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Evaluating Possible Cloud based Architecture to Incorporate ICT in Education

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ABSTRACT
Building and sharing resources are integral part of any teaching learning process. There might be possible bi-directional communication carried out but mostly it is a monologue followed by grievance resolving sessions. Considering education by conducting practical's, there might be a one-step higher level of monologue and more focused on grievances and fetching tutorial guidance.

Current systems are not able to provide a uniform pre-built solution to this educational scenario. Most of the tasks are brought down to either administration level or to even sometimes development level. Considering time constraints of educators, it is not possible to facilitate such long timings on content development with distribution. Again while distribution of content, via lecture/practical presences and availability of student is necessary. Lagging so shall not complete the process. Thus the domain is seen as possible problem domain whose solution could be centralized in a distributed environment and made available over different networks.

In this paper is tried to conduct survey and find the gaps across this technology and possibly propose the solution where that can pitch a product that serves the need of educational domain members.

General Terms
Internet Communication and Technology (ICT):
Used as extended term for IT but is more focused on communications (telecommunication - wired and wireless), than on software's, computing resources and storage associated with it.

Ubiquitous Computing
Ubiquity the latest thriving domain of IT focuses on same. It says there may exist a solution to problem by simply combining two or more solutions pre-existing for problems. It says solutions developed as such may be 1+1=3 or even more[1]. Here it is considered that computing is everywhere; further listing, it out as smart devices, smart environment and smart interaction or Smart DEI model is referred to it. And computing takes place across this model.

Quantified Self
Also with such smartness the data computed is growing, which may be difficult to analyze with generic approaches. The analyzing may lead to specify a trend, it may also lead to predictions or simply list down the operational schedule. This kind of stage is achieved by logging each and every possibly significant data and then statistically analyzing it. The domain referring to do this is called Quantified Self.

Keywords
MOOC (Massive Open Online Course) , AOP (Academic Orientation Process), PDA (Personal Digital Assitant), Moodle, WPS (WiFi Protected Setup)

1. INTRODUCTION
In today's educational institute, it is seen that there is an increase in use of digitized resources as a medium of learning. Also, this change is incremental. With references getting digitized, availability of MOOCs and smart device ownership by individuals in the future where education becomes virtual is not that far away. Yet classroom education has its significance, by incorporating the advances in technology, it can become more effective, more efficient and more user friendly.

By conducting literature survey on such technologies it was observed that the solution existed with large gaps in between. There exist MOOCs, Moodle, use of projectors and audio, video in classrooms; also there are teachers interacting on the forums, there are students conducting Meetups, there are exams conducted online and polls towards and against various topics. There is much more to describe, but yet there is no uniformity seen across this technology.

There are laptops, ultra books, notebooks becoming part of one integral lifestyle. There exist wearable and carry on technologies like smart phones, tablets, smart watches, smart glasses also now smart clothing's. This all smartness peeking out to be utilized.

Majority of the crowd now is online, having direct access to various resources over the internet, where they are continually learning new things, coming across new experiences and staying updated like never before. Which is not yet yielding to any knowledge.

Online there exist blogs speaking about products, blogs speaking about technology, blogs and other posts which collectively influencing crowd on various topics. And individuals as in a crowd interacting with authors and medium to build it, improvise it, contribute towards.

2. THE EXPECTED SETUP
Discussing the basic information sharing model in conjunction with smart devices. There are a variety of smart devices categorized inside a network's and they tend to generate the educational resources. These networks as per traditional division could categorize into a Local Area Network (LAN) and Wide Area Network (WAN) mainly. Also the network can be wired or wireless.

Shown below in diagram explains such networks with information shared across a network (in a generalized

information center view) and proposes two basic categories which is Near and Far referring WiFi network in the vicinity as Near and access over the Internet as Far. Thus, having their respective properties.

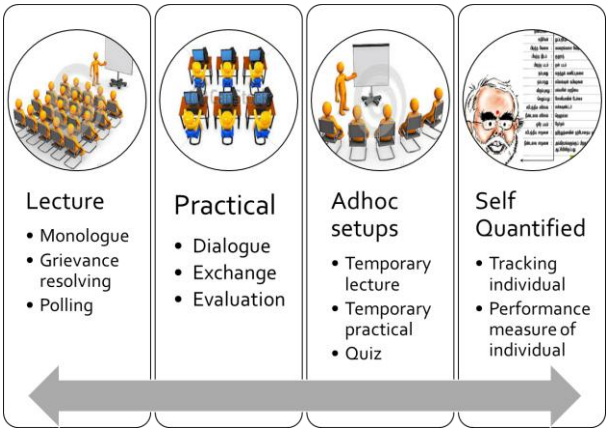

Fig 1: Generalized education scenario – The Environment

Shown above is the generalized educational scenario considering different modes of education that take place in a standard organization. Lectures and Practical are two basic modes where continuous Teaching – Learning Process takes place. As a part of continuous evaluation we see that there is quantifying of one-self done. There might be adhoc situations where the Lectures and Practical may be conducted without notice.

Out of the above scenario we find that there are possible mediums where Teaching Learning takes place and we can also identify the solutions that we have for same.

3. RESOURCES AND THEIR CONSUMPTION

3.1 Lecture & related resources

The lectures and similar conduct of knowledge transfer activity in education are generally monologues followed by grievance resolving sessions. Additionally, there are pre-lecture and post-lecture activities associated with it. Activities taking place pre-lecture include conducting a poll/survey, handout/ notes distribution, orientation or pre-requisite work. In post-lecture activities it is seen that there include homework/ assignment/ tutorials, quizzes, again quick survey polling, and in rare cases it is also seen that there are group discussions taking place.

As of now one can see all activities in pre-lecture & post-lecture are all available in digital solution. There are many solutions and open source codes available to have them running for absolutely free of charge.

All of the teaching-learning resources in a standard educational organization are now a days maintained in digital format. During a lecture in an average college, there exist the use of projectors at least. Handout distribution in major colleges could be seen as an Academic Orientation Activity conducted every semester. This conveys that there is a missing link between all such activities going unexplored.

3.2 Practical And Related Resources

In a practical based education scenario it is seen that there is a bidirectional communication. Both entities equally involved in the teaching - learning process while on entity giving demonstrations and another entity practicing it. Major domains, including Science, Engineering, Arts & Commerce have such activities going on. In few scenarios is the case where interaction with physical objects could be mandatory, mostly practical's are conducted on paper, verbal or any such audio/video/text communication. This activity begins with a demonstration, followed by performance and ending with evaluation. This may be a single or multiple iteration activity.

As of now there again are the resources which have digitized this audio/ video/ textual communication means. There are many open source solutions, allowing us to integrate particular streams of such practical conducting scenarios free to use.

Again it could be seen that there is a missing link, missing solution to cover this domain completely and digitize the practical based education.

3.3 Adhoc Setup & Related Resources

In education domain there are many such situations where the education cannot be categorized into a Lecture or Practical based scenario but is a mix of both. Also, there are situations where the conduct of such setup is not pre planned. As discussed earlier the setup as such for practical based education can take a week tops to setup.

As of now the virtualization domain and smart devices are capable of computing what was earlier possible for only mainframes and super-computers, internet has connected devices across a wide geographic area and is erasing boundaries between physical and real word[2].

Such storage and computational opportunities could not be seen utilized in the educational domain. There are many adhoc technologies in networks which can allow connection across these opportunities on the go. Today's generation is equipped with resources which were beyond imagination just a decade ago. It could be seen as un-utilized resources that could be employed towards education.

3.4 Personalization and Quantization

Individuals as modern day consumers own variety of devices which are rich in features. They may use them to consume a variety or particular stream of resource, for example, smartphones as a PDA with calling functionality or simply calling (may it be audio/ video or both), thus defining their handling[3][4][5]. Todays individuals as modern day users are graced with the presence of the Internet which connects all our resources. Thus introducing us to generate and face abundant information which they may see to it as beyond the capacity of handling.

This information is continuously generated by the software's they used and they may customize it to how they use them or how their use feel to us. But alongside there is bright opportunity to quantify them, leading to quantify one self. For example, individuals as a parent maintain Potty Diary of our new born infant which acts like an observation logs in a journal format for our infant's doctor and help them identify what went wrong. Similarly, they can use our smart devices in conjunction with others and log our digital life in order to quantify one self.

This personalization and assessment can lead to continual improvement in our digital life, and when same applied.

4. EMPIRICAL STUDY

4.1 Wi-Fi & Wi-Fi Direct technology

Wi-Fi being the pioneer networking technology now a days to setup and implement for any networking problem has a new successor by the name or Wi-Fi Direct. Which overcomes the drawbacks left behind with traditional Wi-Fi enabled devices.

Shown are the sales report in less than half decade before of Wi-Fi enabled devices.[1] Below sown are the operational specification for Wi-Fi enabled devices of which 802.11 b is the most sold and common versions of WiFi in the market.

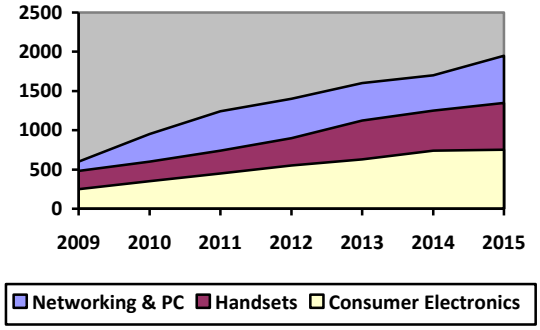

Fig 2: Sales in Wi-Fi technology enabled devices

Table 1: Comparison on Wi-Fi technology popular versions

Parameters	**802.11 a**	**802.11 b**	**802.11 g**	**802.11 n**
Operation frequency	5.15 GHz – 5.35 GHz	2.4 GHz	2.4 GHz	2.4 GHz – 5 GHz
Speed	54 Mbps	11 Mbps	54 Mbps	700 Mbps
Range	50 feet	100 feet	100 feet	50 feet
Cost	Highest	Lowest	Average	Average
Compatibility	Difference in spectrum thus incompatible			Not yet certified by WECA thus incompatible
		Use of same spectrum thus compatible		

The later version named Wi-Fi direct[6] could summarize the benefits of Wi-Fi direct as follows:

1. **Mobility & Portability:** Wi-Fi Direct-certified hand held or carry on devices connect in adhoc situation, anywhere without a need of traditional hotspot.
2. **Immediate Utility:** Consumers can create one on one pair directly and apply their resources to application easily. For example, a new laptop certified for Wi-Fi Direct can create direct connections with the existing legacy Wi-Fi devices in the user's home.
3. **Ease of Use:** Wi-Fi Direct devices have features that allow users to identify available devices and services before establishing a connection.
4. **Simple Secure Connections:** Wi-Fi Protected Setup™ provides with secure setup to establish secure connections between devices. Users in most cases will be able to connect at the push of a button(WPS).

4.2 Wi-Fi Direct: Collaborative Content Sharing in HAN

This paper[7] intends to describe present day home working scenario where individuals have a variety of devices and our contents scattered across this devices which are connected together using Wi-Fi Direct Technology.

The paper proposed DOMS (Decentralized Collaborative Media Content Streaming) for media streaming. This DOMS prototype device with embedded computing machines are verified for its performance under preplanned realistic configurations to test its performance. This proposes us the use of DOMS for sharing resources in our possible educational domain solution,.

4.3 Wi-Fi Direct based Smart Grid for HAN

This paper[8] discusses the use of Wi-Fi Direct technology to test its potential in devising a smart control grid to control devices in the Home Area Network. This paper describes the main issues as power consumption and outage performance to be evaluated to test the use of Wi-Fi Direct in Home Area Network.

They observed that the use of technology improved the downlink outage probability in Home Area Network and limits were tolerable. They also observed that power was saved and consumption of power lowered with these smart devices in HAN.

This proves the use of Wi-Fi Direct technology as continuous communication medium.

4.4 Network-Aware Quality Adaptation Scheme for Device Collaboration Service in Home Networks

This paper [9] addressed the issue in collaborative streaming multimedia content sharing in home networks. It assesses the QOS issues in this network for heterogeneity of electronic devices as members of this network.

This paper proposes schemes to adjust data transmission according to the available bandwidth of the network. It also controls media quality and is also network aware thus stating it as Network-aware Quality Adaptation. This paper uses Scalable Video Coding technique to achieve same. This proposes us the technology to stream video lectures across the network may it be Distance Education or Educating a crowd.

4.5 Social-Based Content Diffusion in Pocket Switched Networks

This paper[10] addressed and proposed the Pocket Switched Networks enabling sharing of information based on opportunity utilized by mobiles phone's proximity with resources. The connectivity proposed is based on both Bluetooth and Wi-Fi Networks.

The paper makes use of DIFFUSE algorithm to pass on the message across PSN nodes before the expiry of that particular message which leads us to propose a system which in education will be able to share such information quickly across the mobile networks and affect relevant audience.

4.6 WiFi Proximity Detection in Mobile Web Applications

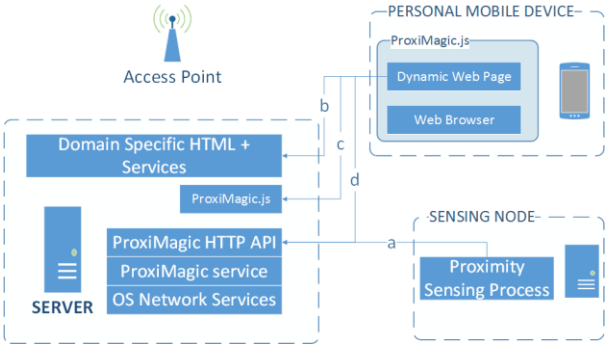

Fig 3: Components of Proxi Magic System

This paper [11] addressed the scenario in museum where there are antics stored and presented to different kind of audiences. This audience can be a general passer-by or could be a research scholar studying the artifact. It proposed an architecture where the one side consumption of information could be upgraded to bi-directional manner where an individual can interact with information using his smart device. The information could be suggested as addition to existing one and without the users need to switch from artifact to artifact.

The proximity of smart device from the artifact is estimated on basis of WiFi Signal's RSSI value received at artifacts end. This paper proposes a very strong model which facilitates a very smart interaction between individuals and artifacts in museum.

In their future work they have proposed to enhance the system to be used in educational domain by replacing artifact in museum to white boards; localized and section specific discussions and information in library.

Thus this paper could significantly emphasize on need of developing the solution as in proposed architecture.

4.7 Unsupervised Locating of WiFi Access Points Using Smartphones

It describes radio mapping the RF fingerprints/ positions of WiFi access points (Aps) which was later used to imagine their locations.[3] The knowledge about AP is considered to be essential in paper in order to enable locating mechanism as well as understanding following parameters defining nature of WiFi: density, connectivity, interference characteristics.

In the paper, proposed approach is called Serendipity, which locates WiFi APs in an unsupervised manner using radio scans collected by ordinary smartphone users. Using the same radio scans, authors extracted dissimilarities between all pairs of WiFi APs and estimated relative positions of APs by analyzing the dissimilarities based on a multidimensional scaling technique. They maintained the inventory and imagined ma for further reference. The APs are to be maintained as a result of discovery so as to manage WiFi networks.

The feasibility and validity of Serendipity was tested, by conducting real experiments at two sites. Authors collected radio scans with three off-the-shelf smartphones as mentioned in paper. Their results shown that WiFi APs are successfully mapped in real coordination through the collaboration of smartphone users, and mobile nodes are localized with small errors based on the estimated positions. Their other observation with respect to their earlier work shows that increase in size of site and number of WiFi APs improves the performance of the pro- posed system; hence, we expect that we can effortlessly deter- mine the positions of WiFi APs in large-scale indoor [12][13][14] places through the participation of smartphone (as they quote it to be) users without causing their intervention..

5. PROPOSED SYSTEM

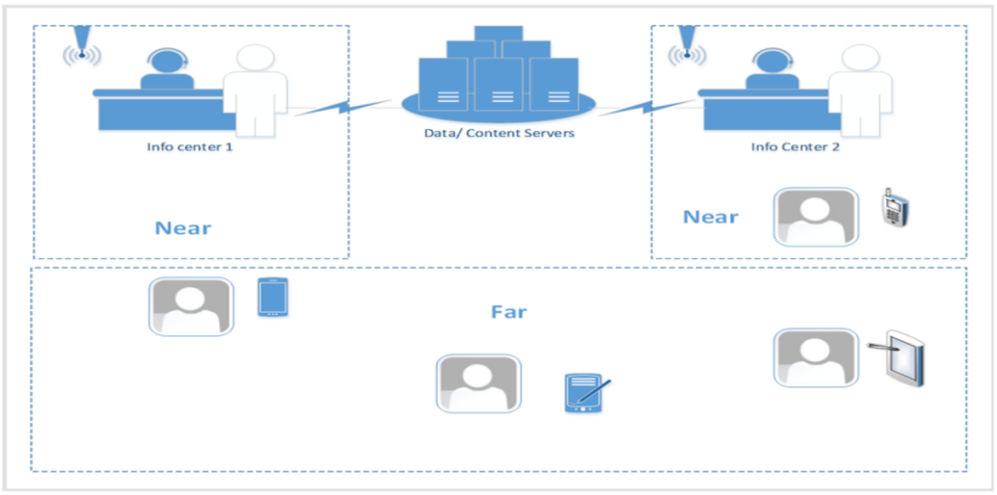

Fig 4: Generalized information center – consumer scenario with proposed Near & Far Categorization

The proposal is to build a system which is distributed locally and over Internet. Categorizing the modules from local system to system available on Internet on basis of content. Namely as *Near* & *Far* devices. Access data from the *Content Servers* by using intermediate *Info Center*'s. This Info Center can thus have properties suiting Near or Far communication.

The properties identified by observing this scenario in educational domain can thus describe time taken to interact and communicate from virtual to real world and vice versa.

Which means if a student is *Near* information provider, needs like resolving grievance regarding information from Information center, can get resolved in minimum time frame. But *Far* may need more time; thus defining further on QOS properties on network used.

On other hand content sharing in *Near* network shall be faster and efficient, than *Far*. Thus, applying the need of channelizing content through different network being aware of network properties.

Shown later is the diagram explaining same in the education domain. It explains a scenario where utilization of ICT is maximized. It is seen that there are dedicated computers to perform practical's where there might be issues of software dependency and also computational requirements. There might be licensing issues associated as well. As of now the laboratory is considered as Internet consumers only where the Internet is used to access information outside lab and not inside information outside the lab. There is heavy utilization of funds to set up such kind of scenario with laboratory setup cost above 10Lakhs of an average.

The basic setup time required to set up a lab may vary up to weeks in setting up basic infrastructure whereas configuration of individual nodes for roughly 40 machines may need 3-4 days. Now considering a scenario where one need to set up temporarily and with heavy customization it shall take a lot of time. Plus the setup cost may be un-bearable for conducting authority. Recovering a dead node in above shown setup is also difficult and may require a healthy amount of time which may lead to lack of resource.

.In scenario as in Fig 5. The lab resources and a tracked device in premise may not be contributing completely towards educational objectives, also their utilization may not be to their fullest. It could be seen as a problem to be solved.

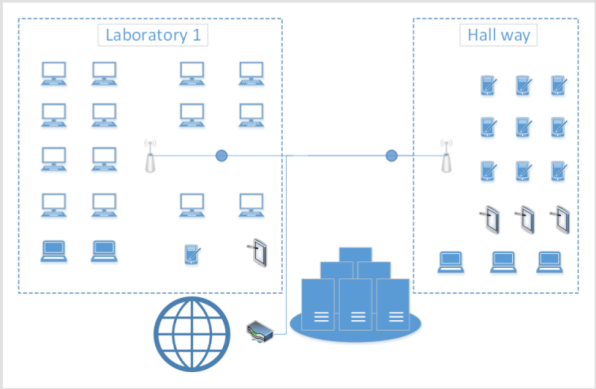

Fig 5: Lab setup and un-tracked devices in premise

As mentioned in Ubiquitous Computing's Smart DEI model[1], above listed components in diagram can all be contributing toward achieving end goal of education; which at present it is not. There are resources which are present in premise, there is data present in premise. Lack of architectural setup prevents it from 100% consumption. Having solutions to solve individual problem may lead to further complications in terms of have end results in non-compatible format.

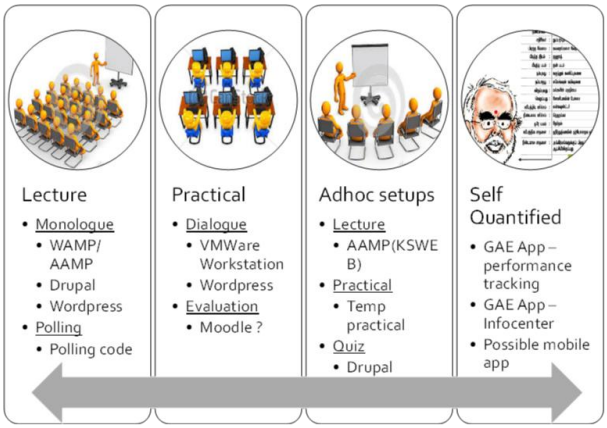

Fig 5: Education scenario – The Smart Environment

As discussed earlier was the generalized scenario, by applying technology on each and every part of educational domain and sub-domain, we can thus replace it by Smart Environment as shown in Fig. 5 above.

The proposed architecture is provide a solution across this domain to make information available based on proximity of devices in this Smart Environment and exchange the information in a form of Smart Interaction, each of whose rules shall be predefined by the educator. Also the proposed architecture aims to facilitate Smart Devices in interaction by categorizing there communication on the basis of proximity and content shared based on same.

The outcome shall be working model of a proximity based content sharing where content delivery model need not to be heavily dependent on the human intervention. The classification of near and far smart devices will allow network and content choice to be defined so as to avoid crossing data limits and yet maintaining newest data copy with the consumer. Outcome desired from proposed system is an architecture that achieves objectives and could be applicable for further development in various other application domains.

6. CONCLUSION

Emerging technologies are changing the face of communication with computation, thus changing the architecture of entire IT for defined environments which is difficult to cope up with. Reasons being cost (in different dimensions like financial, time and other resources). Identifying the key component and primary interactions can help us break this major problem to chunks which can later be kept upgrading without affecting the real time working of system.

7. ACKNOWLEDGMENTS

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