

Gesture Controlled Home Automation

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Abstract—The following research and project is made to assist physically challenged people themselves to control devices around them. The project includes a glove which is wirelessly connected to various day to day appliances such as lights, fan etc. The communication is achieved through generally available Bluetooth modules. In this project two HC05 modules are used wherein one of them attached to gloves which acts as transmitter and the other is attached at the receiver end such as appliance. Thus an attempt made to help people to use appliance at their convenience.

1 INTRODUCTION

There are many way of controls used in home automation like zigbee, API's, cloud based etc. Here we have introduced a new method of control for automation. This method can easily be adapted to real time appliance with minimum variations.

2 .Literature review

A.THE GESTURE PENDANT: A SELF-ILLUMINATING, WEARABLE, INFRARED COMPUTER VISION SYSTEM FOR HOME AUTOMATION CONTROL AND MEDICAL MONITORING ^[4]

Authors: Starner,J. Auxier,D. Ashbrook, M. Gandy
Date Added to IEEE Xplore: 06 August 2002

Abstract:

This paper presents a wearable device for control of home automation systems via hand gestures. By combining other sources of context with the pendant we can reduce the number and complexity of gestures while maintaining functionality. As users input gestures, the system can also analyze their movements for pathological tremors. This information can then be used for medical diagnosis, therapy, and emergency services.

2. CONTROL OF HOME DEVICES BASED ON HAND GESTURE^[5]

Authors: Pomboza-Junez Gonzalo, A. Holgado-Terriza Juan
Date added to IEEE Xplorer :28 January 2016

Abstract:

Human-machine interfaces are constantly evolving. Within this group, the interfaces based on natural gestures of users allow converting these movements into commands for a computer system without contacting any surface. This paper describes the architectural model of a system that addresses these interfaces to control home automation system. This device not only combines the measurement of electrical activity produced by the movement of forearm and hand muscles in order to detect the hand gesture, but also able to capture the orientation and rotation of the movement. Finally, a study is performed of its real time application to control appliances which can be used by many people.

3. Benchmarking:

ZigBee

ZigBee is an 802 wireless communication standard built by the IEEE. Much like Z-Wave, it's seen significant growth in the past few years, and can be found in a relatively large number of devices. It also consumes a very small amount of power, and uses a mesh network structure to offer excellent range and speedy communication between devices. That being said, however, some users have noted that Zigbee devices frequently have difficulty communicating with those made by different manufacturers, so it might not be the best option if you're looking for seamless interoperability.

Z-Wave

Z-Wave is a wireless home automation protocol that runs on the 908.42MHz frequency band. It's relatively new in terms of home automation protocols, but has grown quite rapidly in the past few years. The group behind it, the Z-Wave Alliance, now boasts over 1,000 different compatible devices, giving you a wide range of options when it comes to automating your home. One of the key features of Z-Wave is that it utilizes a type of network called a "mesh network," which essentially means that one Z-Wave product will pass the signal along to another until it reaches its intended destination. This relay system greatly extends its range. It's also extremely low power, which is ideal for devices that rely on battery power.

GCHA vs other products

Gesture controlled home automation find its usefulness where there is no requirement of storing the parameters into the cloud. Thus this method avoids potential security threats due to hacking of cloud data. Hence the technology is reliable, safe, accurate and fast.

Design

The following components are used in this projects

Arduino UNO

Arduino/Genuino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains various peripherals which are essential to support the microcontroller. Thus the board is directly connected to computer with a USB cable or is powered using AC-to-DC adapter or battery to get started. System is highly reliable hence there is no need to worry about safety. At the same time it is highly affordable.

HC 05

HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. The usage of HC-05 Bluetooth Module in a Master or Slave configuration, makes it a simple solution for wireless communication.

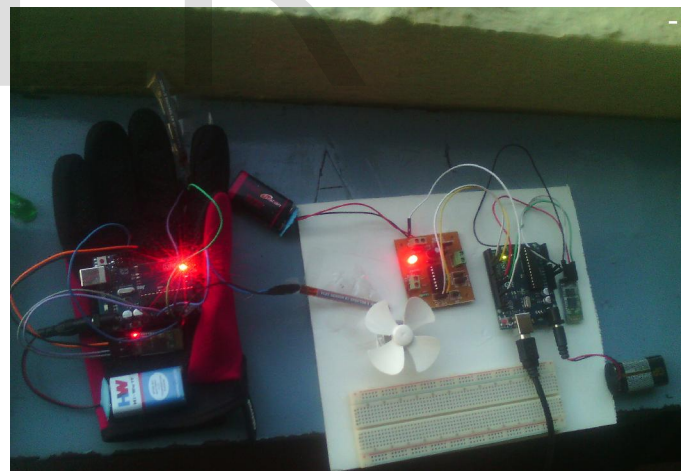
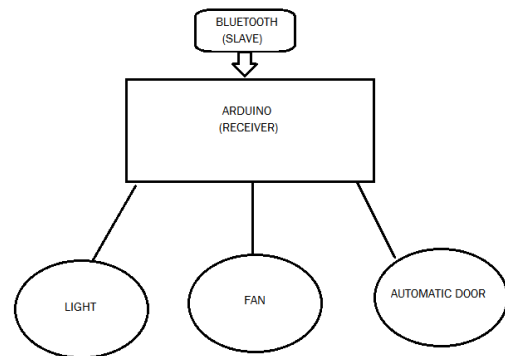
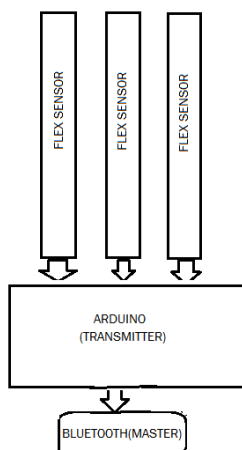
The Bluetooth module HC-05 is a MASTER/SLAVE module. By default the factory setting is SLAVE. The Role of the module (Master or Slave) is configurable by AT COMMANDS. Master module can initiate a connection to other Bluetooth devices where as slave module can accept connections but cannot initiate connection to other Bluetooth device.

Flex sensor

A flex sensor or bend sensor is a sensor that measures the amount of deflection or bending. Usually the sensor is stuck to the surface, and resistance of sensor element is varied by bending the surface. Since the resistance is directly proportional to amount of bend it is used as goniometer, and often called flexible potentiometer.

In this project HC-05 is configured as master and slave mode

Block Diagram:



Procedure to configure HC 05 as master and slave module

Requirements:

- 1.Arduino UNO-to configure Slave module.
- 2.USB-TTL-to configure Master module.
- 3.Arduino IDE software-to give AT commands for slave module
- 4.Teraterm (a terminal software)-to give AT commands to master module

Slave module

Connection of Arduino with HC-05 is as follows.

HC05	Arduino
Vcc	5V
GND	GND
Key	3.3V
Tx	Tx
Rx	Rx

Now the module has entered into command mode at baudrate of 38400 and this is indicated by slow blinking of status LED. Open Serial Monitor of Arduino IDE software ,set baudrate to 38400 and select "Both NL and CR".

The following AT commands are given in serial monitor:

Input	Output
AT	OK
AT+NAME?	Returns name(by default HC-05)
AT+PSWD?	Returns password(by default 1234)
AT+ROLE?	Retruns role ie 0-slave 1-master (by default 0-slave)
AT+ADDR?	Returns address of module

Note down the address of module returned. Remove the colons and insert comma.

Eg: returned address 3014:9:230502
Modified address 3014,9,230502

Now from the module remove the key connection.Reset the module by removing and reconnecting its Vcc connection. Status LED blinks fast indicating that it is looking for a pair.

Master Module:

Connect the USB TTL to other HC05 module with the connections as shown bellow:

HC05	USB TTL
Vcc	5V
GND	GND
Key	3.3V
Tx	Rx
Rx	Tx

Now the module has entered into command mode at baud rate of 38400 and this is indicated by slow blinking of status LED.

Open Teraterm software and select Serial(the port will be assigned automatically).

Under setup open terminal and select CR+LF in transmit

Select Local Echo.

Under setup serial port select baud rate as 38400
You can change the font size from Setup→font

Give the following AT commands

NOTE: These commands must be given in one flow i.e once you write a command and hit enter you should not use back-space or delete and again overwrite it . This terminates the configuration and you shall have to start it again.

Type AT and hit enter to get OK response

Now type following in same order:

Input	Output
AT+ORGL	restores module to original state
AT+RMAAD	releases the module from previous pair
AT+PSWD=1234	sets the password of module to 1234 (same as slave module).
AT+ROLE=1	sets module as master
AT+CMOD=1	allows the module to connect to any

address other than bound one

AT+INIT	starts the SPP library for module(referred library during serial communication).
AT+INQ	returns the address of nearby bluetooth modules(address of slave module is seen)
AT+LINK=type	the address by replacing colons by comma
Eg: AT+LINK=	3014,9,230502

Now from the Master module remove the key connection. Reset the module by removing and reconnecting its Vcc connection. Similarly reset slave module by removing and reconnecting its Vcc connection.

When it is looking for pair the LED blinks fast.

When it gets paired both master and slave LED blinks slowly and simultaneously.

Connections:

Transmitter part

Connect the Arduino to HC 05 master module as below:

Arduino UNO	HC05 (master)
3.3V	Vcc
GND	GND
Pin 11	Tx
Pin 10	Rx

Flex sensor connection:

One end to all flex sensor to GND through 10KOhm resistor.

Other end of

Sensor 1 to pin 2 of Arduino

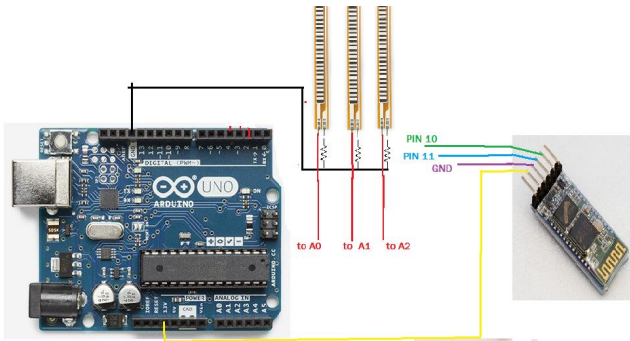
Sensor 2 to pin 3 of Arduino

Receiver Part

Arduino UNO	HC 05(slave)
3.3V	Vcc
GND	GND

Pin 11 Rx
Pin 10 Tx
Connect relay module and appliances as shown below.

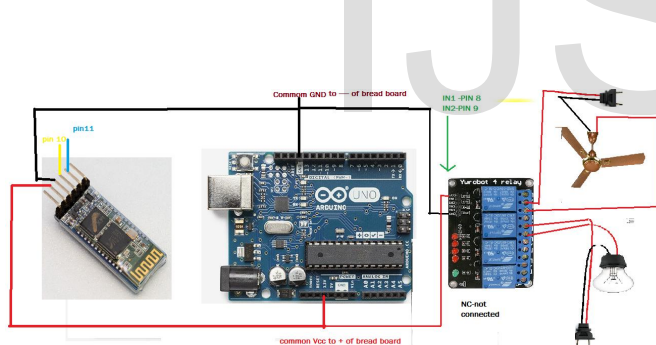
Transmitter Part:



Receiver Part:
ules. Master module is used as transmitter and Slave module is used as receiver.

The range of communication between two HC 05 modules is approximately 10 meters. This makes easy adaptability for home automation.

Receiver Part:



Working:

The following link contains the Arduino code for both master and slave module.

<https://github.com/Rakeshvd/Gesture-Controlled-Home-Automation/tree/master>

The Transmitter part is connected to a glove such that the flex sensor value can be varied by bending the fingers.

By bending fingers thus bending flex sensors, control of appliance such as fan and light can be observed.

To get better and accurate control, flex sensor values are restricted to small range in the coding.

Future Development:

1. By connecting the master HC05 to Bluetooth of a smartphone we can send notifications to others. This becomes very useful in case of any emergency.
2. Any other appliances or devices and be appropriately connected wirelessly with flex sensors for further automation.
3. Many devices can be controlled by a single flex sensor by restricting the sensor values to very small range.

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References:

[4] Starner, J. Auxier, D. Ashbrook, M. Gandy "The gesture pendant: a self-illuminating, wearable, infrared computer vision system for home automation control and medical monitoring"

<http://ieeexplore.ieee.org/document/888469/?reload=true>

(For literature review)

[5] Pomboza-Junez Gonzalo, A. Holgado-Terriza Juan

"CONTROL OF HOME DEVICES BASED ON HAND GESTURES"

<http://ieeexplore.ieee.org/document/7391325/?reload=true&arnumber=7391325> (For literature review)