

ADVANCED HAPTIC AND HOLOGRAPHIC INTERFACE FOR 3D VIDEO CALLING

HARIHARAN S

Information Technology, Toc H, veliparambil house, janatha road, vytila p.o. Kochi, Kerala, INDIA
E-mail: snarahirah@gmail.com

Abstract—The video calling is a process of talking between two or more users face to face. The currently available video calling is mostly based on the 2D video calling. The proposed Video calling (using Holographic Projection, Image processing, gesture recognition, video processing, SOA web services, Point source algorithm, Haptic Technology and Depth analysis algorithm) is based on the 3D video calling to provide a real like face to face communication. The holographic projection technique is used to store the 2D image stream of the video in holographic image frames and project the 3D holographic frames to the air. So that, the actual object in the 2D video can be projected into the air as 3D object. In the proposed video calling, the atmospheric air is considered as the obstacle to project the 3D holograms. The HAPTIC Technology is used for the realistic conversations like hand shake, touching... The user can touch; adjust the other user of the system using this Haptic Technology. The proposed system is a glass less holographic and Haptic Technology base air projected system. In this video call, the 3D depth data is read using the depth analysis algorithm. Image processing technology is used to map the 3D texture to the 3D models. Gesture recognition technology is used to identify the gestures of the user. Light Blue Optics technology is used to turn the projected screen into a touch sensitive touch screen. SOA web services are used to find the details of the things through web services. Video processing technology is used to find the exact positions of the objects in the video. The point source algorithm is used for the 3D reconstruction of the 2D image frames and real time HD video processing. The background subtraction algorithm is used to remove background from the 3D video. A projector is used to project the video and a camera is used for the video calling. The leap technology is used to do easy copy and paste process.

Keywords— Holographic image frames; Haptic Technology; Light Blue Optics; gesture recognition; Leap technology; SOA web services

INTRODUCTION

There is lot of way to video call. Example 2D video call, 3D video call, video chat and etc...The proposed Video calling using holographic projection is specially designed or the 3D holographic video call to make the user feel real like conversation experience. This proposed system is also provides some additional features such as copy from any and paste to any using leap motion technology and etc... Currently there is no any solution for 3D glassless HD holographic video call with less delay. But, the proposed video calling using the holographic projection solves it. The holograms are a photographic record of the light. Holograms are used to display full 3D objects. To view holograms, the external glasses or any other devices are not required. Holograms require laser for the illumination purpose. Illumination is donned to store the holograms. The main advantage of hologram is that, the complete microscopic level details of the object being recorded can be reproduced. Holography is a lens less photography. In holography, the reconstruction is the process of displaying the recorded holographic images to the user. For this, we use photographic plate, virtual object and we also illuminate rays. The rays coming from the virtual object and reconstructed ray are combined and reflected towards the user. As a result of this reflection, the user will see the actual object in 3D.

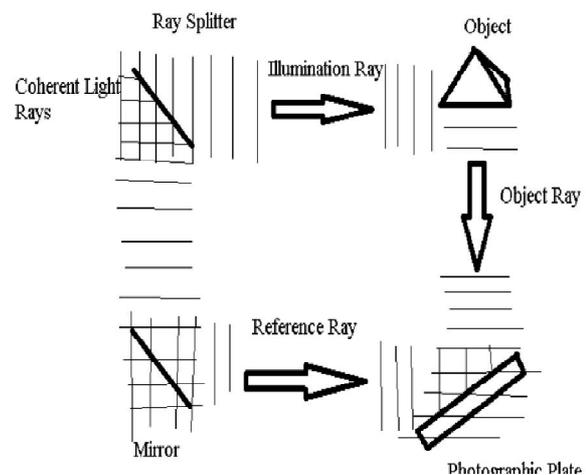


Fig 1: Holography Working

The ray splitter is used to split the number of rays coming from the coherent source lasers. The split rays are illuminated to the 3D object. As a result of this illumination, the object will pass its rays to the photographic plate. The reflected rays from the photographic plate will reach the mirror. The reflected ray from ray split is also reached to the mirror. As a result of this two reflected rays, the mirror will reference the actual 3D object back to the photographic plate. The photographic plate will then store the hologram. When a user calls another user using this proposed video calling using Haptic and projection technology, the user can view the actual

realistic 3D object, video of the ser at the other end with very less latency and very high accuracy.

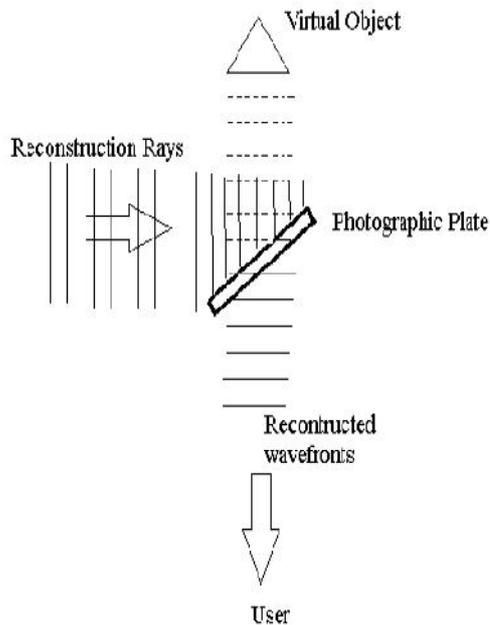


Fig 2: Hologram Recording

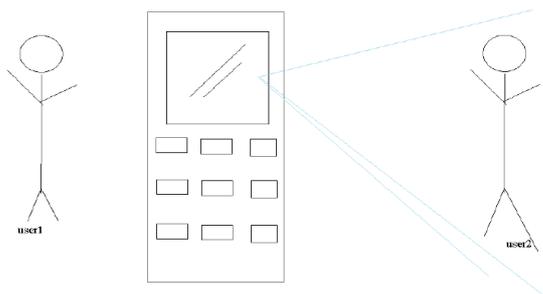


Fig 3: Basic holographic video chat

The basic system architecture of the video calling using Haptic and projection technology is shown below. It consists of two camera, two projector, two computers, two users. When the user starts video call, the 2D video will be converted into 3D and passed to the other side user. The other side user will view the projected 3D projection of the other user.

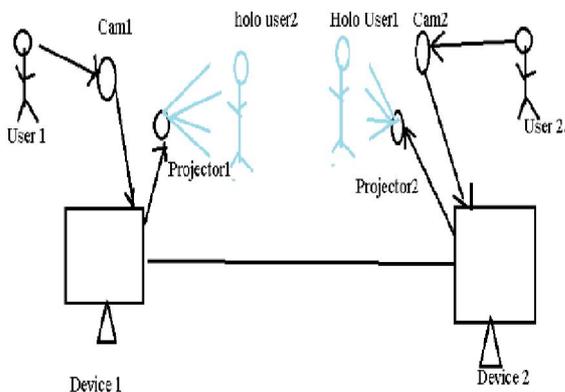


Fig 4: System Architecture

HOLOGRAPHIC PROJECTION

The functions are holographic processing, holographic storage and holographic retrieval.

Holographic Processing

In holographic processing, the 2D video is converted into 2d frames and the 2D frame is stored into 2D frame buffer. From this 2D frame buffer, the frames are converted into 3D holographic frames. Holographic processing uses mirrors for the conversion of the 2D frames into 3D holographic frames. Two types of mirrors used are partially reflective mirror and full or completely reflecting mirror.

Holographic Storage

The 3D holographic frames are stored in the frame buffer. Sequence numbers are used to identify the correct sequence of the holographic frames to combine and produce 3D.

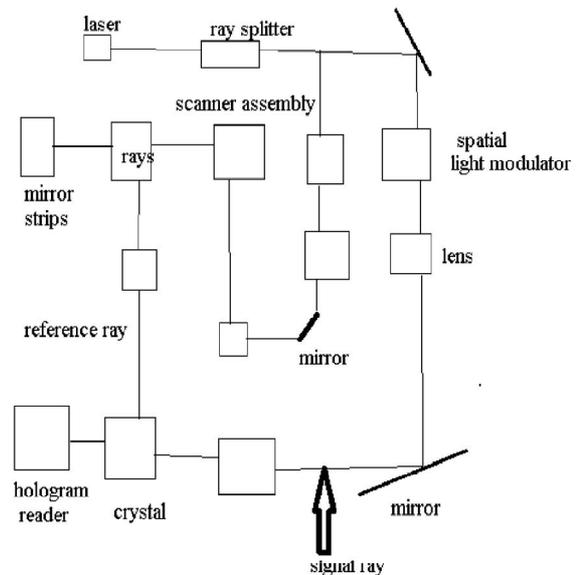


Fig 5: Holographic storage

The holographic storage is consists of laser, rays, scanner assembly, reference ray, hologram reader, crystal, signal ray, mirrors, lens, spatial light modulator and ray splitter. The incoming coherent rays will be split and allowed to pass through mirror to the modulator to improve the strength of the rays. Lens and mirrors are used to pass the rays to the crystal and the holographic read will read the data. The crystal will transfer the rays through scanner assembly. The scanner assembly will transfer the data to the ray splitter through the mirror reflection.

Holographic Retrieval

The process of taking the 3D frames from the 3D Holographic frame buffer and combining them and producing holographic video and pass it to the output device is referred to as holographic retrieval.

IMAGE PROCESSING

The main functions are depth data calculation, 2D to 3D conversion, 3D reconstruction.

Depth Data Calculation

In depth data calculation, the depth data is calculated from the 2D video. Depth data is calculated for the 3D reconstruction of the 2D video

2D to 3D conversion

Using the calculated depth, height, width parameters, and the 3D model is created.

3D reconstruction

In 3D reconstruction, the 3D objects of the 2D images are created.

GESTURE RECOGNITION

The main functions are Add prototype, prototype management, gesture management. Gestures are two types, online gesture and offline gesture. Online gesture, these are the direct manipulation gestures used to scale, rotate a tangible object. Offline gesture, these are the gestures processed after the interaction with the actual object. A standard 2D camera can also be used for the gesture recognition. The different algorithms for the gesture recognition are, 3D model based algorithm, skeletal based algorithm, appearance based algorithm. The all above mentioned gesture recognition algorithms are used in video calling using Haptic and projection technology.

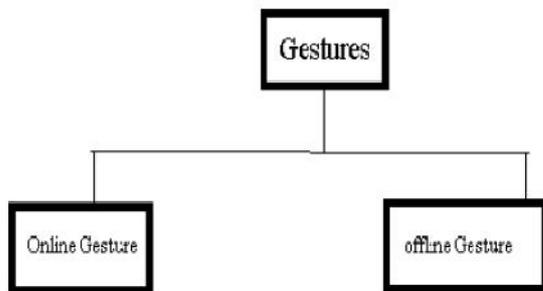


Fig 6: gesture types

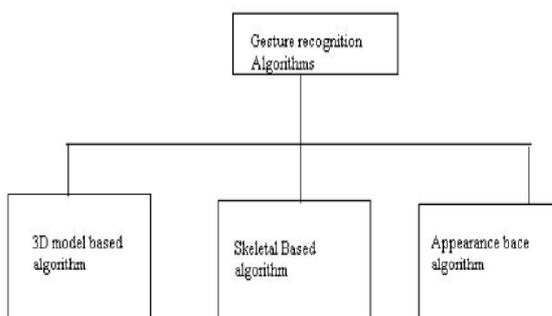


Fig 7: gesture recognition algorithms

Add Prototypes

In this, new prototypes are added to the system. Where, prototypes are used to control the activities of the system with the help of gesture.

Prototype management

All the available prototypes are managed using this prototype management service. In this, an available prototype can be removed, managed. This also provides a provision to add new prototypes.

Gesture Management

In gesture management, all the predefined gestures are managed. Each gesture is associated with a prototype. That is, for each predefined gesture, a corresponding prototype should be executed.

VIDEO PROCESSING

The main functions are tacking Caller, background subtraction.

Tracking Caller

In this, the video processing algorithm is used to identify the user using the face tracking and object tracking algorithms. That is, it is used to track the other side user.

Background Subtraction

Background subtraction is used remove the background from the user object

SOA WEBSERVICE

The main function is personal details tracking.

Personal Details Tracking

The personal information of the person can be tracked using the SOA web service if the user details are available on the Google database.

DEPTH ANALYSIS

The main function is depth data management.

Depth Data Management

Using the previously calculated depth data, point source algorithm and depth analysis algorithms are used to optimize the depth data. The combination of this two depth algorithm will produce more accurate depth data calculation.

BACKGROUND SUBTRACTION

The main functions are object tracking, background identification, background management.

Object Tracking

In object tracking, the object from the video source is tacked using object detection and face tracking techniques.

Background Identification

Using the tracked object, the system will easily identify that the portions of the video other than the object tracked are background.

Background Management

The identified Background's visibility is set to true to make the background invisible.

LIGHT BLUEOPTICS

The main functions are mouse control management, keyboard management and touch management. The main aim of the light blue optics is to convert the projected screen into a touch screen.

Mouse control Management

In mouse control management, the hand gesture is used as the mouse input to the system. The different gestures used for controlling the mouse functions were managed. The hand gesture is used with the projected screen.

Keyboard Management

The Hand is used for the keyboard typing on the projected screen. The corresponding ASCII of the character will be passed to the system using signal processing technology.

Touch Management

Touch management is used to manage the projected screen when touching it, operating it by using the hand.

LEAP TECHNOLOGY

The main functions are drag and drop management, copy from any and paste to any, making anything and doing anything.

Drag and Drop Management

This function enables the user to simply drag any information from any source such as news paper, drawing and etc... and drop the information to any source such as paper, computer, etc.

Copy from any and Paste to any

Similar to drag and drop, copy paste is also possible between different computers using hand gestures.

Make anything and Do any thing

Using this function, we can make any surface into a computer and do any operations within the computer. That is we don't even carry our laptop or pc any time to do anything.

HAPTIC TECHNOLOGY

The main functions are force feed detection, force generation and force processing. The Haptic means a magical or invisible force or vibration. The Haptic

technology can be implemented by using stepper motors and cameras.

Force feed Detection

Force feed detection is used to detect the force of the user used to touch the holographic video.

Force Generation

The detected force will be generated using the system and the same amount of force will be given to the holographic object to produce the real touch experience.

Force processing

Force processing is used to pass the user 1 force to the user 1 holographic video and user 2 forces to the user 2 holographic video.

SIGNAL PROCESSING

The main functions are touch signal detection, touch signal transmission, event signal retrieval.

Touch Signal Detection

This function is used to detect the key pressed by using the hand in the projected screen. That touched key is taken as signal

Touch Signal Transmission

The key pressed signal is transmitted to the system to produce its event of the key press.

Event signal Retrieval

The produce event signal is retrieved and transmitted back to the projected screen.

WORKING

The system will use air as obstacle to project the 3D object to the air. This enables realistic appearance of the object. The water vapours are use to maintain the stable state of the air particle to maintain the projected object. The 2D video taken from the 2D camera is splitted into 2D frames. This 2D frames are converted into 3D frames and this 3D frames are combined to produce 3D video. The converted 3D video is sent to the 2D projector. The Projector uses will project the video on the air. To hold this laser ray on air, we improve the weight of the air particle using water vapour and rainbow method. Thus, we will get a 3D mid air projected video without glasses. To touch the projected 3D object, we use haptic technology. Haptic technology is used to produce invisible force or vibrations to produce force. In this video calling using haptic and projection technology, we use stepper motors to produce the vibration and force. The motors are controlled by the computer and camera. When the user needs to hug, hand shake, touch, etc... the projected 3D video, the force will be given to the 3D video by using the special algorithm

associated with this video calling using haptic and projection technology. The algorithm is named as Hariharan'S pixel force mapping algorithm. The algorithm detect the pixel position of the boundaries of the 3D projected object. And using this locations, the force from the motors will be applied between the inner and the outer boundary of the projected object. Thus, the projected object gets force. When a normal user touches the projected object, the normal user will experiance the touching of a real thing. That is, while video calling, the user can hug, touch, fight and etc... with each other. In this proposed video calling using haptic and projection technology, when the user in the 3D space fight or beat or slap the physically existing user, the physical user will get the result. That is, he may get pain and damage. This property enables the video calling to a real physical talking between the users. That is, the proposed video calling using haptic and projection technology simply say, no one will miss anyone when they are seperated by distance.

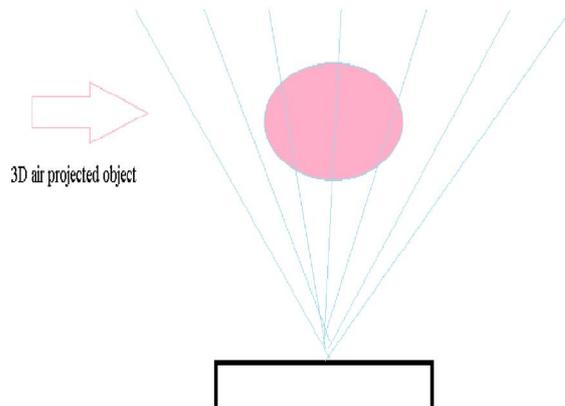


Figure 8: Basic Object Display

CONCLUSION

The proposed video calling using Haptic and projection technology is a multi functional video calling or also can be called as virtual physical conversation. The system uses various latest and advanced technologies to make the experience of the user better. This system will replace all the video calling service because of its features. This system will be implemented within three months.

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