Home Appliances Control Based on Hand Motion Gesture

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Abstract – Presently Gestures are used to control domestic appliances in a modern infrastructure. This project focusses on the current use of gestures in domestic appliances and possible usage for various other domains. Various kinds of appliances are used in households, industries and offices. These devices are mostly controlled by human hand with manual switches. A perfect example is the television control by hand gesture. This idea made it possible to switch channel, change the volume with the use of hand gestures. Present technologies available to recognize gestures in free air which uses common methods include cameras, depth sensors or capacitive systems. This work is focused on the study of electric field (E-field) for advanced proximity sensing which is distorted through hand movements. While compared to the other systems this technology can be employed unobtrusively, work through various materials and does not have a high computational burden also. It allows realization of new user interface applications by detection, tracking and classification of the user's hand or finger motion in free space.

Index Terms – Gesture Pad, ARM7, RF Transceiver, Electronic Device (Radio FM).

1. INTRODUCTION

Due to advancement in technology, there is an improvement in living standard, by automating even simple task to complex tasks. User satisfaction and comfort is the main criteria for home automation. Most of the electrical appliances in every modern household are automated providing security, improving the quality of life and providing more comfort.

Home automation is popular as the home appliances are controlled using automation technology, remote control and internet. Home automation is also controlled using gesture, in which the person must be present to control the appliance. A predefined gesture is used to turn on/off the device. Gesture is defined as a motion of limbs or any other body part which are made to emphasize speech. It can also be defined as an act or a remark made as a sign of attitude. A gesture is scientifically categorized into two distinctive categories: dynamic and static. A waving hand means goodbye, is an example of dynamic gesture and the stop sign is an example of static gesture. It is necessary to explain all the static and dynamic gestures over a period of time in order to understand the message. Gesture recognition is interpretation of human motion by the computing device. Hand gesture can be detected by the controller that contains accelerometers to sense tilting and acceleration of movement.

Hand Gesture Recognition is a dynamic area of research. For different applications, different gesture recognition techniques are used. The basic purpose of this system is to provide a means to control electronic devices (capable of infrared communication) using hand gestures. Thus, this system will act like a remote control for operating all the consumer electronic devices present in a house, which is achieved through hand gestures instead of push buttons. Gestures can be recognized by using sensors, accelerometer etc. Accelerometer-based gesture recognition performs matching or modelling in time domain, in which there is no feature extraction. The detected and recognized hand gestures are used as the command signals for controlling devices, some user interfaces, e.g., icon-based interface or motion-based interface, that are adjusted accordingly to support natural hand control.

Hand Gesture Based Remote is a device to replace all other remotes used in households and perform all their functions. Normally in homes, remotes are used to control appliances like TV, CD player, Air Conditioner, DVD Player and Music System. Remotes are also used for ON/OFF control of light, Door Opener etc. All these devices can be controlled by one Universal Remote. Though the technology is synchronized for all remotes (Infrared Transmission and ON/OFF modulation in

the range of 32-36 KHz), there is no agreed convention on code format for data transmission. Communication is established by a predefined code.

2. LITERATURE SURVEY

In recent years, several remote hand-gesture control systems for home-media systems have become commercially available. Such systems aim to augment the living-room media experience and enhance user enjoyment. In this regard, scenarios that call for user identification include interface customization (i.e., facilitating a personalized gesture vocabulary), content adaptation, and parental control. Traditionally, TV-remote content adaptation and parental control are facilitated using numerical passwords.

Hand gesture recognition is implemented for traffic light control system (TLC). Thresholding Algorithm is used for recognition purpose. The accelerometer sensors are used to sense the gesture of hand using ARM based control unit. To indicate the traffic lights, LED's are used. ZigBee, SD card and speaker are used for transceiver, storage purpose and important announcement respectively.

Kishor P Jadhav, Santosh G Bari proposed system for Virtual Switch Control to remove the need to look into the hand held remote and to search for a specific key for specific function. Firstly, camera captures the image of user`s hand gesture & then sends it to PC for further image processing. Images are captured by using camera and are processed using MATLAB. The circuit consists of AVR microcontroller, relay driver IC, relay, camera, PC, USB to TTL converter and load. But it is costly and not user friendly.

A. Hayder, J. Dargham, A. Chekima, J. kela, and P. Korpiaa proposed Soapbox method of Sensing, Operating and Activating Peripheral Box, that has low power consumption. It is equipped with 3-axis accelerometer, an illumination sensor, an electronic compass and an optical proximity sensor. For communication purpose, it is wireless with RF technology and code is developed in C.

In glove based device controlling approach, the exact location and orientation of the finger, coordinates of palm and hand configuration are proposed (Dan & Mohod, 2014). The glove uses flex sensor that bends whenever the hand finger makes particular gesture and it gives variety of resistance. Then the accelerometer measures the motion of the hand, the flex sensor produces analogue output which are converted into digital output using ADC converter (Ghotkar *et al.*, 2012).

The converted digital signals are then sent to computer to process further the gestures into more meaningful information. Even though the glove based system is expensive it has advantages over the other systems because of its high accuracy and fast speed reaction.

3. PROPOSED METHODOLOGY

This project is designed to control a device based on free air hand gesture motion technology. It uses the Hand gesture pad which works on a principle of e-field distortion. With this technology, any device can be controlled by the user. It can bring a reliable assistance and security in electronics sector. ARM7 based microcontroller is used for data analysis and RF communication is used for communicating gestures from pad to the device section. To fulfill the application embedded C programming and tool of Keil µvision is used.

4. DESIGN OF PROPOSED HARDWARE SYSTEM

The problems mentioned earlier are overcome by implementing this system. With the advancement of technology, the previous drawbacks can be overcome by the proposed method.

This proposed system consists of two sections one is the Gesture Recognization section and another is controlling section.

Gesture Recognization section

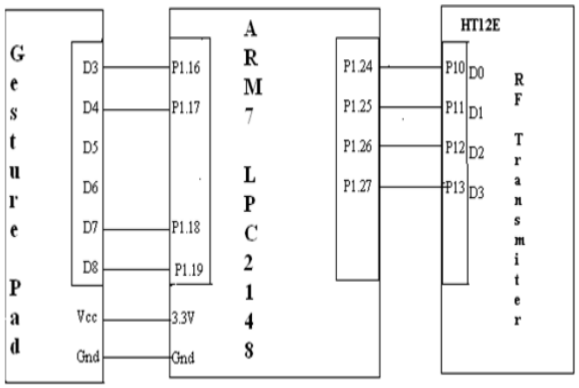

Fig.1.Gesture Recognization Block diagram

Gesture data collection and transmitting is shown in Fig 1. This consists of Gesture pad, LPC2148 microcontroller, RF Encoder and RF Transmitter. Gestures are recognized using IC3130 which is based on Microchip's MGC3X30. It works on the principle of 3D sensor technology which utilizes an electric field (E-field) for advanced proximity sensing. The output data of the Gesture sensor is given to the microcontroller which is then analyzed and sent to the RF Transmitter. Transmitter TWS-434 is used which is extremely small, and is excellent for applications requiring short-range RF remote controls. It needs encoder for isolation between controller and transmitter.

The controlling of home appliances consists of RF Receiver, LPC2148 controller, relay circuit. The data from RF transmitter is decoded by decoder circuit and is transmitted to microcontroller for analyzing. This analyzed data is used to control the device.

5. SYSTEM DESIGN

LPC2148 CONTROLLER:

In this application the main component is Microcontroller, LPC2148 ARM7 based microcontroller. It is ARM7TDMI-S core board microcontroller that uses 16/32-Bit 64 Pin (LQFP) microcontroller LPC2148 from Philips (NXP). Hardware system of LPC2148 includes the necessary devices within only one MCU such as USB, ADC, DAC, Timer/Counter, PWM, I2C, SPI, UART, and etc.

Fig.2. ARM7 Board.

RF Technology

Radio frequency (RF) is a frequency or rate of oscillation within the range of about 3 KHz to 300 GHz. This frequency is used to perform communication or transferring the data, between TWS-434 transmitter and RWS-434 receiver.

RF Transmitter

RF transmitter transmits the data wirelessly through its antenna connected at pin 4. The transmission occurs at the rate of 1Kbps to 10Kbps.Which is received by the RF receiver operating at the same frequency as that of the transmitter.

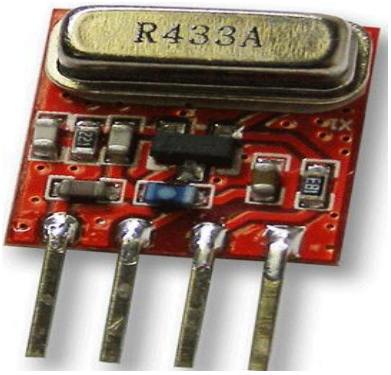

Fig.3. RF Transmitter.

RF Receiver

RWS-434 receiver also operates at 433.92MHz, and has a sensitivity of 3µV. It receives data from the RF transmitter and is given to decoder. Now decoder converts RF data to serial form. The WS-434 receiver operates from 4.5v to 5.5 volts-DC, and has both linear and digital outputs. 0V to Vcc. Data output is available on pin8 and pin 10 to pin 13

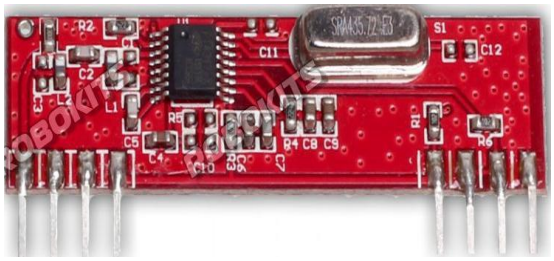

Fig.4. RF Receiver.

Gesture Pad

3D gesture recognition and motion tracking controller chip MGC3X30 based on Microchip's patented GestIC technology, used to recognize the gesture of the human. They enable user command input with natural hand and finger movements. Applying the principles of electrical near field sensing, the MGC3X30 contains all the building blocks to develop robust 3D gesture input sensing system. This gesture pad utilizes electrical near Field (E-field) sensing for advanced proximity sensing. E-Field is generated by electrical charges. The magnitude or strength of an electric field in the space surrounding a source charge is related directly to the quantity of charge on the source charge and inversely proportional to the distance from the source charge.

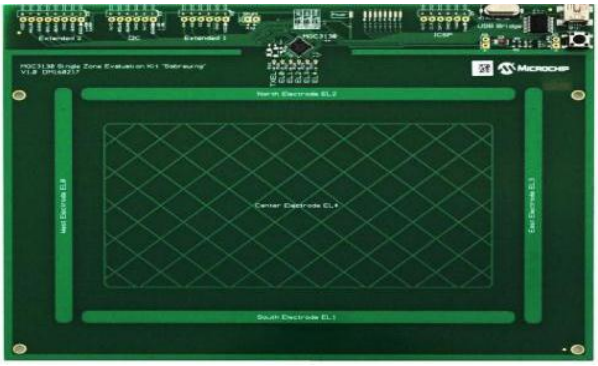

Fig.5. Gesture Pad.

The direction of the electric field is always directed in the direction to that of a positive test charge would be pushed or pulled if placed in the space surrounding the source charge. The gesture Pad consists of five electrodes. The transmitter electrode transmits the charge from the source. The remaining five electrodes receive those positive charges. If a hand is interrupted in the E-Field then the number of negative ions falling on the Rx electrode will change. This makes a signal variation inside the MGC3130 processor and it generate a digital output. Field distortion is translated into 3D hand

tracking gestures, with very low power consumption since nearly no energy is transported.

6. FLOW CHART

Flow chart shown in fig.6 explains the steps of execution of the project.

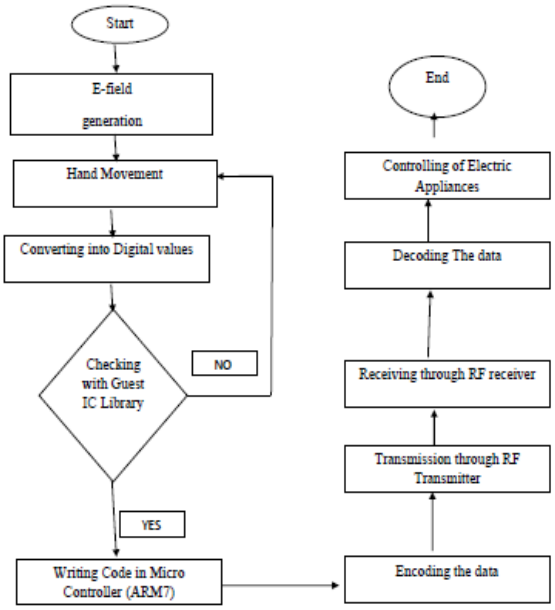

Fig.6. Flow Chart.

7. WORKING PROCEDURE

Recognition of the Hand movement by using Gesture pad is based on electric field variation. The magnitude or strength of an electric field in the space surrounding a source charge is related directly to the quantity of charge on the source charge and inversely proportional to the distance from the source charge. The direction of the electric field is always directed in the direction that a positive test charge would be pushed or pulled if placed in the space surrounding the source charge. These positive charges are received by a negative source. In the gesture pad, the electrodes act as positive charge receivers. These positive charges are then converted into the digital value by the signal processing IC, present inside the Gesture pad kit and are continuously checked by the threshold values. If any value crosses the threshold value set inside the Gesture Pad, it generates the digital output. To control the device, four digital outputs are used. The output of the hand gesture is connected to general purpose input and output pins. In port 1, four pins are configured as input pins and the status of those pins are read through IOPIN register. RF transmitter receives serial data and transmits to the receiver through an antenna which is connected to the 4th pin of the transmitter. The transmitted data is in 12bit format containing 8 address bits and 4 data bits. The encoder then converts the 4-bit parallel data given to pins D0 – D3 to serial data which are available at DOUT. This output serial data is given to RF Transmitter. Status of these Address pins should match with status of address pins in the receiver for the transmission of the data. Data is transmitted only when the Transmit Enable pin (TE) is LOW. It operates at a specific frequency of 433MHz. Receiver receives the data transmitted by the RF Transmitter. Decoder converts the received serial data to 4bit parallel data D0 – D3. The status of these address pins in the decoder should match with the status of address pins in the encoder of the transmitter for the reception of data. Output of RF receiver is input to the ARM controller and device acts as an output to the controller. Based on the RF receiver data and flag, the device performs the operation.

8. RESULT

The proposed system “Gesture based device control is as shown below

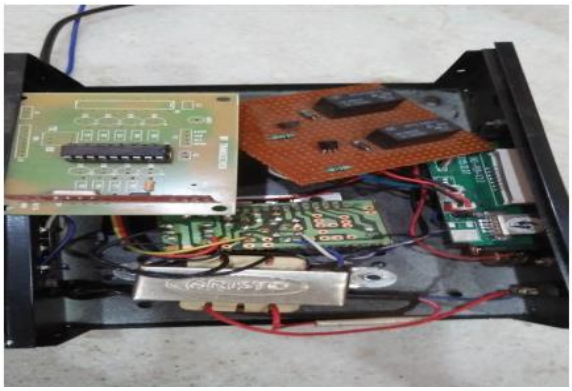

Fig.7. Receiver side

Fig.8. Prototype of Application

Fig.9. Selecting channel 1

Fig.10. Changing to channel 2

Fig.11. Increasing the volume

Fig.12. Decreasing the volume

9. CONCLUSION

Technologies developed based on gesture are now really affordable and converged with familiar and popular technologies. This project has been done to control a device based on free air hand gesture motion technology. It uses the Hand gesture pad which works on a principle of e-field distortion. Hand gesture pad works based on electric field variation. With this technology, any device can be controlled from the user end. It is able to bring a reliable assistance and security in electronic sector.

10. FUTURE SCOPE

In future more, home appliances can be controlled by incorporating those devices with newer versions of gestures, also implemented in every home at low cost. The device helps the aged people who have less mobility.

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