SMART CHAIR

CAPSTONE PROJECT REPORT

SUBMITTED IN PARTIAL FULFILLMENT OF THE

REQUIREMENT FOR THE AWARD OF

THE DEGREE OF

BACHELOR OF TECHNOLOGY

IN

ELECTRONIC AND COMMUNICATION ENGINEERING

(PROJECT TERM, 2016)

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CERTIFICATE

This is to certify that **Seerapu Pankaj, Rama Krishna Bollu, Jeevan babu, S.Devendra Kumar** has successfully completed the Capstone Project entitled "**SMART CHAIR**" under my guidance and supervision for the partial fulfilment for the award of **BACHELOR OF TECHNOLOGY (B. TECH) in ELECTRONICS AND COMMUNICATION ENGINEERING (ECE)** from **LOVELY PROFESSIONAL UNIVERSITY (LPU), PHAGWARA, PUNJAB.**

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DATE:

DECLARATION

We hereby declare that the project work entitled "**SMART CHAIR**" is an authentic record of our own work carried out as requirement of our own work carried out as requirement of final year Capstone Project for the award of degree of Bachelor of Technology (B. Tech) in Electronics and Communication Engineering (ECE) from Lovely Professional University (LPU), Phagwara, Punjab, India, under the guidance of Asst. Prof Mr. Nitin Kumar during January to May 2017.

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Last but not the least we pay a deep sense of gratitude to our family members and friends who have been constant source of inspiration and support and their valuable advice for the preparation of this project.

CONTENTS

ABSTRACT

The main Objective of the project is to create a chair that can ease the human's life style and assist human in doing the featured tasks. This Chair has a feature of virtual notes or a digital note that is developed with an intension of avoiding paper notes and ink. So, that their no unnecessary wastage of paper and ink. This is a step towards making the notes completely digitized. One of the intriguing feature is it will mail the copy of the notes to the verified email address of the user. So, that the person can download it and read it in his personal computer or smart phone.

This chair has feature of adjusting its back rest according to the height of the person sitting in the chair. The chair can also be adjusted to either take rest or just sit according to the comfort of the user sitting on the chair. The back rest and leg rest of the chair are movable the position can be changed with the help of switch or with voice controlled as younger generation find it more obsolete to use buttons so they have a feature to control it with the help of voice commands from an android application.

This Chair is also having a feature of security alert on every time the chair is accessed. This security alert is given by sending a message to registered and verified mobile number. The Chair also speaks to the user and intimates him whether he is sitting in a correct posture so that he gets no back pain. This is done by Ultrasonic sensor that track the positon of the spine so once the timer can be started when the user starts sitting in the chair and after a certain time is the user can be intimated whether he is sitting in correct posture.

LIST OF FIGURES

INTRODUCTION

We are in an era of smart devices and gadgets assisting humans in every aspect of life. They also increase the efficiency of the work and also save time which could be put to some other use. This concept of smart chair is evolved from an idea of designing a virtual notes or digitized notes that doesn't require the usage of a pen or even paper to save the notes. This will reduce the paper usage as well as pen ink. To integrate this digital notes there is a requirement for an element that could be much closer for a student. So, the best idea would be integrating this device with a study chair. As far being a study chair the functionality of the chair should not be limited simply for writing notes. The most common problem faced by students is sitting for long hours in study chair they get tired as well as the back rest of the chair is not as the same height of the person sitting in the chair.

The eliminate the problem of back rest a self-adjusting mechanism that could track the body position and adjust its height accordingly. But this wasn't exactly meeting the demand of students as we can see after studying for long hours they get tired for which they often try to take rest on the chair which is not even comfortable for their sleeping posture. So the solution this project offers to the user is a movable back rest and leg rest so that user after getting tired can even sleep on the chair.

CHAPTER 2: COMPONENTS REQUIRED

2.1 Raspberry Pi 3

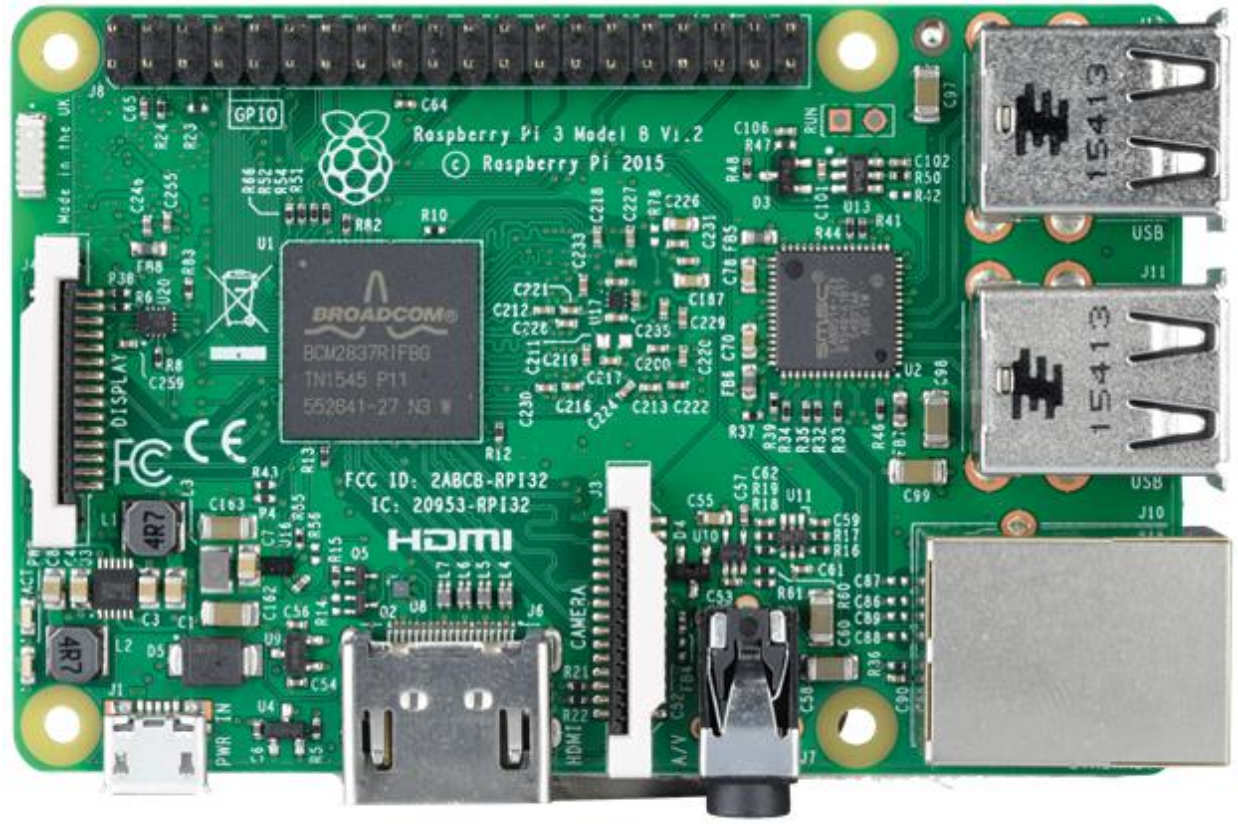

Fig. 2.1

Raspberry pi is third generation series of small engine board computers developed by raspberry pi foundation of the UK. It is generally used for promoting the user friendly science teaching in the developing world. The Raspberry Pi is a credit-card-sized computer that plugs into your TV and a keyboard. It is a capable little computer which can be used in electronics projects, and for many of the things that your desktop PC does, like spreadsheets, word processing, browsing the internet, and playing games. It also plays high-definition video.

2.1.1 SOC

Built specifically for the new Pi 3, the Broadcom BCM2837 system-on-chip (SoC) includes four high-performance ARM Cortex-A53 processing cores running at 1.2GHz with 32kB Level 1 and 512kB Level 2 cache memory, a video core IV graphics processor, and is linked to a 1GB LPDDR2 memory module on the rear of the board. Like the Pi 2, it also has 1GB RAM**.** On the older beta Model B boards, 128 MB was allocated by default to the GPU, leaving 128 MB for the CPU. On the first 256 MB release Model B (and Model A), three different splits were possible. The default split was 192 MB (RAM for CPU), which should be sufficient for standalone 1080p video decoding, or for simple 3D, but probably not for both together. 224 MB was for Linux only, with only a 1080p frame buffer, and was likely to fail for any video or 3D. 128 MB was for heavy 3D, possibly also with video decoding.

The Raspberry Pi 2 and the Raspberry Pi 3 have 1 GB of RAM. The Raspberry Pi Zero and Zero W have 512 MB of RAM.

2.1.2 Networking

The Raspberry Pi 3 and Pi Zero W (wireless) are equipped with 2.4 GHz WiFi 802.11n and Bluetooth 4.1 based on Broadcom BCM43438 chip with no official support for Monitor mode but implemented through unofficial firmware patching and the Pi 3 also has a 10/100 Ethernet port.

2.1.3 Peripherals

The current Model B boards incorporate four USB ports for connecting peripherals. It has 40 GPIO pins. The Raspberry Pi 3 features the same 40-pin general-purpose input-output (GPIO) header as all the Pi's going back to the Model B+ and Model A+. Any existing GPIO hardware will work without modification; the only change is a switch to which UART is exposed on the GPIO's pins, but that's handled internally by the operating system.

2.1.4 Important Specifications:

SoC: Broadcom BCM2837

CPU: 4× ARM Cortex-A53, 1.2GHz

GPU: Broadcom Video Core IV

RAM: 1GB LPDDR2 (900 MHz)

Networking: 10/100 Ethernet, 2.4GHz 802.11n wireless

Bluetooth: Bluetooth 4.1 Classic, Bluetooth Low Energy

Storage: micro SD

GPIO: 40-pin header, populated

Ports: HDMI, 3.5mm analogue audio-video jack, 4× USB 2.0, Ethernet, Camera Serial Interface (CSI), Display Serial Interface (DSI)

2.2 7 inch 1024*600 LCD Panel

fig.2.2

This is LCD TFT Display TFT (Thin Film Transistor) this display helps in providing best resolution as each pixel is controlled by one to four transistors. These are also called Active matrix LCD’s. The model used is 1x7 inch 1024x600 LCD Panel CLAA070 without Touch

Screen. These are most expensive LCD Panel but gives the best resolution in terms of available displays. Liquid crystal displays do not emit the light directly but instead use reflector or a back light to display coloour or monochrome image. They have wide range of applications in computers, automobiles and air crafts. They are also widely used in smart phones. LCD pixels consists of two transmission electrodes which are parallel and perpendicular to the different layers of LCD. The Liquid Crystal has a property of changing it's state as it is in semi liquid state. The LCD becomes solid to semi-liquid depending on the application of different voltages. This property helps in creating different illuminations at a point thus generating different shades of colour. The LCD's have widely revolutionized in consumer electronics.

2.3 LCD Driver Board

fig.2.3

The Driver board for LCD screen is used to power the LCD and act's as a gateway between raspberry pi and LCD screen. The Raspberry pi is connected to the driver board via VGA Port available on the driver board.

2.4 Arduino Uno

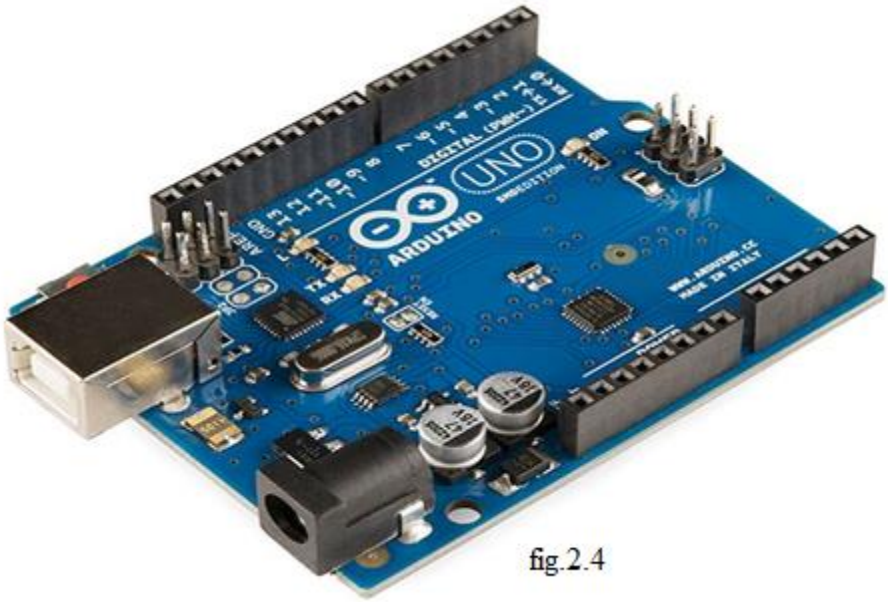

fig.2.4

The Arduino Uno is a microcontroller board based on an ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, 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 an AC-to-DC adapter or battery to get started.

Microcontroller: ATmega328

Architecture: AVR

Operating Voltage: 5V

Flash Memory: 32 KB of which 0.5 KB used by boot loader

SRAM: 2 KB

Clock Speed: 16 MHz

Analog I/O Pins: 6

EEPROM: 1 KB

DC Current per I/O pins: 40 mA on I/O pins; 50 mA on 3.3V pin

Input Voltage: 7-12

Digital I/O pins: 20

PWM Output: 6

PCB Size: 53.4 x 68.6 mm

Weight: 25 g

The arduino uno is best customized on board microcontroller boards and most widely used in DIY projects. The development board has onboard programmer of flash memory of microcontroller. The arduino has a boot loader especially to make programming language understanding in a much user friendly manner. The computing capabilities of Arduino Uno is comparatively quick to other microcontrollers. These board has USB communication support for verifying data and hardware information debugging.

2.5 4 wire Resistive Touch Pad

fig.2.5

A touch pad has a tactile sensor which is sensitive to point touch. It has a special surface that can translate the position of a user's fingers to a relative position to the Arduino. Touchpad are a common feature in computers. Because they vary in size, they can also be found on personal digital assistants and some media players.

Touchpad work in one of several ways, including capacitive sensing and resistive touch screen.

2.5.1 RESISTIVE TOUCH PAD

A resistive touch screen is made of many layers, which are: two thin, transparent electrically resistive layers separated by a thin space. These layers face each other with a thin gap between. The top screen (the screen that is touched) has a coating on the underside surface of the screen. Below it is a similar resistive layer on top of its substrate.

One layer has conductive connections with its sides, the other along top and bottom. A voltage is applied to one layer, and sensed by the other. When an object, such as a fingertip or stylus tip, presses down onto the outer surface, the two layers touch to become connected at that point: The panel then behaves as a pair of voltage dividers, one axis at a time. By rapidly switching between each layer, the position of a pressure on the screen can be read

- The 4-wire Resistive touch screen is the preferred solution for low-cost applications. .
- By alternating the voltage signal between the top layer and the bottom layer, the X and Y coordinates of the user's touch are computed.

2.6 Bluetooth Module

fig.2.6

HC-05 Bluetooth module is the most economical and easiest way to go wireless.
This module allows you to wirelessly extend your serial interface, hence any program running on your Laptop feels its controlling a local serial port (which is over a wireless Bluetooth link)

The 4 pins are +5V, GND, TXD, RXD. Supply voltage should be 3.3 - 6 V. Absolute maximum is 7 V.

2.7 Ultrasonic Sensor

fig.2.7

An Ultrasonic sensor is a device that can measure the distance to an object by using sound waves. It measures distance by sending out a sound wave at a specific frequency and listening for that sound wave to bounce back. By recording the elapsed time between the sound wave being generated and the sound wave bouncing back, it is possible to calculate the distance between the sonar sensor and the object.

Since it is known that sound travels through air at about 344 m/s (1129 ft/s), you can take the time for the sound wave to return and multiply it by 344 meters (or 1129 feet) to find the total round-trip distance of the sound wave. Round-trip means that the sound wave traveled 2 times the distance to the object before it was detected by the sensor; it includes the 'trip' from the sonar sensor to the object AND the 'trip' from the object to the Ultrasonic sensor (after the sound wave bounced off the object). To find the distance to the object, simply divide the round-trip distance in half.

We are using HC-SR04 ultrasonic sensor in our project

Ultrasonic ranging module HC - SR04 provides 2cm - 400cm non-contact measurement function, the ranging accuracy can reach to 3mm. The modules includes ultrasonic transmitters, receiver and control circuit. The basic principle of work:

- Using IO trigger for at least 10us high level signal,
- The Module automatically sends eight 40 kHz and detect whether there is a pulse signal back.
- IF the signal back, through high level, time of high output IO duration is the time from sending ultrasonic to returning.

Test distance = (high level time×velocity of sound (340M/S) / 2

Parameters of HCSR04

Working Voltage DC: 5v

Working Current: 15mA

Working Frequency: 40Hz

Max Range: 4m

Min Range: 2cm

Measuring angle: 15 degree

Trigger Input Signal: 10us TTL pulse

Echo Output Signal: Input TTL lever signal and the range in proportion

Pin Description

- VCC: 5V DC supply voltage is connected to this pin.
- Trigger: The trigger signal for starting the transmission is given to this pin. The trigger signal must be a pulse with 10uS high time. When the module receives a valid trigger signal it issues 8 pulses of 40 KHz ultrasonic sound from the transmitter. The echo of this sound is picked by the receiver.
- Echo: At this pin, the module outputs a waveform with high time proportional to the distance.
- GND: Ground is connected to this pin. The 40KHz pulse train is transmitted just after the 10uS triggering pulse and the echo output is obtained after some more time. The next

triggering pulse can be given only after the echo is faded away and this time period is called cycle period. The cycle period for HC-SR04 must not be below 50mS. According to datasheet, the distance can be calculated from the echo pulse width using the following equations.

- Distance in cm = echo pulse width in uS/58.
- Distance in inch = echo pulse width in uS/148.

2.8 IR Sensor

fig.2.8

The IR sensor works on the principle of reflection of light from the bright surface. It has an inbuilt comparator circuit. There is an IR transmitter and IR Receiver. The IR Receiver is a photodiode that conducts when light is incident on it. The IR receiver gives a certain voltage when IR rays are incident on it after reflecting from a bright surface. Then this signal is provided to a comparator circuit that sets the voltage to a reference 5 volt. The comparator circuit is a LM354 IC which has inbuilt functionality of a comparator. It has potentiometer to change the distance on which it should detect.

2.8.1 Pin Description

Pin 1: 5 volt DC supply for the operation of the ir sensor to power the onboard comparator circuit.

Pin 2: Ground of the 5v DC supply is provided to it.

Pin 3: Output of the IR sensor. This pin goes HIGH when there is obstacle at calibrated distance and goes LOW when there is no obstacle infront of the IR transmitter and receiver combination.

2.9 PIR Sensor

fig.2.9

A passive infrared sensor (PIR sensor) is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view. They are most often used in PIR-based motion detectors.

All objects with a temperature above absolute zero emit heat energy in the form of radiation. Usually this radiation isn't visible to the human eye because it radiates at infrared wavelengths, but it can be detected by electronic devices designed for such a purpose. The term passive in this instance refers to the fact that PIR devices do not generate or radiate any energy for detection purposes. They work entirely by detecting the energy given off by other objects.

PIR sensors don't detect or measure "heat"; instead they detect the infrared radiation emitted or reflected from an object. Most PIR modules have a 3-pin connection at the side or bottom. The pinout may vary between modules so triple-check the pinout! It's often silkscreened on right next to the connection. One pin will be ground, another will be signal and the final one will be power.

Power is usually 3-5VDC input but may be as high as 12V. Sometimes larger modules don't have direct output and instead just operate a relay in which case there is ground, power and the two switch connections.

2.10 Relay:

A Relay is an electro mechanical switch used for driving heavy current loads in electronic circuits. Relay interface the electronic circuits with high voltage AC and there is complete galvanic separation between the two. When current passes through the relay coil, magnetic field develops which attracts a lever and changes the switch contacts. The contacts can be used to connect AC or DC loads which may then turn on / off the load depending on the contact connections. A relay allows one circuit to switch on a second circuit which is completely separate from the first one. In this project, 12V relay is used.

Characteristics of Relay

- Maximum switching current: 7A, 10A
- Maximum switching voltage: 28V dc/ 250V ac
- Ambient temperature: -40^0C - $+85^0$C
- Operation/release time =10/8ms
- Contact capacity: 10A 125V, 7A 250V

2.10.1 Relay coil

The coil inside passes only DC current from the circuit. When DC current passes through the coil, magnetic field develops which attracts the moving contact so that the contacts may break or connect. The relay coil passes relatively large current of 30 to 100 Milli amperes. The relay coil voltage and resistance are important parameters to select the appropriate relay for the circuit.

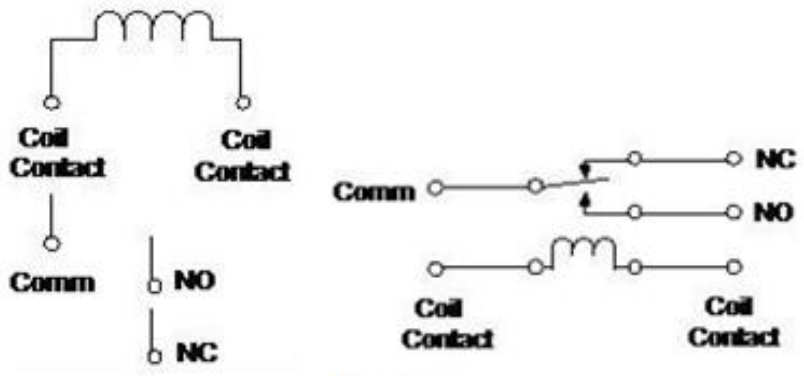

fig.2.10

2.10.2 Relay contacts

Typically, a relay has three contacts. A moving contact called Common (Com) and two fixed contacts. These are Normally Closed (NC) and Normally Open (NO) figure 5 shows the relay contacts. AC / DC is connected to the Com Contact. NO contact is used to connect the circuit when the relay triggers. In this case, the circuit/Gadget remains off when the relay is OFF. NC contact is used to break the supply when the relay energizes. In this case the circuit remain operating until the relay energize.

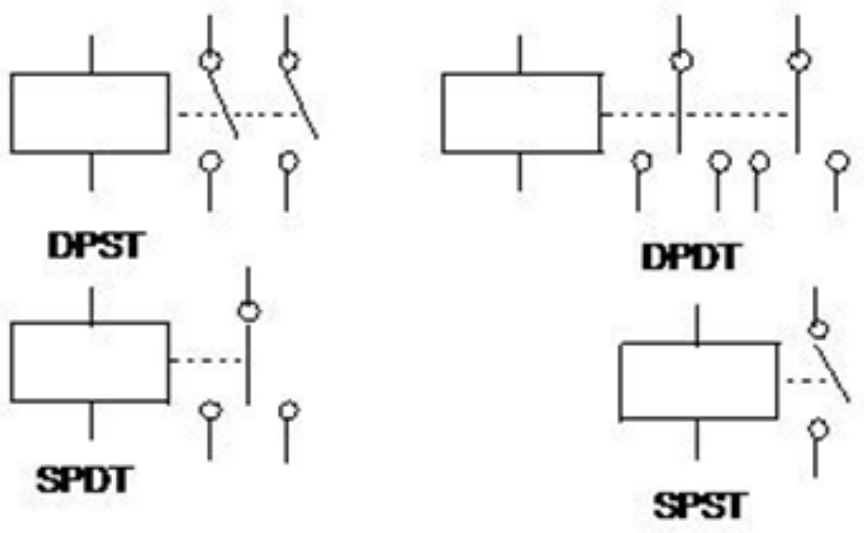

fig.2.11

Based on the number of contacts relays are classified into

- SPDT – Single Pole Double Throw – These have a single Com, NC and NO contacts
- DPDT – Double Pole Double Throw. – These have 2 Com, 2 NC and 2 NO contacts. DPDT relays can be used to drive two loads separately so that on will switch on the load and other will switch off the load depending on the connections in the NO/NC contacts. See in figure 6 below.

2.11 12v DC Adapter

fig.2.12

This is a DC adapter that converts AC to DC and regulates the output voltage to 12 volt and 2 amp. The DC voltage adapter is used to power the LCD Driver Board. Generally there are range of voltage adapters available in the market depending on the output voltage and current rating.

2.12 USB Cable

fig.2.13

The USB cable is used to power the raspberry pi. The USB cable are available depending on the current rating. The raspberry pi 3 require a voltage of 5 volt and 2 amp to work efficiently. The USB cable with DC adapter is used to power raspberry pi.

2.13 Switches

fig.2.14

fig.2.15

Switches used are SPDT (Single Pole Double Throw) sliding switch which has 3 pins. Terminals 1 and 3 are different pins and 2 is common pin. The pin 2 connects either 1 and 3 depending on the sliding of the switch. The push button is working on a simple spring contact that comes in contact on applying pressure.

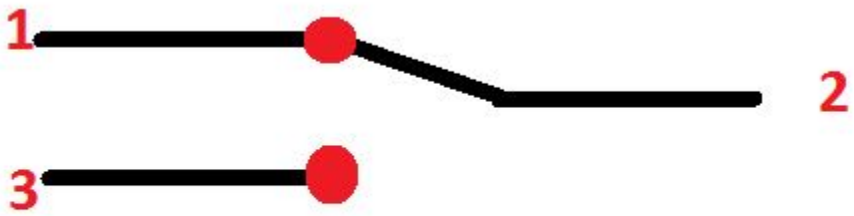

fig.2.16

2.14 HDMI To VGA Converter

Fig. 2.17

HDMI stands for High Definition Multimedia Interface. It is an audio and video transfer interface for uncompressed data. HDMI is a digital solution for analog video transfer methods. HDMI 1.0 has a pixel clock rate of 165Mhz which is sufficient to transfer a 1080p recording that is 1920x1200. HDMI 1.3 has pixel rate upto 340 MHz, for higher resolution of 2560x1600 on a single line. An HDMI interface is either single link or dual link. Single link is of type A, C and D, whereas dual-link is of type B and has pixel rate of 25 MHz to 340 MHz on a single link connection or 25 MHz to 680 MHz for dual link interface. HDMI to VGA converter is used to connect the LCD driver board with raspberry pi 3. The raspberry pi is connected for a display using HDMI port on raspberry pi.

2.15 VGA Cable

Fig. 2.18

VGA stands for Video Graphics Array is a connector having three rows with 15 connectors. The 15 pin VGA connectors are mainly used in connection of computer with projectors, High Definition LCD displays. VGA interface not designed to connect with the host or disconnect with the host when the host is active but it doesn't cause any hardware problems. VGA cable is used to connect to HDMI to VGA connector so that it is connected with the raspberry pi for video transfer.

2.16 Electro-Mechanical Linear Actuators

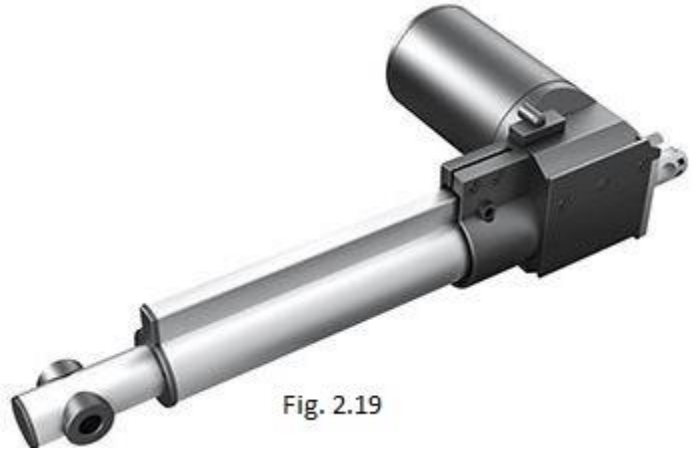

Fig. 2.19

Linear Actuators are used to convert circular motion to linear motion. Linear actuators are generally used in power tools and in industrial machinery. There are generally of many types mainly they are Hydraulic, Pneumatic, Mechanical, Electro-Mechanical.

Mechanical linear actuators convert circular motion to linear motion by mechanisms like leadscrew, ball screw or rack and pinion mechanism.

The Hydraulic linear actuators work on the principle of compressed fluid that is pushed from control valve to either of the chambers to create motion on the desired direction. Similarly, the Pneumatic linear actuators consists of highly compressed air and works similar to hydraulic linear actuator.

The Smart Chair project has Electro-Mechanical Linear Actuators. These are similar to mechanical linear actuators instead they use motor and with the help of ball screw, lead screw or rack and pinion mechanism they convert the rotatory motion of motor to linear motion.

There two linear actuators to create up and down of leg rest as well as back rest. The specifications of these actuators are:

Specifications:

Dynamic Load Push : 6000N

Dynamic Load Pull : 4000N

Static Load push : 6000N

Static Load pull : 4000N

Input DC Voltage : 24Volt

Speed at Full Load : 3 mm/s

The linear actuator assembled at the automated head rest features are

Specifications:

Dynamic Load Push : 1000N

Dynamic Load Pull : 1000N

Static Load push : 1000N

Static Load pull : 1000N

Input DC Voltage : 24Volt

Speed at Full Load : 20 mm/s

CHAPTER 3: CIRCUIT DESCRIPTION

3.1 Interfacing 4 Wire Resistance touch pad with Arduino Uno

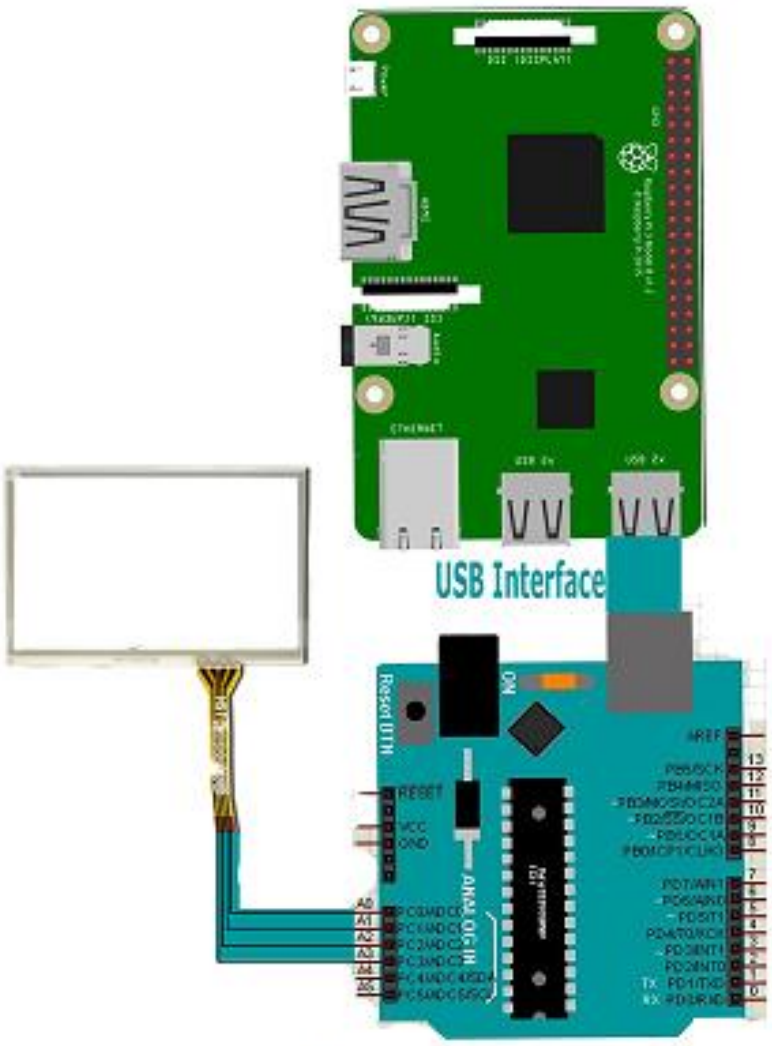

Fig 3.1

Four wire resistive Touch pad has thin film copper strip which has four wires connected to different layers of the touch pad. The touch pad is connected to the zif (zero insertion force). These are used wire to board connectors are used for attaching wires of Touch pad. This helps in connecting the touch pad with analog pins of arduino. These arduino pins by default work as analog input. These are used to read analog voltages from the pins of resistive touch pad. The four pins of touch pad are connected to A0, A1, A2, A3 of Arduino uno. These work on the principle of voltage divider circuit. The touch pad has X+, X-, Y+, Y- pins we either applying

voltage at X+ or X- and read analog voltages from Y+ or Y- then we get X coordinate and by making Y+ or Y- and read analog voltages form X+ or X- then we get Y coordinate. These coordinates are transmitted to raspberry pi through serial communication. Serial communication used is through USB serial port at 9600 baud rate.

3.2 Interfacing Ultrasonic Sensor with Arduino Uno

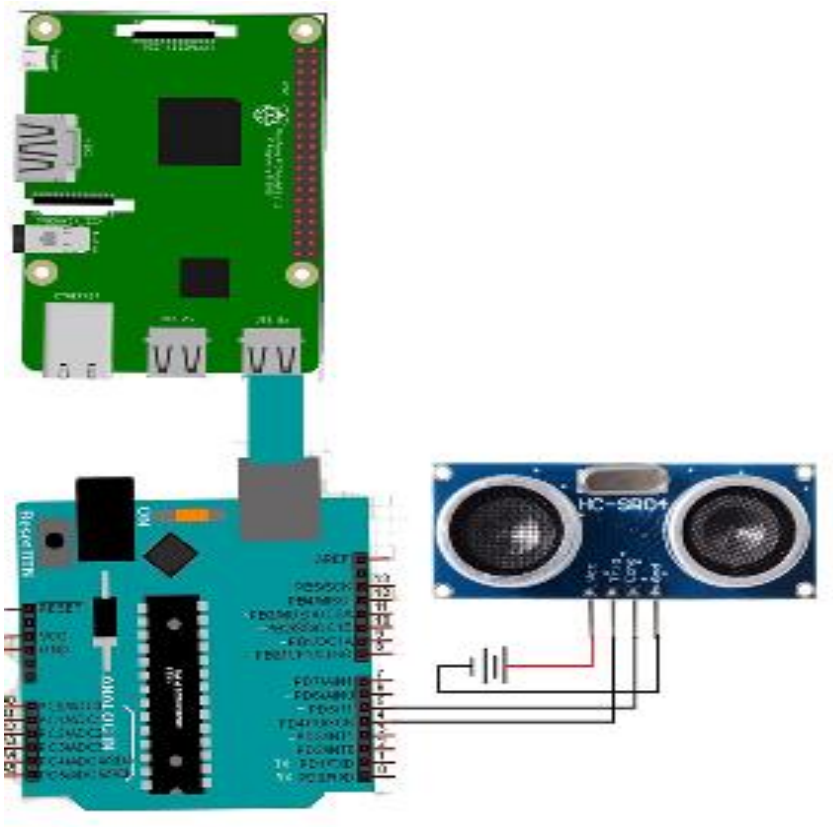

fig 3.2

Ultra sonic sensor has Vcc, Gnd, Trig, Echo pins. It takes a supply of 5 volt. The Trig pin of ultrasonic sensor is connected with digital pin 4 of arduino and Echo pin is connected to digital pin 5 of arduino. This ultrasonic sensor measures distance form transmitting ultrasonic waves and receiving them from the receiver. The ultrasonic waves reflect from the obstacle and echo pin receives them the echo pin receives all the burst transmitted by the transmitter using trigger.

3.3 Interfacing PIR Sensor with Raspberry pi 3

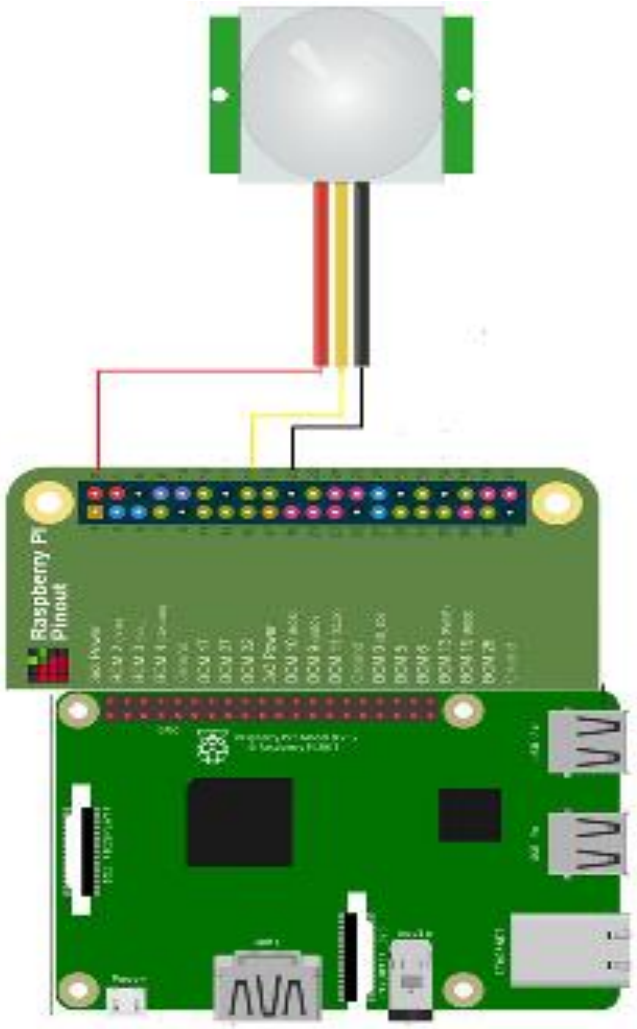

fig 3.3

PIR is a passive infrared sensor that tracks a particular ir radiation. It only detects human IR radiations. The PIR sensor has 3 pins Vcc, Gnd, Out. The output pin of PIR becomes high when there is a human intrusion. The PIR sensor output is connected to pin 20 on board and according to BCM it is BCM 23. The raspberry Pi has two different pin out configurations depending on the python program. Depending on the BCM or board . The GPIO.setup has (GPIO.Board) or

(GPIO.BCM) according to BCM then the onboard is different as the BCM is System on chip that is on raspberry pi.

3.4 Interfacing Switch with Arduino Uno

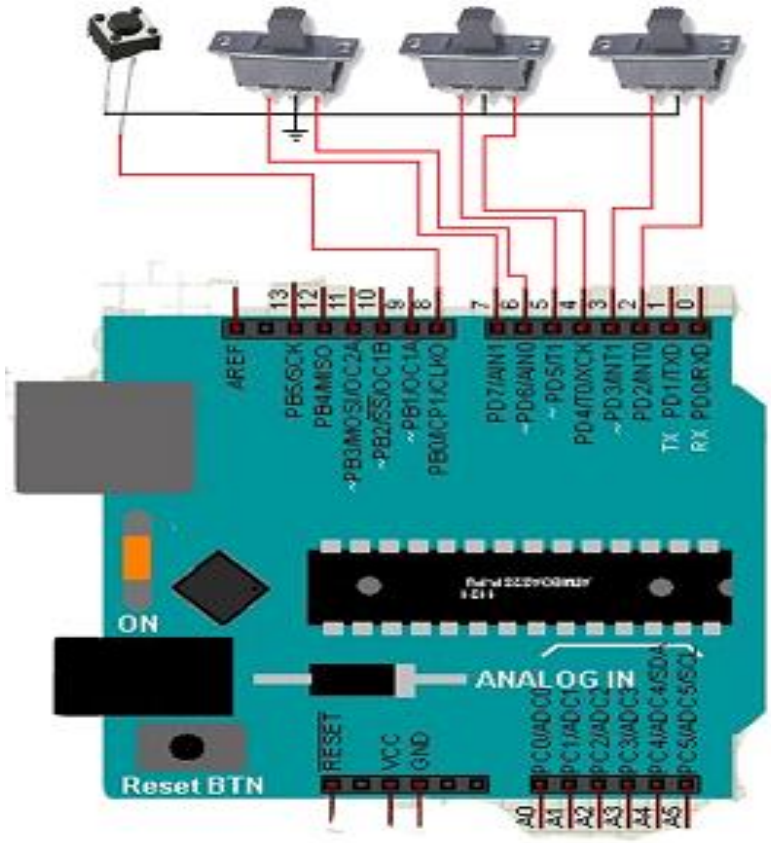

fig.3.4

The sliding switch has 3 pins the middle pin of sliding switch is connected to ground. The digital pins on 2, 3, 4, 5, 6, 7 are declared as input pins on arduino in the program and are pulled up. The concept of pullup is that unless and until the pullup pin is connected to ground that pin remains high. So when they slide to either sides the the particular pin goes LOW. The Arduino is programmed to monitor every pin and respond to corresponding action by driving the linear actuator by providing signal to the relay. The switch one from the right is used to switch between two linear actuators one connected to the back rest and other connected to leg rest. The other two switches are connected to control the motion of actuator connected to control the motion of leg rest or back rest back and forth. There is a push button connected to pin 8 that is used to activate the entire actuators. Till the moment the pin is pressed the actuators motion is active.

3.5 Interfacing Bluetooth Module with Arduino Uno

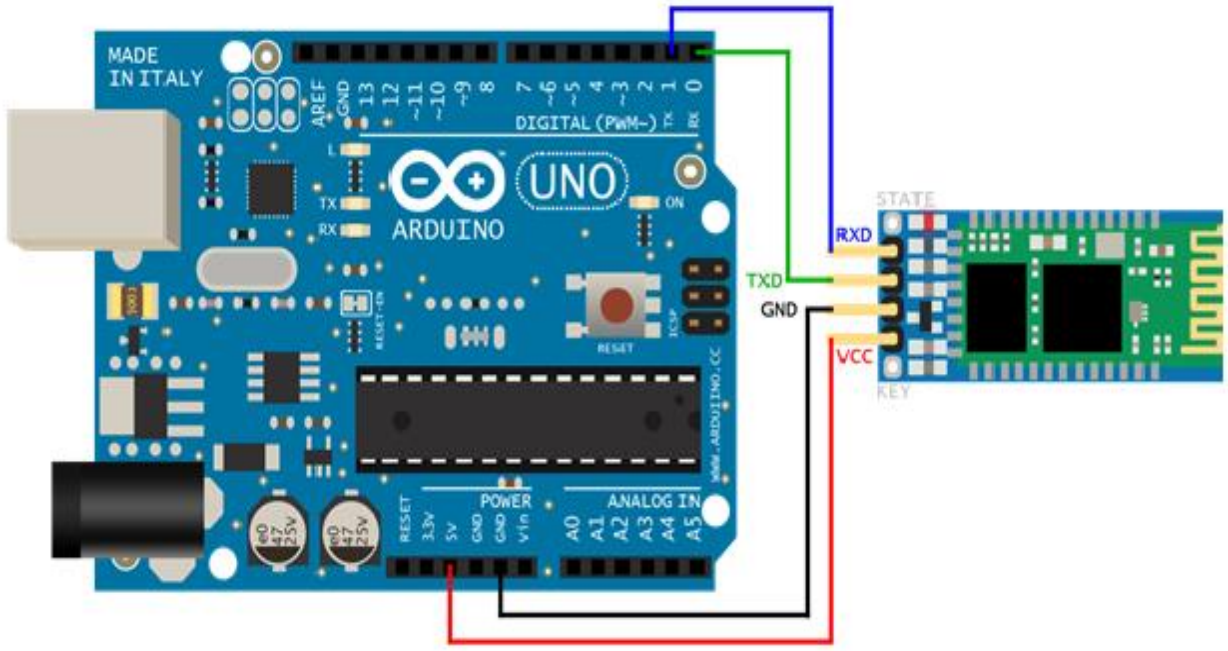

fig.3.5

The Bluetooth Module has four pins Vcc, Gnd, Tx, Rx. The Vcc is provided with 5 volt supply. The Tx and Rx pin work on UART. The data is serially read from bluetooth module using Tx, Rx pins on arduino. This bluetooth module is paired with android mobile and is connected to a application running on the mobile. This application transmitts a voice command as well as it has on screen buttons to transmitt text to bluetooth module. The text received is by bluetooth module and read using UART in arduino and respective tasks are performed. The forward command gives the linear actuator on the back rest to move forward and back gives the linear actuator on the back rest to move backward. Up command gives the actuator at leg rest to raise up and down command gives the actuator at leg rest to go down.

3.6 Interfacing Relay Module and Linear Actuator with Arduino Uno

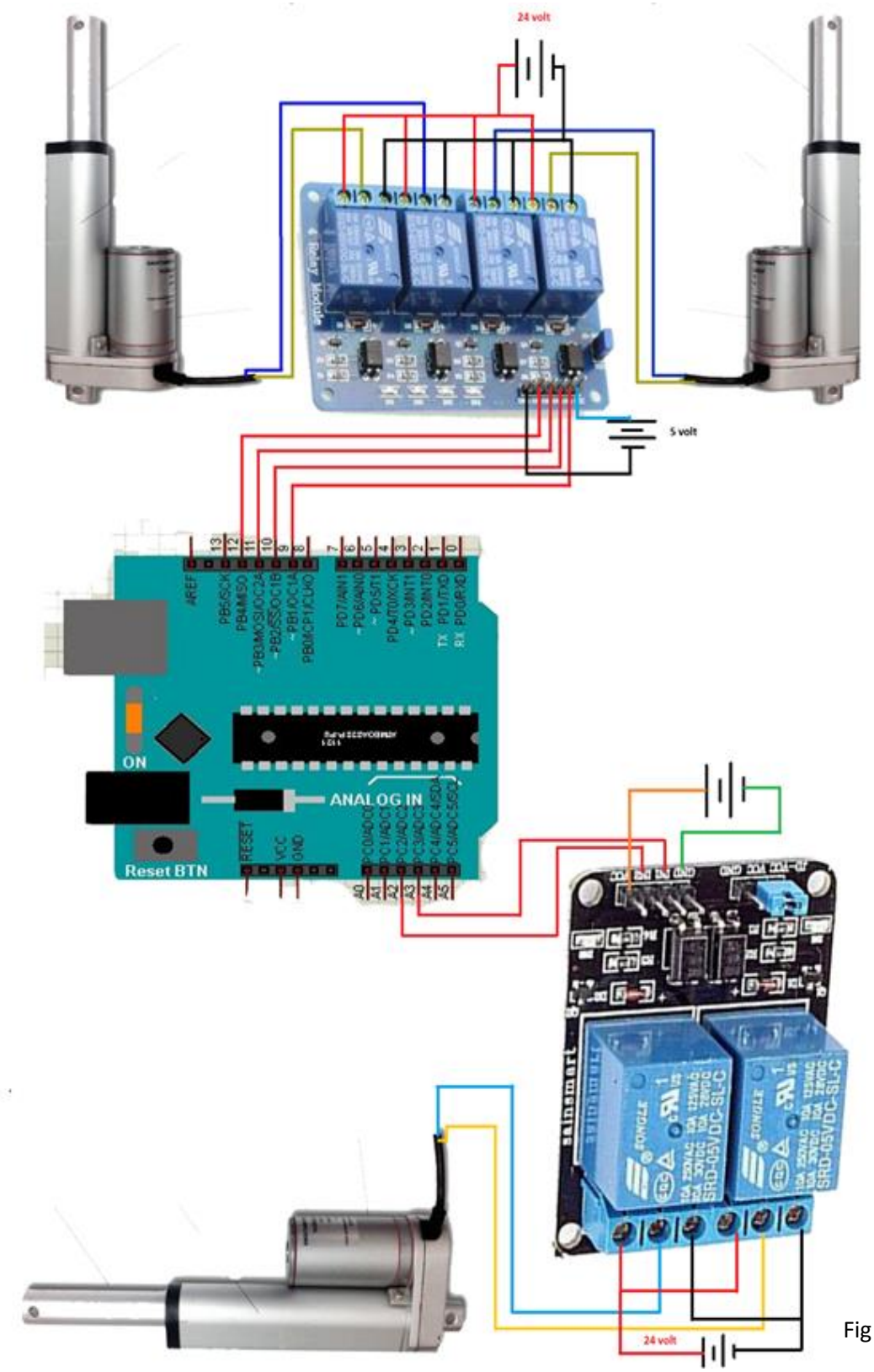

Fig 3.6

There are two Relay modules.The relay module works on 5 volt. One relay module is 4 channel and other relay module is two channel. 4 Channel relay module has 4 input pins to switch the relay. The pins are In1, In2, In3, In4 are connected to digital pins 9, 10, 11, 12 on arduino. These are pins are declared as output. The pin A2, A3 pins are connected to In1, In2 on other relay module. The A2, A3 pins are made HIGH depending on the IR sensor connected to arduino. The commands received from bluetooth module are used to make 9, 10, 11, 12 pins HIGH on arduino to control the relay. The relay modules each can pass voltage around 220-240 voltage AC and 10 Ampere current. This relay module consists of 5 volt relay. They are switched on by supplying 5 voltage to the coil of the relay. The common pin is supplied with 24 volt. To operate 6 relays and to create the linear motion of actuators back and forth. The supply wires of linear actuators are connected to one relay each and other two ends of each relay is supplied with a negative and positive terminal of a 24 volt battery. Similarly, all the six relays are connected with negative terminal and positive terminal of 24 volt battery with Normally connected and Normally opened pins of relay to create desired motion.

3.7 Interfacing IR sensor with Arduino Uno

IR sensor works on the principle of reflection of light from a bright surface that fall on a photodiode to conduct and the voltage is measured using a potential divider circuit connected to a comparator. There are two IR sensors connected to pins A0 and A1 pins and are monitored for them to go HIGH when there is an obstacle detected depending on this if both the IR sensors are HIGH then actuator rises up. If one of the IR is HIGH then actuator goes down. The IR sensors are used because they are cheap and accurate proximity sensors for less range applications. If we are using ultrasonic sensor instead of IR sensor it would suffice the needs but the circuit and program complexity increase which is not desired. The simple solution for proximity to track the back of the user sitting in the chair is to employ an IR sensor. The data received through these IR sensors is used in such a way that when both the IR sensors are active then the linear actuator at head rest moves up to adjust to the height of the user. When both the actuator reach to the top they stop and for the head rest to come to its initial position then if one of the IR sensor is made active it comes back to its home position.

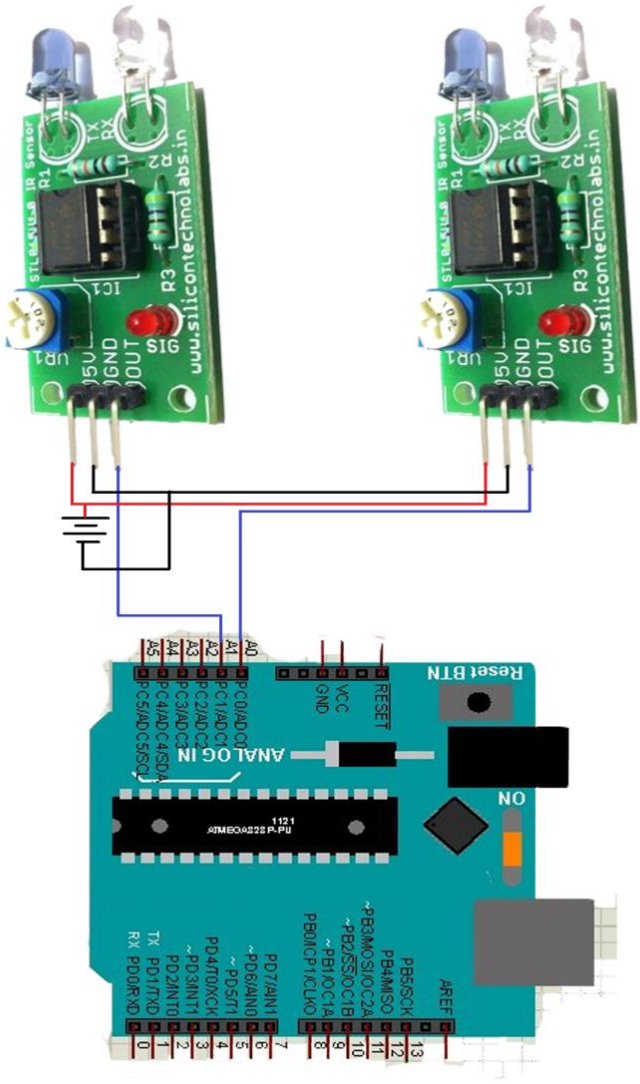
www.siliconteclabs.in
IR Sensor
TX
RX
R1
R2
R3
IC1
VR1
SIG
5V
GND
OUT
Reset BTN
ANALOG IN
NO
RESET
VCC
GND
AREF

Fig 3.7

CHAPTER 4 : WORKING DESCRIPTION OF MODULES

4.1 VIRTUAL NOTES

The Concept of Virtual notes is to make a digital notes which doesn't require pen and paper to record the writing. The notes is automatically recorded by the touch screen coordinates that are received from the touch pad to the Arduino Uno. This Arduino uno in turn sends the data to raspberry pi python application through serial communication. The Python application has a graphical user interface that converts these coordinates to a colored dot when a series of these dots are interconnected to form an alphabet.

Block Diagram of Virtual Notes

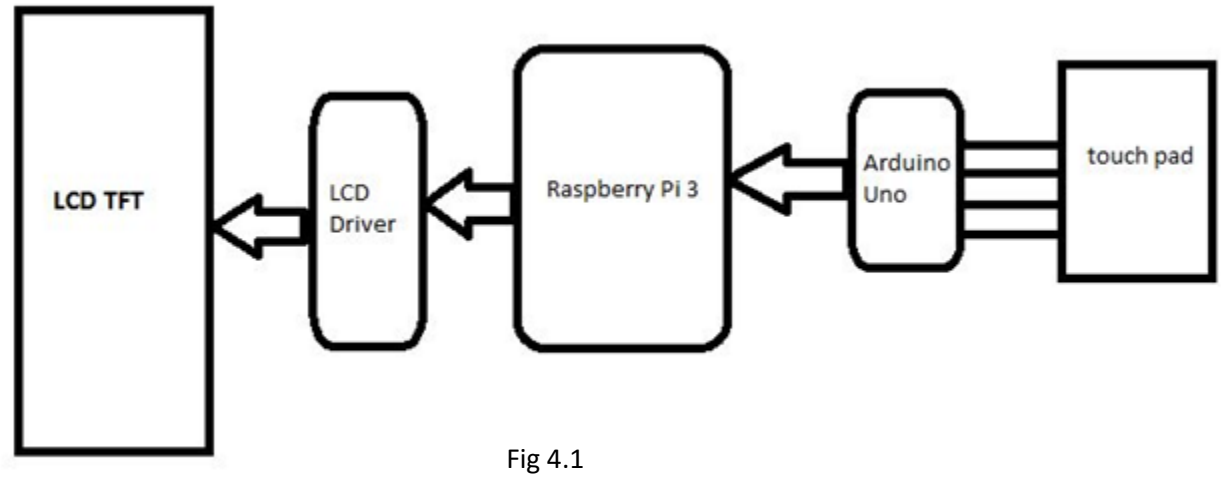

Fig 4.1

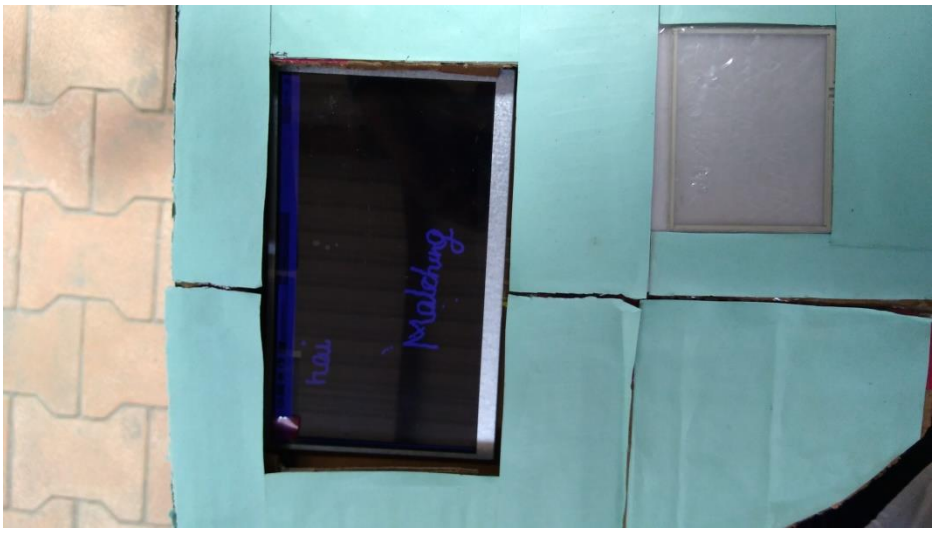

Fig 4.2

4.2 Unauthorized Access of Chair

The Chair is having a feature of sending message to a registered mobile number whenever this chair is accessed. This is accomplished by monitoring PIR (passive infrared sensor) to detect radiation emitted from humans. When the PIR is activated then some human has accessed the chair then a message is send from Twillio API a web service for sending free messages. Twillio will give command to send the message to the registered mobile number. It also sends a mobile Notification through a Channel in PushEtta Web Api Application. This PIR sensor is interfaced with raspberry pi and the program is a python script running on raspberry pi.

Block Diagram of Unauthorized Access of Chair

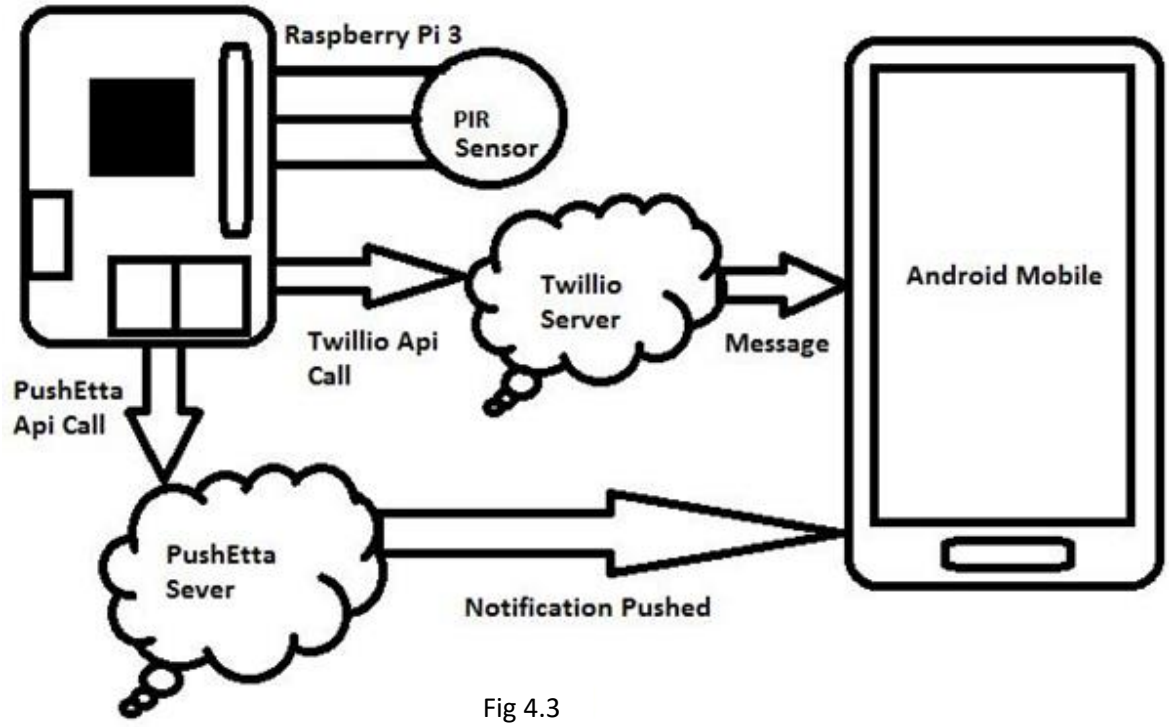

Fig 4.3

4.3 Voice Controlled Chair Sitting Position

The Chair is given voice command through an android application that will convert speech to text using speech recognizer and this text is transmitted wirelessly through Bluetooth connection of phone to the Bluetooth module HC-05 that is interfaced with Arduino uno. This Bluetooth module will receive data send from android mobile and an Arduino program that will compare

the string and activate the relay so that the linear actuator will move accordingly. This linear actuator motion will determine the chair is in sitting position or resting position.

The chair position can be also set with the help of switches. The back rest and leg rest can be adjusted with the help of just toggling switches.

Block diagram of Voice Controlled Chair Sitting position

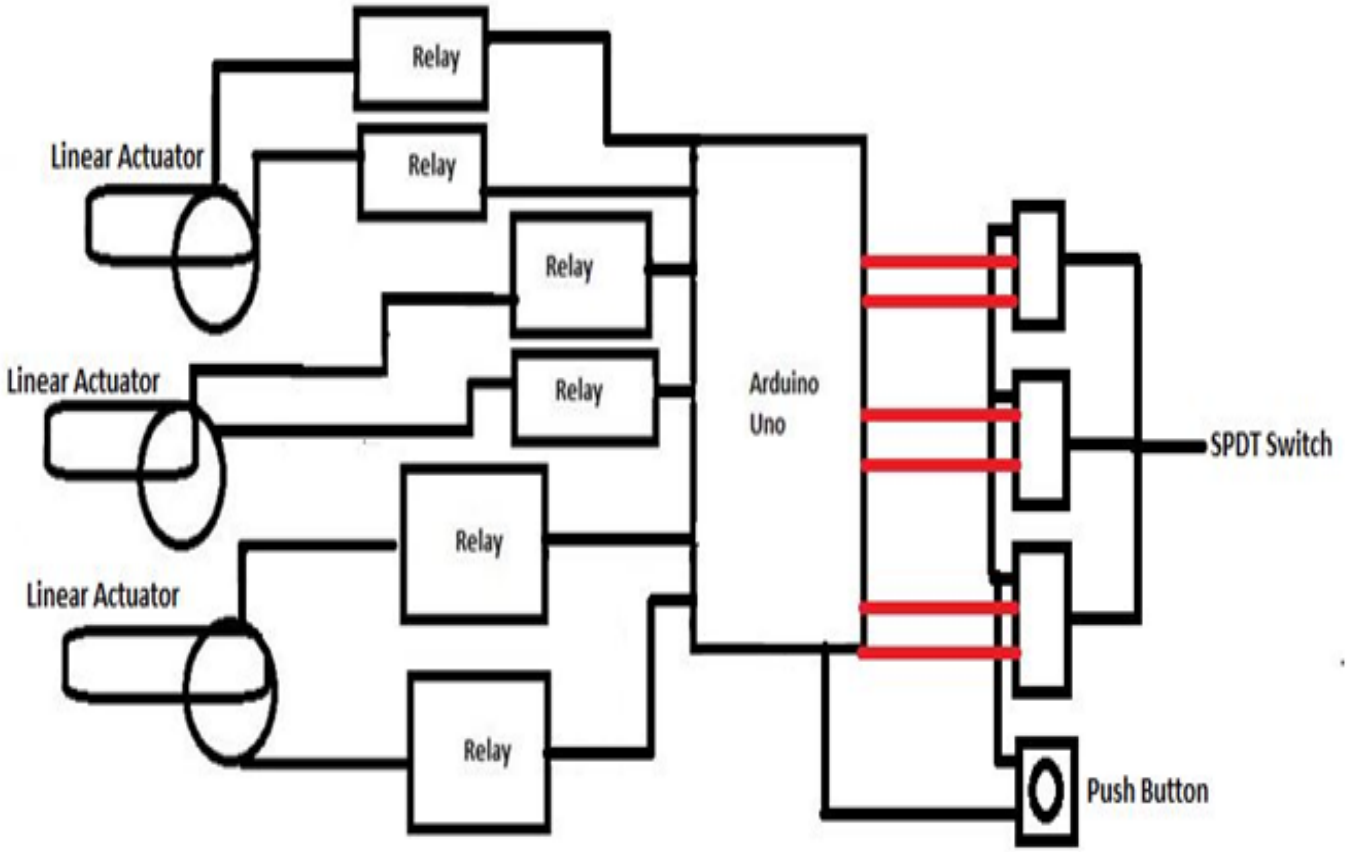

Fig 4.4

4.4 Automated Height Adjusting Back Rest

The chair has a feature of changing the back rest position as it is not fixed because if the back rest is not according to the person sitting in the chair then sitting for long hours can cause back pain. So this chair will automatically adjust it's height depending to the height of the person sitting in the chair. There two IR (Infrared Sensors) track the position and switch the relay

accordingly to drive the linear actuator which is fitted with the back rest of the chair. The Two IR Sensors are mounted in such a way that they track the back position and instruct the relay to switch so that the actuator attached to back rest raises up. As soon as the IR sensors reach the neck position the IR sensors don't get any obstruction they switch off the relay to stabilize there.

Block diagram of Automated Height Adjusting Back Rest

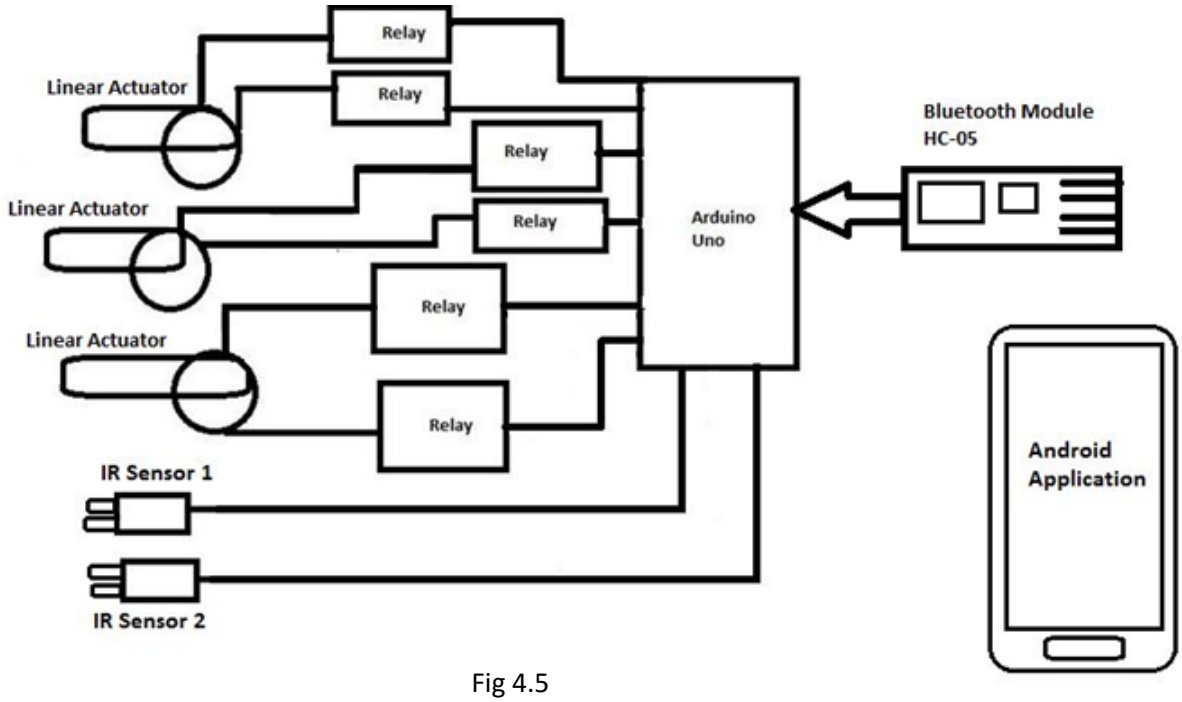

Fig 4.5

4.5 Tracking Sitting Posture

The Sitting position tracker is basically when the person sitting in the chair is bending his/her back bone then ultrasonic sensor assembled on the back rest will measure the distance of the user's back and the back rest if the distance is greater than certain value then chair will speak and inform to sit in correct position. So, that he doesn't get any backache by sitting in that posture for long time. The data received from ultrasonic sensor is programmed to compare the distance is whether than safe range for a human to sit in the chair for long hours. The value of distance is

safe range then it transmits a safe value or else it transmits a unsafe value through serial communication to the python application running on board computer i.e Raspberry Pi. The raspberry pi with the speech synthesizer or text to speech espeak module speaks out and warns the user to sit in a correct position. The espeak is linux text to speech application that uses on board alsa media hardware to produce a interactive voice. It can be configured to speak many voices.

4.5.1 Espeak:

eSpeak is a compact open source software speech synthesizer for English and other languages, for Linux and Windows.

eSpeak uses a "formant synthesis" method. This allows many languages to be provided in a small size. The speech is clear, and can be used at high speeds, but is not as natural or smooth as larger synthesizers which are based on human speech recordings.

eSpeak is available as:

- A command line program (Linux and Windows) to speak text from a file or from stdin.
- A shared library version for use by other programs. (On Windows this is a DLL).
- A SAPI5 version for Windows, so it can be used with screen-readers and other programs that support the Windows SAPI5 interface.
- eSpeak has been ported to other platforms, including Android, Mac OSX and Solaris.

Block Diagram of Tracking sitting posture

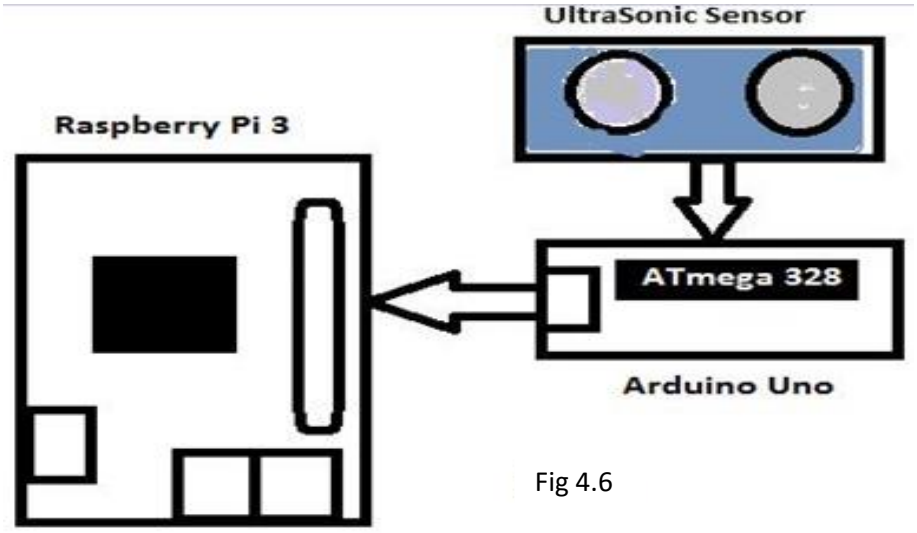

Fig 4.6

4.6 E-Mail of Captured Notes

The Notes that is written on LCD Screen from the Touch pad is captured by providing a keyboard interrupt. This notes captured is stored in a directory inside the memory of raspberry pi and then a python program creates an attachment of the captured notes and mail to the email address provided in the program. The Gmail server is created by the python application and through SMTP (simple mail transfer protocol) access the gmail account specified in the program. The python application cannot access the Gmail account if the option of being accessed by less secure applications is disabled on your Gmail account.

Block Diagram of Email of Captured Notes

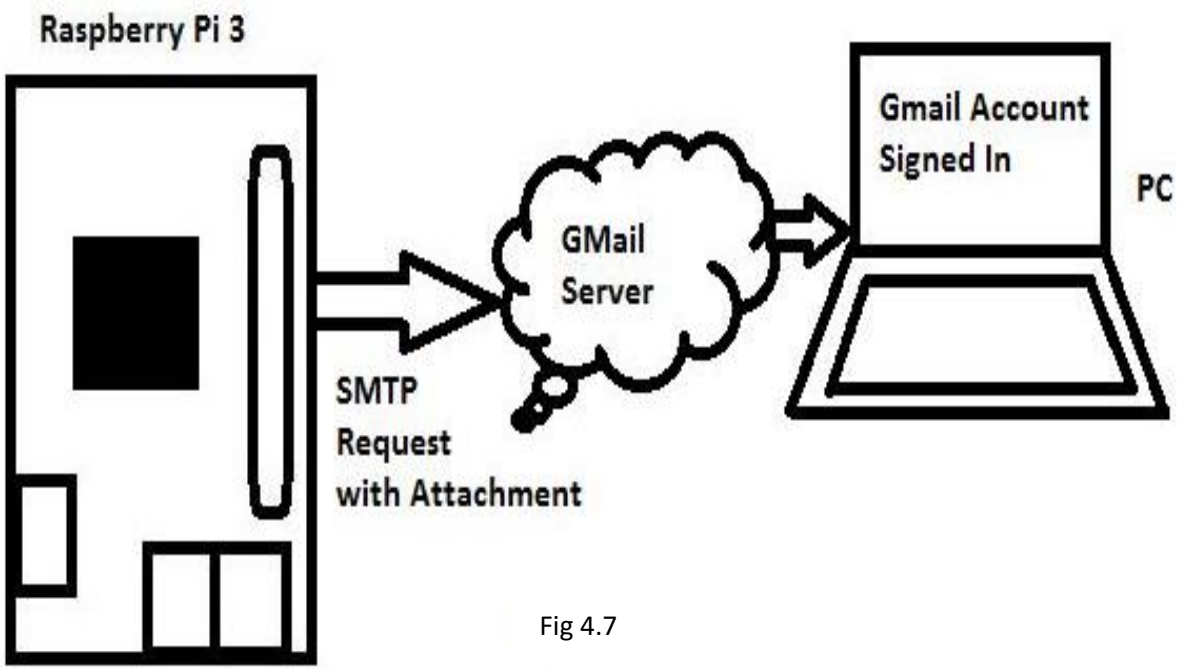

Fig 4.7

Configurations of Smart Chair

Fig 4.8

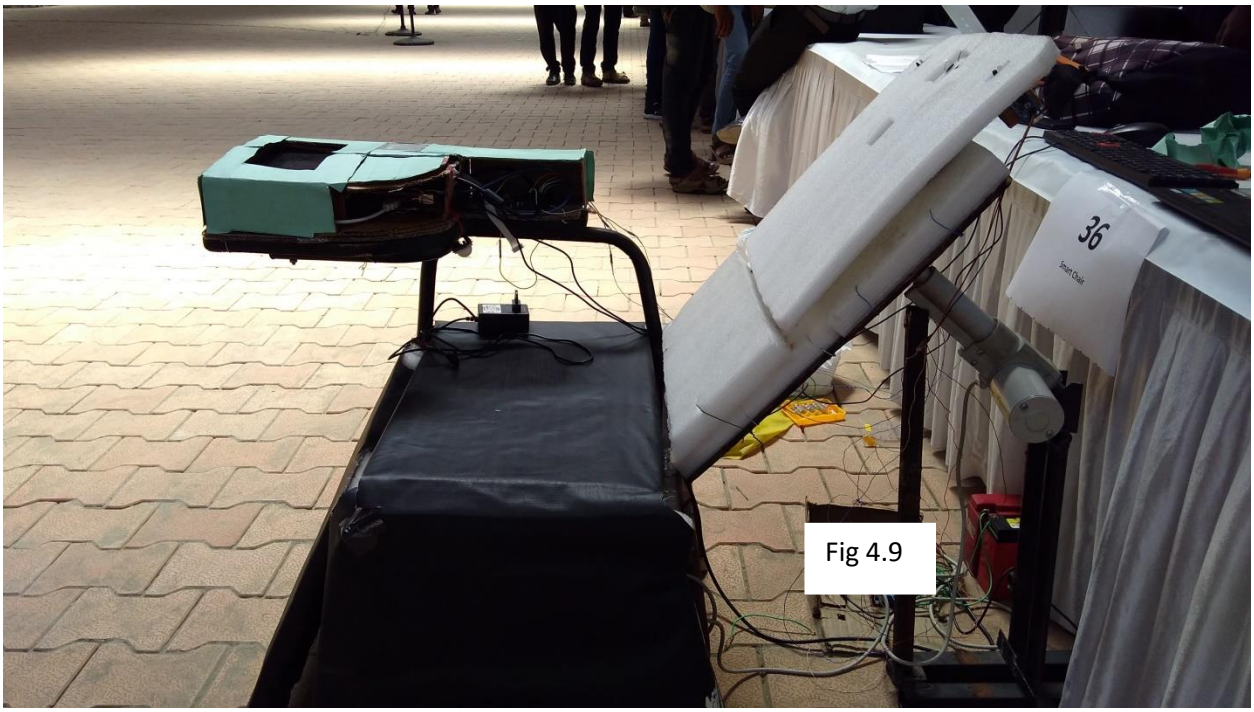

Fig 4.9

Sitting Configuration View

of

SMART CHAIR

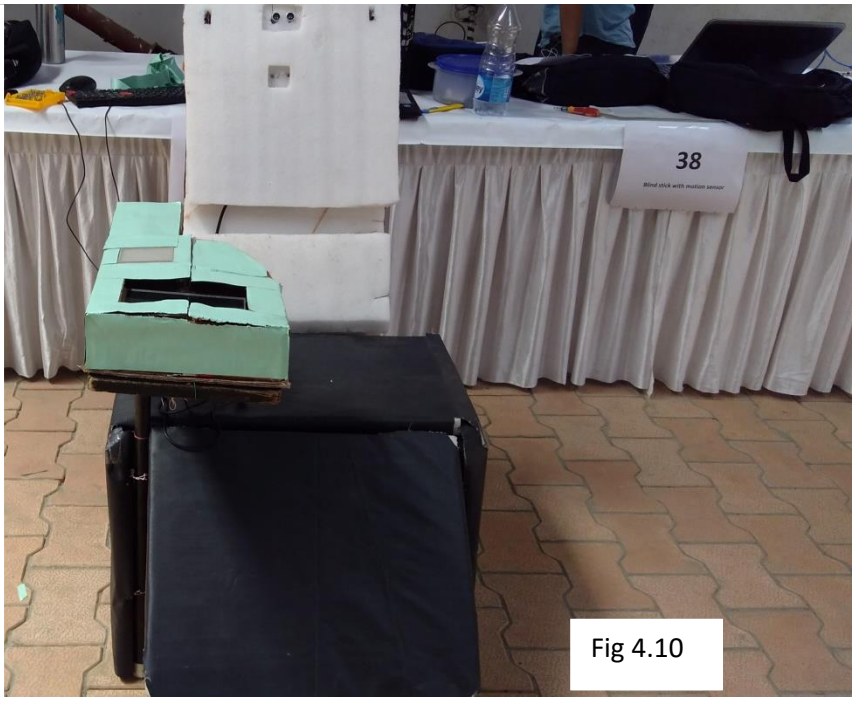

Fig 4.10

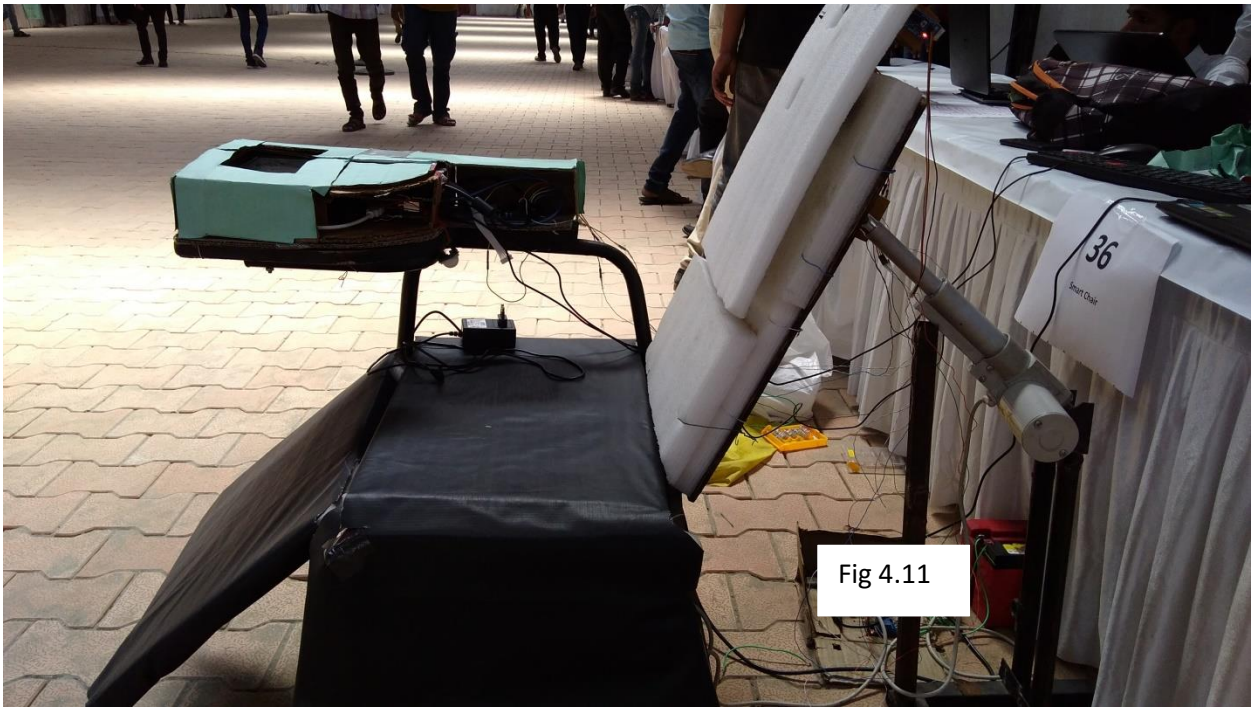

Fig 4.11

CHAPTER 5: Applications and Future Scope

5.1 Applications

The Application of this chair is it can serve as a study chair for students. This is specially made keeping in mind the younger generation. So that they can interact with their study chair. The main feature of this chair is it has a digital note that is engineered to save the natural resource like trees as the paper is made out of tree. If the paper usage can be reduced by shifting towards digital notes that doesn't require any ink pen or paper to actually record the notes. There is touch pad that tracks the user's position of touch on the touch pad to create the exact replica of the written character on the touch pad. The Chair also Mail the notes written by the user on the LCD screen to the gmail account so that he can download it later from any other device and read it. This Chair has an security feature that allows the actual owner of the chair to keep updated on when the chair is being accessed in his/her presence or not when he or she is in a remote location. This security feature allows the person to be safe on his personal files stored on the memory built in the chair. The chair can be used to help the user from getting back pain as most of the chairs now a days are with a backrest that is fixed. But sitting in that kind of chair for long hours can cause back pain. So, this chair has a feature of self-adjusting it's height according to person's height which solves the problem of getting backache.

\5.2 Future Scope

The chair designed has many applications apart from it's interesting features. This chair can be used in offices that have separate Desktops for systems and chairs separate. Instead this smart chair comes with a combination of a computer as well as chair for resting. So the onboard computing applications like excel worksheets, web browsers, PowerPoint presentations can be made on the same chair. In this way it is economical as well as an innovative approach. This makes working conditions interactive for the user. This chair is also designed by keeping in mind the students study chair or study table. In future every company is investing huge time and economy in saving natural resources. So this chair is also build to support that research. Because the chair has a feature of Digital Notes there is no requirement of pen or paper to record his or her writings. This saves a natural resource like wood from which paper is made as well as fruits from which ink is produced. It can also be used in hospitals for patients having backache.

REFERENCES

http://www.arduino.org/products/boards/arduino-uno

https://www.raspberrypi.org/

www.instructables.com/id/4-Wire-Touch-Screen-Interfacing-with-Arduino/

http://espeak.sourceforge.net/