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Comprehensive Study For Upgrading Of Smart Campus In Polytechnic

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Abstract*—Today, cities and campuses share many of the common goals with objectives. They are trying to create services and applications that uplift the lives of citizens/students and keep them safer. And, they are seeking to stand out from the crowd by demonstrating ideas and innovations. "Smart Campus" can provide a stable foundation to enhance all of these goals. With the latest development of technology like 5G, Internet of Things and cloud computing, the conceiving of Smart Campus is going to be the trend setter for educational institutions. Within the city of Guwahati the interest for Smart Campus is slowly emerging. However, most institution are still laid back in implementing Smart Campus as part of their strategy and in developing performance indicators to track their progress in higher technical education. Guwahati as a Smart City can be a reality by making all the facilities in its administration smart. Technical institutions are one of the key growth pole in a Smart City which play a pivotal role in grooming students for a better tomorrow. Smart Campuses will give a platform various social challenges of technical education like low enrolment among female and other disadvantaged groups, access to institutions of higher education from remote villages. A Smart Campus with new experiences can position any institution as a state-of-the-art environment—the kind that students, faculties and staffs want to be part of it. It would also help the technical education of Assam in serving the institutional needs like improvement in the quality of technical education and greater impetus for excellence in skill development, resources for faculty development and student campus placement. The comprehensive study for the upgrading of Smart Campus in the framework of existing campuses could think of alternatives for positively impacting the student in the ways for a better socio-economic society for tomorrow. Based on our research we propose the concept of a Smart Campus that integrates new models of learning, smart sharing of resources and the use of buildings, security and energy efficiency. Furthermore it is advisable that the campus is in itself an object for study for students and faculties and Smart Campus should be made an integral part of the attitude of all stakeholders. The liveable Smart Campus concept provides a path that institutions in technical education can apply in developing their own strategy. Best alternatives are interacted and can be implemented across various polytechnics in the state thereby realizing not only a more ubiquitous environment but also changing the attitude that students and staff have towards sustainable development.

Keywords — Energy efficiency, Internet of Things Smart Campus, Smart City

1. INTRODUCTION

Smart Campus is an integrated campus environment of work, study and living based on the latest technology like internet of things, cloud computing and other information technologies. This environment uses different kinds of application service system as the facilitator and mingles teaching, science research, management and campus life together. What the perspective depicts is the ubiquitous network learning, the network research with innovation, the transparent and efficient management of institution matters, the vibrant campus culture and convenient campus life. In brief, the Smart Campus is to develop a secure, stable, environmental friendly and energy-efficient campus.

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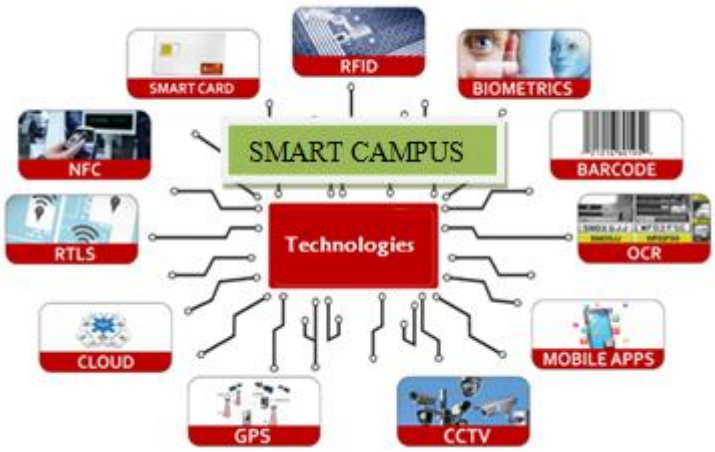
Guwahati is the gateway of North East India and it has connectivity to Singapore, Thailand, Bangladesh, Bhutan, Nepal and Myanmar. At par with leading South Asian institution, campuses in Guwahati can upgrade and transform its existing campuses with investment and exchange of students from other campuses. Students spend most of the time in campuses, and we believe that everything students do in early life deserves a Smart campus to prosper.

A Smart Campus is the appropriate platform for students to share and communicate with rest of the globe. If scope is given to students for development of skill sets and it can raise the bar of human resource index. Basic features possible in Smart Campus are**:** i) Security ii) Wi-Fi and internet connectivity iii) Smart lecture halls and labs iv) Energy efficiency connected to Smart Grid v) E–learning from a the whole world vi) Transparent feedback vii) Institution monitoring vii) A smart Green campus



This paper identifies a number of potentially interesting opportunities for smart campus in technical education, which will be referred to as the Smart Campus. These opportunities take into account the educational and training activities as the core activities of technical education, which can serve as ultimate driving force for campus upgrading

Fig 1: Features in Smart Campus in Guwahati. The Smart Campus concept encompasses many themes**:** Smart Learning and Smart Sharing in the field of education and research and Smart Buildings and Smart Transport in the operations of institute. The goal of this study is to gather input from various

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educational institutions and to provide a Smart Campus framework that will meet the needs of technical education and society at large in the near future.

2. SMART CAMPUS APPROACH

2.1 Objectives

Objectives of Smart Campus define strategies to attain the identified short term and long term goals.

i) Ingrain the use of smart technology into daily life of the Campus, providing an opportunity for the development and application of technology to support a Smart Campus.

ii) Integrate an enhanced process focussed on security, transport, energy and environment.

iii) Provide world class facilities and enabling nationally and internationally featuring smart technologies for campus staff and students.

2.2 Short term goals for near future

1. Digital Lecture hall for every department in the institute.
2. All the department to be connected to a unified network platform.
3. Development to be followed up, existing facilities like MOOCs in Swayam, ICT Academy in the campus for all branches to be used, recorded lectures should be made available for reference.
4. Data of Students and Faculties to be extracted and stored in a common central repository.
5 Students, staff, should get equal access to internet facilities.
6. Students and Staff should be empowered with appropriate devices to access endowment..

2.3 Long Term goals to be accomplished in the future

1 .Acceptable infrastructure allocation, integrating campuses.

2. Smart Intelligent lecture halls, Carbon neutral campus, Remote labs, Video Consultation, and Virtual environment.

3. METHODOLOGY

This study in upgrading Smart campus in polytechnic targeted on introducing new age concept in technical education system, to make it compatible with the need of society and National Board of Accreditation (NBA). And the need of the hour is to restructure the technical education system as a entity. “Smart Campus” is the image which accomplishes the need of modern technical education structure.

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The approach applied in the study are as follows**:**

1. For pursuing the aim of the study, following aspects/sectors are shortlisted for improvement.

● Network/Internet connectivity ● Lecture halls ● Campus Security system ● Institute library

● Parking facilities ● Power supply and water supply

2. Specific data related to current status of polytechnic

3. Outcome review of the aspects is set.

4. Detailed program for upgrading Smart Campus is prepared with solutions to implement the above aspects.

4. STUDY SITE

Recent study is undertaken to upgrade the residential campus of PCPS Girls' Polytechnic as a Smart Campus at Guwahati. Girls' Polytechnic was established in year 1964 by government of Assam. The campus is spread over 15.70 acres of land in Guwahati city. In this comprehensive study the effort is made to upgrade the Campus Smart by providing some latest technologies so that campus can be compared to other well-known higher level technical institute.

Existing status of polytechnic with respect to the above mentioned aspects is mentioned below:-

● Network/Internet connectivity -The existing campus uses a free internet service provided by AMTRON, broadband above 75 mbps. And this service is limited to Principal, HOD and to few computer labs. Hostels and other faculties are not accessible to this service. And there is no corresponding network management system for the wireless network as there is for the wired network. Students and faculties rely on their personal Jio router for internet connectivity. As smart phone are barred in the labs and classrooms hot spot is impossible. Challenges are coverage capacity, density, and security which need to be explored.

● Identity Card- At present all the daily activities in campus such as issuing of books, transaction of fees, payment are monotonous and time consuming processes. Students need to produce different cards for library, hostel mess, book bank for SC and ST students, institution identification and fees payment. Biometrics attendance is mandatory for teaching faculties only. Therefore, it is essential to construct a centralized platform with one unique card and one security number for all the transactions within the campus.

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● Lecture halls - Few of the Lecture halls/ classrooms has smart boards, projectors and most of the classroom has a traditional settings. Along with the inferior quality of furniture there is no provision of projector and CCTV cameras are installed in the corridors and exit and entry points. Method of attendance recorded is simply by circulating an attendance sheet provided by the institute.

●Institutional Library - Digitized system is not completed at present in library which will be helpful to keep a record of books and journals. There is a lack of proper security arrangements and mobile access to library resources. SOUL library automation system is in the pipe line and only data entry has been completed so far.

● Campus Security system - Non availability electronic access control anyone can security breach the entrance without authorization from the principal's office. Polytechnic is next to a slum area and during rush hours point of entry increases stress over the securities for proper monitoring. CCTV cameras are available in the entrance and back yard. And less control on girls hostels because of poor surveillance system. Hostel and lower grade quarters of railways which is in dilapidated condition share a common boundary wall. Hence the hostel is vulnerable to thefts and intruders. Due to the absence of CCTV cameras in all critical spots, which is a crucial component of campus emergency, it becomes difficult to make a judgement of the condition.

● Parking facilities - Existing parking where the students park their vehicle is not in proper shape. The staff parking for institute is somewhat satisfactory with limited parking as it based on reserved parking system but the main parking area of this campus needs modification. Visitors and others from nearby campus park their vehicle without any hesitation.

● Water and power supply System- Deep tube wells are used for water supply and traditional practices for water storage, usage, watering lawns, trees etc. which causes of water loss through faulty devices, obsolete infrastructure. Depletion of ground water in the campus is due to lack of rain water harvesting. Presently direct electric supply from substation through overhead transmission lines. There is absence of permanent power backup for computer labs, departments and residential zone and single phase supply to some buildings in campus. ● Solar power - Solar panels are fixed on the roof of workshop and supplies

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power to hostel and corridors of workshop for few hours during power break down. Wind energy is not yet explored.

● Endangered species –

This campus used to be the nesting ground for the Greater Adjutant stork the most endangered stork of the world in the heart of Guwahati city.These rare species with largest colony in Assam used to attract many foreign visitors in the campus. But recently they have shifted their ground due to reduction of wetlands and landfill in the campus.

Fig 2: Flock of Adjutant Stork in the campus

5. SMART INNOVATIONS WITH POSSIBLE SOLUTIONS

Including smart technologies, current study is initiated to upgrade the campus of PCPS Girls' Polytechnic as a smart campus. To change the campus smart distinct aspects/sectors are shortlisted for improvement. The distinct sectors with respective improving possible solutions identified are as follows**:**

5.1 Facilities for Internet connectivity

Wireless networking:- Wireless networking refers to technology that enables many computers to communicate using standard network protocols, but without network cabling. The wireless routers work on the principle of radio wave. Many devices can be connected with one router. Therefore it is constructive to use wireless routers for internet connections.

5.2 Implementation of e lecture halls

Digital lecture hall:- Digital lecture hall (Fig 3) is an looming concept in Smart Campus. It is mostly used by the educational institute which allows the teachers and students to use lecture halls in a collaborative way.

Digital lecture halls are well equipped with**:**

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i)Interactive smart board ii) smart board with touch screen and wireless keyboard iii) smart board pen tray and joystick iv)smart board notebook sample v) Interactive projector. vi) Wireless microphone vii) Digital podium viii) Wireless access point

Fig 3: Smart board

5.3 Arrangement of Smart Library

● PCPS Girls' Polytechnic can register in the NDL (National digital library) for sharing knowledge which is a repository for learning media. Library RFID Management System:- Role introduces a fair crunch for librarians. This technology grants improved services for of Librarian RFID technology (Fig 4) users in the area of self check out, it allows more efficient use of professional staff, and may efficient use of professional staff, and may reduce repetitive works for library personals RFID tag can contain identifying information. This information is read by

Fig 4: Library RFID Management System

5.4 Implementation of smart cards

● Smart card can provide personal identification, authentication, data storage.The phrase "smart access cards" in education system embraces a wide range of technologies.

Multi-component cards -This card is for a specific solution. These cards where fingerprint sensor is built on the card. One institute can built a card that generates a OTP and displays the data for online transaction.

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▪ Smart access cards with RFID (Radio Frequency Identification) Technology - The common feature of most contactless, proximity based solutions relies on embedded high-frequency RFID technology. Education access-card applications can benefit from RFID's long-read range and fast identification capabilities without physical contact. Institute can eliminate single-file, one-at-a-time card reads. Groups of students can travel through large, open entry and exit points, rather than having to pass through narrow doorways or gates. Secured ID cards made from durable materials can last the entire duration of a student's education—saving the institution the recurring operational costs and time of annual card renewal.

5.5 Smart Campus security and safety

● Entry Control Management:-The entry control reader technology can vary from entry level proximity readers to high security smart card technology or biometrics verification solutions. Features such as assigning a special VIP status, supervisor cards and limiting the number of times a card is used provides enhanced security if needed

● CCTV / Video surveillance

Power source is available on Smart Campus and can provide a smart IP video camera with megapixels sensor and use wireless meshing links to connect it. Using smart lighting and hybrid poles for power and for cameras. Provision of video surveillance to places where it was not explored, including green areas around hundreds of meters from the central network.

Video intercoms for screening and eliminating outsiders- A video intercom system allows staff to view and speak with visitors before allowing them into the secured campus. By delineating a visitor's identity before opening the door, staff can avoid face-to face encounter with unwanted element in case of discrepancy.

● Smart locks and access control

Connected locks makes it simple to control individual has access to buildings on campus. Combine them with other Smart Campus systems—Smart ID card readers, video surveillance, boundary controls—and it can be closely monitor everyone entering and leaving the premises at times. User behaviour-based alarms to alert campus security if someone tries to enter a building during odd hours or even if a door has been kept open. In hostels, verify that everyone is an occupant.

• GSM (Global system for mobile) Communication

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GSM is an open and digital cellular system used for transmitting mobile voice and data services is controlled by a microcontroller with real time clock. It gathers information from the sensors, makes a decision and sends SMS to receiver by using a GSM modem. If any detection of intrusion in its sensors (Passive infrared or IR) then microcontroller will send a SMS thus alerting the users against security risk.

5.6 Facility for electricity and water supply

- The electric supply to the campus will be from ASEB (Assam State Electricity Board) should be through underground cable distribution network as it is the convenient source of supply.
- For internal street network and landscaping in the campus solar street lamps can be provided, which will further reduce electric utility bills.
- During non working hours the power supply will be from solar panels to the campus street network. And fix more solar panels in the roof of hostel and academic building facing south west for more renewable power supply.
- The water level automation system will be provided to each pump unit and overhead storage tanks for each zone and can regulate and stop over flow.
- Drip water supply system can save water and nutrients. In system this water goes directly to roots for trees and shrubs in a row for dry areas.
- Sprinkler system can apply water in controlled manner like the rainfall for lawns in polytechnic campus and replace manual water jets by automatic faucet.

5.7 Smart Green Campus

Implementation of sustainability in campus settings is driven not only by the urgent need to address climate change and contribute to healthier communities, but also to deal with limited resources and socially responsible practices.

- Integrate micro vertical wind turbine to supply power.● Introduce wind trees in landscaping to generate power.● Embed rainwater harvesting for future.● Reduce, reuse, recycle for sustainability. ● Green roofs opportunities, vertical gardens and brown field for future expansion. Use indigenous materials and native plants.● Introduce Mass Rapid Transport.
- The Greater Adjutant Stork as first priority species for conservation. Update campaigns and research facilities in institute website for fund raising.

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5.8 Initiation of smart parking facilities

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Automated car parking System - Automated parking System (Fig.5).with automatic number plate recognition (ANPR) also licence plate recognition (LPR) and WIFI based automatic space booking is a ticket less car parking system for user convenience. Automatic Parking system and

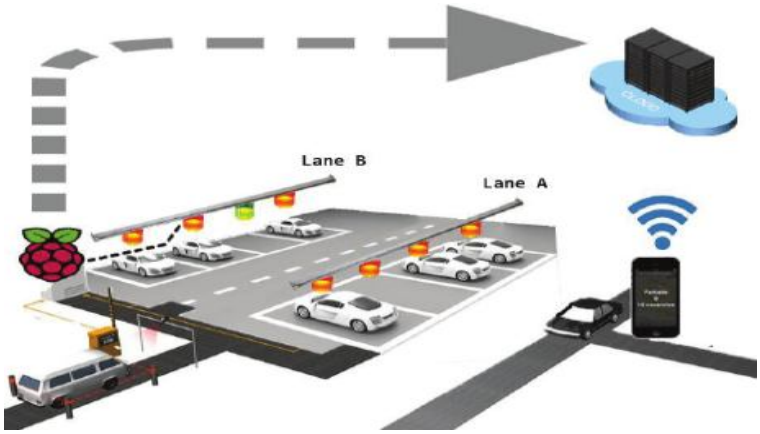

Fig.5 Automated parking system

fee collection based on number plate can generate revenue for the polytechnic. Recognition is a best possible alternative for the existing problem experienced by the staff and students. With the implementation of the proposed system of smart parking, campus will achieve Smart Parking Allocation Centre and better parking fee collection for the polytechnic campus

6. PERFORMANCE REVIEW

To apply various new technologies at campus the existing facilities has been carefully studied and analyzed to understand the lacuna of the existing system and future scope of modern technology. The distinctive attributes and their compatibility for the polytechnic campus possible intervention and effective output to be fulfilled with application of the selected system in the form of performance review at glance discussed as follows.

6.1 Internet Connectivity everywhere and any where

Accomplishment of wireless routers- The wireless 4G router provides centralized Internet access with modern technology. It provides better network protection against hackers and consist of tight security protocols. The 4G router acts as Wi-Fi hotspot, thereby allowing you to connect your phones laptops, computers, tablets, etc. to the router. The latest JioFi cost Rs 1,799 /-(Speed 150 Mbps), Airtel 4G

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Hotspot router cost approx. Rs 2,599/-.(Speed 150 Mbps) and can connect ten 4G devices. The Jio Fibre broadband router cost Rs 2500 for installation with speed of 100 Mbps for multiple connecting devices and with set of box is the key to smart services and allows few free international calls and many educational TV channels.

6.2 E-classroom

Accomplishment of Digital lecture halls- Learning through the use of internet of smart class, software is helpful to stay up to date on the trends and innovation. The E – classroom allows us to reach education goals more effectively. Students and teachers can upgrade quality improvement at any time. Brain storming 3D-videos will help the students to recap the topics and perform better in their subjects. Digitations will bridge gap between students and teachers and ultimately adapt to changing needs for creating perfect places around the campus.

6.3 Smart Library

After adaptation of the library automation system with selected technology campus will achieve, tags which will replace both traditional security systems and bar code. With wireless technology, it can update inventory and indentify items. RIFD system has the ability to scan books on no time and highly reliable and create a "smart library". Automatic book sorting and material handling will reduce time for staff. All members will simply self check- in/ check-out. For improvement suggested technology the institute has to design a database management space for networking and the skilled maintenance.

6.4 Smart ID Card/ Smart payment

Identity cards that are Smart can deliver as, library card, parking card and debit cards for cashless transaction. Smart cards also allow students to pay for stationeries and coffees from vending machines. To empower the students latest ID, the institute has to adopt for RFID short range wireless connectivity technology which will help to mange the smartcard a way to security store data on the card and protect communication.

6.5 Intelligent Security System

Using the suggested technology institute will provide, safety and security of the students, staff and visitors. Secured environment will have complete control over the students and SMS or alarm to user in case

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emergency. Utilising video intercoms in the entrance for visitor screening and after identification of the visitor will be allowed in the polytechnic campus.

6.6 Sustained water and Electricity Supply

After application of proposed solution, the campus will fulfil maintenance of required water level in the over head water tank. Automated water level sensing and microcontroller cost is around Rs 5500 (Osmium green) can be installed in every zone of the campus. Proper utilisation of water resources, zero water wastage due to overflowing and with scope of sufficient rainwater harvesting there is very less chances of water scarcity in the campus. Ultimately enhancing life span and durability of pumps, valves,pipes and other appliances. With the implementation of solution like solar and wind power connected to campus power grid as backup power supply. Sustained water supply and electric supply will support a liveable campus, internet connectivity in campus, surveillance, smart parking, smart library, distant learning are such smarter actions to mentioned.

6.7 Initiation of smart parking facilities

Execution of the proposed system of smart parking, campus will achieve Smart Parking Allotment (Fig.6).maximum utilization of resources and assets, control haphazard parking and improve factor of safety will be fulfilled with latest smart parking system. Indicator and alertness of slot or automobile occupancy in real-time Smart Parking will better empower and real- time will be feasible in the parking lot. Monitoring and disbursement of available parking slot resulting in lucrative solution. Auxiliary revenue can be generated from visitors as there is ample

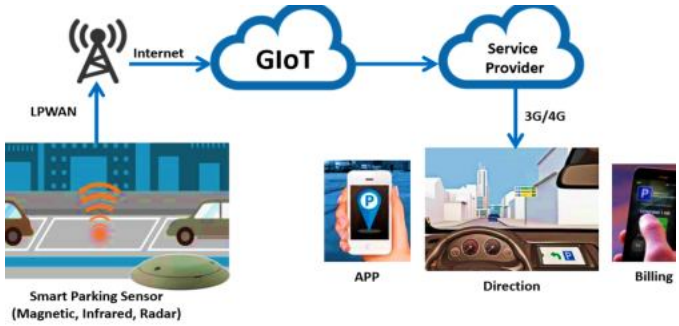

Fig.6. Smart Parking with sensor

For parking and it will provide a device to optimize manpower utilisation and wirelessly pay for parking for parking.

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6.8 Smart Campus learning

Girls' Polytechnic takes great pride in their past traditions, but the last decade has seen many changes to campus learning

Implementation of Smart Campus can adjust to these changes—building on one-to-one and now many-to-one computing devices per student to implement new teaching and learning methods. With students, devices and applications all connecting over the same ubiquitous technology infrastructure, a Smart Campus can redefine lecture halls, collaborative workspaces and even learning itself.

● Distance Learning

On a Smart Campus, students, faculty and administrators no longer need to worry about space constraints, location or weather. Distance learning using video collaborative tools to start up classes for students anywhere in the campus.

● Lecture Capture

Implementation of Smart Campus technologies in the campus of Girls' polytechnic gives freedom to students and faculty from the constraints of physical space, they will allow more flexibility in the Polytechnic. There is possibility of recording and archiving lectures, when student miss out classes due to health condition —or wants to review before exam —every second of lecture can be streamed with a click of a mouse.

6.9 Smart Campus living applications

● Building Automation

Connecting, air conditioning, ventilation and safety equipment in the present campus. Reduce power consumption while making buildings more responsive to the people living, working and learning in them. Linking building control sensors with analytics and location-based services to capture new insights about how people use the space— and make this a better investment and renovation decisions for the campus.

● Smart Lighting

Collect information on parameters such as motion and luminous flux in the campus. Using this information in real time to turn on or off, dim or brighten, or even adjust colour of indoor and outdoor lighting fixtures to reduce energy consumption and improve safety. Automated buildings with sensor and other green initiatives can save up to 60% of energy which can reduce utility bills for Smart campus.

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7. CONCLUSION

The objective to generate a smart campus with sustainable grounds may fuel many opportunities to innovative design, technology development, critical thinking and problem solving. Smart campuses should operate with fewer resources and promote socially responsible practices. Additionally, Smart Campuses should integrate cutting-edge technology not only to operate campus components, but also to provide the most efficient and intelligent systems to support research and teaching endeavours.

An effort to make the campus of PCPS Girls' Polytechnic as "Smart, various system technologies were proposed for implementation. With the thoughtful consideration of the constraint it was decided to upgrade the present instrumental/ technological infrastructure. With the adoption of Wi-Fi technology and IoT student, staff and visitors will be able to experience high speed, uninterrupted connectivity throughout the day. Introduction of e-classroom concept will revolutionise change in the traditional chalk and board system of teaching and learning. Students will have exposure to the latest and updated development.

By making the existing library "Smart" and using NDL e bulk of information available throughout the world will be accessible student at ease. Student staff and occupants of the institute will poses a 'Smart' Card which will provide access to use the services offered by library, parking, canteen, cooperative store and polytechnic office. This smart cards will also provide identity to the student along with acting as credit card which will reduce the burden of cash transaction and step forwards towards Digital India Campaign.The need of security is must within and around the campus to be 'Smart' as such system was proposed to be implemented within the campus to make the campus secured from intruders. Unorganized parking of vehicle within the campus stressed the need of parking system to be smarter which will support the Smart Campus. Thus, with the implementation above technologies it is expected that there will be a great sophistication in the comfort of staff and student of the institute along with great improvement in teaching, learning process. Teaching initiatives should be inclined towards a Smart Campus and with the overall goal to inculcate ideas and enhance the learning experience enjoyable for students. And everyone committed to generate and analyze accurate, real-time operation.

Technology is the only edge in today's world to progress and we should not fall behind. In order to maintain and enhance this, we need Smart Campuses to attract students and visitors. The framework

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proposed in this paper can help in aligning existing initiatives and transforming campus from conventional to contemporary Smart Campus

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