

Concepts of Data Structures on an Interactive Tabletop Tangible User Interface

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Introduction

This project introduces a tangible user interface (TUI) within a tabletop interactive display system, merging physical manipulation with digital content. This advanced approach revolutionizes e-learning, offering a hands-on experience through fiducial-marked objects. The tactile nature of TUI fosters engagement, providing a seamless interaction with projected educational material. This innovative fusion of physical and digital realms elevates the e-learning experience, promoting active participation and understanding.

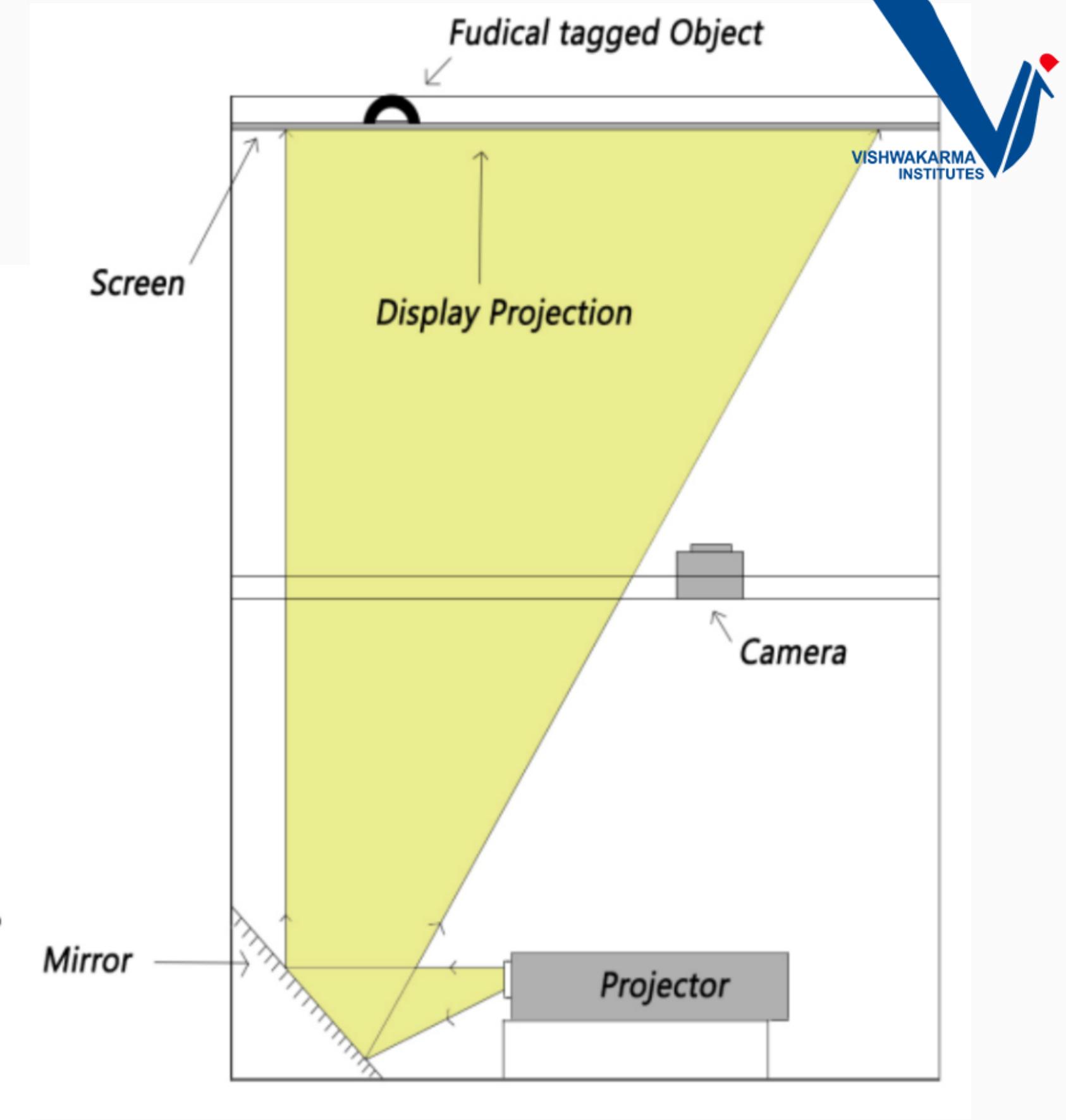
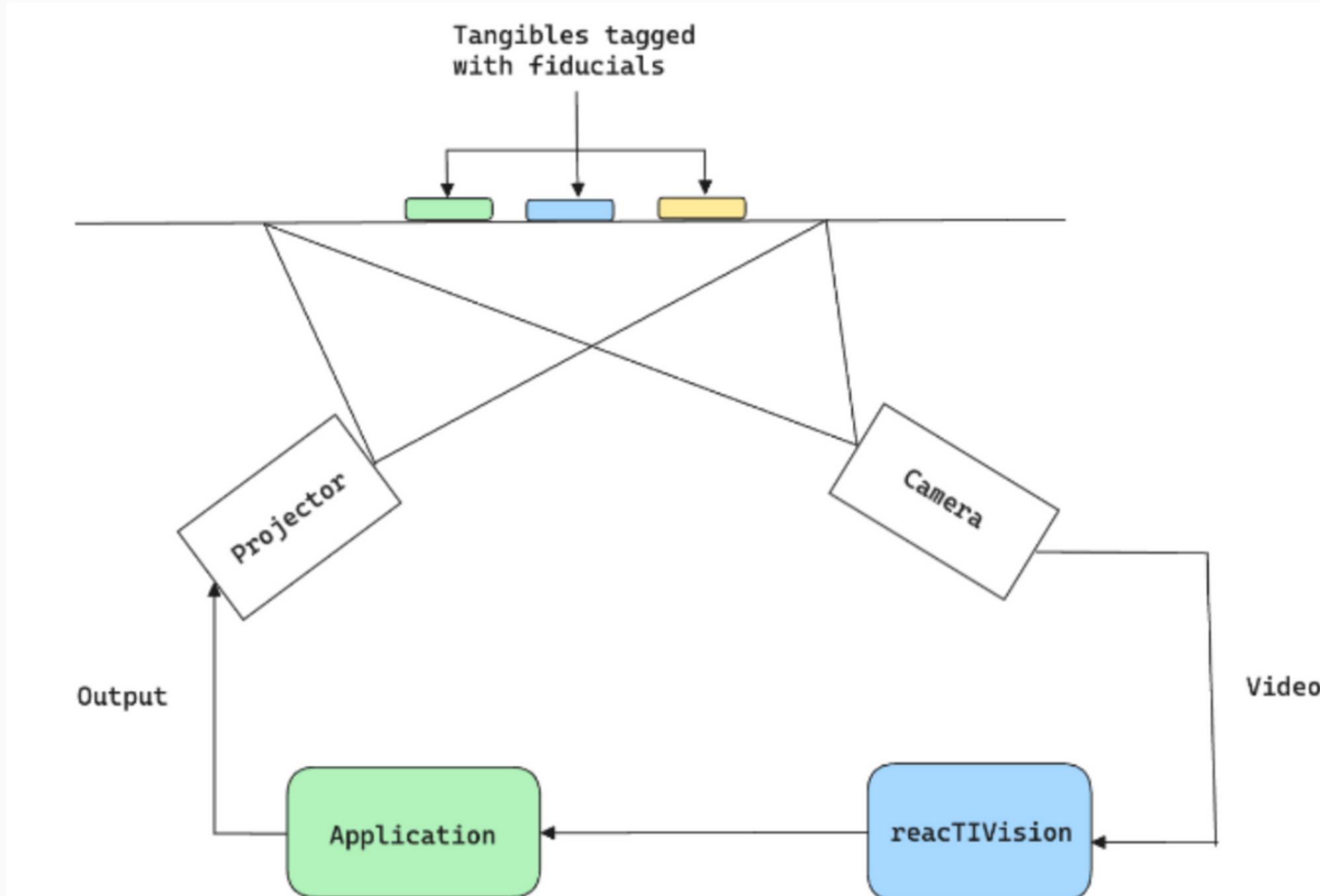
Objectives

- Integrate TUIs with reacTIVision for enhanced learning interactions.
- Enable real-time tracking and recognition of tangible objects using TUIO.
- Foster collaborative and active exploration in educational environments.

Methodology

The project encompasses a tabletop interactive display system, wherein a laptop-connected projector casts the screen onto a semi-transparent surface atop the tabletop box. A strategically positioned mirror redirects the projected rays onto the transparent sheet. The system integrates ReacTIVision software with an embedded camera attached to the laptop. The semi-transparent layer serves as the projection surface, featuring fiducial markings strategically placed. The tabletop box's camera captures images of the fiducials, facilitating their recognition by our application to activate specific interactive features. This sophisticated approach ensures seamless interaction with projected information, triggering designated applications upon detecting fiducial markers.

Architectures



Softwares and Hardware Components



Software Components

Operating System: It interfaces with the underlying operating system, ensuring compatibility with the hardware components and facilitating communication between software applications and hardware. We have used MacOs for our project.

Application Software: The Interactive Table-Top supports various educational and interactive applications, each with its own software interface. These applications bubble sort, selection sort and binary sort done in python language.

Fiducial Object Recognition: The system interfaces with reacTIVision that recognize fiducial objects placed on the tabletop, allowing users to interact with them.

Hardware Components

Tabletop Surface: Utilizes a sanded glass or Plexiglas surface with blurring agent for optimal tracking, minimizing unexpected detection on glossy surfaces.

Camera: Overhead camera captures tabletop images for fiducial object recognition and multi-touch interaction. Compatible with higher-end webcams like PlayStation Eye.

Projector (BenQ TH575): High-resolution (1080p) projector with 3800 lumens brightness, versatile connectivity options, good color accuracy, long lamp life, and decent audio.

Power Supply: Requires a standard power supply for operational functionality.

Laptop: Features an 8-core CPU, 8-core GPU, 16-core Neural Engine, 13.6" LED-backlit display with 2560x1664 resolution, and 500 nits brightness.

Conclusion

It is successfully implemented to deploy an Interactive Table-Top along with two efficient E-Learning apps on Data Structures and Algorithm applications. This groundbreaking method transforms education by giving students real-world experience and strengthening their critical thinking skills. The Interactive Tabletop presents basic principles in a graphical style, fostering skill development and learning capacities. Students gain comfort and dependability from the interactive learning environment, which enhances the educational process and makes it more user-friendly.

OUTCOMES

- Submitted research paper titled "Enhancing E-Learning through Tangible User Interfaces (TUI): A Novel Approach for Engaging and Interactive Learning" at ICTBIG 2023 Flagship Conference
- Filed for an Indian Patent of the concept of the system.
- Submitted research paper titled "A Comprehensive Study on the Integration of Tangible User Interfaces (TUI) to Enhance Engagement in E-Learning" for journal named "International Journal of Performativity Engineering"

Thank You