

## Gesture Control of Home Appliances Using Flex Sensor

<sup>1</sup>Manoharan.S, <sup>2</sup>Ragul.R, <sup>3</sup>Ramanathan.SKS, <sup>4</sup>Vijay.M, <sup>5</sup>Palanivel.R

<sup>1</sup>Professor, Electronics & Instrumentation Engineering, Karpagam College of Engineering, Coimbatore.

<sup>2,3,4,5</sup> UG Scholar Electronics & Instrumentation Engineering, Karpagam College of Engineering, Coimbatore.

<sup>1</sup>hod.eie@kce.ac.in, <sup>2</sup>ragulsekhar13@gmail.com, <sup>3</sup>ramanathan.sks@gmail.com,

<sup>4</sup>vijayraina44@gmail.com, <sup>5</sup>palanivelrajendiran158@gmail.com

**Abstract:** This paper titled “Gesture control of home appliances using flex sensor” to control the home appliances is the easiest way. The main idea of this project is to help the bilateral amputee in other words people who lost their legs and also physically challenged people to control the home appliances by their hand and to reduce some problems that they are facing in day-to-day life. So, we have decided to help of physically challenged people to control their home appliances with gesture to detect their gesture with the help of flex sensor and to make the way easier to them for controlling the home appliance. Wireless communication and Sensors play a vital role in our project and for the wireless communication we used Bluetooth Module and Blend Sensor which is also known as flex sensor. Let's make it simple the sensor will give us resistance value based on the value we can predict the amount of deflection made by person accurately and dynamically, Arduino Nano is the microcontroller is used for processing the input from the user through sensor and Arduino UNO will get the data through the Bluetooth and process the data and find which appliances should be controlled. Based on the input from the user the Arduino which is preprogramed will decide which appliances that the user want to Turn ON or OFF through wirelessly.

**Keywords:** Arduino UNO, Arduino NANO, Bluetooth module, ATmega168V, Flex Sensor, Home Automation.

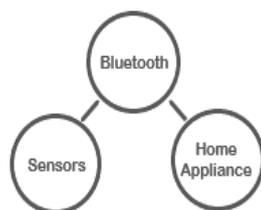
### I. INTRODUCTION

The Flex sensor is used by the physically challenged people for gesture purpose. The Sensor is related to variable resistor but it is flexible sensor. As the Flex sensor bends, there is a change in resistance. The Voltage divider circuit is used to obtain output voltage and it is a resistive type sensor. A Flex sensor is a kind of sensor which is used to measure the amount of deflection otherwise bending. The Flex sensor works on the principle of a variable printed resistor, the Flex Sensor achieves great form-factor on a thin flexible substrate. While the flex sensor operates on the principle of a variable printed resistor, then it achieves the ideal shape-factor in a thin flexible substrate. When the substrate is bent, the resistance output is produced in relative to the curvature radius. If the radius is smaller, the resistance value is high. The design of this sensor can be made using materials such as plastic and carbon.

As the resistor bends in the compression direction across the sensor, the flexion sensor increases in curvature across the tensile direction across the sensor increases [1]. This sensor is used in places where you need to measure curved, flex, otherwise any tool with no change of angle to any device. The internal resistance of this sensor linearly changes and approximately with its angle. Thus, by when connecting the sensor to the device, it may have a flex angle within the resistances of the power parameter.

Thus, it is also named as a curve sensor. Its differential resistance can be directly proportional to the magnitude of the turn, so it can also be used as a goniometer. A curved sensor, also known as a flex sensor, is used to measure the amount of deflection caused by sensor bending. The optical flexibility sensor consists of a flexible conductor ink deposit on which a detached conductor is placed on top to create a flexible potentiometer, in which the resistive transitions on the deflection flexor sensor consist of two layers of conductive materials separated between them and reduced in resistance with respect to deflection between them.

The Flex Sensor range is a distinctive component that the resistance varies when it is bent. The resistance progressively increases when it is bent. The resistance will change based on a certain angle. There is another sensor called the Ole sensor. It is lightweight, inexpensive and resistant to temperature or electromagnetic interference, and can be connected to a public computer system via standard wire and wireless interfaces, but the sensor's shortcomings apply only to two angles, 0 and 90 degrees [2]. This allows you to control small household appliances (low load). This is a step towards home automation [3].



**Fig. 1 Introduction of Proposed System**

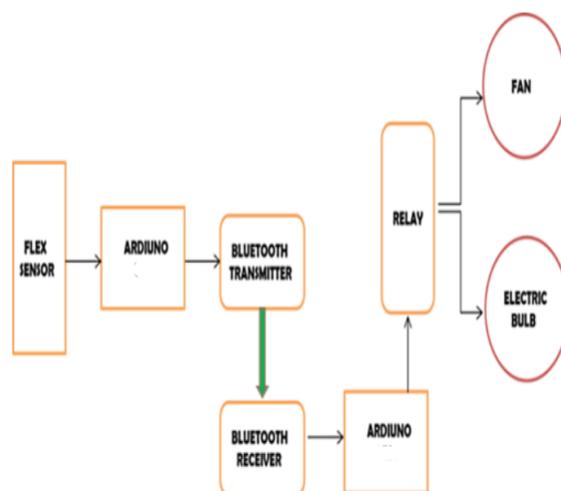
## II. LITERATURE INVESTIGATION

The First Hand Talk glove was designed by Ryan Patterson in the year 2001. He initiated his work with his Sign Language. Sign Language Translator involves two distinct components, a glove that has ten flexible sensors shown into it which display the position of the fingers by reading the electrical resistance made by the fingers as they bent [4].

Authors Arathi P.N et al.[5] uses image processing as the basis for their system. It is complicated to the users to understand. In this system, users can understand easily.

Authors Krishna Rathi et al.[6] uses the accelerometer and flex sensor to control the appliances. In this system only flex sensor is used which is simple and easy to control for the user.

Authors B. Ponakarhika et al.[7] uses gesture table for relay switching which is complicated for the user to understand and need knowledge about it. In this system user control the appliances directly no need of table. It is very simple to study and cost effective.



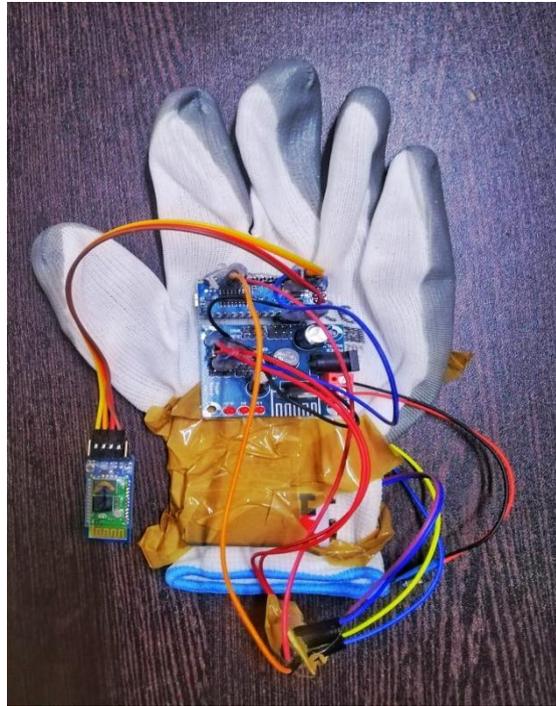
**Fig. 2 Design of Proposed System**

## III. IMPLEMENTATION

### 3.1. Proposed System

The Design includes a flexible sensor, relay, Arduino (NANO/UNO) and Bluetooth module (transmitter and receiver). The Flex sensors will be connected to the Arduino NANO and then it connected to the Bluetooth which will be configured as master. Then Another Bluetooth will be configured as slave it is connected to the Arduino UNO which is linked to the relay which is connected to the appliance. Whenever the user wants to interact with the home appliances to switching ON/OFF all just need to use their hands to control it and When the flex sensor is bend and resistance value changed, then the Arduino converts the change in the current into digital signals and transmits to Bluetooth module master transmits to the other end slave receives the data and sends it to the Arduino through the TX pin of the Bluetooth module. The code uploaded on the Arduino checks and compares the received data. Based on the results that logical data is sent to the relay, a relay can be

controlled by an Arduino or microcontroller which is an electrical switch, it can be programmed. It is used to program devices that use high voltage and/or high current on/off programmatically. If the data obtained is 1, the bulb will run. The bulb turns off when the received data is 0 by this way we can control all the appliances in home.



### 3.2. CircuitDiagram

Flex Sensors are interfaced to the Arduino NANO. The Arduino NANO is powered by a battery is connected with the power supply board, to give the required power to the Arduino. Then Arduino is connected to the Bluetooth (master) which transmits the signal and these are fixed to a glove.

Then there is other part, it has a Bluetooth (slave) to receive the signal from the master and it is connected to the Arduino UNO. The Arduino is powered by the power supply and it is connected to the Relay module. The Relay is connected to the appliances to be controlled.

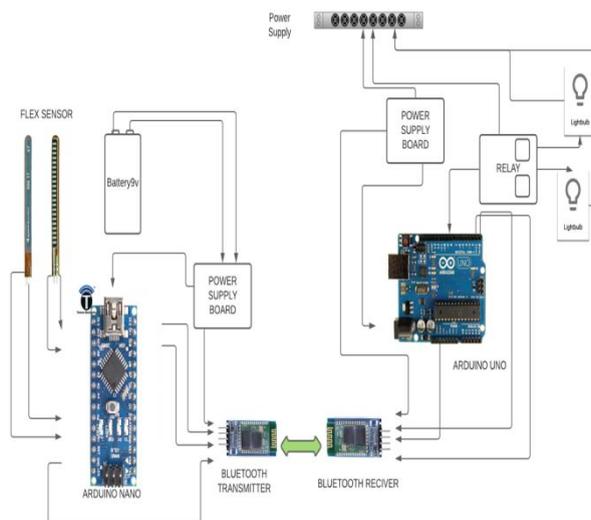


Fig. 3 Circuit of Proposed System

### 3.3. Components Description

#### Flex Sensor

Flex sensors are generally in two sizes. One is 2.2 inches and the other is 4.2 inches sticking to the gloves. A flexible sensor is a very versatile compatibility device. As the sensor flexes, its resistance increases significantly. Using a voltage divider circuit, with a flexible sensor and a carefully selected constant resistor, it can be known when the sensor is flexing and when it is not. The flex sensor is a flexible component, it will generate LED light. Once the sensor is allowed to return to its flexible position, the LED will turn off. Therefore, the load of the circuit, which is the LED, will only be activated if the flex sensor is bent. There are low, medium and high resistance types. Select the suitable type depending on the need. The flex sensor has a flat resistance of  $25K\Omega$  and a bending resistance of  $45K\Omega$  to  $125K\Omega$ , depending on how flexible it is. Flat resistance is the resistance of the flex sensor when it is inflexible. And curvature resistance is the resistance of the sensor when it is bent. The larger the angle at which the sensor is bent, the higher the resistance. The resistive flex sensor is a type of passive sensor that measures the amount of deflection, proportional to its resistance, caused by bending [8]. The property of a flexible sensor is that when the sensor bends it generates a resistance output relative to the radius of curvature.

#### Relay Module

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically drive a switching device, but other operating principles are also used. Relays are used where low power signal (with complete electrical isolation among control and control circuits) is required to control one circuit, or where multiple circuits are to be controlled by a single signal. Some relays have field-replaceable contacts, like certain machine relays; these could also be replaced when wiped out, or changed between normally open and normally closed state, to permit for changes in the controlled circuit. [9].

A simple electromagnetic relay consists of a wire coil around a soft iron core, a magnetic flux, a portable iron armature and an iron yoke that offers a low latency path for one or more connections (there are two in the relay). The Yoke is attached to the armature and mechanically connected to one or more moving contacts. It is placed in place by a spring so that there is an air gap in the magnetic circuits when the relay receives de-energized. In this case, one among the two sets of contacts in the relay image is closed and the other is open. Other relays may have more or less contacts depending on their function. There is a wire connecting the relay armature to the yoke in the picture. This ensures circuit continuity among the moving contacts in the armature and the circuit through the yoke on the printed circuit board (PCB), it is dissolved into the PCB.

When the coil is energized with dc, a diode is placed through the coil to release energy from the collapsing magnetic field during failure, creating a dangerous voltage spike to the semiconductor circuit components. Some vehicle relays include a diode inside the relay case. Alternatively, a contact protection network (snapper circuit) with a capacitor and if the resistors are in series may absorb the flow. If the coil is designed to receive energy with alternating current (AC), a small copper "shadow ring" at the end of the solenoid can generate current outside a small phase, which increases the minimum traction during armature AC rotation.

#### Bluetooth Module

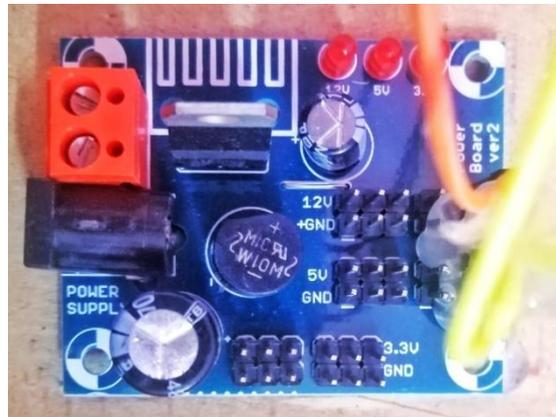
The Bluetooth module is used for wireless communication between the HC-06 Arduino Uno and the smartphone. Bluetooth is a popular means of pointing multi-point communication over short distances [10]. HC-06 is a device and can operate at 3.6 to 6 volts. It consists of 6 needles: State, RXD, DXT, GNT, VCC and EN. Allows wireless serial communication to be used with any microcontroller. It is used to establish short distance wireless data communications between two microcontrollers or systems. This module is highly sought after and popular due to its low cost and superior properties. The module works with Bluetooth 2.0 communication protocol and can only function as a slave device. This wireless data transfer is defined as one of the cheapest and most flexible compared to other methods. The HC-06 module converts data files at a speed of 2.1 Mb / s. Connect the Bluetooth module HC-06 to the Arduino Uno's RX (pin 0) and the RXD pin is to the Arduino Uno's TX (pin 1) for continuous communication. The circuit diagram of the Arduino and Bluetooth (BT) module is explained. Due to its robust interface, Bluetooth is the most widely used wireless solution for industrial applications. [11].

#### Power Supply board

The AC voltage, typically 220V rms, is connected to a transformer, which steps that ac voltage down to the extent of the specified dc output. A diode rectifier then provides a full-wave rectified voltage that's primarily

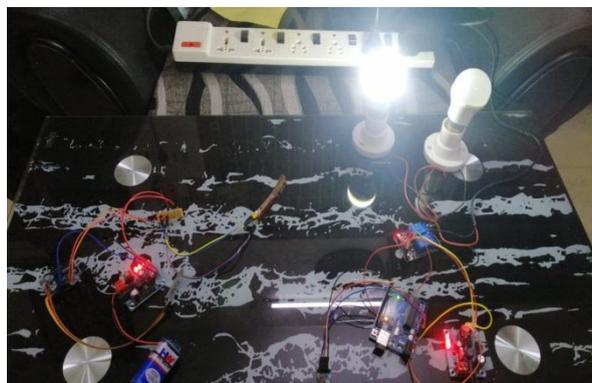
filtered by simple capacitor filter to supply a dc voltage. This resultant dc voltage usually has certain ripple or ac voltage variation.

A regulator circuit eliminates the ripples and also remains same as equivalent dc value even though the input dc voltage varies or the load connected to the output dc voltage changes. This voltage regulation is typically obtained using one among the favored voltage regulator IC units



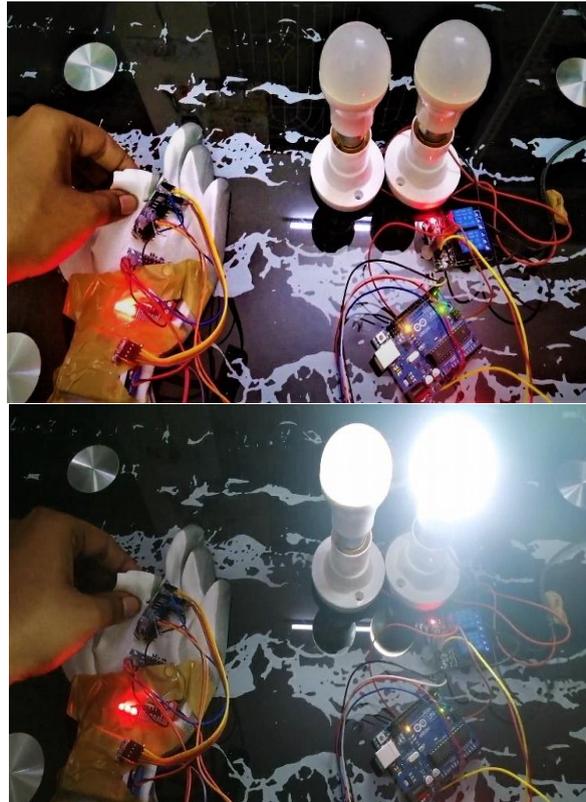
#### IV. WORKING

The System is operated using the specified hardware and software. The mainfactor of this system is the Arduino Uno. It requires a boot loader to burn and download Arduino sketches. The boot loader is programmed under the ISP program controller. The 12V output power adapter is used as an input to the user-controlled flex-sensor and sends the signal to the Arduino. The Arduino system and the master slave configuration send the signal to another Arduino UNO system via Bluetooth. The relays are attached to the output pins of another Arduino Uno to communicate with home appliances. The Bluetooth module (slave) on the other hand is the input and the relay is the output, which are connected to the other Arduino. The bulb or lamp is connected to the relay. The master sends a signal to the slave. The slave signals to Arduino. It checks the status of the program. It sends a signal to the relay, which turns the bulb on or off. When the bend was not to the required limit, the command will be failed to turn on/off the appliance, because the resistance value is not equal be equal to the condition given in the Arduino.



#### V. RESULTS

After the implementation of flex sensor with the glove and the system was tested. It worked properly for every command. It is tested at different distance and transmission between the master and slave Bluetooth was smooth. The Master bluetooth is the transmitter, which is connected to flex sensor with arduino. The Slave bluetooth is the receiver, which is connected to the appliance with arduino and relay. And both are powered using the arduino. When the bend was not to the required limit, the command will be failed to turn on/off the appliance, because the resistance value is not equal be equal to the condition given in the arduino. The Arduino correctly recognizes the flex to turn on/ off the right appliance. It correctly recognizes the appliance is turned on/off and turns on if the appliance is off or turns off if the appliance is on. The Proposed project gave the expected result. Thus, the result was obtained for the proposed project.



## VI. CONCLUSIONS

The Proposed system is basically for the physically challenged people who are unable to move from the respective position. It proposes a viable solution for them. It is very difficult task for them to turn on/off the appliances from their respective position. It helps them to get their home under their control without help of others and manually switch on or off the appliance. From this proposed system. Slave Bluetooth is connected to another Arduino with a relay to the required appliance. The advantage of implementing our proposed system will be cost efficient, less complex and user friendly. The user need not have to immense knowledge over anything. Just by bending the finger the corresponding sensor and value given to that specific appliance to switch on or off will allow the user to have complete control over any appliance with less effort.

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