HOLOGRAPHIC

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Certification

This is to certify that **Mohammad Talha Nawaz (2020-SE-282), Mahnoor Ejaz (2020-SE-244), Aryan Ahmed (2020-SE-264), Shanzay Zahid (2020-SE-265)** have successfully completed the final project **HOLOGRAPHIC,** at the **Sir Syed University** to fulfill the partial requirement of the degree **Bachelor of Science in Software Engineering.**

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HOLOGRAPHIC
Sustainable Development Goals

(Please tick the relevant SDG(s) linked with FYDP)

SDG No	Description of SDG	SDG No	Description of SDG
SDG 1	No Poverty	SDG 9 ✓	Industry, Innovation, and Infrastructure ✓
SDG 2	Zero Hunger	SDG 10	Reduced Inequalities
SDG 3	Good Health and Well Being	SDG 11	Sustainable Cities and Communities
SDG 4	Quality Education	SDG 12	Responsible Consumption and Production
SDG 5	Gender Equality	SDG 13	Climate Change
SDG 6	Clean Water and Sanitation	SDG 14	Life Below Water
SDG 7	Affordable and Clean Energy	SDG 15	Life on Land
SDG 8	Decent Work and Economic Growth	SDG 16	Peace, Justice and Strong Institutions
		SDG 17	Partnerships for the Goals

Range of Complex Problem Solving			
	Attribute	**Complex Problem**	
1	Range of conflicting requirements	Involve wide-ranging or conflicting technical, engineering and other issues.	
2	Depth of analysis required	Have no obvious solution and require abstract thinking, originality in analysis to formulate suitable models.	
3	Depth of knowledge required	Requires research-based knowledge much of which is at, or informed by, the forefront of the professional discipline and which allows a fundamentals-based, first principles analytical approach.	
4	Familiarity of issues	Involve infrequently encountered issues	√
5	Extent of applicable codes	Are outside problems encompassed by standards and codes of practice for professional engineering.	
6	Extent of stakeholder involvement and level of conflicting requirements	Involve diverse groups of stakeholders with widely varying needs.	
7	Consequences	Have significant consequences in a range of contexts.	√
8	Interdependence	Are high level problems including many component parts or sub-problems	√
Range of Complex Problem Activities			
	Attribute	**Complex Activities**	
1	Range of resources	Involve the use of diverse resources (and for this purpose, resources include people, money, equipment, materials, information and technologies).	√
2	Level of interaction	Require resolution of significant problems arising from interactions between wide ranging and conflicting technical, engineering or other issues.	√
3	Innovation	Involve creative use of engineering principles and research-based knowledge in novel ways.	√
4	Consequences to society and the environment	Have significant consequences in a range of contexts, characterized by difficulty of prediction and mitigation.	
5	Familiarity	Can extend beyond previous experiences by applying principles-based approaches.	

Abstract

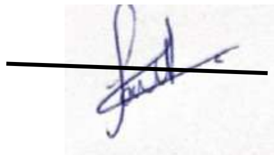
This project delves into the dynamic realm of holographic technology, presenting a multifaceted exploration of its applications in human holograms, product display holograms, and educational models. Fueled by the growing interest in immersive experiences, the research addresses the challenges and potentials inherent in these three domains. The initial focus outlines the key problematics and opportunities surrounding the integration of holographic technology in diverse contexts.

The methodology section delineates the comprehensive research design, encompassing the development and implementation of holographic systems. The project employs cutting-edge holographic projection techniques and augmented reality interfaces, providing a detailed account of the experimental procedures undertaken. Major findings highlight the efficacy of holographic representations in enhancing product visibility and engagement and revolutionizing educational models. These findings underscore the transformative impact of holographic technology on user experience, market dynamics, and educational paradigms.

The conclusions drawn from this research illuminate the potential implications and applications across various sectors. From revolutionizing retail spaces to redefining classroom interactions, the holographic solutions presented in this project contribute to a broader discourse on the future integration of immersive technologies.

Undertaking

I certify that the project **HOLOGRAPHIC** is our own work. The work has not, in whole or in part, been presented elsewhere for assessment. Where material has been used from other sources it has been properly acknowledged/ referred.



Mohammad Talha Nawaz

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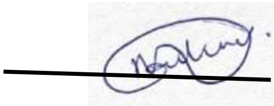

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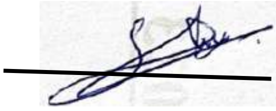

Shanzay Zahid

2020-SE-265

Acknowledgement

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We are also thankful to our friends and families whose silent support led us to complete our project.

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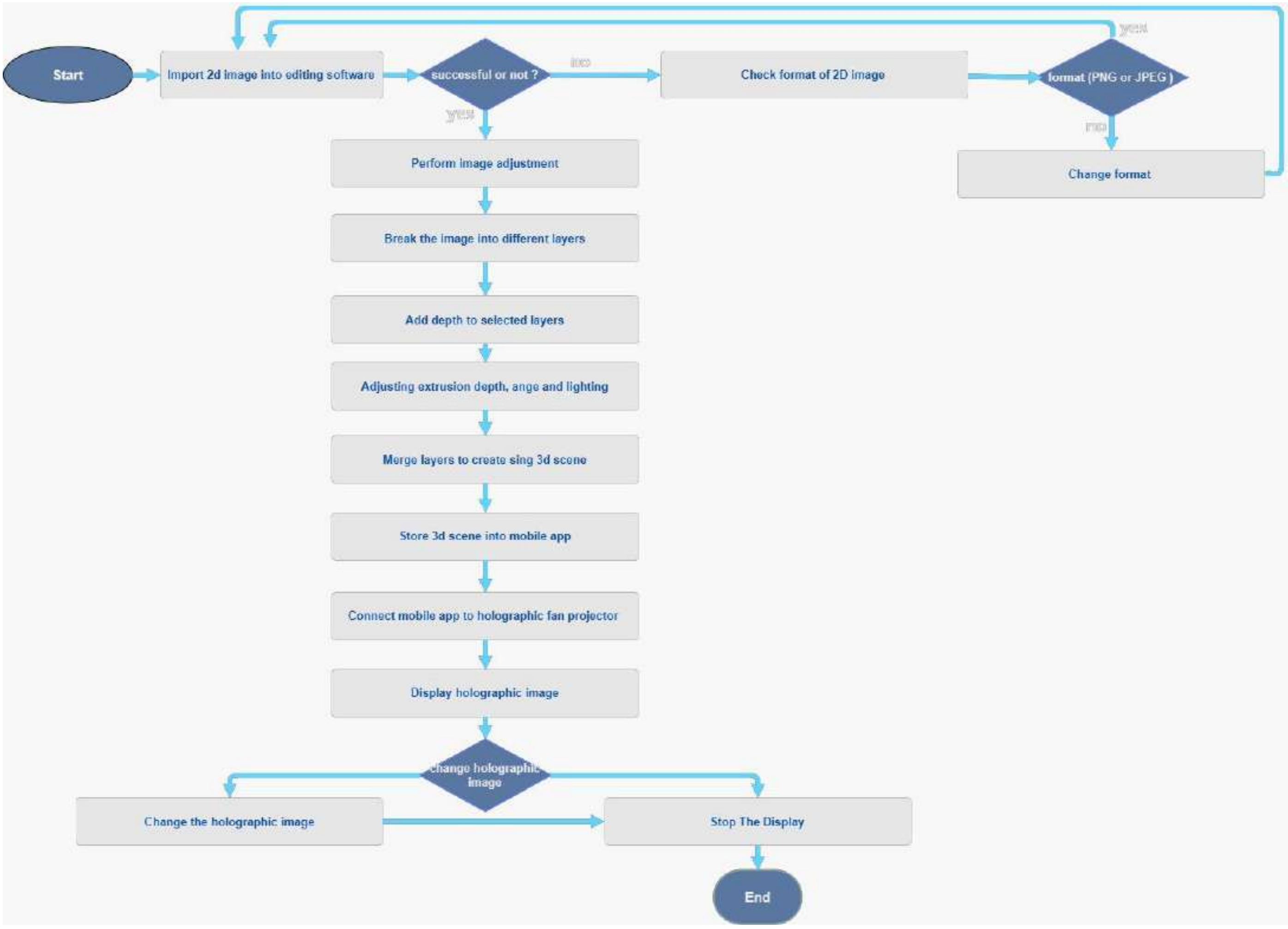
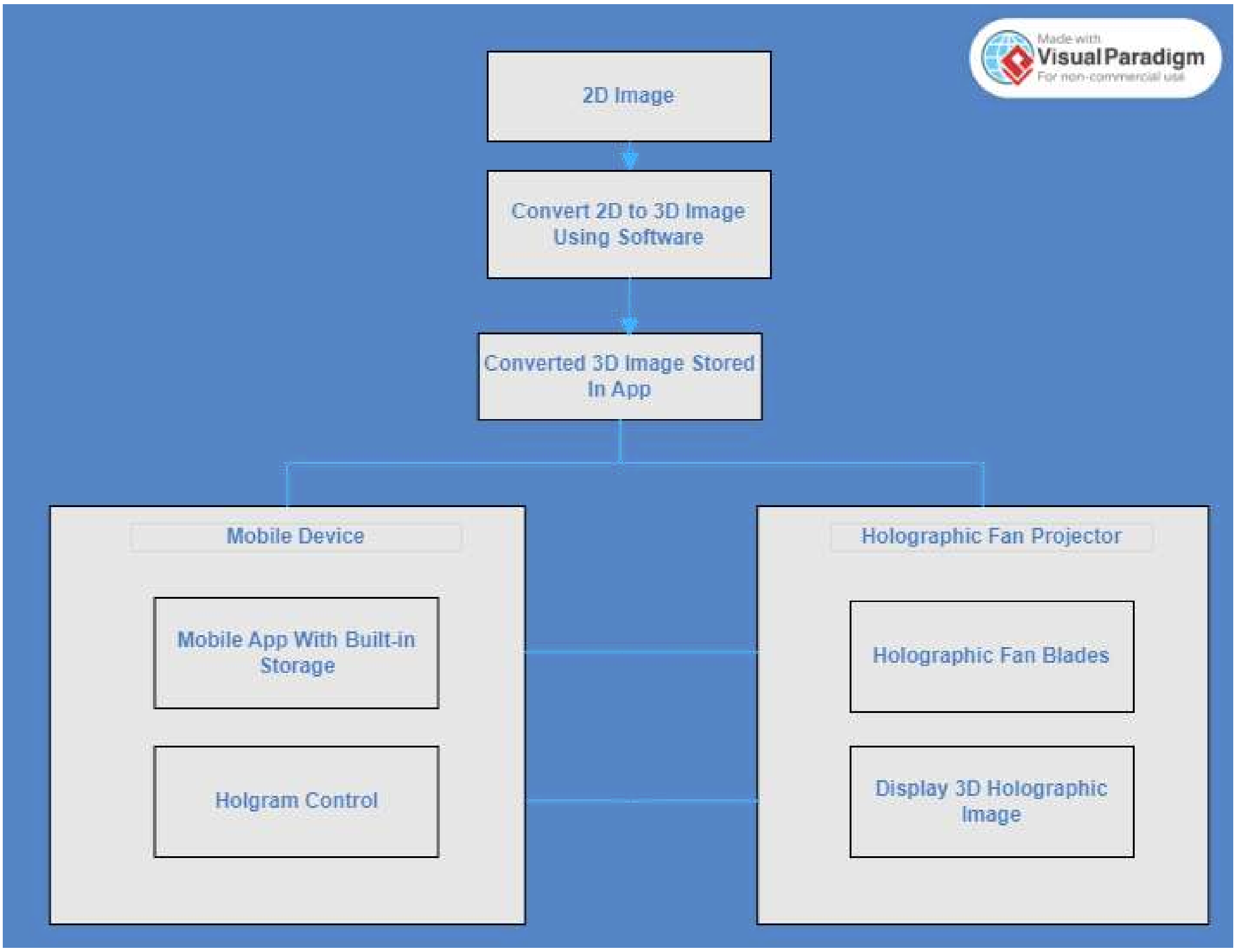


Figure 2: Over All System Diagram:



List of Acronyms

UI: User Interface

GUI: Graphical User Interface

LED: Light Emitting Diode

HDMI: High-Definition Multimedia Interface

IoT: Internet of Things

List of Equations

Equation 1:

Sobel Operator:

$$G_x = \begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix}, G_y = \begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{bmatrix}$$

$$E(x, y) = \sqrt{G_x^2 + G_y^2}$$

Canny Edge Detector:

$$E(x, y) = \text{Canny}(I(x, y))$$

Harris Corner Detection:

$$C(x, y) = \text{Harris}(I(x, y))$$

Depth from Stereo:

$$D(x, y) = \frac{f \times B}{Z},$$

Depth from Focus:

$$D(x, y) = f \times \frac{\sigma^2}{\text{Blur}}$$

Depth Fusion:

$$D_{\text{final}}(x, y) = \text{Fuse}(D_{\text{stereo}}(x, y), D_{\text{focus}}(x, y), \ldots)$$

Chapter 1

1.1. Introduction

The hologram itself is a 3D invented display of images and graphics but these days as in the globe of technology it isn't put in to as such use due to which we want to take it to further future enhancements in terms of use.

The idea is basically to use hologram technology to produce innovation in our daily lives for example to produce a human related hologram image display as output to show temporary presence of an absent individual in areas like education institutions or to use different images and process them to hologram in terms of models to display or model diagrams to be viewed in 3-D environment furthermore, this project can be used at multiple brand stores as innovative marketing strategy of their brands (display brand logo etc as an alternative to banners).

We are creating a program to turn an image in format of PNG or JPEG to holographic image save it in its database or a particular storage and demonstrates the output on a holographic projector

1.2. Statement of the problem

The problem statement is to get rid of old techniques and methods of displaying with an innovative and artistic creativity effects of hologram to provide more realistic and virtual look. Furthermore this technology is to be used in environment of learning and presenting areas so the results or output on this would be more effective due to this tech-machine

1.3. Goals/Aims & Objectives

Develop Holographic Display Technology: One of the main objectives is to design and implement an advanced holographic display system capable of projecting realistic 3D images of brand products.

Create a User-Friendly Interface: The project aims to develop an intuitive and user-friendly interface that brands can use to customize and manage their holographic displays easily.

Support Various Brands and Industries: The holographic system should be versatile enough to accommodate products from different brands and industries, ranging from consumer goods to high-end luxury items.

Measure and Analyze Engagement: Another objective is to integrate analytics into the system, allowing brands to measure customer engagement and interaction with the holographic displays.

1.4. Motivation

Captivating Customer Experiences: Brands understand the significance of providing unique and captivating experiences to their customers. The motivation for our project lies in the belief that holographic displays will captivate audiences, creating an unparalleled level of engagement that fosters stronger connections between brands and consumers.

Differentiation from Competitors: In a competitive market, brands are constantly seeking ways to stand out from their competitors. The holographic advertising platform offers a novel and attention-grabbing way for brands to differentiate themselves, enhancing their visibility and leaving a lasting impression on customers.

Enhanced Brand Visibility and Recall: The motivation behind the project is to provide brands with a powerful tool to increase their visibility and brand recall. Holographic displays can leave a strong and memorable impact on consumers, ensuring that the brand and its products remain in the minds of potential customers.

Addressing the Need for Interactive Advertising: Traditional advertising channels have become less effective in capturing customer attention. Our project's motivation lies in addressing this need for interactivity and offerings fresh and engaging way for brands to interact with their target audience.

Unlocking New and Shaping the Future of Advertising: By pioneering the use of holographic technology in advertising, the motivation is to shape the future of marketing and contribute to the evolution of advertising strategies. The project aims to set new standards for product showcasing and consumer engagement. Holographic displays offer new and unexplored advertising opportunities. The motivation for our project is to unlock these possibilities, enabling brands to communicate their messages in ways that were previously inconceivable.

Adapting to Evolving Consumer Expectations: Consumers today expect more than passive advertising; they seek interactive and immersive experiences. The motivation behind our project is to align with these evolving consumer expectations and deliver advertising that resonates with modern audiences.

Passion for Innovation and Creativity: The underlying motivation for the project is the passion for innovation and creativity. The desire to push the boundaries of what is achievable and create something truly remarkable drives the entire team working on the holographic advertising platform.

1.5. Assumption and Dependencies

The following presumptions and dependencies constitute the foundation for the creation and operation of the hologram advertising system:

The existence of appropriate holographic display technology that satisfies the project's needs is the first presumption. The second supposition is that advertisers will supply the required ad material (videos, interactive features, and graphics) in appropriate file formats.

Dependency 1: For ongoing functioning and remote ad management, the system depends on a reliable power source and internet access.

Dependency 2: The display needs to be in a dimly lit, gloomy area.

1.6. Methods

The Manual Process for Converting 2D to 3D:

Depth Extraction: The manual process of obtaining depth information from two-dimensional photographs.

Conversion Techniques: Creating 3D representations from 2D photos by applying techniques like parallax mapping.

Application of Holographic Fan Projectors:

Hardware Configuration: Specifying the holographic fan projector's hardware configuration, including the choice of an appropriate fan projector.

The fan projector needs to be calibrated in order to accurately produce 3D pictures in the volumetric space that the spinning fan blades create.

Development of Mobile Applications for Management:

Creating a user-friendly interface for the mobile application that will operate the holographic fan projector is known as user interface design. Features for choosing pictures, modifying the projection parameters, and controlling the fan speed might be included.

App-Device Communication: Setting up protocols for communication between the holographic fan projector and the mobile app to enable smooth operation.

Examining and Assessing:

Testing the accuracy of the manual 2D to 3D conversion by contrasting the produced 3D images with the original 2D images is known as conversion accuracy testing.

Testing Holographic Fan Projection: Testing the holographic fan projector to make sure it accurately and efficiently shows three-dimensional images.

User testing: Getting input from users to assess various aspects of the experience, such as holographic projection quality and control response.

1.7. Report Overview

The study describes a pioneering project that focuses on manually transforming 2D photographs into lifelike 3D representations that are shown on a holographic fan projector that is managed by a mobile application. The report starts with a brief context and introduction before navigating through a comprehensive literature review, an in-depth methodology, and a system design. It demonstrates effective applications of holographic projection and manual 2D to 3D conversion, backed by encouraging user comments. The conversation explores the project's successes as well as its difficulties, offering valuable perspectives on how the initiative may affect visual technologies. The report provides a thorough review of the project's technological breakthroughs, user experiences, and possible influence on a variety of applications, including communication, education, and entertainment, before concluding with recommendations and directions for further work.

Chapter 2

2.1. Overall Project Description

Product Perspective

The hologram advertising system a is stand-alone item that can show holographic adverts that can be interacted with. A holographic display, specialized hardware, and supporting software for ad production, management, and scheduling make up the system.

Product Function

The hologram advertising system's main functions are as follows:

Displaying high-quality holographic advertisements: To grab viewers' attention, the system is able to produce lifelike, aesthetically pleasing holographic pictures.

Management of commercials: The system offers an easy-to-use interface for advertisers to design, modify, and control their holographic advertisements.

Advertisers will be able to plan the display of their ads so that they appear at certain times and places using the system.

Operating Environment

The hologram advertising system is built to function in a range of scenarios, including regulated indoor and outdoor settings (often in low-light conditions). The system needs access to a power supply, a steady internet connection, or a data storage tool or device to store data that will be presented as a hologram in order to manage and update advertisements.

Design and Implementation Constraints

The following limitations is applied to the hologram advertising system's design and implementation:

Hardware limits: Considering elements like resolution, viewing angles, and power needs, the system is created to operate within the limitations of the chosen holographic display technology.

Cost factors: Both the hardware and software components are considered while designing the system to minimize costs.

Dimensions: The device is small and portable to facilitate installation and placement in a variety of settings. According to the goals of the advertisement, display size and factors are taken into account.

Technical compatibility: The system supports common communication protocols for ad scheduling and updates, as well as is compatible with regularly used file formats for advertisements.

Chapter 3

3.1 Mathematical Representations

Here are additional considerations that involve edge detection and feature extraction:

Edge Detection:

Sobel Operator:

Compute the gradient of the image using the Sobel operator to highlight edges.

$$G_x = \begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix}, G_y = \begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{bmatrix}$$

$$E(x, y) = \sqrt{G_x^2 + G_y^2}$$

Feature Extraction:

Canny Edge Detector:

Apply the Canny edge detector for improved edge detection.

$$E(x, y) = \text{Canny}(I(x, y))$$

Harris Corner Detection:

Identify key features using Harris corner detection.

$$C(x, y) = \text{Harris}(I(x, y))$$

Depth Inference:

Depth from Stereo:

If multiple images are available (stereo vision), compute depth from the disparity between corresponding points in the images.

$D(x, y) = \frac{f \times B}{Z}$, where B is the baseline distance between the cameras, and Z is the depth.

Depth from Focus:

Utilize depth from focus by analyzing the sharpness of features at different depths.

$D(x, y) = f \times \frac{\sigma^2}{\mathrm{Blur}}$, where σ is the standard deviation of pixel intensities and Blur is a measure of image blurriness.

Integration:

Depth Fusion:

Combine depth information from multiple sources (e.g., stereo vision, depth sensors) for improved accuracy.

$$D_{\mathrm{final}}(x, y) = \mathrm{Fuse}(D_{\mathrm{stereo}}(x, y), D_{\mathrm{focus}}(x, y), \ldots)$$

These methods involve mathematical operations such as convolutions, gradients, and various statistical measures. The actual implementation depends on the specific requirements, the nature of the input images, and the available computational resources

Chapter 4

4.1. Proposed Solution/Results & Discussion

Convert 2D images to 3D Scenes:

Goal: Automated and customizable 2D to 3D conversion process within Blender.

Advantages: Users may easily create dynamic 3D scenarios from 2D photographs, which encourages creativity and makes for a more captivating visual experience.

Storing 3D scenes on mobile

Goal: Creating standardized 3D scene exports for mobile device storage that is both effective and efficient.

Benefits: Ensures accessibility and flexibility by allowing users to easily save and arrange a wide variety of 3D scenes on their mobile devices.

Wi-Fi Communication Protocol:

Goal: The ideal outcome would be seamless Wi-Fi connectivity between the holographic fan projector and smartphone app.

Advantages: Promotes accessibility and eliminates the need for physical connections, improving user experience by facilitating real-time control and projection.

Control App for Holographic Fan Projectors:

Goal: A cross-platform smartphone app that allows the holographic fan projector to be easily controlled.

Benefits: By maximizing accessibility and usability, users enjoy consistent and intuitive control on Android platforms.

Table 1: PERT Activity Time estimate table for holographic fan projection

Activity	**Optimistic (a)**	**Most Likely (m)**	**Pessimistic (b)**	**Expected (Te)**
Loading 3d scene	15 sec	30 sec	60 sec	30 sec
Input detection through app	0.5	1	1.5	1

Chapter 5

5.1. Summary and Future work

This thesis delves into the transformative potential of holographic technology, exploring its applications in human holograms, product display, and educational models. The overarching goal is to unravel the impact of holography on user experiences and its implications across diverse sectors. The project aims to address the challenges and opportunities in integrating holographic technology into these three distinct domains.

The research employs a multifaceted methodology, incorporating cutting-edge holographic projection techniques based on detailed experimentation and development of holographic systems tailored for human representation, product showcasing, and educational content delivery form the foundation of the research design.

Results reveal the efficacy of holographic representations in creating lifelike human avatars, enhancing product visibility and engagement, and revolutionizing educational models for improved learning outcomes. The conclusions drawn underscore the transformative potential of holographic technology in reshaping user experiences, market dynamics, and educational paradigms.

In the recommendations section, the thesis suggests the integration of holographic technology into retail spaces for enhanced customer interactions and proposes its incorporation into educational institutions to augment traditional learning methods. Additionally, recommendations advocate for the integration of holographic technology in various sectors, emphasizing the need for standardized platforms, content creation guidelines, and educational curriculum enhancements to fully exploit the benefits. The thesis encourages stakeholders to invest in holographic infrastructure and training programs to facilitate widespread adoption and the thesis advocates for continued research and development in holographic applications to unlock further possibilities

In the future work section, the project envisions continued exploration into refining holographic technology for hyper-realistic representations, exploring potential applications in medical training and remote collaboration along with potential advancements in interactive communication, expanded product showcasing capabilities, and enhanced educational tools . It raises questions about ethical considerations in creating realistic holographic avatars and suggests further interdisciplinary research to address technical challenges and societal implications. The results pave the way for a future where holograms seamlessly integrate into our daily lives, transforming the way we connect, learn, and experience the world.

Chapter 6

6.1. Conclusion:

Success of Manual 2D to 3D Conversion: It was found that the method of manually converting 2D images into 3D images was both feasible and effective. The photographs' visual attractiveness was improved by the methodical process used to recreate a three-dimensional representation and extract depth information.

Efficacy of Holographic Face Projection: Holographic face projection's effectiveness was shown by its use as a display mechanism, which allowed for the creation of immersive visual experiences. An immersive user experience was enhanced by the projection's ability to realistically and subtly portray the depth and realism of the converted 3D visuals.

Control of smartphone App: Users had a pleasant and easy-to-use interface when the holographic face projector was controlled by a smartphone app. User interaction and pleasure were improved by the easy editing and customization of the presented 3D pictures made possible by the seamless integration.

User Input and Engagement: Results from user testing indicated that the 3D picture conversion and holographic projection were well received. Users praised the technology's innovation and voiced excitement about its possible uses in a variety of contexts, such as communication, education, and entertainment.

Challenges and Learnings: Overcoming difficulties in the manual conversion procedure and resolving holographic face projector technological complexities provided insightful information. The project team's expertise in debugging and optimizing the system for peak performance led to a greater comprehension of holographic projection technologies and 2D to 3D conversion.

6.2. Recommendations:

Automated Conversion Improvements: To simplify and accelerate the creation of three-dimensional representations, look into ways to automate certain parts of the 2D to 3D conversion process. This might entail incorporating machine learning algorithms to facilitate more effective depth mapping.

Improved Mobile App User UI: Make an investment in creating a feature-rich and easy-to-use mobile app UI. To improve the user experience and provide users more direct control over the holographic projections, include extra controls, customization choices, and augmented reality aspects.

Increase Content Compatibility: Increase the system's capacity to handle a greater variety of content sources and formats. This could entail developing the mobile app's functionality to interact with well-known content-sharing networks and improving the software to analyze various kinds of 2D images.

User Education and Outreach: To increase public knowledge of the technology and its possible uses, create educational resources and outreach initiatives. Assist users in making the most of the technology by offering resources and lessons, and create a community around the creative potential of holographic projection and manual 2D to 3D conversion.

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