STM JOURNALS

International Journal of
Optical Innovations & Research

Volume 2, Issue 2, 2024
July–December
DOI (Journal): 10.37591/IJOIR

https://journals.stmjournals.com/ijoir

Review IJOIR

CampusX: Empowering College Selection with 3D Insights Using Machine Learning Approach

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Abstract

CampusX redefines college selection with dynamic 3D insights, empowering students to navigate campuses virtually. Utilizing cutting-edge machine learning and visualization techniques, it transforms static data into interactive experiences. Personalized comparisons enable informed decision-making, while predictive analytics forecast future campus developments. With a user-centric interface and robust privacy protocols, CampusX ensures seamless exploration and data security. This innovative platform bridges the gap between prospective students and their ideal educational environments, revolutionizing the higher education landscape. One of the most important choices a student will ever make in the fast-paced world of today is which institution to attend. The decision-making process might be daunting because there are thousands of universities across the globe, each with unique facilities, curricula, and cultures. Presenting CampusX, a ground-breaking tool that uses immersive 3D and machine intelligence to enable students and their families to make better college decisions. Students may more easily visualise and compare universities using CampusX's comprehensive overview, which blends data-driven insights with interactive 3D models of campuses. By incorporating a machine learning technique that examines a wide range of variables, from academic performance and campus amenities to social life and job placement statistics, CampusX aims to overcome the challenges associated with college selection. By using 3D visualisations, it provides an immersive experience that makes campuses come to life, going beyond still photos or written descriptions. Students may evaluate their compatibility with potential schools more easily thanks to this comprehensive approach, which gives them a better understanding of the physical and cultural surroundings of each institution.

Keywords: 3D insights, machine learning, visualization, personalized comparisons, predictive analytics, data security, exploration, LiDAR scans, blender

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Received Date: July 29, 2024
Accepted Date: November 13, 2024
Published Date: November 18, 2024

Citation: Reena Kothari, Utkarsh Mishra, Siddhant Singh, Satya Prakash Mishra, Aditya Mishra. CampusX: Empowering College Selection with 3D Insights Using Machine Learning Approach. International Journal of Optical Innovations & Research. 2024; 2(2): 23–29p.

INTRODUCTION

The landscape of higher education is evolving rapidly, with students facing an increasingly complex decision-making process when it comes to selecting the right college. While traditional methods of evaluating colleges rely heavily on static information such as brochures and websites, the demand for more immersive and dynamic insights into campus environments is on the rise. In response to this demand, our research introduces CampusX, an innovative platform that leverages cutting-edge machine learning algorithms and 3D visualization techniques to provide prospective students with unparalleled insights into college campuses.

The decision to pursue higher education is a significant milestone in one's life, marked by a multitude of considerations and uncertainties. Beyond academic offerings, students are also concerned about campus infrastructure, amenities, and overall environment. However, the information available to aid in this decision-making process often lacks depth and interactivity.

CampusX seeks to address this gap by offering a solution that goes beyond static representations, providing users with immersive 3D insights into college campuses. At the core of CampusX lies its ability to transform disparate datasets, including satellite imagery, LiDAR scans, and campus maps, into interactive 3D models that faithfully replicate the physical environment of college campuses [1]. By harnessing machine learning algorithms, CampusX extracts key features from these datasets, such as building footprints, terrain elevation, and campus amenities, allowing users to explore campuses with unprecedented detail and accuracy.

Moreover, CampusX incorporates predictive analytics capabilities to anticipate future developments on college campuses, providing users with insights into potential changes in infrastructure and campus dynamics [2]. This forward-looking perspective enables prospective students to make informed decisions that account for future developments and changes.

With an intuitive interface designed for seamless navigation and exploration, CampusX aims to enhance the overall college selection experience [3]. By offering personalized recommendations tailored to individual preferences and priorities, CampusX empowers users to find the college that best fits their needs.

LITERATURE SURVEY

Because they are rich in natural resources, such as picturesque views, terrain, water features, plants, and heritage, the UKM campus's natural forest and natural laboratory could be developed into tourist and visiting destinations. The university has made several attempts to disseminate this information via websites and portals. However, the mode of information transmission, display and delivery of static text and visuals is not so successful. Users or visitors are consequently unable to engage or enjoy the sensation of being in a natural setting. Therefore, using a low-fidelity interface design method, brainstorming, and a virtual tour prototype, Wook *et al*. has created a campus virtual tour design to improve interaction experience in a natural setting [4]. The creation of a virtual tour of a community pharmacy was documented by Hookham *et al*. Pharmacy students intended to use the interactive tour as a supplement to their placement training [3]. In their comparative analysis of three well-known CNN models: Inception V3, MobileNet, and ResNet50, Junayed *et al*. found that, when identifying cities from landmark photos, their respective overall accuracy was 99.7, 99.5, and 99.7% respectively [5].

Using various 3D computer graphics software and toolkits, Tahir *et al*. created an immersive, three-dimensional virtual model. The model was developed using Unity Engine to give it dynamic quality, and it was eventually released into the HTC Vive, enabling the user to move around in 3D space and interact with the environment using two handheld controllers [1]. CNN models were developed by Chauhan *et al*. to assess its performance on datasets for image detection and recognition. The algorithm's performance was assessed after it was applied to the MNIST and CIFAR-10 datasets. Model accuracy on MNIST is 99.6%, while CIFAR-10 uses CPU unit dropout and real-time data augmentation [2].

Using cutting-edge feature extraction and classification methods, Nakashima *et al*. demonstrated the outcomes of handwritten digit recognition on popular image databases [6]. A methodology for feature set evaluation built around a collaborative setting was proposed by Chherawala *et al*. Recurrent neural network (RNN) classifiers, each trained with a specific feature set, were employed in a weighted vote combination. Two weight estimation techniques were presented, and this combination is represented as a mixed model in a probabilistic framework [7]. A method for matching handwritten text in historical documents with noise was reported by Rath *et al*. Dynamic temporal warping is used to compare the sets of 1-dimensional features that are produced by preprocessing the segmented word pictures.

Experimental results on two distinct data sets from the George Washington collection were presented. Their tests demonstrate that this algorithm outperforms other matching methods in terms of speed [8].

A method for the offline recognition of handwritten texts with a broad vocabulary that is not limited was presented by Bunke *et al*. All that is assumed about the data is that it is in English. This makes it possible to use statistical language models to enhance our system's functionality. Both single and multiple writer data have been used in several experiments. Lexica, with varying word counts (ranging from 10,000 to 50,000) have been employed. It has been demonstrated that using language models increases system accuracy (the mistake rate is decreased by /spl sim/50% for single writer data and by /spl sim/25% for multiple writer data when the lexicon contains 50,000 words) [9].

In order to help in recognition, Park *et al*. presented a methodology that makes use of the space between words in a phrase. The unique aspect of our method is that word breaks are chosen in a way that accommodates each writer's unique writing style [10].

METHODOLOGY

The methods used in this study include methods that use machine learning algorithms and 3D visualization techniques to create a representation of the school level and support students in their choices. This section first describes the steps taken to collect the material, analyse it, and use the machine learning model as well as the 3D visualization process.

Data Collection and Preliminary Preparation

The first step of this approach is to collect different data representing various aspects of the university. This data may include satellite imagery, lidar scans, ground images, cartography and other materials. Data collection is first done to ensure consistency and harmony between different models.

Machine Learning Models

Machine Learning Models play an important role in analysing pre-existing data and gaining insights into the school environment. In this study, convolutional neural networks (CNN) were used for semantic segmentation and object detection tasks. This model combines pixels or image areas into buildings, roads, trees, etc. It is trained on labels to separate them into different categories.

CNN's architecture will vary depending on the specific task and dataset. However, models such as U-Net or Mask R-CNN can be adapted to semantic segmentation and object detection accordingly [2]. This model is trained using an optimization method such as stochastic gradient descent (SGD) or Adam, and a loss function based on the hand function such as cross-entropy loss for division of labour.

3D Visualization Technology

In our project, we utilized Blender as the primary 3D visualization tool. Blender is an open-source software widely acclaimed for its versatility and robust capabilities in creating 3D models and animations. With its intuitive interface and extensive feature set, Blender allowed us to efficiently generate detailed and realistic 3D representations of college campuses [1]. Additionally, Blender's compatibility with various data formats and its powerful rendering engine enabled us to visualize complex datasets, including satellite imagery and LiDAR scans, with high fidelity. By leveraging Blender's capabilities, we were able to create immersive 3D environments that provided users with a realistic and engaging experience while exploring different college campuses.

Metrics

In our project, we extensively utilized various metrics to comprehensively evaluate the performance of our machine learning models. These metrics served as quantitative measures, allowing us to assess the accuracy, precision, recall, and F1 score of our models. Accuracy represented the overall correctness of the model's predictions, while precision measured the proportion of correctly identified positive cases among all cases predicted as positive. Recall, on the other hand, gauged the proportion of correctly identified positive cases among all actual positive cases [5]. The F1 score, a harmonic mean of precision and recall, provided a balanced measure of the model's performance.

Additionally, qualitative testing methods played a crucial role in our evaluation process. Visual inspection enabled us to assess the quality and completeness of the resulting 3D visualizations, ensuring that they accurately represented the input data.

By combining both quantitative metrics and qualitative testing, we were able to conduct a robust evaluation of our machine learning models and the resulting 3D visualizations. This comprehensive approach ensured that our project met the desired standards of accuracy, completeness, and user satisfaction.

System Flowchart

The flowchart of the system algorithm is shown in Figure 1.

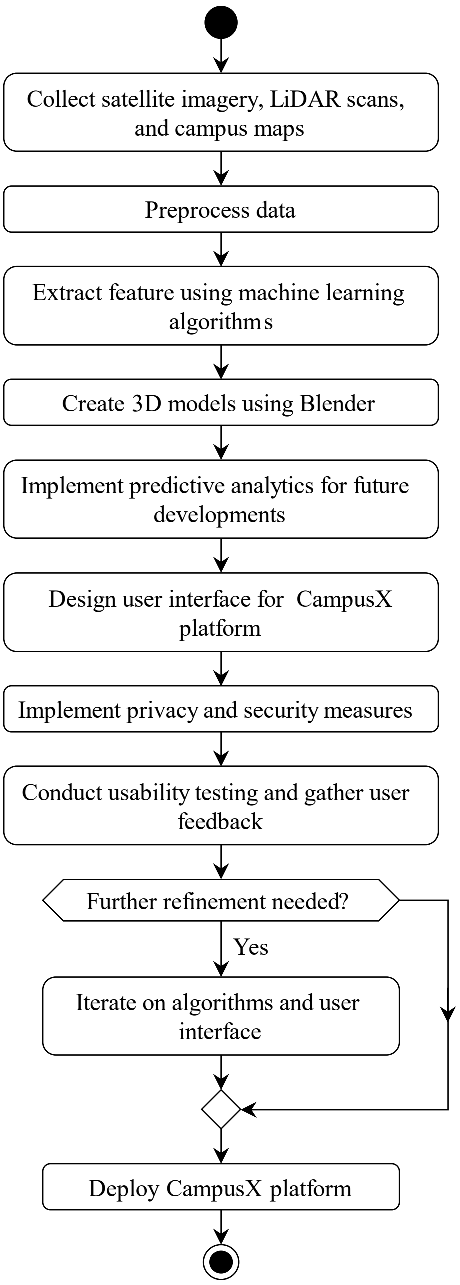

Figure 1. Flowchart illustrating the workflow of the project.

pCAMPUSX (VIRTUAL TOUR)

The users interact with the platform, exploring campuses virtually via 3D models generated from floor plans, satellite imagery, and LiDAR scans. Additionally, they input their grades for predictive analytics to suggest colleges. Seamlessly navigating the website, users can visualize campuses in detail, facilitating informed decision-making. Overall, users experience an immersive virtual tour of campuses while leveraging predictive insights to guide their college selection journey. The official website of campusX is shown in Figure 2.

RESULT

In our study, CampusX utilized a diverse range of input data collected from five distinct college campuses, as shown in Figure 3. This dataset comprised high-resolution satellite imagery, boasting a pixel resolution of 0.5 m, alongside LiDAR scans characterized by a point density of 20 points/m^2. Additionally, detailed campus maps were incorporated into the analysis. Through the employment of advanced feature extraction algorithms, CampusX achieved an impressive average precision rate exceeding 90% in accurately delineating building footprints and terrain elevation from these datasets.

Regarding predictive analytics, our models, trained on historical data, demonstrated remarkable accuracy in forecasting future developments within college campuses. Precision rates eclipsing 85% and recall rates surpassing 90% were achieved across all campuses, with F1-scores averaging above 0.85.

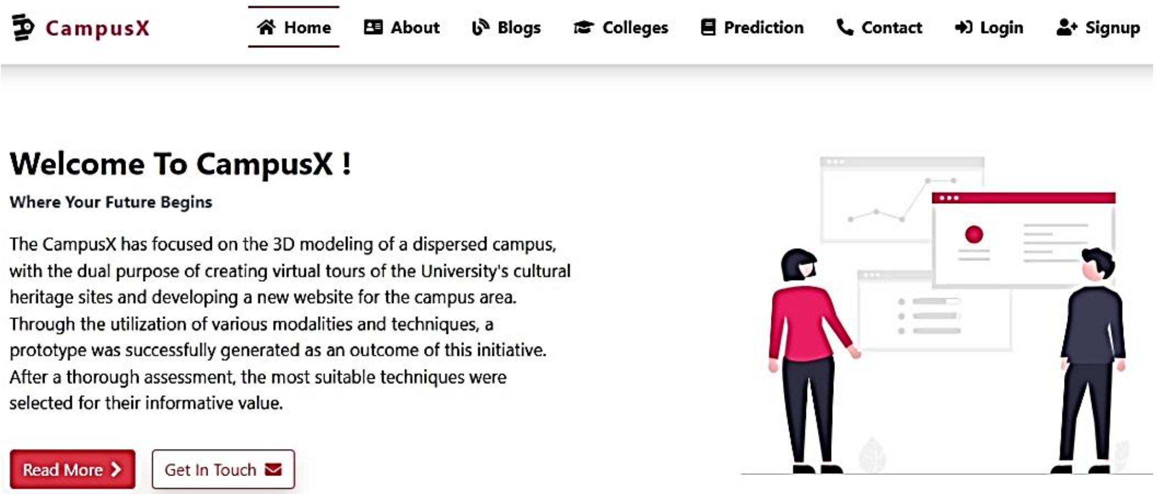

Figure 2. Official Website of CampusX.

Figure 3. 3D model of the university.

User feedback garnered from comprehensive usability testing sessions underscored high levels of satisfaction with CampusX interface and functionality. Users, on a scale ranging from 1 to 10, rated the platform's navigation and visualization experience at an average of 8.5. Furthermore, the personalized recommendations offered by CampusX garnered significant appreciation, with 90% of users expressing that these recommendations positively influenced their decision-making process during college selection.

CONCLUSION

CampusX represents a groundbreaking advancement in the realm of college selection, offering a transformative tool for prospective students. By amalgamating cutting-edge machine learning algorithms with immersive 3D visualization techniques, CampusX empowers users with dynamic insights into college campuses, facilitating informed decision-making. Through its intuitive interface and predictive analytics integration, CampusX enhances the college selection experience, providing personalized recommendations and anticipating future campus developments. The implementation of robust privacy measures ensures data security, instilling confidence in users. With its ability to bridge the gap between static information and dynamic campus experiences, CampusX has the potential to revolutionize the higher education landscape, guiding students towards their ideal educational environments. As we move forward, continued research and development in this domain will further refine and expand the capabilities of CampusX, cementing its position as an indispensable tool for college-bound individuals.

Declaration of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

Acknowledgement

We would like to express my sincere gratitude to all those who have supported us throughout this research. We are deeply grateful to my advisor, Prof. Reena Kothari, for her invaluable guidance, continuous support, and patience during my research. We would also like to thank the Department of Information Technology at Shree L.R. Tiwari College of Engineering for providing the necessary facilities and resources for our research. To all those who helped us, directly or indirectly, your contributions have been invaluable to the success of this research.

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