ELECTROMAGNETIC SPACE SHUTTLE LAUNCHER

Report submitted
In partial fulfillment of requirement for the award of degree of

Bachelor of Engineering
in
Electrical Engineering

Submitted by
Swaraj Rasmin Jadhav
Umesh Yadneshwar Joshi
Ashfaque Hamid Hussain Khan
Mayuri Shantaram Pawar

Under The Guidance Of
Prof. IFTEKAR PATEL

Department of Electrical Engineering

Anjuman-I-Islam's Kalsekar Technical Campus, Panvel
Mumbai University, Mumbai

2020-21

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CERTIFICATE

This is to certify that the dissertation titled "**Electromagnetic Space Shuttle Launcher**", which is being submitted herewith for the award of the, **'Bachlor of Engineering'** in **Electrical Engineering** of Anjuman-I-Islam's Kalsekar Technical Campus, New Panvel (M.S., India). This is the result of the original research work and contribution by **'Mr. Swaraj Rashmin Jadhav, Mr. Umesh Yadneshwar Joshi, Mr. Ashfaque Hamid Hussain Khan, Miss Mayuri Shantaram Pawar'** under my supervision and guidance. The work embodied in this dissertation has not formed earlier for the basis of award of any degree or compatible certificate or similar title of this for any other diploma/examining body or university to the best of knowledge and belief.

Place :Panvel

Date :

Prof. Iftekar Patel

Guide

Prof. Rizwan Farade

H O D

Dr. Abdul Razak Honnutagi

Director AIKTC

DECLARATION

I hereby declare that I have formed, completed and written the dissertation entitled "**Electromagnetic Space Shuttle Launcher**". It has not previously submitted for the basis of the award of any degree or diploma or either similar title of this for any other diploma/examining body/university.

Place :Panvel

Date :

(Signature)

SWARAJ JADHAV

(Signature)

UMESH JOSHI

(Signature)

ASHFAQUE KHAN

(Signature)

MAYURI PAWAR

ACKNOWLEDGMENT

We would like to express our sincere thanks to Prof. Iftekar Patel for taking time from his busy schedule to provide us with great deal of help, support and encouragement to work diligently at every aspect of our project.

We are thankful to our college Director Dr. Abdul Razak Honnutagi,

HOD Prof. Rizwan Farade and all staff members of Electrical department for providing us various facilities and guiding us whenever required.

Finally, we would like to thank our parents and our friends for constantly supporting and encouraging our efforts.

ABSTRACT

- The aim of this project is to present experimental research information on coil-guns and related topics. Thus we hope to foster interest in the fields of physics and engineering. Our long term objective is to design and construct a multi-stage coil-guns capable of firing projectiles at supersonic speed.

- Recent advances in energy storage, switching and magnet technology make electromagnetic acceleration a viable alternative to chemical propulsion for certain tasks, and means to perform other tasks not previously feasible.

- Many advances in electromagnetic railgun or coilgun and power supply technology have been made in recent years. A coilgun system concept is described here and technology development issues are identified.

- This topic involves simultaneous use of both propellant and the magnetic field throughout its journey, along with change in the complete structural and material design of the space shuttle, to suite conditions being discussed.

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CHAPTER:1

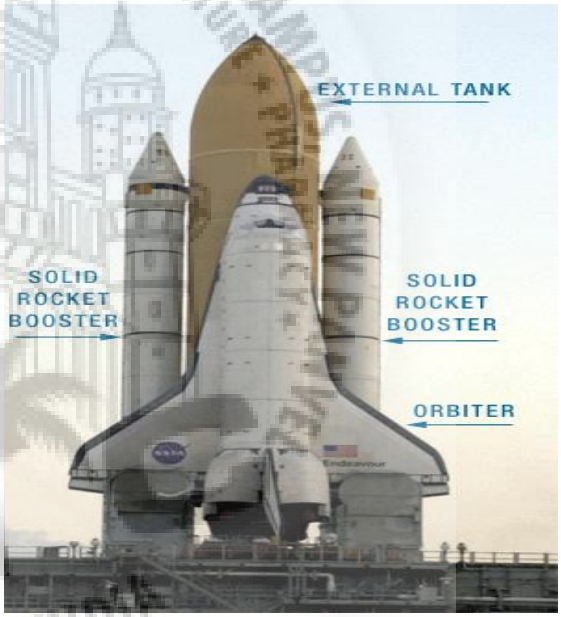
1.1 : PROBLEM STATEMENT

Nowadays for shuttle launching the fuel and the manpower required is more, which we will overcome using the Electromagnetic Space Shuttle Launching System (EMSSLS).

The time required to launch the shuttle is less and also the space required is reduced. The Electromagnetic Shuttle Launching System is more reliable and uses less energy.

The disadvantage of all the staged rocket launching system employed so far is the non-reusability and the very small ratio of the payload to the fuel mass which is generally termed as propellant mass fraction which is less than 1% which has become a problem in terms of costing . Plus the uplifting thrust required is also less. To overcome these problem efforts have been taken to establish reusable engines and rockets. This can be solved by employing a new technique based on an electromagnetic space shuttle launching machine using electromagnetic force for acceleration of the projectile. By using this electromagnetic launching system the major disadvantage of the conventional rockets can be overcome. The reusability also can be obtained by this technique.

The Space Shuttle:

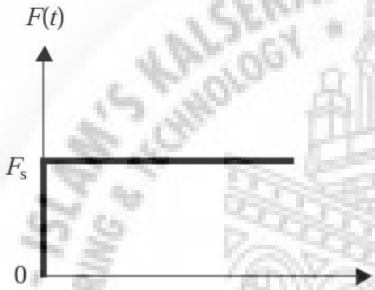


A typical Space Shuttle vehicle consists of the Orbiter, External Tank (ET) and two Solid Rocket Boosters (SRBs),as shown in fig. The structures that make up the Shuttle and hold it together must withstand the forces of lift-off, ascent, orbital maneuvers, re-entry, and landing. The most critical design forces are the lift-off loads from the Space Shuttle Main Engines (SSMEs), which are mounted on the Orbiter, and from the SRBs. The critical lift-off forces consist of the 100% steadystate thrust developed by the engines and the boosters plus the dynamic force components, which depend on how rapidly the thrust builds up in the first place. The dynamic force component, which is referred to as the "dynamic overshoot," is always a fraction of the steady force .Rockets reach maximum thrust rapidly. For example, the SRBs reach maximum thrust in 600 milliseconds.

This behavior approximates the familiar unit-step-input function, which is shown in below fig. The sudden thrust causes the force to over shoot and it subjects the parts of the Space Shuttle to greater loads than the applied loads. Unless the greater loads are considered, the safety and reliability of the system will be threatened.

1.1.2. Typical Single Stage Coil gun:

Many hobbyists use low-cost rudimentary designs to experiment with coil guns, for example using photoflash capacitors from a disposable camera, or a capacitor from a standard cathode-ray tube television as the energy source, and a low inductance coil to propel the projectile forward. Some designs have non-ferromagnetic projectiles, of such as aluminum or copper, with the armature of the projectile acting as an electromagnet with internal current induced by pulses of the acceleration coils. A superconducting coil gun called a quench gun could be created by successively quenching a line of adjacent coaxial superconducting coils forming a Bun barrel, generating a wave of magnetic field gradient traveling at any desired speed. A traveling superconducting coil might be made to ride this wave like a surfboard. The device would be a mass driver or linear synchronous motor with the propulsion energy stored directly in the drive coils.



1.1.3. Switching:

One main obstacle in coilgun design is switching the power through the coils. There are several common solutions-the simplest (and probably least effective) is the spark gap, which releases the stored energy through the coil when the voltage reaches a certain threshold. A better option is to use solid-state switches these include IGBTs or power MOSFETs (which can be switched off mid-pulse) and SCRs (which release all stored energy before turning off).However, a large amount of the energy will be dissipated as heat and light, and, due to the tube being a spark gap, the tube will stop conducting once the voltage across it drops sufficiently, leaving some charge remaining on the capacitor.

1.1.4. Multistage Coilgun:

The electrical resistance of the coils and the equivalent series resistance (ESR) of the current source are among other limits to the efficiency of a coilgun. The magnetic circuit Ideally, 100% of the magnetic flux generated by the coil would be delivered to and act on the projectile, but this is often far from the case due to the common air-core solenoid construction of most coilguns, which are usually relatively simple and inefficient designs made by hobbyists. To reduce component size, weight, durability requirements, and most importantly, cost, the magnetic circuit to deliver more energy to the projectile for a given energy input. This has been addressed to some extent by the use of back iron and end iron, which are pieces of magnetic material that enclose the coil and create paths of lower reluctance in order to improve the amount of magnetic flux coupled into the projectile.

1.2 Description:

In this project we are developing the Electromagnetic antinuclear launcher for missile launching and space shuttle launching, this works on principle of magnetizing and demagnetizing of coil. There is a wide length tube and the object to be fired is placed in tube. Over the tube, coils are wounded. When the supply is given, first coil get energized it try to attract an object and suddenly object get attracted towards it. After attraction the first coil De-energized and suddenly second coil is energized, Then the object get attracted towards that coil.

This procedure of energizing and de-energizing is continued tin the object get not reached to last coil, In between this running process the object will get a large force and energy, that the object is fired from the tube with the sound speed and to the decided direction. The speed of the object can be control by varying supply voltage by voltage regulator. It is a projectile launcher conceived in 1983 at the University of Washington that uses chemical energy to accelerate projectiles to hyperemic speeds (Hertzberg al. 1988). Although it resembles a conventional big-barreled maroon, the principle of operation of the ram accelerator is notably different, being related to that of a supersonic air breathing ramjet engine. This device consists of a stationary tube, analogous to the cylindrical outer coating of a ramjet engine lied with combustible gaseous mixtures (typical y methane or hydrogen, oxygen,and diluents such as nitrogen, helium, of excess hydrogen) at fill Pressures ranging from 5 to 200 atm. Franbible diaphragms dose off each end of the tube to contain the propellant.

This technology reduces stress on airframes because they can be accelerated more gradually to take off speed. In the EMSLS consists of four elements:

- Linear Induction Motor
- Energy storage subsystem
- Power conversion subsystem
- Control consoles

1.3 Objectives:

- The objective of this project is to successfully design and construct a linear electromagnetic accelerator capable of accelerating a lightweight payload to velocities greater than 1000m/s so that high velocity erosion in the rail/armature interface can be investigated.

- Few of the intriguing application is electromagnetically catapulting aircraft from the deck of an aircraft carrier, firing a missile & roller coaster in amusement parks.

- We aim to make a small prototype by making use of coilguns.

Chapter 2

Literature Review

PAPER 1. Reluctance Launcher Coil-Gun Simulations and Experiment (2019)

The (induction) coil gun is a type of electromagnetic mass launcher that uses the Lorentz force to accelerate a projectile. A coil gun consists of a stack of outer coils forming the "barrer (stator) that generates a magnetic field which pushes a second, coaxial, single coil axially along a guide-way. The moving coil is referred to as the armature. A typical induction coil gun has a shorted armature in which current is induced by the changing magnetic flux from the outer coils. The induced armature current interacts with the magnetic field from the outer coils an produces a J × B force propelling the armature along the guide-way.

Author: YafitOrbach, Matan Oren, Aviv Golan and Moshe Einat

PAPER 2. IEEE Transactions on Magnetics (2003)

The Electromagnetic antinuclear launcher for missile launching and space shuttle launching, this works on principle of magnetizing and demagnetizing of coil. There is a wide length tube and the object to be fired is placed in tube. Over the tube, coils are wounded. When the supply is given, first coil get energized it try to attract a object and suddenly object get attracted towards it. After attraction the first coil De-energized and suddenly second coil is energized, Then the object get attracted towards that coil. This procedure of energizing and de-energizing is continued tin the object get not reached to last coil, In between this running process the object will get a large force and energy, that the object is fired from the tube with the sound speed and to the decided direction.

Author: I.R. McNab

PAPER3. Design and Implementation of Electromagnetic Railgun Simulation System

One solution is the electromagnetic rail gun, or rail gun for short. Using a magnetic field powered by electricity, a rail gun can accelerate a projectile up to 52, 493 feet (16, 000 meters) per second. And while current Navy guns have a maximum range of 12 miles, rail guns can hit a target 250 miles away in six minutes.

Author: Ming Yangand Yuwei Hu

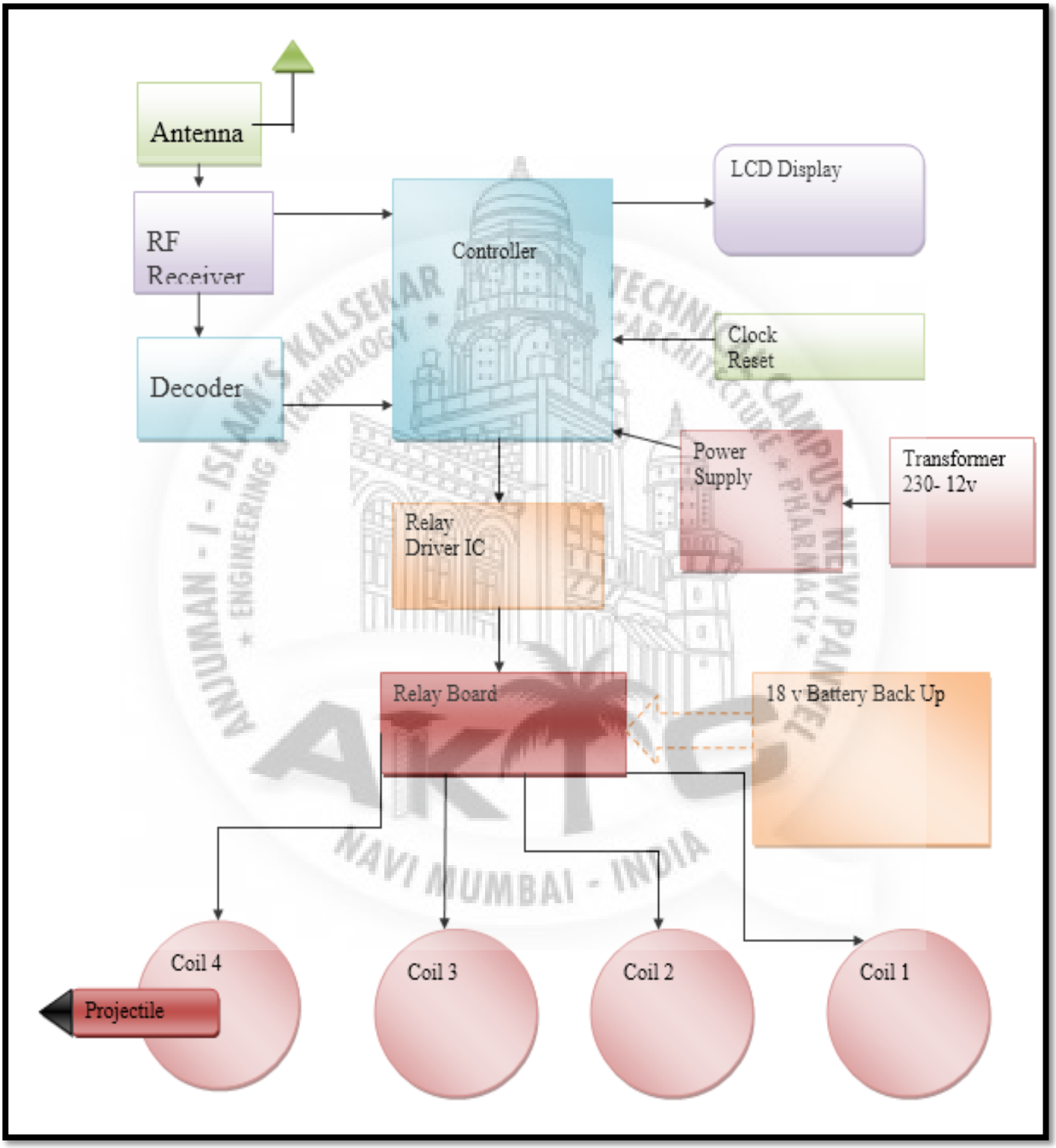
PAPER 4. Ram Accelerator as an Impulsive Space Launcher (2007)

It is a projectile launcher conceived in 1983 at the University of Washington that uses chemical energy to accelerate projectiles to hyperemic speeds (Hertzberg al. 1988). Although it resembles a conventional big-barreled, the principle of operation of the ram accelerator is notably different, being related to that of a supersonic air breathing ramjet engine. This device consists of a stationary tube, analogous to the cylindrical outer coating of a ramjet engine lied with combustible gaseous mixtures (typically methane or hydrogen, oxygen, and diluents such as nitrogen, helium, of excess hydrogen) at fill Pressures ranging from 5 to 200 atm. Frangible diaphragms dose off each end of the tube to contain the propellant.

Author: B. Joseph and A.P. Bruckner

CHAPTER:3

3.1 BLOCK DIAGRAM



- **ANTENNA:**

The two functions of an antenna are:

(1) For transmission of a signal, radiofrequency electrical energy from the transmitter is converted into electromagnetic energy by the antenna and radiated into the surrounding environment (atmosphere, space, water.

(2) for reception of a signal, electromagnetic energy impinging on the antenna is converted into radio-frequency electrical energy and fed into the receiver.

- **RF RECEIVER:**

In radio communications, a **radio receiver**, also known as a **receiver**, a **wireless** or simply a **radio**, is an electronic device that receives radio waves and converts the information carried by them to a usable form. It is used with an antenna. The antenna intercepts radio waves and converts them to tiny alternating currents which are applied to the receiver, and the receiver extracts the desired information. The receiver uses electronic filter to separate the desired radio frequency signal from all the other signals picked up by the antenna, an electronic amplifier to increase the power of the signal for further processing, and finally recovers the desired information through demodulations.

1) The mix of radio signals from the antenna is filtered to extract the signal of the desired transmitter.
2) this oscillating voltage is sent through a radio frequency (RF) amplifier to increase its strength to a level sufficient to drive the demodulator.
3) the demodulator recovers the modulation signal from the modulated radio carrier wave.

- **DECODER:**

1. Decoder is a combinational circuit that has 'n' input lines and maximum of 2^n output lines. One of these outputs will be active High based on the combination of inputs present, when the decoder is enabled. That means decoder detects a particular code.
2. A decoder is a circuit that changes a code into a set of signals. It is called a decoder because it does the reverse of encoding, but we will begin our study of encoders and decoders with decoders because they are simpler to design.

- **CONTROLLER:**

A controller is a comparative device that receives an input signal from a measured process variable, compares this value with that of a predetermined control point value (set point), and determines the

appropriate amount of output signal required by the final control element to provide corrective action within a control loop.

1. Proportional (P) — Proportional control reacts to the size of the deviation from set point when sending a corrective signal. The size of the corrective signal can be adjusted in relation to the size of the error by changing the width of the proportional band. A narrow proportional band will cause a large corrective action in relation to a given amount of error, while a wider proportional band will cause a smaller corrective action in relation to the same amount of error.
2. Integral (I) — Integral control reacts to the length of time that the deviation from set point exists when sending a corrective signal. The longer the error exists, the greater the corrective signal.
3. Derivative (D) — Derivative control reacts to the speed in which the deviation is changing. The corrective signal will be proportional to the rate of change within the process.

- **RELAY DRIVER IC:**

A **Relay driver IC** is an electro-magnetic switch that will be used whenever we want to use a low voltage **circuit** to switch a light bulb ON and OFF which is connected to 220V mains supply

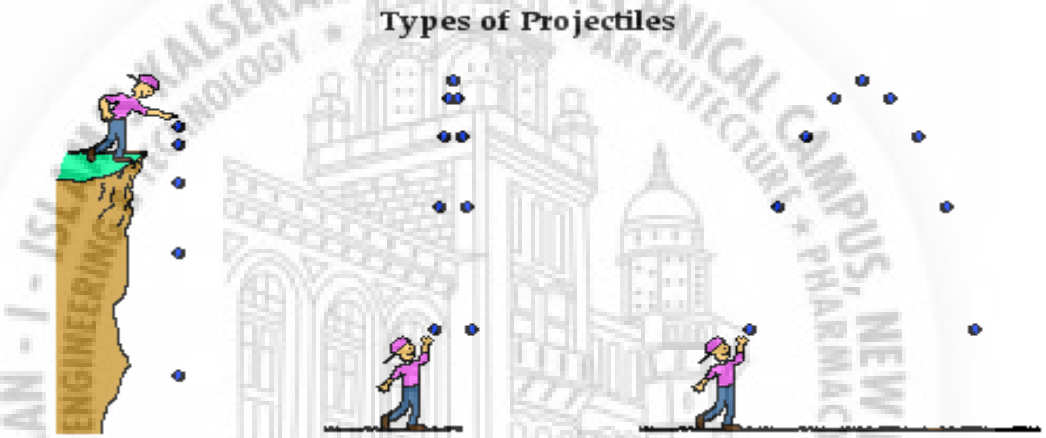
- Relays have unique properties and are replaced with solid state switches that are strong than solid-state devices. High current capacities, capability to stand ESD and drive circuit isolation are the unique properties of Relays.
- There are various ways to drive relays. Some of the Relay Driver ICs are as below.
    - High side toggle switch driver
    - Low side toggle switch driver
    - Bipolar NPN transistor driver
    - N-Channel MOSFET driver and
    - Darlington transistor driver
    - ULN2003 driver

➢ **RELAY BOARD:**

1. Relay boards are computer boards with an array of relays and switches. They have input and output terminals and are designed to control the voltage supply. Relay boards provide independently programmable, real-time control for each of several onboard relay channels.
2. Relay boards are used in many different applications. Some products are used to control lights, motors, and other electronic devices in industrial and commercial applications. Others are also used to control heater temperatures, or are used in power switching applications.

- **PROJECTILE:**

1. A projectile is an object upon which the only force acting is gravity.
2. A projectile is any object that once *projected* or dropped continues in motion by its own inertia and is influenced only by the downward force of gravity.



- **CLOCK AND RESET:**

1. A **reset** and **clock** circuit for providing a valid power-up **reset** signal prior to distribution of a **clock** signal includes power sensing circuitry, a **clock** generator and a **reset** generator.
2. **Resets** are a **necessary** part of all synchronous designs because they allow them to be brought into a known state. However, such a simple process can lead to many problems within an SoC. No

longer can **reset** be considered a simple operation when power initially is applied to a circuit.

➢ TRANSFORMER:

A **transformer** is defined as a passive electrical device that transfers electrical energy from one circuit to another through the process of electromagnetic induction. It is most commonly used to increase ('step up') or decrease ('step down') voltage levels between circuits.

1. STEP UP TRANSFORMER:

- The step-up transformer is a type of transformer with the function of converting low voltage (LV) and high current from the transformer's primary side to high voltage (HV) and low current value on the transformers' secondary side.
- In a step-up transformer, the low voltage winding is the primary coil, and the high voltage winding is the secondary winding. In contrast, in a step-down transformer, the low voltage winding is the secondary winding.
- In a step-up transformer, the current and magnetic field develop less on the secondary, and it grows high on the primary. In contrast, in a step-down transformer, the secondary end's voltage is lower due to there, the high current and magnetic field.

➢ POWER SUPPLY:

- A **power supply** is an electrical device that supplies electric power to an electrical load. The primary function of a power supply is to convert electric current from a source to the correct voltage, current, and frequency to power the load.

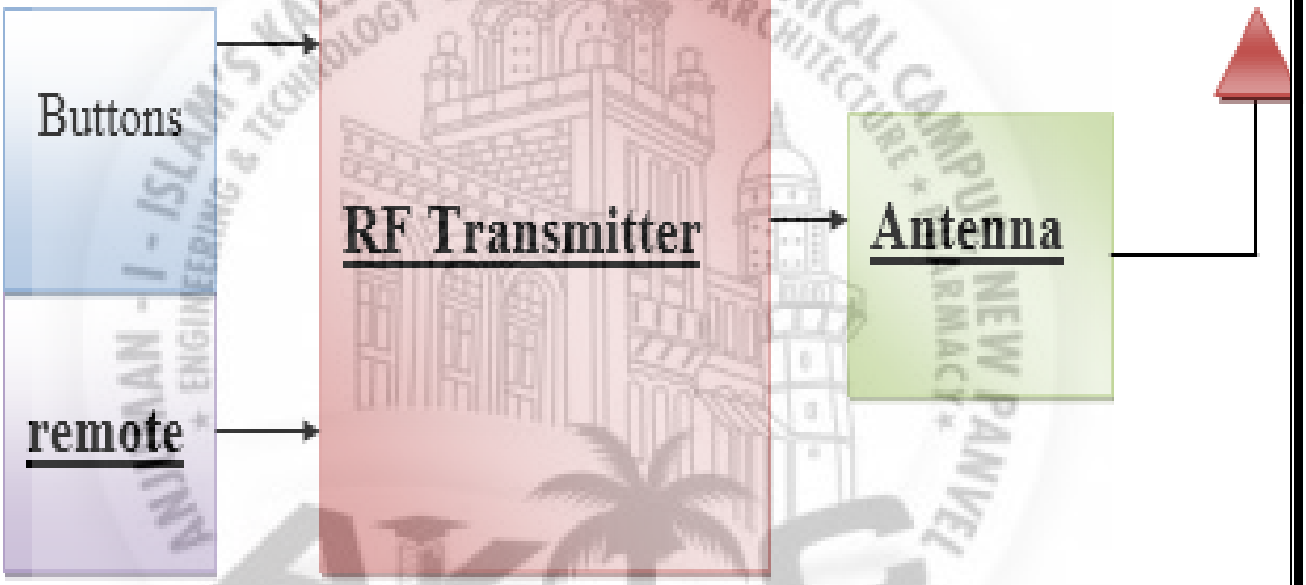
- **DC power supplies** An AC-to-DC power supply operates on an AC input voltage and generates a DC output voltage. Depending on application requirements the output voltage may contain large or negligible amounts AC frequency components known as ripple voltage, related to AC input voltage frequency and the power supply's operation. A DC power supply operating on DC input voltage is called a DC-to-DC converter. This section focuses mostly on the AC-to-DC variant.

➢ 18 VOLT BATTERY BACKUP:

1) A **backup battery** provides power to a system when the primary source of power is unavailable. Backup batteries range from small single cells to retain clock time and date in computers, up to large battery room facilities that power uninterruptible power supply systems for large data centers. Small backup batteries may be primary cells; rechargeable backup batteries are kept charged by the prime power supply.

2) APC says the **battery** in this model should **last** 3-5 years, and are replaceable. This model gives you about 25 minutes of **battery backup** with a 100-watt load. That's enough time to save your work and shutdown, but not a good solution if you want to stay up and running during a longer power outage.

Transmitter Section



A.BUTTONS:

- The button control represents a standard windows button. It is generally used to generate used to generate a click event by providing a handler for the click event.
- The button role identifies an element as a button to screen readers.
- A button is a widget used to perform actions such as submitting a form, operating a dialog, cancelling an action or performing a command.

B. REMOTE:

- Remote control is an electronic device used to operate another device from a distance usually wirelessly.
- A remote control can allow operations of devices that are out of convenient reach for direct operation of controls.

C.ANTENNA:

The two functions of an antenna are:

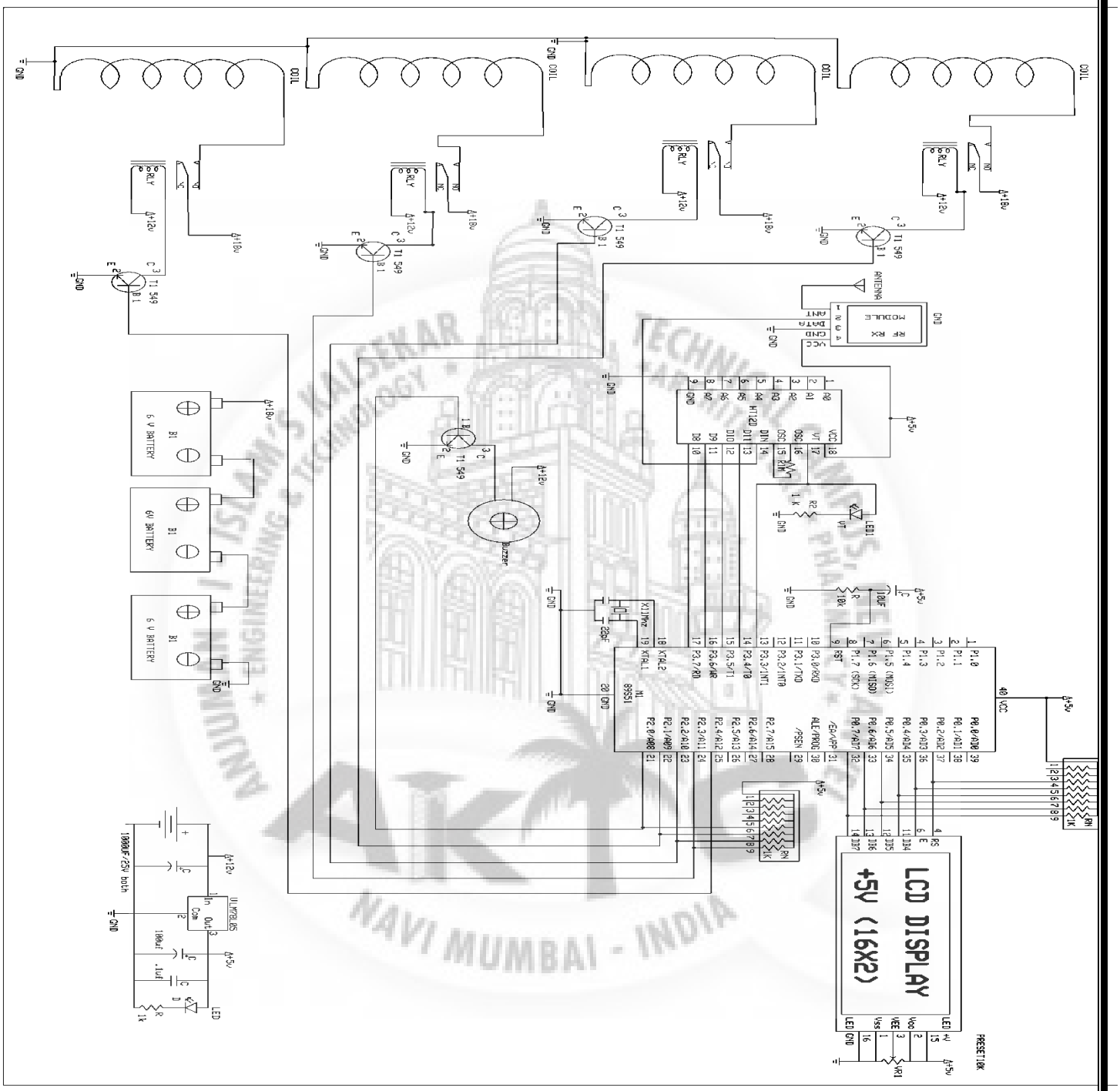
(1) For transmission of a signal, radiofrequency electrical energy from the transmitter is converted into electromagnetic energy by the antenna and radiated into the surrounding environment (atmosphere, space, water).

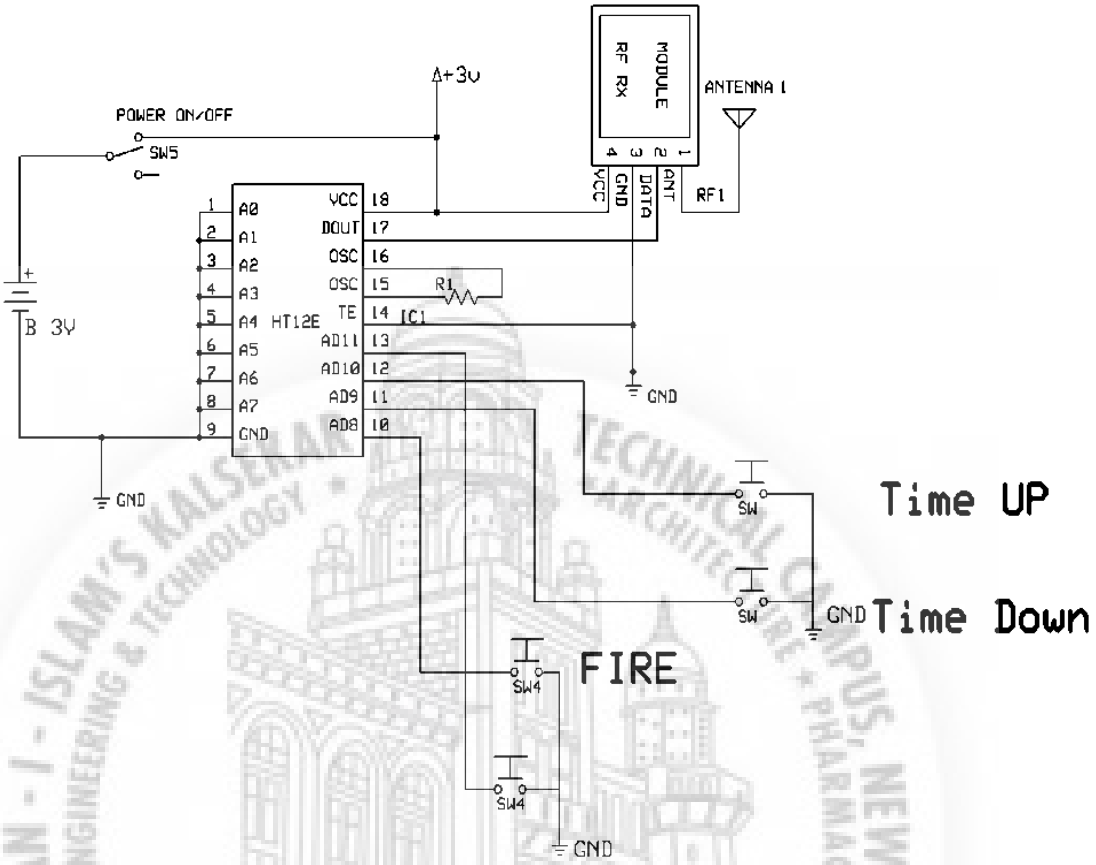
(2) for reception of a signal, electromagnetic energy impinging on the antenna is converted into radio-frequency electrical energy and fed into the receiver.

D.RF TRANSMITTER:

- An RF transmitter receives serial data and transmits it wirelessely through RF through its antenna connected pin.
- The radio transmitter has several functions:
  (1) To generate and RF carrier wave
  (2) To amplify the carrier waves.
  (3) To amplify the modulated signal
  (4) To modulate the carrier wave with a sound wave, digital signal, or some other form of information.

3.2 CIRCUIT DIAGRAM




+3v
POWER ON/OFF
SW5
B 3V
A0
A1
A2
A3
A4
A5
A6
A7
GND
HT12E
VCC
DOUT
OSC
OSC
TE
AD11
AD10
AD9
AD8
R1
IC1
MODULE
RF RX
VCC
GND
DATA
ANT
ANTENNA 1
RF1
GND
SW
Time UP
SW
GND
Time Down
SW4
FIRE
SW4
GND

3.3WORKING

In this project we are developing the antinuclear launcher for missile launcher and space shuttle launcher, this works on same principle of magnetizing and demagnetizing of coil. There is a wide length tube and the object to be placed in tube. Over the tube, coils are wounded. when the first coil get energized it try to attract a object and suddenly object get attracted towards it.

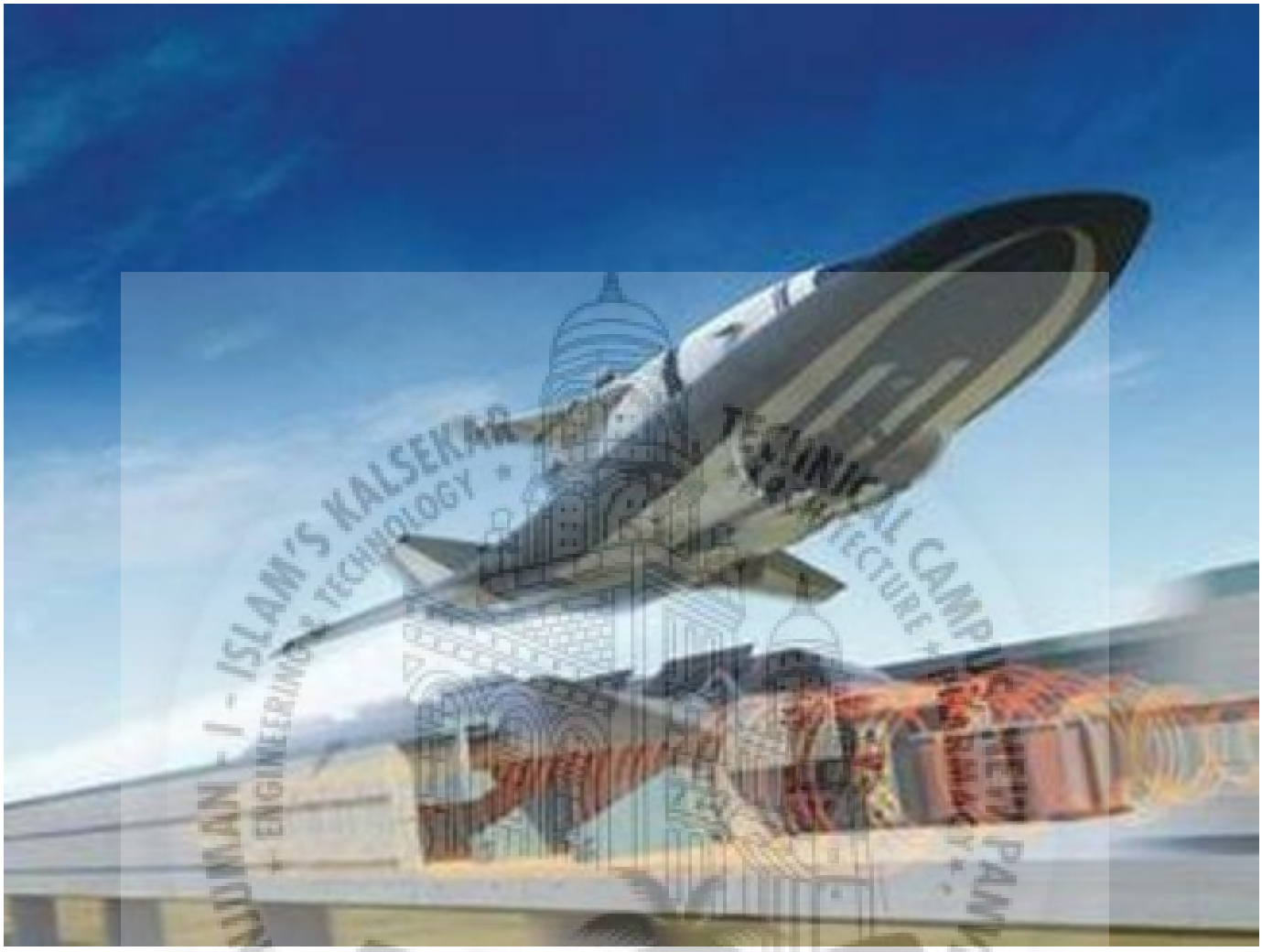
After attraction the first coil de-energized and suddenly second coil is energized, then the object get attracted towards that coil, this procedure of energizing and de-energizing is continued till the object get not reached to last coil, In between this running process the object will get a large force and energy, that the object is fired from the tube with high speed and to the decided direction. The speed of the object can be control by varying supply voltage by voltage regulator. A typical coil gun, as the name implies, consists of a coil of wire, an electromagnet, with a ferromagnetic projectile placed at one of its ends.

Effectively a coil gun is a solenoid, a current-carrying coil which will draw a ferromagnetic object through its center. A large current is pulsed through the coil of wire and a strong magnetic field forms, pulling the projectile to the center of the coil.

When the projectile nears this point the electromagnet is switched off and the next electromagnet can be switched on, progressively accelerating the projectile down successive stages. In common coilgun designs the "barrel "of the gun is made up of a track that the projectile rides on, with the driver Into the magnetic coils around the track.

Power ls supplied to the electromagnet from some sort of fast discharge storage device, typically a battery or high-capacity high voltage capacitors designed for fast energy discharge. A diode is used to protect polarity sensitive components (such as semiconductors or electrolytic capacitors) from damage due to inverse polarity of the voltage after turning off the coil.

There are two main types or setups of a coil gun : single-stage and multistage. A single-stage coilgun uses one electromagnet to propel a projectile. A multistage



coil gun uses several electromagnets in succession to progressively increase the speed of the projectile.Typical single stage coil gun :

Many hobbyists use low-cost rudimentary designs to experiment with coilguns, for example using photoflash capacitors from a disposable camera, or a capacitor from a standard cathode-ray tube television as the energy source, and a low inductance coil to propel the projectile forward. Some designs have non-ferromagnetic projectiles, of such as aluminum or copper, with the armature of the projectile acting as an electromagnet with internal current induced by pulses of the acceleration coils.

A superconducting coilgun called a quench gun could be created by successively quenching a line of adjacent coaxial superconducting coils forming a Bun barrel, generating a wave of magnetic field gradient traveling at any desired speed. A traveling superconducting coil might be made to ride this wave like a surfboard. The device would be a mass driver or linear synchronous motor with the propulsion energy stored directly in the drive coils.

Another method would have non-superconducting acceleration coils and propulsion energy stored outside of them but a projectile with superconducting magnets. Though the cost of power switching and other factors can limit projectile energy, a notable benefit of some coilgun designs over simpler railguns is avoiding an intrinsic velocity limit from hypervelocity physical contact and erosion. By having the projectile pulled towards or levitated within the center of the coils as it is accelerated, no physical friction with the walls of the bore occurs. If the bore is a total vacuum (such as a tube with a plasma window) there is no friction at all which helps prolonged reusability.

Switching

One main obstacle in coilgun design is switching the power through the coils. There are several common solutions-the simplest (and probably least effective) is the spark gap, which releases the stored energy through the coil when the voltage reaches a certain threshold. A better option is to use solid-state switches these include IGBTs or power MOSFETs (which can be switched off mid-pulse) and scRs (which release all stored energy before turning off).

A quick-and-dirty method for switching, especially for those using a flash camera for the main components, is to use the flash tube itself as a switch. By wiring it in series with the coil, it can silently and non-destructively (assuming that the energy in the capacitor is kept below the tube's safe operating limits) allow a large amount of current to pass through to the coil. Like any flash tube, ionizing the gas in the tube with a high voltage triggers it.
However, a large amount of the energy will be dissipated as heat and light, and, due to the tube being a spark gap, the tube will stop conducting once the voltage across it drops sufficiently, leaving some charge remaining on the capacitor.

A Multistage coilgun

The electrical resistance of the coils and the equivalent series resistance (ESR) of the current source are among other limits to the efficiency of a coilgun. magnetic circuit Ideally, 10o% of the magnetic flux generated by the coil would be delivered to and act on the projectile, but this is often far from the case due to the common air- core solenoid construction of most coilguns, which are usually relatively simple and inefficient designs made by hobbyists.

With a simple air-cored solenoid, the majority of the magnetic flux is not coupled into the projectile because of the magnetic circuit's high reluctance. The uncoupled flux generates a magnetic field that stores energy in the surrounding air. The energy that is stored in this field does not simply disappear from the magnetic circuit once the capacitor finishes discharging, instead returning to the

coil gun's electric circuit. Because the coil gun's electric circuit is inherently analogous to an LC oscillator, the unused energy returns in the reverse direction ('ringing'), which can seriously damage polarized capacitors such as electrolytic capacitors.

Reverse charging can be prevented by a diode connected in reverse-parallel across the capacitor terminals ; as a result, this diode and the coil dissipate all of the unused energy as heat. While this is a simple and frequently utilized solution, it requires additional expensive high-power semiconductors and a well-designed coil with enough thermal mass and heat dissipation capability in order to prevent component failure. Some designs attempt to re cover the energy stored in the magnetic field by using a pair of diodes. These diodes, instead of being forced to dissipate the remaining energy, recharge the capacitors with the right polarity for the next discharge cycle.

This will also avoid the need to fully recharge the capacitors, thus significantly reducing charge times. However, the practicality a solution of limited by the resulting high recharge current through the equivalent series resistance (ESR) of the capacitors ; the ESR will dissipate some of the recharge current, generating heat within the capacitors and potentially shortening their lifetime.

To reduce component size, weight, durability requirements, and most importantly, cost, the magnetic circuit to deliver more energy to the projectile for a given energy input. This has been addressed to some extent by the use of back iron and end iron, which are pieces of magnetic material that enclose the coil and create paths of lower reluctance in order to improve the amount of magnetic flux coupled into the projectile.
Results can vary widely depending on the materials used ; hobbyist designs may use, for example, materials ranging anywhere from magnetic steel (more effective, lower reluctance) to video tape (little improvement in reluctance). Moreover, the additional pieces of magnetic material in the magnetic circuit can potentially exacerbate the possibility of flux saturation and other magnetic losses.

CHAPTER : 4

PROPOSED METHODOLOGY

This paper presents developing the antinuclear launcher for missile launcher and space shuttle launcher, this works on same principle of magnetizing and demagnetizing of coil. There is a wide length tube and the object to be placed in tube. Over the tube, coils are wounded. when the first coil get energized it try to attract a object and suddenly object get attracted towards it.

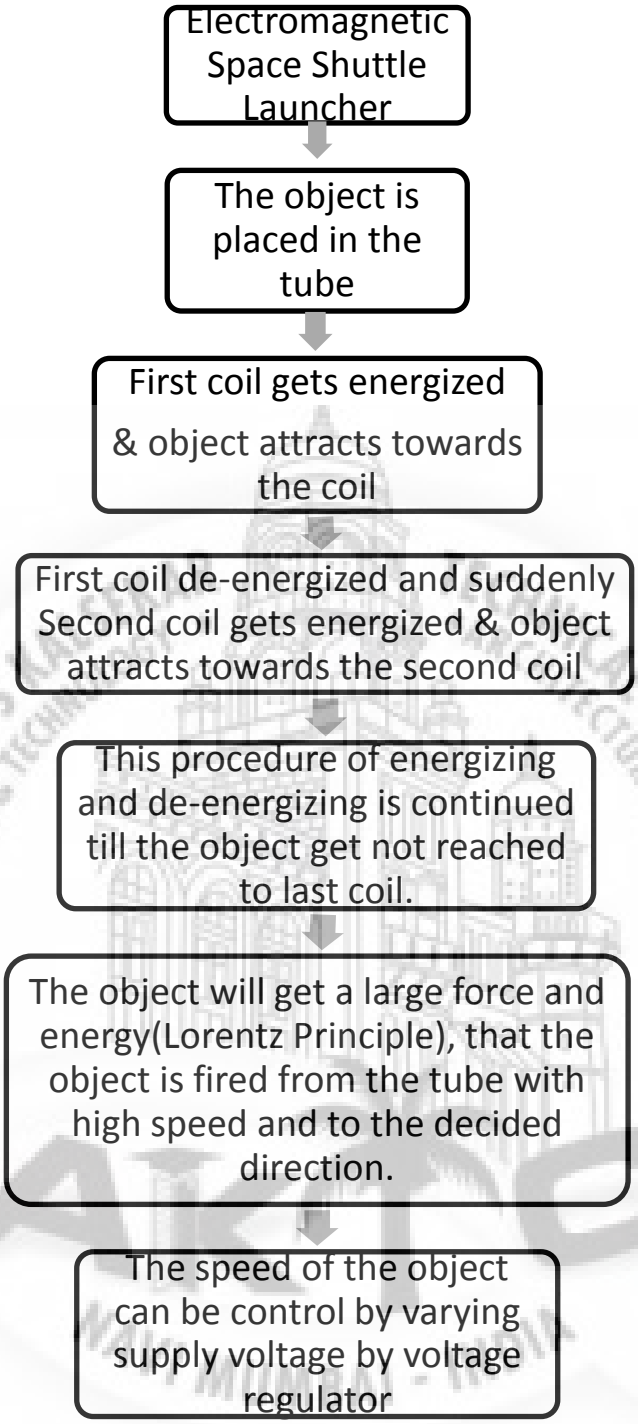
After attraction the first coil de-energized and suddenly second coil is energized, then the object get attracted towards that coil, this procedure of energizing and de-energizing is continued till the object get not reached to last coil, In between this running process the object will get a large force and energy, that the object is fired from the tube with high speed and to the decided direction. The speed of the object can be control by varying supply voltage by voltage regulator. A typical coil gun, as the name implies, consists of a coil of wire, an electromagnet, with a ferromagnetic projectile placed at one of its ends.

Effectively a coil gun is a solenoid, a current-carrying coil which will draw a ferromagnetic object through its center. A large current is pulsed through the coil of wire and a strong magnetic field forms, pulling the projectile to the center of the coil.

When the projectile nears this point the electromagnet is switched off and the next electromagnet can be switched on, progressively accelerating the projectile down successive stages. In common coil gun designs the"barrel"of the gun is made up of a track that the projectile rides on, with the driver into the magnetic coils around the track.

Power is supplied to the electromagnet from some sort of fast discharge storage device, typically a battery or high-capacity high voltage capacitors designed for fast energy discharge. A diode is used to protect polarity sensitive components (such as semiconductors or electrolytic capacitors) from damage due to inverse polarity of the voltage after turning off the coil.

There are two main types or setups of a coil gun: single-stage and multistage. A single-stage coil gun uses one electromagnet to propel a projectile. A multistage coil gun uses several electromagnets in succession to progressively increase the speed of the projectile.



CHAPTER:5

5.1 SOFTWARE DEVELOPMENT

The following tasks are to be executed :-
Requirement Analysis Phase 1
Requirement Analysis Phase 2
Design of System
Coding Phase 1
Coding Phase 2
Testing Phase 1

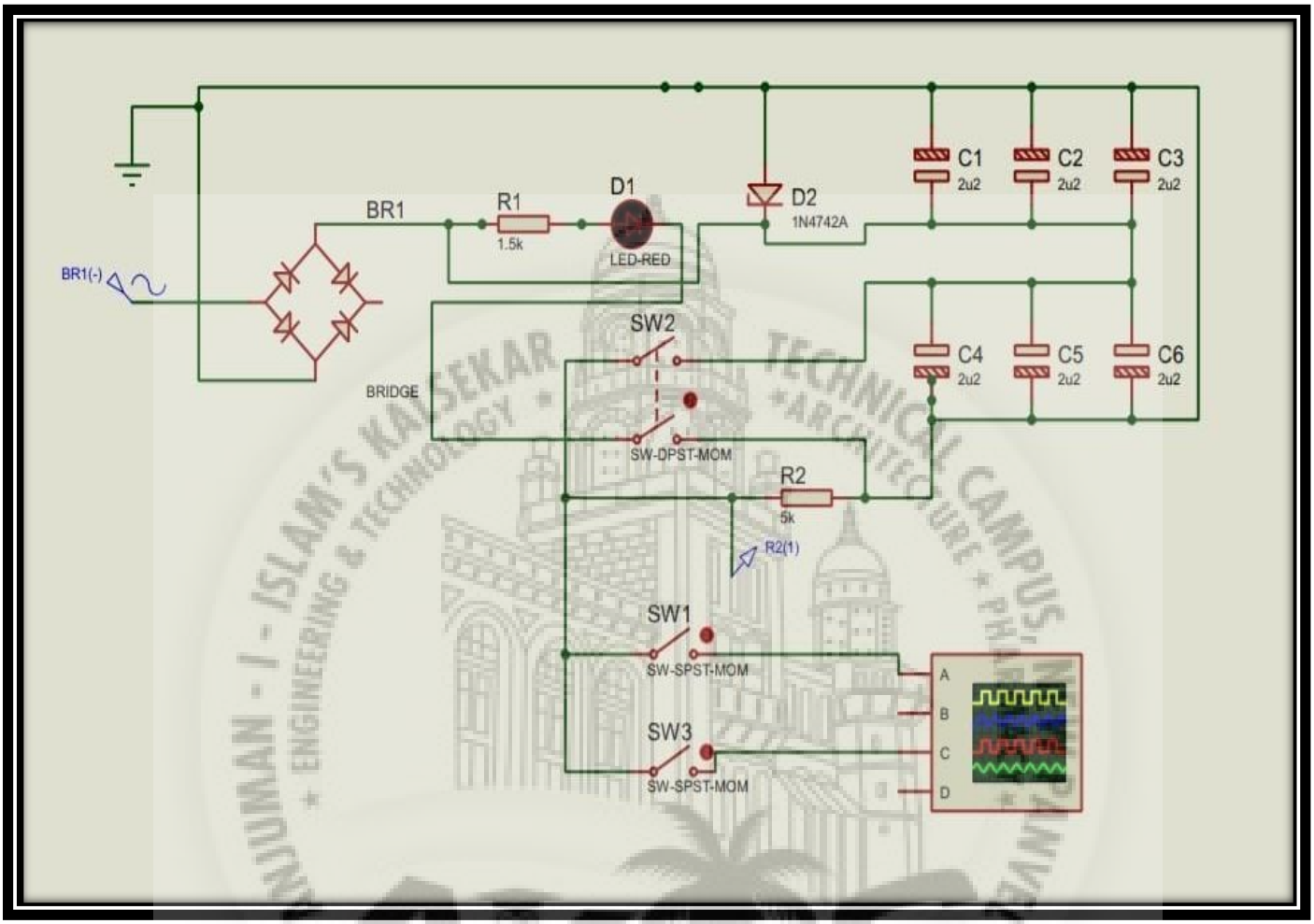
Requirement analysis 1 : This will include the research of existing software and a discussion with the Project guide.
Requirement Analysis Phase 2 : Based on the above results, the project team will discuss and finalize the requirements that are to be provided. We shall consult a number of experts during this phase. The SPMP shall also be prepared during this phase.

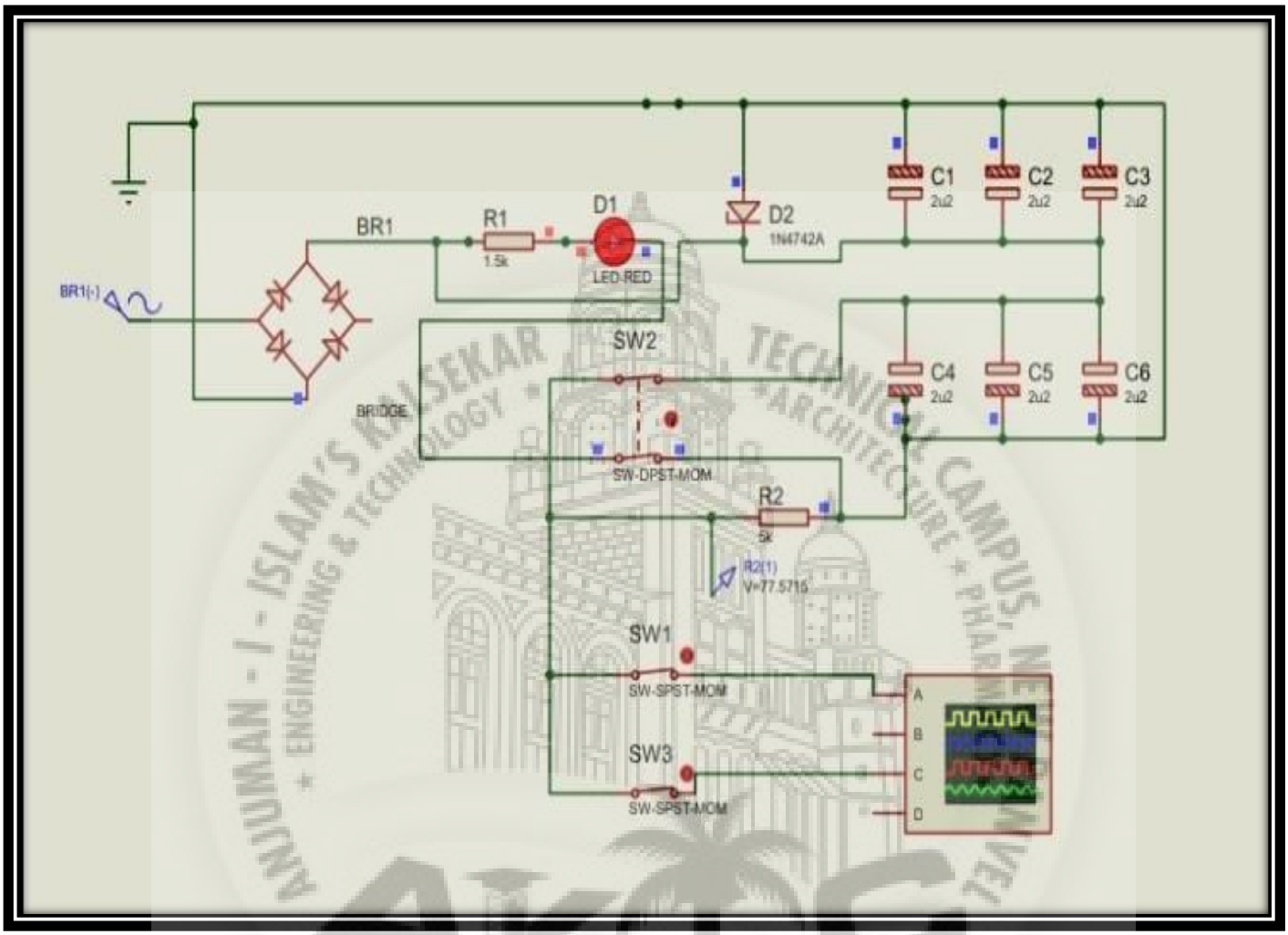
Design Phase : The design phase will involve the design of the static view, dynamic view, and the functional view of the software. A number of diagrams including the Use case, class diagram, activity diagram, and data flow diagrams will be used to model the software. Also, the GUIs will be designed during this phase

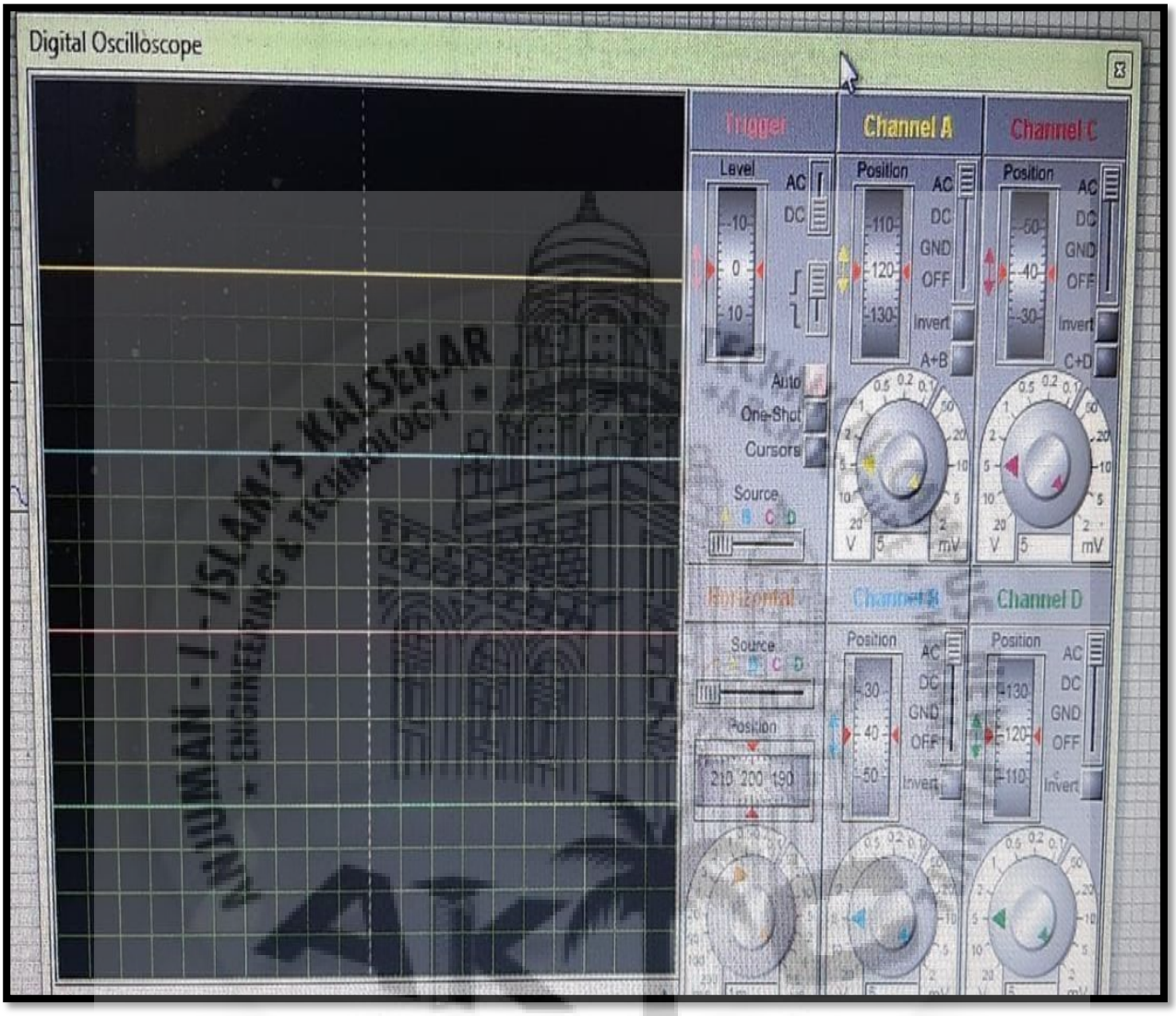
Coding Phase 1 : The prerequisite to this phase is the study of Microsoft Visual basic6. After this study, an initial code of the entire project will be written. Also, the database will be created during this phase. Finally, we shall conduct unit tests.
Coding Phase 2 : This phase will include a review of the code created in Phase 1. After the review, the necessary code and database will be modified to include the results of review.

Testing Phase : We shall be following a testing program that will involve unit testing, integration testing, and validation testing. More information will be known after further discussion.

5.2: SIMULATION






Digital Oscilloscope
Trigger
Channel A
Channel C
Level
Position
AC
DC
GND
OFF
Invert
A+B
C+D
Auto
One-Shot
Cursors
Source
Horizontal
Channel B
Channel D
V
mV

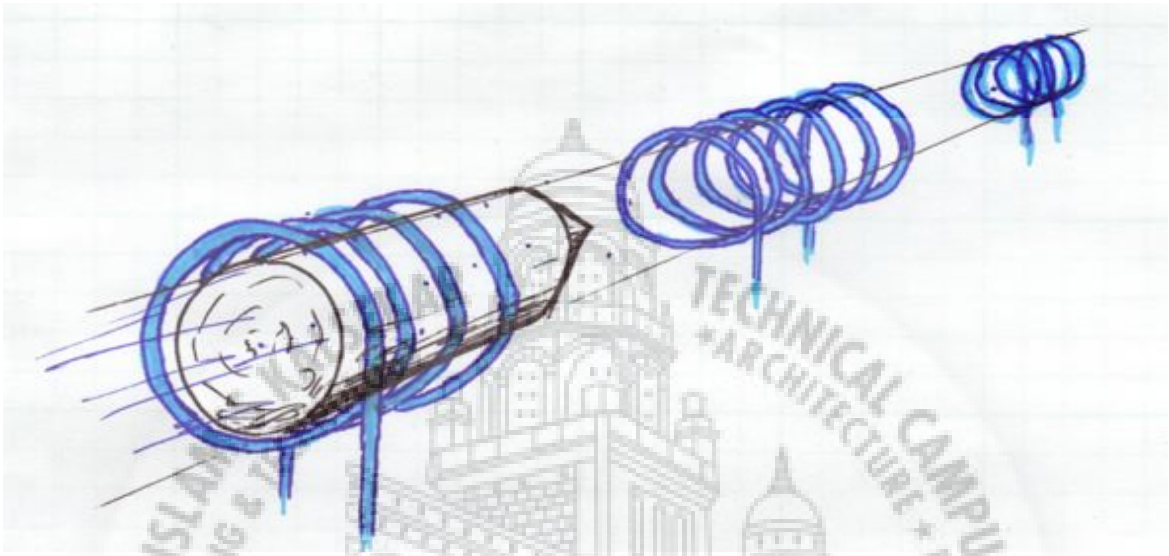
CHAPTER 6: DISCUSSIONS

6.1: COMPONENT LIST

SERIAL NUMBER	COMPONENTS	QUANTITY	COST
1	Acrylic sheet	1	280
2	Aluminium strips (3 mm thick)	1	50
3	450 volt micro farad capacitor	5	130
4	Ball bearing (projectile)	1	10
5	5 volt charger	1	150
6	Control circuit (5v-2kv step up)	1	130
7	650 volt output capacitor	1	20
8	LED indicator for charging	1	150
9	Series capacitor (0.22 micro farad – 2kv)	1	20
10	Transistor for oscillation circuit (2N5609)	2	50
11	Step up transformer (5 volt- 2kv)	2	300
12	Nut bolts	As required	50
13	Wire	As required	200

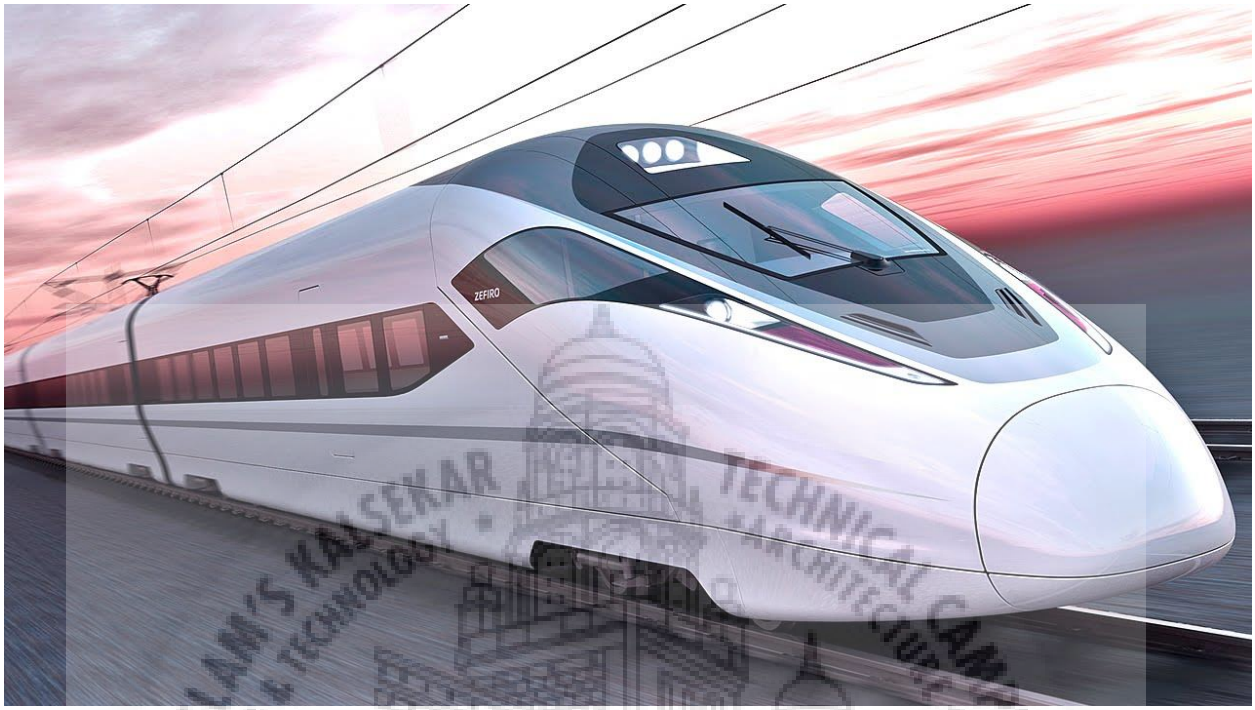
6.2 :APPLICATIONS

1.**Coil Gun**



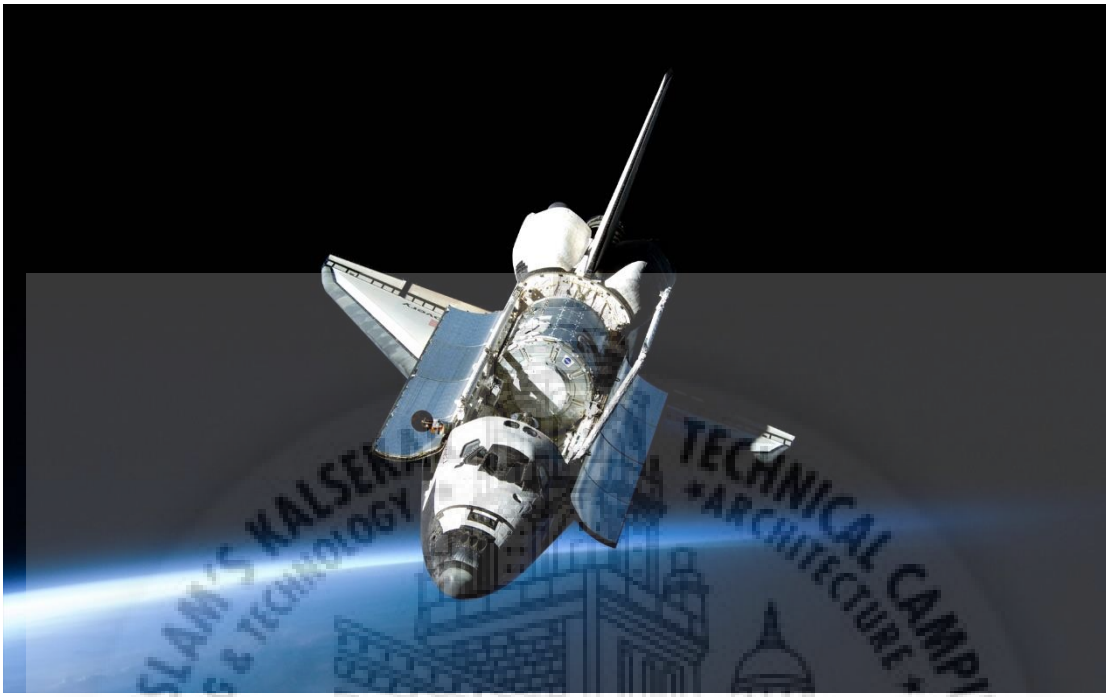
A coil gun is a type of projectile accelerator that consists of one or more coils used as electrowaves in the configuration of a synchronous linear which accelerate a magnetic projectile to high velocity. The name Gauss gun is sometimes used for such devices in reference to carl Friedrich Gau who formulated mathematical descriptions of the magnetic effect used by magnetic accelerators.
Coilguns consist of one or more coils arranged along a barrel. The coils are switched on and off in sequence, causing the projectile to be accelerated quickly along the barrel via magnetic forces. Coil guns are distinct from which pass a large current through the projectile or sabot via slidins contacts. Coilguns and railguns also operate on different principles. The first operational coilgun was developed and patented by Norwegjanphysicist mstian Birkeland. In 1934 an American inventor developed a machine gun similar in concept to the coilgun. Except for a photo in a few publications, very little is known about it.

2.**Magnetic Train**



Maglev (derived from magnetic leviation), is a system of transportation that uses magnetic levitation to suspend, guide and propel vehicles from magnets rather than using mechanical methods, such as wheels, axles and bearings. Maglev transport is a means of flying a vehicle or object along a guide way by using magnets to create both lift and thrust, only a few inches above the guide way surface. High-speed maglev vehicles are lifted off their guide way and thus are claimed to move more smoothly and quietly and require less maintenance than wheeled mass systems-regardless of speed. It is claimed that non-reliance on friction also means that acceleration and deceleration can far surpass that of existing forms of transport. The power needed for levitation is not a particularly large percentage of the overall energy consumption most of the power used is needed to overcome air resistance), as with any other high-speed form of transport.

3.**Space Shuttle Launcher**



The space shuttle was a partially reusable launch system and orbital space craft operated by the U.S. (NASA) for human missions. The first of four orbital test lights occurred in 1981 leading to operational flights beginning in 1982. It was used on a total of 135 missions from 1981 to 2011 all launched from Major missions included launching numerous satelites, interplanetary probes, Hubble Telescope (conducting space science experiments, and constructing and servicing the space station. Major componentss included the , payloads, and supporting infrastructure. Five space-worthy orbiters were built ; two were destroyed in accidents.

During launch, the external tank provided fuel for the orbiter's main engines. The sRBs and ET were jettisoned before the orbiter reached orbit. At the conclusion of the orbiter's space mission, it fired its thrusters to drop out of orbit and the lower atmosphere. The orbiter decelerated in the atmosphere before flying like a glider but with reaction control thrusters before landing on a long runway.

6.3 :ADVANTAGES

- ❖ EMSSL is more reliable.
- ❖ It uses less energy.
- ❖ Time required to launch the shuttle is less.
- ❖ Requirement of man power is less.
- ❖ Elimination of complex mechanisms.
- ❖ Increased service life of carrier based aircraft.

DISADVANTAGES

- ❖ Costs are prohibitive.
- ❖ Signal reception can be spotty.
- ❖ Requirements of high power generation sources.
- ❖ Requirements of separate cooling systems.
- ❖ Unreliability for carrier operations.

6.4: Testing & Troubleshooting

Before you apply power, read the instructions carefully to check you haven't missed anything, and whether there are any specific instructions for switching on and testing.
Check again that you have all polarity sensitive components the right way around, and that all components are in the correct places.
Check off - board components are connected correctly. Check the underside of the board carefully for short circuits between tracks - a common reason for circuits failing to work.
When you are sure everything is correct, apply power and see if the circuit behaves as expected, again following the kit manufacturers instructions.
If it works, WELL DONE! You have your first working circuit - be proud of it! Skip the rest of this page and click the right arrow at the bottom.

If it doesn't quite work as expected, or doesn't work at all, don't despair. The chances are the fault is quite simple. However, disconnect the power before reading on.

Check the basic's first - is the battery flat? Are you sure the 'On' switch really is on? (Don't laugh, it's easily done) If the project has other switches and controls check these are set correctly.
Next - check again all the components are in the correct place - refer to the diagram in the instructions. Look again at the underside of the board - are there any short circuits? These can be caused by almost invisible 'whiskers' of solder, so check for these with a magnifying glass in good light. Brushing the bottom of the board vigorously with a stiff brush can sometimes remove these.

Pull the components gently to see if they are all fixed into the board properly. Check the soldered joints - poor soldering is the most common cause of circuits failing to work.
The joints should by shiny, and those on the circuit board should be volcano shaped with the component wire end sticking out of the top. If any look suspect then redo them. Remove the solder with a solder sucker or braid and try again.

Check for solder splashes shorting across adjacent tracks on the circuit board, especially where connections are very close such as on integrated circuits ('chips'). Solder splashes are most likely on stripboard.
You can check for shorts using a multimeter set it to it's continuity range, or low resistance range. Be aware if you do this though, that there will be a resistance between some tracks due to the components.
Any resistance below 1 ohm between tracks is likely to be a solder splash. Run the soldering iron between tracks on stripboard to remove any solder bridges.

If the circuit still fails to work you will need to refer to the circuit diagram and take voltage readings from the circuit to find out what's wrong. You will need a multimeter to do this, Remember that if you find one fault such as a reversed component and correct it, it might have caused damage to other components.

More Tools & Test Equipment

To design your own circuits, or build more complex kits, you will probably need more in the way of tools and test equipment. If you did not buy a multimeter before then this is essential now, a basic power supply is also very useful.

More expensive items such as an oscilloscope can be useful, but think carefully about whether you really need them - after all, you can build a lot of projects for the price of an oscilloscope. PC-based virtual instruments could perhaps be more suitable. Other tools can be useful too.

Here is a list of other useful items, although this by no means covers all the tools and equipment available. Maplin codes are included, however similar items are available from most suppliers.

Tools:

Helping Hands - Useful for holding PCB's, connectors etc. while you solder them. Also normally have a magnifying glass to help see small components. Can save hours of aggravation! Maplin code YK53H A small vice can also be useful and provides a more rigid mounting than a Helping Hands.

Pearl Catcher - Useful for the retrieving those screws that inevitably fall into the most inaccessible corner of a project! Maplin code BK43W

Heat Shunt - an inexpensive item for soldering heat sensitive devices. Clipped onto the component lead between the joint and the component it will soak up the heat to save you melting your components. As you get faster at soldering you probably won't need it so much. Maplin code FR10L

RCD Circuit Breaker - If you start building mains projects (only do this when you are more experienced and are aware of the safety requirements) then one of these is ESSENTIAL. It could also prevent a shock if you accidentally melt through the soldering iron flex.

These are sold very cheaply in most electrical shops. Well worth the price, although check if your building wiring is already protected by an RCD in the consumer unit first.

Breadboard - If you want to test a circuit without soldering it together permanently then these are useful. Just push the wires into holes joined by metal strips to build the circuit. If the circuit doesn't work, you can easily make changes. Different sizes are available, e.g. Maplin code AG10L

Other items - Other sizes of screwdriver, 0.5Kg reel of solder, tool roll or box etc.

Test Equipment:
Multimeter - almost essential for all but the absolute beginner. See the tools section for more information.

Power Supply - Also very useful for powering circuits that you are testing. One with a variable voltage up to at least 12V is best. The current rating doesn't need to be that high, 1A maximum is fine for most jobs.
If you can afford it then one with an adjustable current limit is useful - set right it can prevent damage to an incorrect circuit, rather than frying it instantly!

Oscilloscope Quite expensive and not really worth it for all but the advanced constructor. None the less a very useful piece of test equipment, especially on audio circuits.
There are some cheaper PC based alternatives, and some hand - held 'scopes now, although I haven't tried them.

Signal Generator - Useful when testing audio circuits, again not really necessary for beginners.
Produces variable frequency waves of several different waveforms (sine, square, triangle)

CHAPTER 7
CONCLUSION

The purpose of this project is to present experimental research information on coil guns and related topics. Thus we hope to foster interest in the fields of physics and engineering. Our long term objective is to design and construct a multi-stage coil guns capable of firing projectiles at supersonic speed. In the past few years other scientists and engineers have published a series of new methods which promise to revolutionize space launching system.
These include the cable accelerator, circle launcher and space keeper, space elevator transport system, space towers, kinetic towers, the gas-tube method, sling rotary method, asteroid employment, electromagnetic accelerator, tether system, Sun and magnetic sails, solar wind sail, radioisotope sail, electrostatic space sail, laser beam, kinetic anti-gravitates, Earth–Moon or Earth-Mars non-rocket transport system, multi-reflective beam propulsion system, electrostatic levitation, etc. Many advances in electromagnetic rail gun or coil gun and power supply technology have been made in recent years.

A coil gun system concept is described here and technology development issues are identified. There are new ideas in aviation which can be useful for flights in planet atmosphere. Some of these have the potential to decrease launch costs thousands of times, other allow the speed and direction of space apparatus to be changed without the spending of fuel.

This topic involves simultaneous use of both propellant and the magnetic field throughout its journey, along with change in the complete structural and material design of the space shuttle.

CHAPTER 8

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