WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Virtual Architect using Computer Vision

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ABSTRACT:

In previous years many architects and designers visualized their ideas and manually draw 3D sketches of them. Now designers create 3D images and animation with the help of the latest software that help them communicate with their clients in a clear manner at the initial stages the project. Developing 3D software allows the designer to implement their ideas in a manner of 3D visualization in a simple way. The architects can also modify their previous designs according to the client's satisfaction thus it allows the architecture to initialize their plans and achieve the goal of designing easily in a short-term period. This can be achieved by creating a designing software application and providing the virtual access to it. Then the client or user can access the application with the help of their hand gestures for designing the urban planning with three dimensional (3D) objects.

Index terms: 3D Objects, Virtual Reality, Graphical User Interface

1. Introduction

When it comes to Human Computer Interaction (HCI), hand gestures are an unprompted and reliable transmission method. The current system will have a desktop or laptop interface where hand gestures can be made by wearing data gloves or by using a web camera to take pictures of hands. Keyboard, mouse, joystick, and touch screens are some input devices for connection with the computer but they don't provide an appropriate interface. Hand capture and analysis is the initial step towards gesture recognition. In Data-Glove approaches, sensors are utilized to initialize finger movement and programme hand movements. In contrast, the vision-based approach simply requires a camera, allowing it to recognize the actual interaction between a human and a computer without the need for any additional hardware. The difficulties with this technique include a steady background, occasionally people, and illumination. Here, along with the recognition methods, several processes and algorithms used in this system are described. Segmentation is the process of looking for a connecting section in a photograph that matches a specified specification, such as color or intensity, and where a pattern and algorithm are programmable.

The traditional approaches to planning and designing urban landscapes are unable to include designs into the overall planning processes of planning scenes and are unable to effectively, intuitively, and cogently explain the planning consequences of numerous schemes and huge scenes. Virtual reality (VR) technology, which is based on similar theory, mathematics theory, control theory, and graphics processing theory, has become increasingly essential in many facets of urban landscape planning and design with the advancement of computer science and technology. This article elaborated the research status and importance of three-dimensional (3D) visualized urban landscape planning and design on the basis of summarizing and analyzing prior research works. It also elaborated the development background, current status, and upcoming challenges of VR technology, introduced the techniques and principles of spatial roaming sorting algorithm and evaluation indicator screening and system construction, established 3D database, and virtual scene modification.. The findings demonstrate that VR technology offers designers realistic information processing effects through intelligent drawing, full display, and timely information, which significantly boosts design efficiency and effectively promotes design quality. Additionally, the 3D visualized technology can transmit a large amount of information through graphics in a short amount of time, allowing professionals to intuitively and quickly observe test results or interactively process these results.

1.1 Objective of the Proposal

To design a three dimensional (3D) objects and uses it as a tool for construction planning by the architect through virtual interface.

1.2 Scope of the Proposal

The goal of the research is to create a synchronous gesture classification system that can automatically detect movements in varying illumination conditions.

1.3 Literature Survey

[1] In order to provide insights on the application of 3D technologies in objects conservation and restoration, a state of the art was presented on the use of 3D models in conservation and restoration work. A survey was set up with the objective to research the point of view, experience and concerns of the restorer on the application of 3D technologies in restoration projects. For the practical application, a literature study was conducted to find the entire peer and non peer- reviewed literature on how 3D technologies can assist restoration cases for loss compensation. The survey showed a positive trend towards 3D technologies; the respondents think 3D technologies can be useful in restoration work and almost half of the respondents had experience with 3D scanning, digital modeling or digital manufacturing. However, the survey also pointed out the fact that there are still serious concerns in the application of 3D technologies. The most common concern is the uncertainty about the suitability of the 3D printing materials. The required prior knowledge, the applicability, ethical considerations, required work and costs, managing and storage of data and the achieved results are other important points of attention. The amount of concerns expressed by the respondents show a lack of familiarity with the many possibilities, and necessities, these techniques offer. Therefore, Future research and documenting of executed cases are crucial in order for restorers to get an overview on the potential of 3D technologies for their own work.

[2] The rise of BIM technology opens up a new horizon for the development of smart buildings is paper review related journal articles on the BIM applications in smart buildings and also consults related BIM reports and guidelines. Is paper identifies and analyzes the nexus of BIM and smart buildings from three dimensions: BIM attributes, project phases, and smart attributes. Identification of nexus dimensions reveals multiple essential and related characteristics of the BIM application in the smart building. The cross-analysis further identifies the key attributes in various application studies to guide the specific smart function research is study's outcome would contribute to improving the smartness of the BIM application in terms of comprehensive function design, whole life cycle management, and smart technology integration. is paper summarizes the three main aspects of the BIM applications in smart buildings. The advantages of BIM in solving issues related to smart buildings, applicability of BIM in all stages of the life cycle of smart buildings and smart building functions that BIM can achieve. The application advantages of BIM in the field of smart buildings have four aspects, including the integration of BIM and other systems, the convenience of information advances in Civil Engineering sharing and exchange, the visualization of the whole process and results, and the analysis and simulation of building functions. BIM is mainly applied to the planning, design, and construction phases of smart buildings, and the potential value of the operation and maintenance phase is gradually recognized.

[3] The literature review of 3D reconstruction, comparison and the discussion of a possible application have shown that interactive 3D reconstruction is able to create CAD (Computer Aided Design) ready model not just dense or sparse models. We agree with that a fully automatic reconstruction for high quality object creation is currently not feasible. To show the ability of interactive 3D reconstruction we started to implement the proposed methods. We expect the identification of even more weaknesses of current 3D reconstruction and computer vision methods in the course of research conducted in the proposed directions. Finally, we are optimistic that an interactive 3D reconstruction tool could create models of real world objects which can be "translated" back to the real world with 3D printers and CNC machines or can be used for many CAD tasks.

[4] Whether it is face movements or whole-body gestures, gesture detection has been redesigned for various research applications. There were few applications that had defined and hard requirements for this type of recognition system. Regarding the static recognition system, it is a design recognition challenge. For instance, before any standard pattern or design recognition procedure can be applied to it, feature extraction—a crucial aspect of the design recognition preprocessing level must be regulated or managed. Features under particular lighting conditions correspond to the most preferred information about the image. Numerous areas of feature extraction have been the subject of extensive research. Parvini and Shahabi devised a method for classifying static and dynamic hand gestures by analyzing the movements captured by sensors placed on human hands. The system successfully recognized more than 75% of the ASL signs. Furthermore, because gloves are required to communicate with the system, a user must follow and apply a glove-based interface to extract the features of hand movements, which affects their usability in real-world applications. It is challenging to create recognition systems that are effective at operating in a variety of settings, but it is more feasible because these obstacles exist in the real world. These requirements include various compound and lighting backgrounds, as well as a limited number of translational, rotational, and angular scaling effects. The cost of computation is another factor that needs to be taken into consideration. Few feature extraction strategies, like the combination of Gabor filters and PCA, have the drawback of being unexpected and taking more time as a result, which may restrict their utility in practical applications.

[5] This article established 3D database and virtual scene model of urban landscapes, performed 3D visualized urban land space modeling, realized 3D presentation of virtual scene landscape, discussed the integration and optimization of landscape design schemes, analyzed the 3D modeling and interactive adjustment of the landscape planning and design schemes, and finally conducted simulation experiment and its result analysis. The realization of the 3D virtual scene model is mainly to improve the fidelity and fluency of the virtual scene; in order to ensure this effect, the degree of conformity between the virtual environment and the real environment must be improved. The key is to meet the visualized needs of users, which is guaranteed by improving the realism and fluency of the virtual picture in the visualized scene generation of the system. The planning and design results are made into a VR system, which breaks through the limitations of traditional renderings, can fully display the effects of the planning plan after completion, and communicate with decision makers and visitors intuitively in the form of roaming on any path. When making a virtual design, the designer must first digitally process the map of the city, create a basic model, and then combine the location of each landscape in reality to make a 3D arrangement to display the aesthetic characteristics of the city and brings more accurate and intuitive technical support to the overall design. In short, the VR technology provides design staff with realistic information processing effects through intelligent drawing, which greatly improves design efficiency and promotes the effective improvement of design quality. The 3D visualized technology can transmit a large amount of information through graphics in a short time so that professionals can intuitively and quickly observe the test results or interactively process the results.

2. System Study

It is a process of collecting and interpreting facts, identifying the problems, and decomposition of a system into its components. System analysis is conducted for the purpose of studying a system or its parts in order to identify its objectives. It is a problem solving technique that improves the system and ensures that all the components of the system work efficiently to accomplish their purpose. Analysis specifies what the system should do.

2.1 Existing System

- Urban landscapes can be planned and designed using VR technology.
- The designed landscape can be visualized through three-dimensional (3D) visualization.

2.1.1 Drawback:

- The user cannot experience the virtual reality thoroughly without accessing the designing process through virtual interface.
- Input devices (mouse, keyboard) are used to perform an action for designing the urban landscape.

2.2 Proposed System

- In order to reduce the input devices camera is used here to capture the image for hand recognition.
- Then the urban planning can be done in the designing application with the help of virtual interface (hand gestures) through the camera.

2.2.1 Advantages:

- The user can experience a virtual reality in a virtual way.
- The input devices are reduced.

2.3 Software Description

A software project description ought to begin with an overview that describes the kind of software that will be created, the issue it will address, and the advantages it will have for both customers and the company. The end product and its advantages should be the main emphasis of the overview rather than the project's technical details.

2.3.1 Python

Python is a computer programming language often used to build websites and software, automate tasks, and conduct data analysis. Python is a general-purpose language, meaning it can be used to create a variety of different programs and isn't specialized for any specific problems. The adage "Every picture can tell us a story" is well known. An image may include a lot of information that is hidden, and we may interpret it from several angles. What exactly is an image, and how do you cope with one? Simply put, we may argue that a picture is a visual representation of something, and that computer vision could (from a machine learning standpoint) readily deal with it. A video can be thought of as a recording of an ongoing series of moving images. However, we may discuss utilizing computer vision to analyze videos in a different blog!

Computer vision, which is frequently abbreviated as "CV," is a branch of artificial intelligence that aims to extract useful information from digital images, videos, and other types of media. In the present period, "CV" has a wide range of practical uses in practically every industry, including medicine, the automobile, manufacturing, and agricultural sectors.

Many libraries are available in Python for image processing. OpenCV is a real-time computer vision-focused image processing library that finds utility in a variety of fields, including object identification, mobile robots, 2D and 3D feature toolkits, facial and gesture recognition, and human-computer interaction. For processing and manipulating images, use the Numpy and Scipy libraries. Numerous image processing algorithms are offered by Sckikit. Python Imaging Library (PIL) is used to carry out fundamental operations on images, such as thumbnail creation, resizing, rotation, and file format conversion.

OS Module

Python's OS module offers tools for communicating with the operating system. Python's basic utility modules cover the OS. A portable method of exploiting operating system-specific functionality is offered by this module. Numerous functions for interacting with the file system are included in the os. Think of the Python operating directory, or Current Working Directory (CWD), as a folder.

Python assumes that the file starts in the CWD if it is called simply by name, so a name-only reference will only work if the file is in Python's CWD.The Current Directory refers to the folder in which the Python script is now running.

OpenCV-Python

A collection of Python bindings called OpenCV-Python was created to address issues with computer vision. Python is a general-purpose programming language created by Guido van Rossum that quickly gained popularity, largely due to its ease of use and readable code.

PyQt5

A complete set of Python bindings for Qt v5 is available as PyQt5. On all platforms that are supported, including iOS and Android, it enables Python to be used as an alternative to C++ for application development. It is implemented as more than 35 extension modules.

Visual Studio Code

An Integrated Development Environment (IDE), a feature-rich tool, assists numerous aspects of software development. Using the Visual Studio IDE as your creative launch pad, you may edit, debug, build, and publish an app. In addition to the standard editor and debugger that are provided by the majority of IDEs, Visual Studio also includes compilers, code completion tools, graphic designers, and many other features to enhance the software development process..

Mediapipe

A framework called MediaPipe is used to create machine learning pipelines for processing time-series data, such as audio and video. The desktop/server, Android, iOS, and embedded devices like the Raspberry Pi and Jetson Nano are all supported by this cross-platform framework.

Jupyter Notebook

To create and share documents with live code, equations, visualizations, and text, you can use the free and open-source Jupyter Notebook web application. The staff of Project Jupyter is in charge of maintaining Jupyter Notebook.

The IPython project, which formerly had an IPython Notebook project of its own, gave rise to Jupyter Notebooks. The primary programming languages it supports are Julia, Python, and R, hence the name Jupyter. There are presently more than 100 additional kernels available; however Jupyter comes with the IPython kernel, which enables Python programming.

You can create and share documents with real-time code, equations, graphics, and text using the open-source Jupyter Notebook web tool. Examples of applications include data cleansing and transformation, statistical modeling, data visualization, machine learning, and many others.

Jupyter supports more than 40 programming languages, including Python. Python (Python 3.3 or later or Python 2.7) is needed to install the Jupyter Notebook itself.

2.4 System Architecture

System Architecture is the conceptual model that defines the structure, behavior, and more views of a system. An architecture description is a formal description and representation of a system, organized in a way that supports reasoning about the structures and behaviors of the system.

It is a visual layout of a process, project or job in the form of a flow chart. It's a highly effective way to impart the steps more easily in a business process, how each one will be completed, by whom and in what sequence. It makes work easier and your organization more secure overall.

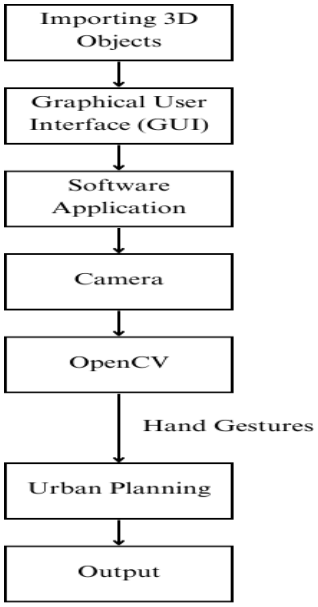

Fig 2.4.1. System Architecture Diagram

The process of defining how the information system should be built (i.e., physical system design), ensuring that the information system is operational and used, ensuring that the information system meets quality standard (i.e., quality assurance).

2.5 Modules Description

A module is a group of source files and builds an option that enables you to segment the functionality of your project into distinct functional units. Your project may have one or several modules, and one module may depend on another module. Each module can be separately built, tested, and debugged.

List of Modules

i. 3D Object

ii. Camera Module

iii. Detection module

iv. Interface Module

v. Designing Module

2.5.1 3D Objects

Objects that can be measured in 3 directions are called three-dimensional objects. These objects are also called solids. Length, width, and height (or depth or thicknesses) are the three measurements of three-dimensional objects. These are the part of three-dimensional geometry. They are different from 2D objects because they have thickness. Several examples can be found in everyday life. Some of them are: tubes, sphere, cones, etc.

2.5.2 Camera Module

The detecting module receives the image from this module and processes it as frames after receiving input from the various types of picture markers. Hand belts, data gloves, and cameras are the most frequently used methods of capturing and identifying input. In our framework, we make smart use of the built-in webcam to see both static and moving signs.

2.5.3 Detection Module

This module is in charge of processing images. The output of the camera module is subjected to several image processing techniques, including as color conversion, noise reduction, and thresholding, before the image undergoes contour extraction. Convexity faults are discovered at that point, allowing the gesture to be recognized if the image has imperfections. If there are no flaws, the gesture is then recognized by classifying the image using the Haar cascade.

2.5.4 Interface Module

This module is in charge of matching the hand gestures that are recognized to the corresponding actions. The appropriate application is then given these actions. Three windows can be found on the front. The video input from the camera is displayed in the main window along with the name of the gesture associated with it. The contours located inside the supplied image are displayed in the following window. The image's smooth threshold adaption may be seen in the third window. The threshold and contour window's inclusion in the graphical user interface has the advantage of alerting the user to backdrop abnormalities that could impair the system's input and allowing them to move their laptop web camera to avoid them.

2.5.5 Designing Module

This stage, known as Low Level Design (LLD), specifies the internal details for every system module. The design must be compatible with the other system architecture modules as well as other external systems. Additionally, a random unit is used to govern the sizes, ratios, or architecture of a building's component sections. The proportions of the order in Classical architecture were determined by a number of modules based on the diameter of a column.

3. Results and Conclusion

As a result the designing of urban planning using 3D objects or models was implemented and executed successfully. The 3D models can be downloaded from the corresponding websites and can be imported here for a complete design process. The user can access the interface through virtual access (i.e. using hand gestures). These hand gestures will be detected and recognized by the camera used in the system.

It allows the user to interact with the system in a virtual way. Thus it will lead to the development of technology in the future. With this technology the input devices can be reduced such as the functions of mouse and keyboard can be done in virtual way. Thus the new technology can be very useful for the future generations.

3.1 Conclusion

Future generations will have access to new technology thanks to the technology utilized in the virtual architect, enabling them to virtually experience virtual reality. With the help of this application, urban planning can be created virtually, allowing the user to simulate real-world conditions. The programme will accept imported 3D models as well as those that can be downloaded. A design interface for urban planning is provided via the graphic user interface (GUI). Because designing is done virtually, the system needs to have a camera. The user can then virtually access the programme by making hand movements in front of the camera. In light of this, it can be said that developing urban planning with three-dimensional things, which will be a virtual reality, can be accessed virtually and also experienced in detail virtually.

3.2 Future Enhancement

In this project, the user can utilize hand movements to interact with the interface virtually. The system's camera will be able to identify and detect these hand gestures. It enables virtual user interaction with the system. Thus, it will contribute to the future growth of technology. With the use of this technology, fewer input devices are needed because keyboard and mouse functions may be performed virtually. Therefore, new technology has a lot of potential to benefit coming generations. In many other sectors as well, this technology can be used in this way. Education, medicine, research, and other areas are only a few of them. As a result, in the future, it will usher in a new era of technology.

References

[1]. Abhilash S, Lisho Thomas, Naveen Wilson, Chaithanya C, “Virtual Mouse Using Hand Gesture”, IRJET, April 2018.

[2]. Ang Yang, Mingzhe Han, Qingcheng Zeng, Yuhui Sun, “Adopting Building Information Modeling for the development of smart buildings: A review of enabling applications and challenges ”, HINDAWI, March 2021.

[3]. Ibrahim Moh'd A.Q Saraireh, Ahmad Tarmizi Haron, “Understanding the Conceptual of Building Information Modeling: A Literature Review ”, IAEME, January 2020.

[4]. Julius Schoning and Gunther Heidemann, “Interactive 3D modeling: A survey-based perspective on interactive 3D reconstruction ”, ICPRAM, .

[5]. Lien Acke, Kristel De Vis, Stijn Verwulgen, Jouke Verlinden, “Survey and literature study to provide insights on the application of 3D technologies in objects conservation and restoration ”, Journal of Cultural Heritage, March 2021.

[6]. Mohammed A. Abdulla , Hala Khuder Ali, Raghad S Jamel, “ CAD- CAM Technology: A Literature Review ”, Al-Rafidain Dental Journal, April 2020.

[7]. Surya Narayan Sharma, Dr. A Rengarajan, “Hand Gesture Recognition using OpenCV and Python”, IJTSRD, February 2020.

[8]. Xing Liu, “Three Dimensional Visualized Urban Landscape Planning and Design based on Virtual Reality Technology”, IEEE Access, August 2020.