Project Report
EEE-2422
Electrical Drives and Instrumentation Lab

Name of the Project :

Robot “TARS”

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Motivation : Interstellar is recognised as the most perfect science fiction movie of all times. The movie introduced us to some marvelous technologies. It introduced us to two smart AI robots. TARS and CASE. Both of them were so smart and looked similar. There was a space shuttle called “The Endurance”. The robots were programmed in a way that they could control the space shuttle from the user’s voice or key command. The robots were so advanced that they were able to conduct work not only inside the shuttle but also out of the shuttle. It is developed based on advanced Artificial Intelligence algorithms and Internet of Things. And of course it is a science fiction movie. But our team was highly inspired to create something like that. So we picked up its 2 core features. TARS and CASE were able to move. Also we’ve seen in the “Miller's Planet” TARS picked up Dr. Brandt on its arm. So firstly it can Move and it also can pick things. We also worked to develop these two features.

Features : We developed an android and IOS controlled robot called **TARS** that is able to move through wheels and pick some small objects weighted 13-20 gm.

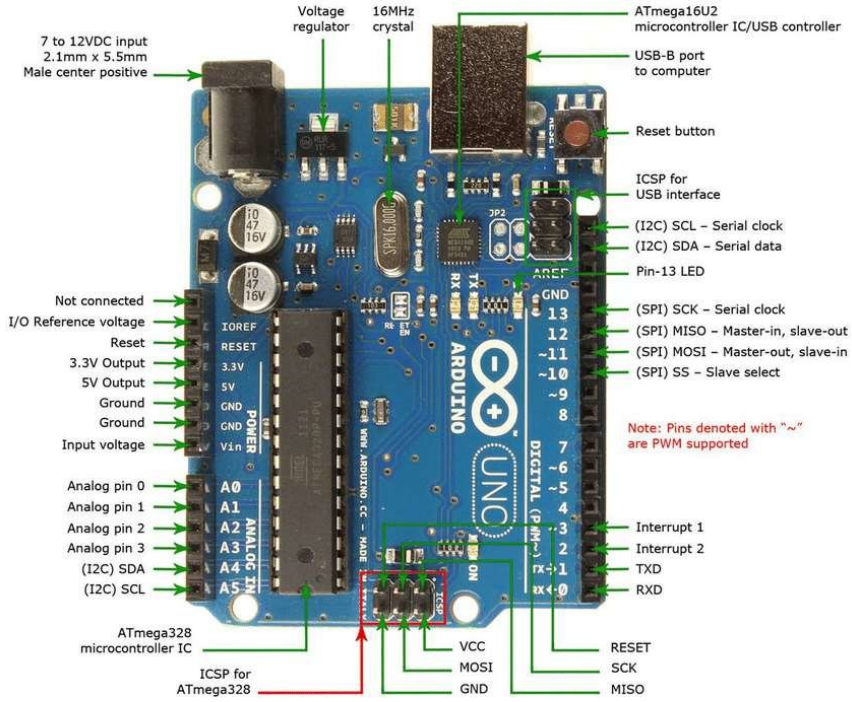
Limitations : The structure of the arm is built with some ice-cream sticks. These are very vulnerable. They are not able to lift heavy weighted objects. On the other hand the servo motor that we have used is also the minimal. It is built in a way to lift not more than 13 grams of weights. Also the outlook of the **TARS** robot is not as fancy as we expected. But it works precisely.

Equipments :

Equipments	Unit Price	Pcs	Cost
Arduino Uno R3	900	1	900
DC Motor	90	2	180
Wheel	100	2	200
Rotator Wheel	50	1	50
L298 motor Driver	180	1	180
Buzzer	20	1	20
Lithium Battery 3.7	100	4	400
Battery Case X 4	80	1	80

HC05 Bluetooth Module	320	1	320
Jumper Wire	2		100
BreadBoard	80	1	80
Servo Motor	130	2	260
Power Bank	—	—	—
Android or IOS Device	—	—	—
Total	—	—	2770

Arduino Uno R3 :



Arduino has a lot of pins for various purposes. It has basically 2 types of pins which are used mostly for I/O (input and output). The description of the pins are given below. Arduino has a capability to be operated from 5V to 20V. Recommended is to use inside 7V to 20V. Arduino uno board has one serial port at digital pins 0(RX) and 1(TX) to communicate with other external serial devices such as computers through USB cable. Pulse Width Modulation (PWM) is a method in which the width of a pulse is varied while keeping the frequency of the wave constant. It is a method for generating an analog signal using a digital source. It has an LED Pin at number 13.

L298 Motor Driver : A DC motor has two terminals positive and negative. But it cannot take any digital input signal or generate any output signal. To convert into the digital Signal we use the motor drivers. It has 4 output and 4 input pins. These are marked as Out1, Out2, Out3, Out4 and In1, In2, In3, In4. The signal is passed into the In1-4 pins from the arduino boards then the signal works for the Out1-4 according to the pin numbers. The Out1, Out2 refers to the left side Motor. Then the Out3, Out4 refers to the right motor. Same goes for the In1,2,3,4.

In1/In3	In2/In4	Output
0	0	Stop
1	1	Stop
1	0	Clockwise
0	1	Anti Clockwise

HC05 Bluetooth Modules : To interact between the Android / IOS devices and the robot is conducted through the Bluetooth modules. To use it we must know how it works. There are six pins in the bluetooth module. We would mainly use 4 of them. Two of them are VCC and GND. VCC is for voltage source. The Bluetooth module uses 3.3 volt from the Arduino 3.3 V pins. The GND is referred to the ground or the negative terminal. Then the most important two pins are TX and RX. TX is known as a Transmit Pin or the pin that sends serial data. RX is known as the receiver that receives serial data. As we send data from the Arduino to Bluetooth so Arduino's TX will be connected to Bluetooth's RX and Arduino's RX will be connected to Bluetooth's TX. That's how it could transmit and receive data from the bluetooth and the arduino. The Bluetooth module will be connected through the mobile bluetooth module when we operate the operation.

Servo Motor : Servo motor is a special kind of motor that could be programmed using an arduino based upon our requirements. We can control its angular movement using its angular values. Servo motor has 3 pins. VCC that takes 5 volts as inputs, GND that is a ground pin that uses the negative terminals. The signal pins. The signal pin should be connected to an arduino PWM pin. PWM (Pulse Width Modulation) Pulse-width modulation, or pulse-duration modulation, is a method of reducing the average power delivered by an electrical signal, by effectively chopping it up into discrete parts. Using the PWM pin we can control its angles we desire. The PWM pins in the Digital pins serial are marked using ~ mark.

Methodology : We have divided the methodology in 4 steps.

i. Circuit and Model Design
ii. Connections
iii. Apps Decode
iv. Coding
v. Testing

i. Circuit and Model Design : It is also divided into two parts.

a. Circuit Diagrams :

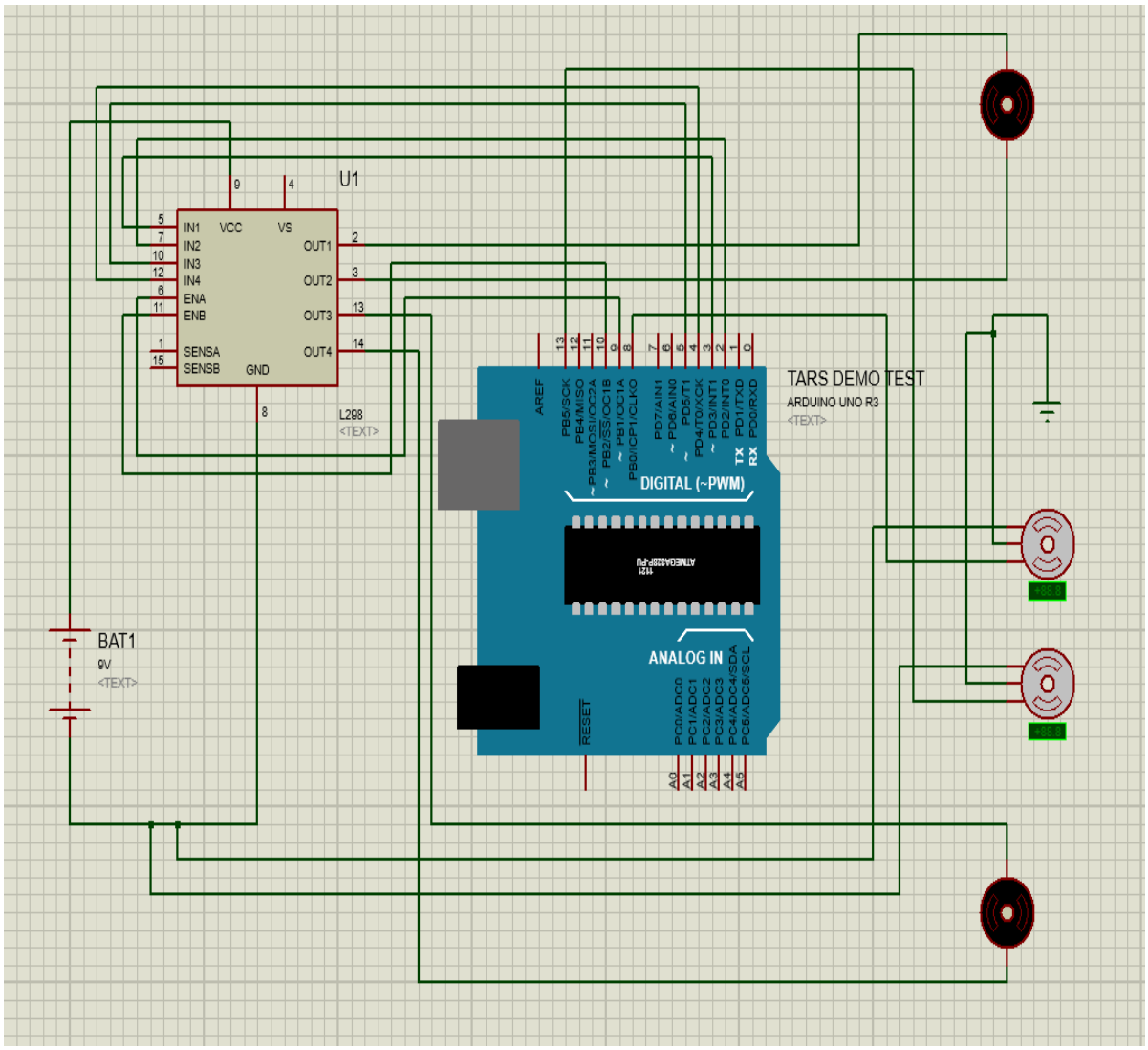
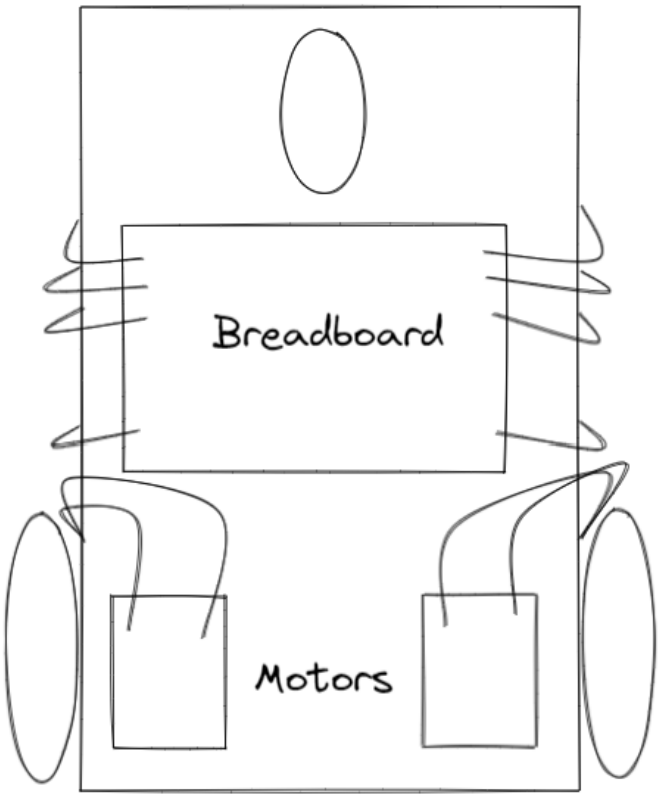
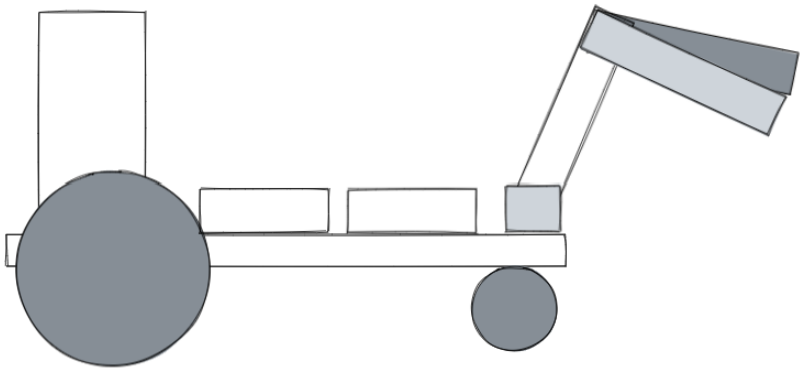


Fig : TARS Demo Circuit

b. Model Design :



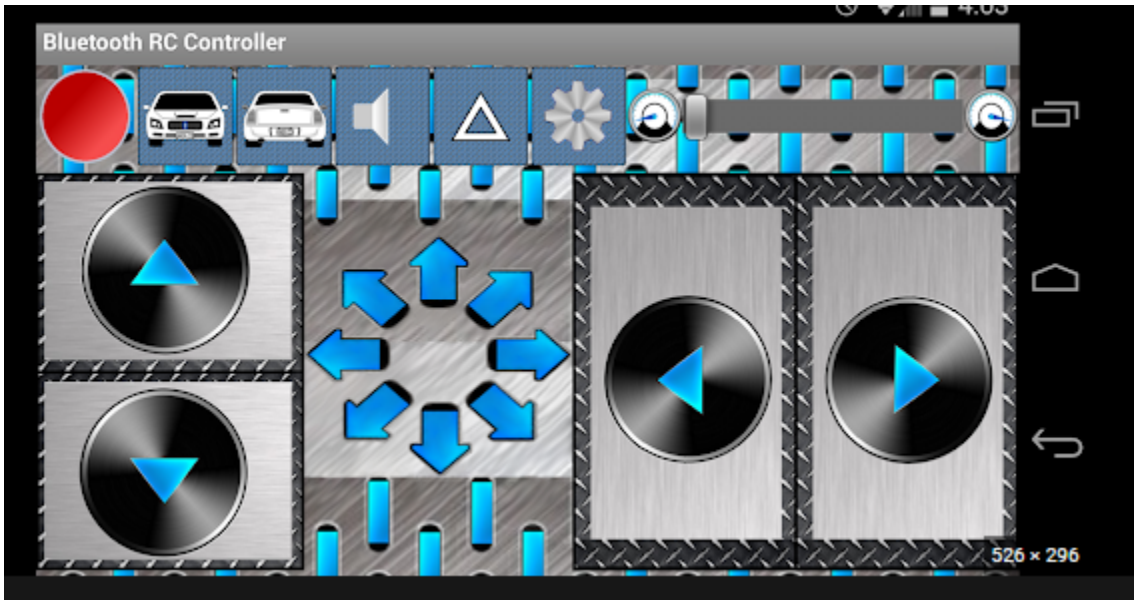
Bottom Views



Side Views

ii. Connections : Firstly we connect the battery holder with the L298 driver. It needs 12 volts so we are using 4 3.7 volts battery. Then from the power of L298 one connection moves to a breadboards positive and another one to the negative terminal. From the series connection these are connected to arduino vin and gnd. Then we took input 1 and 2 to the arduino's 2nd and 4th digital pins. Took the input 3 and 4 to the arduino's 12th and 7th digital pins. The motors from two sides go to the output 1 to 4. The bluetooth module took power and ground from the arduino. The Servo motors took the power from the battery +, - from the breadboard. The Lower Servo motor's signal pin is connected to the arduino's 5th pin which is a PWM pin. The second upper servo motor is connected to the 10th pin which is also a PWM pin.

iii. Apps Decode : As we planned to control the **TARS** through mobile phones. We needed some specific applications. Though we could develop the apps it would have taken some time. But there are some apps built in. We will use Bluetooth RC Controller apps found in Play store. But we need to decode these apps first.



Using Arduino's RX to HC05's Rx and Arduino's TX to HC05's TX we could use the serial monitor and decode which button does what. Now I am able to decode the apps. Suppose if I press the up arrow in the screen it will send a data **F**. if I press the down arrow it will send a data **B.** Using this method we will decode all the buttons we are going to use. Then we assigned the decoded data in our code.

iv. Coding :

```
#define MotorRight1 7
#define MotorRight2 12
#define MotorLeft1 2
#define MotorLeft2 4
//#define MotorRightSpeed 9
//#define MotorLeftSpeed 10

#include <Servo.h>
Servo CraneWars1;
Servo CraneWars2;
//int Speed = 150;
char command;
void setup()
{
  // put your setup code here, to run once:
  pinMode(MotorLeft1, OUTPUT);
  pinMode(MotorLeft2, OUTPUT);
  pinMode(MotorRight1, OUTPUT);
  pinMode(MotorRight2, OUTPUT);
//  pinMode(MotorRightSpeed, OUTPUT);
//  pinMode(MotorLeftSpeed, OUTPUT);
  Serial.begin(9600);
  CraneWars1.attach(5);
  CraneWars2.attach(10);
  CraneWars1.write(-20);
  CraneWars2.write(-100);
}

void loop()
{
  if(Serial.available())
  {
    command = Serial.read();
  }
  //analogWrite(MotorRightSpeed, Speed);
  //analogWrite(MotorLeftSpeed, Speed);
  if(command == 'S')
  {
    Stop();
  }
  if(command == 'F')
  {
    Forward();
  }
  if(command == 'B')
  {
    Backward();
```

```
  }
  if(command == 'L')
  {
    Right();
  }
  if(command == 'R')
  {
    Left();
  }
  if(command == 'X') //Angle button on
  {
    CraneWars1.write(63);
    delay(500);
  }
  if(command == 'x') //Angle button off
  {
    CraneWars1.write(-40);
    delay(500);
  }
  if(command == 'U')
  {
    CraneWars2.write(18);
    delay(500);
  }
  if(command == 'u')
  {
    CraneWars2.write(-100);
    delay(500);
  }
}

void Forward()
{
  digitalWrite(MotorRight1, HIGH);
  digitalWrite(MotorRight2, LOW);
  digitalWrite(MotorLeft1, HIGH);
  digitalWrite(MotorLeft2, LOW);
}

void Backward()
{
  digitalWrite(MotorRight1, LOW);
  digitalWrite(MotorRight2, HIGH);
  digitalWrite(MotorLeft1, LOW);
  digitalWrite(MotorLeft2, HIGH);
}

void Stop()
{
```

```
  digitalWrite(MotorRight1, LOW);
  digitalWrite(MotorRight2, LOW);
  digitalWrite(MotorLeft1, LOW);
  digitalWrite(MotorLeft2, LOW);
}

void Right()
{
  digitalWrite(MotorRight1, HIGH);
  digitalWrite(MotorRight2, LOW);
  digitalWrite(MotorLeft1, LOW);
  //digitalWrite(MotorLeft2, LOW);
  digitalWrite(MotorLeft2, HIGH);
}

void Left()
{
  digitalWrite(MotorRight1, LOW);
  //digitalWrite(MotorRight2, LOW);
  digitalWrite(MotorRight2, HIGH);
  digitalWrite(MotorLeft1, HIGH);
  digitalWrite(MotorLeft2, LOW);
}
```

v. Testing : A Video link of successful testing the file is given. https://drive.google.com/drive/folders/1JDNoBdx-yoyVe5LfYNI-7h4i_33XfO9e?usp=share_link

Future Scopes : As defined in the motivation part, It is inspired from Interstellar TARS. TARS had a lot of features rather than move and pick. Our dream is to provide more features as TARS had. Like capability to examine the environment, Controlling some smart devices, Connecting TARS to the Internet (IOT) using raspberry pi. Adding some high caliber cameras and sensors. We could even add a feature like a drone that could make it fly.

Social Impacts and Discussion : Our TARS is one kind of inspirational robot. It is built in a way that is more visible to people and inspires them as a small device is moving and conducting some pick up work controlled via a mobile phone. It could be used to pick up some small objects from one place to another. Idle people could use this feature. Moreover we expect that we must make it useful in some research field while we add some AI and ML algorithms. We are also eager to use raspberry pi with IOT devices so that it makes a great impact in advanced research specially to space.

Thank You