

Original Research Article

Smart Technologies for Smart Campus Information System

ABSTRACT

The increasing development of intelligent technologies offer opportunities for objects in the real world to communicate using sensors and communication networks. One of the application areas is the smart campus for the smart information system. The construction of the smart campus based on the smart technologies such as Bigdata, cloud computing, mobile computing, network infrastructure needs the understanding of the exploration of these technologies in the development process. This conceptual paper explored the roles of the smart technologies for smart campus development toward a smart city information system. Through the analysis of the key concepts, the architectural layers for the smart campus were proposed hoping to promote smart campus information system for a sustainable intelligent campus towards smart city campus.

Keywords: Bigdata, Cloud Computing, Network, Smart Campus, campus, City

1. INTRODUCTION

The progress in smart technologies have influenced the educational sphere and offered opportunities for objects in our conventional campus to communicate with each other via communication technologies. Intelligent campus (i-campus) refers to a holistic intelligent campus environment, in which technologies such as cloud and mobile-powered learning, mobile apps, RFID (Radio-Frequency Identification)-based security management are established to support holistic e-learning, networking, administration, and governance. These objects like doors, windows, printers, projectors, books, poles, benches, and complex objects like buildings, campus, laboratories and parking are converted into smart objects by attaching sensors and are given a level of intelligence to communicate to each other (Kwok, 2015; Snehal, et al, 2017). Smart campus creates an environment for learners, teachers and learning devices to interact for the purposes of learning. The rise of information and communication technologies in education has quietly changed the traditional role of teachers, with a shift of emphasis towards an autonomous and innovative learning, and a

fusion of diverse pedagogical methods and strategies (Klimova, 2016, Gambo, 2017).

The development of local area network (LAN) on campus makes it much easier and efficient to get the needed service and desired requirements (Bernabas & Sengupta, 2017), however, campus technologies are limited in providing direct communication between objects. The idea of objects making sense and communicate with each other refers to the internet of things. The Internet of Things (IoT) is a rapidly growing network of a variety of different connected things. The use of IoT in campus is like a new wave of change that has brought new opportunities and possibilities for the improvement of both teaching-learning process and educational institutions' infrastructure (Shahla, et al., 2017). The number of connected devices is increasing enormously and many predictions have been made with this concept (Gul, et al., 2016; Elyamany & Alkhairi, 2016).

The IoT technology has a great impact on campus. IoT has not only changed the traditional teaching practices but has also brought changes in the infrastructure of educational institutions (Mohanapriya, 2016). It adds values to students, teachers and other academics to enhance communication for the purposes of improving learning on smart campus. A smart campus may have many other smart features like smart campus, smart parking, smart inventory, smart lighting, and smart tracking of students, goods, and equipment using RFID technology (Cata, 2015; Kaushal, 2015). The smart education institute can have a smart campus, smart corridors with info boards and datacenters for processing all types of data (Simic, et al., 2015, Gambo, 2017). At present, the design and construction of the smart campus is still at the exploration stage. A number of studies have proposed different models for smart campus. Many advanced and innovative concepts are being proposed or introduced in education like introducing IoT technology with Bigdata technology in e-education can be effective for improving learning and teaching processes and communications in smart campus

The paper is organized as follows: Section 2 presents the conceptual technologies; section 3 presents related works; section 4 presents the components of smart campus design and conclusion in section 5.

2. IDEA OF A SMART CAMPUS INFORMATION SYSTEM

A Smart campus is a subset of smart city embedded with sensors and intelligent terminals on the concepts of cloud, Internet of things technology and related technologies synthesis. The idea is for administrators, teachers, and students through a more sophisticated environment can smartly communicate to enhance learning experiences and communication (Jian, 2015; Kumar, 2015). A typical smart campus is depicted as shown in figure 1, where each of the devices can communicate with each other remotely using smart apps.

Features of Smart Campus



Figure 1: SmartSchool, 2014

The related technologies of smart campus related to the following smart technologies:

Smart Apps

This is mobile as well as a web application that facilitates communication between devices in a smart campus. The smart apps act an interface between the user and the devices to facilities communication and sensing.

The Internet of Things

The Internet of Things are sensors, controllers, machines, people, and things in a new way to realize intelligent identification, location, tracking, monitoring, and management which integrates intelligent sensing, identification technology, wired network and mobile Internet for smart communication.

Cloud Computing

The cloud computing as a new model of computing has brought a paradigm shift in education. This new technology attracts the interests of academics and industrial experts. Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.

Cloud computing was built on existing technologies as like grid computing, high-performance computing, parallel computing, distributed computing, powerful integrated computing, only the use of open, integrated, collaborative information architecture and dynamically configurable resources, high scalability, on-demand services that can provide communication in a smart campus setting (Kumar, 2015; Wang, 2017).

Big Data

Big data is the driving force for mass data storage, analysis, and processing. A Smart campus is connected with different intelligent technologies and terminals, information systems and sensing devices generate a large volume of data. This new technology can collect such large data, stored, analyze and process for intelligent applications and devices for smart communications to support decision-making processes.

Smart Knowledge Management

Knowledge management is the prime technology of smart campus. It is the most important and the most common activity of knowledgeable person and campus. This is the planning and management, creation, processing, and application knowledge.

3. RELATED WORKS

Sagar, et al., (2016), developed an android academic web portal for the smart campus environment to help in interaction. The proposed system helped the college to manage records and save natural resources and job gets done in less time compared to an existing system. Users get the information without delays because of real-time use of the proposed system. It helps to reach to every student and faculties in the college in very less time. The data is stored on database helps the management to take major decisions on the suggestion and ideas.

Creating smart learning environments needs to understand the characteristics of such environments, combine formal and informal learning, and take learners' perceptions and learning behaviors into account, to exploit more effective learning methods and tools, and design space more appealing to personalized and autonomous learning (Gros, 2016). The Smart learning environment is not simply about the application of technology, but more significantly enables the fusion of pedagogy and technology to create an ecosystem in which educators and learners are able to interact more efficiently. There is a need for pedagogical innovations to support smart learning as well as emerging technologies that offer endless learning opportunities and communication in a smart campus environment (Kinshuk, Chen, Cheng, & Chew, 2016)

The Smart education deals with better learning in a digital age. A conceptual framework of smart education was proposed, containing three essential elements: smart environments, as technological support; smart pedagogy, as methodological support; and smart learner, as the goal of smart education (Zhu, Yu, & Riezebos, 2016). The authors studied the impact of smart campus, a major role in building e-education system, on transforming universities to be part of the e-society vision. The positive aspects include developing new talents, shifting education towards democracy, enabling learners to apply theoretical knowledge into practice, and boosting blended learning. However, there are some considerations as well, such as a need for redefining educational models and the ability to make use of the smart design (Aguilar, 2016).

Antevski, Redondi, & Pitic, (2016) present an approach to encourage group collaborations in smart libraries by creating study groups through a mobile application, locating the groups using hybrid Bluetooth Low Energy technology and Wi-Fi indoor positioning system, and recommending the groups to other students via a server-based infrastructure. A prototype of a campus-wide supersensory network was developed and deployed around the campus of the University of Glasgow to support different groups of end users including staff, faculty, and students. The supersensory has more powerful computing capability, and are believed to empower more flexible data collection, processing, and reaction (Hentschel, Jacob, Singer, & Chalmers, 2016). This technology offers a smart campus environment for smart education.

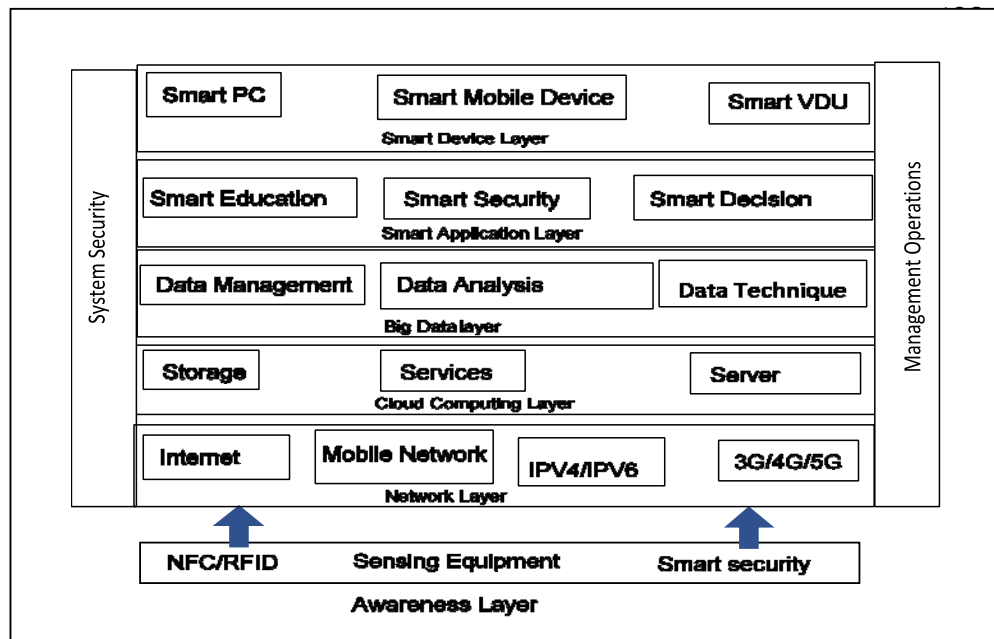
Sruthi, et al, (2017): proposed Smart Campus Using Android based Smart Phone, the idea of constructing a “Smart field” implies that the establishment can adopt advanced ICT (Information Communication Technologies) to mechanically monitor and management each facility on campus. The Smart campus includes portal architecture, management, and service, smart management, infrastructure, etc. The Smart campus system integrates hardware device of digital school, and cloud storage as the means of data storage is applied to enhance communication in a campus. The results of the simulation show that the system can be accessed without the internet, possess a low power consumption, user-friendly, mobile controllable, and fault detection can be easily identified with the short span of time.

The above literature shows that smart campus is in the process of development, experimentation, and implementation. This new computing paradigm offers a more intelligent environment to enhance intelligence on campus. A number of architectures have been proposed each having a degree of design with different layers of implementations. The next section discusses the five layers conceptual architecture for a smart campus.

4 CONCEPTUAL DESIGN LAYERS FOR A SMART CAMPUS

A typical smart campus integrates the physical space and the digital space (Kumar, 2015; Jian, 2015). The big data interface between the smart devices (intelligent device layer & application layer) and the communication layers (cloud computing and network layer) to achieve personalized and collaborative interaction for the business of smart campus information system. Figure 2 below show the proposed smart campus model. The layers of the proposed model are discussed as follows:

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Figure 2: Proposed Smart Campus Model

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Smart Device Layer

Smart campus integrates smart devices and existing application systems to use the application layer to achieve a smart campus information system. A variety of terminal access technologies, including traditional mobile apps, web-based, PCs, smart terminals, self-service devices, and wearable devices, provide users with a seamless, adaptive environment, personalized human-computer interaction model for specific application scenarios based on different environments, enhanced user access to campus information, service experience for campus information technology applications to provide integrated, seamless access and support (Wang, 2017).

Smart Application Layer

The smart applications provide students and teacher an opportunity to learn and provide campus management with comprehensive and appropriate service functions, management decision, smart security, and smart campus facilities for the smooth smart campus functionalities (Gambo, 2017).

Cloud Computing Layer

This provides a computing paradigm based on related technologies such as virtualization, distributed computing, high-performance computing, centralized storage, distributed storage and other storage technologies to achieve efficient, transparent and reliable infrastructure. The campus's big data processing and intelligent applications provide universal, on-demand computing and storage support (Wang, 2017).

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Big Data Layer

The Big data layer is a prime mover toward smart campus. The information gathered in the campus environment, activities, business, interaction, and other information needs to follow the information standards and standardization, establish the data sharing and exchange mechanism, the database infrastructure theme, the unified data platform application construction, connect in cyberspace and campus Intelligent virtual images (Wang, 2017). This technology provides the capturing, storage, analysis and processing of data for the decision-making process in a smart campus environment.

Network Communication Layer

This composes of campus wired network, WIFI wireless network, 4G mobile network and other communication technology, for the intelligent perception layer to collect various types of environmental and activity data for teachers and students anytime, anywhere using the Internet to provide high coverage transmission services to provide high-speed access services (Wang, 2017). This layer provides communication in a smart campus environment.

System Security and Operations

These segments provide safety operations and security for a smart campus environment. The support system is the basis for the continuous provision of high-quality services. The components includes the information security system that ensures campus information security and reliability, and also the operation and maintenance service system that ensures the stable operation of the park infrastructure and application system. The safe, stable and efficient operation to provide practical protection (Wang, 2017)

Awareness Layer

This connects everything through RFID, sensor, QR code and real-time positioning technology can realizes the intelligent identification, location, and management for the smooth smart campus operations.

5. CONCLUSION AND FURTHER WORK

The construction of a smart campus requires the understanding of conceptual design, structural analysis from the perspectives of smart technologies. This becomes possible if the elements of Bigdata technology for the storage, analysis are integrated in decision-making within the confine of an intelligent environment. The construction of a smart campus also requires smart devices, network, smart applications, and the cloud computing technology to produce information services and management for effective campus - information - system. The integration of these related technologies to design a smart campus to achieve a sustaining campus Information system becomes necessary as many things including human, tends to communicate with smart technologies to achieve a smart and intelligent environment for effective commutation and decision-making process in a learning environment.

This conceptual paper proposed a five-layer architecture for manageability and security. In the future, a mobile apps smart campus will be developed based on the layers to understand the applicability and practicability of smart campus.

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