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SIGN LANGUAGE BASED TELEVISION CONTROL SYSTEM

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Abstract:

Sign language based television (TV) control system is attracting more and more researchers. Sign language algorithm and its corresponding user interface were focused by most of the existing systems, while the computational cost and the consumption of power is not taken into consideration. The camera devices and the gesture recognition module often consume more energy and high cost, and also it will have some malfunctions during the night times. This paper proposes an automatic recognition and controlling through sign language methods. The new approach of controlling TV using array of Ultrasonic sensors helps the user to perform basic graphical control like channel adjustment, increasing and decreasing the volumes etc by moving their hands. These types of UV based control system could provide a user a more sophisticated and independent life.

Key Words: Sign Language, Gesture Recognition, Ultrasonic Sensor, Doppler Effect & TV Control

1. Introduction:

In this section Gesture recognition has gained a lot of importance since few years. Various applications can be controlled using gestures. Face gestures like lip movements is used to recognize the language spoken, hand gestures are used in various applications like gaming, mouse control etc. In an application like robot control using hand gestures, the robot responds to hand gestures given by the human. This hand sign of humans is visually observed by robot through a camera. The algorithm that enables the robot to identify the hand gesture from the image is of interest. In this present era, the number of devices have increased manifold as well the degree of interaction involved with these devices has also increased.

Although there are devices which use techniques like motion detection for interacting with the user, most of them involve the use of some kind of hand held accessory. This becomes troublesome on the part of the end user. This is where gesture recognition and control techniques come into picture. Our goal is to build computers and machines which are easy to use. Machines may be easier to use if we could operate them through natural language or gestural interactions. Focusing on a concrete instance of the general problem, we study how to operate a television set remotely. This is a familiar, yet useful problem. People value the ability to control a television set from a distance. In a survey, Americans were asked what high technology gadget had improved their quality of life the most. The top responses were microwave ovens and television remote controls. Television (TV) is widely used all around the world. Till now, the TV display screen has been innovated for several generations while the TV controller keeps nearly unchanged during a long period. Recently, with the 2 enrichment of TV programs, more and more frequent controlling operations such as channel switching and program searching are required, which makes the traditional point-click-style hand-held TV controller inconvenient. Taking the channel switching for example, it requires the user to lower his/her head to first see and then press the small buttons. Next, he/she needs to look up at the TV screen to see whether the program is the expected one. Otherwise, he has to repeat this process to switch the channel.

Contemporary hand-held television remote controls are very successful, yet not without awes. They can be lost. There is a small industry for products related to losing remote controls replacements remotes, devices which indicate where the remote control is, and televisions which locate the remote control. Even if the remote control is not lost, it can be an inconvenience to have to get it from another part of the room. It is reasonable to study additional ways to control the television remotely. That's why this system is used to controlling the television by using the sensor and hand gesture. Generally, with respect to the energy consumption, two aspects are considered: the sensor device, e.g., a red-green-blue (RGB) camera or a depth camera, and the gesture recognition module

The objective of this project presents a system that detects the hand gesture motions using the principle of Doppler Effect. Ultrasonic waves are transmitted by a sensor module and are reflected by a moving hand. The received waves are frequency shifted due to Doppler Effect. These frequency shifts in the ultrasonic waves are characterized to determine gestures. The gestures once recognized are mapped into commands to control the operation of television. Current research work spans only five gestures: Turning on, Channel increase and decrease, Volume increase and decrease.

2. Related Work:

Gesture recognition is an art of computer science and language technology human gestures interpreted using various mathematical algorithms. Current focuses in the field include emotion recognition from the face and hand gesture recognition. There exist many techniques that use cameras and computer vision algorithms to interpret sign language. Proposed method uses a camera, a mobile ARM platform and computer vision technology, such as image segmentation and gesture recognition, to control TV operations such as changing channels, increasing or decreasing volume etc. For processing the images we implemented the code using Open CV library. Hand detection is one of the important stages for applications such as gesture recognition and hand tracking. In this project, it proposes a new method to extract hand region and consequently the fingertips from colour images. In this work, we are using hand gestures to control the Television operations such as increasing or decreasing the volume, changing the channels. In this project camera is connected to the ARM board through camera expansion connector. The image captured by 10 cameras will be processed to recognize the gestures. After processing the gestures the manipulated signals will be sent to the Television set controller to operate according to gestures.

Television is a representative system for this kind of interface because of its complex requirements for various functions. Icon-based interfaces are the general method used. However, according to the performed survey, various functions were Manipulate the gesture to control TV parameters Send Controlled output to the TV set using HDMI Cable Correct gesture. START Capture the input using camera. Camera is connected to the panda board using camera connector Process the input for Gesture Recognition No Yes 11 not required for watching TV. So far, however, the following obstacles still need to be solved. 1) It is difficult to achieve competitive price and performance for high-end sensor units compared to low-end remote controls. 2) Dedicated hardware or motion recognition is absent. Resource allocation is required to process sensor signals. 3) Lastly, the user interface provides low usability.

The main drawbacks of this system are as follows: Camera suits only for normal and bright light conditions and not for low light and night use. The system fails to distinguish the movement of hands from the movement of any other skin colour object in the background and Need extensive computing algorithm in a heavy system.

A. Gesture Recognizing Hand-Held Interface with Vibrotactile Feedback for 3D Interaction:

This project presents a hand-held interface system for 3D interaction with digital media contents. The system is featured with 1) tracking of the full 6 degrees of freedom position, 2) robust gesture recognition using continuous hidden Markov models, and 3) dual-mode vibrotactile feedback using both vibration motor and voice-coil actuator. This hand-held 3D interface system consists of a remote controller and a PC with a camera. The remote controller works as a 3D hand-held interface, and has a 3D accelerometer that senses the acceleration of the movement of the user's hand holding the controller. An optical marker that has four infrared (IR) light-emitting diodes (LEDs) in a tetrahedral configuration is installed in front of the controller to track its 3D position and orientation via the camera on the PC. Bluetooth is used for communication between the controller and the PC. The PC runs a server program for applications. For 3D interaction, the acceleration of the remote controller and the status of controller buttons received via Bluetooth are fed to related modules. The server also reads images from the camera with an IR filter that captures the IR LED marker on the controller, processes them, and obtains the full 6 DOF pose of the remote controller. The Advantages of this system is Tracking of the full 6 degrees of freedom position and orientation of handheld controller and Dual mode vibrotactile feedback. Few Drawbacks are Requires API and additional hardware and Accelerometer to be carried everywhere.

B. A Realistic Game System Using Multi-Modal User Interfaces:

This project proposed a realistic game system using a multi-modal interface, including gaze tracking, hand gesture recognition and bio-signal analysis. The research is novel in the following four ways, compared to previous game systems. First, a highly immersive and realistic game is implemented on a head mounted display (HMD), with a gaze tracker, a gesture recognizer and a bio-signal analyzer. Second, since the camera module for eye tracking is attached below the HMD, a user's gaze position onto the HMD display can be calculated without wearing any additional eye tracking devices. Third, an aiming cursor in the game system is controlled by the gaze tracking` Finally, the level of difficulty in the game system is adaptively controlled according to the measurement and analysis of a user's bio signals. This research presented a realistic game system using a multi-modal interface based on gaze tracking, gesture recognition, and the measurement of bio signals, such as PPG, GSR, and SKT. To calculate the gaze position, designed the gaze tracking module which was attached below the HMD. The gaze tracking is used for the navigation interaction in a game. The gaze tracking is used for the navigation interaction in a game. The gesture recognition was performed by a commercial data glove, which was used to perform the selection events in the game. The bio-signals were used for adjusting the level of difficulty of the game. The proposed method provided a higher effect on experiencing immersion and interest to users, compared to the conventional mouse. The Advantages of this system is Gaze tracking operational protocol is similar to that of a conventional computer mouse and Its throughput is very high compared to that of the hand operation based conventional input devices, such as a mouse, a keyboard. The Drawback is Complex due to Head mounted display always on head and it's suitable only for gaming experience.

C. Actual Remote Control: A Universal Remote Control Using Hand Motions on a Virtual Menu:

This project presents a wristwatch-type of remote that offers a unified way to control various devices. Total of seven gestures that are based on hand motions are defined. These seven gestures are suitable to the wearable wristwatch-type device.. Gestures are not designed and analyzed in a discrete manner; instead, they are designed in continuous hand motions and analyzed in gesture commands. Also, a method of modelling a virtual menu from the menu on a consumer electronic device is introduced. With the virtual menu, the user is able to control various devices by using gestures. The virtual menu has to reflect hand motion characteristics and represents functions of electronic appliances. The virtual menu is implemented in XML to represent the basic menu construction and its properties. In order to use virtual menu, we introduce how a user's hand motions can be used in a fast and effective way. Finally wearable remote control compared to conventional remote control through user tests in terms of user convenience and efficiency. The advantages are designing simple and effective hand motion gestures for controlling devices, and Able to perform many gestures. Few disadvantages are IrDA is an invisible light; changing the radiation angle gives tradeoffs between convenience and accuracy. And its requires the user to hold or wear a device which may be difficult to found sometimes in a big room.

D. Expanding kinds of gestures for hierarchical menu selection by Unicursal Gesture Interface:

This project presents Unicursal Gesture Interface (UGI) which is a thumb gesture to expand the number of gestures possible from a TV remote with a touchpad. The Unicursal Gesture Interface as a new gesture-based interface which easily combines with the standard gesture-based interface on handheld devices with touchpad. UGI allow user to comfortably access hierarchical menus such as EPG or VOD. It can be expected that that users, who frequently used handheld devices with touch pads in daily life, can input commands of the UGI without looking at the device. UGI pairs a shape with orientation to create a command. The shapes are unicursal figures whose paths start and end at the same position and that are easy for the user's thumb to remember. Since Swipe, Drag and Micro Roll are gestures whose paths start positions differ from their end positions, users can combine UGI with the gestures commonly offered by touchpad interfaces. UGI allows users to 8 enter different shapes to directly access different layers of a hierarchical menu without explicitly switching layers. Advantages are use of Unicursor Gesture Interface (UGI) to expand the number of possible gestures and UGI allows user to access the different layers comfortably. The disadvantages are training was needed, to make the gesture in a precise manner and requires the user to hold or wear a device which may be difficult to found sometimes.

E. Low-Cost Visual Motion Data Glove as an Input Device to Interpret Human Hand Gestures:

Motion data gloves are frequently used input devices that interpret human hand gestures for applications such as virtual reality and human-computer interaction. However, commercial motion data gloves are too expensive for consumer use, and this has limited their popularity. This project presents an inexpensive motion data glove to overcome this obstacle. For real time performance and convenience, the 3D hand motion estimation algorithm is designed as a closed analytical form instead of using a nonlinear iterative approach. For real time performance and convenience we designed the 3D hand motion estimation algorithm as a closed analytical form instead of using a nonlinear iterative approach. Performance evaluations verified that our algorithm has a lower and more consistent computing time relative to nonlinear iterative-type algorithms. The reduced computing time is useful for real-time applications, and the more consistent 9 computing time makes it possible to predefine the number of processed image frames per second. The advantages are reduced computing time for real time applications and Low cost visual motion data gloves. Disadvantage is motion data gloves need to be wear always, which makes user uncomfortable

3. Our Contribution:

The state of art of human TV interaction presents the facts that for controlling the TV processes gestures of various types of hand movements have been used. As gesture recognition technology has improved, it has been applied to various consumer appliances to provide natural interfaces. Television is a representative system for this kind of interface because of its complex requirements for various functions. Icon-based interfaces are the general method used. However, according to the performed survey, various functions were not required for watching TV.

Gesture recognition is a topic in computer science and language technology with the goal of interpreting human gestures via mathematical algorithms. Gestures can originate from any bodily motion or state but commonly originate from the face or hand. Current focuses in the field include emotion recognition from the face and hand gesture recognition. Many approaches have been made using cameras and computer vision algorithms to interpret sign language. However, the identification and recognition of posture, gait, proxemics, and human behaviours is also the subject of gesture recognition techniques.

This work found most viewers mainly tend to use some specific functions such as channel or volume. These functions should be controlled easily and quickly since they are frequently used. However, the icon based interface has difficulty fulfilling this requirement since it is affected by Fitts' law. Hence, this paper proposes a gesture based method for easy and quick control. Gesture recognition can be seen as a way for computers to begin to understand human body language, thus building a richer bridge between machines and humans than primitive text user interfaces or even GUIs (graphical user interfaces), which still limit the majority of input to keyboard and mouse. This system detects the hand gesture motions using the principle of Doppler Effect.

Ultrasonic waves are transmitted by a sensor module and are reflected by a moving hand. The received waves are frequency shifted due to Doppler Effect. These frequency shifts in the ultrasonic waves are characterized to determine gestures. The gestures once recognized are mapped into commands to control the movement of a small robot. Current research work spans only four gestures: front movement, back movement, move left and move right. In order to recognize hand gestures, the principle of Doppler Effect is used here. An ultrasonic wave of frequency 22 KHz is generated with the help of an ultrasonic sensor. When a hand is waved near the source of Ultrasound wave, there is shift in the frequency of the sound wave, due to Doppler Effect. The received signal is then analyzed for characteristic shifts to determine whether the motion was push, pull, clockwise rotation or anti-clockwise rotation.

The system comprises of an ultrasonic pair of transmitter and a receiver. The transmitter transmits an inaudible tone that is reflected by a hand in motion, in proximity. The reflected tone undergoes a frequency shift due to Doppler Effect. This amount of shift is dependent on the velocity of hand. The receiver captures the frequency shifted signals. The signals received are used to characterize the movement of the hand, in time domain. This type of user interface using gesture has advantages of ease of access and human machine interaction. Gestures are a natural form of communication and are easy to learn. The relationship between observed frequency f and emitted frequency f0 is given by

$$f = \left(\frac{c + v_r}{c + v_s}\right)$$

Where, c is the velocity of waves in the air; v_r is the velocity of the receiver in air and v_s is the velocity of the source in air. After each FFT vector is computed, it is further processed to determine the bandwidth of the signals, speed of gestures and motion detection. The detected motions are then converted to commands.

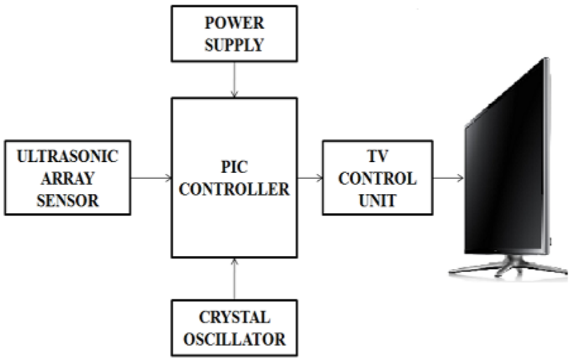

Figure 1: Block diagram for hand gesture based TV control

An ultrasonic module has on board transmitter and receiver. This module is connected to the PIC microcontroller. This popular ultrasonic distance sensor provides stable and accurate distance measurements from 2cm to 450cm. This particular sensor sends out an ultrasonic sound that has a frequency of about 40 kHz. A PIC controller integrates all type of advanced interfacing ports and memory modules. The microcontroller emits the waves at a regular interval through the ultrasonic array sensors. If there is any hand motion occurs, then the ultrasonic waves will be reflected, frequency shifted.

The microcontroller performs a multiplication function to compare the incoming and outgoing signals in hardware. After computing and characterizing the waves, the TV control unit attached to the microcontroller will receive commands from the microcontroller corresponding to each gesture. Then control unit provides control signals to TV such as channel and volume changes according to received commands. This unit consists of a LCD display to display the control action provided by the controller to TV such as either volume or channel changes. Based on the hand gestures the controller will control TV operations.

The below circuit comprises of PIC microcontroller, HC-SR04 Ultrasonic sensor, and two TV and control unit. The sensors TRIG and ECHO pins are connected to the microcontrollers ADC port. The TV control unit is connected to the other input/output port. The ultrasonic waves are emitted and if there is any object obstructing these signals, then the ultrasonic waves are reflected back. The receiver in the ultrasonic module receives the frequency shifted signal at the pin connected to ECHO of sensor. These received waves are buffered and stored in the microcontroller.

The microcontroller analyzes the signal for a pattern. If the pattern matches a gesture in the database, then it further determines the command associated with the gesture. The command is given in the form of logic HIGH or LOW to the pins of the control unit. The processing of the microcontroller is also reflected in the LCD. The gestures determined and the corresponding robotic actions are displayed on the Liquid Crystal Display, simultaneously as the commands are given to the robot.

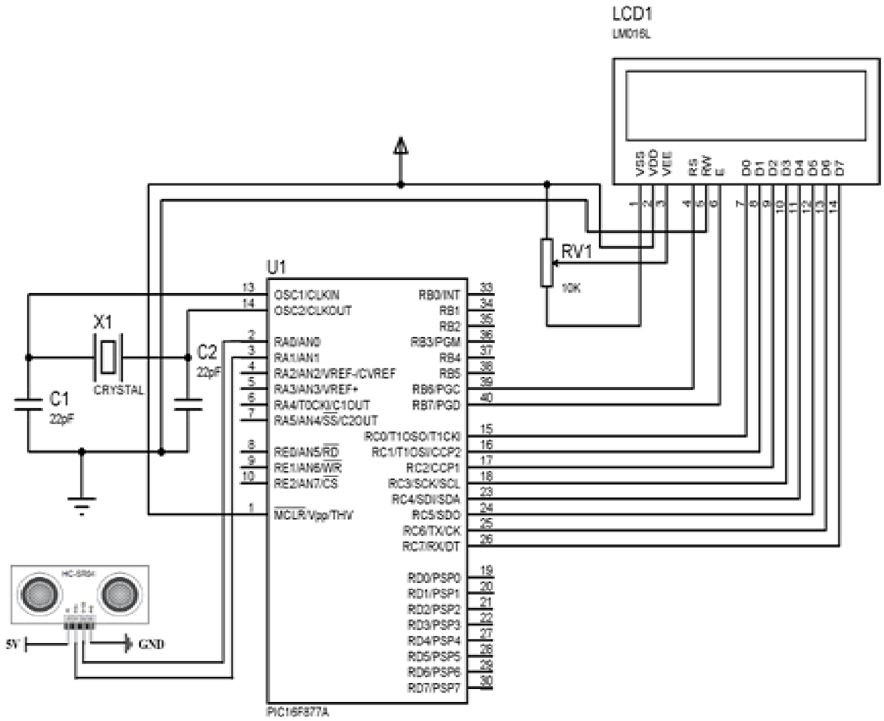

Figure 2: Schematic Diagram

The gestures and corresponding functions that are executed in the current project

Gesture Motion	Function
Front movement	Channel Forward
Back movement	Channel Backward
Clockwise movement	Volume increase
Anticlockwise movement	Volume decrease

Table 1: Gestures and Functions

The gesture patterns used in this project are

Figure 3: Turning on

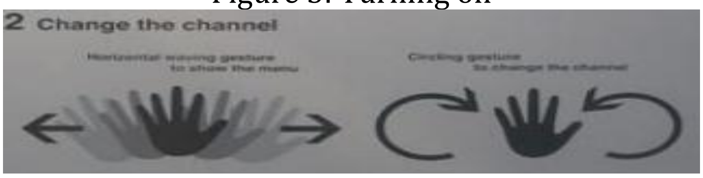

Figure 4: Changing channel

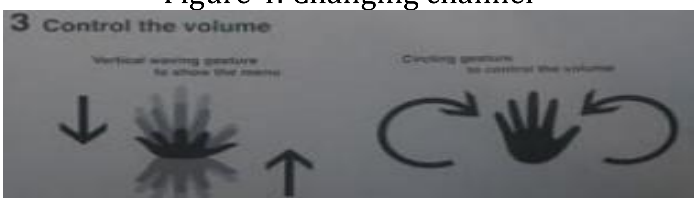

Figure 5: Changing volumes

First Pattern matching is the frequency shift pattern of ultrasonic waves is stored in a database, where each shift consists of different control actions. These patterns are to be used as reference. Second Hand tracking is hand motion is detected, when there is a frequency shift in waves. Then hand detection is analyzed to check whether the detected motion was within one of the six gestures predefined in the database. Third one is Control using gesture, by using these two functions; we can control TV according to the hand motion. Application Areas of Gesture recognition is useful in processing information from human beings that is not conveyed through speech or other methods. This technology is useful in following areas Immersive gaming technology, Control through facial gestures, Alternative computer interfaces, Remote control and Home Appliances control.

4. Conclusion:

A user state recognition scheme is proposed to reduce free-hand TV control's computational cost and power consumption. The proposed model involves static user defined gestures to control equipments like TV, laptop, wheel chair, etc. Additional gesture recognition opportunities exist in medical applications where, for health and safety reasons, a nurse or doctor may not be able to touch a display or track-pad but still needs to control a system. Gesture recognition may be used in automobiles for user control, and among other motivations as an incremental convenience and safety capability. Robots, if trained to recognize some gestures can be used in situations of social needs, like rehabilitation or catastrophe, more independently.

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