ELECTROMAGNETIC PULSE CAR

by K. Abishek

Submission date: 22-May-2020 12:19PM (UTC+0530)
Submission ID: 1329683025
File name: 1NH18EE719.pdf (616.82K)
Word count: 2429
Character count: 12245

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

MINI PROJECT

ELECTROMAGNETIC PULSE CAR

GROUP MENTOR

Mr. VINOD KUMAR S

SUBMITTED BY

K. ABISHEK - 1NH18EE719

K. AJAY – 1NH18EE720

SANDESH VANTAGODI – 1NH19EE409

INTRODUCTION

The purpose of EMP is to interfere/destroy electronic equipment. the project has mostly military/defense applications. Currently only our military communications infrastructure is protected from an EMP.

This leaves all other civilian infrastructure vulnerable, including cell phones, television, radio, and others. With additional research in the EMP, we will know better how to protect ourselves form foreign enemies employing such attacks against us. While at the same time, develop better weapons of this kind to maintain superiority.

The project has a lot of limitations , for starters we cannot generate strong electromagnetic pulses as that would require very high voltage which is dangerous and hard to generate on top of a Bluetooth controlled car and not to mention the stronger the electromagnetic pulse the easier it is for the EMP to destroy the microcontroller or the circuits used in the project. The other limitations include cost risk of damaging nearby electronics and the size of the project (Bluetooth controlled car) and the battery. The range of the emp is relatively small.

This EMP generator will be designed to release an electromagnetic pulse. The purpose of the said pulse is to induce a potential, or voltage, that heats up semiconductor material so quickly that it changes the crystal lattice structure of the material and thereby electrically destroying it. Such a pulse generator can have good military applications. Since this is a mini project, the generator will be scaled down just enough to demonstrate the principle behind an EMP. The purpose of using the Bluetooth controlled car is to provide mobility for the electromagnetic pulse generator.

LIST OF COMPONENTS

1. 3/8" Acrylic sheet (for main chassis)
2. Adafruit Motor driver shield
3. Arduino Mega 2560
4. HC-06 Bluetooth receiver
5. Gear Motors (4)
6. Wheels (4)
7. Machine screws (12-16)
8. 12V, 1.1 Amp Lithium-Polymer rechargeable battery
9. Smart phone (app)
10. Relay driver circuit
11. DC-DC CV CC Step Down Module
12. High voltage generator
13. Coil
14. Green LED
15. 1KΩ Resistors (2)
16. 25V, 220µF capacitors (2)
17. BC547/548 NPN Transistor
18. 12V Relay

BLOCK DIAGRAM

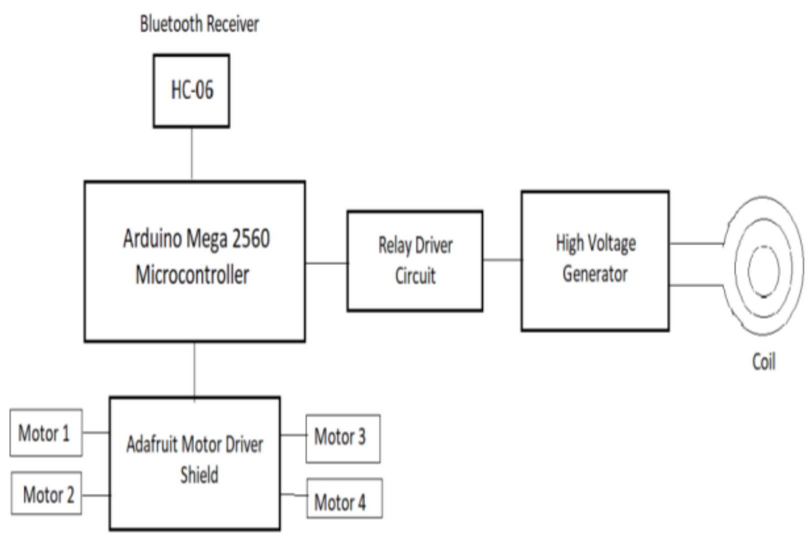

Fig.1: Block diagram of the project

WORKING

The project can be divided into two main parts

A) The Bluetooth controlled car

B) The electromagnetic pulse generator

The Electromagnetic Pulse Generator

The Arduino receives the command "X" from the Bluetooth RC controller app which then turns the 46th digital i/o pin of the Arduino high which then connected to the relay driver circuit which in turn provides power to the DC-DC cv cc step down module/ Buck converter through which we can control the power to the High voltage generator then the arc gap decides the charging/ discharging rate of the capacitor in the high voltage generator, the coil then creates the electromagnetic pulses from the high voltage passing through it.

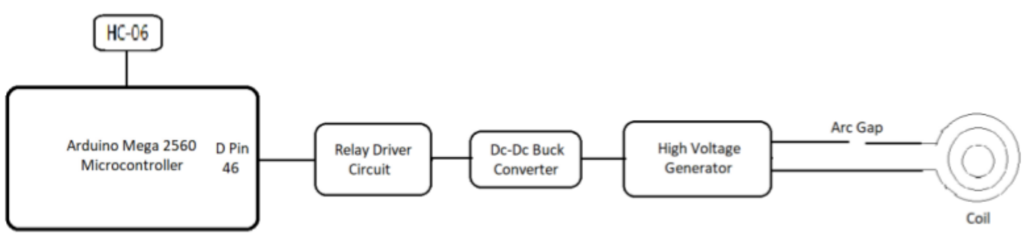

Fig.2: Block diagram of EMP generator

The EMP Generator can be divided into

1) The Arduino and the Bluetooth receiver
2) The relay driver circuit
3) DC-DC cv cc step down module/buck converter
4) The high voltage generator
5) The arc gap and the coil

The Arduino and the Bluetooth receiver

First, turn on the Bluetooth in your smartphone, pair with the Bluetooth receiver HC-06, the password is usually '1234' or '0000'. After successfully connecting with the Bluetooth module, if we click on the Delta option ,the app sends the command "X" (through the Bluetooth RC controller application) to the Bluetooth receiver HC-06 which then sends the data to the Arduino microcontroller which then interprets these commands and then turns the 46th digital i/o pin of the microcontroller.

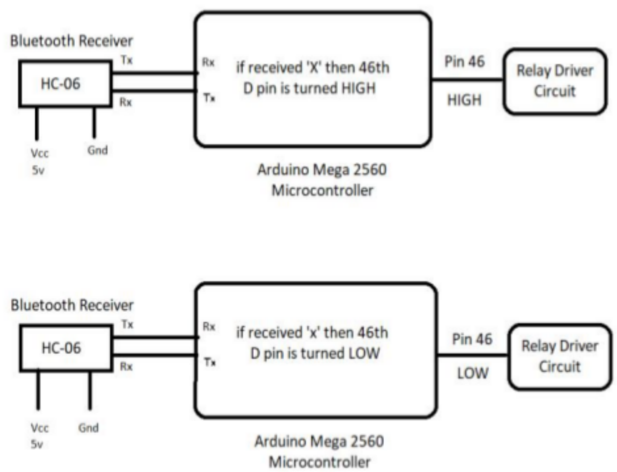

Fig.3: Block diagram for Arduino and Bluetooth receiver

If we click on the Delta option again the app sends the command "X" is received then the Arduino turns the 46th digital i/o pin low.

NOTE: The commands are case sensitive.

The Relay Driver Circuit

One of the serious problems in relay operated circuits is the relay clicking or chattering during the on/off of the relay driver transistor. This problem is very severe if the input circuit is fluctuating or has a limited current output (like the Arduino). During the transition of signal levels, the relay clicks which may cause sparking of contacts. This problem can be avoided.

Below is the circuit or a relay driver using the NPN transistor BC 548 (but most of the NPN transistor will work). The relay is connected between the positive rail and the collector of the transistor. When the input signal passes through the 1K resistor to the base of the transistor, it conducts and pulls the relay. By adding a 470µF electrolytic capacitor at the base of the relay driver transistor, a short lag can be induced so that the transistor switches on only if the input signal is persisting. Again, even if the input signal ceases, the transistor remains conducting till the capacitor discharges completely. This avoids relay clicking and offers clean switching of the relay.

The relay is connected to the DC-DC cv cc step down module/buck converter.

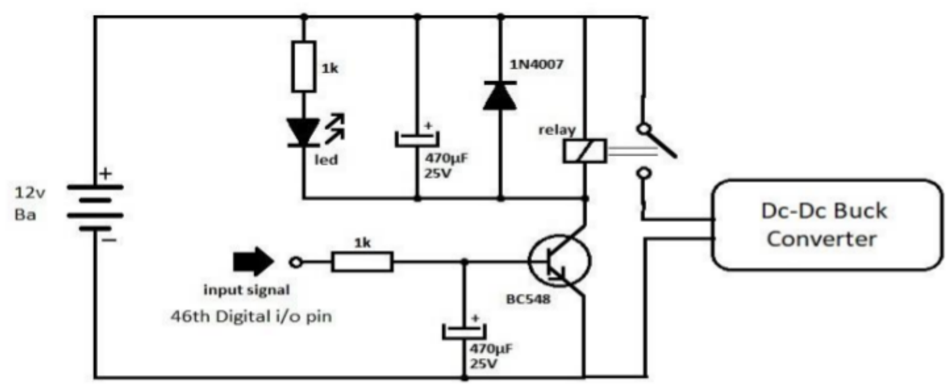

Fig.4: circuit for relay driver circuit

DC-DC CV CC Step Down Module/Buck Converter

For the project we are going to use XL4015 Step-Down DC Module with CV/CC Control.

The purpose of using XL4015 Step-Down DC Module is to be able to control the voltage and current going to the high voltage generator this in-turn helps us control the high voltage produced and since **the effective range of the emp is directly proportional to the voltage going through the coil and the coil itself.**

Therefore, by controlling the voltage we can control the range of the emp.

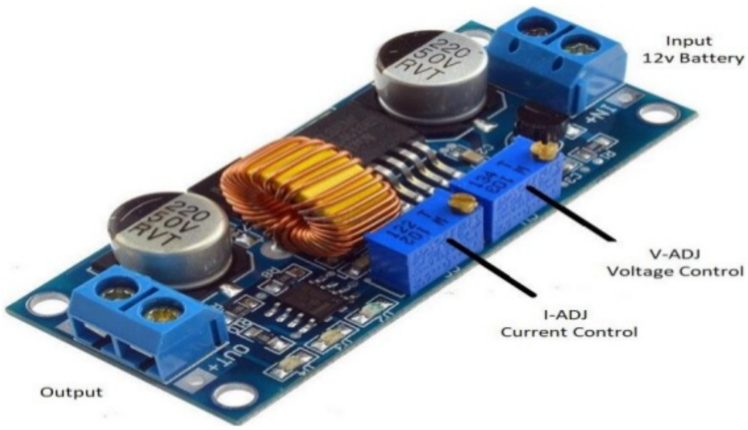

Fig.5: Buck Converter

Slowly turning the voltage adjustment (V-ADJ) trim-pot clockwise will raise the output voltage gradually, and a counterclockwise rotation will lower it. Likewise, clockwise turning of the current adjustment (I-ADJ) trim-pot increases the current limit while counterclockwise direction action decreases the current limit.

The output of the step-down module is connected to the high voltage generator.

The High Voltage Generator

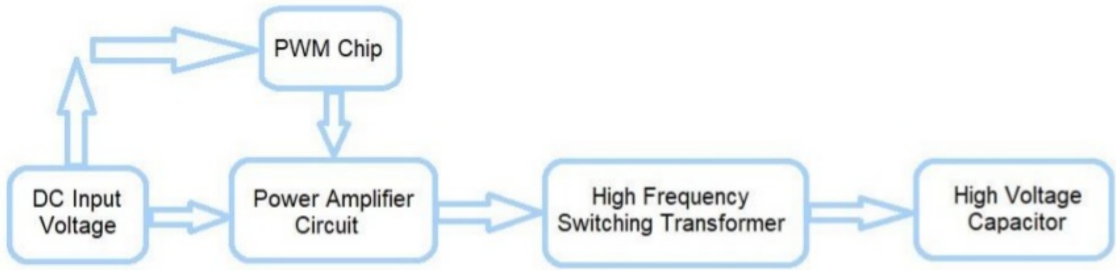

Fig.6: Block diagram of high voltage generator

This circuit is based on three stages. The first stage is DC to high frequency AC using PWM chip and then power NPN transistor and a high frequency switching transformer (the transformer turn ratio and input voltage and current are directly proportional to the high voltage). The transformer (ferrite core) converts low DC voltage into high frequency AC.

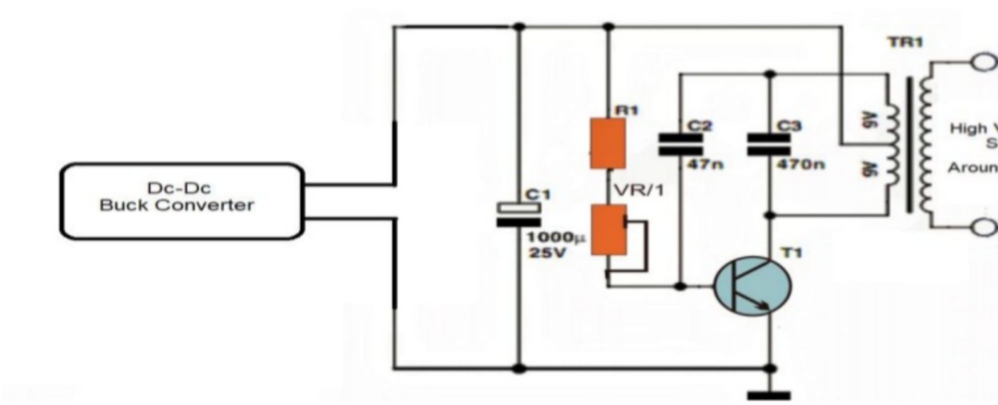

Fig.7: connection circuit of high voltage generator

The high voltage generator consists of a switching circuit controlling a power NPN (tip3055) transistor which is connected to the primary of a flyback transformer (EHT) which turns a low voltage high current source which is connected to a high voltage capacitor, and the arc gap decides the charging/discharging rate.

The Arc Gap and The Coil

The arc gap and the coil are one of the most **dangerous** and one of the most important parts of the project as it exposes voltages in the range of 1-6Kv depending on the input of the high voltage generator.

The arc gap decides the charging/ discharging rate of the high voltage capacitor.

The arc gap also decides the high voltage i.e. **if the gap is too small then as soon as the voltage across the gap reaches the breakdown voltage, the high voltage ionizes the air in between the gap which in turn allows the current to pass through the gap and the high voltage capacitor discharges before reaching its maximum and the cycle repeats.**

Fig.8: Arc Gap

But if the arc gap is too long the breakdown voltage will exceed the maximum of the high voltage generator(6Kv) and there will be no arcing. Therefore, no current will pass through the coil and no emp.

To successfully interfere/ destroy victim circuits, it is very important to choose the arc gap based on the size of the victim circuit as they are directly proportional, i.e. **if the victim circuit is small, then we need a high frequency electromagnetic pulse for enough voltage/ current to be induced to cause any sort of interference or damage to the victim circuit and since the arc gap and frequency of the emp are directly proportional, we need a smaller arc gap for the device to successfully interfere with the victim circuit**. While high frequency will effect small circuits at the same time the range of the emp will be reduced, but this problem can be easily solved by increasing the voltage.

For longer circuits the low frequency electromagnetic pulse should be able to successfully interfere victim circuits and therefore larger gap.

To conclude the arc gap decides the effective range of the emp and the size of the victim circuit which it can interfere/destroy.

The coil is also an important part of the project as it acts as an antenna and which is the part of the project which actually generates the electromagnetic pulses and which also decides the range of the emp.

Fig.9: spring coil

It is very important to choose the proper shape and appropriate number of turns of the coil. The shape of the coil decides how the electromagnetic pulses are distributed (for aiming purpose). For example, a conical shaped coil will distribute the emp in a way that we can easily aim at the target circuit.

The number of turns is directly proportional to the number of emp fields generated and therefore the strength of the emp.

But we need to be careful while choosing the number of turns because as the number of turns increases so does the length of the wire increases and therefore more resistance, and inductance also increases which can reduce the strength of the emp. So, there needs to be a proper balance between the number of turns and the effective range of the emp.

The Bluetooth controlled car

Follow the initial steps for connecting the Bluetooth receiver HC-06 with the Arduino app. the Bluetooth receiver commands from the Bluetooth RC controller app the Arduino then process these commands and then motor shield and the motor shield in-turn controls the four gear motors.

After successfully connecting with the Bluetooth receiver HC-06.

The first step is to set the Bluetooth car.

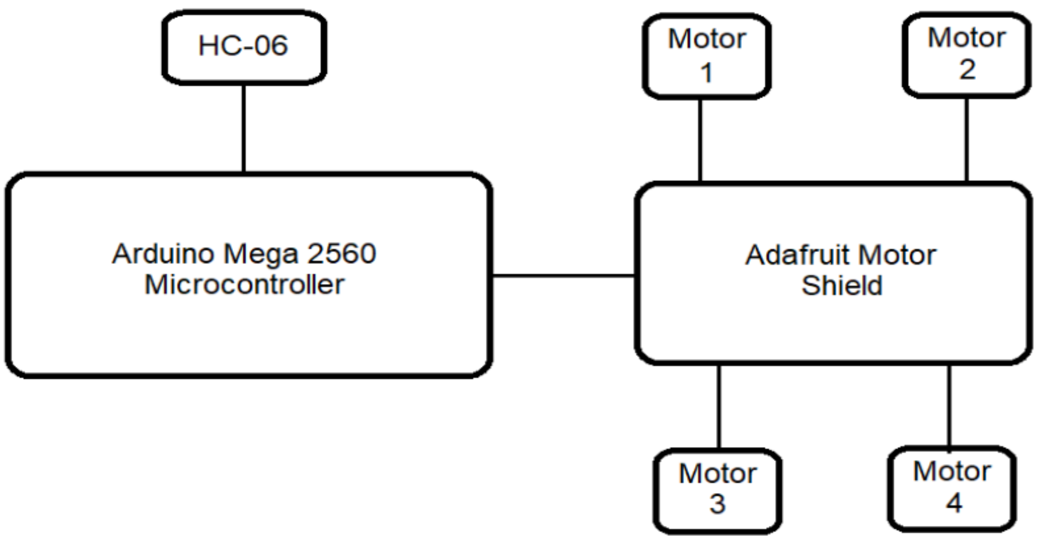

Fig.10: Block diagram of Bluetooth controlled car

Then we can use the following commands to control the Bluetooth controller car.

- Forward → F
- Back → B
- Left→ L
- Right→ R
- Forward Left→ G
- Forward Right→ I
- Back Left→ H
- Back Right→ J
- Stop→ S
- Lights On→ W
- Lights Off→ w
- EMP On→ X
- EMP Off→ x
- Speed 0→ 0
- Speed 10→ 1
- Speed 20→ 2
- Speed 30→ 3
- Speed 40→ 4
- Speed 50→ 5
- Speed 60→ 6
- Speed 70→ 7
- Speed 80→ 8
- Speed 90→ 9
- Speed 100→ q
- Stop All→ D

We have also added SMD LED's for the purpose of lighting up the Bluetooth car.

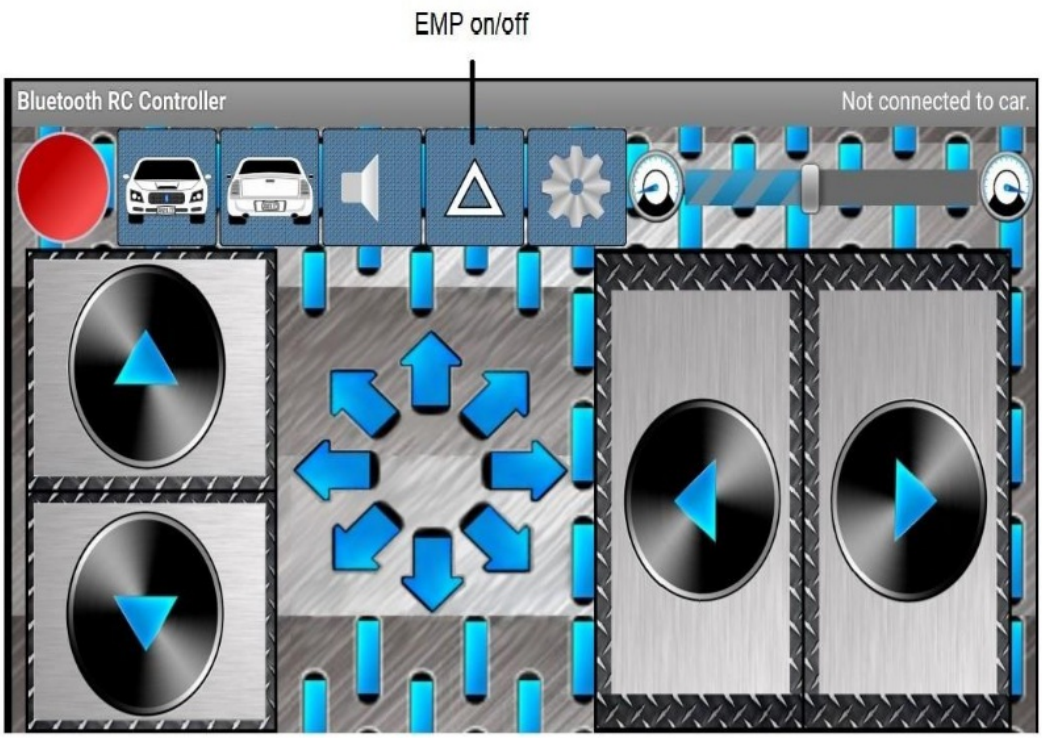

Fig.11: Bluetooth car controlling app

<u>PROGRAM CODE</u>

```
#include <AFMotor.h>
int i;
int LIGHTS=50;
int EMP=46;
AF_DCMotor motor1(1, MOTOR12_1KHZ);
AF_DCMotor motor2(2, MOTOR12_1KHZ);
AF_DCMotor motor3(3, MOTOR34_1KHZ);
AF_DCMotor motor4(4, MOTOR34_1KHZ);
char command;

void setup()
{
pinMode(LIGHTS, OUTPUT);
pinMode(EMP, OUTPUT);
 Serial3.begin(9600);
}

void loop(){
 if(Serial3.available() > 0){
  command = Serial3.read();
  Stop();
  switch(command){
  case 'F':
   forward();
   break;
  case 'B':
    back();
   break;
  case 'L':
   left();
   break;
  case 'R':
   right();
   break;
   case '0':
   i=0;
   break;
   case '1':
   i=65;
```

```
break;
case '3':
i=75;
break;
case '5':
i=100;
break;
case '7':
i=130;
break;
case '9':
i=160;
break;
case 'W':
digitalWrite(LIGHTS, HIGH);
break;
case 'w':
digitalWrite(LIGHTS, LOW);
break;
case 'X':
digitalWrite(EMP, HIGH);
break;
case 'x':
digitalWrite(EMP, LOW);
break;

}}
}
void forward()
{
 motor1.setSpeed(i);
 motor1.run(FORWARD);
 motor2.setSpeed(i);
 motor2.run(FORWARD);
 motor3.setSpeed(i);
 motor3.run(FORWARD);
 motor4.setSpeed(i);
 motor4.run(FORWARD);
}

void back()
```

```
{
  motor1.setSpeed(i);
  motor1.run(BACKWARD);
  motor2.setSpeed(i);
  motor2.run(BACKWARD);
  motor3.setSpeed(i);
  motor3.run(BACKWARD);
  motor4.setSpeed(i);
  motor4.run(BACKWARD);
}

void left()
{
  motor1.setSpeed(i);
  motor1.run(BACKWARD);
  motor2.setSpeed(i);
  motor2.run(BACKWARD);
  motor3.setSpeed(i);
  motor3.run(FORWARD);
  motor4.setSpeed(i);
  motor4.run(FORWARD);
}

void right()
{
  motor1.setSpeed(i);
  motor1.run(FORWARD);
  motor2.setSpeed(i);
  motor2.run(FORWARD);
  motor3.setSpeed(i);
  motor3.run(BACKWARD);
  motor4.setSpeed(i);
  motor4.run(BACKWARD);
}

void Stop()
{
  motor1.setSpeed(0);
  motor1.run(RELEASE);
  motor2.setSpeed(0);
  motor2.run(RELEASE);
```

```
  motor3.setSpeed(0);
  motor3.run(RELEASE);
  motor4.setSpeed(0);
  motor4.run(RELEASE);
}
```

APPLICATIONS

- **As Weapons**
  - The EMPs are used in a variety of ways. EMPs can cause power outages and cab even damage electronics by short-circuiting them.
- **To Stop Cars**
  - The police could use an electromagnetic pulse device stop fleeing cars. EMPs could stop a vehicle safely, from without harming driver or passengers.
- **As Protection Shield**
  - The EMP generator can be used to stop the electronic devices (drones) from entering into restricted air space.

    For example, the EMP generator can be used along the international borders between India and other neighboring countries to prevent/ stop enemy drones, surveillance equipment.

If the frequency of the EMP is powerful enough and the frequency of the EMP is tuned properly we can interfere with the communication between malicious terror groups.

CONCLUSION

The project explores the electromagnetic pulse (EMP) phenomenon and its effect on other electronic devices. The goal of an electromagnetic pulse is to interfere/destroy all electronics in the vicinity. So, just goal was achieved by the project.

The maximum effective range of the project is around 60-80 cms from the coil. The effective range can be controlled by varying the input voltage (power) to the high voltage generator.

In our opinion, there needs to be done more research and development on the topic of EMP and its effects and how to shield electronic devices from EMP.

If the next world war ever happens, the war may not be fought with guns and explosives, it may probably be fought by interrupting/ destroying with the infrastructure of a country, most of the modern military equipment are shielded from EMP. But almost all commercial electronics are not shielded from EMP. So, the best way of fighting a war might be to disrupt the county's infrastructure and internal communication by using EMP, Biological weapons.

ELECTROMAGNETIC PULSE CAR

ORIGINALITY REPORT

1%	%	1%	%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Young-Kyung Jeong, Dong-Gi Youn, Moon-Qee Lee. "A Study on Optimization of Compact High-voltage Generator Based on Magnetic-core Tesla Transformer", Journal of Electrical Engineering and Technology, 2014 Publication	<1%
2	Tao Dajun, Ge Baojun, Lv Yanling, Zhang Zhiqiang. "Systematically study on the static power-angle characteristics of a high voltage cable-wound generator prototype", 2009 International Conference on Sustainable Power Generation and Supply, 2009 Publication	<1%

Exclude quotes	Off	Exclude matches	Off
Exclude bibliography	Off		