ME3425 - MINI PROJECT

FINAL PRESENTATION

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PROBLEM STATEMENT

It is difficult for a forklift to move in a warehouse with tight spaces.

SOLUTION

Octadirectional car with mecanum wheels

CONCEPT EVALUATION MATRIX

DECISION VARIABLES	CONCEPT 1	CONCEPT 2	CONCEPT 3
No. of Wheels	2	3	4
Movement along Y axis	Possible	Possible	Possible
Movement along X axis	Not Possible	Possible	Possible
Movement in XY plane	Possible (not preferred)	Possible	Possible
Rotation	Not Possible	Possible but, complex	Possible
Stability	Not Good	Good	Better
Wear & Tear	Less	High	Very High
Cost	Less	High	Very High

Calculations

Approx mass = 3 kg

4 Mecanum wheels (4*50g), 4 Stepper motors (4*250g),Battery (150g)Assuming,body of the vehicle and other electronic components weighs the rest 650g. Considering 1 kg as tolerance in calculations.

Assuming

AeroDynamic drag is negligible, since projected area as well as velocity is less.

Gradient Resistance is zero as we are driving it on plane surfaces.

The only force we have to overcome to move the vehicle is rolling resistance.

Rolling Resistance = mg(C.O.F)/sqroot(2)

C.O.F values for different material bases

Material base	C.O.F (experimental value)
Concrete	0.65
Aluminium	0.40
Wet surface	0.30
Wooden surface	0.21
Painted surface	0.35

Material base	Value of Traction force (N)
Concrete	13.15
Aluminium	8.3
Wet	6.237
Wooden	4.366
Painted	7.28

Torque for each wheel =

(Total Traction Force/4)*WheelRadius

Mecanum wheels of diameter 48 mm 0r 60mm

Torque on each wheel

Surface	48mm (Nm)	60mm (Nm)
Concrete	0.0789	0.099
Aluminium	0.049	0.062
Wet	0.037	0.047
Wooden	0.026	0.033
Painted	0.044	0.055

Stepper Motors

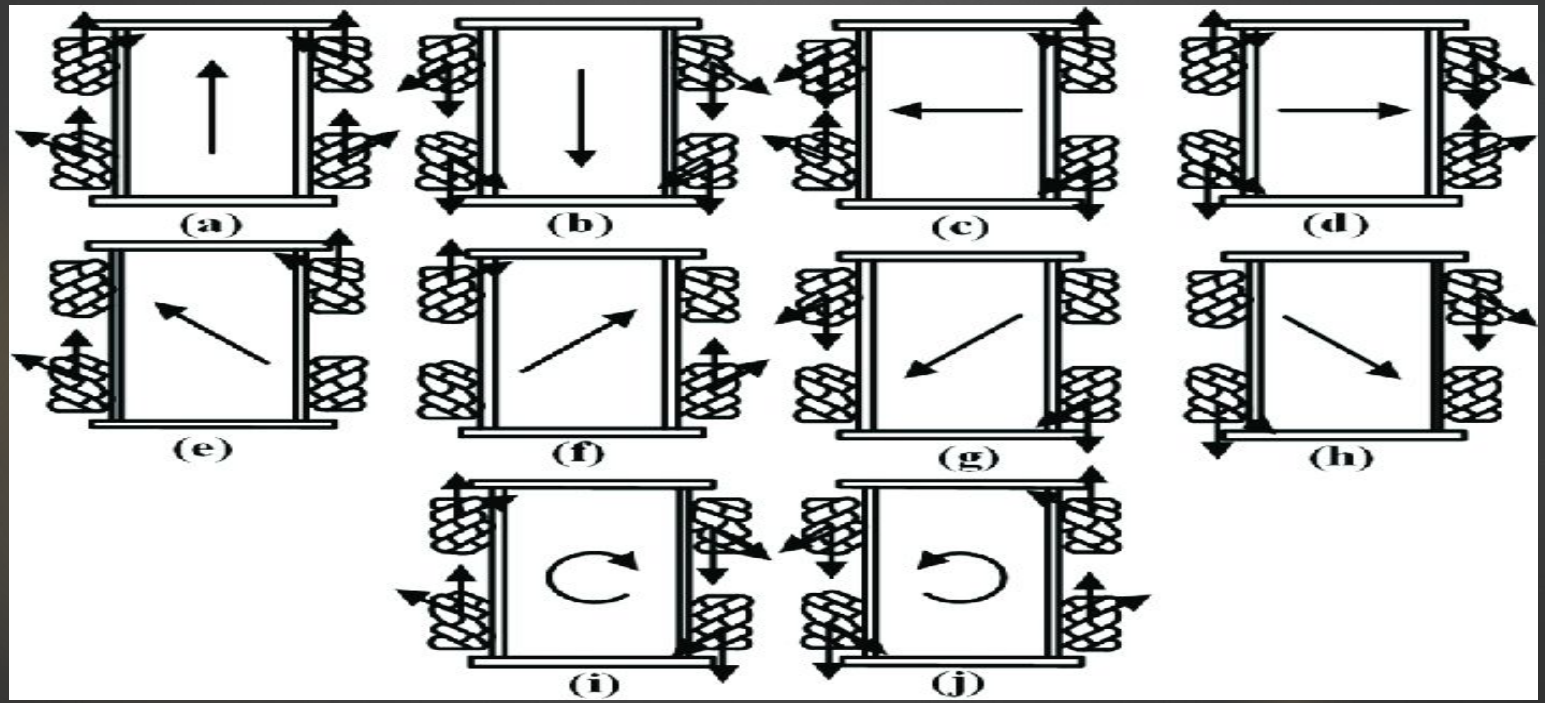
	Dimensions (mm)	Holding Torque upto (Nm)	
NEMA 8	20	0.03	Lower
NEMA 11	28	0.12	Compatible
NEMA 14	**35/39**	**0.28**	**Compatible**
NEMA 17	**42**	**0.8**	**Compatible**
NEMA 23	57/60	3.2	Higher
NEMA 34	86	12	Higher
NEMA 42	110	30	Higher

All components

- 4 Mecanum wheels
- 4 Stepper motors
- 4 DRV8825 motor drivers
- Arduino UNO
- Bluetooth module HC-05 : car is controlled by an app via bluetooth
- 12V battery
- Toycar chassis

Design & Results

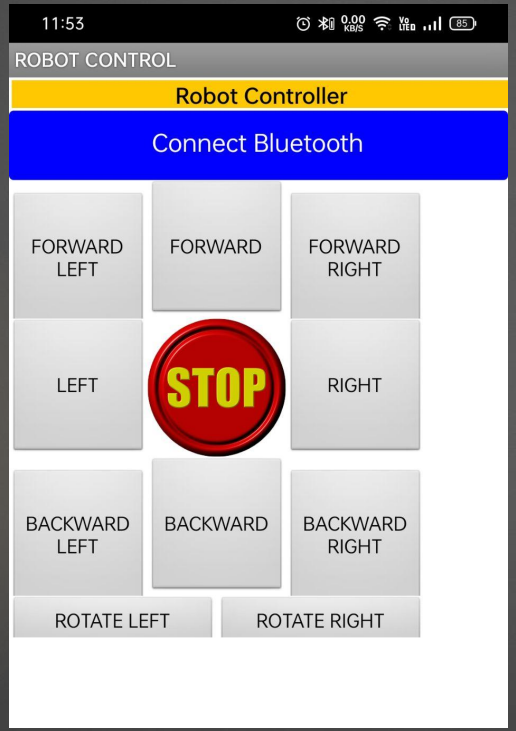
Schematic Diagram



Arduino Code

```
AF_DCMotor motor1(1); //Front Left Wheel
AF_DCMotor motor2(2); //Back Left Wheel
AF_DCMotor motor3(3); //Front Right Wheel
AF_DCMotor motor4(4); //Back Right Wheel

String readString;

void setup() {
  Serial.begin(9600);
  motor1.setSpeed(250);    //Set Motor Speed
  motor2.setSpeed(250);
  motor3.setSpeed(250);
  motor4.setSpeed(250);
}

void loop() {
  while(Serial.available()){
    delay(50);
    char c=Serial.read();
    readString+=c;
  }
  if(readString.length()>0){
    Serial.println(readString);
    if (readString =="FORWARD"){       // MOVE
      motor1.run (FORWARD);
      motor2.run (FORWARD);
      motor3.run (FORWARD);
      motor4.run (FORWARD);
    }
    if (readString =="BACKWARD"){      // MOVE BACKWARD
      motor1.run (BACKWARD);
      motor2.run (BACKWARD);
      motor3.run (BACKWARD);
      motor4.run (BACKWARD);
    }
    if (readString =="LEFT"){      // MOVE LEFT SIDE
      motor1.run (FORWARD);
      motor2.run (BACKWARD);
      motor3.run (FORWARD);
      motor4.run (BACKWARD);
    }
    if (readString =="RIGHT"){      // MOVE RIGHT SIDE
      motor1.run (BACKWARD);
      motor2.run (FORWARD);
      motor3.run (BACKWARD);
      motor4.run (FORWARD);
    }
    if (readString =="FORWARDLEFT"){      // MOVE FORWARD LEFT
      motor1.run (FORWARD);
      motor2.run (RELEASE);
      motor3.run (FORWARD);
      motor4.run (RELEASE);
    }
    if (readString =="FORWARDRIGHT"){      // MOVE FORWARD RIGHT
      motor1.run (RELEASE);
      motor2.run (FORWARD);
      motor3.run (RELEASE);
      motor4.run (FORWARD);
    }
    if (readString =="BACKWARDLEFT"){      // MOVE BACKWARD LEFT
      motor1.run (RELEASE);
      motor2.run (BACKWARD);
      motor3.run (RELEASE);
      motor4.run (BACKWARD);
    }
    if (readString =="BACKWARDRIGHT"){      // MOVE BACKWARD RIGHT
      motor1.run (BACKWARD);
      motor2.run (RELEASE);
      motor3.run (BACKWARD);
      motor4.run (RELEASE);
    }
    if (readString =="ROTATELEFT"){      // ROTATE LEFT SIDE
      motor1.run (BACKWARD);
      motor2.run (FORWARD);
      motor3.run (FORWARD);
      motor4.run (BACKWARD);
    }
    if (readString =="ROTATERIGHT"){      // ROTATE RIGHT SIDE
      motor1.run (FORWARD);
      motor2.run (BACKWARD);
      motor3.run (BACKWARD);
      motor4.run (FORWARD);
    }
    if (readString =="STOP"){      // STOP
      motor1.run (RELEASE);
      motor2.run (RELEASE);
      motor3.run (RELEASE);
      motor4.run (RELEASE);
    }

    readString="";
  }
}
```

Bluetooth app Interface



Improvements

Because of unavailability, we replaced stepper motors with PMDC motors which are seen in toy cars. Main advantage of using PMDC is that we can control all four motors with a single motor driver (we used L293D motor driver shield), require less power than stepper motors and still gives enough torque.

Since, PMDC uses only less power we could replace 12V with 9V as input voltage.