IoT Based Smart, Digital and Green Campus

Khaja Saif Uddin[1], Mohammed Arshan Ahmed[2], Shaikh Adnan[3], S.MD. Mazhar-ul-haq[4]
[1,2,3]*UG Scholar, ISL Engineering College, Hyderabad*
[4]*Assistant Professor, ISL Engineering College, Hyderabad*

***Abstract*— The global web is a revolutionary innovation; it continually grows through new types of software and computing devices, making it fascinating to anybody. IoT may be defined as a cloud-based global neural network that links numerous items. IoT offers machine-to-machine connection. The Internet of Things (IoT) is an infrastructure that consists of numerous smart linked devices and networks that collaborate and connect to various technological devices, surroundings, assets, and frameworks. The Internet of Things has a significant impact on education as well as in fields such as trade, conveyance, medicine, power generation, farming, and more. A college or university campus is a perfect setting for the development of an environment that is smart. The purpose of this article is to introduce a novel idea known as Smart Campus by offering a comprehensive summary of IoT devices and reviewing the technologies that support them including sensor networks.**

***Index Terms*— Internet of Things, Smart campus, Super sensors, Wireless sensor node.**

I. INTRODUCTION

The concept of sustainability analysis is expanding beyond the realm of the natural world to the social, financial, and academic zones. Campus sustainability is very crucial as an integral aspect of the community. Yet, many educational institutions today confront issues such as excessive resource usage, excessive use of energy, and considerable adverse environmental effects. For instance, in China, the average water intake for each student, as well as typical power usage, is significantly higher compared to the global average threshold, and elementary and middle schools use up almost fifteen percent of the overall urban residential water usage, whereas university power usage makes up roughly five percent of overall nation-wide energy usage, along with this percentage steadily rising. As a required solution to this challenge, an environmentally conscious campus has emerged as an urgent concern in the area of environmental sustainability. The existing green campus assessment process is still plagued by confusing assessment criteria as well as an absence of authorized standards, promotes qualitative assessment over quantitative assessment, and requires quantitative assessment. The green campus of elementary and middle schools is used as the study objective in this work, and a smart assessment system is built using the issues they face in sustainable growth as the basis for analysis. As a result, statistical analysis and assessment are finished. The long-term viability of the university campus as an interpersonal component, as well as its assessment, is critical for advancing the overall sustainability of the entire community.

The German Good Company introduced the Sustainable Pathways Toolkit, which offers an in-depth assessment of various elements like water and energy resources, reuse of gadgets or paper, the environment upkeep, mankind improving, safeguarding the environment, and air quality in the workplace, while it does not have a system for evaluating performance, making intercampus evaluations tough and the metrics for assessment are broad but hard to categorize.

The University Leaders for a Sustainable Future assessment tool, the Sustainability Evaluation Questionnaire, addresses the environment-related curriculum, educational outcomes, working and administration, faculty and staff guidance, welfare programs, student involvement, ecological campaigning, accountability, along with organizing for sustainable growth, however, the assessment outcomes are only indicative of the institution's relative sustainability.

The Green Building Council of China issued three distinct kinds of metrics for assessment: regulatory products, universal supplies, and outstanding commodities, which examine green Universities in 7 features: land conserving, power, water supplies, material assets, leadership, execution, schooling, and exposure. There are additional issues, which include the addition of new criteria and a challenge in conducting an assessment. According to the analysis above, existing sustainable campus assessment methodologies are geared towards qualitative and analytical assessment, making interschool comparisons challenging, and have restricted use and scope. As a result, the purpose of this study is to build on the existing assessment structure, create an environment-friendly campus evaluation index framework from the standpoint of environment-friendly growth, and undertake assessment research utilizing quantitative approaches. Furthermore, the assessing techniques employed in modern studies on sustainability evaluations are primarily hierarchical evaluation, fuzzy comprehensive assessment, gray method of assessment, the optimal approach, and furthermore. These methodologies are heavily impacted by subjective considerations and are unable to completely ensure the neutrality of the green campus ecological evaluation process and findings. Practical evaluation techniques often fail to provide multiple weights for various evaluation targets and simply analyze the amount of fluctuation of variables in the index as a whole along with their level of effect on the remaining indicators. As a result, the purpose of this work is to present the self-education-based complete assessment approach, which is one of the utilization of self-learning strategies in assessment. Its benefits include the fact that the system doesn't necessitate human interaction and may totally eliminate human error.

ANFIS built around DBN not just harnesses the adaptive and self-learning power of neural networks, but additionally provides neural network nodes and weights the obvious real-world significance. DBN is based on the rear distribution for mathematical inference, whereas ever-changing Bayesian prediction for ANFIS allows one to concentrate on the probability spectrum of the whole variable distance, automatically modify the dimension of the regularization factors throughout network development, and optimize the regularization factors. This as well potentially improves the durability and adaptation capabilities of ANFIS systems, resulting in a more precise prediction model.

A. Objective

This work seeks to build a comprehensive and empirical evaluation index system using the viewpoint of environmental sustainability, and it uses the ANFIS upgraded by DBN to assess a smart campus. The goal is to create a smart campus evaluation index system based on environmental sustainability, with four aspects: campus resource consumption, campus environment development, building usage administration, and campus ecological effectiveness.

II. LITERATURE SURVEY

[1] The authors outline a method for creating a single-board computer-based network of sensors that spans the entire college campus. For diverse university stakeholders, we provide a variety of applications for data from environmental sensors. Our main assumption is that more adaptable data gathering, analyzing, and response are made possible by super sensors—sensors with high computational capabilities. This study presents the first super sensor network model installation of theirs in just one department of the University of Glasgow.

[2] Here, a Wi-Fi wireless infrastructure with a built-in Linux web host is used for making industries and buildings fully automated, and it is integrated with a network of sensor nodes. The IEEE 802.11n standard is employed in this framework, which focuses on creating an inexpensive Wi-Fi-based WSN powered by the ESP8266. Many current WSNs are built using RF & ZigBee technology. The sensing devices are at the bottom of the system's hierarchical order, followed by actuators and supervising nodes, which are at the middle and top. The manager may respond actively or passively. It is demonstrated that the system allows for any possible device failure situation. If necessary, the management team is able to supervise all of the controllers' supervisory workload. With the help of an ARM Linux developer board and Apache+PHP+SQLite3, an integrated platform capable of offering a Linux-based server, and database structure, including a PHP execution environment was created. Wi-Fi technology was used to provide a variety of Internet connections. The WSN's core computer, the Raspberry Pi, links the sensor node via Wi-Fi, gathers sensor information from various sensing devices, and provides multi-client solutions, involving data presentation, using an embedded Linux-based Web-Server.

[3] Since nearly every process is now automated and replaced the old processes that were manual. During this modern era of digitalization and robotics, everyday life is becoming easier. Modern individuals

have incorporated the internet into their daily lives to the point that they are inefficient without it. The Internet of Things offers a foundation that enables connections, remote sensing, and distant management of objects over a networking architecture. This study focuses on house monitoring via computers and smart phones. The digital, electrical, and mechanical components utilized in a variety of buildings are controlled and monitored by IoT devices. One administrator facilitates several users who are linked to numerous sensors and controller nodes while controlling the devices linked to the cloud platform. A single user is able to govern only those nodes to which they are linked; however, the administrator holds access to and authority over all of the nodes linked to every user. Employing the Internet of Things, a full network of computers and mobile devices will eventually be able to remotely manage all the attributes and activities of household electronic devices from any place in the globe. The setup is cost-effective and expandable since it enables connectivity and management of several electronic devices.

[4] There has been a lot to explore in the field of Internet of Things. Over the past few years, a lot of academic findings have been presented. The definitions employed in the works of literature, however, are not entirely clear. The concepts of smart sensors, smart devices, and "things" in the Internet of Things are contrasted in this paper.

[5] The Internet of Things is going to impact every need, task, and thing concerning the most simple to the most intricate and perhaps even people like us, since the global web remains one of the biggest human inventions. The Internet of Things will certainly have a significant impact on educational institutions in addition to industries like commerce, shipping, power, healthcare, the agricultural sector, and many. A college campus can be the best location to develop a smart environment. The purpose of the following article is to discuss a novel idea known as the Smart University, beginning with requirements and benefits then concluding with a potential design built around artificial intelligence.

III. PROPOSED METHODOLOGY

A. Evaluation Index System Construction

In accordance with the prevailing green campus evaluation index system, the viewpoint of ecological sustainability creates a comparatively flawless assessment procedure for the following sustainable growth of eco-friendly campuses from various starting locations In accordance with the prevailing green campus evaluation index system, the viewpoint of ecological sustainability creates a comparatively flawless assessment procedure for the following sustainable growth of eco-friendly campuses from various starting locations. The four levels of assessment indicators regarding green campus evaluation according to the concept of sustainable development have been analyzed and arranged. The ecological campus assessment indicators framework presented in this work relies on the concept of sustainable growth, accompanied by the details of other important and sophisticated evaluation systems. The present article will provide a more thorough introduction to each tier's assessment indexes.

B. Campus Resource Utilization Indicators

The campus resource utilization index is separated into 3 main sections: the utilization of natural resources, the utilization of energy, as well as utilization of materials. Figure 1 displays the segmented indices. The utilization of natural resources has been split into the use of land resources and the use of water resources; the utilization of energy is split into the use of energy generated from renewable sources, energy-efficient devices, and buildings; and the use of materials is grouped into the use of materials for campus activities and the use of decorations.

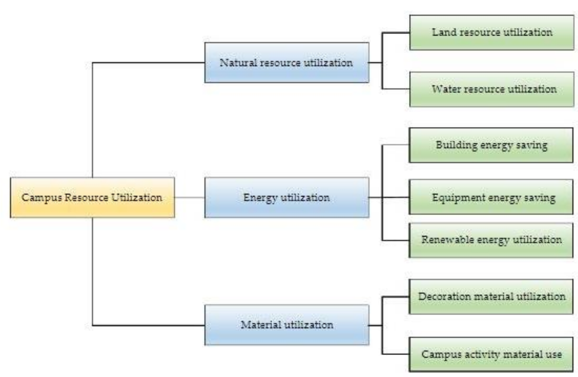

Figure 1: Campus resource utilization

The use of land resources, both above- & below-ground areas, is decided throughout the campus design procedure in accordance with appropriate rules and regulations. The dimensions of the above- and below-ground levels, total volume proportion, maximum parking spots, structure thickness, greenery proportion, and so forth are the primary financial metrics of the construction site that was identified. A significant portion of the final operations in the university initiative's building phase includes the usage of water supplies. Managing the amount and supply of water usage, water pipes, and water supplies tools, among others is more important in the planning phase assessment. The advantages of water availability in university activities are the preservation and appropriate revitalization of water-based supplies once the building process is finished, which includes assessing the impact of water machinery, making prudent utilization of non-municipal water, and primarily through the continual installation of water conservation equipment, renewing water supply of campus greenery using rainfall water.

C. Block diagram and working principle

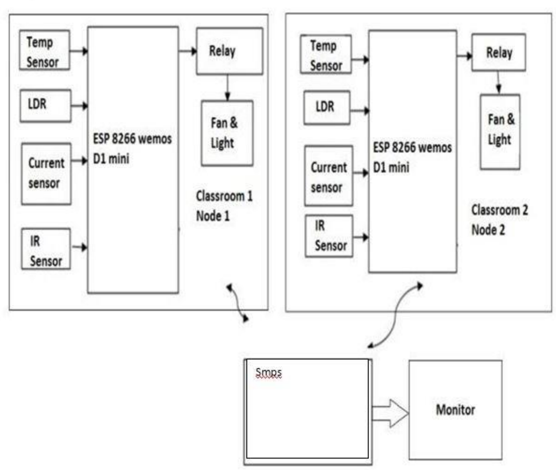

Figure 2: Block diagram for smart campus implementation

DHT11 sensors are used on smart campuses to regulate temperature levels in school rooms. Full information about the classes is maintained on a web-based server employing Adafruit API credentials. The LDR detector is connected as well to a Uno Arduino board in order to measure the brightness level of the classrooms. Additionally, the overall number of people coming inside each class is tallied with the help of an infrared detector. A pair of nodes with Arduino Uno & Nodemcu devices is used to replicate the work in two classes with online access.

IV. EXPERIMENTAL RESULTS

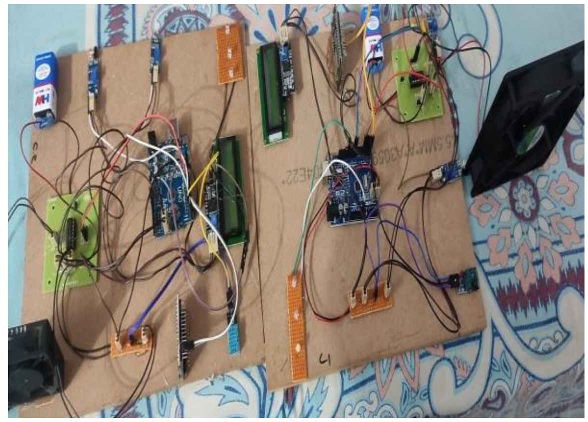

Figure 3: Experimental setup for smart campus

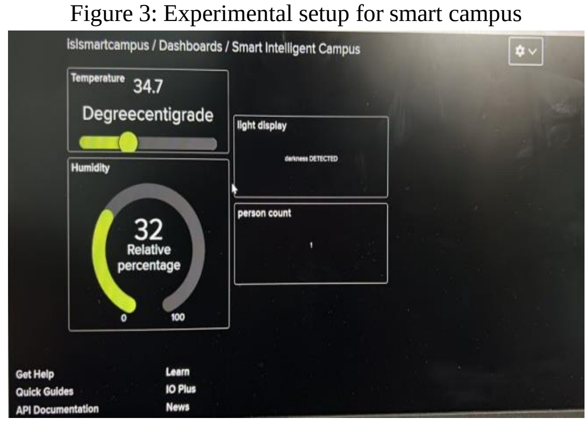

Figure 4: Adafruit server for wireless connectivity

V. CONCLUSION

Develops an intelligent evaluation method based on ANFIS, and the parameters of the ANFIS model are optimized based on DBN, so as to establish an intelligent evaluation model based on DBN-ANFIS and apply it to the evaluation of green campus with the Spark big data running platform.

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