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Smart Remote for the Setup Box Using Gesture Control

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ABSTRACT
The basic purpose of this project is to provide a means to control a set top box (capable of infrared communication), in this case Hathway using hand gestures. Thus, this system will act like a remote control for operating set top box, but this will be achieved through hand gestures instead of pushing buttons. To send and receive remote control signals, this project uses an infrared LED as Transmitter. Using an infrared receiver, an Arduino can detect the bits being sent by a remote control. And to playback a remote control signal, the Arduino can flash an infrared LED at 38 kHz. With this project we can design a gesture controlled remote by using a glove, it can be fixed to the hand, we can send any signal of any length, at any related frequency, and thus we can design a universal remote.

Keywords - Arduino, Gestures, Infrared LED, Set Top Box, Universal Remote.

I. INTRODUCTION

The introduction of the Television has completely changed the way people consume data and it called for drastic changes in the Entertainment industry. In the beginning T.V's came with knobs and rings which were used to change channels, increase volume and other functionalities. But these knobs were to be operated by a person and required constant movement to and fro from the T.V.

The invention of remote changed the entire picture, it gave a whole new way to communicate with the T.V. The I.R (infra red) technology was implemented as a platform of communication. This wireless means of sending instructions has been the same for the past 35-40 years since its introduction into the consumer market. Thus it screams for a change and our project aims at providing an alternative method of input for the modern Television.

Gesture is defined 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 to sense tilting and acceleration of movement.

The basic purpose of this system is to (capable of infrared communication) using hand gestures. Thus, this system will act like a remote control for operating set top box, but this will be achieved through hand gestures instead of pushing buttons. Gestures can be recognized by using sensors, accelerometer etc. Accelerometer- based gesture recognition performs matching or modeling in time domain, there is no feature extraction stage. 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 are adjusted accordingly in order to support natural hand control.

1.1 Aim of Thesis:

Our project "SMART REMOTE FOR SET TOP BOX USING GESTURE CONTROL" aims at delivering an alternative method of input fitting to the current modern Televisions. This project is implemented to replace the common buttons on a remote with hand gestures.

1.2 Organization and Technical Approach:

In a Television, a remote is an integral part. It is the main mode of input to access various features of the T.V. We presented an alternate mode of input which replaces the traditional remote with a much simpler and fun hardware. The idea is to improve the traditional mode of input.

To send and receive remote control signals, this project uses an infrared LED and receiver. Infrared light is invisible to the human eye but easy for electronic sensors to detect. To make the transmission of signals more reliable, devices typically modulate (flash or flicker) infrared light very quickly, so there's less chance for stray infrared light (like from sunlight) to interfere. An infrared receiver is a small device

that can pick up infrared signals modulated at a particular frequency, commonly 38 kHz (38,000 times per second). Using an infrared receiver, an Arduino can detect the bits being sent by a remote control. And to play back a remote control signal, the Arduino can flash an infrared LED at 38 kHz.

1.3 Problem Statement:

The typical T.V remote consists of various buttons namely the power button, numbers (for channels), and volume controls etc. This has been the case all these years, though there has been a lot of change in the technology used in the actual T.V the remote has been the same. The sensor that will be implemented in this project is the infrared sensor (same as a common remote). Nowadays, infrared sensor is widely used in daily activities such as for security, motion detection and other purposes.

Problem statements in this project are:

- Provide an alternative method of input to the remote.
- Replace buttons.
- To implement all the basic controls with gestures.

1.4 Project Objective:

The main objective of the project is to present an alternate method of input in order to control the set top box of a T.V. (in this case HATHWAY). This alternate method of input utilizes a more natural and common mode of communication i.e., Hand gestures. People have been using hand gestures to communicate for a long time now and our vision is to extend these basic gestures to control a Television, thus providing a much more natural and interactive mode of input. These gestures are sensed using an accelerometer.

To drive the main objective, there are several supporting goals need to be achieved as listed below:

- To detect hand gestures.
- To convert these gestures into IR commands.
- To transmit these commands and communicate with the set top box.

1.5 Scope of Project:

Basically, the project can be classified in two parts. Those mention are software and hardware parts that will be used in order to implement this project. The scope of this project will focus on replacing the traditional IR remote as mode of input in a Television.

The scope will include as follows:

- Using an accelerometer to detect gestures
- Processing these gestures and converting into Corresponding IR code.
- Transmitting this IR code to the set top box.
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II. ARDUINO

2.1 What is Arduino?

Arduino is a tool for making computers that can sense and control more of the physical world than your desktop computer. It's an open-source physical computing platform based on a simple microcontroller board, and a development environment for writing software for the board.

Arduino can be used to develop interactive objects, taking inputs from a variety of switches or sensors, and controlling a variety of lights, motors, and other physical outputs. Arduino projects can be stand-alone, or they can communicate with software running on your computer.

The Arduino programming language is an implementation of Wiring, a similar physical computing platform, which is based on the Processing multimedia programming environment

2.2 Arduino Duemilanove

The Arduino Duemilanove ("2009") is a microcontroller board based on the ATmega168 or ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16MHzcrystaloscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

2.3 Arduino Specifications

Microcontroller	ATmega168
Operating Voltage	5V
Input Voltage	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory (ATmega168)	16KB Or 32 KB(ATmega328) Of which 2 KB used by Boot loader
SRAM (ATmega168) or (ATmega328)	1 KB 2 KB

EEPROM	512 bytes (ATmega168) or 1 KB (ATmega328)
Clock Speed	16MHz

2.4. Arduino Hardware

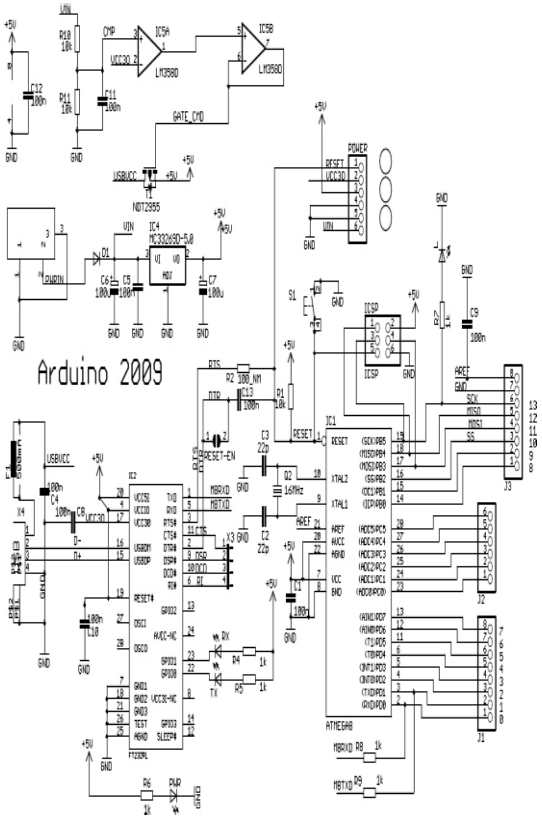


Fig: 2.1 Arduino hardware internal

III. METHODOLOGY

3.1 How does the system work?

The project "SMART REMOTE FOR SET TOP BOX USING GESTURE CONTROLS" basically works in two modes

- Accelerometer Mode
- Number Mode

Accelerometer mode: In this mode the input gestures are sensed using a 3-axis accelerometer. This 3-axis accelerometer gives out 3 values namely x, y, z representing the 3D space. These 3 values of xyz are analog voltage levels. The analog voltage levels obtained from the accelerometer can be read using our microcontroller's analog pins which contain inbuilt 10-bit ADC (analog to digital converter) pins. The values obtained will range from 0-1023. Thus the coding is done in such a way that based on these values of x, y & z the microcontroller can detect the respective gesture.

Number mode: This mode mainly relies on the rings i.e., a physical arrangement used to detect the position of the fingers. The mode can be changed to number mode by freeing the index finger and little finger while holding down rest of the fingers. The numbers can be detected by the natural count of the fingers till 5 and the from 6-10 the hand is held vertical to the ground and same count repeats with 6 meaning the thumb is up. This mode is mainly helpful in navigating to farther channels from the current one.

The arrangement consists of a white LED that when turned on represents that the system is working in number mode and when the LED is off it means that the system is working in accelerometer mode.

3.2 Hardware Design

3.2.1 Accelerometer:

Accelerometers are devices that measure acceleration, which is the rate of change of the Velocity of an object. They measure in meters per second squared (m/s^2) or in G-forces (g). A single G-force for us here on planet Earth is equivalent to 9.8 m/s^2, but this does vary slightly with elevation (and will be a different value on different planets due to variations in gravitational pull). Accelerometers are useful for sensing vibrations in systems or for orientation applications.

Accelerometers are electromechanical devices that sense either static or dynamic forces of acceleration. Static forces include gravity, while dynamic forces can include vibrations and movement.

Fig: 3.1 Accelerometer sensor

Accelerometers can measure acceleration on one, two, or three axes. 3-axis units are becoming more common as the cost of development for them decreases.

Generally, accelerometers contain capacitive plates internally. Some of these are fixed, while others are attached to miniscule springs that move internally as acceleration forces act upon the sensor. As these plates move in relation to each other, the capacitors between them changes. From these changes in capacitance, the acceleration can be determined. Other accelerometers can be centered on piezoelectric materials. These tiny crystal structures output electrical charge when placed under mechanical stress (e.g. acceleration). Accelerometers will communicate over analog, digital, or pulse-width modulated connection interface.

3.2.2 IR Led:

An IR LED, also known as IR transmitter, is a special purpose led that transmits infrared rays in the range of 760 nm wavelength. Such LEDs are usually made of gallium arsenide or aluminum gallium arsenide. They, along with IR receivers, are commonly used as sensors.

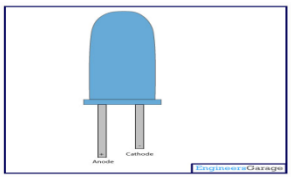


Fig: 3.2 IR LED

3.2.3 IR Sensor:

An IR sensor is an electronic device that emits and/or detects infra red radiation in order to sense some aspect of its surroundings. Infrared sensors can measure the heat of an object, as well as detect motion. Many of these types of sensors only measure infrared radiation, rather than emitting it, and thus are known as passive infrared (PIR) sensors.

All objects emit some form of thermal radiation, usually in the infrared spectrum. This radiation is invisible to our eyes, but can be detected by an infrared sensor that accepts and interprets it. In a typical infrared sensor like a motion detector, radiation enters the front and reaches the sensor itself at the center of the device. This part may be composed of more than one individual sensor, each of them being made from pyroelectric materials, whether natural or artificial. These are materials that generate an electrical voltage when heated or cooled.

These pyroelectric materials are integrated into a small circuit board. They are wired in such a way so that when the sensor detects an increase in the heat of a small part of its field of view, it will trigger the motion detector's alarm. It is very common for an infrared sensor to be integrated into motion detectors like those used as part of a residential or commercial security system. Instead of Fresnel lenses, some motion detectors are fitted with small parabolic mirrors which serve the same purpose.

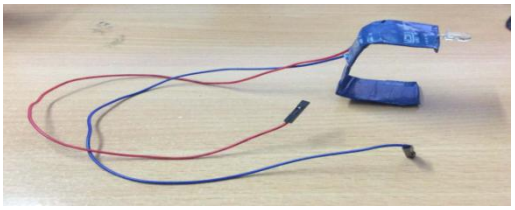


Fig 3.3 IR Sensor

An infrared sensor can be thought of as a camera that briefly remembers how an area's infrared radiation appears. A sudden change in one area of the field of view, especially one that moves, will change the way electricity goes from the pyroelectric materials through the rest of the circuit. This will trigger the motion detector to activate an alarm. If the whole field of view changes temperature, this will not trigger the device. This makes it so that sudden flashes of light and natural changes in temperature do not activate the sensor and cause false alarms.

3.3.4 TSOP:

TSOP is an IR receiver which will help you to interface your TV remote with Arduino. The TSOP outputs a constant HIGH signal when idle and as it receives data, it tends to invert the data. i.e., when an IR LED is transmitting data onto the TSOP, every time the IR led goes high, the TSOP will go LOW and vice versa. Remote control signals are often bytes of data that is encoded and transmitted by pulsing(switching ON & OFF the IR LED at a specific frequency) Most TV remote controls work at 32-40 KHz frequency and most receivers can receive this range.

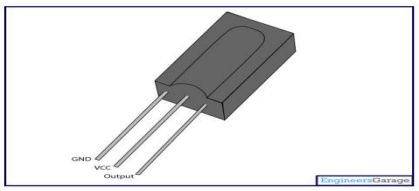


Fig 3.4 IR receiver (TSOP)

3.3.5 Rings:

Fig 3.5 Rings

The above shown figure is an aluminum sheet cut into the shape of a ring, these rings are arranged in such a way there are two rings for 1 finger so a total of 10 rings were designed by us for 5 fingers. When a finger is straight, both rings on the finger touch each other and since aluminum is a good conductor, a voltage is passed through the second ring. These rings are arranged identical to a push button interfacing a microcontroller. A button exactly is replaced by two rings.

By using these aluminum rings, it can be detected if the finger is straight or not. So these rings are digital sensors just like a normal SPST (Single Pole Single Throw) switch.

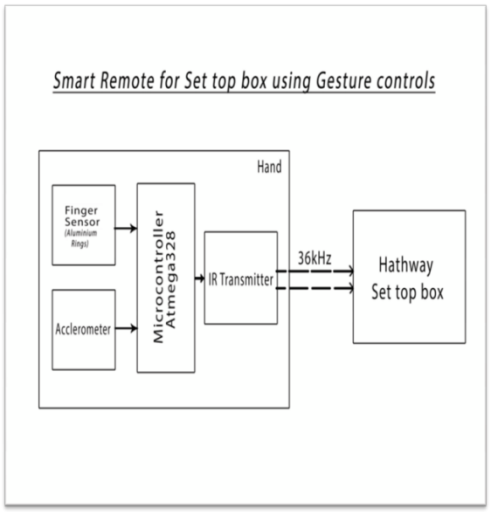
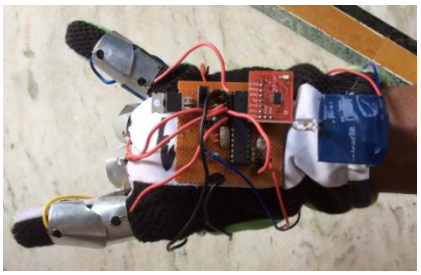


Fig 3.6 Block diagram of Smart Remote For Set Top Box Using Gestures Controls

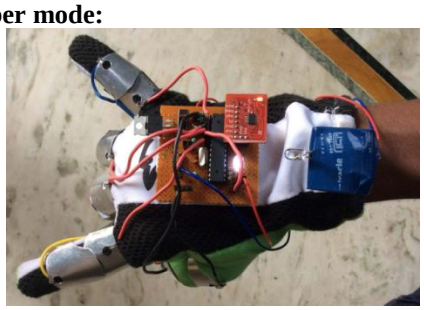
The above shown figure is the block diagram of SMART REMOTE FOR SET TOP BOX USING GESTURES CONTROLS. Accelerometer and finger sensor are acting as inputs in this case. Accelerometer used here is a 3-axis accelerometer. The signal from accelerometer is an analog signal which represents x, y and z axis. Finger sensors are used to detect for all the fingers, which finger is straight and which is not. These signals are sent to the microcontroller in this case ATMEGA328. According to the signals received from accelerometer and finger sensor, the microcontroller modulates the IR sensor at the frequency required with the required signal for the required action according to the action given.

IV. GESTURES

Accelerometer mode:

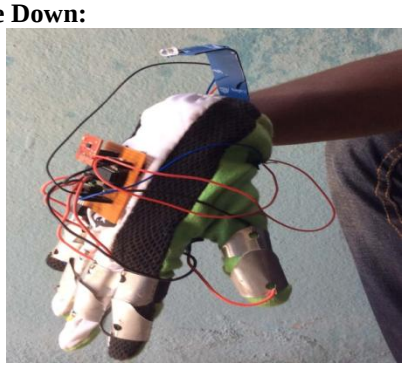


Number mode:

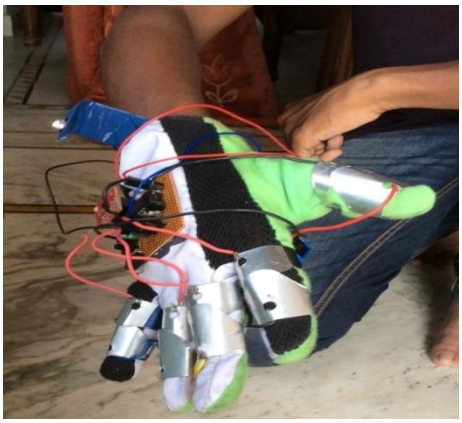


Accelerometer mode
Volume Up

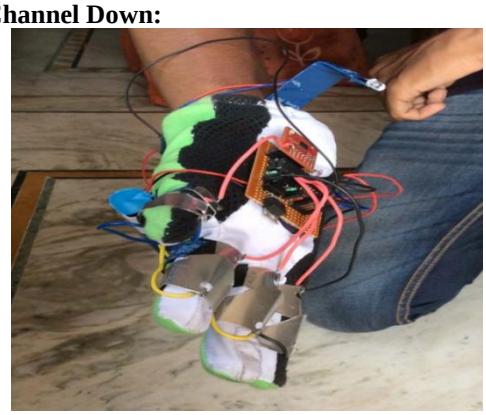
Volume Down:



Channel Up:

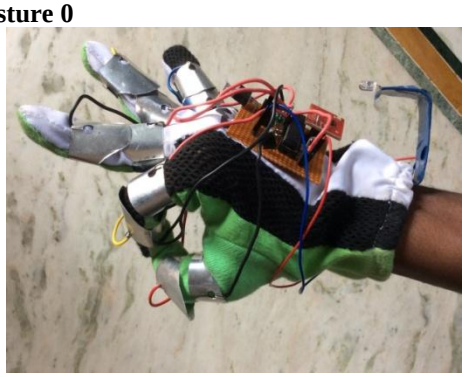


Channel Down:

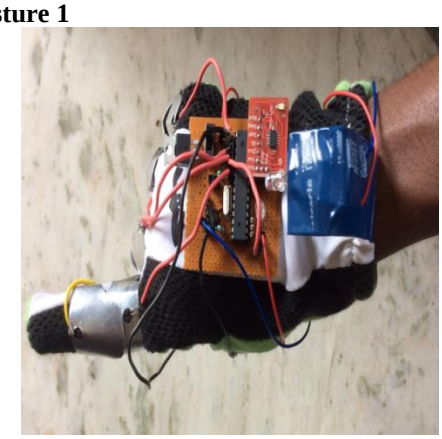


Number Mode

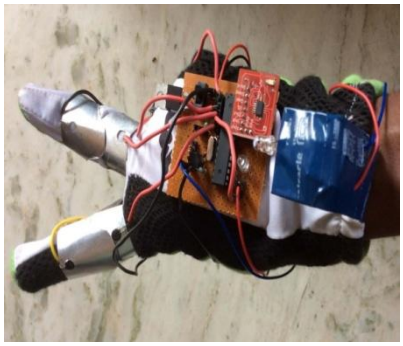
Gesture 0



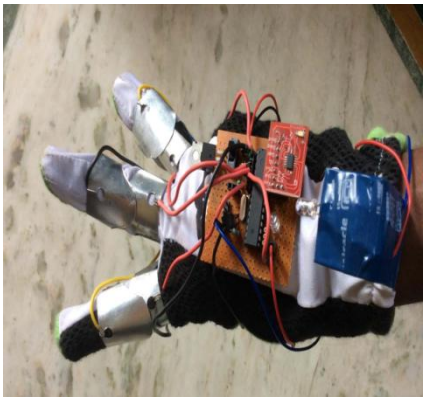
Gesture 1



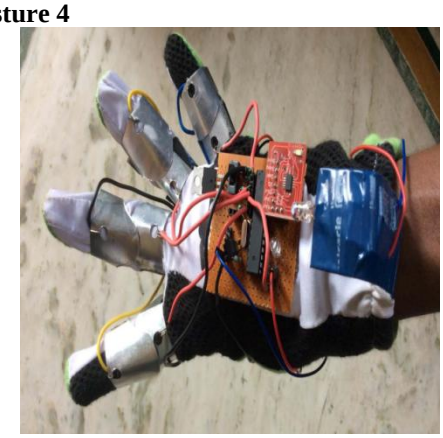
Gesture 2



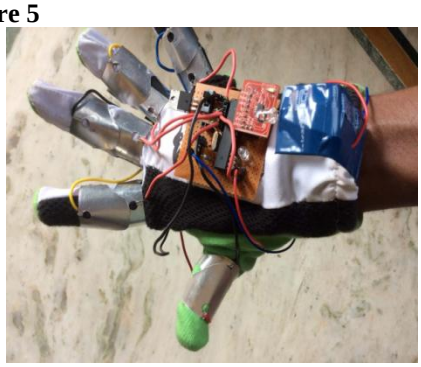
Gesture 3



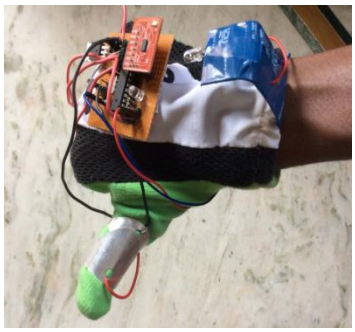
Gesture 4



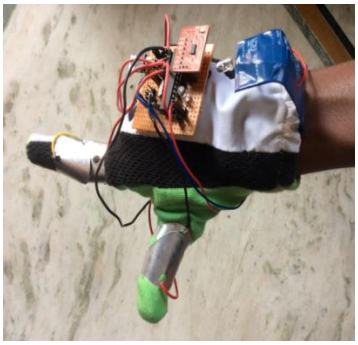
Gesture 5



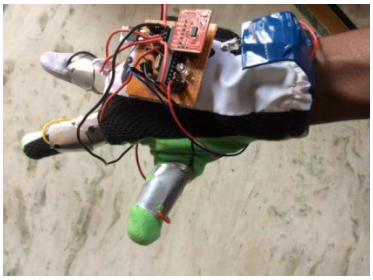
Gesture 6



Gesture 7



Gesture 8



Gesture 9

V. RESULT

We have designed a gesture controlled remote by using a glove, it can be fixed to the hand, we can send any signal of any length, at any related frequency, and thus we can design a universal remote. Now that we can design a universal remote, we can control everything that works with remote i.e., we can control Air Conditioner (A.C), TV, Set Top Box etc.

VI. FUTURE SCOPE

This gesture controlled remote can be made in such a way to send a 138 KHz, with a size of 32bits or so. We can put it completely in a way no other can know, to generate the same signal, there is a very low possibility as, it is not known to anybody that the signal is 38KHz and even if somebody gets to know that it is a 38Khz signal, there are 2^{32} possible codes to be sent through IR, hence setting an IR generated code and setting it as password to open a door can be a great application. When compared to any normal password locked doors, this will have a very low probability to open the door or this idea of password can be applied for any electronic device which needs to be protected.

Every device that has IR for its remote must have a receiver to take the IR and decode the code, this receiver is available and is known as TSOP. This receiver is available for a very low price, hence when a code is received, a relay can be triggered and hence home appliances can be controlled by using the same gesture controlled remote. Like the accelerometer values and the rings triggering can be used again to make gestures but this time to switch on the fan or light that works at 230V AC.

This application on further research and implementation can be set to check heartbeat, pulse and health conditions that can be known through hand. So, fan can be regulated according to body temperature or AC temperature can be maintained by body temperature. This can be made like one glove for everything. Light intensity can be measured by adding a small LDR and hence lights can be switched on entering the room. Some way some sensor must be connected to detect the glove is in the room or out of the room and it becomes one glove for everything.

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