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Design of Image Projection Using Combined Approach for Tracking

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***Abstract*:** *Over the years the techniques and methods that have been used to interact with the computers have evolved significantly. From the primitive use of punch cards to the latest touch screen panels we can see the vast improvement in interaction with the system. There are many new ways of projection and interaction technologies that can reshape our perception and interaction methodologies. Also projection technology is very useful for creating various geometric displays. In earlier generations, the projector technology was used for projecting images and videos on single screen, using large and bulky setup. To overcome the earlier limitations we are designing "Wireless Image Projection Tracking", which is a system that uses IR (Infrared) technology to track the body in the IR range and uses their movements for image orientation and manipulations like zoom, tilt/rotate, and scale. We are presenting a method of mapping IR light source position and orientation to an image. By using this system we can also track single and multiple IR light source positions and also it can be used effectively to see the image projection in 3D view. Extension in this technology can further be useful for future tracking capabilities to implement the touch screen feature for commercial applications.*

Index Terms: *image projection, object's location detection, detection of x, y and z-axis values.*

I. INTRODUCTION

Today, computers and computer-generated images are occupied and used in many aspects of our daily life. Computer imagery especially is found in many media and activities such as presentation materials, newspapers, weather reports, and surgical procedures. The image visualization technology significantly improves the quality and intuitiveness of output information, but input part still depends on some traditional ways such as keyboard typing, mouse pointing and remote controlling. Recently, advancements in input technology in game and mobile fields provide the potential power for inventing more intuitive, natural and easier-to-use human-computer interaction (HCI) methods.

The proposed system allows users to track their finger movements in 3D space by using the Wiimote's built-in infrared camera with an LED array and reflectors. Head tracking is based on a simple concept that there is a base position in which your head is at the center in front of the screen and at a certain distance (predefined) from the screen. Moving left, right, up, down, towards or away from the camera results in the detection of other coordinates (this can be seen as an offset from the center). The values are calculated in coordinates and then its location is calculated by the localization scheme. Also this design will ensure that we can see the 3D image from the 2D input image.

Wiimote is a smart device used for developing a unified human computer interface. It is a handheld device resembling a television remote, but in addition to buttons, it contains a 3-axis accelerometer, a high-resolution high speed IR camera, motion sensor and wireless Bluetooth connectivity. This technology makes the Wii remote one of the most sophisticated PC compatible input devices available today.

The aim of this research is to improve the projector technology in a way that it can be easily applicable at places where more number of projectors are used and the image can be minimized, maximized, tilted, rotated and its 3D view can be viewed. In this research we are proposing a scheme to implement (Infrared) IR light source tracking system which can be used for tracking single and multiple IR light source positions and can be used effectively in optical tracking problems such as tracking head position which is a basic requirement in a Virtual Reality System. We are designing a system that uses IR (Infrared) technology to track the body in the IR range and uses their movements for image manipulations like zoom, tilt/rotate, and scale.

We are presenting a method of mapping IR light source position and orientation to an image. By using this system we can also track single and multiple IR light source positions and also it can be used to see the image projection in 3D view.

II. Literature Survey

Since the introduction of the "Wiimote" work has been done in the area of wireless communication by Johnny Chung Lee, the further researches improved the use of Wiimote. Wiimote is a multipurpose device as it contains multiple devices included with it like IR camera tracker, accelerometer, LEDs, speaker, vibration motor, Bluetooth connectivity, internal flash memory, batteries, expansion port and buttons. The wireless remote also nicknamed as "Wiimote" is a smart device which has multiple features [1].

For converting the Wiimote readouts to the position and orientation of the corresponding mobile unit based on major axes identification, coordinate transformation, and position updating. The scheme and the algorithm are validated by tracking the Wiimote location on a two-axis linear servomotor. The 2D IR source location sensing was designed by D. Gu, Y.-T. Fu, K.-S. Ou and K.-S. Chen [2].

The head location tracking is used with Wiimote to track the head behind a computer screen. Also the tracking method was use in Windows with the use of Windows based OpenGL and made it as a library which can be used in any OpenGL application. The application is created with the use of Direct X and the Microsoft Windows operating system was presented by Bharat L, Shashank S, Nageli V S, Sangeeta Shrivastava and S Rakshit [3].

The two handed surface-less interaction for presentation based on infrared based point tracking was then developed. It contributed a robust method for pairing and pinching that allowed to detect hands and and their actions. It was useful to work with slide decks, images and videos. Luc Vlaming, Jasper Smit, and Tobias Isenberg presented this interaction with hands which showed rotation and scaling using hand gestures and movements of fingers and handle the images videos and slide presentations. It also presented geometric transformation methods for rotation of objects and also for translation and scaling [4].

Hector Vragas, Enrique Preza, and Ramiro Velazquez proposed a method to detect the working area of the Wiimote and also useful for tracking positioning and tracking of the small aerial vehicles. It also showed a method of 3D tracking using the Wiimote [5].

Thus by surveying the previous work done we are proposing a design for wireless image projection tracking.

III. Research Methodology

Infrared communication has high directionality and can identify the person with whom you are communicating. Compared with the wireless communication with a maximum speed of about 100 Mbps, the infrared communication has a potential of 1 Gbps. The IR LEDs are used as IR sources and as IR sensor we used Wii Remote. IR is used to provide a range for the system such that it can be used inside that particular range only. Using the Wii Remote's built-in camera, the position and orientation of the Wii Remote in 3D space can be calculated by tracking four known infrared (IR) LEDs (LED - Light Emitting Diode) positions and then relating these values to the reported position retrieved from the camera. It can be utilized as a tracking device. We can set up expressions that linearly transform IR LEDs from a known position in the global coordinate space into the camera's coordinate space.

Bluetooth is a wireless technology standard for exchanging data over short distances. Bluetooth operates in the range of 2400–2483.5 MHz. This is in the globally Industrial, Scientific and Medical (ISM) 2.4 GHz short-range radio frequency band. Bluetooth is used to establish the communication between the IR transmitter, smart device and the computer. Communication is established using the Bluetooth protocol. The software aspect of this communication is handled by the Bluetooth Stack which should be installed in the system.

Object positioning is used to track the position of the objects in the form of IR reflectors. Smart device is proposed to act as finger and gesture tracking sensor to manipulate the image operations like scaling, rotating and zooming. The position and orientation of the corresponding object is based on major axes identification, coordinate transformation, and position updating. These values are used to locate the object and image processing will be used for image manipulations.

For head tracking the camera detects two IR points which are placed on the two sides of the goggle and translates these to two coordinates onto the plane. The camera takes in the coordinates of the IR sources and translates this into an absolute movement with respect to the default position of the head.

The present module is the communication between the computer and the wiimote. It consists of the interfacing program. The interface here is Bluetooth technology. With the help of the Bluetooth technology it becomes easier to both track and transfer the information. The next module is the event activation which is the activation of the buttons in the wiimote. The future module is the finger tracking and its related events activation. It will be an approach for wireless mouse. The final module will be the 3D view generation. It consists of the generation of the Z-axis of the 2D plane.

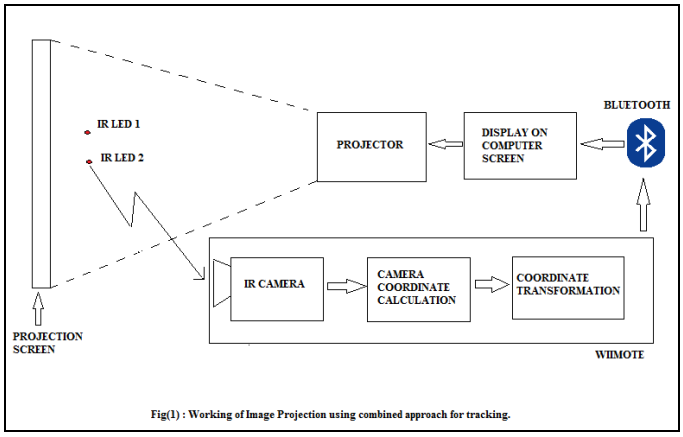
The modules work in combination to form the Projection of wireless image using tracking. Hence every parameter to be measured and calculated is to be accurate for the proper functioning of the whole system.

In order to operate the system, the WiiMote must be connected to the operating laptop. The WiiMote communicates with the laptop via Bluetooth, therefore the laptop must have accessibility to Bluetooth devices, in case the laptop doesn't have that ability, it is necessary to connect a Bluetooth USB dongle that will enable the Bluetooth connections. Generally the Bluetooth accessibility is inbuilt in the today's laptops still for accurate working of the setup we use Bluetooth dongle.

The idea is that the detected distance between the object vs. the distance of the center of the other object from the IR camera is being mapped. Then a curve fitting is being used to find a good approximation formula that will represent the distance from the screen by detecting the distance between the two objects.

IV. Working Diagram

The working diagram shows the generalized working of the image projection of image using combined approach for tracking.



Fig(1) : Working of Image Projection using combined approach for tracking.

The fig.(1) has a wiimote which consist inbuilt camera and the camera coordinates are calculated by the wiimote. The calculated values are sent to the computer using Bluetooth. These calculated values are given to the computer or laptop for viewing. This laptop or computer is connected to a projector which projects this tracked values and operates according to the tracked operation.

V. Algorithm

The algorithm for this system is as follows:

1. Detect the object in the range of the camera. Check whether the object is detected by the camera by seeing the help of a dot point in the detection screen.
2. If object is detected then keep the wiimote stationary and record the coordinate values in a table.
3. Now change the location of the object and then repeat the step 2.
4. Keep changing the wiimote location and record the x, y and z coordinate values.
5. Check the events of the wiimote by pressing each of the buttons and also check whether the appropriate box gets clicked or not.
6. If the events are properly working then we will use this device to operate as wireless mouse and run paint application by using its events buttons.

This algorithm is the modification of the base paper's algorithm [1]. The existing algorithm was only using this for head tracking but its modified version is used for the projection and tracking in our experiment.

VI. Expected Outcome

The result of this research will be that we can have an easy and efficient interaction between human and computer also it will reduce the bulky setup and improve the projector technology. Manipulation of the image and 3D view will be projected on the screen.

VII. Future Scope

In future this research will be helpful in the following ways:

1. Image can be stored in the viewer's screen.
2. Image can be transmitted to other communication systems.
3. Can be copied on the projector itself.
4. Outputs to multiple screens.

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