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SMART UNIVERSITY CAMPUS USING IoT

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ABSTRACT

Internet of Things (IoT) has brought many wonderful changes to our lives. Apart from areas such as Industries, Smart cities, Transportation, Healthcare, Agriculture and different areas, the IoT will also have a major association in universities or colleges. In this era of digital revolution, IoT technology can be used to maintain smart and secure environment in University campus. The objective of this paper is to focus on how IoT plays vital role in developing smart University campus along with to study challenges in its implementation.

KEYWORDS: *Internet of things (IoT), Smart University Campus, Sensors.*

I. INTRODUCTION

An Internet of things (IoT) can be defined as network that connects uniquely identifiable "Things" to the Internet. IoT makes "Things" to have capabilities like sensing, actuation and programmability. IoT is a giant network of connected "things" (which also includes people). IoT comprises of everything from Vending machine, Washing machines, lamps, wearable devices and almost anything else you can think of. Gartner, Inc. forecast says that by 2020 there will be over 26 billion devices which will be connected to Internet.

The connection will be between things-things, people-people, and people-things. The four basic key elements of IoT are Sensing, Communication, Cloud Based Capture & Consolidation and Delivery of Information. In a wider sense (IoT) is all about interconnectedness of numerous devices that can report, monitor, or offer services that are of important to end users[1].

Smart University Campus

University campuses are exclusive because they offer variety of services. It is an ideal place where students, faculties and its staff study, stay, visit and work. Research is just as important activity as teaching and learning. Most of the universities can be visualized as small to medium-sized communities. As the campuses spread over very large areas it becomes difficult to manage and control the activities in the campus.

Smart University campus is a campus that promotes sharing of resources, which are eco-friendly, energy efficient, well-managed, safe & secure. Smart campus can be defined as a new model of thinking which integrates different components including but not limited to holistic e-learning, effective utilization of ICT, sustainability through use of sensor management systems, automated security control and real time surveillance.

The Smart Campus provides teachers and students an intelligent and open education and teaching environment as well as a convenient and comfortable living environment [2][3]

Basic Building blocks of Smart University campus

The concept of Smart in education area involves the advent of technologies such as smart boards, smart screens and wireless Internet access for all over the place.

- **Smart Education** – Smart education is a system which aims for a driving force that will initiate the education system that is self - directed, adaptive, resource equipped.
- **Smart Learning Environment** – Smart Learning environment is an adaptive system which provides appropriate support, guidelines, feedback at right time to the students.
- **Smart Teaching Solution** – This includes various practical oriented methods, tools, teaching games, teaching material, simulations and provides constant support based on technology.
- **Smart classrooms** – Smart classrooms are the classroom enhanced with technological equipment's for better learning, teaching and smart pedagogy. It includes laptops or computers or Tablets, projectors, Internet connectivity.

II. RELATED WORK

Snehal K. Dixit et al. has developed a concept called Smart University by providing a broad overview of the IoT scenario and reviews its technologies and the sensor network. Author has proposed a system to control and monitor temperature and light sensors. Data is transferred to Wi-Fi enabled board. Raspberry pi microcontroller is used to store and transfer data to the main server.

The system also contains web based GUI to display information. When the values crosses predefined limits the fan or light will automatically be turned off [1].

Md. Nahid Sultan et al. explored the various possibilities and opportunities relating to classrooms libraries building, labs for the Hajee Mohammad Danesh Science and Technology University (HSTU) in Bangladesh. The research paper further explores different potential IoT based services in smart campus and limitations of the use of IoT in Bangladesh [2].

LIU Xiong put forward the concept of Smart university campus based on data analytics that is big data. The author has proposed the framework for smart campus with the objective to provide development and direction for establishment of smart campus construction [3].

Shivaraj Kumar et al. gave a thought on need of adopting IoT in secured campus for Education system. The author has introduced short model for smart E-campus Architecture for the application – Smart inventory system – smart parking system and smart automated street light system. [4].

Abdelrahman Abuarqoub et al. focus on how IoT technologies can be used to build modular approach for campus. Author has identified the motivation for development of IoT Based campus, and designed challenges for its applications [5].

Karan Phougat et al presented a case study for Bharti Vidapeeth campus. In the on-going project author have integrated various services for smart university campus like one Smart card approach for the transactions like payment, controlling access, smart micro- grid, smart waste management system ,smart lighting system, Environment monitoring etc. In the paper they have introduced unique architecture which has protocol stack, link layer

technology, and hardware and software platform.

Marti Widya Sari et al. author focused on mainly 3 services smart education, smart parking and smart rooms for the case study of PGRI Yogyakarta University , Indonesia.

In the proposed method wireless connectivity through Bluetooth, hardware consist of microcontroller and sensor module, software cloud services are considered [7].

Swaroop P T et al., here they have presented the idea about smart college based on IoT technology. They have considered all new trends which are currently available for implanting smart college [8]

Shahla Gul et al. in their paper discusses about the practicality and applications services of IoT in the field of education. Furthermore, it tries to present the study of current research works, challenges and impact of IoT and challenge of Privacy issues about the IoT in future education [9].

The author proposed a smart campus and “Living Laboratory” that exploits use of its infrastructure and encourage engagement between the campus’ stakeholders and energy. Living laboratory helps to integrate experimental energy supply and demand technologies. Also it helps to optimize performance of campus using building management system & energy monitoring system [10].

This paper focuses challenges like security, privacy, quality & ethics that will be encountered while developing IOT enabled campuses for higher education. It elaborates concept of digital campus that reduce operational cost, offers security & learning tools to all stakeholders [11]

III. ROLE OF IoT FOR SMART UNIVERSITY CAMPUSES

University campus can be compares with small town where many teachers, students, Alumni, researchers and staff working at university. Controlling & Keeping track of all the activities happens in the campus are practically not possible. The IoT can play an important role in campus planning. With the help of sensors it is possible to overcome many problems. IoT in smart campuses will bring high quality services, protect the environment and will save the cost [2] [4]

IV. PROPOSED SERVICES FOR SMART UNIVERSITY CAMPUS

Sr. No.	Applications/services	Commonly used IoT devices/Systems
1	Class Room	<ul style="list-style-type: none"> Interactive White board Smart HVAC System Connected Laptop Temperature sensors Attendance Tracking System (through access control) Video-conferencing for distance education E-books Smoke & Gas Detection sensors
2	Laboratories	<ul style="list-style-type: none"> Motion sensors Smoke & Gas Detection sensors Access control Attendance through Smart card or RFID Computer usage system
3	Library	<ul style="list-style-type: none"> Use of RFID tag to easy identification, prevention from theft Transaction monitoring- Issue & return of book Access control, Card reader will be installed on entry & exit points of the library. The access (door opening) will be controlled from Central Server System (using card reader inputs). The doors will be auto closed. Smoke & Gas Detection sensors
4	Parking	<ul style="list-style-type: none"> Motion sensor Lighting control Monitoring presence of vehicle using pressure / strain-gauge Smoke & Gas Detection sensors
5	Waste & water Management	<ul style="list-style-type: none"> Level sensors for Smart bin system Scheduling the time for waste pickup truck Tap-water control (for optimum water usage)
6	Lighting Control	<ul style="list-style-type: none"> In class room (based on utilization) Street lighting control Parking lighting control
7	Environment monitoring	<ul style="list-style-type: none"> Temperature sensor track temperature reading Air quality Sensors will check the air quality and send the alerts.
8	Security & privacy	<ul style="list-style-type: none"> Motion sensors, Proximity sensors to prevent unauthorized access in restricted area Video surveillance using CCTV Warning/ Alerts should be provided to the authority on mobile
9	Asset tracking & Inventory	<ul style="list-style-type: none"> Real-time visibility sensor-driven automation university owned assets enable tracking and management of high-value products and assets.

Figure1: Proposed Services

V. CHALLENGES WITH INTEGRATION OF IoT IN SMART CAMPUSES

- **Managing voluminous Data** – Smart campuses needs to handle and explore scattered and massive data, hence the data management technology must be

able to efficiently manage large amount of data. Moreover, there is a need for a standardized data format for heterogeneous data generated by IoT devices. The data management system is another big issue.

- **Standards** – Standards play significant role in developing IoT application. The IoT standards covers the data standards , the information processing standards , the application standards, the architecture standards, the communication protocol standards, the security standards and the public service platform standards. A standard is essential to allow all actors to equally access and use. Developments and coordination of standards and proposals will promote efficient development of IoT infrastructures and applications, services, and devices.
- **Quality** – The IoT offers exclusive prospects to deliver high quality education. However, it also brings challenges to maintain the quality of teaching and assessment of student's effort. IoT applications in academics need tools and technologies for instructors, professors and the scientific community to improve the quality of research and address ethical issues within higher education.
- **Ethics** – IoT handles large amount of data including personal information. It is required to protect this from unauthorized access. Also it is important not to utilize this personal information for illegal purpose.
- **Reliable network** – For successful implementation of use of IoT for smart campuses need continuous high-speed wireless networks which provide the bandwidth for overall monitoring and control.

- **Insane Cost** – The technology is continuously evolving. Use of IoT – based applications are continuously growing vertically as well as horizontally. Due to evolving technology there will be a need to update the devices & equipment. This will increase the cost, so Universities need to come with new ideas for finance including research in low cost technology.
- **Privacy & Security** – IoT environment stores data on Internet-based network. So privacy and security issues become very crucial. The private information about the financial background of the family, medical records, and student's progress should not be disclosed in any case. There is a need of high level of Encryption techniques to avoid the data from hacking.
- **Energy efficiency** - Finally, another important challenge of IoT- enabled smart campuses is the power supply and energy efficiency. Smart grid and solar based system can be used for efficient management and control on energy usage [9] [10].

VI. CONCEPTUAL DESIGN OF SMART CAMPUS ARCHITECTURE

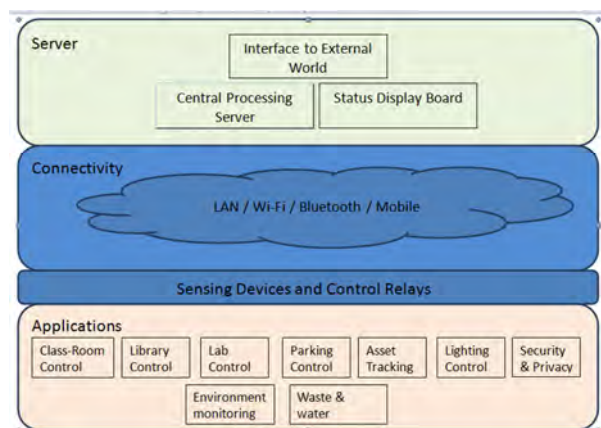


Figure2: Conceptual Design of Smart campus Architecture

VII. BRIEF EXPLANATION OF THE CAMPUS ARCHITECTURE

- **Server module** - First module contains server, status display board – Server can be considered as heart of the campus management system. Server captures, collects, stores and processes data generated through sensor nodes. The data generated will be store using Some Database management system. Dash board can be used as a Notice board where all necessary information is displayed.
- **Connectivity module** - LAN, Wi-Fi, Bluetooth, mobile network. IoT system can use individual or combination of network technologies for transferring data to the server. This data is processed and then the microcontroller sends the actuating signal via these networks.
- **Sensing devices and control replay module** - consists of various types of sensors, relays and actuators. Hundreds of sensors devices capable of continuously remains active will monitor the environment e.g. Temperature sensors, Motion Sensors, RFID, IR sensor, Cameras.
- **Application module** – Application layer is the last layer which will receive and process the information to various services that are applications specific

VIII. CONCLUSION

With the advancement in networking technology and connectivity and sensors i.e. IoT universities can resolve many challenges for example keeping track of assets develop access to information, build smarter plans, and design and development

of safer campuses environment. IoT in education have tremendous potential to bring substantial standards to higher education by engaging and motivating the students and staff, and to increase speed and quality in learning. The purpose of this study was to find out the prospective of IoT in university campus benefits while addressing its challenges and reducing the risks involved with it.

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