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Approved by AICTE New Delhi, Recognized by the Governmentof Maharashtra and Affiliated to MSBTE, Mumbai
Institute Code: **0141**

A Dissertation on

DYNAMIC WIRELESS CHARGING FOR EVS

PROGRAM- AE-6 I
COURSE NAME – CPE, CODE: 22060
Year: 2023-24

BY

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UNDER THE GUIDANCE OF
Mr.G.M.Nagane.

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DEPARTMENT OF AUTOMOBILE ENGINEERING

VISION AND MISSION OF THE INSTITUTE

VISION:

Achieve excellence in quality technical education by imparting knowledge, skills and abilities to build a better technocrat.

MISSION:

M1: Empower the students by inculcating various technical and soft skills.

M2: Upgrade teaching-learning process and industry-institute interaction continuously.

DEPARTMENT OF AUTOMOBILE ENGINEERING

VISION AND MISSION

VISION:

To achieve excellence in technological and social aspects of automobile engineering

MISSION:

M1: Comprehensive development of students by using state of art infrastructural facilities.
M2: Development of engineering mindset within the students.
M3: Continuous enhancement of skill sets of student and faculty through industry-institute interaction.
M4: Imparting social and ethical values among the students.

PROGRAM OUTCOMES (POs)

PO1: Basic and Discipline specific knowledge: Apply knowledge of basic mathematics, science, engineering fundamentals and automobile engineering to solve the automobile engineering problems.

PO2: Problem analysis: Identify and analyze well-defined engineering problems using codified standard methods in automobile engineering.

PO3: Design/ development of solutions: Design solutions for well- defined automobile engineering problems and assist with the design of systems, components or processes to meet specified needs.

PO4: Engineering Tools, Experimentation and Testing: Apply modern automobile engineering tools and technique to conduct standard tests and measurements.

PO5: Engineering practices for society, sustainability and environment: Apply automobile engineering technology in context of society, sustainability, environment and ethical practices.

PO6: Project Management: Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined automobile engineering activities.

PO7: Life-long learning: Ability to analyze individual needs and engage in updating in the context of technological changes.

PROGRAM SPECIFIC OUTCOMES (PSO)

The Diploma in automobile Engineering will prepare students to attain:

1. **Automobile Maintenance:** Use state-of-the-art technologies in maintenance of automobiles.

2. **Automobile Manufacturing Processes:** Use relevant machinery, materials, equipment and processes to manufacture automobile components.

CO-PO-PSO-Mapping (2023-24)

Sr No.	Project Name	Name of Guide	POs										PSOs	
			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
1.	Dynamic Wireless Charging For EVS	G.M. Nagane												

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CERTIFICATE

This is to certify that Mr. BRANDON JUDE ALPHONSO [En. No. 2201410549] from **AISSMS Polytechnic, Pune-01 affiliated to MSBTE, Mumbai** has completed **Final Project Report** in sixth semester, during academic year 2023-24. Having title **"DYNAMIC WIRELESS CHARGING FOR EVS"** in a group consisting of five persons under the guidance of the Faculty Guide.
.

Prof. G.M. NAGANE.
Project Guide and HOD

Prof. S.M. RAMNANI
Project Co-coordinator

External Examiner
MSBTE

Mr. S.K. GIRAM
PRINCIPAL
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Prof. G.M. NAGANE.
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Prof. G.M NAGANE.
Project Guide and HOD

Prof. S.M. RAMNANI
Project Co-coordinator

External Examiner
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ACKNOWLEDGMENT

It gives us great pleasure to finalize this project on the **“DYNAMIC WIRELESS CHARGING FOR EVS”** domain with title. We are thankful to our guide **MR.G.M.Nagane..** for encouragement and support that they have extended and also for theireffort to the Final Capstone Project. We would also like to thank our project coordinator, **Mr.S.M.Ramnani** for their valuable guidance and support throughout the process.

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We would also like to thank all teaching / Non–Teaching staff members of the Mechanical Engineering Department for showing us the way for finalizing the project, its fabrication andfinal testing.

Thank you to all!

Team members

MR: PRATHMESH VIVEK OTARI
MR: BRANDON JUDE ALPHONSO
MR: SHUBHAM SACHIN KATE
MR: YASH VINAYAK JADHAV
MR: KENONI ZAPHINATH RAJ C

ABSTRACT

Dynamic wireless charging (DWC) for electric vehicles (EVs) is a cutting-edge technology that aims to revolutionize the way EVs are powered and charged. This abstract provides a brief overview of the key concepts, benefits, challenges, and future prospects of DWC for EVs.Dynamic wireless charging enables EVs to charge their batteries while in motion, eliminating the need for frequent stops at charging stations and extending the range and usability of EVs. The technology relies on wireless power transfer systems embedded in roadways or infrastructure, which transmit power to receivers installed on EVs via electromagnetic fields. This seamless charging process allows EVs to recharge their batteries continuously while driving, enhancing convenience and reducing range anxiety for EV users. The adoption of dynamic wireless charging has the potential to address several challenges associated with conventional EV charging infrastructure, such as limited charging station availability, long charging times, and range limitations. By integrating DWC into existing roadways and transportation networks, EVs can operate more efficiently and autonomously, leading to increased adoption and acceptance of electric mobility.

However, the widespread implementation of dynamic wireless charging faces several technical, regulatory, and economic challenges. These include the development of standardized charging protocols, interoperability between different EV models and chargingsystems, infrastructure costs, regulatory approvals, and public acceptance. Addressing thesechallenges requires collaborative efforts from industry stakeholders, policymakers, and researchers to create a conducive environment for DWC deployment and adoption.

CONTENTS

CHAPTER 1

INTRODUCTION:

The advantage of electric vehicles (EVs) has sparked a paradigm shift in the automotive industry, offering a cleaner and more sustainable alternative to traditional internal combustion engine vehicles. However, despite significant advancements in EV technology, challenges suchas limited driving range, lengthy charging times, and the need for extensive charging infrastructure continue to hinder widespread adoption. In response to these challenges, dynamic wireless charging (DWC) technology has emerged as a promising solution to revolutionize theway EVs are powered and charged. Unlike traditional stationary charging methods, DWC enables EVs to charge their batteries while in motion, providing continuous power delivery without the need for frequent stops at charging stations.

The transportation sector stands at a pivotal juncture, with increasing emphasis on sustainability, efficiency, and innovation. Electric vehicles (EVs) have emerged as a key solution to address environmental concerns and reduce dependence on fossil fuels. However, the widespread adoption of EVs faces significant challenges, including limited range, lengthy charging times, and inadequate charging infrastructure. In this context, dynamic wireless charging (DWC) presents a transformative solution that has the potential to revolutionize the way EVs are powered and charged. Dynamic wireless charging enables EVs to charge their batteries while in motion, eliminating the need for traditional plug-in charging methods and offering unparalleled convenience and flexibility to EV users. This groundbreaking technologyrelies on wireless power transfer systems embedded in roadways or infrastructure, which transmit power to receivers installed on EVs via electromagnetic fields. As EVs travel over these charging segments, they seamlessly replenish their batteries, extending their range and usability without the need for frequent stops at charging stations.

The adoption of dynamic wireless charging promises to address several critical barriers hindering the widespread uptake of EVs. By enabling continuous charging while driving, DWCalleviates range anxiety, one of the primary concerns among prospective EV buyers. Additionally, DWC enhances the feasibility of electric mobility in urban environments and high-traffic corridors, where stationary charging infrastructure may be limited or impractical. Moreover, by promoting the electrification of transportation, DWC contributes to reducing greenhouse gas emissions, improving air quality, and advancing energy sustainability goals. Despite these challenges, the potential benefits of dynamic wireless charging for electric vehicles are immense. As advancements continue in wireless power transfer technology, battery efficiency, and infrastructure development, DWC holds the promise of transforming transportation systems into cleaner, more efficient, and sustainable ecosystems. Collaborationamong industry stakeholders, policymakers, and researchers is essential to overcoming hurdlesand unlocking the full potential of dynamic wireless charging for electric vehicles. In doing so,we can usher in a new era of electric mobility that is accessible, convenient, and environmentally responsible.

1. Project Definition:

Dynamic Wireless Charging (DWC) is an innovative technology aimed at revolutionizing how electric vehicles (EVs) are powered and charged. Unlike traditional EV charging methods that require vehicles to stop at designated charging stations and plug in, dynamicwireless charging enables EVs to charge their batteries while on the move.

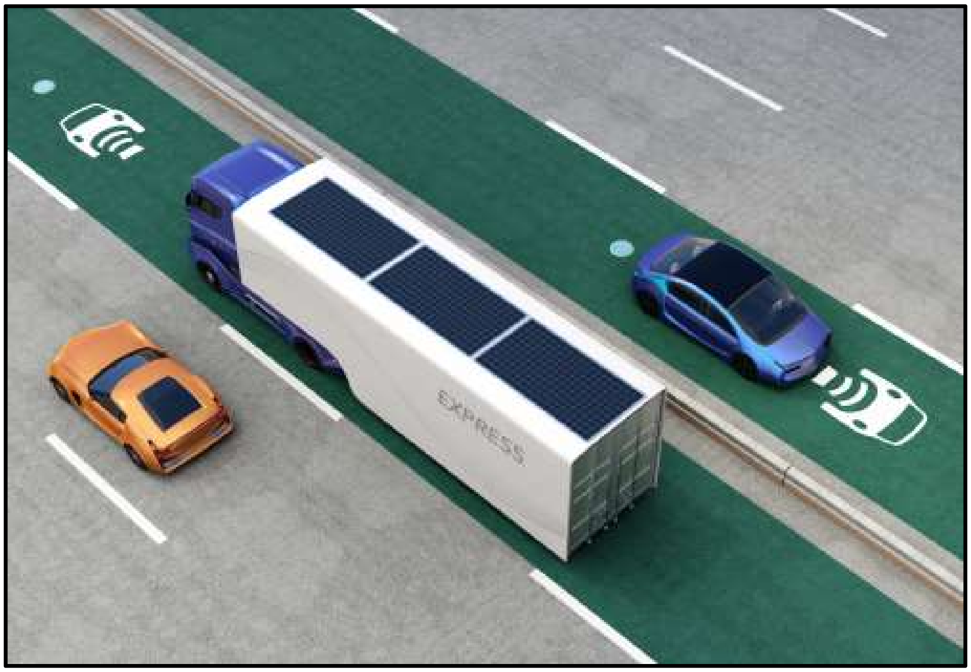
2 Problem Statements:

This project aims to solve the current shortcomings of EVs. Currently EV charging and their range is a topic of concern. EVs don't particularly deliver their full range under a lot of circumstances such as change in temperature, loads, etc. These are the places where IC engines overtake them in terms of advantages. Even the recharging time is a massive drawback in EVs as compared to IC engines. Currently recharging an EV battery Can take anywhere between 2-3 hours as compared to a couple of minutes for a fuel refill at a fuel pump for IC vehicles. Hence DWC aims to solve these problems by allowing the EVs to charge while driving on a specialized strip of road. This solves the recharging time problem by allowing the battery to charge to charge on the go.It also could considerably increase the range of the EV since it is continuously charging. Widespread implementation of this project will encourage the adaptation of EVs for the mass public and hence all the advantages of having an EV (like zero tail pipe emissions, etc)

3 Project Objectives:

- **Develop Efficient Dynamic Wireless Charging System**: Design and develop a dynamic wireless charging system capable of efficiently transferring power to electric vehicles (EVs) while in motion.
- **Optimize Charging Efficiency**: Investigate and optimize the efficiency of power transfer between the charging infrastructure and EVs, considering factors such as alignment, distance, and frequency of charging.
- **Enhance Charging Flexibility**: Explore methods to enhance the flexibility and adaptability of dynamic wireless charging systems to accommodate various road and traffic conditions.
- **Ensure Safety and Reliability**: Prioritize the safety and reliability of the dynamic wireless charging system by implementing robust communication protocols, fail-safe mechanisms, and real-time monitoring.
- **Minimize Environmental Impact**: Assess the environmental impact of dynamic wireless charging systems and aim to minimize energy losses, electromagnetic interference, and potential hazards to wildlife and ecosystems.
- **Evaluate Economic Viability**: Conduct a comprehensive economic analysis to evaluate the cost-effectiveness and feasibility of implementing dynamic wireless charging infrastructure on a large scale, considering installation, maintenance, and operational costs.
- **Demonstrate Practical Application**: Demonstrate the practical application of dynamic wireless charging technology in real-world scenarios, such as urban environments, highways, and public transportation systems.
- **Integrate with Smart Grids and Renewable Energy Sources**: Explore integration possibilities with smart grid technologies and renewable energy sources to optimize energy distribution, reduce grid strain, and promote sustainable transportation solutions.

- **Facilitate Standardization and Interoperability**: Collaborate with industry stakeholders to establish standards and protocols for dynamic wireless charging systems, ensuring interoperability between different manufacturers and promoting widespread adoption.



CHAPTER 2

LITERATURE SURVEY FOR PROBLEM IDENTIFICATION

Evolution of wireless charging

The evolution of wireless charging technologies spans several decades and has seen significant advancements in efficiency, convenience, and application versatility. Here's a brief overview:

Early Developments (20th Century):

Wireless power transfer (WPT) technologies trace back to the pioneering work of Nikola Teslain the late 19th and early 20th centuries. Tesla demonstrated wireless power transmission experiments, including lighting bulbs wirelessly over short distances using resonant inductivecoupling.
Early experiments laid the foundation for future wireless charging technologies but faced limitations in efficiency and practicality.

Inductive Charging (2000s):

Inductive charging, based on electromagnetic induction, gained traction in the early 21st century for consumer electronics such as electric toothbrushes and smartphones.
The Wireless Power Consortium (WPC) developed the Qi standard in 2008, providing a common specification for inductive charging systems and enabling interoperability across various devices.Inductive charging utilizes coils in both the charging pad (transmitter) and the device (receiver) to transfer power through magnetic fields. While efficient, it typically requires precise alignment and proximity between the coils.

Resonant Charging (2010s):

Resonant wireless charging emerged as a significant advancement, offering greater flexibility inalignment and distance between transmitter and receiver coils.
By resonating at the same frequency, resonant charging systems achieve higher efficiency andcan tolerate larger spatial gaps between coils.
Organizations like the Alliance for Wireless Power (A4WP) and the AirFuel Alliance developedstandards such as Rezence (A4WP) and AirFuel Resonant, promoting interoperability and driving adoption in various applications.

Magnetic Resonance Coupling:

Magnetic resonance coupling represents a further refinement of resonant charging technology,enabling even greater distances between the transmitter and receiver coils.

Unlike traditional inductive charging, magnetic resonance allows for spatial freedom and can charge multiple devices simultaneously on a single charging pad.

Major technology companies like WiTricity and Qualcomm have pioneered magnetic resonance charging solutions, targeting applications ranging from consumer electronics to electric vehicles.High Power Applications and Automotive Industry:

In recent years, wireless charging has gained momentum in high-power applications, particularly in the automotive industry for electric vehicle (EV) charging.

Dynamic wireless charging (DWC) technology has emerged as a promising solution for EVs, enabling continuous charging while in motion on roads equipped with embedded charging infrastructure.

Research and development efforts focus on optimizing efficiency, increasing power transfer capabilities, and addressing challenges such as coil misalignment and energy loss.

Future Directions:

Future wireless charging technologies are likely to focus on enhancing efficiency, increasing power levels, and expanding application versatility.

Innovations such as beam forming, meta materials, and resonant repeaters hold promise for overcoming existing limitations and enabling new use cases, such as long-range wireless powertransfer and integration with IoT devices.

Current State of Dynamic Wireless Charging (DWC) for EV

As of the latest available information, the field of Dynamic Wireless Charging (DWC) for Electric Vehicles (EVs) has been progressing steadily, with ongoing research, development, and some pilot projects around the world. Here's an overview of the current state:

Pilot Projects and Demonstrations:

Several pilot projects have been initiated to test and demonstrate the feasibility of DWC for EVs in real-world settings. These projects typically involve equipping test vehicles with dynamic wireless charging capabilities and deploying charging infrastructure along selected routes.

For example, in Sweden, the eRoad Arlanda project implemented a test track equipped with aninductive charging system embedded in the road surface, enabling electric trucks to charge whiledriving. Similar projects have been launched in other countries, including the United States, South Korea, and the United Kingdom.

Research and Development Efforts:

Universities, research institutions, and companies are actively engaged in R&D activities aimed
at advancing DWC technology for EVs.
Research focuses on improving system efficiency, optimizing power transfer algorithms, enhancing vehicle-to-infrastructure communication, and addressing practical challenges such asalignment tolerance and interoperability.
Advanced simulations and modeling techniques are being used to evaluate the performance ofDWC systems under different conditions and scenarios.
Technological Advancements:

Advances in power electronics, wireless communication, and materials science are driving technological improvements in DWC for EVs.
Innovations such as bi-directional power transfer, dynamic power control, and adaptive chargingalgorithms are being explored to enhance system efficiency and flexibility.
Integration with smart grid technologies and vehicle-to-grid (V2G) communication protocols isbeing investigated to enable bidirectional energy flow and optimize the utilization of renewableenergy sources

Industry Collaboration and Standardization:

Industry consortia, standards organizations, and government agencies are collaborating toestablish common standards and protocols for DWC systems.
Efforts are underway to address technical challenges, ensure interoperability between different manufacturers' systems, and establish safety and regulatory guidelines.
Standardization initiatives aim to accelerate the deployment of DWC infrastructure and facilitate the widespread adoption of dynamic wireless charging for electric vehicles.
Challenges and Limitations:

Despite progress, DWC technology for EVs still faces several challenges and limitations, including high installation costs, limited infrastructure availability, and regulatory barriers.
Practical issues such as coil misalignment, energy loss, and system scalability need to beaddressed to realize the full potential of DWC for EVs.
Public acceptance and consumer confidence in the reliability and safety of DWC systems arealso important factors influencing adoption rates.

Key Components and Technologies

Charging Infrastructure:

Roadway Embedded Coils: Conductive or inductive coils embedded in the roadway surface serve as the primary charging infrastructure. These coils generate an electromagnetic field to transfer power wirelessly to the vehicle's receiver coil. Power Supply and Control Unit: Manages power distribution to the embedded coils and ensuressafe and efficient operation of the charging system. It may include power electronics, communication interfaces, and monitoring sensors.
Vehicle Components:

Receiver Coil: Installed on the underside of the electric vehicle, the receiver coil captures theelectromagnetic energy transmitted by the roadway coils and converts it into electrical power for charging the vehicle's battery.
Power Management System: Regulates the power flow from the receiver coil to the vehicle's battery, monitors battery status, and manages charging protocols to ensure optimal performanceand safety.

Communication Interface: Facilitates communication between the vehicle and the charging infrastructure to coordinate power transfer, optimize alignment, and exchange operational data.Alignment Optimization Technologies:

Sensor Systems: Utilize various sensors, such as cameras, lidar, or magnetic field sensors, to detect the relative position and orientation of the vehicle with respect to the roadway coils. Thisinformation is used to adjust the vehicle's position for optimal alignment during charging.
Control Algorithms: Employ sophisticated control algorithms to dynamically adjust the vehicle's trajectory and orientation to maximize charging efficiency and maintain alignment with the roadway coils.
Power Transfer Technologies:
Magnetic Resonance Coupling: Employed in many DWC systems, magnetic resonance coupling enables efficient power transfer over short distances with minimal coupling losses. Resonance occurs when the frequencies of the transmitting and receiving coils are closely matched, allowing for robust power transfer even with variations in distance and alignment.
Dynamic Power Control: Adaptive power control algorithms adjust the power level and frequency of the transmitted electromagnetic field based on real-time feedback from the vehicle's receiver and environmental conditions. This helps optimize power transfer efficiencyand mitigate electromagnetic interference.
Safety and Regulatory Systems:

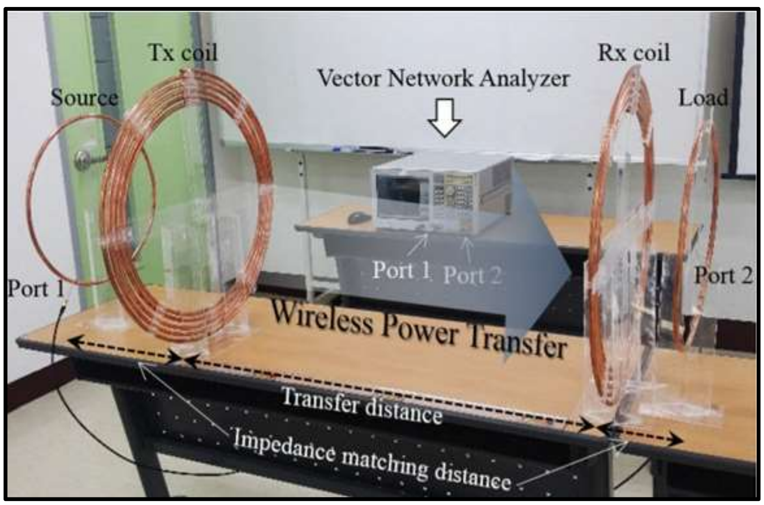
Over current and Over voltage Protection: Integrated safety features monitor the charging process and protect against potential hazards such as excessive current or voltage levels.

Compliance with Standards: DWC systems must adhere to relevant safety and regulatory standards, ensuring compatibility, interoperability, and compliance with electromagnetic radiation limits.

Materials and Manufacturing:

Advanced Materials: High-performance materials with excellent electrical conductivity, thermal stability, and durability are used in the construction of roadway coils and vehicle components to withstand harsh operating conditions and maintain long-term reliability.

Manufacturing Processes: Precision manufacturing techniques are employed to fabricate roadway coils and vehicle components with tight tolerances and high-quality standards,ensuring reliable performance and compatibility across different DWC systems.



HEVO

OAK RIDGE
National Laboratory

CHAPTER 3

Scope of the Project

1. Project Specifications:

1) **Wireless Charging Technology:** Incorporate a dynamic wireless charging system capable of transferring power efficiently from the primary coil embedded in the track to the secondary coil on the toy car.
2) **Coil Design and Placement:** Design and position the primary and secondary coils to ensure effective power transfer while the toy car moves along the track. Optimize coil dimensions, spacing, and alignment for maximum efficiency.
3) **Power Electronics:** Include power electronics components such as rectifiers, inverters, and voltage regulators to manage the power flow between the primary and secondary coils and to regulate the voltage and current for safe charging.
4) **Control System:** Implement a control system to manage the wireless charging process, monitor parameters such as voltage, current, and ensure safe operation of the charging system.
5) **Toy Car Design:** Design a toy car model with a lightweight and aerodynamic body, suitable for dynamic wireless charging on the track. Incorporate space for the secondary coil and power electronics components while maintaining the aesthetic appeal of the toy car.
6) **Track Construction:** Construct a track made of plywood or similar material, embedding the primary coil within the track surface. Ensure the track design allows for smooth movement of the toy car and optimal alignment with the primary coil.
7) **Power Source:** Provide a power source to supply electricity to the primary coil embedded in the track. Consider using a low-voltage DC power supply or a battery pack to energize the charging system.
8) **Safety Features:** Implement safety features such as overcurrent protection, overvoltage protection to prevent damage to the charging system and ensure user safety during operation.
9) **Testing and Calibration:** Conduct thorough testing and calibration of the dynamic wireless charging system to verify performance, efficiency, and reliability under various operating conditions.

2. Planning and design requirements:

1. **Budget:** Determine the budget for the project, considering the costs of materials, components, and tools required for construction.
2. **Timeline:** Establish a timeline for the project, outlining key milestones and deadlines for design, fabrication, testing, and completion.
3. **Skills and Expertise:** Assess the skills and expertise required to undertake the project, including knowledge of electrical engineering, wireless charging technology, mechanical design, and fabrication techniques.
4. **Safety Regulations:** Adhere to relevant safety regulations and guidelines governing the construction and operation of electrical devices and toys, ensuring compliance with safety standards.
5. **Aesthetics and Presentation:** Consider the aesthetic appearance and presentation of the toy

car model and charging track, aiming for an attractive and engaging design that captures the interest of users.

6. **User Experience:** Prioritize user experience by designing intuitive controls, clear instructions, and engaging interactions that enhance the enjoyment and usability of the dynamic wireless charging toy car.
7. **Sustainability**: Consider the environmental impact of the project and strive to use sustainable materials and practices wherever possible, minimizing waste and promotingeco-friendly design principles.
8. **Documentation and Reporting**: Maintain detailed documentation throughout theproject, including design specifications, fabrication processes, test results, and lessonslearned, to facilitate future replication and dissemination of knowledge.

3. Applications:

1) **Electric Vehicles (EVs) and Autonomous Vehicles (AVs)**:
   a) **Public Transportation**: Dynamic wireless charging can be implemented in public transportation systems such as buses and trams, allowing vehicles to charge while in motion, thus extending their operational range without the needfor frequent stops.
   b) **Fleet Operations**: Dynamic wireless charging can benefit fleet operators by enabling continuous charging of electric vehicles, reducing downtime for recharging and increasing overall fleet efficiency.
   c) **Autonomous Vehicles**: DEVC technology can support autonomous vehicle fleets by providing continuous power to self-driving cars, eliminating the needfor manual charging and enabling uninterrupted operation.
2) **Urban Infrastructure**:
   a) **Roads and Highways**: Integration of dynamic wireless charging into roadways and highways can enable electric vehicles to charge while driving, offering a seamless and convenient charging experience for commuters and long-distancetravelers.
   b) **Traffic Management**: DEVC technology can be used in conjunction with intelligent transportation systems (ITS) to optimize traffic flow, reduce congestion, and improve air quality in urban areas by encouraging the adoptionof electric vehicles.
3) **Logistics and Transportation**:
   a) **Freight Transport**: Dynamic wireless charging can revolutionize freight transportation by enabling electric trucks to charge while on the move, therebyincreasing efficiency, reducing emissions, and lowering operating costs for logistics companies.
   b) **Ports and Warehousing**: DEVC technology can be deployed in port facilities and distribution centers to support electric cargo handling equipment, such as forklifts and pallet trucks, ensuring continuous operation without the need for manual charging.

Potential Advantages of Dynamic Charging

1. If wireless EV charging technology can be perfected and implemented in infrastructure, the widespread use of dynamic inductive power transfer has many potential advantages.

2. Continuous electric vehicle battery charging can alleviate range anxiety because vehicles can charge as they move, potentially boosting their market share.

3. Effective dynamic charging solutions reduce the need for plug-in charging stations, saving space.

4. Ongoing charging allows for a smaller EV battery size with reduced weight, helping to decrease the cost of EVs and conserving materials.

5. Dynamic charging is more convenient than using a gas station or stationary EV charging stations because it saves time, helping to boost the popularity and appeal of EVs.

6. If wireless EV charging technology becomes widely used, it could accelerate the transition to cleaner energy sources and help mitigate climate change.

7. Increases the potential uses for electric vehicles, including long-haul trucks.

Disadvantages of Wireless EV Charging

1. Although dynamic wireless charging is promising, it does have challenges requiring further research and funding.

2. More research is needed to boost the power levels and efficiency of the existing technology. For example, misalignments or deviations of the receiving coil's position from the optimal position above the transmitting coil can impact the efficiency and reliability of wireless dynamic charging systems.

3. Finding the space for the wireless charging pad and equipment on the underside of an existing vehicle can be challenging.

4. Overcoming technological challenges related to vehicle body interference with power transfer efficiency.

5. Retrofitting infrastructure and integrating dynamic wireless charging capabilities into existing construction for widespread implementation would be costly.

CHAPTER 4

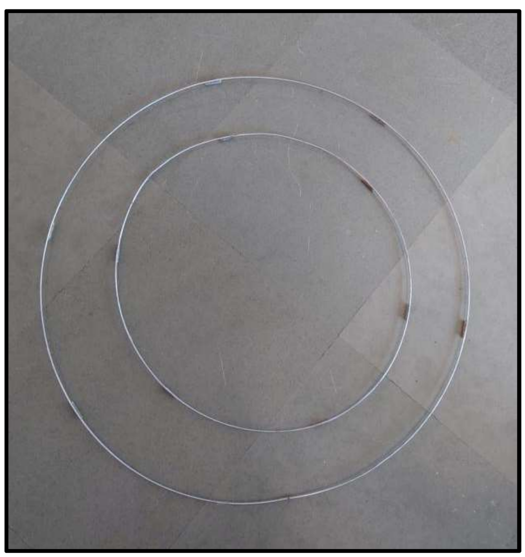
Methodology

Designing Procedure:
After an entire semester of CPP (Capstone Project Planning) steps to arrive at a fully functional project was determined. This semester those steps were followed as such:

- First we acquired the main components. These include the plywood, bolts, nuts, washers, toy car, motor, batteries, transformer cores, bobbins, copper, and steel wire

- Then after the components were acquired we proceeded to begin fabrication.

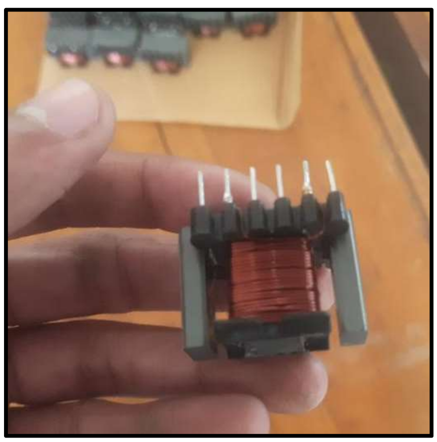
- The tracks were made first out of steel wire with an outer diameter of 30 inches and an inner diameter of 21 inches.



- Hence the difference between the two tracks was set to 4,5 inches which is the width of the toy car from end to end.

- After that we took one of the ply and called it the top ply. On the top ply we marked the centre and drew out the 30 inch and 21 inch circle to mark out where the track would sit.
- Then we took the cores bobbins and copper and started to wind them. We wound a total of 45 cores, out of which, 42 were later on placed on the top ply and one in the car. All the cores were wound with 45 turns

- After wound the copper around the bobbins, we scrapped the insulation from the ends of the wire and soldered it to the pins on the bobbins.
- Once the bobbins were wound and scrapped and soldered, the cores were then stuck onto it using a rubber adhesive – FeviBond



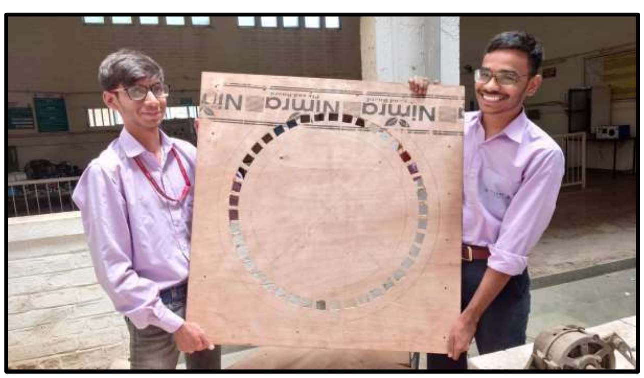
- Now the core assemblies were ready.The dimensions of the cores were then measured and

then slots were drawn on the top ply to be cut out. The slots were made to lie right in the middle of the track width.

- These slots were then cut out over a course of multiple days using tools like chisels, hammers, and drilling machine.This work was performed under the guidance of **Rahul Patre** sir from the workshop.

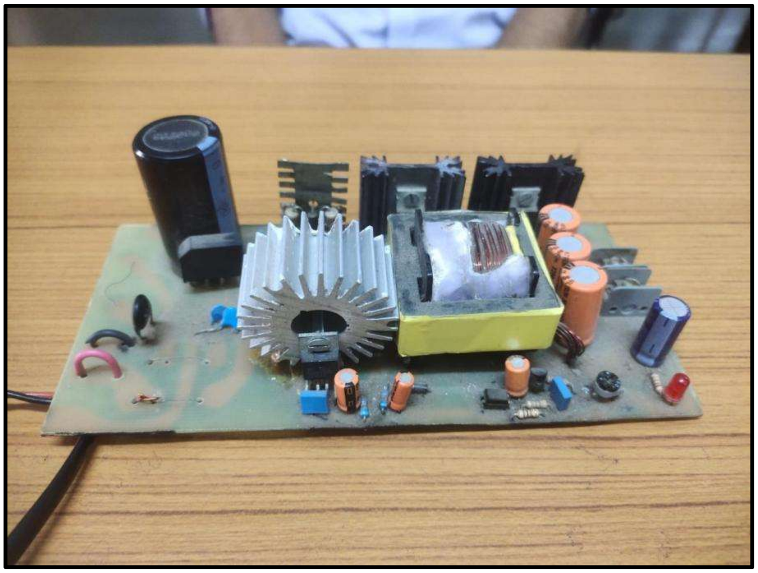
- Once the slots were cut, they were filed with the help of a file in order to provide a smooth surface for the core to slide into and also stick to. While filing we were making sure that the core was sliding in with no issue.

- The ply was losing its top layer during this process especially while filing it. This damage and its amplitude was noted in order to rectify it later on.Once the ply was cut it was then



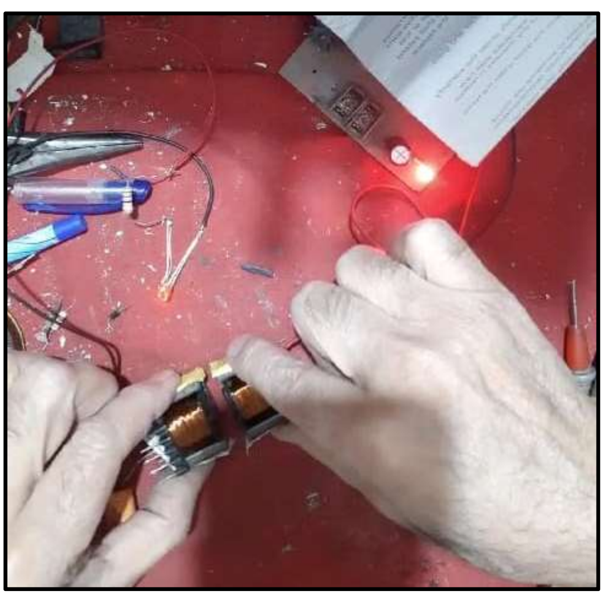
drilled with 25 holes – 6 on each side of the ply and 5 in the centre. The same holes were drilled in the same place again in the bottom ply.

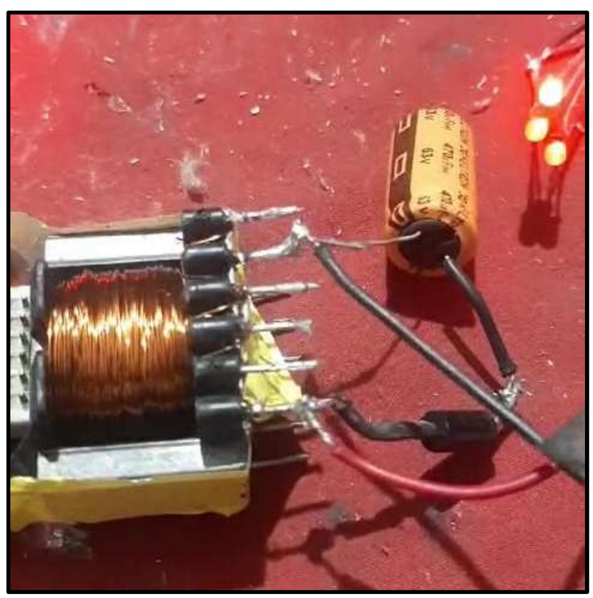
- Professor S.M. Ramnani helped in the making of the SMPS supply which would receive 220 volts from the grid, step it down to 12 volts, but increase its frequency to 50k Hz from 50 Hz.



- Once the SMPS was ready an initial test was performed using two cores, one as a primary and the other as a secondary. We observed whether there was induction of current from the primary to the secondary without any contact. We also observed the distance of transmission of energy. It was observed that the lower the distance between the cores were kept the higher output would be available at the secondary

- After the success of this initial test of the system we proceeded to repair our damaged ply by applying M – Seal. The M – Seal was bleeding into the slots prepared so once it was dry we proceeded to sand it using the file so that the cores would still slide in with no problem.





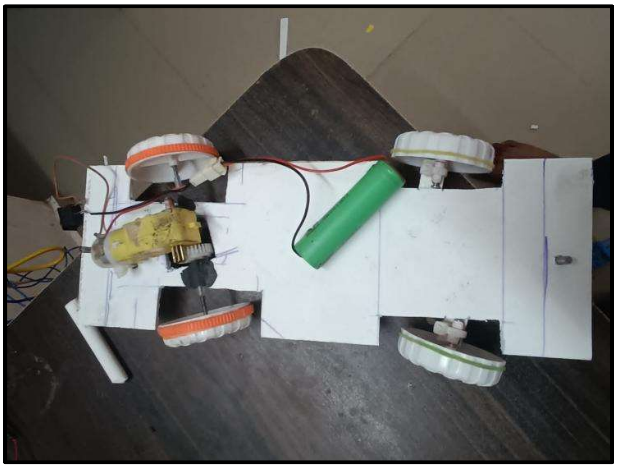
- We then went to the college workshop to make pulleys out of wood to replace the wheels of the car in order for it to run on the track (like a train).

- Under the guidance of **Rahul Patre** Sir the pulleys were made on a wooden lathe machine. All four pulleys were made on a single job and were later on cut using an angle grinder the following day

- We proceeded to install the tracks on the top ply which were attached on the the ply sticking some small pieces of foam board into some groves that were chiseled onto the outline of the track that was drawn from earlier, and the track on top of the foam board in order to give the track a slight elevation above the ply.

- We replaced the car wheels with the pulleys that were made and attempted to run it on the tracks, but we found that we car was to big and the circle of the track was to small to ignore curvature. The car's axle would not align to the the track and hence the pulleys would not sit on it

- Hence in order to solve this problem, we removed the inner track and angled the axles of the car by preparing a custom base for the car made out of foam board. After a lot of trials and errors, fails and successes, we finally were able to have the toy car rotate around the track with constantly with no problem. While reaching this stage we had to ditch the wooden pulleys we made earlier and revert back to the original toy wheels.

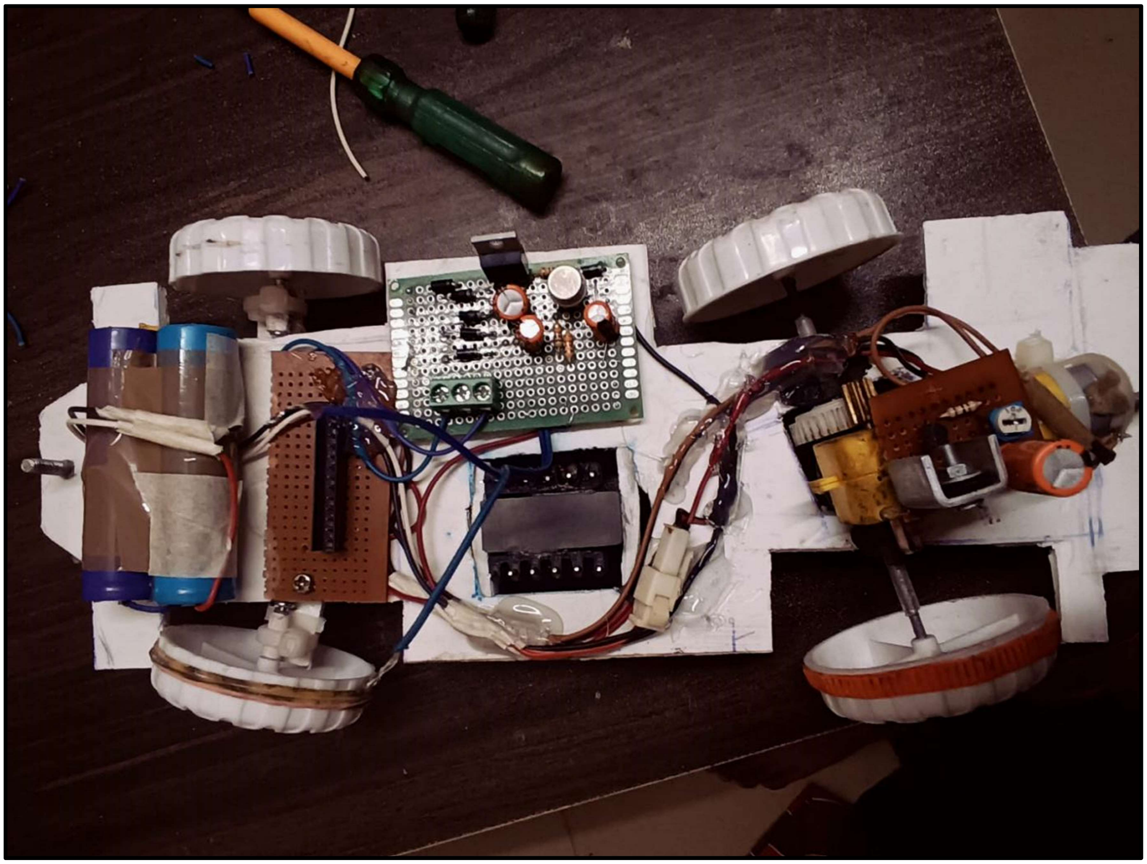


- Once that was done the cores were placed in the slots on the top ply and they were connected and soldered to each other. All the starting of the windings was soldered to each other, and all the endings of windings were soldered to each other. Hence all 42 cores were connected in parallel with two wires ready to be connected to the SMPS.

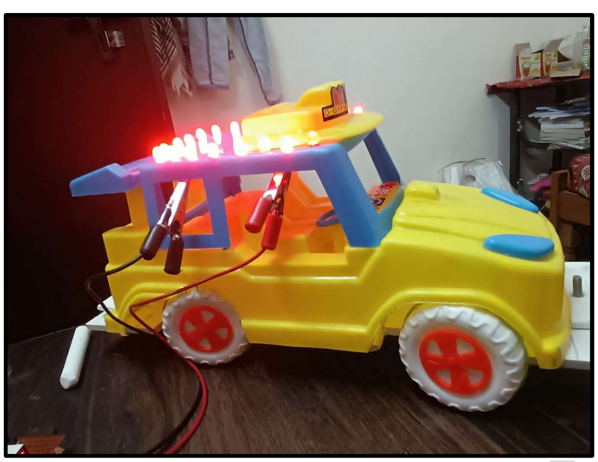
- After all the cores were connected in parallel, they were stuck to the ply using hot glue at first, followed by Feviquik.

- Once the cores were fully stuck, the top ply was bolted onto the bottom ply with some distance in-between the two to accommodate the SMPS. The height was uniformed for all the bolts so that the top ply would sit level on top.

- The top ply was then removed and the SMPS was drilled into the bottom ply so that it would sit flush and not move or fall of. A connector was then added between the SMPS output and primary coils input for fast connection or disconnection.



- The focus was shifted to the fabrication of the car now. We took out the base and made a hole in it to accommodate our secondary or receiver core of the car. After that under the guidance of **Ramnani** Sir we prepared our filter and condenser circuit that converts AC from the receiving coil to DC by using a fast recovery diode (FR) and used a 7805 voltage regulator to maintain the voltage level of the output and a 100nF capacitor to prevent fluctuations or pulsations while moving from one coil to the next. We then took the roof of the car and made 20 holes in it. These holes would hold 20 LEDs on top of the car. The purpose of these LEDs is to show that we are receiving current wirelessly from the coils



- Two Lithium Ion batteries were taken and then connected in parallel to each other. Hence the nominal output voltage of the batteries remains at 4 volts. The LEDs and the batteries were then connected to the output of the 7805 regulator in parallel and a IN4007 diode in between the battery to prevent current from flowing back to charge the LEDs.

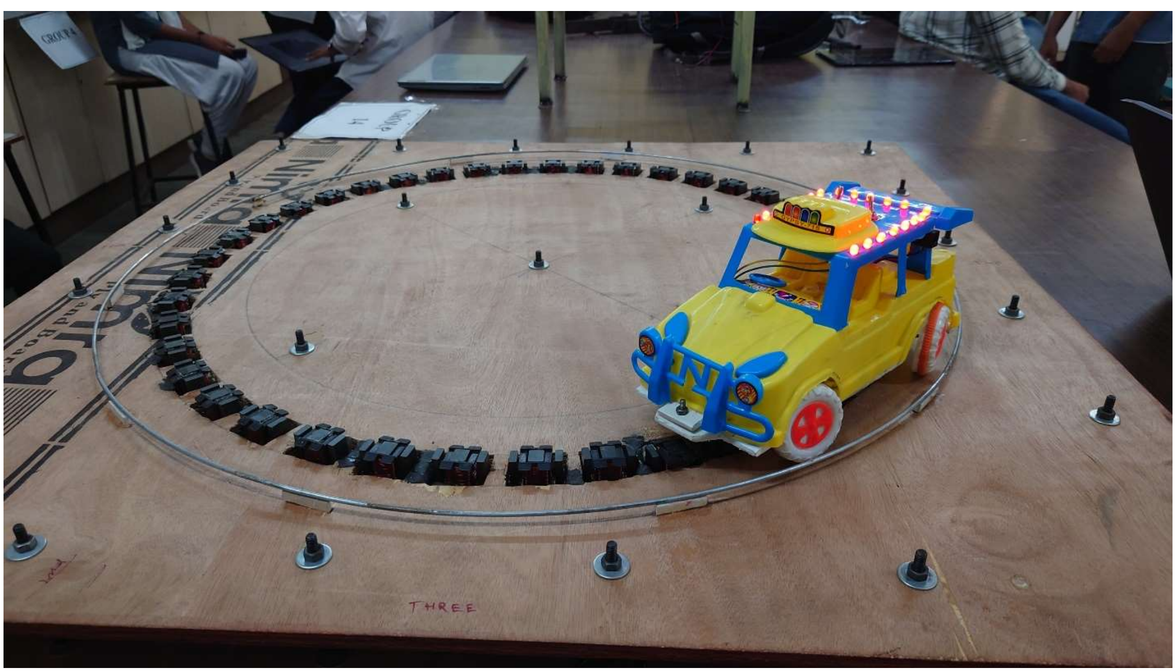
- A voltage regulator circuit was then prepared to control the speed of the motor. It was prepared using resistors, transistors, potentiometer, heat sink and a capacitor.

- This circuit was connected to the battery and the output of the speed controller was connected to the motor. Care was taken while connecting the motor to the output of the controller to ensure that the polarity was not incorrect or else the motor would spin in the clockwise direction which would cause the car to reverse around the track

- Once the car circuits were ready finishing touches were given.We added switches for the LEDs and the motor. The height of the receiving core was adjusted to be as close to the transmitting coils and hence to keep efficiency of the circuit as high as possible.

- We added a charging port for the batteries to replicate a real life EV. The charger was also connected in parallel to the battery. A connector was added between all the wires between the body of the vehicle and the base of the vehicle so that both parts could easily be separated for ease of work and repairs. Also small nuts and bolts were attached to the base and the body for an easy and firm connection between the base and the body.

- Once all that was completed, a final test was performed to ensure everything was perfectly working and that the the LEDs and the batteries were properly receiving current before painting the project and decorating it with some prints

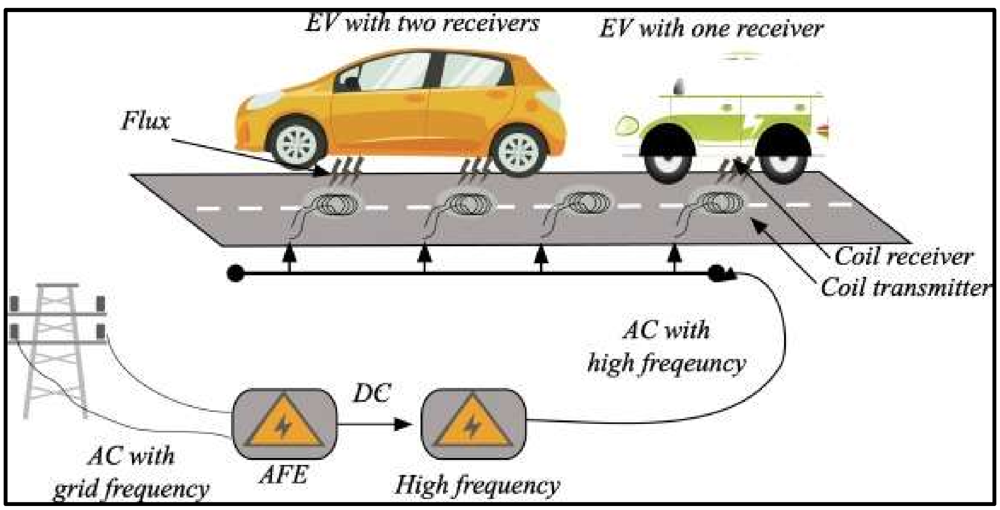


CHAPTER 5

Details of Design, Working and Process

Circuit details:

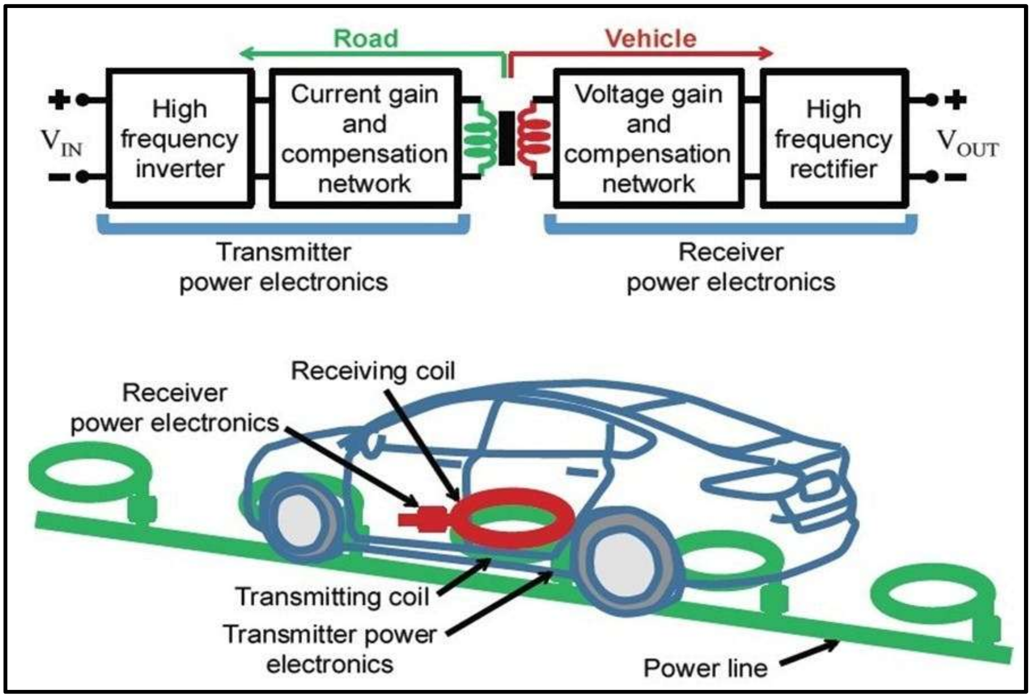
- SMPS is a 220 volt and 50 Hz AC input and 12 volt 50 kHz AC output. It reduces the voltage for scaling and conceptual purpose and increases the frequency for wireless transfer.
- Both the primary and secondary coils have the same number of turns which is 45 turns.
- The primary coils receive 12 volts AC and the secondary coils provides about 9 volts AC at the output with about 30% loss due to wireless transfer.
- The filter and condenser receive the 9 volts and regulate it to 5 volts which is used to power the LEDs and charge the batteries



- For real life application the primary coil would need at least 30kw of power at the input as compared to the 0.012kw we have provided in this project.
- If a same 70% loss is observed then we can expect an output of 21kw from the output of the secondary or the receiver coil of the vehicle
- If the vehicle remains stationary then this would would provide roughly 100kms of range per hour of charging, but this could vary depending on the vehicle itself
- An EV uses about 0.02kwh of electricity per kilometer of driving, which is about 20kwh per 100 kms

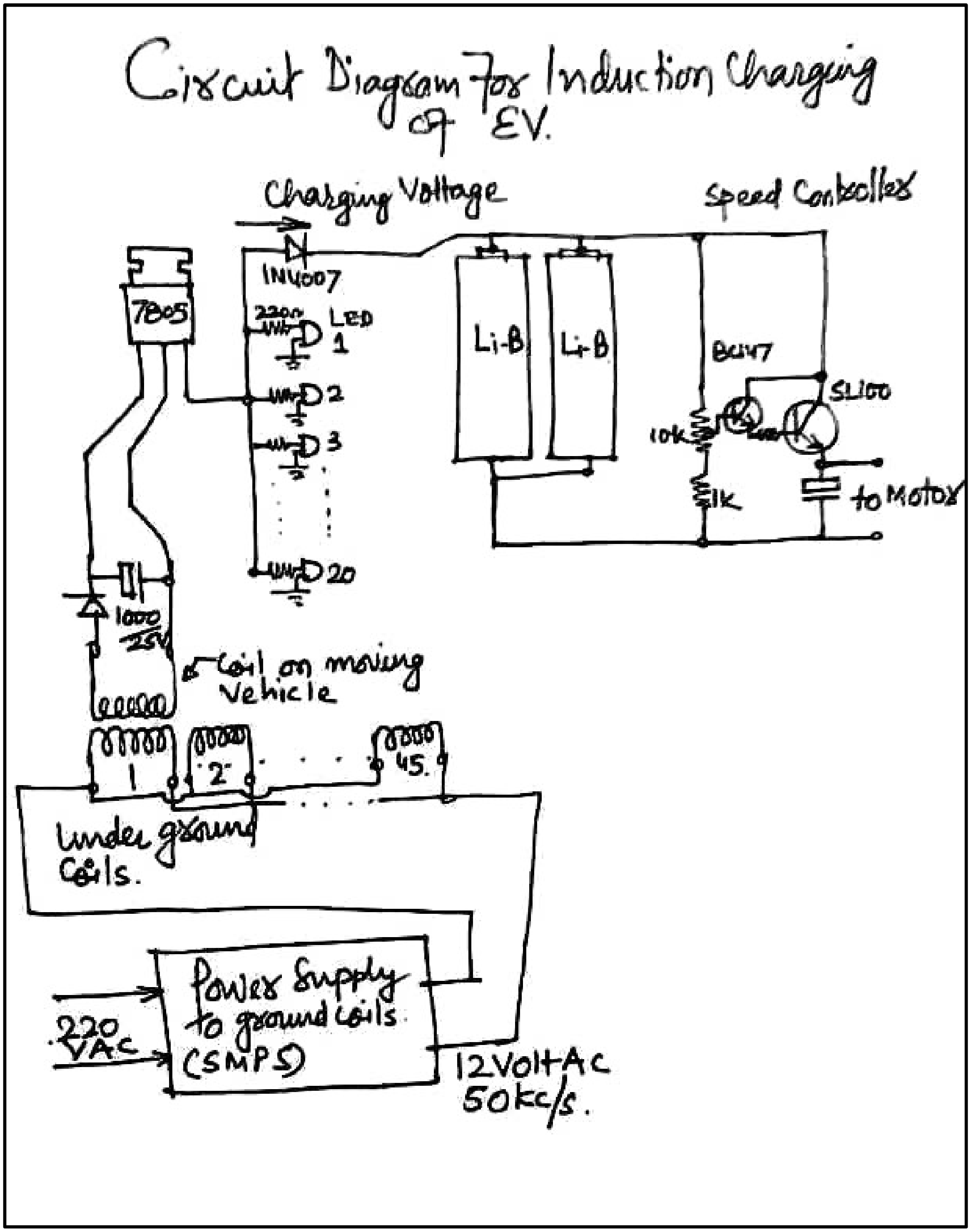
- Hence with rough calculations the car should take about 6 hrs to fully charge but the could widely change depending on the size of the battery, inherent charging system of the vehicle, its speed on the road, its drag coefficient, its ground clearance etc.

- Also the presence or absence of regenerative braking could also widely affect the charging time of the vehicle



- While the project does sound like it would completely solve the charging problem by providing infinite range of the vehicle, but with current technology it could only considerably increase range at most.
- With current technology the vehicle would eventually run out of charge
- But it is not completely impossible to achieve an ‘infinite range situation’, it would just involve a lot of optimization of not only the off-board and on-board charging systems but also of the entire vehicle, including its aerodynamics.

Circuit Diagram of the Project:



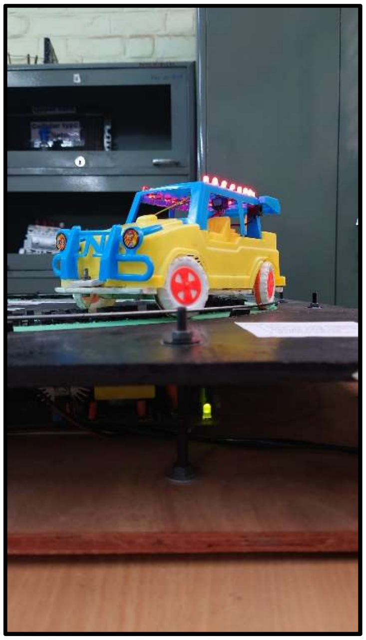
CHAPTER 6

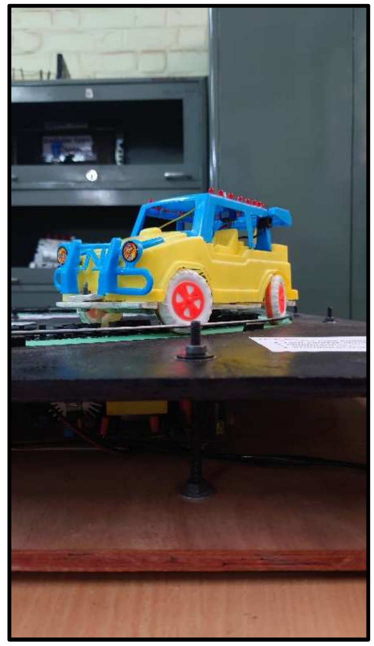
Project Results, Analysis and Applications

Prepared project:

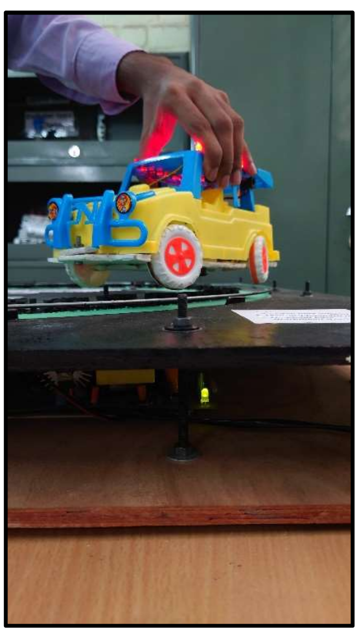
Working:

1. When the SMPS is turned on, and the LED switch is closed on the car the LEDs will glow
2. When the SMPS is turned off the LEDs will stop glowing even if the switch is closed.





3. If the SMPS is kept on, and the car is raised, the LEDs will slowly discharge
4. This indicates that the car is indeed having current wirelessly induced in the secondary/ receiving coil



CHAPTER 7

PROJECT MANAGEMENT

Bill of materials:

Sr No.	Name of materials	Specifications	Quantity	Cost
1.	Plywood	3x3 feet	2	660
2.	Steel Wire	5 meters	1	100
3.	Toy Car	-	1	100
4.	Smooth File	-	1	100
5.	Bolts (small)	6mm, 3.5 inch	2	20
6.	Bolts (big)	3mm, 10mm	25	250
7.	Nuts	6mm	75	150
8.	Washers	6mm	100	100
9.	Adhesives	Fevibond, Flexquik, Feviquick	5	140
10.	M-Seal	-	2	40
11.	LEDs	Red	20	20
12.	Solder wire	-	1	100
13.	Transformer cores	E+I	45	900
14.	Transformer bobbins	-	45	450
15.	Lithium Ion Batteries	18650	2	160
16.	Electrical components	Resistors, Capacitors, Diodes, Transistors, Switches, Potentiometers, Connectors, Wires, etc.	50	2000
TOTAL:				5290

Transportation cost: Rs. 1000 and Consultancy fees: 3000
Total cost of project: Rs.9290

CHAPTER 8

- **Project Milestones: -**

1st Prize in Pimpri Chinchwad Polytchnic's Intercollegiate Project Competition: Our Project was recognized at an intercollegiate level and won first prize

2nd Prize in Anantrao Pawar's National Level Project Competition: Our Project was recognized at a National level and won second prize

- **Achievement certificates: -**

Brandon Jude Alphonso

Yash Vinayak Jadhav

Shubham Sachin Kate

Kenoni Zaphinath Raj C

Prathmesh Vivek Otari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Dr. Abhay B. Shelar
Co-ordinator
TECHNOTHON 2024

Dr. Sunil B. Thakare
Principal & Convener
APCOER, Pune

Mrs. Pramila B. Gaikwad
General Secretary
ABMS Parishad, Pune

CHAPTER 9

CONCULSION AND RECOMMENDATION

Conclusion:

In conclusion, dynamic wireless charging (DWC) for electric vehicles represents a transformative technology with the potential to revolutionize the transportation sector. The evolution of DWC systems has seen significant advancements in key components and technologies, enabling efficient and reliable power transfer while vehicles are in motion. Pilot projects and research efforts worldwide have demonstrated the feasibility and benefits of DWC, including increased convenience, extended range, and reduced environmental impact.

However, despite progress, several challenges and limitations remain, including high installation costs, limited infrastructure availability, and regulatory barriers. Addressing these challenges will require continued research, development, and collaboration among industry stakeholders, standards organizations, and policymakers.

Recommendations:

Investment in R&D: Continued investment in research and development is essential to drive innovation and overcome technical challenges in DWC technology. Funding initiatives should support interdisciplinary research efforts focused on improving efficiency, reliability, and cost-effectiveness.

Infrastructure Deployment: Governments and private stakeholders should collaborate to accelerate the deployment of DWC infrastructure, including roadway embedded coils and supporting infrastructure. Strategic planning and investment in infrastructure projects can helpcreate a robust charging network and facilitate widespread adoption of DWC technology. Installation of solar panels and other renewable energy, with minimal usage of land resources, to increase the sustainability of the technology.

Standardization and Regulation: Establishing common standards and regulatory frameworks iscritical to ensuring interoperability, safety, and compliance with electromagnetic radiation limits. Industry collaboration and engagement with regulatory authorities can streamline the certification process and remove barriers to market entry. Manufacturers should expose some interest in the technology which they can flaunt off. Standard dimensions to be followed to standardize such technology to publish among people with different choices of their personal automobile.

Public Awareness and Education: Educating consumers and stakeholders about the benefits and capabilities of DWC technology is essential to foster public acceptance and support. Outreach campaigns, pilot demonstrations, and educational initiatives can raise awareness andbuild confidence in the reliability and safety of DWC systems. Also public should to be taughtlane discipline, speed limiting and other road rules to make the energy transfer effective and efficient.

Collaborative Partnerships: Industry consortia, academic institutions, and government agenciesshould collaborate to share knowledge, resources, and best practices in DWC research and deployment. Collaborative partnerships can accelerate progress, drive innovation, and address complex challenges more effectively.