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NUST COLLEGE OF

ELECTRICAL AND MECHANICAL ENGINEERING

INTELLIGENT GLOVE

A PROJECT REPORT
DE-40 (DC&SE)

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Abstract

In the field of health it is most important that patient is being cared and his comfort level is taken care of. Science and technology over the time has revolutionized the field of medicine with the passage of time. Hospital bed is used by every patient and has a caretaker all the time to be taken care of. The purpose of this project is to evolve the concept of hospital beds. As the beds already existing in hospitals have manual cranks or electrical wired remotes to operate. This concept was revolutionized by introducing image processing based technology to read the hand gestures and then through microcontroller command was sent to operate the bed. We aim to replace this image processing based technology with sensor based in hospital beds. This project aims to provide a hospital bed which has two primary motions of Up and Down for patient to sit and lay back and two additional movements of left and right to assist the patient to change his sides independently. Moreover we have given appliances controls inside patient room to patient to control their switching independently while lying down on the bed. After wearing a hand glove a patient will be able to control four motions of his bed and will have controls of fan and light in his room. Purpose of this project is to increase comfort level of patient and give him independence to control bed and appliance on specific hand gestures. Also use of heart rate sensors it is easy for the staff to have check on the heart rate and temperature. This will eliminate the need of caretaker for every patient and a large number of manpower will become free and will contribute in our nation building. Hospitals will no longer be overcrowded and patients will have a scientific alternate to existing setup. For future we aim to provide multiple solutions especially the height adjustment of the bed.

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Study Rationale

The central justification this investigation is that significant difficulties with considerable ramifications for the prosperity of patients are facing they gave medical care framework. An innovative work is expected to fuel the essential advances in science and innovation to address these difficulties. These moves mean to work with patients to expand their solace level. An outline of the difficulties looked by medical services labourers is as per the following:

1- Need of caretaker for each patient making hospital overcrowded and is difficult for families to stay as caretakers as our hospitals have inadequate facilities for patients they cannot afford to accommodate such numerous people along with patients.

2- Paralyzed patient cannot communicate with healthcare workers because of his severe health condition and remains unprovided with his requirements and facilities when required.

3- Patient needs caretaker to adjust his bed for certain positions he is dependent on availability of caretaker to carry on this action.

4- Every patient is not healthy enough to operate remote control beds as mostly remote is placed on foot end of bed. Serious patients who are hardly able to move their hand cannot operate remote to change position of bed.

This study presents the rationale for all aspects of the challenges faced by patients and healthcare workers using sensor based technology to make patient independent to control his bed positions along with room appliances through Gesture based sensors.

Importance of the Problem

- The problem is of current interest and is highlighted in every part of the

  World as automated beds with such feature are expensive enough to buy and utilize.

- World is facing this problem since ages and will continue in future if we will not bring innovation and technology to healthcare industry providing them with fully equipped product in low price.

- Automated bed is a revolution and there is space for such innovations in medical field in future to increase comfort level of patient. Utilizing smart technologies can make it a better product.

- A large number of population of world needs this technology as it aims to target people between ages 40 – 60 years depending on their health condition and especially aims to facilitate paralyzed patients.

Background Theory

Chapter 1

Historical Perspective:

Humans have been fascinated since prehistoric times with extraordinary beings, mechanical men, and other creatures, that to them were fantasies. People in the past developed stretchers using a big piece of cloth Supported by two bamboos to carry the patient. This technique served humanity for centuries and for longer journeys these stretchers were tied behind the horses. This shows the interest of humanity in increasing its comfort level since ages. This developed their interest in machines. Advancement in health sector was always a priority to mankind so the Britishers in 1800 brought revolutionary changes in design of Hospital Bed by providing two mechanical movements for the adjustment of height by using crank to move the rails in up & down positions. The design evolved and improved with ages and now we have comfortable beds in our hospitals.

Definition of Beds:

Several definitions of beds exist:

a. The popular conception is of a mechanical bed capable of carrying patients with mechanical set ups to easily adjust the height of the bed.
b. Users have a suitable definition: ‘ A bed should have rails for adjustments of different body parts simply they divide human into three parts Head end, Feet end and middle body finally a system with variable programmed motions for the performance of a variety of tasks.

Fig1.1.1: Normal Bed

1.1 Why Automation in Beds?

Automation is being used more and more in industrial and commercial applications. At the present time, the number of systems equipped with automation are increasing in number. Automation in beds is aimed at freeing manpower and facilitating patients to freely adjust different positions of their beds. Early developments in development of modern day bed are asunder.

1.1.1 Basic Stretcher:

a. In early ages it was developed as a stretcher having two supports on sides and a piece of cloth is attached in between them.
b. Patients required with sudden treatment was carried in this stretcher.
c. These stretchers were tied behind the horses for carrying patients too far away places.

Fig1.1.2: Basic Stretcher

1.1.2 Developments in 1815:

From 1815 to 1830 revolutionary changes brought in design of Hospital Bed by providing two mechanical movements for the adjustment of height by using crank to move the rails in up & down positions.

Fig1.1.3: Basic Stretcher(1815)

1.1.3 Developments in 1874:

In this era a mattress manufacturing company designed a mattress which could be tilted. This new concept changed the idea of hospital bed and with time taking developments in science today we have beds fully equipped with basic facilities.

Fig1.1.4: Basic Stretcher(1874)

1.1.4 Developments in 1909:

The chairperson of university of Indiana led to the next step of innovation in hospital beds. He invented a bed which was able to lift up the head and feet of the patient. This was considered as a very good facility for the patients in that time.

1.1.5 Developments in 1945:

In this time a push button was installed in the beds as an addition to the previous technology. The other interesting feature was that they made a built in toilet.

1.1.6 Developments in 1946:

A well off person named Hughes met a plane accident. The medical aid provided to him was not up to his standard to relief his pain during treatment so he made a bed consisting of 30 electric-engines and 6 sections.

1.1.7 Developments in 1949:

At this stage the main functions like control system came into emergence.

1.1.8 Developments in 1956:

A British company was the first to make a fully electronic engine based bed.

1.1.9 Developments in 1958:

A circo-lectric bed was developed. Meanwhile many other alternatives were built to meet the need of medical science.

1.1.10 Developments in 1964:

A bed was introduced which was having a basic control.

1.1.11 Developments in 1974:

A bed was introduced which had a control panel on the side rails of the bed.

1.1.12 Developments in 1978:

An addition was made which was very interesting that they added a remote control system along the control panel on the side rails.

1.1.13 Developments in 1980s:

In this era scientists were more focused on the formation of the mattress-based beds that are used in hospital. Therapeutic mattress was invented. Position detectors were also developed in the 1980s. Such a system was made so that the can measure the weight of patient while he is lying in the bed. Patent exit monitoring machines was formed. Other inventions included permanent cardiovascular monitoring and a system via that patient can call for the nurse and many more like this became standard bed functions.

1.1.14 Developments in 1983:

A bed was introduced that could be used at home for the patient.

1.1.15 Developments in 1990s

In 1990s Mechatronics was no more a theory and it came into field of practice. Due to this focus was inclined towards the intelligence based technology.

1.1.16 Developments in 1993

Now it was time to eliminate the risk factors so work was done to reduce the mechanical and electrical hazards.

1.1.17 Developments in Today's Era

Development is a process that never ends now a days they are focusing on the further modernization of the beds to make them more comfortable, reliable and to add more electrical, mechanical and intelligence based features. So that they can be used and facilitate the patient anywhere either at home or at hospital.

Fig1.1.5: Latest Stretcher

1.2.1 Different Beds in Hospitals

There are many types of beds used in hospitals, health care centres and homes. Type of bed being used by a patient depends on his health condition and type of treatment. Here are some common types of beds discussed below:

1.2.1.1 Gatch Bed

A hospital bed that can be manually operated by turning cranks present at the bottom of the beds to execute up and down movements. Side rails are always adjustable in this type of bed.

Fig1.1.6: Gatch Bed

1.2.1.2 Electric Bed

The purpose of the bed is to help in maintaining proper body posture while sleeping to avoid several pains. This bed evenly divides the whole weight of the body and gives support to proper circulation of blood. This bed id operated electrically and is user friendly everyone can operate this bed.

Fig 1.1.7: Electric Bed

1.2.1.3 Clinitron Bed

A low interface pressure bed which has efficient height control and supports the body evenly. It is filled with sand like material. The bed supports healing procedure by controlling temperature. IT reduces pressure on skin to avoid bed sore. The bed is utilized by elder and serious patients especially those having skin diseases.

Fig 1.1.8: Clinitron Bed

1.2.2 Type of control

These different types of beds have certain controls to perform required movements to provide comfort to patient. These controls are of certain types

.

Flexible Patient Panel

Especially designed for elder and disabled patients. A panel mounted on bed helps patients to control their bed movement. Different controls are added according to the requirement of the patient.

Fig 1.1.9: Flexible Patient Panel

a. Remote Control

A remote having 1.5 meter wire is attached with the circuitry installed in bed. The remote is just and alternate solution to existing manual Operations of bed. Remote has buttons to execute.

Fig 1.2.0: Remote Control

b. Manual Control

The most economical type of bed is having 2 cranks for manual operation of the bed.Commonly these two cranks are manually operated to adjust height of the bed and the Head body part of the patient to lean easily

Fig 1.2.1: Manual Control

c. Image Processing Based Control

A camera is placed in front of patient to read the hand gesture made by patient it is programmed and processed if it this sign matches to the recorded or programmed gesture the bed performs.

Fig 1.2.2: Manual Control

Chapter 2

2.1 Gestures

It is a type of communicating non verbally. Different messages are conveyed through this nonverbal communication. Hand and head are most commonly used in making gestures. There are two types of gestures.

1- Dynamic Gestures

2- Static Gestures

Fig 2.1: Hand Gesture Instance

2.2.1 Dynamic Gestures

As name suggests that dynamic is something moving and when head or hand is moved to make certain gestures those gestures are called dynamic gestures. Key features of this gesture are

1- Velocity
2- Location
3- Orientation
4- Shape

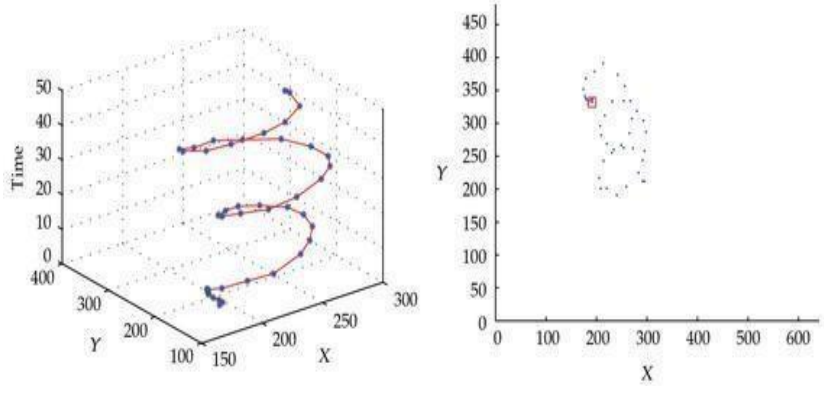

Fig 2.2: Dynamic Hand Gesture Instance

2.2.2 Static Gestures

Static ones are those that just require the handling of a solitary picture at the contribution of the classifier, the upside of this methodology is the lower computational expense. This gesture focuses on three main points.

1- The partition of the hand from the lower arm area.

2- Pivot standardization utilizing the maths and geometry.

3- User / client and view autonomous motion acknowledgment.

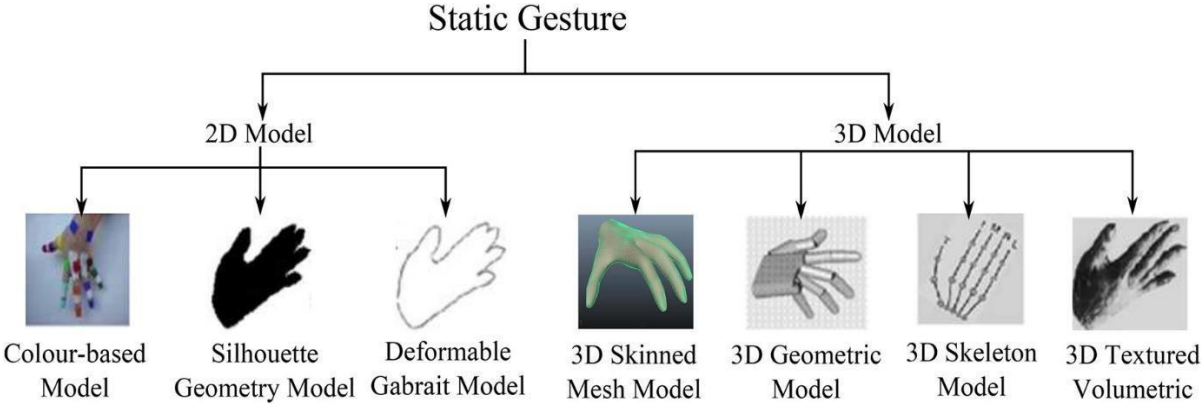

Fig 2.3: Static Gesture

2.2.3 H C I (Human Computer Interface)

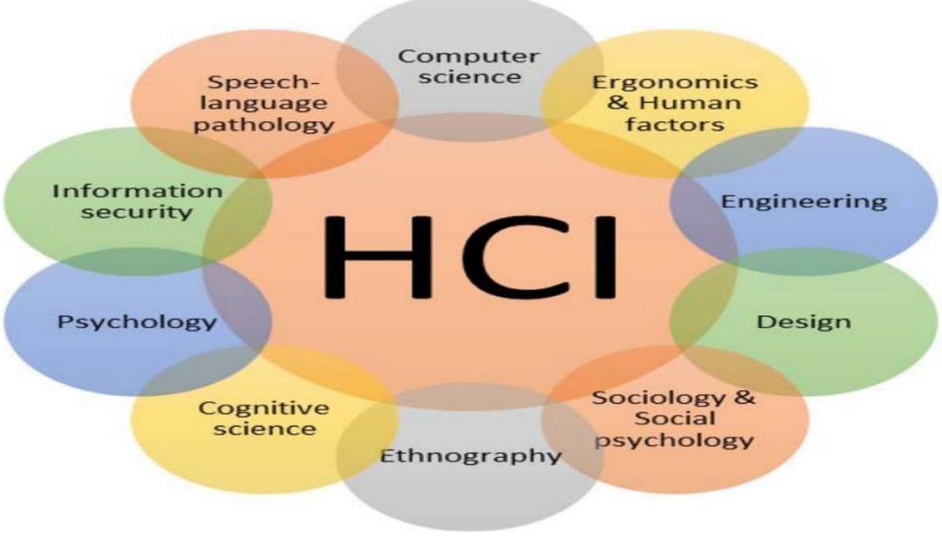

Fig 2.4: Human Common Interface

The ability of computer systems to realize hand gestures visually is essential for development in human–pc interaction. Gesture set programs starting from signal language to scientific help to virtual reality. However, gesture identification is extremely hard no longer best because of its diverse contexts, more than one interpretations, and spatio-temporal variations however also because of the complex non-rigid houses of the hand. This take a look at surveys predominant constraints on vision-based gesture popularity occurring in detection and pre-processing, representation and characteristic extraction, and recognition.

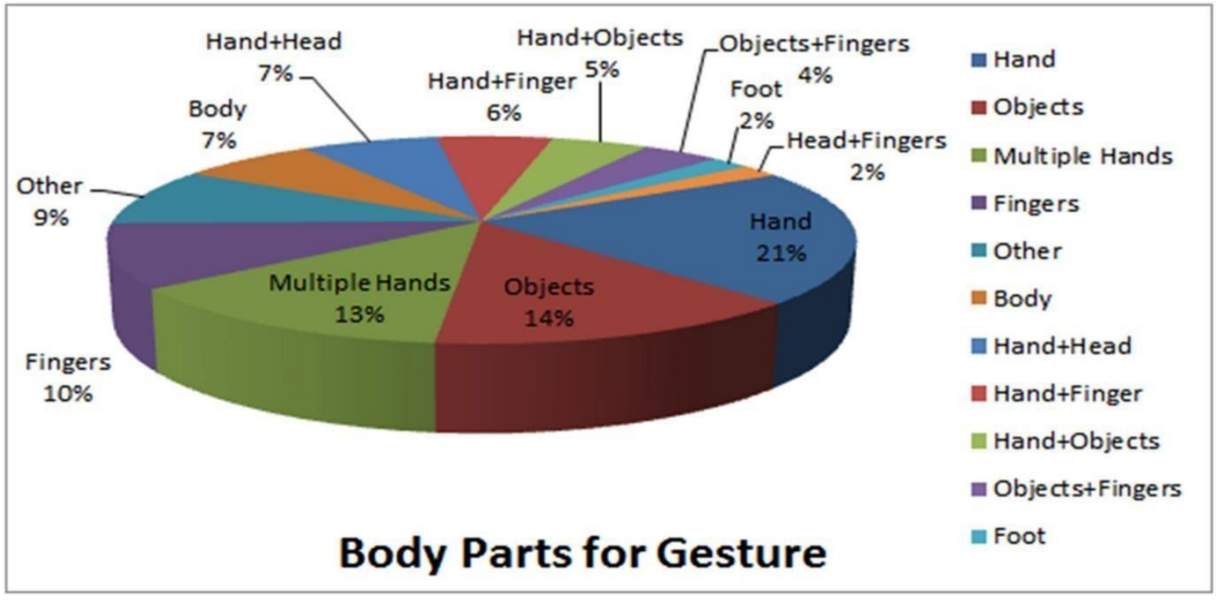

Fig 2.5: Body Parts for Gesture

It is always difficult to recognize hand gestures of different sizes given by unique users. Especially in case of dynamic ones the gesture has a higher complexity level and according to research many issues have been faced in its recognition and measurement. The difficulties and issues related to identification of gesture that affect its overall accuracy are discussed below.

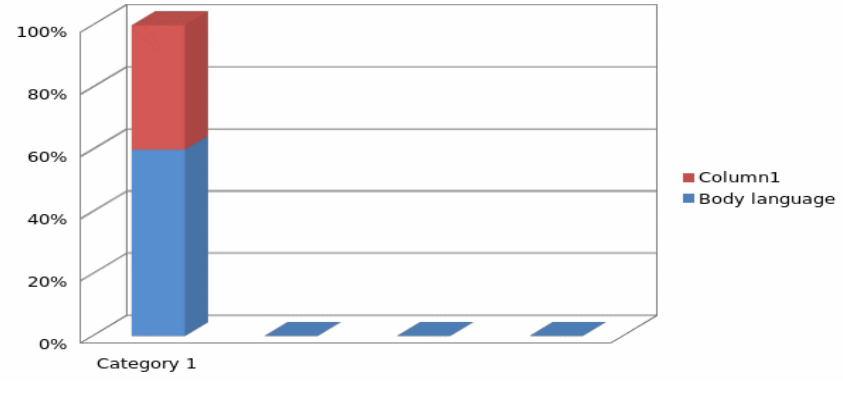

Fig 2.6: Understanding Body Parts for Gesture

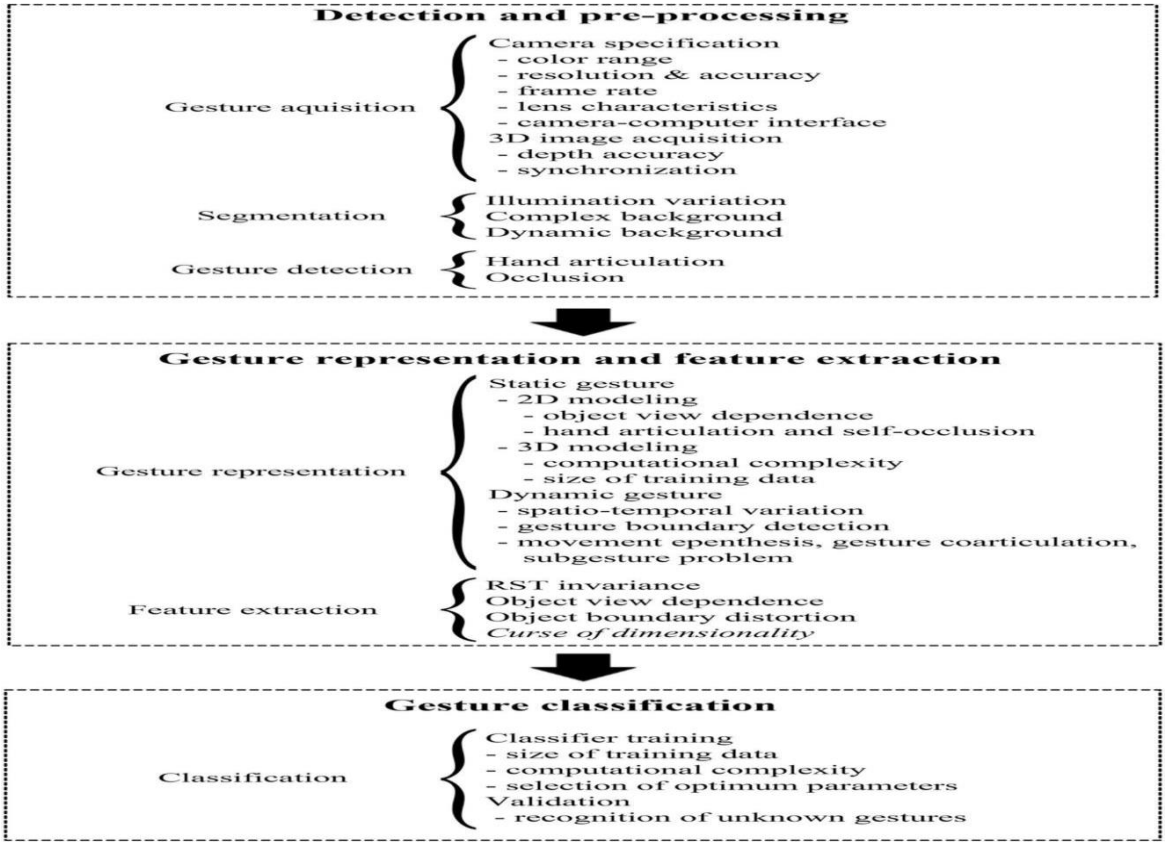

Fig 2.7: Gesture Identification

Experimental Techniques

Chapter 3

Working of the Project

3.1 Techniques for calculating Hand Gestures

Normally patient is required to wear a hand glove which has the circuitry mounted on it. For hand gesture there are six gestures required for our project and are in x and y axis. An accelerometer is used for this purpose among many we selected ADXL345 accelerometer sensor which has three axis but we have used two of them. As through accelerometer bed is to be controlled and requires four basic movements one movement is positive x-axis the other one in negative x-axis and same is the case for y-axis in positive and negative sides respectively. Certain angles are set for normal position of bed for both servo motors. For support side angle is set on 100 degree for normal position and for servo controlling bed 80 degree angle is set as normal angle. For controlling on and off of appliances from bed flex sensors are used as in this project we have two appliances like fan and light so two flex sensors are used to control them. In this a hand has complete six controls programmed and mounted on hand glove.

3.1.1 Controls of Bed

For controlling four movements of bed ADXL345 sensor is used and sensor can sense in three axis here we are utilizing only two axis.

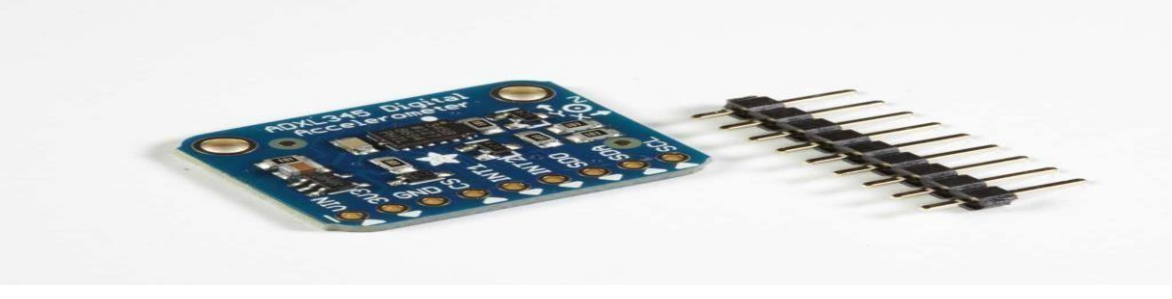

Fig 3.1: Controls of Bed

For AXL345 sensor we have defined 2 variables of x-out and y-out for these two axis. For data we defined a variable int data-sent all these int x, int y, int data-sent are set to zero and are of integer type. Communication of ADXL345 is through two pins of Arduino Nano and same pins are used for OLED too. These are A4 and A5 pins of Arduino. When data is to be given to OLED or accelerometer for that we give them separate address. From address it becomes clear that data is of OLED or accelerometer. When accelerometer is on data on its address is fetched then through end transmission ports are made free and OLED can communicate in this duration. It shows data of x in x-out folder and of y in y-out folder.

3.1.2 Working of Hand Glove

When we move our hand in downward direction the support moves up and when hand is moved upward support moves back to its normal straight position. For side change hand is tilted right the bed rotates toward right and when limit is reached the buzzer is on for half a second and bed stops

to tilt further. For moving bed towards left the hand is tilted toward left and the bed tilts in left direction when limit is reached buzzer is on and bed stops further movement. In the same way we tilt right to bring back our bed to normal position. The flex1 is presses to turn on fan and after delay of three seconds the flex1 is pressed again and fan goes off. When flex2 is pressed the light is on and after same delay of three seconds the flex2 is pressed again and light is off.

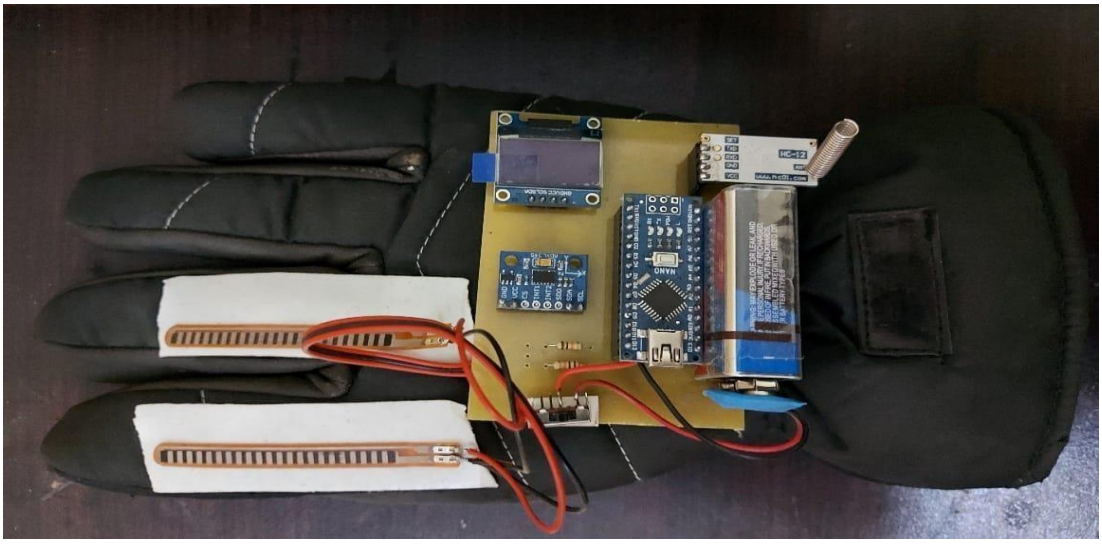

Fig 3.2: Hand Glove

3.1.2 Working of ADXL345

Now talking about data of x when our hand is in normal position then it has some value of x but that is not a higher value. When we move hand downwards value increases from 100 and when value of x-axis crosses 130. Arduino will read data of ADXL and send data as ‘’zero’’. Then LCD displays ‘’SUPPORT UP’’. Tx will write data as ‘0’’and send this to antenna of RX. When zero is read on Rx end motor is on and support starts going up because our hand was in positive x-axis. When we move hand upward we are going in -ve x-axis. In -ve x-axis value becomes -ve and data is read as ‘1’. And LCD shows now ‘’SUPPORT DOWN’’. Tx sends data ‘1’ to Rx antenna and the support moves down in the meantime.

In y-axis when we tilt our hand in right direction value will become negative because of moving in -ve y-axis so it will read data as ‘2’. Display becomes clear and LCD shows now ‘’ Right Tilt’ ’Tx sends data ‘2’ to Rx and bed tilts to right.

When hand is moved in left side we enter +ve y-axis so sensor reads data as ‘3’. Display becomes clear and shows ‘LEFT TILT’. On Tx side when ‘3’ is received motor starts to move bed in left side.

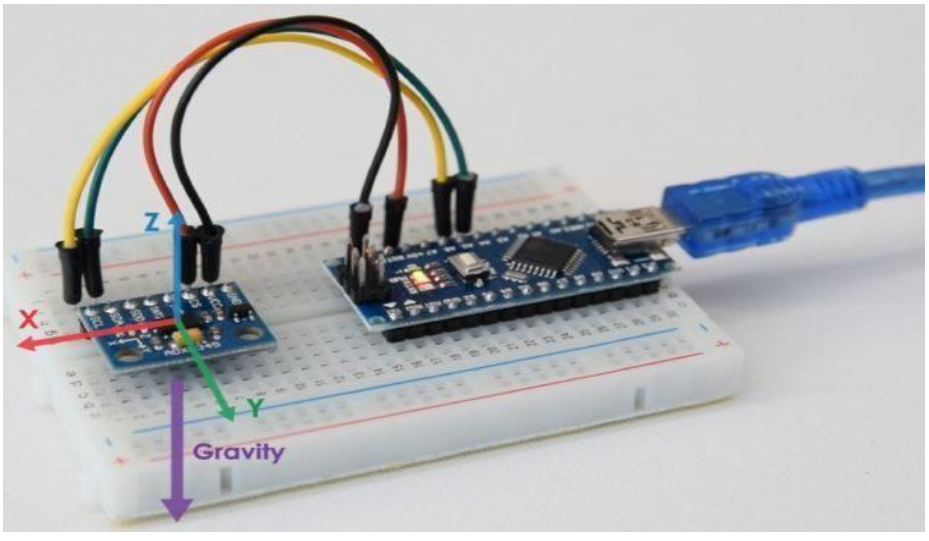

Fig 3.3: Working of ADXL345

3.1.2 Working of Flex Sensors

Flex sensor is connected to A0 pin of Arduino. When flex is pressed value is changed when value goes below 170 it gives data as '4' Relay of fan is off and displays Fan OFF. After delay of three seconds when flex is pressed again it gives data as '5' LCD displays 'FAN ON'. Receiver side checks that data is '5' so it turns the fan ON.

Flex 2 is connected to A1 pin of Arduino. Same procedure is followed light is OFF at '6' and when pressed again gives data as '7'. This data will cause 'LIGHT OFF'. In receiver side everything depends on 0 to 7 numbers received as data. All actions depend on them.

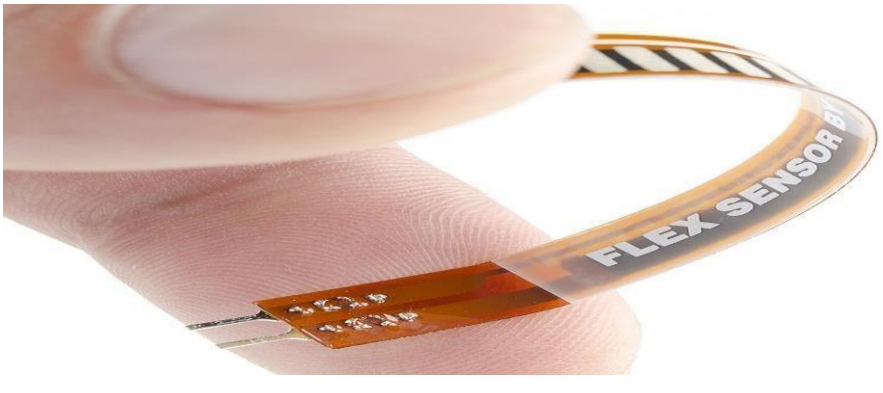

Fig 3.4: Working of Flex Sensor

3.1.3 Working of Rx Side

Receiver side depends upon data from transmitter side. If our transmitter send data as 0 receiver will receive that data and then Arduino will read that data and our motor will move in clockwise direction for Bed support UP. Similarly if on transmitter side data is received as 1 motor will move in anticlockwise direction and Support will move downward. When data received is 2 the motor

rotates bed in right direction using servo motor 2 and when data is read as 3 motor rotates in anticlockwise direction to move or tilt bed in left direction. When data on receiver side is 5 from flex sensor relay of Fan is on and that of light goes off and Fan becomes on. Fan is off when data received is 4. For light On data from flex2 is read as 7 and when data from felx2 is as 6 light goes off.

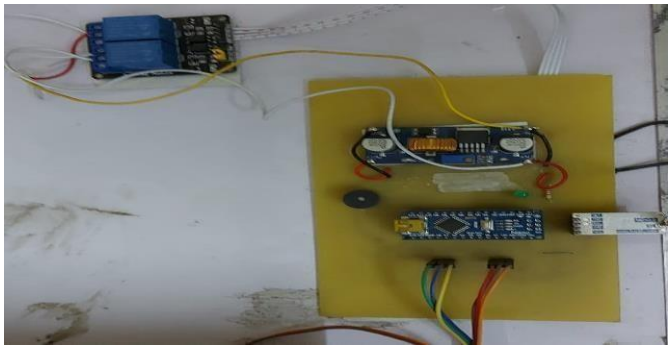

Fig 3.5: Working of RX Side

Chapter 4

4.1 Sensing Devices

There are certain types of sensors here two sensors are used in this project one for the bed movement and other for appliances control.

1- ADXL 345

2- Flex sensor

3- Pulse sensor

4- Temperature sensor

4.1.1 SPO2 (Pulse Sensor)

The purpose of using pulse sensor is to make user and the concerned staff aware of heart rate's variations. It comprises 2 LEDs, photo detector and optimized optics most importantly it is low-noise signal processing sensor.

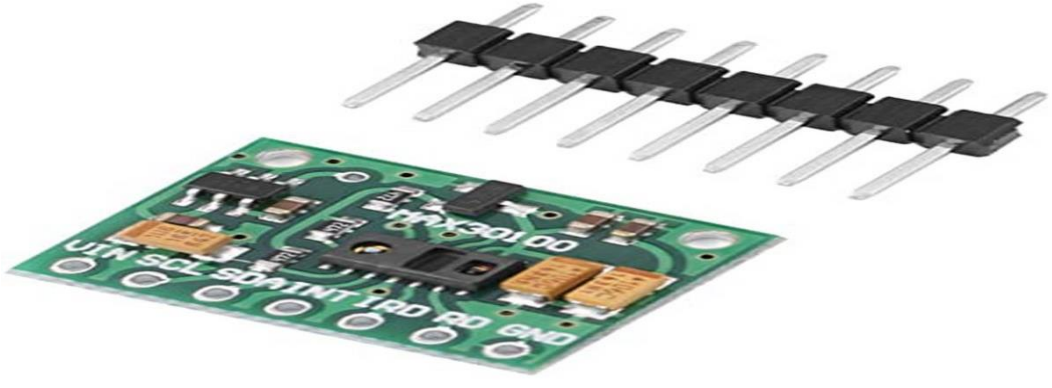

Figure 4.1.1: SPO2 Pulse Sensor

Features

- IR based Optical Sensor with red LED
- Measures pulse by absorbing blood
- It includes INT pin along with I2C interface
- It increases life of wearable devices by operating on ultra-low power i.e 3.3V

Specifications

- **Operations-** It operates on 3.3V
- **Interface-** Interface is I2C type
- **Dimensions of Module-** It is 18.8mm long with width reaching 14.4mm having

height 3mm

- **Weight-**Light weight of 1.2g
- **Pinouts**

1. **VIN:** 1.8V – 5.5V Power Input
2. **SCL:** I2C Serial Clock
3. **SDA:** I2C Serial Data
4. **INT:** MAX30100 Interrupt
5. **IRD:** IR LED Cathode and LED Driver Connection Point. Leave floating in the circuit.
6. **RD:** Red LED Cathode and LED Driver Connection Point. Leave floating in the circuit.
7. **GND:** 0V / Reference Voltage

4.1.2 DS18B20 Temperature Sensor

A water proof temperature sensor used is 1 meter long based on the DS18B20 sensor. Being digital in nature it is useful in both far away distances and wet conditions because it does not requires any signal degradation with precision of +- 0.5V.

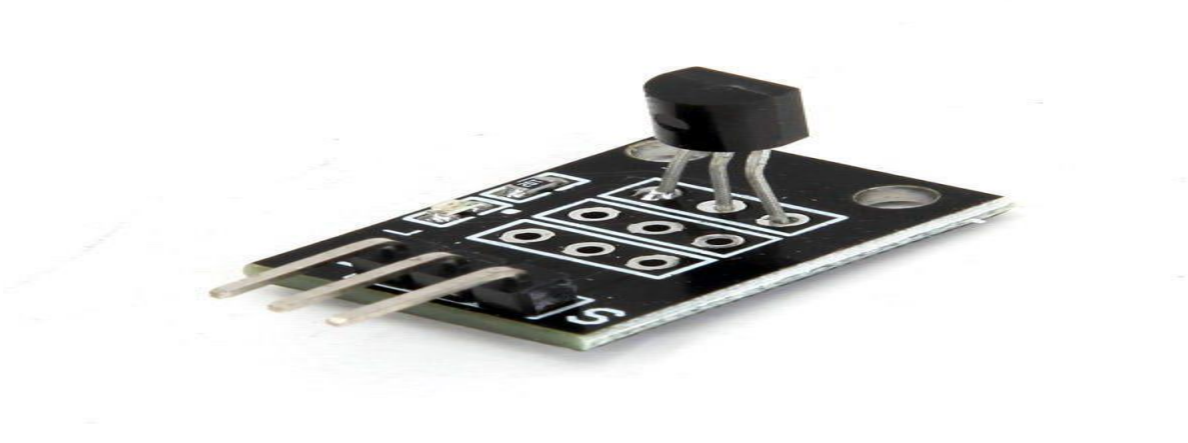

Figure 4.1.2: DS18B20 Temperature Sensor

Features

- It uses 3V-5V supply
- The range of the temperature is -55C to+125C
- It contains unique single bus without external components
- Made of stainless steel tube
- Encapsulation makes it waterproof

Specification

- It has Temp-limit alarm system

- Having a less query time of 750ms
- Keeping the accuracy up to +-0.5C
- It requires only one digital pin with 1- Wire interface for communication

4.1.3 ADXL 345

It is a 3-axis accelerometer which senses gestures in x, y and z axis. It is used for measuring static acceleration in tilt-sensing applications. Here as movements required by the bed are in two axis. One up and down movement in y axis and the other left or right movement in x-axis. It is an accelerometer sensor and is likely used in sensor based application where big range is covered.

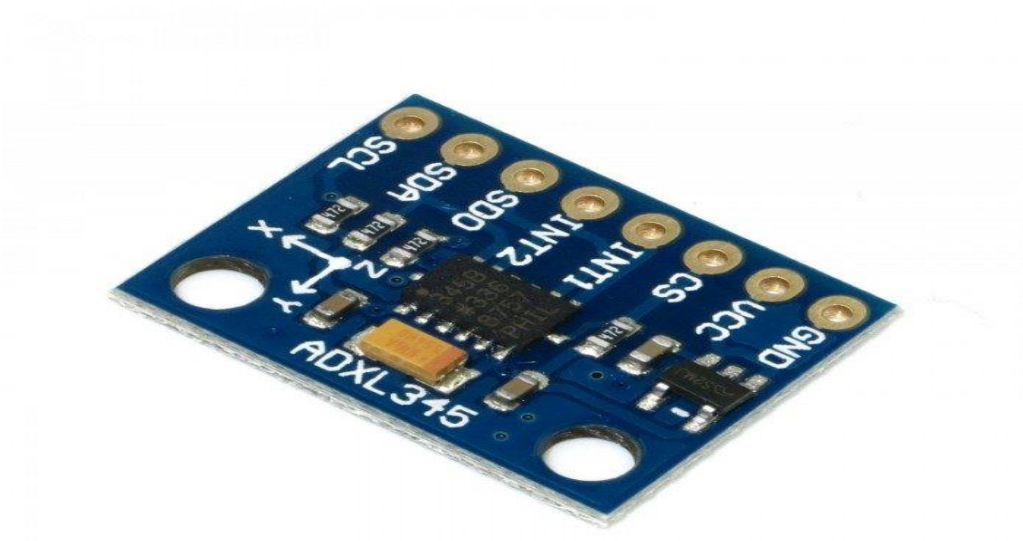

Figure 4.1.3: ADXL 345 Sensor

4.1.4 Mechanism of Working:

It can completely measure the acceleration of the 3-axis with range width of ±2 *g, to* ±16 *g.* it has capability to measure both static and dynamic acceleration of a system. It can also serve as a tilt-sensor. It is surface micro-machined sensor that is made on a layer of polysilicon.

We use differential capacitors to measure the structure deflection. This is achieved with the help of fixed plates and moving mass intersecting plates of the capacitor. Differential capacitor is un-balanced and beam is deflected due to acceleration which yields us an output whose amplitude is same as of the acceleration.

4.1.5 Power Saving:

This sensor is capable of adjusting its power according to the output data which is mentioned in the below table. We can also lower the power consumption with the help of lower power consumption mode. This mode sensor reduces the sampling rate as a result a power saving of 12 Hz to 450 Hz range is achieved. Given below is the table of the power consumption in which I linearly scales with Vs.

(T_A = 25°C, V_S = 2.5 V, $V_{DD\ I/O}$ = 1.8 V)

Output Data Rate (Hz)	Bandwidth (Hz)	Rate Code	I_{DD} (µA)
3200	1600	1111	145
1600	800	1110	100
800	400	1101	145
400	200	1100	145
200	100	1011	145
100	50	1010	145
50	25	1001	100
25	12.5	1000	65
12.5	6.25	0111	55
6.25	3.125	0110	40

Table 4.1.4: Power Saving

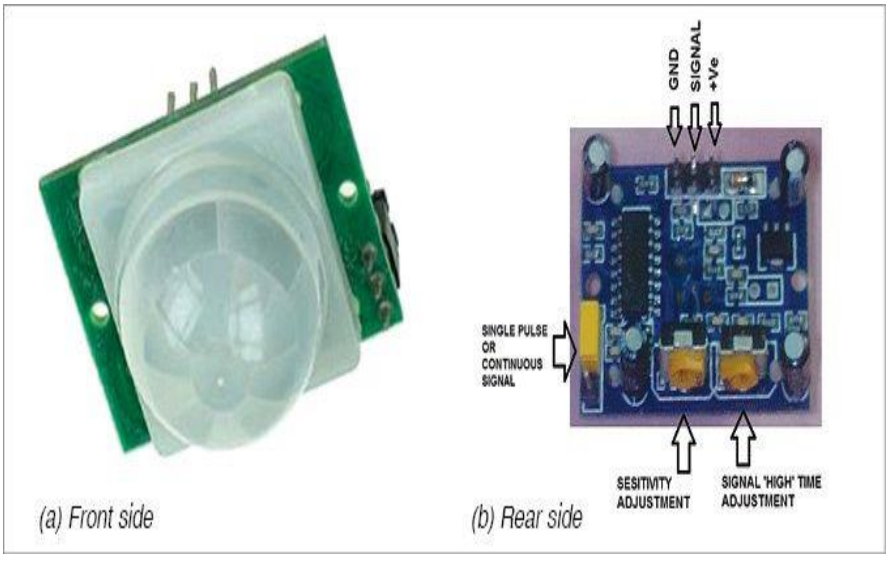

Figure 4.1.5: Power Saving

SERIAL COMMUNICATION:

Two modes of serial communication are available to us in this sensor.

1) SPI
2) I2C mode,

SPI:

In SPI, we can use 3 or r wire configuration. 4 wire mode is selected when the data format bit of SPI is cleared. On the other hand if we do setting of SPI bit it will proceed towards 3 wire mode. The SPI it has a max of 5.2 MHZ clock-speed. And its loading value is calculated as 100pf.

SPI master is the one who control port enable-line. When transmission is started lone, when our transmission is started the line gets low and vice versa. The serial port is called SCLK. Data sampling is done at the rising-edge of SCLK.

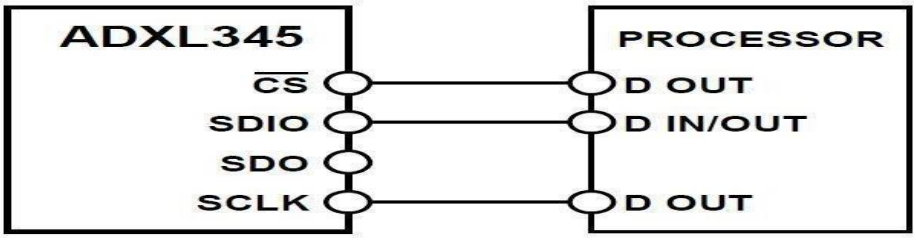

Fig 4.1.6: Wire SPI Connection Diagram 1

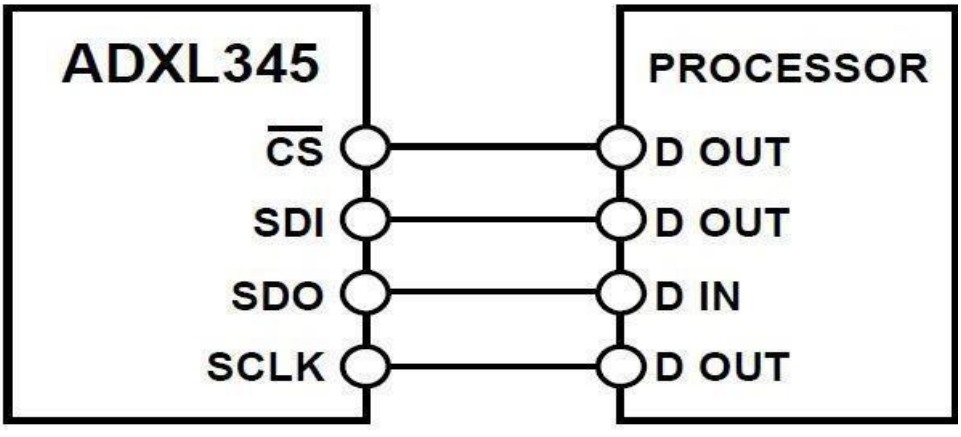

Fig 4.1.7 Wire SPI Connection Diagram 2

The timing diagram of SPI Serial Communication is shown below

4.1.6 Wire Diagram

4 wire read diagram:

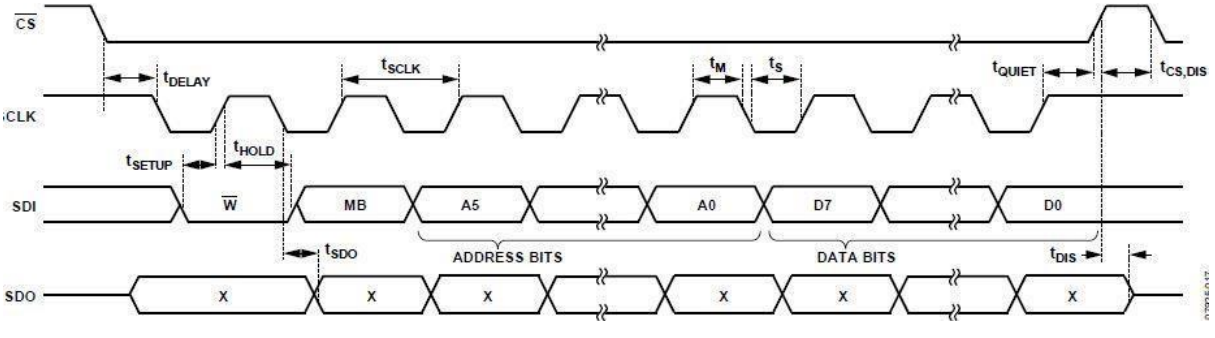

Fig 4.1.8 Wire read diagram

4 wire write diagram:

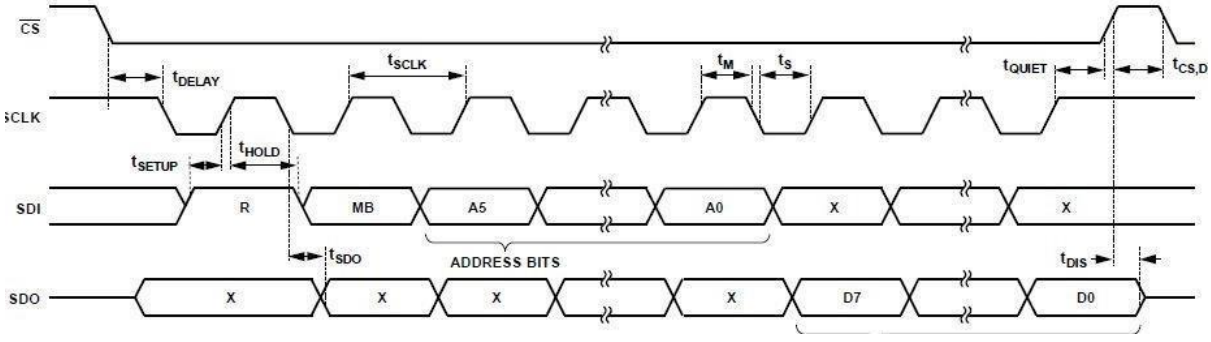

Fig 4.1.9 Wire Write diagram

3 wire read & write diagram:

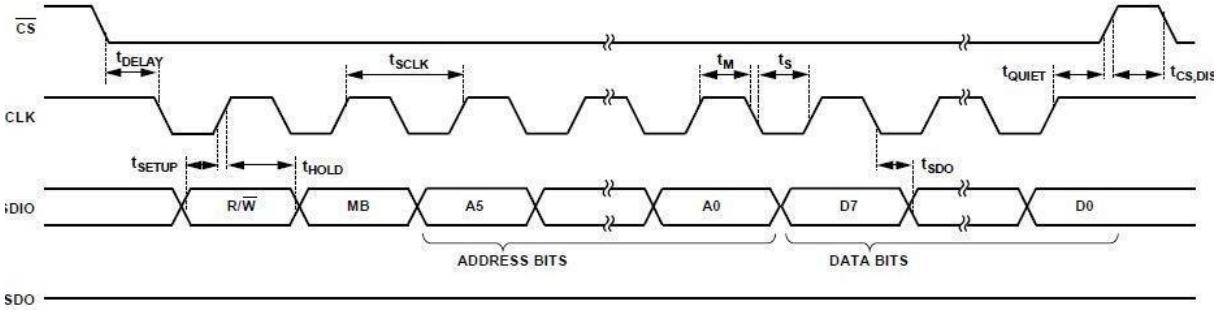

Fig 4.2.0 Wire read &Write diagram

4.1.7 I2C:

When the tide is high I2C mode of ADXL345 is activated. It consists of 2 wire connection. It supports multiple bytes reading and writing. Different coding and their translation are given below. If more devices are required to connect to same IC , their voltage can never rise more than 0.3 volts.

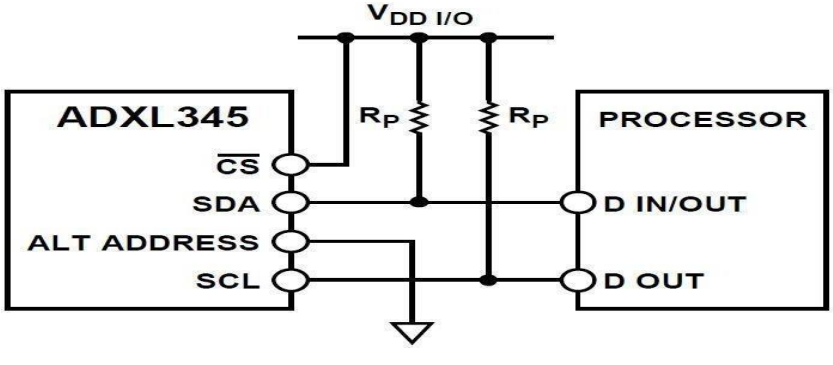

Fig 4.2.1: I2C Connection Diagram (Address 0x53)

4.2 REGISTER MAP:

Address		Name	Type	Reset Value	Description
Hex	Dec				
0x00	0	DEVID	R	11100101	Device ID.
0x01 to 0x01C	1 to 28	Reserved			Reserved. Do not access.
0x1D	29	THRESH_TAP	R/$\overline{W}$	00000000	Tap threshold.
0x1E	30	OFSX	R/$\overline{W}$	00000000	X-axis offset.
0x1F	31	OFSY	R/$\overline{W}$	00000000	Y-axis offset.
0x20	32	OFSZ	R/$\overline{W}$	00000000	Z-axis offset.
0x21	33	DUR	R/$\overline{W}$	00000000	Tap duration.
0x22	34	Latent	R/$\overline{W}$	00000000	Tap latency.
0x23	35	Window	R/$\overline{W}$	00000000	Tap window.
0x24	36	THRESH_ACT	R/$\overline{W}$	00000000	Activity threshold.
0x25	37	THRESH_INACT	R/$\overline{W}$	00000000	Inactivity threshold.
0x26	38	TIME_INACT	R/$\overline{W}$	00000000	Inactivity time.
0x27	39	ACT_INACT_CTL	R/$\overline{W}$	00000000	Axis enable control for activity and inactivity detection.
0x28	40	THRESH_FF	R/$\overline{W}$	00000000	Free-fall threshold.
0x29	41	TIME_FF	R/$\overline{W}$	00000000	Free-fall time.
0x2A	42	TAP_AXES	R/$\overline{W}$	00000000	Axis control for tap/double tap.
0x2B	43	ACT_TAP_STATUS	R	00000000	Source of tap/double tap.
0x2C	44	BW_RATE	R/$\overline{W}$	00001010	Data rate and power mode control.
0x2D	45	POWER_CTL	R/$\overline{W}$	00000000	Power-saving features control.
0x2E	46	INT_ENABLE	R/$\overline{W}$	00000000	Interrupt enable control.
0x2F	47	INT_MAP	R/$\overline{W}$	00000000	Interrupt mapping control.
0x30	48	INT_SOURCE	R	00000010	Source of interrupts.
0x31	49	DATA_FORMAT	R/$\overline{W}$	00000000	Data format control.
0x32	50	DATAX0	R	00000000	X-Axis Data 0.
0x33	51	DATAX1	R	00000000	X-Axis Data 1.
0x34	52	DATAY0	R	00000000	Y-Axis Data 0.
0x35	53	DATAY1	R	00000000	Y-Axis Data 1.
0x36	54	DATAZ0	R	00000000	Z-Axis Data 0.
0x37	55	DATAZ1	R	00000000	Z-Axis Data 1.

Table 4.2.2 Register Map

4.2.1 THRESH-TAP Register:

Address: 0x1D

This register works for reading and writing. This has 8- bits and it holds and controls thresh hold values of interrupts.

4.2.2 OFSY, OFSX, OFSZ Register:

Address: 0x20

Each of them is 8-bit register and their function is to adjust the user type input data.

4.2.3 DUR Register:

Address: 0x21

This is also used to read and write. It also contains 8-bits. It contains some un-signed time that represents the max time value in which an event should be above that so its thresh hold can qualify as tap-event.

4.2.4 Latent Register:

Address: 0x22

It is 8-bit register and is also used for reading and writing. It contains some un-signed time value that represent waiting time for an event to occur and the start window time during which another event may also occur.

4.2.5 Window Register:

Address: 0x23

It is 8-bit register. It has some un-signed time value that is used to detect to expiry after Latent register functionality is over.

4.2.6 Thresh-Act Register:

Address: 0x24

It is 8-bit register. It is used to detect activity value/ time of thresh hold. Its data format is also un-signed.

4.2.7 Flex sensor

It is a type of sensor that can measure and detect the amount of deflection. It is mainly composed of plastic and carbon. Carbon is used by pasting it on a plastic strip. When the sensor is turned towards the sides, it will change the resistance of sensor. It is a type of GONI-METER and sometimes also termed as bending sensor.

Fig 4.2.3: Flex Sensors

4.2.8 Types:

There are two types of flex sensor

a. 2.2 inch sensor
b. 4.5 inch sensor

There is difference in size because of the difference in resistance. So we can choose the size according to our requirement. These sensors are widely used in security systems, controlling motors, intensity regulation and in different interfering systems.

4.2.9 Pin Configurations:

It contains 2 terminals named as P-1 AND P-2. There terminals are not doped a=, hence there terminals do not have any +ive or -ive terminal. To turn on these sensors, a DC voltage ranging between 3.3V to 5V is required.

Fig 4.2.4: Pin Configuration

4.2.10 Working:

It works on bending phenomena which means that if we twist/bend the sensor resistance will change and this change will be measured using some controller. It is somehow similar to variable resistor.

4.2.11 Specifications:

The features of flex sensor are as under.

- Required voltage : 0V-5V
- Can work properly even at low-voltage.
- Working temperature: -45 To 80ºC.
- Net resistance : 25K Ohms
- Bending resistance : 45K -125K Ω

4.2.12 Applications:

The flex sensor is widely used in the following devices and systems.

- ✓ Medical devices
- ✓ Mechatronics
- ✓ Medical Therapy
- ✓ Virtual Movement
- ✓ Music instrument

Chapter 5

5.1.1 Transmitter Circuit

Transmitter circuit has a battery for power input, an OLED for command display, a HC-12
Wireless communication module which has long range, ADXL 345 sensor which is a 3-axis
Accelerometer for motion sensing and two flex sensors for appliances on/off control.
Along with SPO2 pulse Oximeter heart rate sensor module MAX30100 for sensing of heart beat.
Temperature sensor Waterproof DS18B20 for calculating the body temperature of the user.
All these components are attached through circuitry and the circuit implemented on PCB is mounted on hand glove.

Fig 5.1: Transmitter circuit

5.1.2 Block Diagram

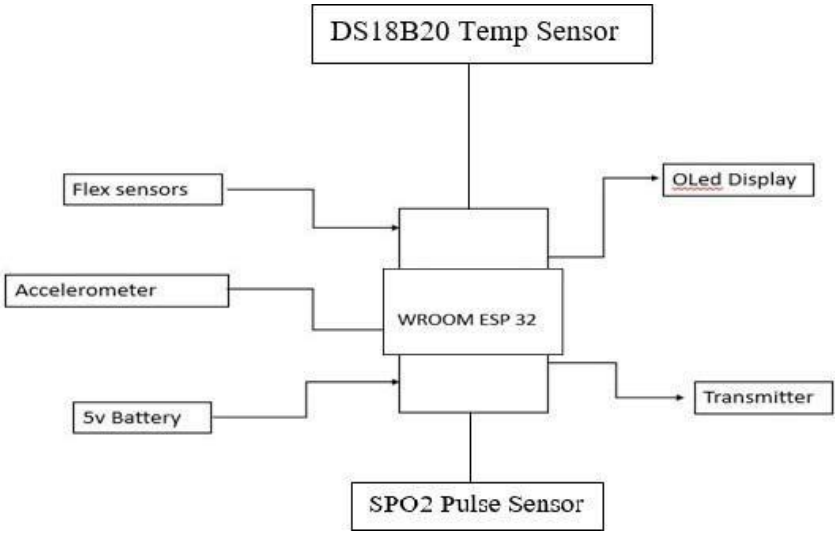

Fig 5.2: Block Diagram of Transmitter

5.1.3 PCB Layout of Transmitter Circuit

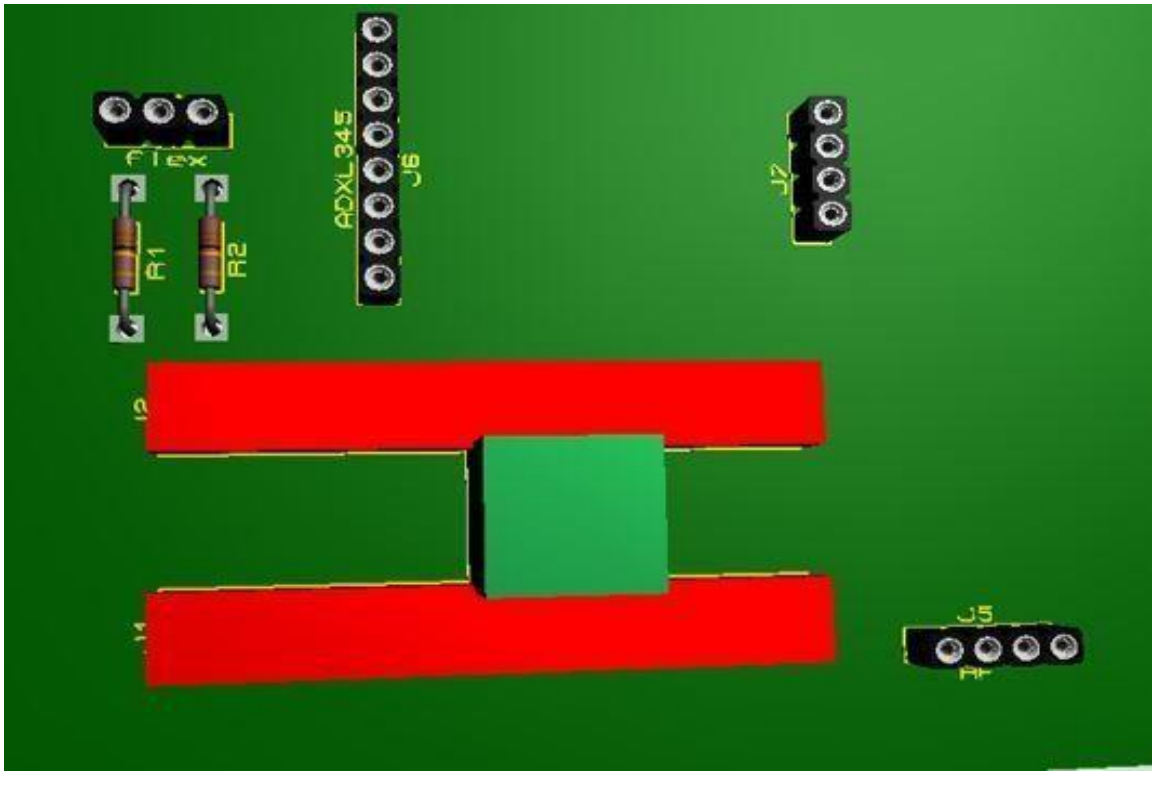

Fig 5.3: PCB Layout of Transmitter Circuit

5.1.4 Circuit Diagram

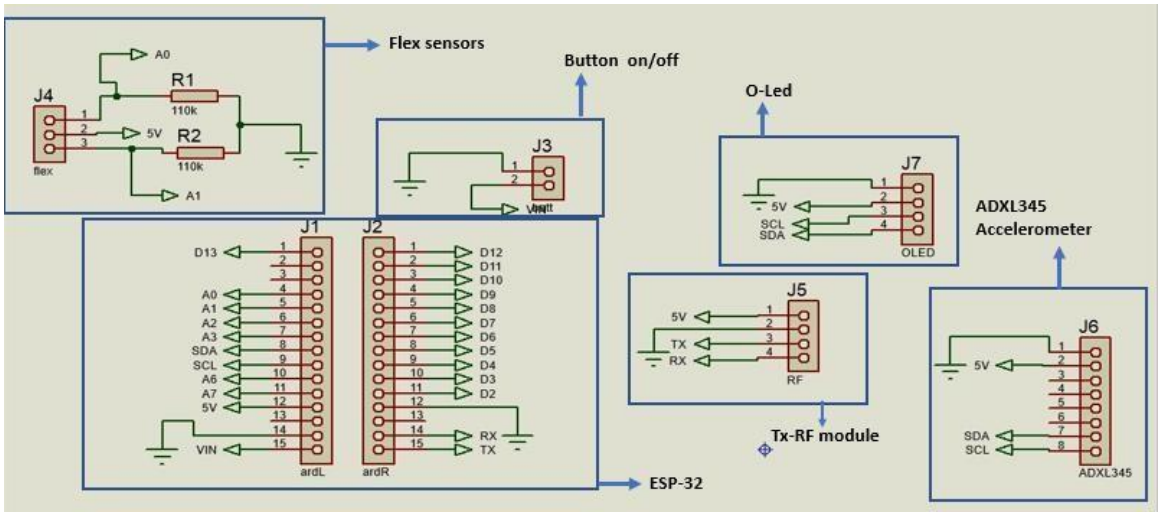

Fig 5.4: Circuit Diagram of Transmitter

5.1.5 Working of Tx:

When we move our hand in downward direction the support moves up and when hand is moved upward support moves back to its normal straight position. For side change hand is tilted right the bed rotates toward right and when limit is reached the buzzer is on for half a second and bed stops to tilt further. For moving bed towards left the hand is tilted toward left and the bed tilts in left direction when limit is reached buzzer is on and bed stops further movement. In the same way we tilt right to bring back our bed to normal position. The flex1 is presses to turn on fan and after delay of three seconds the flex1 is pressed again and fan goes off. When flex2 is pressed the light is on and after same delay of three seconds the flex2 is pressed again and light is off.

Chapter 6

6.1.1 Receiver Circuit

Receiver circuit is composed of two servo motors, Arduino Nano microcontroller, an XL-4015 DC-DC buck converter, two channel relay module for appliances control, a HC- 12 wireless communication module which has long rang and a buzzer for limit reached alarm as warning. The receiver receives data from transmitter and through microcontroller implements the command.

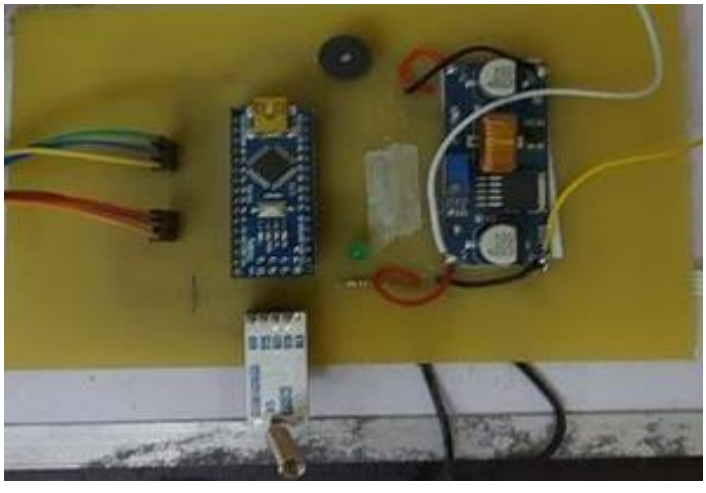

Fig 6.1.1: Receiver Circuit

Block Diagram

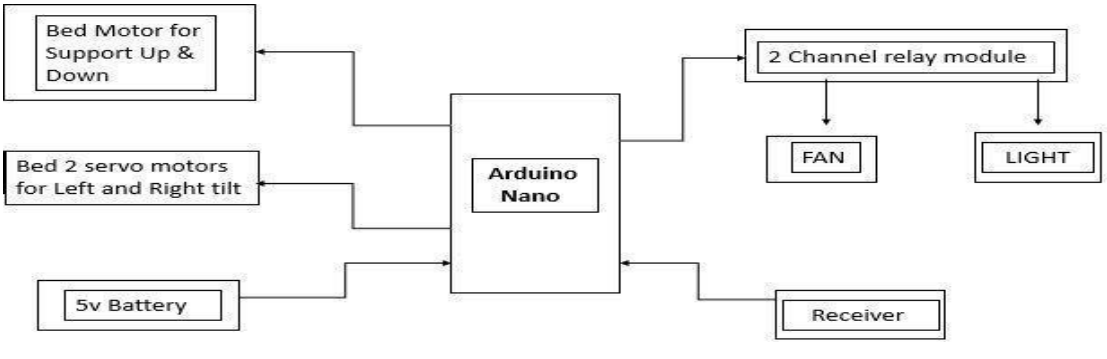

Fig 6.1.2: Block Diagram

6.1.2 PCB Layout of Receiver Circuit

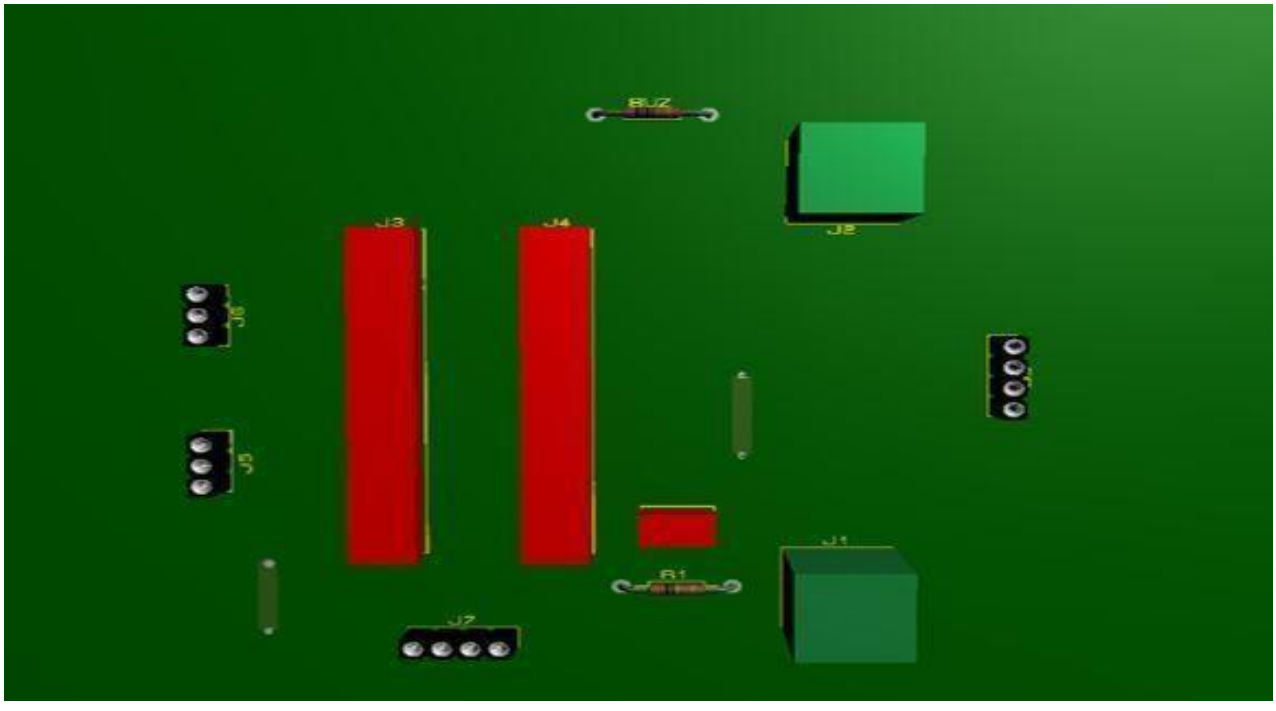

Fig 6.1.3: PCB Layout of Receiver Circuit

6.1.3 Circuit Diagram

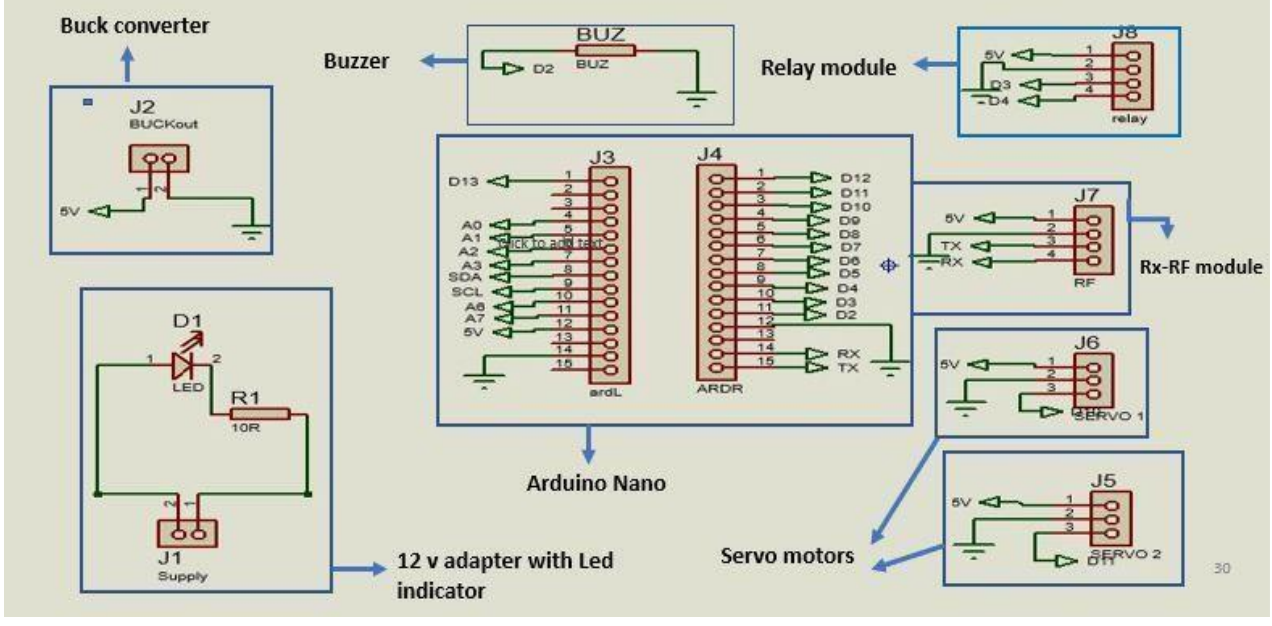

Fig 6.1.4: Receiver Circuit Diagram

6.1.4 Working of Rx:

Receiver side depends upon data from transmitter side. If our transmitter send data as 0 receiver will receive that data and then Arduino will read that data and our motor will move in clockwise direction for Bed support UP. Similarly if on transmitter side data is received as 1 motor will move in anticlockwise direction and Support will move downward. When data received is 2 the motor rotates bed in right direction using servo motor 2 and when data is read as 3 motor rotates in anticlockwise direction to move or tilt bed in left direction. When data on receiver side is 5 from flex sensor relay of Fan is on and that of light goes off and Fan becomes on. Fan is off when data received is 4. For light On data from flex2 is read as 7 and when data from felx2 is as 6 light goes off.

Circuit Diagram

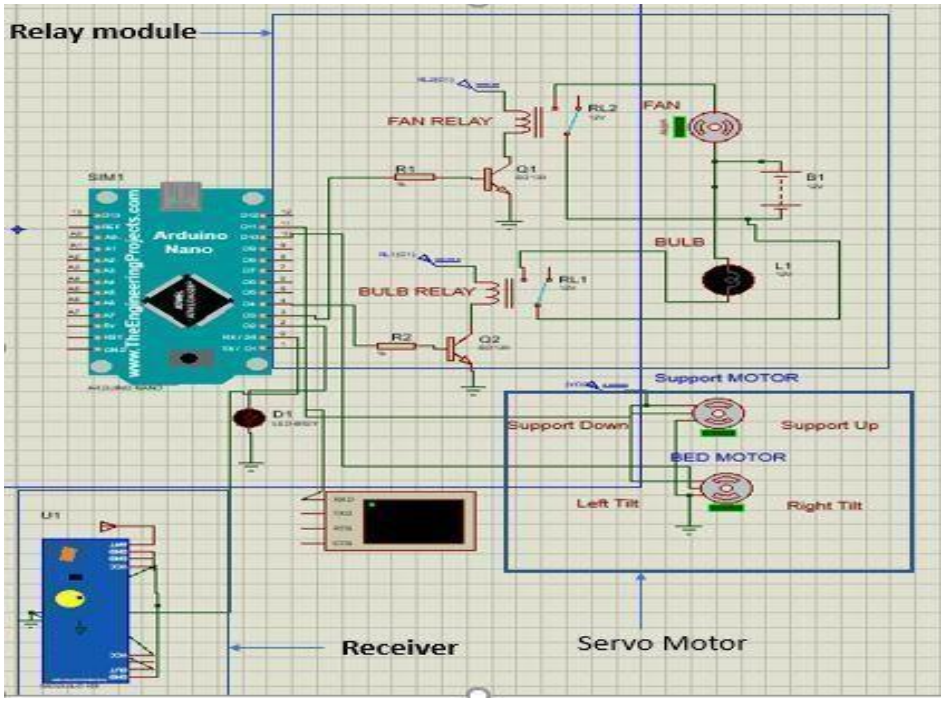

Fig 6.1.5: Circuit Diagram

6.1.5 Software Part

6.1.6 Arduino & Proteus

The software used in this project is Proteus and Arduino Nano and ESP 32.

Proteus:

Proteus is used for circuit diagram and for designing of PCB.

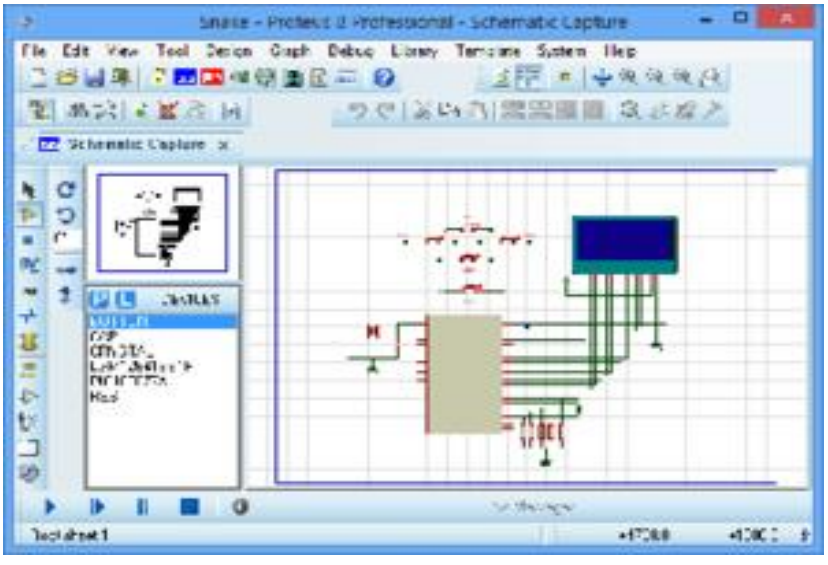

Fig 6.1.6: Proteous Window

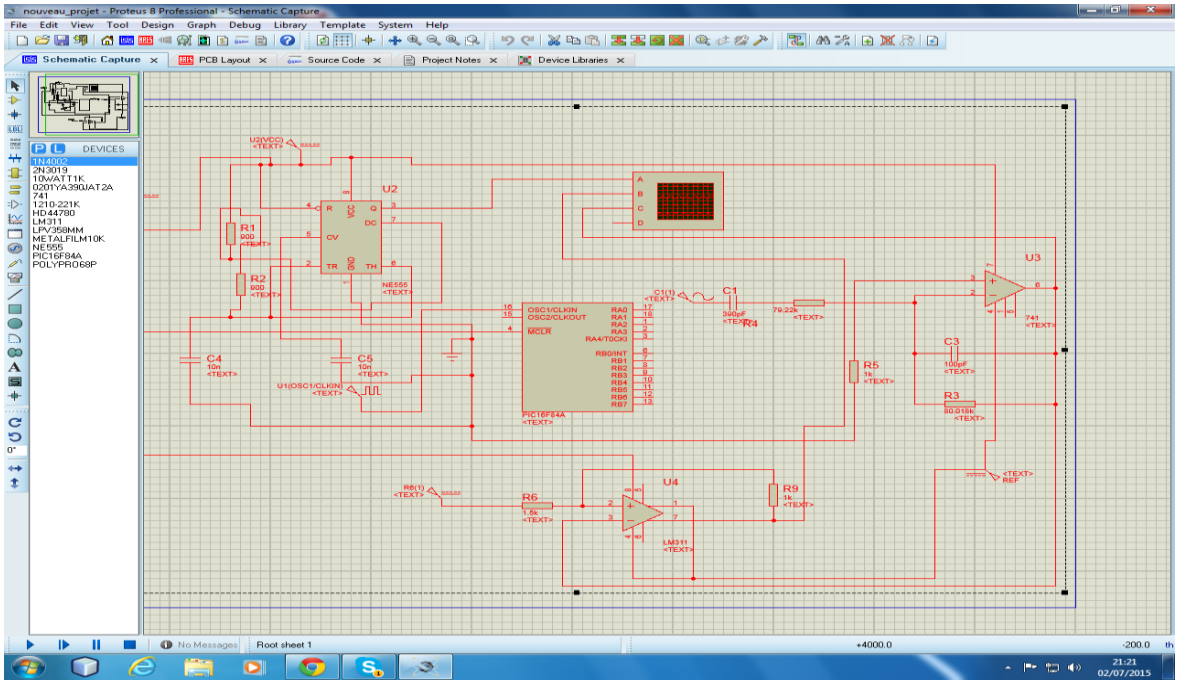

Fig 6.1.7: Circuit Diagram ESP-32

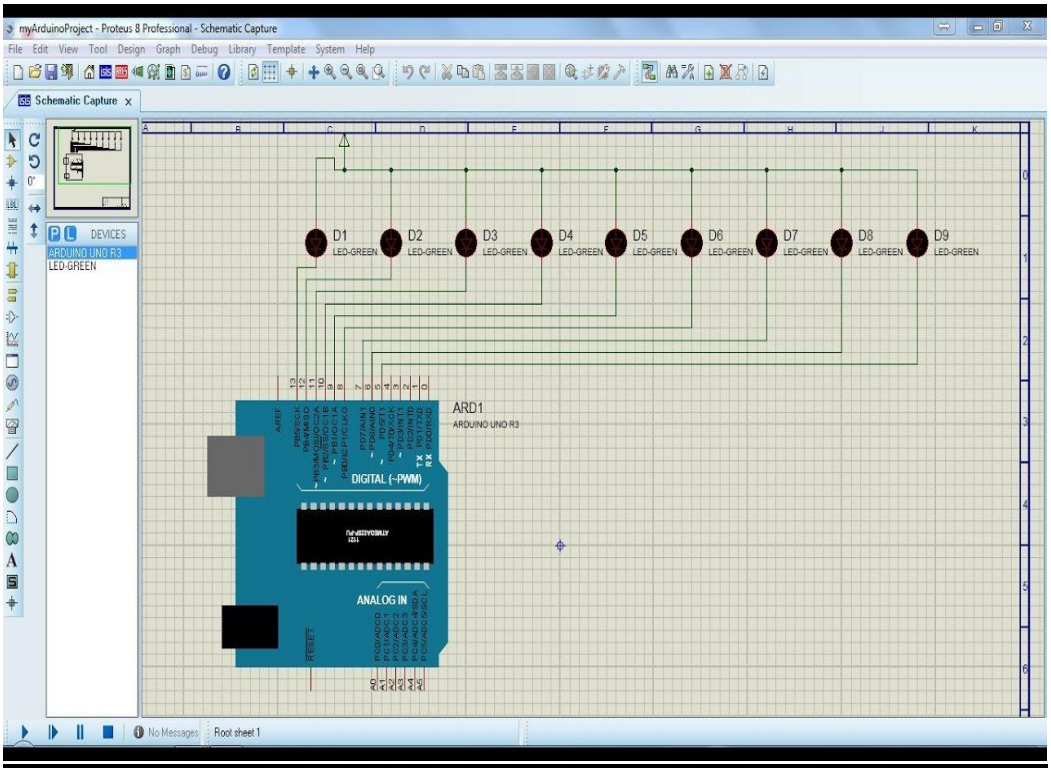

Fig 6.1.8: Circuit Diagram ESP-32

Arduino:

The Microcontroller Arduino programming is done by Arduino software.

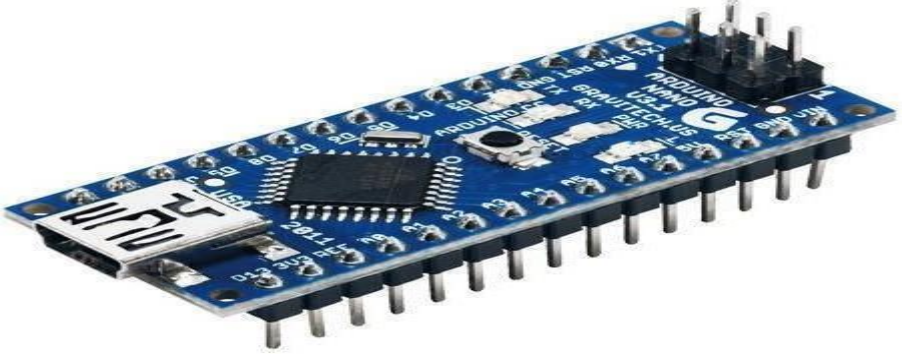

Fig 6.1.9: Arduino

6.1.7 ESP 32:

A high level of integration with built in antenna switches having low power consumption which for Bluetooth and Wi-Fi operations necessary for IOT based work.Basic purpose of using ESP 32.

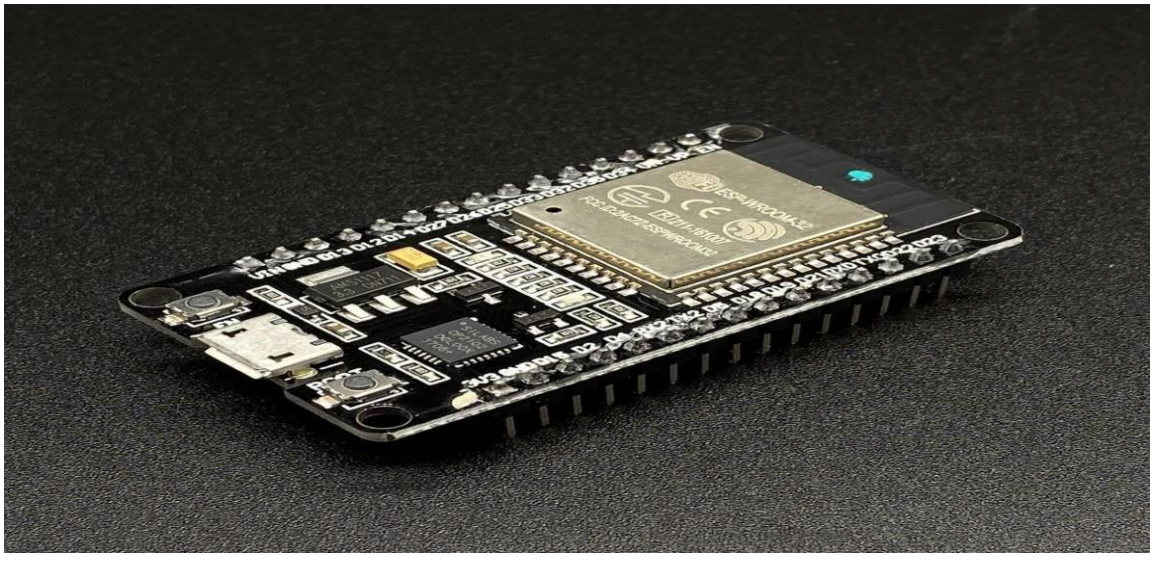

Fig 6.2.0: ESP-32

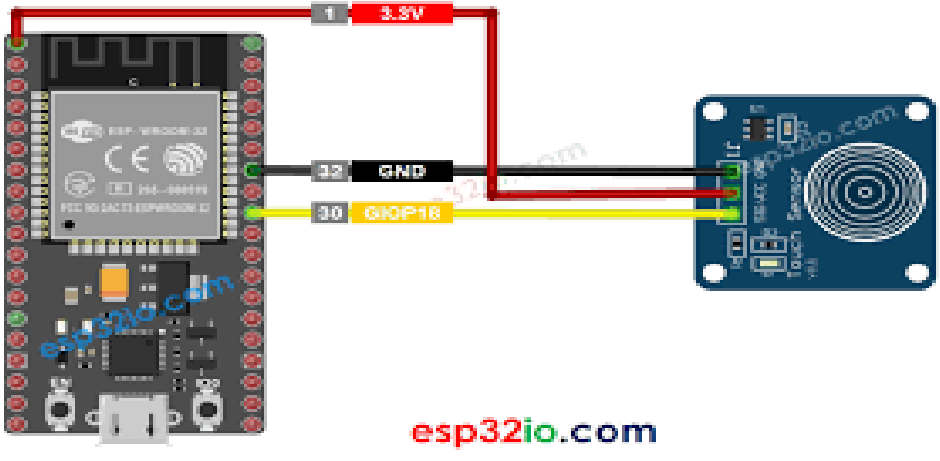

Fig 6.2.1: ESP-32 Toggle Relay

Chapter 7

Conclusion

The aim of technology is to facilitate people and introduce products to increase comfort level of its users. Hospital beds are evolved with the passage of time and features were added accordingly. This project aims to provide necessary features in a handy control for paralyzed patients. Patients will have freedom to control their bed movements and will have control of appliances on specific gestures. The concept of caretaker is not feasible in this modern world where everyone is busy and has specific jobs to be performed so this project will bring an end to this existing concept by providing best alternate solution to the problem. The bed is in product form and will be among economical hospital beds so that every hospital can avail this facility for their patients. In future work can be done on this project to add more features which aim to increase comfort level of patient. Height adjustment can be added through sensors and if a patient has no hands and is disabled a hair band can be used instead of glove they will have sensors mounted to recognize eye gaze movement for specific actions. Bed can also be controlled through signals from brain. As the bed is evolved time to time will have scope in future for this work. In future with the help of research and development it can have many features by now our project is focused on primary needs of every patient and main aim of project is to eliminate the concept of caretaker because during pandemic hospitals are already overcrowded and if every patient is without caretaker will reduce the numbers in hospital and will be helpful for medical health care workers to do their jobs comfortably. Project has been tested and carries all mentioned features in working condition.

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