Smartphone Controlled Mobile Robot

*Note: This is Documentation for a Project ICS

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***Abstract*—Mobile robots have increasing impact on our daily life. Not just to the bigger tasks but also to the common daily activities they can be deployed. With the robots capable of assisting basic household activities, mobile robots can also assist human tasks on factory floors, in distribution centers, along electric transmission lines, and in hospitals, shopping centers, and airports. Such devices could have broader scope with better usability and convenience if they could simply be controlled by smartphone. A control application can wirelessly handle the maneuver and further movement of robot within the range of connectivity. This paper presents the establishment of an effective communication protocol between the control application and robot. Path detection and task accomplishment is optimized based on the environmental data analysis.**

I. Introduction

Mobile robots make their movement based on the set of instruction given to it and the environmental circumstances around it. Many complex robotic systems are developed over the time for Human-risking tasks and based on their system components and complexity, they have been quite expensive for large number of people who may be willing it to have for common household tasks within the smaller control range with better affordability and simplicity.

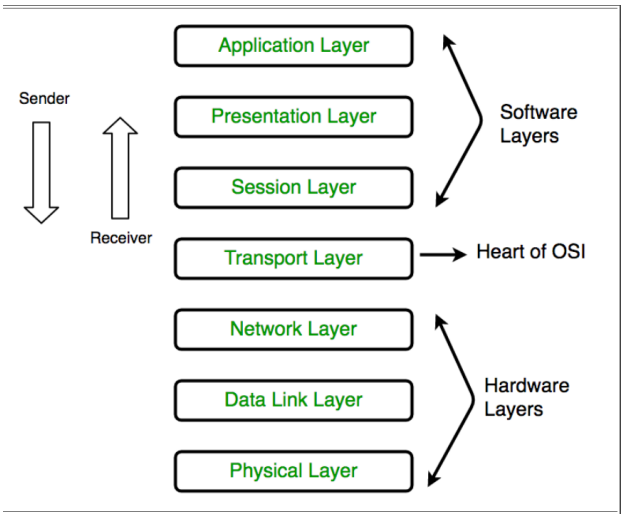
The concept of this mobile robot is risen to be realized by utilizing the most used piece of technology today: Smartphone. An application on Smartphone is considered which can simply control the direction and movement of the robot. The robotic device has a Bluetooth module embedded in it's micro-controller That can establish a stable connection under standard networking layer and communication protocol. The project has specifically focused on efficient operation of robot under wireless communication via. Bluetooth. Our team believes that the robot will bring phenomenal breakthrough on handling daily tasks as the system is considering least possible weight of the body and other mechanical parts. And so reducing the cost. The circuit and entire system is designed in a best suited way for better performance and less power consumption.

The device can assist to the tasks like cleaning, gardening, lifting loads to some distance under specified constraints. Motor wheels are the key mechanical parts for Locomotion. The device can change the direction as per the command transmitted via Bluetooth connection. In this paper, system architecture, communication and networking is presented on the following 1st section. In the next section it is well described on the implementation with the Arduino code and the simulation is performed on Matlab.

II. System Architecture and Communication

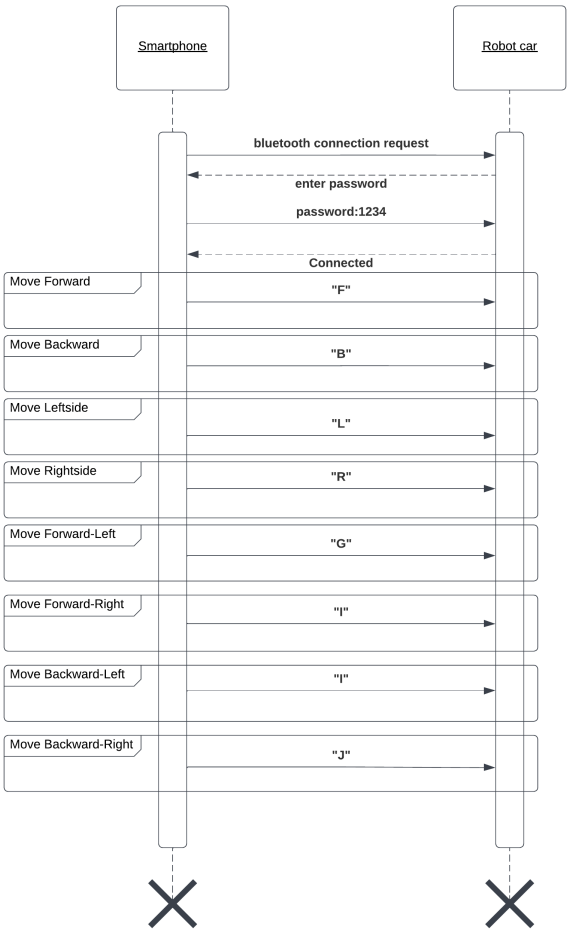
A. *Architecture of networking between devices*

As computer networks advanced, a need to frame rules for networks arose. Therefore, International Standard Organization (ISO) formed a subcommittee for " Open System Interconnection" (ISO /TC97/SC16) in 1977. The purpose of the OSI model is for open communication between different systems without requiring changes to the logic of the underlying hardware and software [4]. The OSI model is not a protocol, it is a model for understanding and designing a network architecture that is flexible, robust, and interoperable [5]. It is composed of seven layers. In other words, OSI is a set of guidelines for interoperability between products and software.



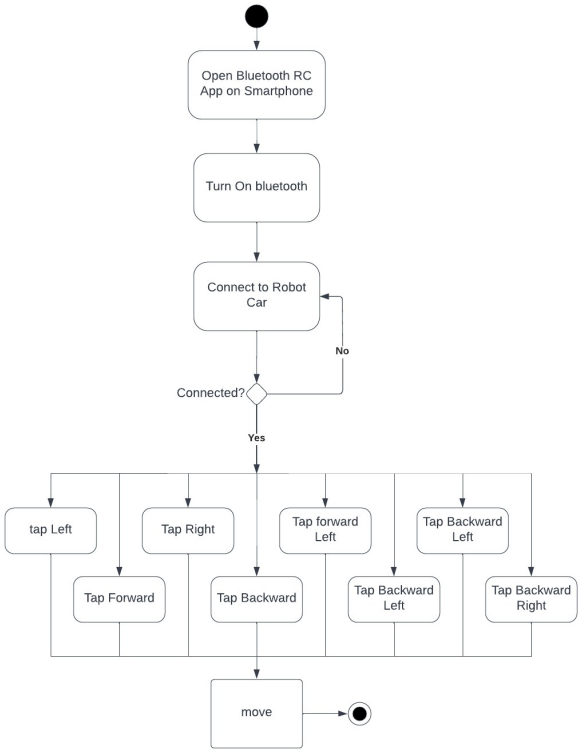
1. OSI architecture [1]

The application layer, Presentation layer, and Session layer constitute the Software layer or upper layer. The application layer allows access to network resources. The presentation layer is used to translate, encrypt, and compress data. The session layer establishes, manages, and terminates the sessions. The transport layer is called the heart of OSI. The transport layer provides a reliable process to give message and error delivery. The network layer, Data link layer, and physical layer constitute the hardware layers or lower layers. The network layer is used to move packets from source to destination and provides internet working. The data link layer organizes bits into frames. Lastly, the Physical layer transmits bits over a medium. It also provides mechanical and electrical specifications.



2. Sequence Diagram

This is the OSI architecture which states how data is communicated between two communicating devices. In our project, this basic architecture can be used to understand how a car can be controlled using a smartphone via Bluetooth. Let's see how the smartphone can interact with a car using Bluetooth. The application layer will establish a connection between a smartphone and a car. The presentation layer will encrypt the data or instructions to be sent to the car. The session layer will establish a session to communicate. The transport layer will deliver the message from smartphone to car. The network layer will deliver the message in bits from smartphone to car. Datalink converts the message in bits to frames. The physical layer will transmit this data or message over a medium like Bluetooth technology. This is how the sender communicates with the receiver. Similarly, the receiver can also communicate exactly in the opposite way starting from the physical layer to the application layer.



3. Activity Diagram

*B. **Bluetooth technology***

Bluetooth is a wireless technology which is used for communication over short distances.one device creates a fixed personal are network(PAN). Telekom Vendor Ericsson created this in 1994. It was planned to be a wireless to RS-32 data cables. Bluetooth overcomes synchronization because it has several devices at a time.

Range of Operation:
Normally , Range of Bluetooth technology is 2400-2483.5MHz. Globally accepted short-range frequency band of bluetooth 2.4GHz.Bluetooth uses the radio technology named frequency-hopping spread spectrum. the data transfer is done using packet system. at first data is divided into packages , and after that packages are transmitted. there are 79 transmission channel in blietooth. each channel 1MHz bandwith. The first channel continues to 2480MHz starting from 2403 MHz with 1MHz increments. 1600 Hops per second are performed by bluetooth, with adapting frequency(AEH) enabled.

Communication:
in piconet which is a specialized computer network of bluetooth technology, a bluetooth device can communicate with 7 devices at a time. the devices can swith activities according to agreements. for example, another device can be the master device. for example, a bluetooth device started connection with the smartphone as a master, because connection is initiated by it. but it can decide to be the subordinate device.For the connection, bluetooth core provides two or more piconet to form a scattered, in which deevices play the main role in one piconet simultaneously and the subordinate role in another.

Data Transmission:
At any given time, data can be transferred between master and an other connected bluetooth device.with whom to transfer data is chosen by the master.Normally, it switches from one devices to other. There are several USB Bluetooth adapters or "dongles" available, some include an IrDA adapter. there is limited capacities in older bluetooth dongles.they offer less powerful radio and range is also so less(maximum 100 m). Modern adapters give services which was unimaginable in old adapters.

Bluetooth Uses:
Bluetooth is a protocol which is designed to work in low power for a short range data transfer using radio wave. there is low cost transmitter receiver in each devices.Because, the connection is wireless, both device must not stay on same place, they can communicate keeping certain distance between them

III. Implementation

Our motive is to control the movement of a robot car with smartphone using bluetooth technology.

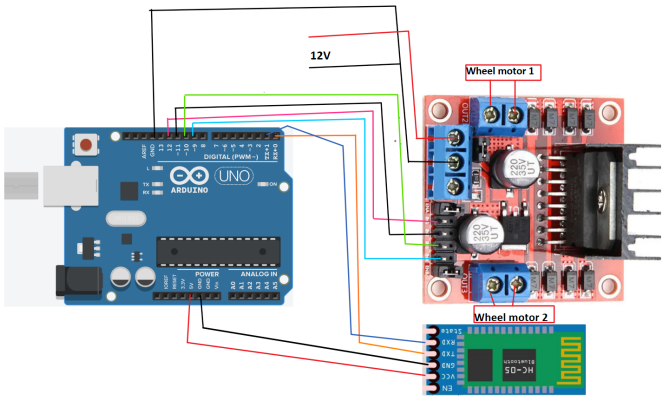
Let's begin:

Hardware requirements:
(1) A Arduino Uno R3 & A cable for Arduino UNO
(2) DC 3-6V BO Gear motor with plastic tire wheel
(3) HC 05 Bluetooth wireless UART module
(4) L298N motor driver Module for Arduino
(5) 12V dc battery

Software Requirement:
(1) Bluetooth RC car app
(2) Arduino Programme

A. *Circuit Design*

At first connect all the components with cables below:



4. Circuit [2]

We will use three 4v dc batteries on serial connection to supply 12V as a power source to the Arduino.
Now, Let's upload the code written below to the Arduino microcontroller using Arduino UNO IDE.

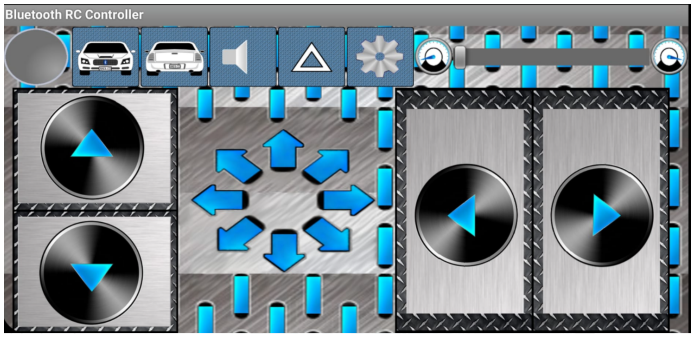
B. *Arduino Code*

```
// Starting of Program
#include <SoftwareSerial.h>

SoftwareSerial MyBlue(0, 1); // RX | TX

// Starting of Program
int m1a = 12;
int m1b = 11;
int m2a = 10;
int m2b = 9;
char val;

void setup()
{
 Serial.begin(9600);
 MyBlue.begin(9600);
  pinMode(m1a, OUTPUT);
// Digital pin 12 set as output Pin
  pinMode(m1b, OUTPUT);
// Digital pin 11 set as output Pin
  pinMode(m2a, OUTPUT);
// Digital pin 10 set as output Pin
  pinMode(m2b, OUTPUT);
// Digital pin 9 set as output Pin
  Serial.println("Ready to connect\nDefualt passwo
}

void loop()
{

   while (MyBlue.available())
```

```
 {
  val = MyBlue.read();
 Serial.println(val);
          }

if ( val == 'F') // Forward
{
  digitalWrite(m1a, LOW);
  digitalWrite(m1b, HIGH);
  digitalWrite(m2a, LOW);
  digitalWrite(m2b, HIGH);
     }
else if (val == 'B') // Backward
{


  digitalWrite(m1a, HIGH);
  digitalWrite(m1b, LOW);
  digitalWrite(m2a, HIGH);
  digitalWrite(m2b, LOW);
}

else if (val == 'R') //Right
{
  digitalWrite(m1a, LOW);
  digitalWrite(m1b, LOW);
  digitalWrite(m2a, LOW);
  digitalWrite(m2b, HIGH);
}
else if (val == 'L') //Left
{
  digitalWrite(m1a, LOW);
  digitalWrite(m1b, HIGH);
  digitalWrite(m2a, LOW);
  digitalWrite(m2b, LOW);
}

else if (val == 'S') //Stop
{
  digitalWrite(m1a, LOW);
  digitalWrite(m1b, LOW);
  digitalWrite(m2a, LOW);
  digitalWrite(m2b, LOW);
}
else if (val == 'I') //Forward Right
{
  digitalWrite(m1a, LOW);
  digitalWrite(m1b, LOW);
  digitalWrite(m2a, LOW);
  digitalWrite(m2b, HIGH);
}
else if (val == 'J') //Backward Right
{
  digitalWrite(m1a, LOW);
  digitalWrite(m1b, LOW);
  digitalWrite(m2a, HIGH);
  digitalWrite(m2b, LOW);
  }
  else if (val == 'G') //Forward Left
  {
  digitalWrite(m1a, LOW);
  digitalWrite(m1b, HIGH);
  digitalWrite(m2a, LOW);
  digitalWrite(m2b, LOW);
  }
  else if (val == 'H') //Backward Left
  {
  digitalWrite(m1a, HIGH);
  digitalWrite(m1b, LOW);
  digitalWrite(m2a, LOW);
  digitalWrite(m2b, LOW);
  }
}
```

We can Install a mobile app to control the movement of the robot via Bluetooth to our android smartphone . The app can be downloaded from here:
Click here to download the apk file

The interface of the app will be as below:



[3]Bluetooth RC car app interface

Now, We're done!! Just run the app , turn on the bluetooth, connect with the robot as normal Bluetooth connection and enjoy!!

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