IOT enabled Futurus Smart Campus with effective E-Learning : i-Campus

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Abstract—**New technology like IoT in recent years rapidly developing in a computing world. In digital era our College campus need of IoT technology for classy environment to utilize effective E-learning. Our traditional normal college campus lacks in utilization of any modern technology for e-learning activities in academic course of action. This article focuses on need of adopting IoT technology in campus using E-learning for academics. In near future drastically make changes for students in highly enabled IoT: *i-Campus* environments.**

Keywords— Internet of things, Smart Campus, E-learning

I. INTRODUCTION

IoTs with E-learning is intended to support for collecting data from devices and share to other devices in utilize for effective E–learning application from Smart Campus. This paper hence provides a detailed study to a way of designing such system with IoTs. "THE Internet of Things (IoT) is a recent communication paradigm that envisions a near future, in which the objects of everyday life will be equipped with microcontrollers, transceivers for digital communication, and suitable protocol stacks that will make them able to communicate with one another and with the users, becoming an integral part of the Internet"[1]. By working in this way access and communication with the different variety of gadgets and devices like camera, audio recorder, smart watches, Google glass, Digital broad displays, sensors …etc. the IoT will nurture the improvement of learning circumstance that make use of the huge subject data generated by those objects to provide dynamic services to teachers, learners and even to content developers in modern Campus. Smart campus enables us to use IoT methodologies to make it available for classroom notes everywhere inside network Area. Our objectives are to create easily shareable notes sharing using web-based applications s/w which allow us to share via IoT enabled medium to accesses within network limit. We do not have any IOT enabled resources in college and university campuses for this purpose so far in learning environment.

There is no common description for Smart E-learning Application, but the aim is to define its importance's by making use of enhanced devices related to IoTs in that, to increasing the betterment of students learning environment, offering to add excessive subject notes in digitalized records. This task seeks the developments of a model which describe architecture of E-Learning with IoT. In IoT enabled smart classroom, a communication between smart board & E-Learning application provides unified, simple, and cost-effective subject notes to any corner of smart campus for students, thus gives probable teamwork to rapidly increasing timely delivery of subject's notes, easy way of learning and data reaches speedily. IoT enabled E- Learning, indeed, may bring benefits to an educational institute, educator, and the students in multiple ways for the teacher, learning activity.

Moreover, the availability of different subject notes data, collected by a smart classroom with IoTs devices can be transferred to E-Learning Application. To integrate updates every time scheduled duration. It increases the strategic relation between educator and institute to promote the smart college campus & university for better learning courses. And enhance the people to do more research on their interested disciplines.

The Main objective of this paper is to discuss a way of utilizing IoT technology to Smart Campus with modern IoT enabled classrooms in which data collection can be possible by using devices for E-Learning application. Describe an importance of Smart classroom with IoT enhanced devices to fetch data in a real-time activity. In order to that the study of overview of E-Learning Application with IoT Technology implementation and approach for the services provided by E-learning application to students by showing its ability & workable of Application to Smart Campus Environments.

Lastly, it will justify with the discussion of various features. To understand the technical solutions adopts for the perception of the IoT in Smart Campus by Classroom with devices connected E-Learning System.

II. STUDY OF IoT WITH E-LEARNING IMPORTANCE: SMART i-CAMPUS

The Internet of Things (IoT) is effectively used to sense its surrounding environments. Small microchips inside every device create a vast difference in its activity to sense, observe, react, record, Etc. Inter-connected enhanced device shares their data to another device. So Smart classroom consist of an enhanced device will collect data for e-learning application. Instead of traditional classroom smart classroom with IOT device integrates e-learning system. Data sharing in the multiple way Machine to Machine and also M2 human

possible, M to Mobile. "The IoT intelligently connects humans, devices and systems, (Internet of Things in 2020, 2008). Analysts describe two distinct modes of communication in the IoT: thing to the person and thing-to-thing communication (Raunio, 2005)."[02]

IoT used in wide variety of application domain "The internet of things application domains are Medical technology, Retail, logistics and supply chain management, Transport, Insurance, Energy, Information security, Home automation, Environment monitoring, Manufacturing, Agriculture, Education, Telecommunications" [02]

 "A recent research paper from IBM lays out the top five: Cost, Trust, Longevity, Utility, Making money - Brody predicts that it is only in 2016 or 2017 that we will see a flood of new devices that actually add value, and in sustainable ways."[03] Among 5 parameters, utility play a major role in IoT to connect multiple machines for wide usage in various things and fields.

"IoT can enable interaction with physical spaces for learning purposes or communication."[04] Classroom physical spaces and college campus can use IoT technology to observe teaching activity and communicates to connected data recording device to share it in e-learning platform application. So it will effectively transform the traditional classroom into a smart classroom then efficiently synchronize to e-learning application.

"The overall concept of IoT has several components, including the devices (or endpoints) that will be connected, the connectivity, the platforms to manage the endpoints and applications, and the analytics capability required to manage the data and turn it into something meaningful for decision makers to act on or review." [05]

Connected enhanced devices are endpoints inducted in sharing network with e-learning platform to communicate Machine to Man (human). Smart classroom collected information, storing as digitalized data in a memory of e-learning platform. Learning approach can be chosen based on our curiosity way in which we are keen to learn. It creates impact on our memory while learning then recalling several. IOT technology helps on creating platform for fascinating learning by means of smart classroom surroundings.

Internet of things impact on education field and its institution will be drastically make changes in term of future upcoming college's campus infrastructures and the way of utilizing various IOT things will be connected to educational classroom's and its physical environments.

This proposed model of IoT enabled college campus and concept not implemented as whole anywhere still relative implementation concepts and its application are listed below accordingly available in markets in which they are trying

utilize mooc in IoT, OpenEdx, Xerox, MIT virtual reality learning, NYAS's chip, keepsake box, sock with tracker, Uk Schools IoT project's, Nymi with wearable smartband, LMS with IoT..Etc.

"The **Internet of Everything (IoE)**, allowing people, processes, and things to harness that data to improve decision making for organizations and assist us in our daily lives."[006] "New job roles for IoE will be in demand for future course, as such cloud architect, cyber security specialist, data scientist, mobile application developer, and network programmer"[06]

"Top universities like Stanford and MIT, who helped pioneer the **MOOC** concept. A platform for offering high-bandwidth applications such as video conferencing, animations, and simulations to a every students audience of interconnected users, who can share content with each other in the network, online course modules and MOOCs are IoE enabled accomplishments"[06]

"IoE-enabled education tool at **Xerox** involves the ability to connect people by video over the Internet on a portal." [06] **"OpenEdX** is the open-source release of the edX platform developed by the nonprofit organization edX, which was founded by Harvard University and MIT"[06]

"Stanford has recently used IoT instrumentation to address the challenge of how to offer lab work as part of science or engineering MOOCs. In their Electrical Engineering departments graduate students have formulate a method for digitizing a physical experimentation and delivering it as a virtual lab to the large number of students registered in a MOOC'[06]

"Virtual Reality Keeps People Connected at MIT - The MIT Sloan Management school has locate *virtual-reality assisted learning* into play in the business sphere; an example is the use of virtual avatars as part of its Big Data program, "Big Data: Making Complex Things Simple.""[06]

"NYAS programs work on meaningful projects in ways incorporating IoT. For e.g., a group of 4th graders has "prototyped" a *swallowable chip* to send information to them about whether their grandparents are getting enough food and nutrients. A group of 7th & 8th graders devastated at having lost their family photos to Hurricane Sandy has designed a waterproof *keepsake box with a GPS tracker* in it able to reunite them with cherished items. A 17-year-old has designed a *tracking device that can be worn in a sock* by his grandfather with Alzheimer's disease to alert family members if he has wandered outside the radius of the home"[06]

"The association for furthering education through advanced technologies, aims to develop **"the internet of school things"** with *eight UK schools by estimating project cost of £800,000 project.* It's critical that schools understand how to leverage the internet of things so they can enhance the quality of

education and prepare students to be active contributors to, and beneficiaries of, this 21st century industrial revolution,"[07]

"As students walk into the classroom, student's attendance can be logged automatically using a smart device such as the *Nymi*, a *wearable "smartband"* that uses the wearer's ECG pattern to validate student's identity."[08]

"QR code or RFID tag using a phone or tablet and the data is immediately transmitted to the group's collaborative work area housed within the course's online learning management system (LMS). A notification is sent to other members within a group, whose phones or tablets login to the LMS and automatically on time prompt them to download the information or access the website."[09] we need to go beyond content delivery to have the potential for immersive, customizable, fully supporting learning experiences that are truly obtainable anytime and anywhere. [09]

III. SMART I- CAMPUS

Smart Campus can be termed as combination of multiple smart things together in single system like following

Smart E-learning Application with IOT

Smart IOT enabled Classroom

Smart IOT enabled LAB Room

IOT Sensor for Notes Sharing

IOT Sensor for Mobiles Devices

IOT based Hotspot for Campus

Future "Futurus" IOT Campus will provide various services in smart campus accessible in handheld devices by doing ideal connectivity among multiple things to integrate E-learning for academics.

IV. SMART I-CAMPUS : E-LEARNING APPLICATION

A. **Smart Classroom With Iot Enhanced Device's: need of the hour**

Traditional classroom usually has blackboard, projector connected with PC, this type of classroom do not record their activity in any form. However, it can do recording of teaching & learning activity can be collected through any enhanced devices. These recorded classroom activity helps in many ways to all students even those who do not know those subjects topics.

"Blackboard but these are becoming less common in well-equipped schools because of new alternatives like flipcharts, whiteboards, and interactive whiteboards. Many classrooms also have TVs, maps, charts, pencils, books, monographs and LCD projectors for presenting information and images from a computer."[10]

These devices just used to display, present information & images to students from connected PC. But proposed one will do a collection of data from the classroom, just not only presenting information to students and collect from their interaction. By doing so, we are able to store those data for future use. And, also these data can be uploaded in required format then and there by using smart e-learning application. This application synchronizes those things timely duration to reach outsiders of classroom. So anybody can learn those lessons even being outside that classroom.

"New learning technologies and mobile devices make it possible for learning to take place at any time, at any place, and at any place that the learner desires." [10] So because of technologies used and mobile devices, learning take place anytime, anywhere, subject's data, teaching of high profile Professor's Lecture reaches out any corner of the world from world top universities and colleges. Until there is no such system to transform top institute professor's teaching to reach other students in anywhere in the world. Certainly, thinking of technical difficulties, a clear standard model is still lacking, although some initiative going on to fill up this gap and overcome this issue's in implementation. The situation would have become the worst if we do not find out enhanced handy devices, cost-effective and efficient model to supports E-Learning with IoT. If this condition changes in near future e-learning with IoT is a big market for an entire world in every department.

IoT uses various network connecting technologies for making grouping system under common network. "IoT leverages advances in electronics, enabling the development of smaller, reduced power, and most importantly offering less expensive wireless systems that can be integrated in almost any type of device. IoT leverages other connectivity technologies like Wi-Fi, Zigbee, NFC, RFID & Bluetooth." [11]

Sharing Classroom Note's features

- ✓ *Note's Content*
- ✓ *Easy delivery*
- ✓ *Synchronized update*
- ✓ *Capable of handling more target devices (smart phones)*
- ✓ *Constant Improvements in content*
- ✓ *Intent to student's expectation*

These activities help us to integrate classroom learning with Physical space of college campus environments

Outcomes using IoT in Subject Note's Sharing

Internet of things helps in multiple way to use in learning process. Encircle factor like easy way to capture data, Storing of data, manipulate it, assessment of students, avoiding delay of transmission, frequency of usage. ..Etc.
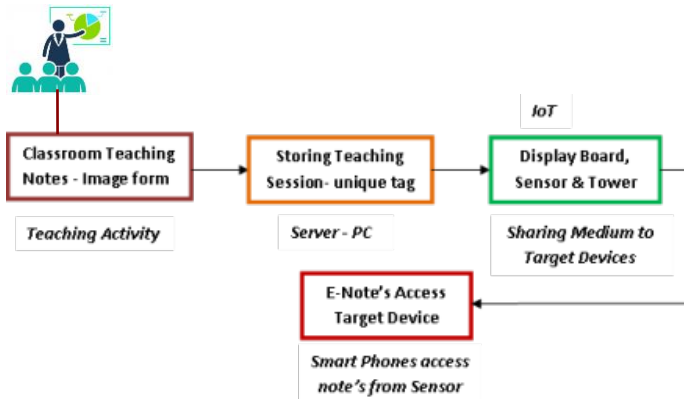

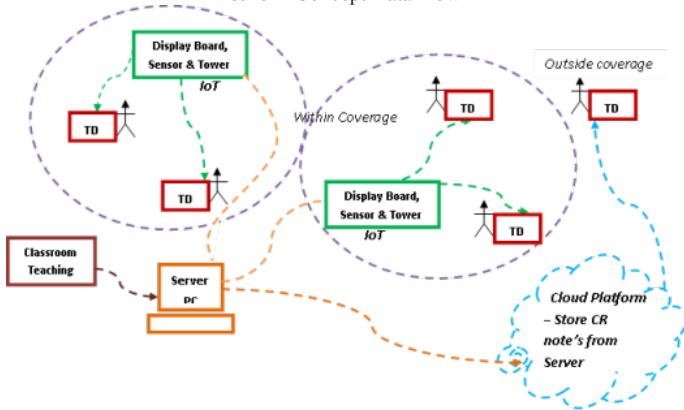Fig.1. Classroom Note's sharing using Smart E-Learning & IoT -Concept Data Flow

Fig -2 Classroom Note's sharing using Smart E-Learning & IoT –Architecture Model: i-Campus

"The Internet of Things doesn't function without cloud-based applications to interpret and transmit the data coming from all these sensors."[12] It reflects the importance of using cloud with IoT technology. This architecture depicts the same note sharing data storing in cloud to synchronize with IoT Tower sensor.

B. *Importance of using IoT enabled Smart Classroom for E-Learning Application*

➢ *Easy to share with others outside classroom using smart classroom*

s Admin can share any form of converted notes to others through this E-Learning application to make them easily accessible. It widely creates a great impact on learning circles.

➢ *Collaborative Learning can achieve in Classroom Environment*

This will effortlessly allow us to create collaborative learning environments in classroom with more number of students in different classroom in different region easy to make available virtually in single classroom, all in one place.

➢ *Improves Institutes Reputation next level by affording Top Professor's Lecture from well-esteemed organization*
"Potential to extend the reach of effective teachers" [13] Students can attend Top Professor's Lecture through this IOT Enabled smart classroom system easily.

➢ *Increase Competitiveness between Local & International Students*
Students can have direct competition with international students in all form of activities.

➢ *Easy to Setup Blended learning environments*
Due to sharing classroom with one region to another place in the world makes easy to give blended learning classroom with the different set of students from an entire world. "Flex - Most of the curriculum is delivered via a digital platform and teachers are available for face-to-face consultation and support" [14]

➢ *Enhances communication with IoT Device's in Classroom*
It allows teachers to send announcements and start lecture discussions instantly. At single instance, it can handle easily more than one Classroom.

➢ *Affordable to all Students for Subjects E-Notes from top professor*
This application makes easiest way of collecting and sharing subjects e-notes to everyone in that particular network easily throughout world.

C. *Internet of Things for Smart E-Learning Application : Important Features*

Smart Classroom is roadmap to integrate IOT in E-Learning platform, students can use this features easily on strong bound of IOT technology in smart classroom with enhanced device's data collection and sharing subjects e-notes to everyone. Network Model Setup to Smart Classrooms with IoT requisite of perfect network to observe, sense and collect data related to classroom activities.

Features relates to technically supporting Classroom E-notes sharing: *i-Campus*

Course Content (content based on Subjects & Professor's)
User Interface Design (easy to understand UI)
Community Building –group community based on subject interest.
Delivering of E-Learning Classroom Note's

Digital Libraries for E-Learning *(additionally EBooks, PPTs, Video and Audio Clip file ...etc)*
IOT Infrastructure to E-Learning Environments *(way of using IoT in colleges and university campus)*
Importance of compressing Note's Images *(to reduce memory wastage)*
Target Device E-Learning Application *(to create mobile apps for accessing e-notes to reach all students within campus area)*

IoT Device's for Smart Classroom

Device's enhancement using microchip in performance plays an imperative role to transform classroom into smart classroom.

➢ *Smart Whiteboard using IoT*
Predominant main device in this setup is smart whiteboard. Its role is to become hub of all devices to get connected in single point of IOT sources.

➢ *Standard Communication Techniques for New Model Setup*
Data and communication flow between all data collection sources.

➢ *Smart Classroom Monitoring*
Admin can monitor all activities of classroom and smart whiteboard can updates & synchronize with e-leaning system.

➢ *Collaborating Classroom using New Model Setup*
Amalgamating multiple smart whiteboard from different locality of classroom to create collaborate learning environment by using smart classrooms.

➢ *Energy Consumption to IoT device's*
Conserve more energy consumption while devices are in ideal state. Monitoring system used to conserve device energy efficiently.

➢ *E-Notes Management*
Lecture notes collected from smart board to share using e-learning application. Device will help for collecting notes, it will be in digital data to share easily in common platform.

➢ *Automation of Subject's Notes Sharing*
Platform used to share notes using admin activities in spite of that notes shared through automation activity using device to e-learning application from smart classroom.

➢ *Useful Gadgets in this New Model Setup*
Apart from standard smart classroom devices additional gadgets can be added to this setup for sharing basic information like alert, alarm, short description of notes, augmented visuals, …etc.

➢ *Data Congestion*
Notes sharing use enormous data traffic in smart classroom. It's very significance to use congestion algorithm for proficient usage, free of traffic blockage which get out of slow down data rate. "Data management is a crucial aspect in the Internet of Things. When considering a world of objects interconnected and constantly exchanging all types of information, the volume of the generated data and the processes involved in the handling of those data become critical."

➢ *Interoperability in the Internet of Things*
The advancement of future Internet depends on Internet of Things. Smart board things connected to multiple classrooms for sharing notes resources. On the basis interconnecting various things, machines, and smart objects to network its interoperability depends. "As for the IoT, future networks will continue to be heterogeneous, multivendor, multi-services and largely distributed."[15]

V.   IOT BASED E-LEARNING APPLICATION MODEL

Smart classroom is user centric to carry forward notes to next level through e-learning on source collecting from IOT devices. "The development of the IoT is expected to come along with a new range of user-centric services, based on the interaction of day-to-day processes with the network."

"Social Learning application is challenging task to integrate various functionalities in one system. The smart classroom takes a key step in the development of smart e learning system. Teaching is most important activities in traditional learning process for colleges and universities. So this can be used to share with smart e learning system in social networking."[16]

"The business model for the delivery of those services will require the interaction and collaboration of several organizations."[16] The delivery of those services will be frequently seamless for the user, requiring no specific interaction with them. In particular "event-driven" middleware and sensor "dynamic service capability declaration" is required.

Augmented reality with IOT enabled Smart Classroom: AR enables Smart Classroom to Store and share context based data collection when students come into closeness to sensor devices; it depends on locality and connected things. Such data may possibly displayed on mobile phone, any wearable gadgets or using well located smart display boards.

3D Virtual objects with IOT: IOT devices possibly used to display 3D virtual visual to students in smart classroom. Inputs for this visual can be captured in real time from

physically located materials or can be accessed from already recorded 3d visual. Data can be collected in both ways from real 3D virtual world or from the real location.

Smart Information Display Board using IOT: Student outside classroom can access subject data notes using information sharing Display board and it can be controlled by administrator for adding updates.

Smart Phone devices and Smart Display Board using IoT: *Interaction among mobile phone and display board to share subject notes using IoT which data is collected from smart classrooms. So it connects student even from outside learning session.*

Intelligent IOT objects: *IOT things connected among each other for efficient smart class room. Classroom activities are key factor to centralize, control and updates information gathered from classrooms. Intelligence level to IoT enabled smart classroom is highest priority, then 2nd level importance to smart display board to share all gathered notes to students using this thing. Interactive display device is installed in standard defined network setup is key one.*

Administrator for IOT smart classroom: Standardized role is defined for admin activities on basis of architectures used; Data sharing schemes, protocols is used.

VI. FUTURE SCOPE

Smart Classroom Note's can be improvising in many ways like

- ✓ Adding audio to that notes,
- ✓ Allow to add short video clips,
- ✓ To make live chat session while accessing notes, Etc.
- ✓ In terms of *Sharing Medium to Target Devices* STD IoT H/W we can make centralized STD h/w which can communicate to multiple STD's h/w and share's data among each others.

"A next generation Learning Management System and Experience APIs may enable real IoT integration and propel business training to the next level."[17] LMS is part of E-learning technology in future E-learning will be enabled with IoT.

Robotics: Connected everyday objects and sensor networks are key enablers for robots. Onboard wireless communications may be critical for interconnecting robot systems.

Geotagging / geocaching: Geographic information systems (GIS) play a role in locating things. An Internet of Places (IoP) can arise as more systems recognize where they are and can access GIS.

Mirror worlds: Electronic media – whether a simple display or a complex virtual-reality platform – can help people visualize distant events and situations. Software can use icons and other abstractions to help visualize the location of real world objects. Objects including vehicles, personnel and equipment can self-report via various types of sensors, machine vision and other technologies.

Futurus *i-Campus*: Outcomes

As IoT & IoE placing more points for technology into daily day to day lives, it is obvious that learning and education will also cultivate to use those things to become more of a development for all of us. Rapid transformation of connecting things, Students will have to find for develops experts skills by frequently using technology and its shifts, especially education which have a long-lasting major role to play in staying up to date. Every institution are looking further on to exploit the potential of IoT in the educational space by better providing IoT enabled campus infrastructures to keep on connected within the digital and bring in valuable outcome to the next generation.

CONCLUSION

In this paper, we analyzed the efficacy and need of Internet of things in Smart College Campus: i-Campus the converse technologies are going hit market very soon and will be standardized and many industry companies are will be part of providing active services in related terms to enable the future applications, such as those illustrated in all the Section. "A concrete proof-of-concept implementation, deployed in collaboration with the city of Padova, Italy, has also been described as a relevant example of application of the IoT paradigm to smart cities."[18] As per this smart city implementation in near future smart IoT Campus: *i-Campus* will be implemented. So need of the hour to see how smart e-learning will be integrate to that i-Campus System. "New technologies and IoT applications can be leveraged to further enhance e-learning platforms and improve completion, reduce costs, and improve learning outcomes for careers."[19].

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