Smart Campus: Enforcement of Today's Education System into Forthcoming Prospects

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Abstract---- We all live in the Internet era in which millions of computers are interconnected to each other to share the digital or binary data. But in the current time, not only computers but the number of digital devices are connected and share data with little or no human interference. These interconnected digital devices are called the Smart devices and this perception is called IoT (Internet of Things). IoT is the new technology that develops very rapidly in a computing World. With the help of sensors it connects the number of devices globally in the cloud. On the IoT platform number of devices are connected to each other, sensed through sensors and also controlled remotely across a network. Application of IoT in the education domain is the new way of teaching and learning process and also renovates the experience of both students and educators. The IoT enabled campus becomes the smart campus. In smart campus, servers, peripherals, the infrastructure of the campus, students, faculties, and other staff are connected. The campus becomes a platform for innovation and in this way everything of the campus shares data through IoT. Therefore, the present paper gives its justification by discussing the influence and application of IoT in the field of teaching systems.

Keywords--- Internet of Things(IoT), Smart Campus, Smart Learning, Smart Classroom, Smart Learning, Smart Building, Sensors

I. INTRODUCTION

Internet of Things (IoT) is firstly coined by Kevin Ashton in 1999. IoT is an international network that associate objects through the internet to communicate with the environment. The physical objects become smarter objects by using different devices like sensors, Radiofrequency Identification (RFID), Mobile phones, Actuators, GPS devices, and many more. In IoT, things interact with one another to achieve their goals[1]. The Internet has transformed many industries in the past few years. The objects around us have become smarter due to the rise of the internet which has to lead to innovations in technology. Earlier phones were merely used to drop a text or pick a call, but now smartphones are a whole lot of another world that has everything from music to readings books, to the simple functions of the phone. This concept of the connected device has been a revolution on the Internet. Anything that is connected to the internet becomes smart and these devices can further share data with the exchange of information to make decisions. IoT technology is already implemented in various domains like home automation, traffic control, health monitoring, smart vehicles, smart grids, smart cities, smart campuses, and many more. The smart campus is an emerging area that adopted by number of universities globally. Smart campuses provide timely and accurate information with

minimum effort and help to reduce operational costs as compared to the digital campus [2].In IoT technology, objects or things are communicating with the usage of sensors, actuators to perform meaningful tasks[3]. IoT uses in the learning process in multiple ways like an easy way to collect data, storing the data from different sources, manipulate the stored data and also perform the assessment of students and also avoiding in the delay of transmission [4].

In the learning process, IoT technology play an vital role like easily capture and store the data, analyze the data, doing the assessment of students and also avoid the delay of transmission of data[5]. With the CampusTalk platform, all networked and physical devices are easily reconfigured and reused to create new applications with or without some programming efforts.

II. IOT MODELS

Internet Architecture Board describes another IoT characteristic refers to the communication models [6]:

- *Device to Device Model:*
This model characterize number of devices that are connected directly and communicate via intermediate applications over several networks including IP networks or internet

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- *Device to Cloud Model:*

In this model, things are connected to the cloud with the help of internet to communicate each other.

- *Device to Gateway Model:*

This model helps to connect things to cloud services through internet with the help of software applications which act as gateway devices and also provide number of applications like data and protocol transmission and security to the things or devices.

- *Back End Data Sharing Model:*

This model represents the communication architecture which allows users to evaluate and transfer data from cloud services.

III. ARCHITECTURE OF IOT

The architecture of IoT generally comprises of these four layers[7]:
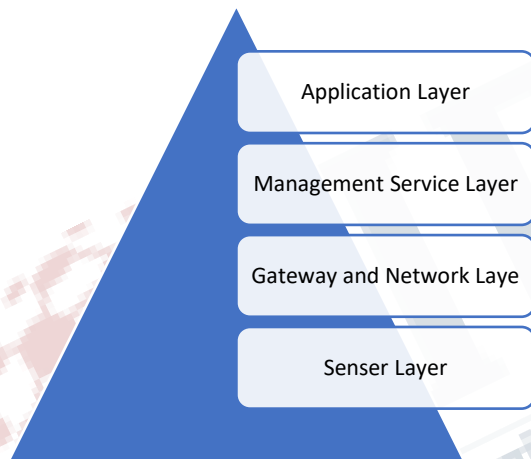

Fig 1. Architecture of IoT

A. Sensors Layer:

The sensors and actuators give the ability to emit, accept, and process signals. IoT embedded platforms can have sensors like infrared, gyroscopes, 2D bar code, etc. to gather information about the real-world object. The sensors are selected according to the requirement of the application. Each sensor has identification and information storage and collection process [7].

B. Gateway and Network Layer:

In this layer, data collected by sensors are transfer to the next layer. it should provide the standard protocols to transferring the data from different types of sensors nodes. The medium can be wireless or wire-based.

C. Management Service Layer:

This layer act as an interface between the gateway network and the application layer. The main responsibility of this layer is a device management and also accountable for capturing a large amount of raw data. Meaningful information is also extracted from the stored data or real-time data.

D. Application Layer:

Being a top most layer its main motive is to provide a user interface to access different applications by the users. The applications can be used in various domains like transportation, Health care, Agriculture, and many more.

IV. DIGITAL CAMPUS

Digital Campus is an educational resource and an important platform for students which provides e-Learning materials and provides students all kind of information. E-Learning is not confined with e-books with pdf, but also add on like e-media, interactive sessions for teaching. New technology has a great influence on the education center hence; there has been an increasing demand for smart campuses or digital campuses in the education sector. For the implementation of digital campus, a well designed physical campus and technology is required to implement the teaching, learning and research process. The primary objectives of any smart campus environment are learning, reasoning, and predicting. Digital campus classrooms can be an interactive platform for both students and teachers. Teachers can evaluate the best study guide for the students, and can also share the student's progress report to evaluate student's ability and making up their weaknesses. Students, on the other hand, can share notes through the cloud, they can also bookmark the particular note they wish to.

Digital campus, in general, will be a campus connected to the Internet, and hence there will be objects that will be converted to smart objects through IoT. The objects can be converted into smart objects through sensors. Although education is the primary objective of the smart campus but management can also not be neglected. The sensor-enabled street lights, parking, doors; classrooms can be a part of a smart campus. These sensor-enabled devices will work together continuously to make the lives of humans more comforting and education interesting.
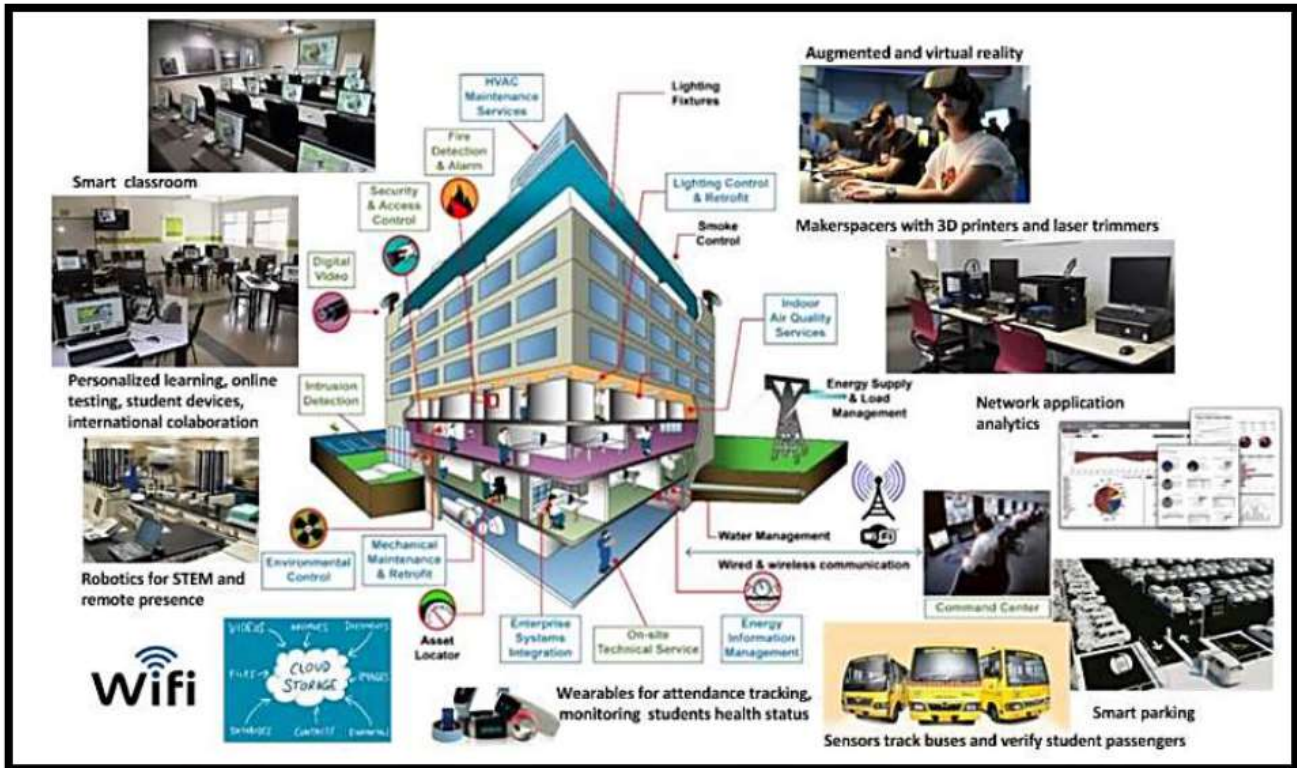
Fig 2: IoT Enabled Smart Campus [1]

With the usage of technology, physical campus become the smart campus and also enhances the functioning and services to the students, faculties and admin staff. The following are the differentiable points of the smart campus over traditional digital campus[2].

- *Save Cost and Time:*

By the implementation of IoT technology, the campus becomes smart by implementing the smart energy model and waste management. For example, sensors would control lights on the campus if there is no movement in the room of the campus.

- *Automate* Maintenance:

Sensors could attach to every electrical device of the campus for monitoring the devices and observed by the expert system. The team of maintenance would immediately notify the operation of devices and take appropriate action on time.

- *Efficient* Parking:

Lots of time of students and staff waste to search the parking lot in every working day. It is time-consuming, expensive and also creates traffic jams but this problem can be solved by implementing sensor technology in the

parking lot which would help to find the nearest parking lot.

- *Attendance* of Staff and Students:

The task of attendance in the campus is time consuming process. By the implementation of automated attendance in the campus though IoT technology save the time and also reduce the human error in the mark of attendance.

V.   BENEFITS OF SMART CAMPUS

The Internet plays an important role in the education system. Number of changes is done in the campus by the implementation of new technology like IoT. Number of IoT devices like interactive boards are utilized in the education domain and also the text is transferred digitally with the usages of smartphones. By the usage of these devices, students are easily interacting with educators, peers, and experts globally at their time slot by using these devices [1]. In the traditional campus, the traditional way is to take classes in an institute or university with face to face communication at the same time.x But with the implementation of technology in the education domain has modified the way of teaching and learning process and campus become the smart campus by adopting these new

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technologies [8].
Some of the advantages are listed as:

A. Smart Classroom:

Classroom Management is made easier with the introduction of IoT enabled classrooms in the college campus. The teacher can make the classroom more interesting and can know when the students are losing interest and when the level of concentration is decreasing. With this technology, we can design the smart classrooms. The few interactive devices that are used are:

- Interactive Whiteboards
- Tablets and Mobile devices
- 3-D Printers
- E-Books
- Student ID Cards
- Temperature Sensors
- Security Cameras and Video
- Room Temperature Sensors
- Electric Lighting and Maintenance
- Smart HVAC systems
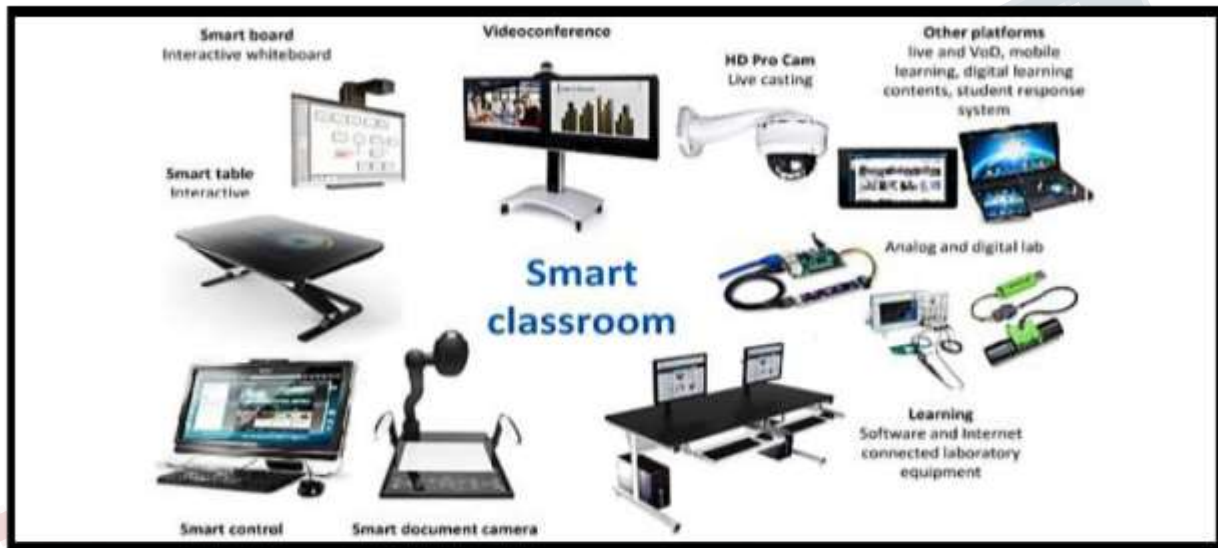- Attendance Tracking Systems
- Wireless door lock

Fig 3: Smart Classroom [1]

B. Smart Education:

With this technology education become smart education whose motive to provide better education to the learner. A smart education system creates a smart environment with smart pedagogies and supports the development of smart teachers and learners [14].
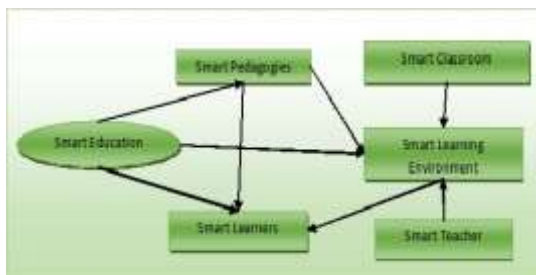

Fig 4: Smart Education

C. Smart Classroom Attendance System:

With the IoT enabled devices now there is no need for the teachers to take attendance. The attendance will be taken care of by the IoT enabled devices. There may be many different kinds of technology to take care of attendance with fewer chances of false attendance. The student will mark present only when he is in the classroom because it is based on Near Field Communication(NFS) technology in smartphones. NFC is wireless communication technology based on Radio Frequency Identification (RFID) which used the electromagnetic induction for the transfer of data [12]. The NFC based attendance system is easy to implement as compared to other attendance systems like biometric systems. Another feature of the NFC attendance system is simple and the speed of connection establishment is fast [13].

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Fig 4: NFC Based Attendance System Architecture [13]

Smart Laboratories:

With the usage of IoT devices in laboratories, students can perform remotely by connecting lab devices. To perform experiments remotely, students just need to log in to their accounts after selecting the required lab. Grades and assessment rules are stored in the system with the help of IoT devices and automatically provide to the students after completing the activity or experiment by the student. IoT devices also monitor the activity of students like, time is taken to complete the activity or experiment, the number of errors, and also a number of attempts to complete the task.
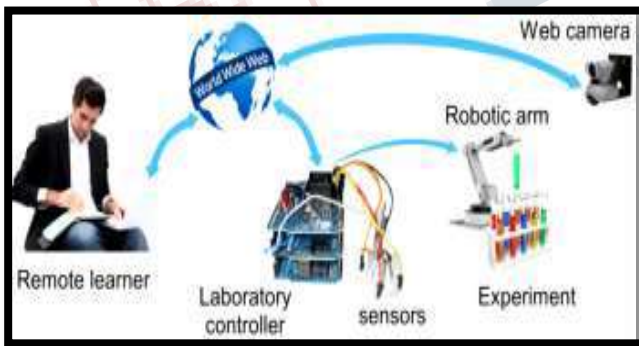

Fig 5: Smart Laboratories

D. Global Education:

IoT will allow the students to sit at home and experience all that has happened in the classroom. With the introduction of IoT in education, studies are not just restricted to the four walls of the classroom. The students can study more content than in their syllabus to acquire more knowledge of the subject they are interested in. With this technology, learners using the digital resource to interact the smart learning system globally and also provide the necessary guidance of learning, supportive tools in the right place, at the right time, and in the right form [14].

E. Energy Conservation:

The smart campus will have smart lights, smart thermostats, and smart meters to conserve energy. The temperature of the class will be regulated by these IoT enabled devices, hence saving energy. The air conditioner will work according to the specified temperature, and there will be a cut off when a certain temperature is maintained. The lights will be automated and will be switched off as soon as the students move out of the classroom.

F. Communication Technology:

Smart campus will help to improve the communication between staff, students, and parents by sending messages with centralized campus software. Any information reading admission process, fees dues, holidays, schedule of examinations, results, and events are manage and easily communicate with a smart communication system [16].

G. Safe Campus:

By the usage of CCTV, the smart campus becomes the safe place by recording the movement of students and staff in a campus area [16].

VI. IoT SMART EDUCATION MODEL

The functional model of IoT smart education mainly includes the four layers like:

A. Education Service Portal:

This layer provides the platform through which users or learners can interact with the smart campus. It includes E-learning, online resources like books, notes, and other kinds of data and also provides the online evaluation system. It also includes the administrator to control all these activities.

B. Education Cloud:

The education cloud is acting as the source center where all data of smart campus is stored and this data can be access from anywhere with the smart devices.

C. Campus Network:

This layer creates the network of all nodes of the campus with IoT devices like sensors which help to communicate these nodes with one another.

D. Smart Classrooms:

Simple classrooms are become smart classrooms after implementing IoT devices like sensors. Their main motive

is to collect the data and store that data on the education cloud that helps to provide the information to the nodes after processing on education cloud.
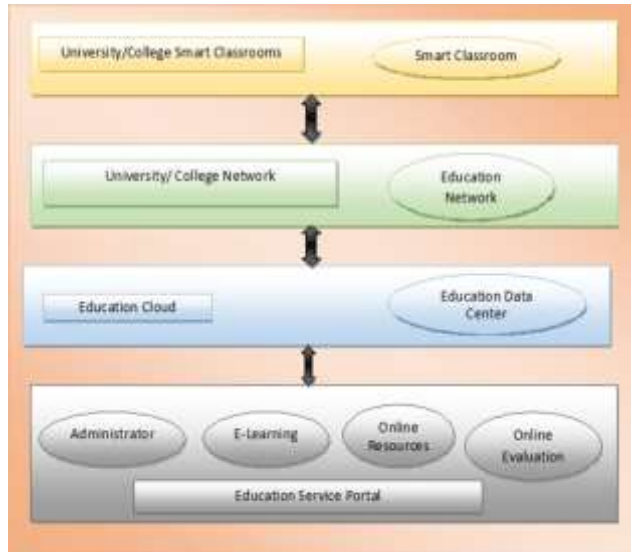

Fig 6: Functional model of IoT smart education(Kuppusamy, 2019)

VII.   CHALLENGES OF SMART CAMPUS

i   Security and Privacy:

Every day millions of data are exchanged using different channels in a smart campus which are vulnerable. These channels can be easily hacked and the privacy of the students will be compromised. Tracking devices like phones and cars will compromise privacy. The integration of visual features with voice recognition helps to regularly watch the activity and listen to conversations and transmit this data for processing on the cloud which sometimes takes the help of a third party.

ii   Standard Data Representation:

The standard data representation is the challenging task of IoT technology. So Smart campus need a semantic model based on standards whose main task is to represent the data in the standard way and also in an understandable format by all the members like students and staff of smart campus [15].

iii   Reliable Wi-Fi Connection:

For IoT enabled devices to work with full efficiency there is a need for a high-speed reliable Wi-Fi connection. The video lectures and the sensor devices are of no use if there is no high-speed network as they will not work otherwise. This makes it difficult for the management of the institute to handle such problems.

iv   Cost:

The cost of emerging technologies are continues to increase. The applications of emerging technologies are growing very fast. To develop an IoT based infrastructure separate strategy to be designed and identify the total cost along with the information technology as well as laboratory charges.

VIII.   IoT IN THE CLASSROOMS OF THE FUTURE

Around the world number of classes used IoT devices. In smart classes, sensors are used to increase student engagement and also help to provide real-time feedback. Implementation of IoT technology in the teaching field will enable us to fully remotely access physical education. Educators can use IoT technology to prepare lesson plans and also make teaching interesting. The benefit of IoT technology is clear in the education domain. But still, some hurdles are present for such innovations to present everywhere across the world. During the COVID-19 pandemic, the education system is facing the challenges globally to see how IoT technology overcome problems like social distancing and closed of educational institutes during this time. For the next-generation future, this technology creates the education system more effective, engaging, and inclusive.

IX.   CONCLUSION

By the implementation of emerging technology like IoT in the education domain, universities become the smart campus by removing the shortcomings like manage the essential records, access of information from anywhere and design safer campuses. IoT technology provides the significant changes for the staff and students and motivating them, hence, increasing the speed of learning. The motive of this research paper is to find out the scope of IoT technology in higher education as well as methods to maximize the benefits while putting forward the potential challenges and risks that implementation of IoT will encounter.

REFERENCES

[1]   R. S. Abd-Ali, S. A. Radhi, and Z. I. Rasool, "A survey: The role of the internet of things in the development of education," *Indones. J. Electr. Eng. Comput. Sci.*, vol. 19, no. 1, pp. 215–221, 2020, doi: 10.11591/ijeecs.v19.i1.pp215-221.

[2]   A. Abuarqoub *et al.*, "A survey on internet of things enabled smart campus applications," *ACM Int. Conf. Proceeding Ser.*, vol. Part F1305, no. July, 2017, doi: 10.1145/3102304.3109810.

[3]   P. Sethi and S. R. Sarangi, "Internet of Things:

Architectures, Protocols, and Applications," *J. Electr. Comput. Eng.*, vol. 2017, 2017, doi: 10.1155/2017/9324035.

[4] Y. B. Lin, L. K. Chen, M. Z. Shieh, Y. W. Lin, and T. H. Yen, "CampusTalk: IoT Devices and Their Interesting Features on Campus Applications," *IEEE Access*, vol. 6, no. c, pp. 26036–26046, 2018, doi: 10.1109/ACCESS.2018.2832222.

[5] M. R. . Veeramanickam and M. Mohanapriya, "IOT enabled Futures Smart Campus with effective E-Learning : i-Campus," *Int. J. Eng. Technol.*, vol. 2, no. 3, pp. 14–20, 2014, doi: 10.5176/2251-3701.

[6] M. D. Carolyn, "IAB Releases Guidelines for Internet-of-Things Developers – IETF Journal," 2015. .

[7] S. Naveen and S. Hegde, "Study of IoT: Understanding IoT Architecture, Applications, Issues and Challenges," *Int. J. Adv. Netw. Appl.*, no. January, pp. 477–482, 2016.

[8] W. Muhammad, N. B. Kurniawan, and S. Yazid, "Smart Campus Features, Technologies and Applications: SLR," *Icitsi*, 2017, doi: 10.1109/ICITSI.2017.8267975.

[9] P. Kuppusamy, "Smart Education Using Internet of Things Technology," no. May, pp. 385–412, 2019, doi: 10.4018/978-1-5225-8446-9.ch017.

[10] V. Subbarao, K. Srinivas, and R. S. Pavithr, "A survey on internet of things based smart, digital green and intelligent campus," *Proc. - 2019 4th Int. Conf. Internet Things Smart Innov. Usages, IoT-SIU 2019*, pp. 1–6, 2019, doi: 10.1109/IoT-SIU.2019.8777476.

[11] S. D. Nagowah, H. Ben Sta, and B. A. Gobin-Rahimbux, "Towards achieving semantic interoperability in an IoT-enabled smart campus," *5th IEEE Int. Smart Cities Conf. ISC2 2019*, pp. 593–598, 2019, doi: 10.1109/ISC246665.2019.9071694.

[12] Ambilkar, S., Hegonde, S., Therade, R., & Lingamwar, S. (2018). Smart Campus an Android and Web based Application using IoT and NFC Technology. 968–972

[13] Chew, C. B. (2015). Sensors-Enabled Smart Attendance Systems Using Nfc and Rfid Technologies. International Journal of New Computer Architectures and Their Applications, 5(1), 19–28. https://doi.org/10.17781/p001645

[14] Kuppusamy, P. (2019). Smart Education Using Internet of Things Technology. May, 385–412. https://doi.org/10.4018/978-1-5225-8446-9.ch017

[15] Nagowah, S. D., Sta, H. Ben, & Gobin-Rahimbux, B. A. (2019). Towards achieving semantic interoperability in an IoT-enabled smart campus. 5th

IEEE International Smart Cities Conference, ISC2 2019, 593–598. https://doi.org/10.1109/ISC246665.2019.9071694

[16] Subbarao, V., Srinivas, K., & Pavithr, R. S. (2019). A survey on internet of things based smart, digital green and intelligent campus. Proceedings - 2019 4th International Conference on Internet of Things: Smart Innovation and Usages, IoT-SIU 2019, 1–6. https://doi.org/10.1109/IoT-SIU.2019.8777476.