SAE Baja Team

Operation/Assembly Assignment

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Introduction:

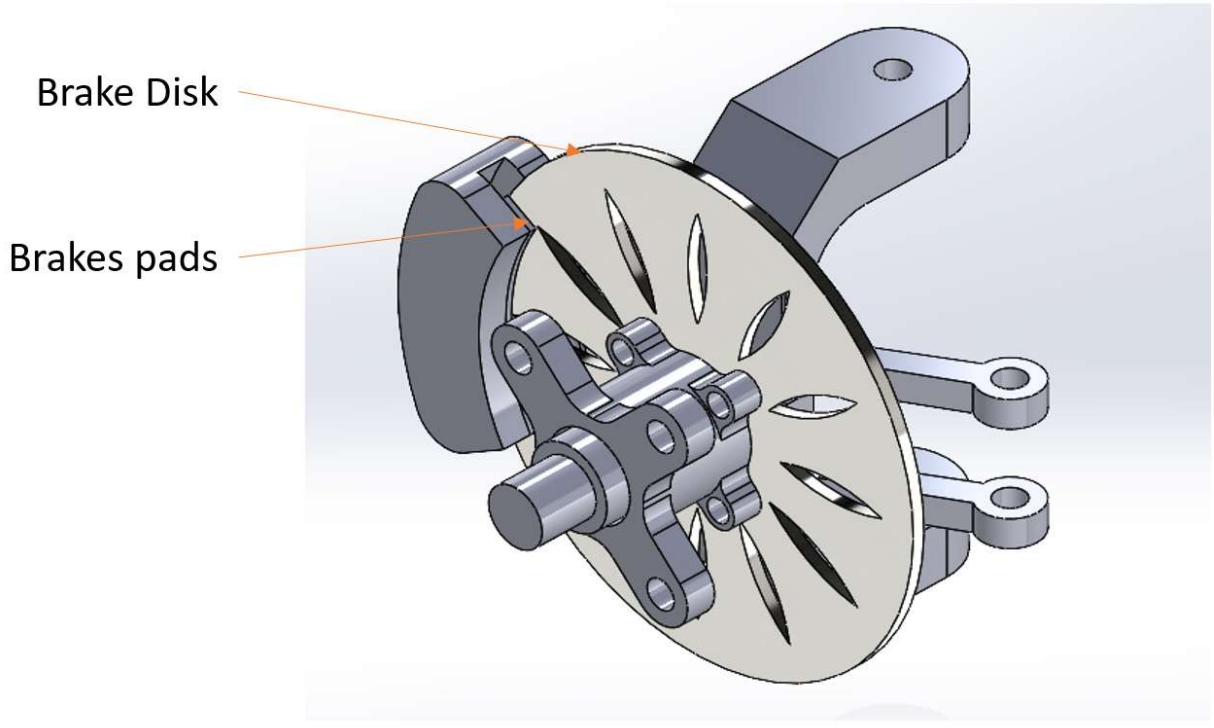
The operational manual for the SAE Baja vehicle includes the Brakes, Suspension, Steering, and Dashboard systems. The team will explain the operation of each system in section 2 by the team. The complete assembly instructions are shown in section 3. Section 4 provides the full guidelines for maintaining all systems in the project. All the instructions are provided in these sections related to the vehicle systems. However, as it is impossible to anticipate every condition or situation, unique situations or problems during operation, assembly, or maintenance could be encountered and not provided in this manual. It's recommended to have the best knowledge before any actions.

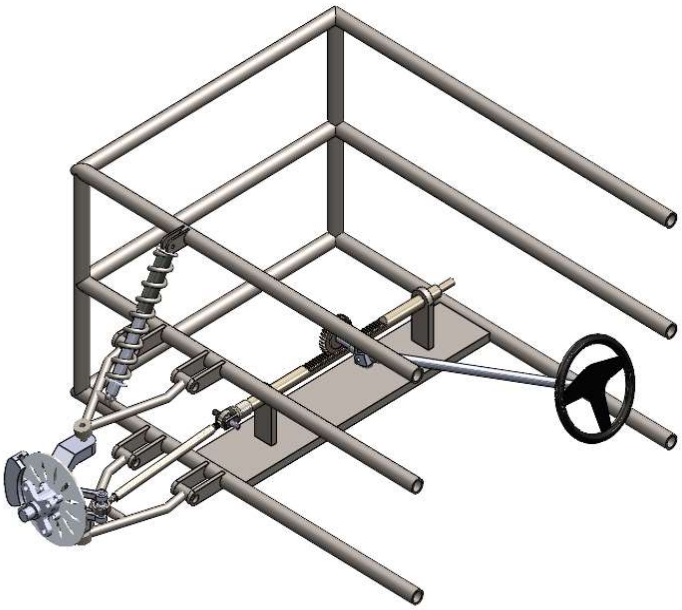
Operation:

The operations of different systems are explained in this section to assist in operating the vehicle under general use.

1.1 Brake System

The brake system is one of the essential parts of the SAE Baja vehicle. The brake disk rotates circularly with the wheel while the car is moving. Once the driver applies the brakes, the brake pads in the caliper moves towards the brake disk to make contact with it. Due to this contact, the vehicle stops.





1.2 Front suspension:

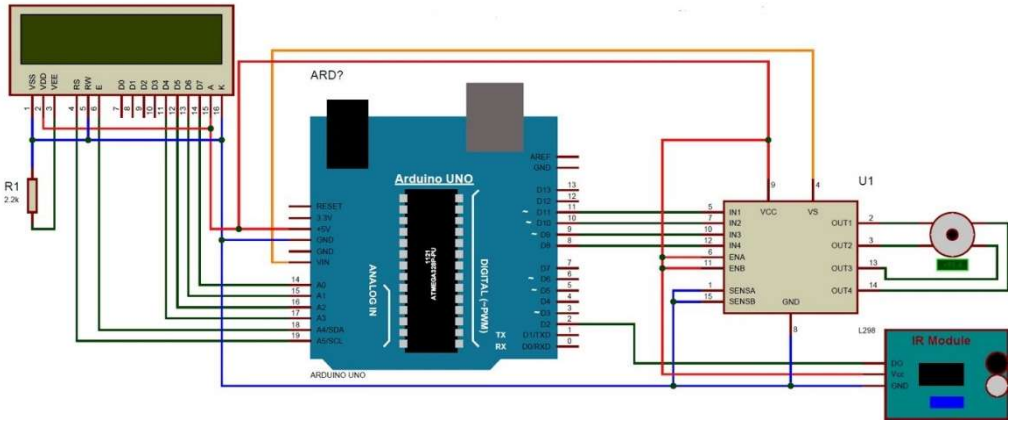
Equal A-Arms Suspension System is being used for the front suspension. As such, its endurance and supports both the weight of the vehicle and the weight of the drive. Using this system ensures that the driver is protected from stroke on the road, which is caused rough environment. The upper arm, the lower arm, and the shock absorber with coil spring make up this subsystem. The shock absorber operation is to protect the driver without feeling a bumpiness or reaction forces due to the stroke. The coil spring in the shock absorber will absorb that caused by the stroke. Then, these forces transmit equally to both arms which are the upper and lower of the front suspension.

1.3 Steering System:

In developing the steering subsystem, a rack and pinion gear are designed for this subsystem. To start with, the steering system is composed of the steering wheel, steering column, rack and pinion, gear assembly, and the tier rods. The operation of steering wheel is that function by the driver to direct the car is supposed to take. The motion of the car begins when the driver applies a small force to the steering wheel. The force is converted through the steering column to the pinion gear. Once this happens, the translational force makes the tie rods initiate the motion of the car. The tie rods subjected the rack to the knuckle. When they move, so does the steering knuckle. The result is that the steering knuckle rotates, and the vehicle will turn as well.

1.4 Dashboard System:

The dahsboard board system is a design based on the Arduino board. The dashboard is an indispensable part of the project. It provides the driver with real-time data of the vehicle, which can effectively help driving. Through the measurement of the sensor, the vehicle speed data can be displayed on the LCD, and the pointer on the analog dashboard can point to the set angle. Designed to obtain vehicle data by using IR sensors to detect the number of gaps of a wheel. It is the The material list is Arduino, LCD, stepper motor, L298N motor driver, IR sensor, 220V-12V adopter and circuit components. This is the schematic of the dsahboard, which displays how the compoents connected. The Arduino code is also included as screenshot.



```
#include<LiquidCrystal.h>
LiquidCrystal lcd(A5,A4,A3,A2,A1,A0);
#include <Stepper.h>
const int stepsPerRevolution = 200;  // change this t
Stepper myStepper(stepsPerRevolution, 8, 9, 10, 11);
volatile byte REV;
unsigned long int rpm,RPM;
unsigned long st=0;
unsigned long time;
int ledPin = 13;
int led = 0,RPMlen , prevRPM;
int flag = 0;

int flagl=1;
#define bladesInFan 2
float radius=16;   // inch
int preSteps=0;
float stepAngle= 360.0/(float)stepsPerRevolution;
float minSpeed=0;
float maxSpeed=280.0;
float minSteps=0;
float maxSteps=maxSpeed/stepAngle;

void setup()
{
  myStepper.setSpeed(60);
  Serial.begin(9600);
  pinMode(ledPin, OUTPUT);
  lcd.begin(16,2);
  lcd.print("Speedometer");
  delay(2000);
  attachInterrupt(0, RPMCount, RISING);
}
 void loop()
 {
     readRPM();
     radius=((radius * 2.54)/100.0);  // convering in meter
     int Speed= ((float)RPM * 60.0 * (2.0 * 3.14 * radius)/1000.0);
     // RPM in 60 minute, diameter of tyre (2pi r) r is radius, 1000 to convert in km
     int Steps=map(Speed, minSpeed,maxSpeed,minSteps,maxSteps);

    if(flagl)
    {
     Serial.print(Speed);
     Serial.println("Kmh");
      lcd.setCursor(0,0);
      lcd.print("RPM: ");
      lcd.print(RPM);
      lcd.print("           ");
      lcd.setCursor(0,1);
      lcd.print("Speed: ");
      lcd.print(Speed);
      lcd.print(" Km/h       ");
     flagl=0;
    }
     int currSteps=Steps;
     int steps= currSteps-preSteps;
     preSteps=currSteps;
     myStepper.step(steps);
 }
```

```
int readRPM()
{
  if(REV >= 10 or millis()>=st+1000)                    //  IT
  {
     if(flag==0)
       flag=1;
     rpm = (60)*(1000/(millis() - time))*REV/bladesInFan;
     time = millis();
     REV = 0;
     int x= rpm;
     while(x!=0)
     {
       x = x/10;
       RPMlen++;
     }
     Serial.println(rpm,DEC);
     RPM=rpm;
     delay(500);
     st=millis();
     flag1=1;
   }
}

void RPMCount()
 {
   REV++;
   if (led == LOW)
   {
     led = HIGH;
   }
   else
   {
     led = LOW;
   }
   digitalWrite(ledPin, led);
 }
```

2 Assembly:

This section explains the complete assembly of the vehicle systems from the different parts. The vehicle has four major systems, the front suspension, steering, brake, and dashboard. Each system will be discussed and explained to feed the reader knowledge about the team's project.

2.1 Brake System

The brake system contains a caliper, disk, brake pads. As this section is about the assembly, the steps of the braking will be explained in sequence in four steps:

Step 1: The force produced by the driver's foot from the pedal.

Step 2: The master cylinder is responsible for pushing the pressure produced by the driver's foot on the pedal.

Step 3: Brake caliper receives the brake lines' pressure into the clamping force that we calculated as 760 N.

Step 4: Two pads that are in each caliper.

Step 5: Rotors are in contact with pads to stop the vehicle once the driver applies the braking.

2.2 Front Suspension

The front suspension consists of the upper arm, lower arm, shock absorber and joints. During the assembly process, the car body becomes a vital part of all the major installations. Therefore, the assembly procedure for the front suspension will be shown in the steps

Step 1: The arms of the suspension system are attached to the chassis with a ball joint.

Step 2: Attached the lower arm to knuckle and chassis as well with nuts and joints

Step 3: Attached the steering knuckle to the other arm

Step 4: Attach the shock absorber to the upper arm and the vehicle’s chassis with a nut and bolt at both joints.

2.3 Steering System

Just like the Front Suspension, the Steering System will also be attached to the vehicle. The steering system consist of the rack and pinion, tie road, column of wheel, and wheel steering. Fellowly, the assembly procedure for the steering system will be shown in the steps

Step 1: Attach the tie rods to the steering couple using the bolts.

Step 2: Attach the rack gear to the sliding support contact on the vehicle's chassis

Step 3: Attach the open end of the rack gear to the tie rods using the bolt.

Step 4: The steering column will be attached to the support, and this allows for the steering column to rotate.

Step 5: The steering wheel needs to be attached at the driver's end of the vehicle.

Step 6: Attach and install the steering column to the pinion gear with a universal joint**.**

Step 7: the rack and pinion gear need to be aligned. This occurs by silting the bolts in the steering system.

2.4 Dashboard System

The instrument panel needs to set the measuring object and place the sensor in a suitable position to detect the changing frequency of the obstruction in front of the sensor.

Step 1: Connect the components according to the circuit diagram.

Step 2: Determine the detection target and place the sensor on the side of the wheel.

Step 3: Determine the wheel radius and the number of gaps of the wheel and modify the parameters in the Arduino code.

Step 4: Connect the power supply and start testing.

3 Maintenance:

The section's goal is to make frequency maintenance of SAE Baja vehicles to prevent and ensure that the vehicle remains safe to operate Not only that, but it ensures that the vehicle is durable and reliable too. Four systems will be explained in detailed below.

3.1 Brake System:

One of the engineering requirements that the team consider is reliability, and the SAE Baja teams should maintain the brake pads because pads will wear by braking after high usage, which means after long distances, the teams of SAE Baja vehicles will be responsible for checking out the pads or if they have some leaks in the master cylinder that pushes the liquid to decelerate the vehicle speed or stop it. Replace the new pads and then reattach the caliper to the knuckle. Being able to replace the brake disk, the hub should be removed along with the brake disk. Then the brake disk should separate by removing the bolts. After replacing the brake disk, the hub and brake disk should be mounted back into the system.

3.2 Suspension System:

The front suspension of the vehicle requires frequency maintenance just like any other part. For this part, several checks can be done to ensure the safety of the car. All bolts associated with the suspension are tightened properly to avoid loss and damage of held areas. Sometimes the nuts and bolts may be old. Immediate replacement is advised for such cases. The major area that comprises the front-end suspension is the coil system. Springs can compress and expand depending on the amount of force they are subjected to. The shock absorber should be subjected regularly. If the shock absorber has been damaged, it will result in the vehicle. The car's front suspension should be kept well maintained.

3.3 Steering System:

The rack and pinion gear assembly, as well as the joints between the tie rods and the steering knuckle, need to be maintained frequently. All of the joints in the steering subsystem should be checked regularly. If faults are monitored in any of the joints, then they must be replaced immediately. Ensuring that they are less likely to break down.

3.4 Dashboard System:

Since the dashboard is an electronic device, it is necessary to periodically check whether the wires are connected in place. The contamination and obstructions on the sensor, such as dirt and dust, need to be cleaned regularly. Need to detect the impact of vehicle shake on it. Electronic equipment is prone to ageing and is easily affected by weather and environmental factors. A protective shell should be added to the outside of the equipment to avoid direct contact with rain, sunlight and environmental impact.