Gesture Human-Machine Interface (GHMI) in Home Automation

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Abstract - *Hand gesture based electronic device control is gaining more importance now days. Most of electronic devices focus on the hand gesture recognition algorithm and the corresponding user interface. Gesture Human-Machine Interface (GHMI) uses an accelerometer and flex sensor. GHMI mostly based on hand gesture recognition algorithm which is used to control electronic/electrical devices. The hardware module consists of an accelerometer, flex sensor, Bluetooth model, raspberry pi and Arduino kit. The hand gestures are determined by the accelerometer & flex sensor. These signals are wirelessly transmitted to Raspberry pi using Bluetooth model HC-05. The raspberry pi receives and process data send by the Bluetooth model. It also consists of relay and breakup boards to support the hardware.*

For Home automation, when the switch at door is pressed the end user will receive a text message to inform him/her that someone is at the door. With the help of the camera installed at the door, image captured from the camera is compared with the image stored in the data base of home authorized persons. After processing and comparing the image, authorized person is given access and message is been forwarded to updated owner about the presence of person at door. The email containing the photo, fixed format SMS and a personal phone call is generated by the system to inform the switch is pressed. For the security reason unauthorized person photo is captured and send to owner via email.

Key Words: Accelerometer, Flex sensor, Bluetooth model, Raspberry pi and Arduino.

1. INTRODUCTION

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 full message. Gesture recognition is interpretation of human motion by computing device. Hand gesture can be detected by controller that contains accelerometers & flex to sense tilting and acceleration of movement.

The basic purpose of Gesture Human-Machine Interface (GHMI) is to provide a means to control electronic devices using hand gestures. The GHMI will act like a remote control for operating all the consumer electronic devices present in a house, but this will be achieved through hand gestures instead of pushing buttons. Gestures can be recognized by using sensors i.e. accelerometer, flex etc. Accelerometer-based gesture recognition performs matching or modeling in time domain. The detected and recognized hand gestures are used as the command signals for controlling devices.

GHMI is a device to replace all other hand held remotes used in households and perform all their functions. Normally in homes, remotes are used for appliances like TV, CD player, Air Conditioner, DVD Player and Music System. GHMI can be used as a remote for lights ON/OFF control, Door Opener etc. All these devices can be controlled by GHMI.

The wireless technology used in GHMI is set to revolutionize the way people perceive digital devices in our homes and office environment. This wireless technology is useful in home environment, where there exists an infrastructure to interconnect home appliances. This technology is suitably used for home automation in a cost-effective manner.

2. LITERATURE SERVAY

Home automation means control of home applications and other systems to provide efficiency and security. Home automation provides the good quality of life for the handicapped persons.

For controlling the home applications android software is used. Using Android software we can control the applications such as light, fan, TV and other applications.[1] In GHMI hand gesture is used instead of Android software. The VPL DataGlove was built by Thomas Zimmerman, who also patented the optical flex sensor used by gloves. The DataGlove was a fabric glove with two fiber optic loop on each finger. If a user had extra large or small hand, the loop will not correspond very well to actual position and the user will not be able to produce accurate gesture. At one end of each loop there is LED and at other end there is photo sensor.[2]

When finger is bent, the light escape from fiber optic cable. The amount of light reaching the photo sensor was measured and converted into a measure of how much finger was bent.

Valdimir Vujoic explains the implement of sensor as Internet of Things (IOT) using Raspberry Pi. The IOT technology provides various advantages such as security, safety, cost saving etc. In this project IOT is used for door security such that if door bell is pressed the message will send to owners mobile that someone is at the door.[3]

To control the home automation GSM modem is used. The security is controlled by text message i.e. SMS. For GSM communication and status of device the AT commands is used where we know that the device is switch ON or OFF.[4]

CCTV (Closed Circuit Television) plays a important role for safety of public and also helps the police for investigation of certain crime. CCTV was basically designed in 1965 to record the video signal, but now it is used for security purpose. [5]

The main limitations of CCTV system are high maintenance, difficult to edit, low quality video etc. It is very costly to implement the CCTV camera and has drawback that it require constant monitoring of every activity. In GHMI OV7670 camera is used which has a resolution of 640x480 and pixel size is 3.6μm x 3. 6μm.

3. OBJECTIVES

Main objective of this project are as follows:
1. Detection of simple hand gesture using various sensors modules.
2. Design and implement of smart gloves to detect hand movement.
3. Face Recognition for door unlocking system.
4. Updating the end user by sending a message using Wi-Fi transmission.
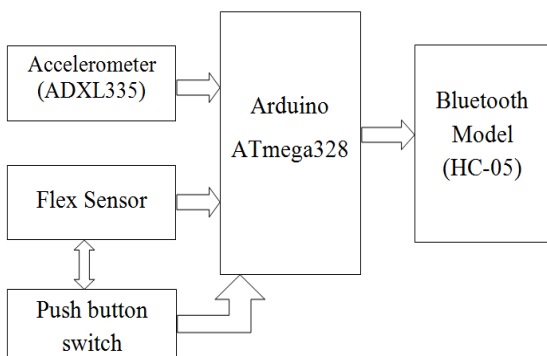
4. DESIGN OF SYSTEM

Fig 1: Transmitter section of GHMI

In Transmitter section Arduino Uno is used as the main controller i.e. the heart of the transmitter. There are various sensors such as Flex sensor, Accelerometer sensor to generate the gesture. With the help of these sensors the gesture are detected. The Occurrence of this event is updated from transmitter side to the receiver side.

The accelerometer sensor is used to select the device which is need to power and the flex sensor is used to turn ON and OFF the device.

In transmitter section Bluetooth HC-05 module is used for serial communication, which is used to send the movement of the hand which is detected by flex and accelerometer is send to receiver section.
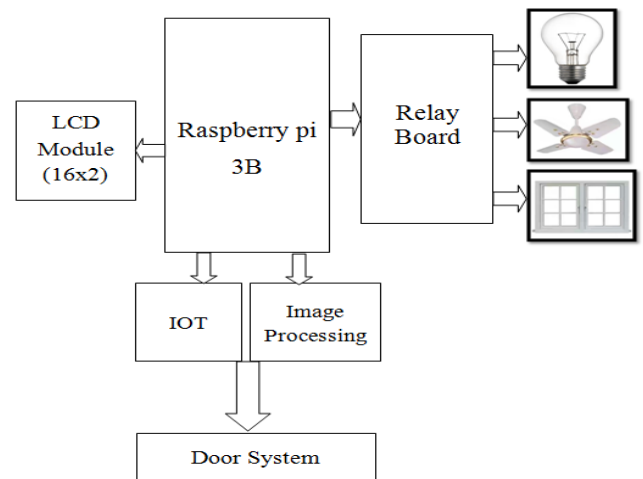

Fig 2: Receiver section of GHMI

In Receiver section Bluetooth is used to receive message packets about occurrence of event at the transmitter side.

At the receiver module the device which is needed to be controlled are physically connected. There are various devices such s light, fan, window are controlled wirelessly without buttons. In this section various relay boards are used. This relay board is used to control the devices.

Door security for home automation is provided by using IOT concepts and powerful Image processing algorithms for authentication and authorization.

5. ALGORITHMS

The algorithm is divided into two parts as Transmitter algorithm and Receiver algorithm.

5.1 Transmitter Algorithm:

1) Start.
2) Generate the gestures throw Flex and accelerometer sensors.

3) Combine both gestures values.
4) Press switch in case when flex fails.
5) Initialize the Bluetooth HC-05.
6) Transmit the raw co-ordinate using Bluetooth HC-05.
7) End.

5.2 Receiver Algorithm:

1) Start.
2) Pair HC-05 with the In-build Bluetooth of Raspberry pi.
3) Control (ON/OFF) fan, light, window etc.
4) Connect with android application.
5) Training of images.
6) Waiting for switch pressed.
7) Switch pressed.
8) Image capture by camera module.
9) Image compare by PCA algorithm.
10) Text message & email will be send to the end user.
11) Call will get to the end user.
12) System waits for switch to be pressed again.
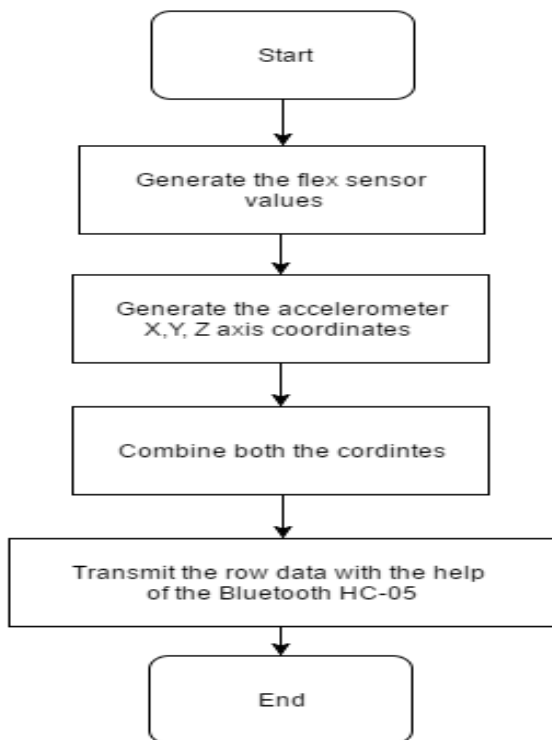13) End

6. FLOWCHARTS

Fig 3:Flow chart of transmitter section

In this section (Transmitter section) flex sensor and push button switch is used to generate the values, which are used to turn on/off the desired relay from the relay board. In the flex sensor, resistance increased when flex sensor is tilted to 45 and 90 degree this will help to perform the on/off function. The accelerometer is used to generate the coordinates in X, Y, Z axis, this coordinates are use to select the relay from number of relays present on the board. The Coordinates from both the sensors will be combined together to perform the combined action. Then this coordinates will be transmit as the raw data with the help of Bluetooth module HC-05 to the receiver raspberry pi Bluetooth module.
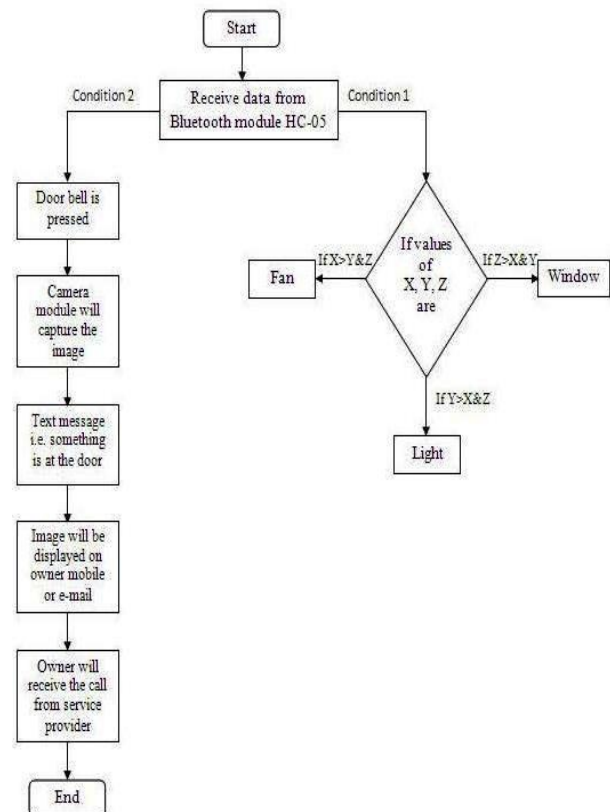

Fig 4:Flow chart of receiver section

In this section (Receiver section) the coordinates as the raw data will be received from Bluetooth module HC-05. As the coordinates from flex sensor and accelerometer sensor changes accordingly the devices such as Fan, Light and window connected at the receiver relay board will turn ON and OFF.

Another part of receiver section is image processing. When door bell is pressed, the message will be sent to user's mobile that **"someone is at the door"** by the service provider named Twilio. At the same time the camera module will capture the image and compare it with the image stored in database. The captured image will be send over the users e-mail. For extra security, the system user also gets a call from the same service provider. If Bell is pressed but there is no one in front of camera, it will just capture the image and send over the e-mail. But there will no message on the terminal window of raspberry pi.

7. RESULTS

Fig 5: Result of transmitter section

This is the transmitter section in which the flex sensor and accelerometer sensor is providing the values which is transmitted through Bluetooth module to receiver section.

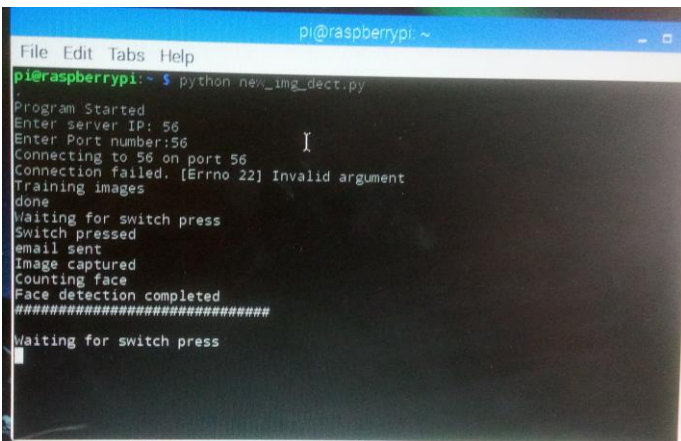When the switch (Door Bell) at the Receiver side is pressed by the user
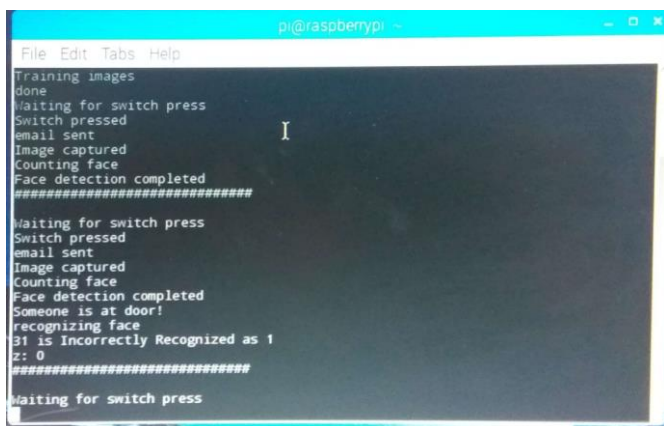

Fig 6: No person in front of the door

Fig 7: Person is present in front of the door

8. CONCLUSION

The Gesture Home Machine Interface (GHMI) is mainly used to help physical impaired people for controlling their home application by hand gestures using flex and the accelerometer sensor. The proposed system provides high comfort and convenience to the disable people by using GHMI system.

GHMI is implemented by using concept of IOT and Image processing. GHMI is also able to provide home security by authenticating person identity. The proposed systems facilitate the wireless gesture based system for controlling home devices which can also be used for Industrial applications.

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BIOGRAPHIES

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