Conditions will affect positively on the adoption of the IoT in HEI's of Pakistan.

H. Price Value

Price Value PV is known as the cognitive exchange among IoT financial expectation costs and expected profits in institutions. PV typically has an impact on the user's behavioral goal, so higher PV means more information

system practices. PV is established as a central structure in customer IoT acceptance and use in UTAUT2 [15], and has been found a significant determinant of behavioral intent [29][30]. PV is projected to have an effect on the adoption of non-IoT educational practices in higher education, as well as the Internet of Things (IoT). Thus, the following hypothesis is proposed:

H7: Price Value will affect negatively on the adoption of IoT in HEI's of Pakistan.

I. Privacy

In this research, we support and explain the perspective that users' personal data is not allowed not be used or misused by IoT smart learning technology [31], [32]. Since IoT quality and functionality are crucial, personal selection is an important part of IoT vision [33]. When using IoT smart learning technology, privacy is described as an individual's belief that information can be kept private and confidential.

H8: Privacy PR will affect negatively on the adoption of the IoT in HEI's of Pakistan

J. Trust

Consumer research and IoT acceptance have become valuable constructs to build trust. One of the main requirements for IoT is the inclusion of a reliable and effective privacy and security mechanism. Higher education puts the IoT ecosystem's security and privacy at risk [4][34]. Trust will be specifically relevant in the IoT acceptance context for several reasons. Firstly, most IoT technologies in higher academic institutes are new [19]. Secondly, higher education puts the IoT ecosystem's stability and privacy at risk. As a result, the following hypothesis is proposed:

H9: Trust will affect positively on the adoption of the IoT in HEI's of Pakistan.

K. Job Relevance

The degree to which a method fits tasks as identified in the current environment and as identified in task analysis is referred to as relevance. Relevance considers both recall and accuracy when determining the effectiveness of a retrieval information system [35]. Relevance is a concept that is crucial in determining the usefulness of a retrieval information system for user-based decisions. In fact, the principle of relevance is fundamental to the evaluation of information retrieval systems [36], [37]. As a result, the following hypothesis is proposed:

H10: Job Relevance will affect positively on the adoption of the IoT in HEI's of Pakistan.

L. Compatibility

One of the most important factors in the diffusion of new services and products has been the principle of compatibility introduced by innovation diffusion theory. [38] introduced the concept of compatibility, which was described as "the degree to which an innovation is well-operated in accordance with traditional and current needs [38]"). As a result, proposed hypothesis is following:

H11: Compatibility will affect positively on the adoption of the IoT in HEI's of Pakistan.

4.CONCLUSION AND FUTURE WORK

The Internet of Things (IoT) is a modern phenomenon that will have an effect on many facets of our lives. The aim of the research is to look into the acceptance of IoT in higher academic institutes in Pakistan. IoT can help universities to overcome many problems with technological advancement. IoT systems exhibits huge potential for supporting and facilitating faculty and students in higher education, as well as for speeding up learning. This study aimed to recognize crucial deliverables and the imminent gains in IoT in higher education, as well as how to optimize its remuneration while resolving challenges and minimizing risks. Hence, the focus of our further work will be the implementing IoT in higher education.

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