WHEELCARE

A PROTECTIVE WHEELCHAIR

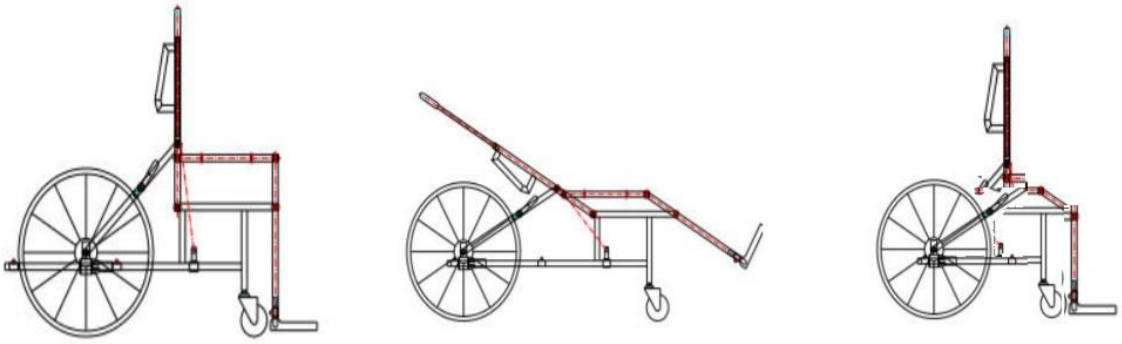
Wheelchair is a Supportive & Mobility gadget designed to be accommodate for moving physically challenged people from one place to other with the help of attendee or by means of self-propelling. Wheelchairs are not tailor-made to the person's need and body ergonomics resulting in induced discomfort and pain.

Idea is about creating a design that would both improve user comfort and safety, as well as remove some of the stigma surrounding wheelchairs. Making wheelchair Smarter & Stronger Real Time assistant. Intended to create a more human-centred vehicle to improve the everyday lives of users.

OBJECTIVES:

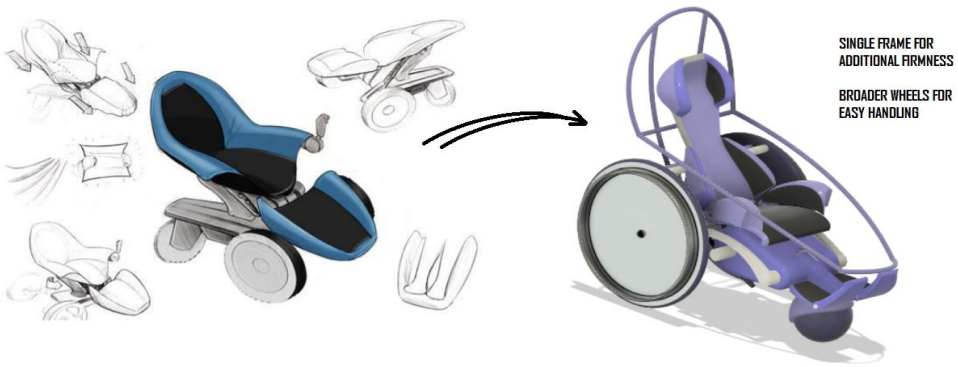
1) Light weight & stronger structure
2) Ergonomic Design
3) Obstacle Avoidance
4) Continuous Health Monitoring & Alert System

Major Mechanics of Wheel Chair



In general, wheel chair are primarily designed for sitting position and in some recent developments wheelchairs are provided with slanting mechanisms. This facilitates users comfortable horizontal laying position.

With additional modifications of mechanism, wheelchair has been upgraded to help users to stand erect for standing position to facilitate user to stand from sitting position. Advanced exoskeleton system also available but not affordable for common users economically.



With the help of advanced CAD softwares available, many concepts were developed and investigated for its advantages and disadvantages. Stating the primary agenda of making frame of wheel chair lighter and stronger, CES EDU PACK has been used.

Based on the following criteria the material of construction for wheelchair is selected.

Selection of Material:

Criteria for Stage 1: Material should be stronger enough and light weight. Minimum value of strength of 270 MPa executed for structural design and Density to 7750 kg/m3, so as lesser than steels weight.

Point to note that, here strength referring to Maximum tensile strength. As strength is different for different materials, like concrete its crushing strength, elastomers it's tearing strength, etc. care should be taken appropriately in choosing material.

Shortlisted Materials are:

Aluminium Alloys, Nickel alloys, Copper alloys, Molybdenum alloys, Zinc alloys, lead alloys and Cast Iron are excluded as density is greater than 7750 kg/m3 and based on polymer foams, elastomers, polymers, woods are excluded based on plastic deformation strength 270 MPa.

Materials are,

Composites

Magnesium Alloys

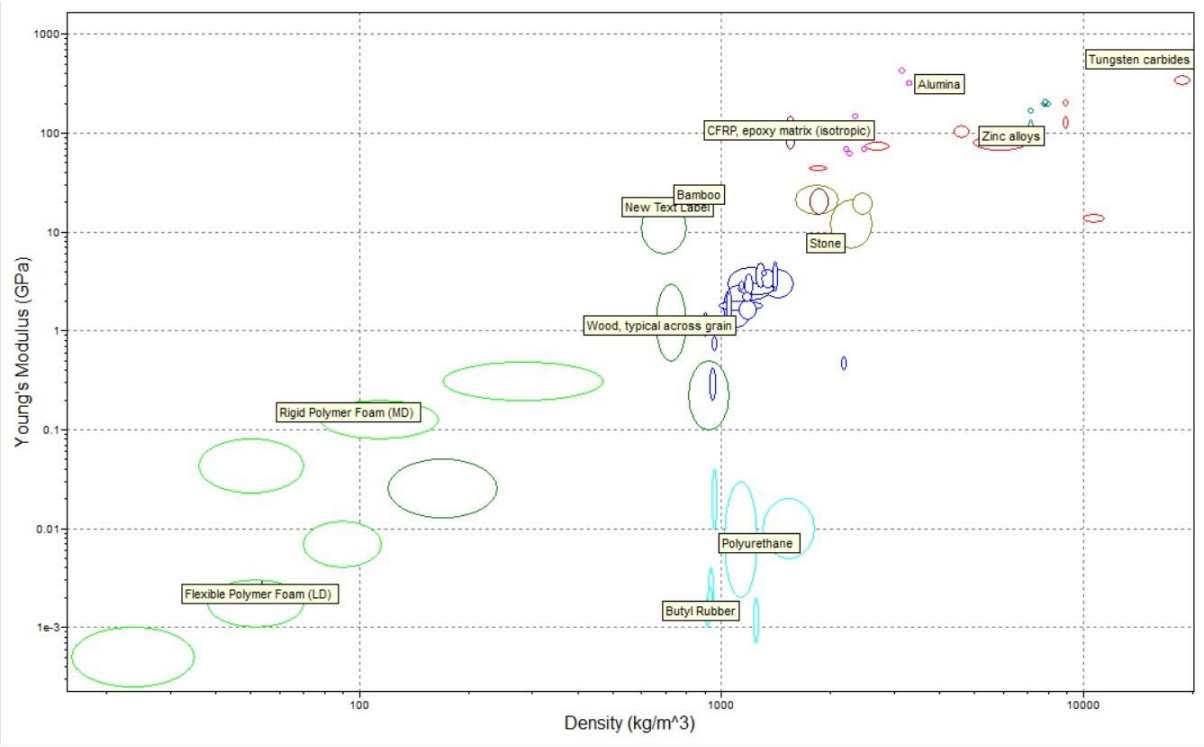
Aluminium Alloys

Ti Alloys

Ceramics

Stage 2:

YOUNG's MODULUS vs DENSITY



Criteria for Stage 2: Young's Modulus determines the stiffness or sag ability of Material of construction. Out of shortlisted materials ascending order of materials in accordance with higher rankings are sorted.

Shortlisted Materials are:

Carbon Fibre Reinforced Polymer

Titanium Alloys

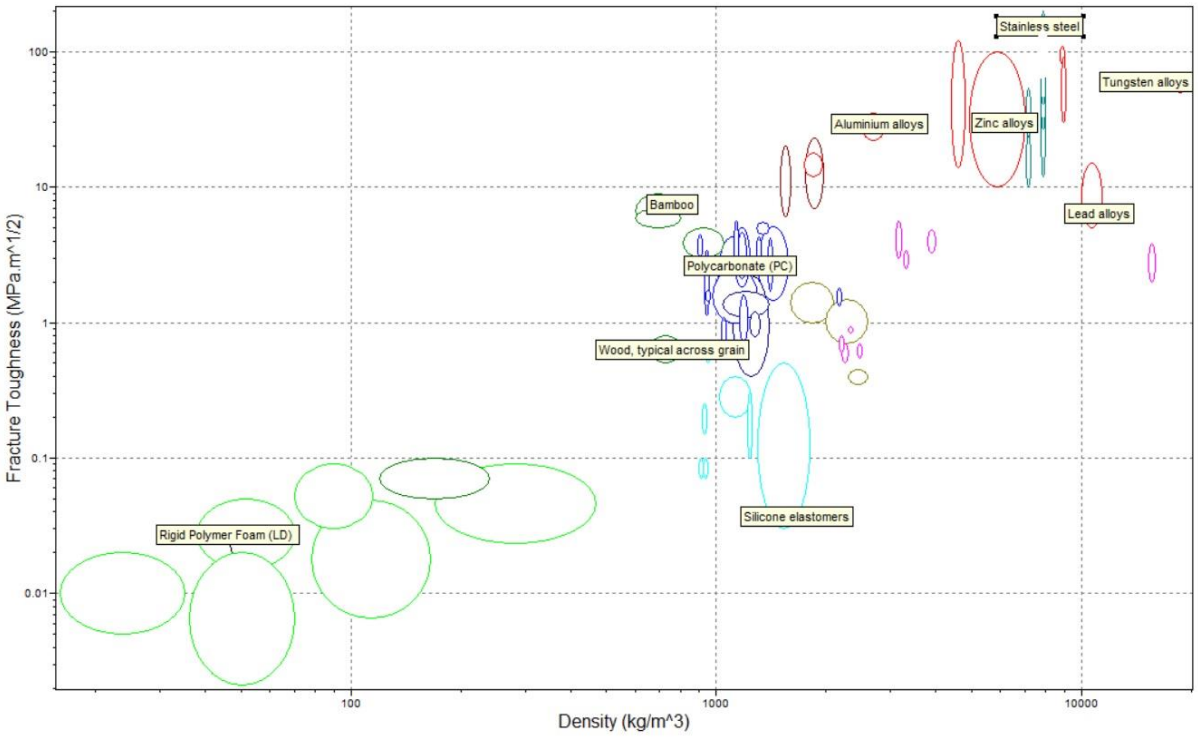
Glass Fibre Reinforced Polymer

Aluminium Alloys

Magnesium Alloys

Stage 3:

FRACTURE TOUGHNESS vs DENSITY



Criteria for Stage 3: Fracture Toughness determines the resistance of Crack propagation once crack has been initiated in the structure. Lower the value brittle is the material, with little load or damage initiation the metal will shatter immediately. On the same front, with higher value of Fracture Toughness, material will deform more & more before tearing.

Above 20 MPa $m^{1/2}$ is the range of Engineering Materials and hence the minimum value for conventional design is kept as 20 MPa $m^{1/2}$. Almost all materials shortlisted satisfies this criteria as well.

Shortlisted Materials remains same.

Carbon Fibre Reinforced Polymer

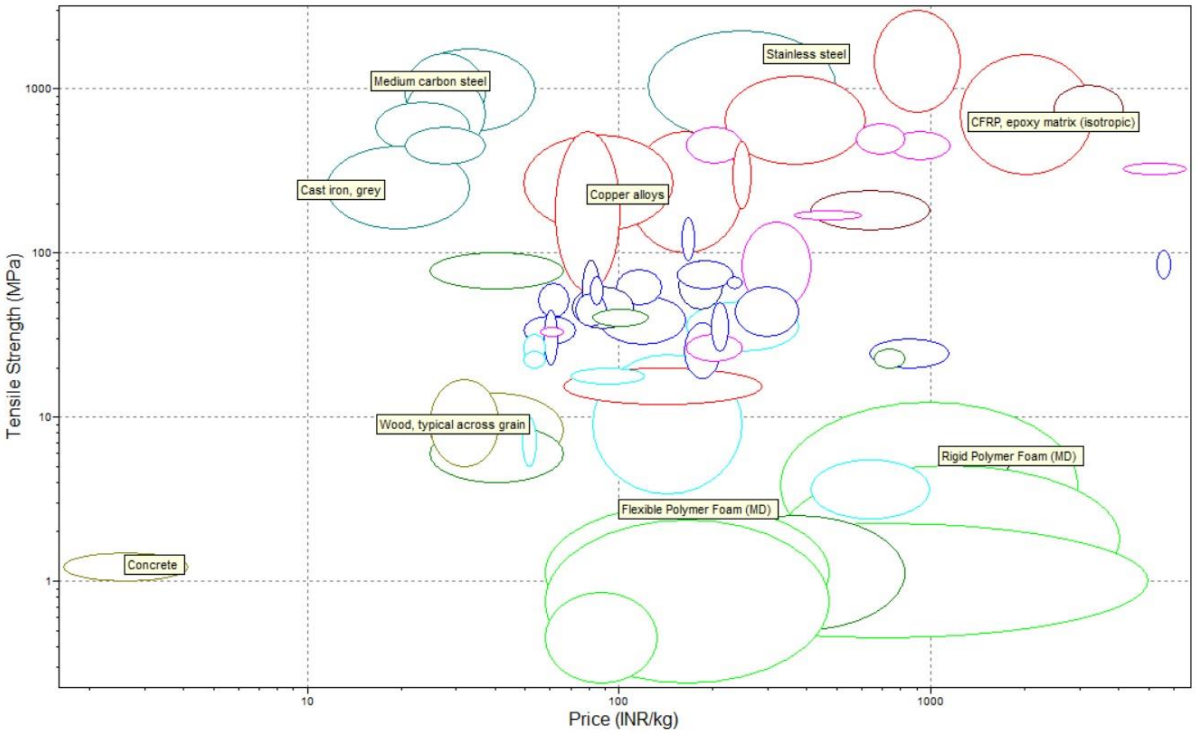
Titanium Alloys

Glass Fibre Reinforced Polymer

Aluminium Alloys

Stage 4:

STRENGTH OF MATERIAL vs COST INR



Criteria for Stage 4: Cheaper material is always preferred in the industry and cheaper material with higher strength is added advantage. Based on the priority criteria we have the shortlisted remains almost same.

Shortlisted Materials.

Carbon Fibre Reinforced Polymer

Titanium Alloys

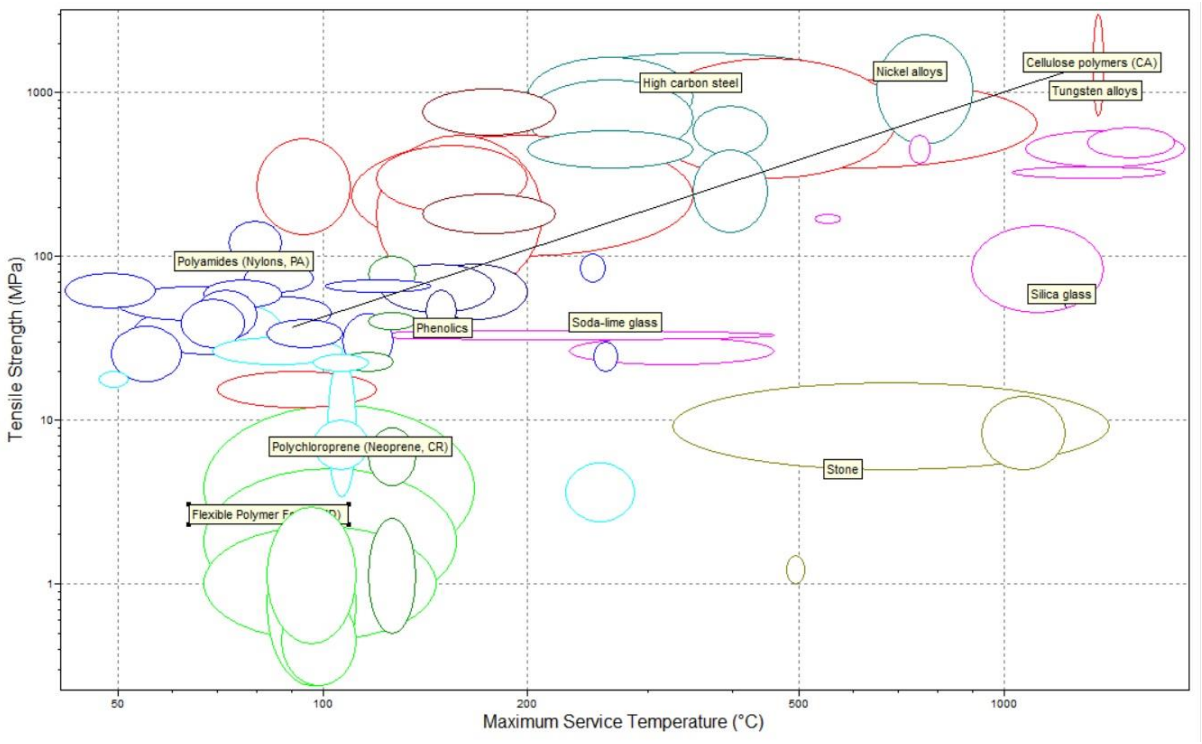
Glass Fibre Reinforced Polymer

Aluminium Alloys

Out of above lists, aluminium alloys are easily available and lower cost compared to other making process.

Stage 5:

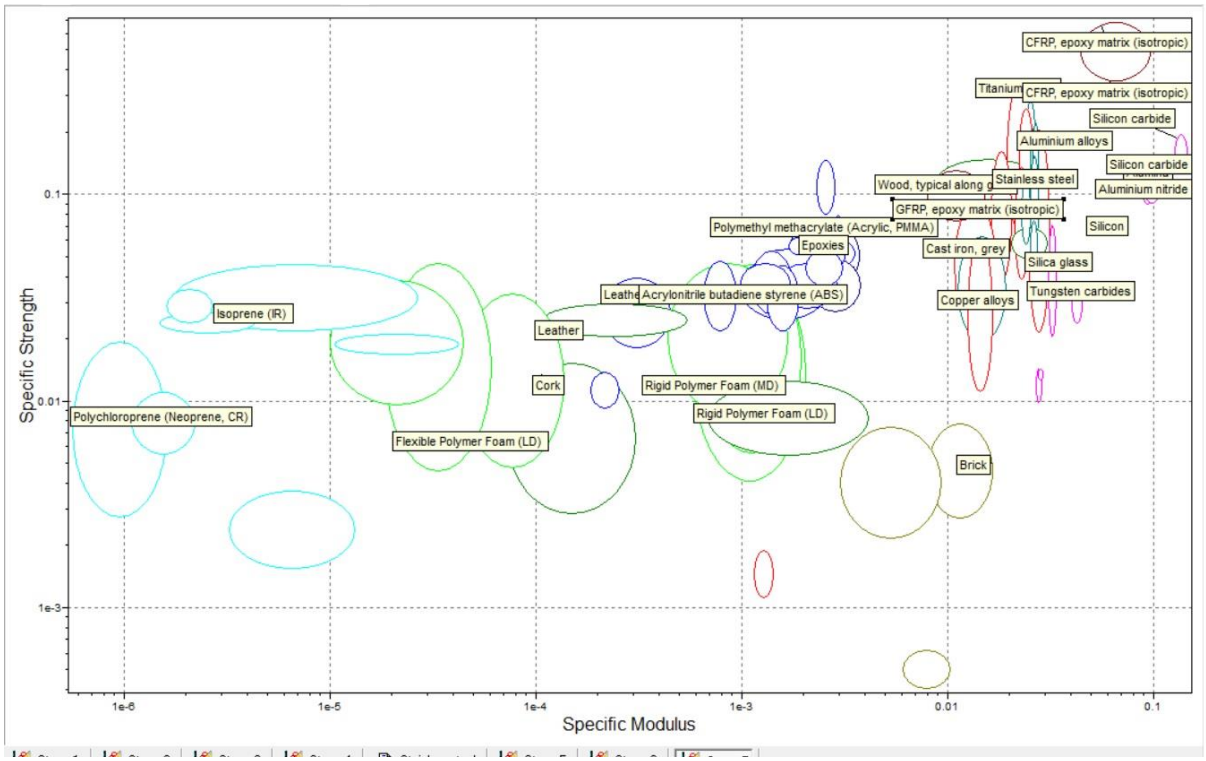
STRENGTH OF MATERIAL vs MAXIMUM SURFACE TEMPERATURE



Criteria for Stage 5: For wheel chair frame, the temperature range that will be exposed is never more than 200 degree Celsius. From the shortlisted materials, limiting the maximum temperature less than 200 degree Celsius and since it has battery will be used in the design, the proper thermal isolation should be taken care while making enclosure for electronic components. And making them water proof is also very eminent. Design of frame is made in such a way that temperature at frame should not reach above 50 degree Celsius. Aluminium alloys fits to this category as well.

Stage 6:

SPECIFIC STIFFNESS vs SPECIFIC STRENGTH OF MATERIAL



Criteria for Stage 6: The ratio of Strength of the Material to its density is the defined as specific strength of the material. This formulation is done by using advanced feature of CES tool. Similarly, the ratio of Young's modulus to it's respective density is called as Specific modulus of the material. Aluminium shares the capabilities similar to stainless steel. Less weight with more strength is most preferred. As so, aluminium alloys fits best in the lot.

From the slots of Aluminium alloys, Aluminium 6000 Series is selected as they used in automobile industry which will be optimum for designing Wheel chair frame.

Aluminium alloys

Design guidelines

Aluminum alloys are light, can be strong, and are easily worked. Pure aluminum has outstanding electrical and thermal conductivity (copper is the only competition here) and is relatively cheap - though still more than twice the price of steel. It is a reactive metal - in powder form it can explode - but in bulk an oxide film (Al2O3) forms on its surface, protecting it from corrosion in water and acids (but not strong alkalis). Aluminum alloys are not good for sliding surfaces - they scuff - and the fatigue strength of the high-strength alloys is poor. Nearly pure aluminum (1000 series alloys) is used for small appliances and siding; high strength alloys are used in aerospace (2000 and 7000 series), and extrudable, medium strength alloys are used in the automotive and general engineering sectors (6000 series).

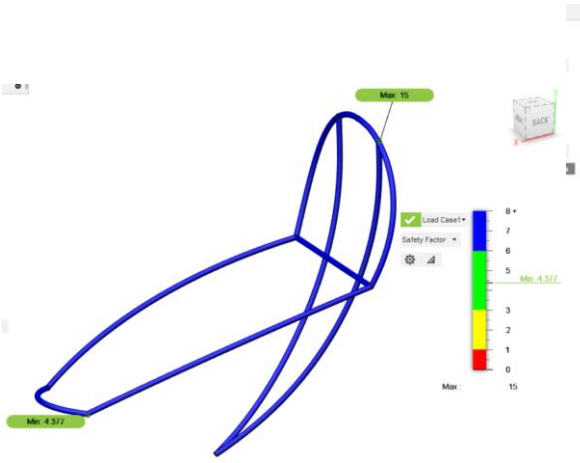
Technical notes

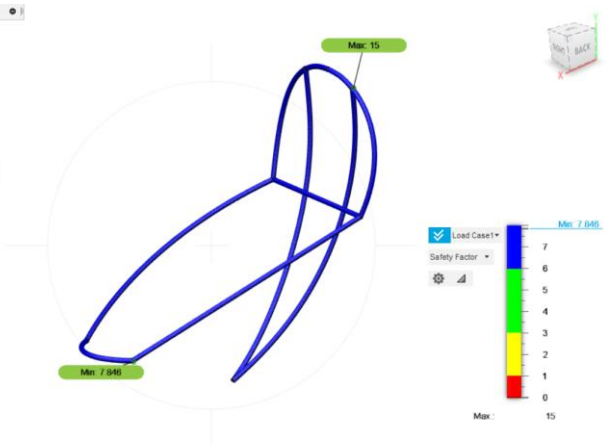
Until 1970, designations of wrought aluminum alloys were a mess; in many countries, they were simply numbered in the order of their development. The International Alloy Designation System (IADS), now widely accepted, gives each wrought alloy a 4-digit number. The first digit indicates the major alloying element or elements. Thus the series 1xxx describe unalloyed aluminum; the 2xxx series contain copper as the major alloying element, and so forth. The third and fourth digits are significant in the 1xxx series but not in the others; in 1xxx series they describe the minimum purity of the aluminum; thus 1145 has a minimum purity of 99.45%; 1200 has a minimum purity of 99.00%. In all other series, the third and fourth digits are simply serial numbers; thus 5082 and 5083 are two distinct aluminum-magnesium alloys. The second digit has a curious function: it indicates a close relationship: thus 5352 is closely related to 5052 and 5252; and 7075 and 7475 differ only slightly in composition. To these serial numbers are added a suffix indicating the state of hardening or heat treatment. The suffix F means 'as fabricated'. Suffix O means 'annealed wrought products'. The suffix H means that the material is 'cold worked'. The suffix T means that it has been 'heat treated'. No classification system for cast aluminum alloys has international acceptance. In the most widely used (the AAUS system), the first digit indicates the alloy group. In the 1xx.x group, the second two digits indicate the minimum percentage of aluminum; thus 150.x indicates a composition containing a minimum of 99.5% aluminum. The digit to the right of the decimal point indicates the product form: 0 means 'castings' and 1 means 'ingot'. In the 2xx.x to 9xx.x groups, the second two digits are simply serial numbers. The digit to the right of the decimal point again indicates product form. More information on designations and equivalent grades can be found in the Users section of the Granta Design website, www.grantadesign.com

Typical uses

Aerospace engineering; automotive engineering - pistons, clutch housings, exhaust manifolds; die cast chassis for household and electronic products; siding for buildings; foil for containers and packaging; beverage cans; electrical and thermal conductors.

Based on the above stages of selection criteria, Aluminium 6000 series has been selected for the construction of wheel chair frame. In-future, with appropriate market survey apt series of material will be shortlisted.


Max: 15
Load Case1
Safety Factor
8
7
6
5
Min: 4.377
3
2
1
0
Max: 15
Min: 4.377


Max: 15
Load Case1
Safety Factor
Min: 7.846
7
6
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2
1
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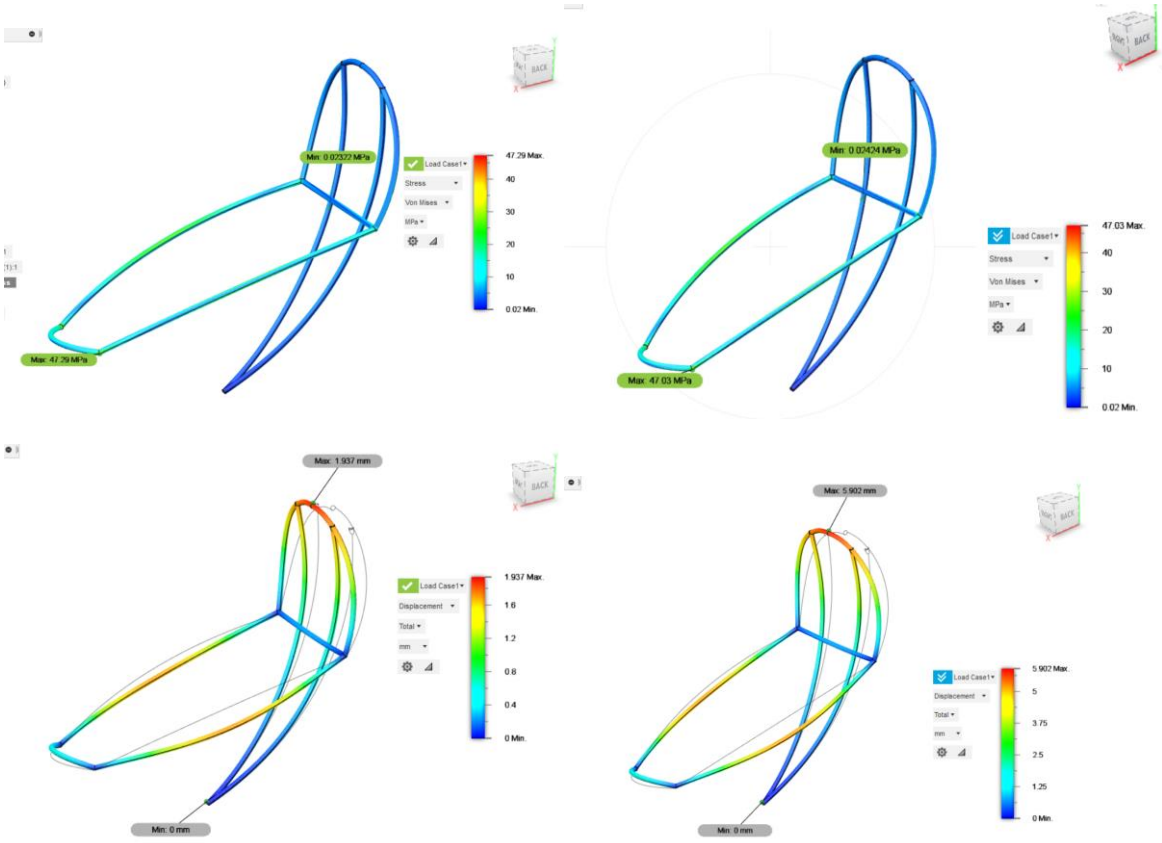
Max: 15
Min: 7.846



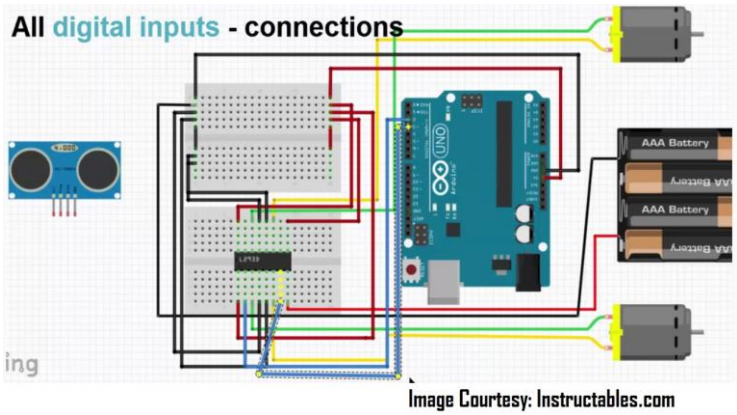
From static analysis of Chasis with the nominal propable maximum average load steel and aluminium structures where compared.

The factor of safety wasa almost at par however, aluminium deforms more than the steel, but with in the permissible limits.

To attain cushioning effect of the seat, and to provide comfort and support a Laser Sintering approach using TPU materials shall be selected for its flexibility and strength.

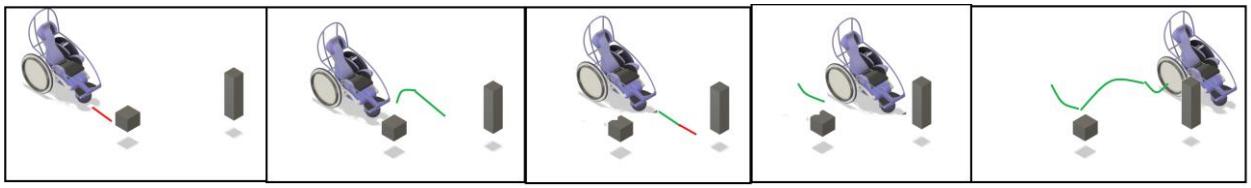
Micro Controllers & Sensor Details:

1) OBSTACLE AVOIDANCE CIRCUIT:



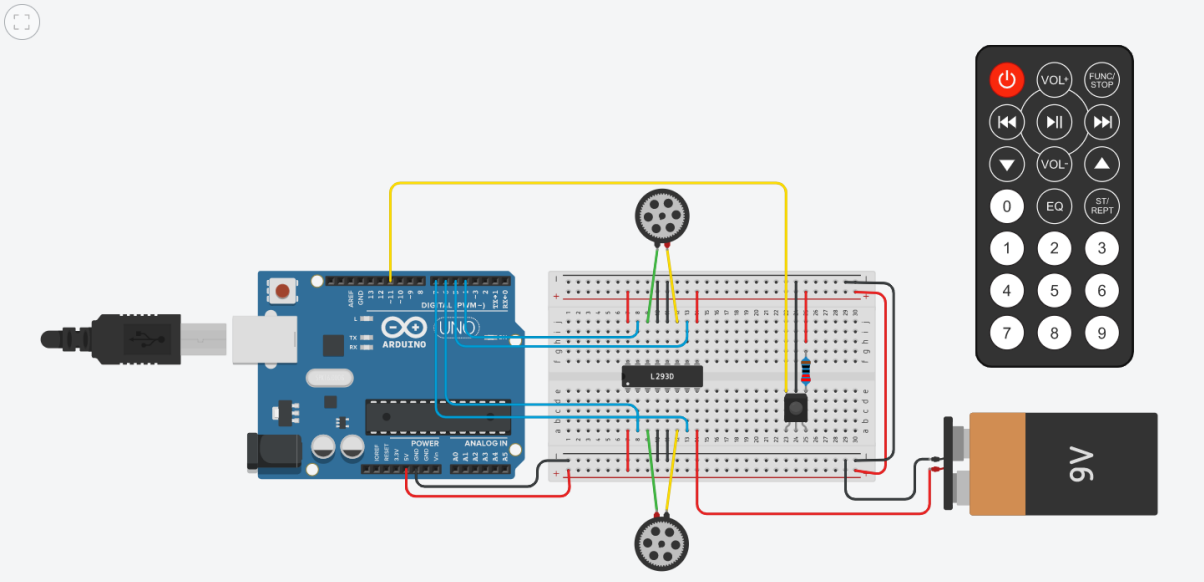
Source Code:

Source Code available in the Assignment #3 of the webpage for the same.



Using the ultrasonic sensors, the vehicle moves intelligently avoiding the obstacles and taking turns, when any obstacles comes in the vicinity of programmed range.,

For Controlling over Wifi/GSM/Bluetooth/IR Controller.

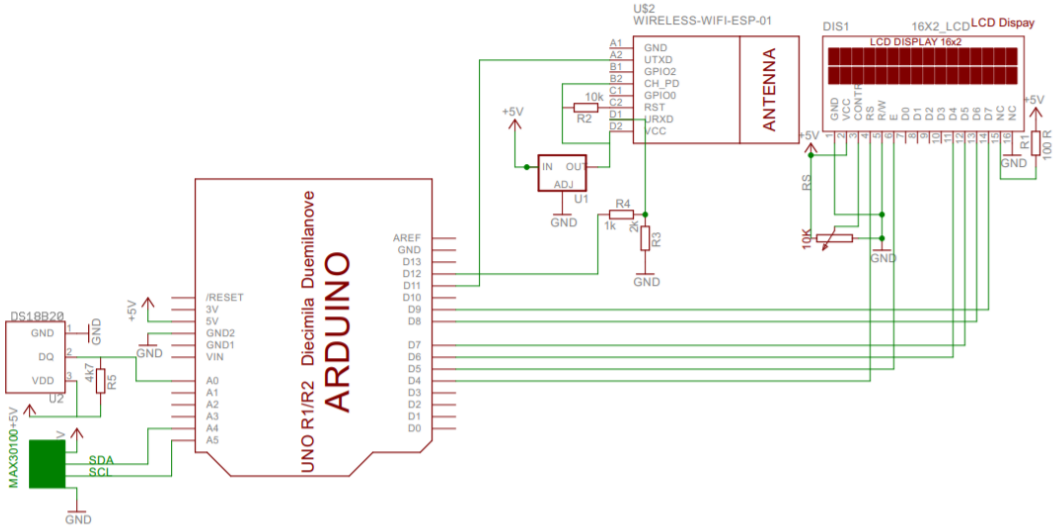


Source Code

```
#include <IRremote.h>


int RECV_PIN = 11;

IRrecv irrecv(RECV_PIN);

decode_results results;


int motor_pin1 = 4;    // Left motor

int motor_pin2 = 5;

int motor_pin3 = 6;    // Right motor

int motor_pin4 = 7;


void setup ()

{

  irrecv.enableIRIn();

  pinMode(motor_pin1,OUTPUT);    // Left motor

  pinMode(motor_pin2,OUTPUT);

  pinMode(motor_pin3,OUTPUT);    // Right motor

  pinMode(motor_pin4,OUTPUT);

  Serial.begin(9600);

}


void loop() {


  //if some date is sent, reads it and saves in state

  if (irrecv.decode(&results)) {

    irrecv.resume();   // Receive the next value

    }


  if (results.value == 0xFD807F) {
// VOL+ this is where you put in your IR remote button #

    digitalWrite(motor_pin1,LOW);
// Left motor forward

    digitalWrite(motor_pin2,HIGH);

    digitalWrite(motor_pin3,LOW);
// Right motor forward

    digitalWrite(motor_pin4,HIGH);

    {

     Serial.println("Go Forward!");

     }
```

```
  }


 //if some date is sent, reads it and saves in state
 if (irrecv.decode(&results)) {
  irrecv.resume();  // Receive the next value
  }


  if (results.value == 0xFD906F) { // VOL-  this is where you put in your IR remote button #
    digitalWrite(motor_pin1,HIGH); // Left motor backward
    digitalWrite(motor_pin2,LOW);
    digitalWrite(motor_pin3,HIGH); // Right motor backward
    digitalWrite(motor_pin4,LOW);
    {
     Serial.println("Go Backward!");
    }
  }



 //if some date is sent, reads it and saves in state
 if (irrecv.decode(&results))
 {
  irrecv.resume();  // Receive the next value
 }


  if (results.value == 0xFD20DF) { // |<<  this is where you put in your IR remote button #
    digitalWrite(motor_pin1,HIGH); // Left motor backward
    digitalWrite(motor_pin2,LOW);
    digitalWrite(motor_pin3,LOW); // Right motor forward
    digitalWrite(motor_pin4,HIGH);
    {
     Serial.println("Turn Left!");
    }
  }


 //if some date is sent, reads it and saves in state
 if (irrecv.decode(&results)) {
  irrecv.resume();  // Receive the next value
  }


  if (results.value == 0xFD609F) { // >>|  this is where you put in your IR remote button #
    digitalWrite(motor_pin1,LOW); // Left motor forward
    digitalWrite(motor_pin2,HIGH);
    digitalWrite(motor_pin3,HIGH); // Right motor backward
    digitalWrite(motor_pin4,LOW);
    {
     Serial.println("turn Right!");
    }
  }


 //if some date is sent, reads it and saves in state
 if (irrecv.decode(&results)) {
  irrecv.resume();  // Receive the next value
  }


  if (results.value == 0xFDA05F) { // PLAY/PAUSE  this is where you put in your IR remote button #
    digitalWrite(motor_pin1,LOW); // Stops left motor
    digitalWrite(motor_pin2,LOW);
    digitalWrite(motor_pin3,LOW); // Stops right motor
    digitalWrite(motor_pin4,LOW);
    {
     Serial.println("Stop!");
    }
  }
}
```

For Pulse Oximeter & Temperature Module



Source Code:

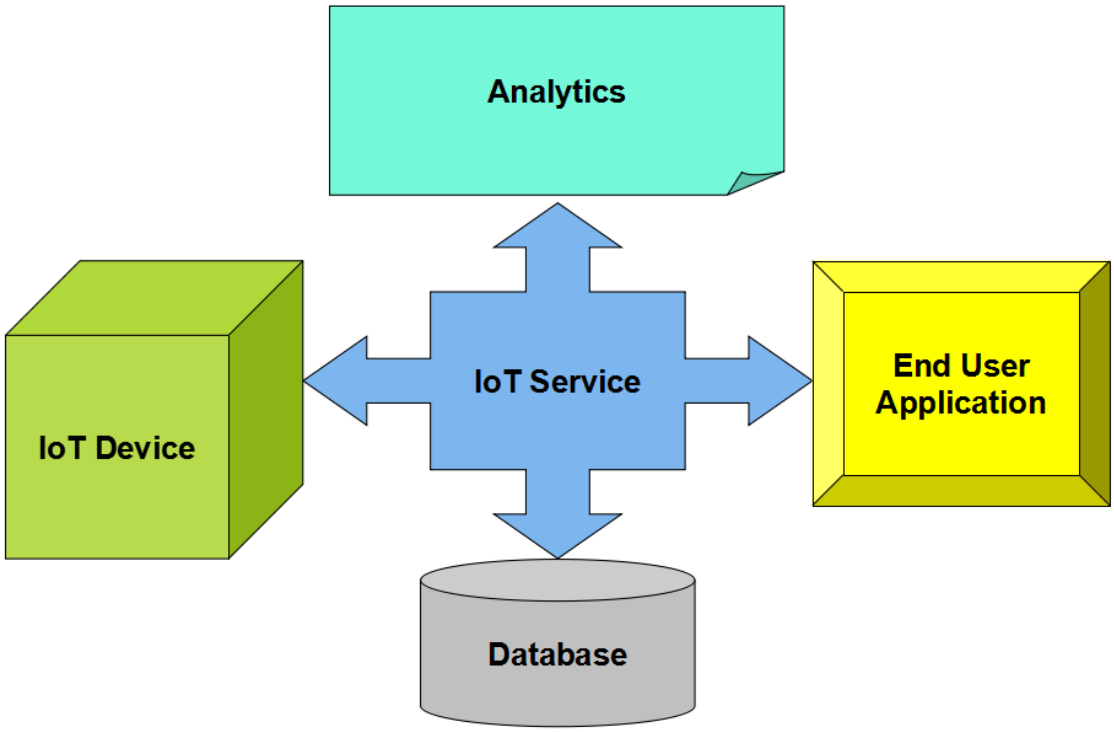
```
/*
 * SSID  = AndriodAP
 * Pass = 87654321
 */


#include <LiquidCrystal.h>
#include <OneWire.h>
#include <DallasTemperature.h>
#define ONE_WIRE_BUS A0
OneWire oneWire(ONE_WIRE_BUS);
DallasTemperature sensors(&oneWire);


LiquidCrystal lcd(4,5,6,7,8,9);
#include <SoftwareSerial.h>
float pulse = 0;
float temp = 0;
SoftwareSerial ser(11,12);
String apiKey = "0QA0GW6PS6W3RXFY";
unsigned long previousMillis=0, previousMillis2=0;
#include <Wire.h>
#include "MAX30100_PulseOximeter.h"
#define REPORTING_PERIOD_MS 1000
PulseOximeter pox;
uint32_t tsLastReport = 0;
int flag;
int led = 13;


void onBeatDetected()
{
   Serial.println("Beat!");
   digitalWrite(led,HIGH);
}


void init_bpm()
{
 if (!pox.begin()) {
      Serial.println("FAILED");
      for(;;);
  } else {
      Serial.println("SUCCESS");
  }

pox.setOnBeatDetectedCallback(onBeatDetected);


}
void setup()
{
  lcd.begin(16, 2);
  sensors.begin();
  Serial.begin(115200); // we agree to talk fast!
  pinMode(led,OUTPUT);
  digitalWrite(led,LOW);
```

```
 init_bpm();
 lcd.clear();
 lcd.setCursor(0,0);
 lcd.print(" Patient Health");
 lcd.setCursor(0,1);
 lcd.print(" Monitoring ");


 delay(2000);
 lcd.clear();
 lcd.setCursor(0,0);
 lcd.print("Initializing....");
 delay(3000);
 lcd.clear();
 lcd.setCursor(0,0);
 lcd.print("Getting Data....");
 ser.begin(115200);
 ser.println("AT");
 delay(1000);
 ser.println("AT+GMR");
 delay(1000);
 ser.println("AT+CWMODE=3");
 delay(1000);
 ser.println("AT+RST");
 delay(5000);
 ser.println("AT+CIPMUX=1");
 delay(1000);


 String
cmd="AT+CWJAP=\"AndroidAP\",\"
87654321\"";
 ser.println(cmd);
 delay(1000);
 ser.println("AT+CIFSR");
 delay(1000);
}
//**************************
******************************
***
// Where the Magic Happens
void loop()
{
   digitalWrite(led,LOW);
   pox.update();
   if (millis() - tsLastReport >
REPORTING_PERIOD_MS) {
      pulse = pox.getHeartRate();
      lcd.setCursor(0,0);
      lcd.print("BPM :          ");
      lcd.setCursor(7,0);
      lcd.print(pulse);
      tsLastReport = millis();


   }
 if(millis() - previousMillis2 >
15000)
 {
   read_temp();
   previousMillis2 = millis();
   init_bpm();
 }
 if(millis() - previousMillis > 20000)
 {
   esp_8266();
   previousMillis = millis();
   init_bpm();
 }
}
//**************************
******************************
***
void esp_8266()
{
 // TCP connection
AT+CIPSTART=4,"TCP","184.106.153.1
49",80
 String cmd =
"AT+CIPSTART=4,\"TCP\",\"";
 cmd += "184.106.153.149"; //
api.thingspeak.com
 cmd += "\",80";
 ser.println(cmd);
 Serial.println(cmd);
 if(ser.find("Error"))
 {
  Serial.println("AT+CIPSTART
error");
  return;
 }
 String getStr = "GET
/update?api_key=";
 getStr += apiKey;
 getStr +="&field1=";
 getStr +=String(temp);
 getStr +="&field2=";
 getStr +=String(pulse);
 getStr += "\r\n\r\n";
 // send data length
 cmd = "AT+CIPSEND=4,";
 cmd += String(getStr.length());
```

```
 ser.println(cmd);
 Serial.println(cmd);
 delay(1000);
 ser.print(getStr);
 Serial.println(getStr);
//thingspeak needs 15 sec delay
between updates
 delay(3000);
}
//**************************
*****************************
***
void read_temp()
{
 sensors.requestTemperatures();
 temp =
sensors.getTempCByIndex(0);
 Serial.print("Temperature:");
 Serial.println(temp);
 lcd.clear();
 lcd.setCursor(0,0);
 lcd.print("BPM :          ");
 lcd.setCursor(7,0);
 lcd.print(pulse);
 lcd.setCursor(0,1);
 lcd.print("Temp.:         ");
 lcd.setCursor(7,1);
 lcd.print(temp);
 lcd.setCursor(13,1);
 lcd.print("C");

}
//**************************
*****************************
***
```

Introduction

The Internet of Things(IoT) is a system of 'connected things'. The things generally comprise of an embedded operating system and an ability to communicate with the internet or with the neighboring things. One of the key elements of a generic IoT system that bridges the various 'things' is an IoT service. An interesting implication from the 'things' comprising the IoT systems is that the things by themselves cannot do anything. At a bare minimum, they should have an ability to connect to other 'things'. But the real power of IoT is harnessed when the things connect to a 'service' either directly or via other 'things'. In such systems, the service plays the role of an invisible manager by providing capabilities ranging from simple data collection and monitoring to complex data analytics. The below diagram illustrates where an IoT service fits in an IoT ecosystem:



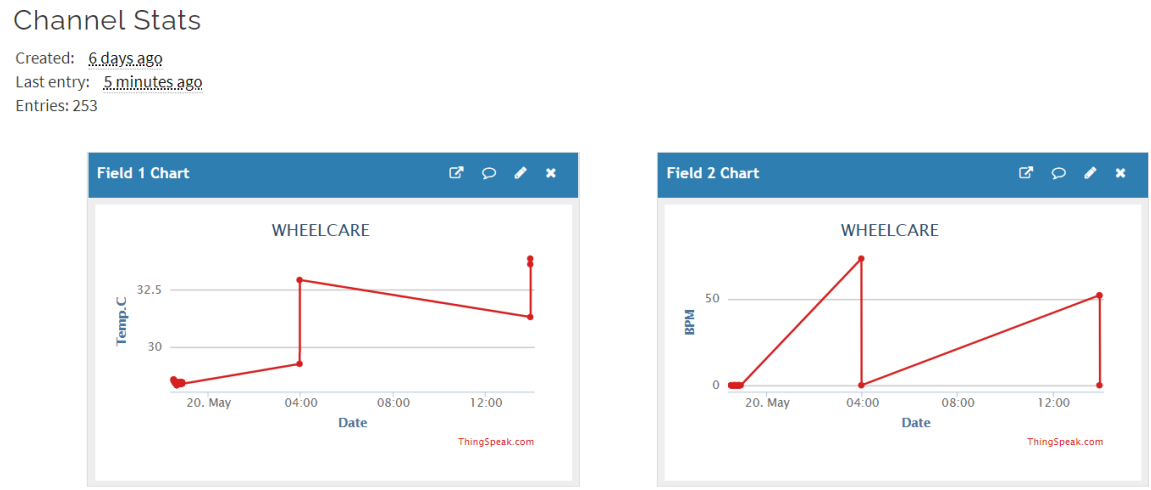
One such IoT application platform that offers a wide variety of analysis, monitoring and counter-action capabilities is 'ThingSpeak'. Let us consider ThingSpeak in detail.

One of the key elements of an IoT system is an IoT service. ThingSpeak is one such application platform offering a wide variety of features. At the heart of ThingSpeak is a channel which can be used for storing and processing data collected from the 'things'. ThingSpeak also provides various apps for integration with web services, other APIs and

social networks and provides the capability to create the applications as plugins. It is a great platform with extensive possibilities to explore the integration of the Internet of Things.

Channel created will host live data of sensor. Which can be monitored Over Internet.

When we view channel, it presents the curves generated. As shown in figure below.

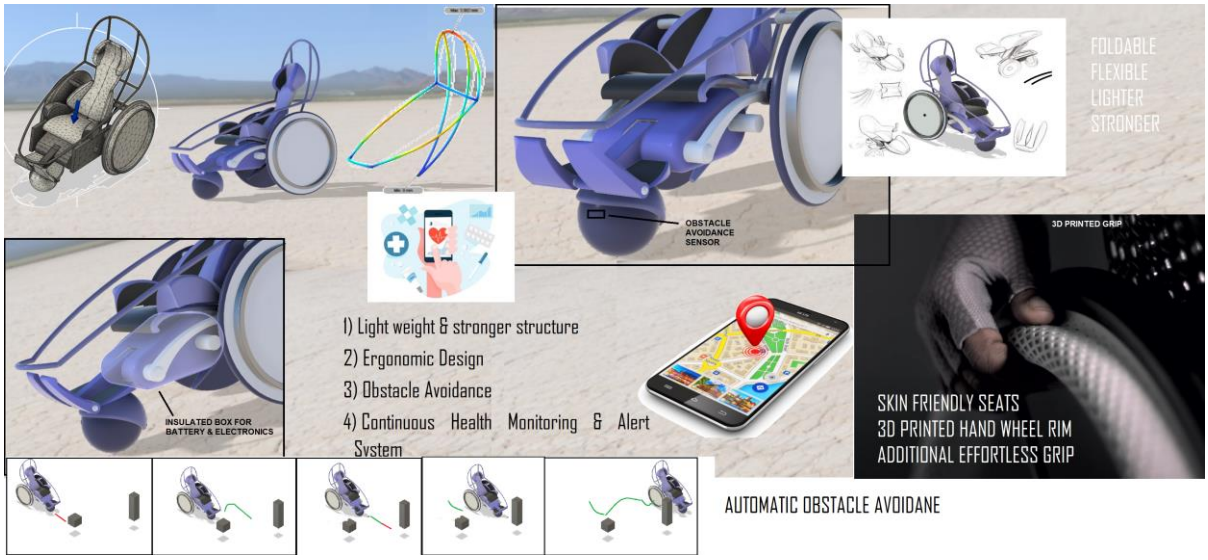


Similarly, most of the data including location of the user can be found and tracked as well.

This will help in the complete care taking of User who are physically challenged and changes the whole world and we care about them.

Source Codes and Project details are available in the Final Project Webpage.

Future Scope:



Using the technology available, let us focus more on better and happy living opportunity to everyone around. Let make no one feel less and make every pain points as a pleasure points. Wheel chair has more gaps that need to be addressed and it has to be tailor made for every individual in need and we shall make it possible.