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CHALLENGES, ISSUES AND SOCIAL IMPLICATIONS OF SMART LEARNING THROUGH INTERNET OF THINGS (IOT)

Dr. Parul Verma
Assistant Professor, Amity University, Lucknow, India
pverma1@lko.amity.edu

Abstract: ***IoT and Smart Learning is a new vibe in education domain. The goal of ubiquitous learning can be fulfilled by making the best use of smart devices and exploiting the benefits of the technologies used by IoT. Smart education is ready to change the complete scenario of teaching and learning process. Not learning is no more confined within the boundaries it is now anywhere and everywhere learning concept. The customization of learning is the prime focus of Smart Learning Environment (SLE) along with the guidance based on performance analysis of the learner. The paper focus on the framework of SLE, challenges/issue for SLE and also discuss the societal implications of the Smart Learning.***
Keywords: Smart learning, Internet of Things, Smart Learning Environment, Social Implications Smart Learning, SLE framework.

1. Introduction

The Internet now is reachable to everyone and consumer access is no more restricted only to desktops/laptops. Nowadays it can be accessed through mobile devices or smart phones as well. IoT connects each online object and device which widens the reachability of innovative services to smart cities, healthcare and smart homes. IoT is a huge pool of interconnected devices, sensors, vehicles, embedded software and many other things. Such things are connected seamlessly using wired/wire-less connection media. Each such device/sensor/thing is treated as a node which can be configured by itself. This globally connected network of things/nodes works on infrastructure that is dynamic in nature and well supported by the communication technologies like - GSM– Wi-Fi, RFID, GPRS etc. [1]

Many IoT applications allow users to interact with smart environments that provide them with information and adapt according to user's needs and preferences, with or without these users as part of the system. IoT applications are exploiting large diffusion and pervasive deployment of smart objects that are tiny devices equipped with a micro-controller, a communication interface (wired or wireless), a power supply, and a set of sensors and actuators that are used to interface with the surrounding environment. [2]

The networked world of IoT introduces a huge number of new intelligent devices that organizations can exploit for analytics and real-time business purposes. The IoT is impacting and transforming almost all individuals and industries, opening up new business models as well as new sources of operational efficiencies and revenues.

IoT is impacting every corner of our lives; education should not be left out. IoT is now ready to contribute towards Smart Learning which is now a new buzz in education sector too. The vision of smart learning is to not consume time in class rooms or auditoriums, besides that exchanging information through the bunch of connected devices. The concept of Smart Learning is an integration of wide variety of technologies. The overall goal is to improve the learning process, by cashing maximum benefits of the connected devices and the technologies. There are versatile technologies that contribute to Smart Learning environment like smart phones, multimedia devices and Near Field Communication (NFC). The digitization of every sector also demands towards digitization of education too.

Education is an important pillar of the society and transformation of education mode from normal class rooms to smart class rooms will definitely have a great impact on our society too.

In the recent years smart education has got obvious focus and many of the global projects are using such concept. ([3];[4]; [5];[6]; [7]). Many researchers like Kim et al. [8] and Middleton [9] consider that smart learning should fulfill the goal of learner-centric education. Lee [10] also supported these researchers and proposed that smart learning should be personalized, collaborative and learner centric. According to MEST [11] smart learning is rich in technology, adaptive and self-directed.

The paper will widely discuss the issues and challenges of the smart education using IoT and also the social implications of it. Section 2 will cover the introduction about Smart Learning environment and the technologies supporting it. Section 3 will discuss the issues and challenges of Smart learning. Section 4 will elaborate the societal implications of Smart learning followed by the conclusion.

2. Smart Learning Environment (SLE)

With the personalization of everything in this digital world we are now paving our way towards personalized learning concept. Personalized learning is another keyword for Smart Learning. The context aware / personalized learning seems to be quite promising which requires a technologically rich smart learning environment.

A smart learning environment is not only about accessing digital learning resources from anywhere, anytime, but it is all about guiding learners, providing them supportive tools, and giving hints to them as and when required. [12] To cater such requirements the smart learning not only needs a rich knowledge pool of resources, besides that it requires to digitally connecting academicians, teachers and counselors as well.

SLE environments are basically physical spaces enriched digitally, facilitated by context specific sensors/actuators. SLE supports hybrid learning environment which is a culmination of formal and informal learning. This actually means class room learning but on varied time/place (not in a fixed class room or fixed time). SLE are more and more learner centric and the most important aspect about it to adapt according to the learners needs and demands. SLE are smart enough to keep a track of learners requirement and accordingly provide recommendation to them. SLE is primarily facilitated by IoT and for SLE following are the areas of concern- Infrastructure for SLE and User's need

2.1 Infrastructure for SLE

The smart learning environment demands to be rich in terms of two aspects- infrastructure and academic resources. Robust infrastructure will facilitate to connect the academic resource pool smoothly and rich academic contents will help learners to exploit the maximum benefit of SLE.

The IoT has the key role in the infrastructure of SLE where internet provides the smooth internet services and things are the connected set of device used to process and acquire data from it. The IoT platform is a network of distributed sensors which act as data providers. The data generated by this network is being utilized by the end users called Data consumers. Data generated is stored in non-relational databases which are distributed and delocalized in nature which can further accessed by the clients. Now the biggest issue is to fit in the academic contents or resources within this network.

The prime important aspect of SLE is a smart IT infrastructure. It is nowadays referred as digital agent/assistant. The contents/resources/knowledge base required for the user of SLE is gathered in a cloud. Storing these contents in

cloud make it accessible to the end user wherever you move. The learner will get the required information in result of a query from the network of semantically integrated contents/resources.

The optimum benefits of SLE is not just providing the required content, rather than that providing the high quality content which is made possible by using a combination of internal and external platform. The internal learning platform can use Moodle which is an open source learning platform. Moodle is basically a personalized learning platform designed to provide learning platform designed to provide learners and educators with a single secure and robust integrated system. The external platform can use resources such as online libraries, blogs, discussion forum etc.

The SLE environment should be an interface between these external and internal platform and provides the end users all the relevant information as per the users requirement OER EExcess project is an example of such kind of smart learning environment. The basic motive of such project is to access the scientific and cultural educational resources and deliver it to the end user's. The culture of open education is in demand by the end users. Voluminous amount of data is available on web in the form of images, videos, scientific contents, historical maps, paintings and many more. Such information is scattered on various digital libraries, archives, museum websites etc. The indexed databases provide specific information but they are not connected. The role of EExcess is to connect educational and scientific databases and provide educational resources to the end users at one common point.

Besides all that SLE also require smart digital equipment's like smart mobile phone, tablets, smart walls, TVs, power walls and many other smart devices. The specialized software for smart learning is also required like EExcess, Moodle etc. LMS (Learning Management System) is also one of the systems which was facilitating e-learning environment. LMS can now be upgraded as per the requirements of the smart learning environment.

2.2 User's Requirements

The core of every system is the end users. The system is successful if it fulfills the demands and the requirements of the end user. Looking from the smart learners perspective following are their requirements from SLE-

- The learners interface should by adaptive as per the individual. If an end user is having some problem in hand the interface should cater voice instructions.
- The learning content should be adaptive and individual specific rather than generalized.
- The SLE should trace the context of their end users and should take into account while delivering knowledge/information to them.
- The feedback and guidance should be personalized and on the basis of that feedback, suggestions, strategies and learning tools should be provided to the end user.
- The accountability of personal and environmental factors in respect of end user should be done in order to facilitate them for both formal and informal learning.

3. Smart Learning Environment Framework and its Challenges

Smart computing is the latest cycle of tech innovation and growth that began in 2008 [13] and an important technology in smart learning environments. It blends elements of hardware, software and networks together with digital sensors, smart devices, Internet technologies, big data analytics, computational intelligence and intelligent systems to realize various innovative applications.[14]

The framework for smart learning environment can be outlined into three layers – User Interface, Technology and Learning Framework. SLE is still not very common. There is a long way to go ahead. The growth of technologies should be able to cater the dynamic features of SLE to provide feedbacks; fulfill just in time requirements of data, dedicated data and many other goals of SLE.

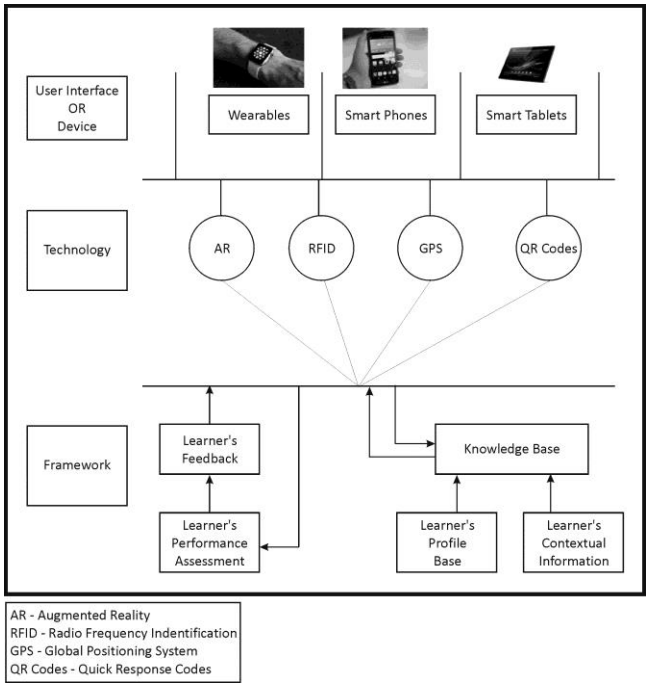

Figure 1. Framework for Smart Learning Environment

There are numerous challenges for creating the SLE that are learners specific and adaptive as well. Following are the bottlenecks for meeting the goals of SLE at every layer of the Framework.

3.1 User Interface or Device

The smart devices are making connectivity ubiquitous. The inbuilt GPS in such devices work smoothly and help the learner in mapping the learning content as per their requirement. The smart devices can be used to get the recent updates on the knowledge-base as per the learner requirement. The smart devices make the students free from the constraint of a fixed data point of the hardwired computer.

Smart learning environment is not only about accessing the information by the learner using smart devices but it is the another way also where the teacher/ educator will know about the learner- how they are feeling and understanding using actuators, modern sensors and wearable devices. The smart devices help the teachers to know the mindsets of the learners and help them to improve or motivate students accordingly.

- The smart devices share and process voluminous sensitive data, and the security of such huge volume of data is a serious concern. These devices are not well designed to cope up with cyber-security issues.
- Personalized information of learners is at stake.
- The cost of these smart devices is also one of the challenge
- High quality sensors are required to provide real time responsiveness to the end users.
- Centralized dedicated servers are required to provide lab utility services to the end users all the time.

3.2 Technology

3.2.1 Augmented Reality(AR)

AR is not at all a new concepts used for teaching/learning. It was first used in 1990's for the training of pilots. AR uses the concept of 3D layering space that creates new experiences of the world. Several researchers have suggested that students/learners can strengthen their knowledge by using realism-based practices with AR.

- The real challenge of using AR is to integrate it with learning framework of SLE
- The cost factor of implementing user interfaces with AR is quiet high which is again a hindrance for the viability of the technology.

3.2.2 RFID

RFID works as an enabler for augmented paradigms. It is one of the fast expanding technology that have a great impact on society. RFID tag is a microchip attached to a minuscule antenna. RFID reader transmits commands and energy to active tags by electromagnetic wave tags. Communication from one tag to reader is based on inductive coupling or on electromagnetic wave. The scanning device (reader) converts the radio waves reflected back from the tag into digital information that can then be passed on to the computer network. RFID in SLE basically facilitates to locate the end user and context awareness.

- The data transmission using radiowaves pose a real challenge for the privacy and security of the data.
- Another challenge can be the learner's surveillance which actually breaches the privacy of learners.
- Cost of the sensors is again a critical challenge.

3.2.3 QR Codes

QR codes are machine readable codes that consist of black and white squares, which actually store the URLs or other information by the camera or smartphones. QR codes can also be used for the improvement in performance of smart learning. QR codes can be helpful for learners in different ways.

Students can access and learn contextual information or we can say that they can access information which is in relation to their physical location. QR codes give solution to the collaborative and just in time learning framework. It

can be used by learners for various research works by accessing GPS coordinates and can also access quick response contents/web page. It can also be used by learners for their self-assessment, by directly linking the QR code with a web page and assessing the performance of the learner.

- A QR code contains a link/URL that can be a malware which will directly infect the end user's device.
- Another challenge for QR code is that hackers can misuse and can have illegitimate access to system resources of the end user.
- It is quiet difficult to identify an authentic QR code. No end user can identify whether it is an authentic QR code or forged one.

3.2.4 GPS

Global Positioning System is a satellite based navigation system. The signals produced by GPS receivers can be used to navigate the location, speed and time of various vehicles, person and many other devices. The GPS satellite uses the repetitive signals to trace the location at a particular time. Signals move at the speed of light and arrive at different time zone because few satellites are quiet away than others. The distance of the GPS satellite can be evaluated by estimating the time it takes to reach to the receiver. GPS is considered to be successful but every technology has certain limitations-

- Require 3G, 4G or Wi-Fi Network. In case the signal strength is weak the smart learning device can not be located and learner will suffer.

3.3 Smart Learning Environment Framework

The most important aspect of smart learning framework is the learner's perspective. The framework should be proficient enough to support the learners, suggest them in the right place, at the right time. The aim of the smart learning framework is the ubiquitous learning. This aspect can only be fulfilled by the availability/connectivity of the learners all the time through sensors or by other means. IoT is supposed to bring revolution in the way of teaching – learning process. It will have a great impact in the education methodology in the coming future by incorporating different novel means of education like 3D real time training, virtual classrooms, simulation technology for practical training and using smart intelligent devices which will fulfill the just in time requirement of the knowledge. To fulfill the requirements of the smart learning framework demands to be quiet rich technologically.

The smart learning framework should consist of following modules to meet the end user requirements and to fulfill the goal of ubiquitous learning-

3.3.1 Knowledge Base

Availability of knowledge and customization of knowledge by the end users is required. The foremost requirement of SLE is to have rich knowledge base. Knowledge base should be vast and updated. It should be readily available to the end users and can be customized as per the requirements of the end-user. Customization of knowledge base is dependent upon the profile and contextual information of the end user's.

Let's say that end user who is a science student wish to access knowledge about a particular subject. Depending upon its profile whether he/she is a UG/PG/10^{th}/12^{th} standard student, contents will be delivered to him/her. Besides that contextual information like if student is from rural background content delivered to him/her in easy English or

may be if required translated in regional language. Such kind of customization will definitely alleviate the performance level of SLE and will help in fulfilling the goals of SLE.

3.3.2 Learner's Profile Base

Maintaining the profile of the end users to provide them learner specific information. It will store each and every bit of information about the end user. It will help in delivering customized information/knowledge to the end users.

3.3.3 Learner's Contextual Base

It provides context specific assistance to the end user's considering their real time situation. Along with demographic details of the end user it will also store the weakness and strong points of the learners. It will help in assessing and giving feedback to the end user.

3.3.4 Learner's Performance Assessment

Learning is incomplete without assessment. Performance assessment of the learners can be done by quiz, test or may be some video calling mode. It can be done at various level of learning cycle. It will assist feedback module of the framework.

3.3.5 Learner's Feedback

Timely feedback of the learner progress is based on their performance. The outcome of learning is the feedback of learner's. The assessment module will assess the learners on various parameters and will provide feedback to the learner. The feedback will help the end user in alleviating their performance level by knowing their weak points.
Following are the few challenges for the framework.

- Maintaining and updating rich knowledge base which can be customized as per the end user's requirements.
- Updation of contextual information of the learner's is a cumbersome task.

4. Social Implications of Smart Learning

IoT is connecting people and devices anywhere and everywhere through sensors, wearables, smart phones and many other means. Connecting people share their personalized information as well, which can be harmful from the societal point of view. In general, 'smart' in smart education refers to intelligent, personalized and adaptive however the definition varies in different scenarios. Personalization in smart learning system will also face social and ethical hazards like – lacking control, reducing the capability of an individual, compromising privacy and commodification of education.

In every such system certain checks are required to address such issues by putting certain restriction on accessing data. Certified access control to the data entries can be implemented. The individual privacy and security is of main area of concern which can be handled by making data anonymous so that end user can not relate it to an individual.

Conclusion

The impact of IOT is visible in every domain of our lives. Education is not left out. Smart learning will certainly bring revolution but another face of coin is the societal implications of it. Smart learning is still in nascent stage. Besides all the challenges if we outweigh the benefits of IoT based Smart learning, it will be on the higher side. Smart learning will definitely fulfill the goal of anywhere, everywhere learning along with the customized learning

with appropriate feedback analysis and suggestions to the end-user also. Smart learning will change the education scenario in the coming future which will definitely benefit the society.

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