

ELECTRICAL AND ELECTRONICS ENGINEERING DEPARTMENT

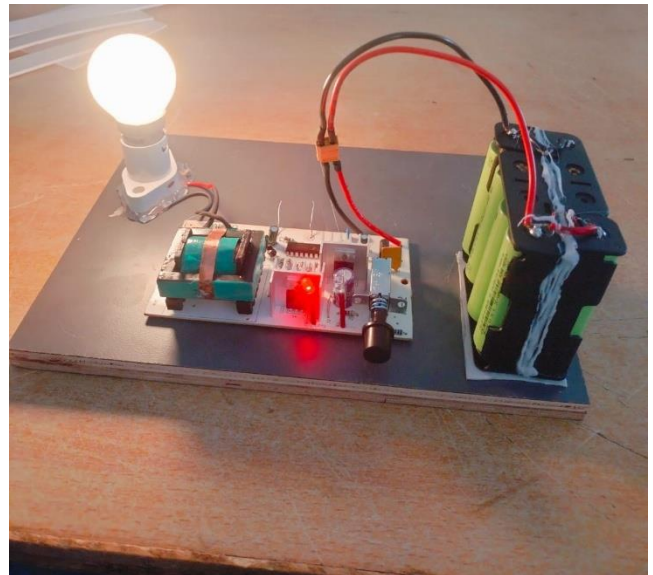
INNOVATIONS

2024-25

1. Multi – Level Inverter Topology

A **multilevel inverter topology** is a power electronic circuit used to generate a high-quality AC output voltage from multiple lower-level DC voltage sources. Instead of switching a single DC source at high frequency, multilevel inverters synthesize the output waveform in several voltage steps, which greatly reduces harmonic distortion, switching stress, and electromagnetic interference. The most common topologies include the **Diode-Clamped (Neutral-Point Clamped) Multilevel Inverter**, which uses clamping diodes to divide the DC bus into multiple levels; the **Flying Capacitor Multilevel Inverter**, which uses floating capacitors to achieve voltage balancing and redundant switching states; and the **Cascaded H-Bridge Multilevel Inverter**, which connects several H-bridge cells in series, each with its own isolated DC source, making it ideal for renewable energy systems like solar PV. Advanced variants such as hybrid multilevel inverters, reduced-switch topologies, T-type inverters, and Active NPC inverters aim to reduce component count and improve efficiency. Multilevel inverters are widely used in medium-voltage motor drives, HVDC systems, FACTS controllers, electric vehicles, and renewable energy integration due to their high efficiency, scalability, and ability to generate near-sinusoidal waveforms.

This setup appears to be a small-scale electronics project demonstrating a DC-to-AC inverter or backup power system. On the right, a pack of rechargeable batteries supplies power to the circuit board in the center. The board contains components such as a transformer, capacitors, transistors/ICs, and indicator LEDs—one of which is glowing red, showing that the circuit is active. The transformer suggests that the circuit is stepping up voltage, likely converting the DC from the battery pack into an AC output. On the left, a bulb connected to the board is glowing brightly, indicating successful power conversion and load operation. The entire assembly is neatly mounted on a wooden base, making it suitable for demonstration or academic project work.

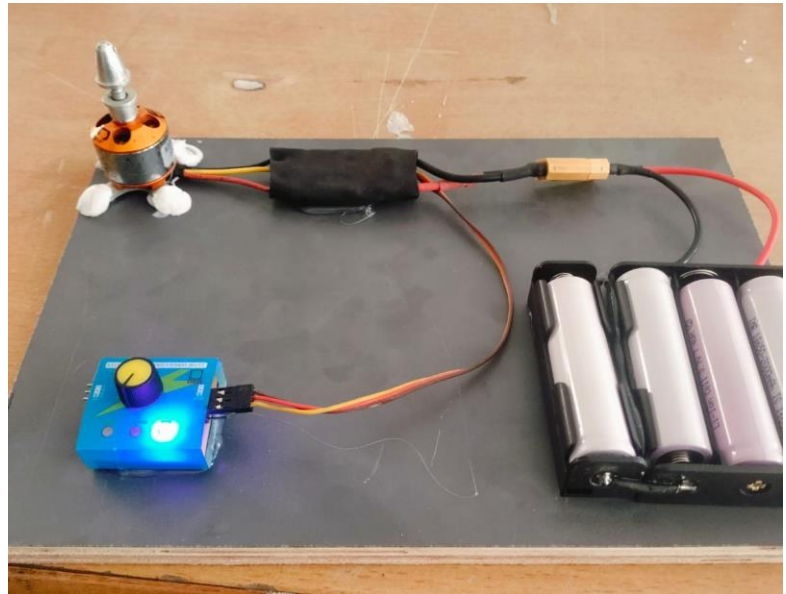


2. Speed Control of BLDC Motor using PWM Technique

Speed control of a Brushless DC (BLDC) motor using the Pulse Width Modulation (PWM) technique is a widely used and efficient method in modern motor control applications. In this approach, the input voltage supplied to the motor is regulated by varying the duty cycle of the PWM signal. A higher duty cycle delivers more average voltage to the motor windings, increasing the speed, while a lower duty cycle reduces the voltage and slows the motor down. PWM signals are typically generated using microcontrollers or dedicated motor driver circuits, which also handle electronic commutation using Hall sensors or sensorless algorithms. This method provides smooth and precise speed regulation, reduced power losses, and improved overall efficiency. PWM-based control is used in electric vehicles, drones, cooling fans, robotics, and various industrial automation systems due to its simplicity, reliability, and energy efficiency.

This model demonstrates a simple setup for **speed control of a BLDC (Brushless DC) motor using PWM (Pulse Width Modulation)**.

On the left, the BLDC motor is mounted securely, and its three-phase wires are connected to an ESC (Electronic Speed Controller), which is wrapped in black heat-shrink for protection. The ESC receives power from a battery pack on the right, consisting of multiple lithium-ion cells housed in a holder. At the bottom left, a PWM-based motor controller or servo tester is used to vary the motor speed. The knob on the controller allows the user to adjust the duty cycle of the PWM signal, which the ESC interprets to regulate the motor's speed. The glowing indicator light on the controller shows that the system is powered and actively controlling the motor. Overall, this setup provides a clear and practical demonstration of BLDC motor speed control using PWM, commonly used in drones, RC vehicles, and robotics.



3. Mechanical Speed-Breaker Energy Harvesting Model

A Mechanical Speed-Breaker Energy Harvesting Model is a demonstrative system designed to convert the vertical motion generated by vehicles passing over a speed breaker into electrical energy. When a vehicle applies downward force on the speed breaker, the mechanism beneath it—typically consisting of springs, shock absorbers, or a rack-and-pinion arrangement—compresses and produces mechanical movement. This motion is transferred to a small generator or dynamo, which converts the mechanical input into electrical output. The produced electricity can be used to power streetlights, sensors, or stored in batteries for later use. This model provides a practical illustration of how wasted kinetic energy from vehicular movement can be captured and utilized, promoting sustainable energy concepts and demonstrating renewable energy harvesting in transportation systems.

This equipment appears to be a **mechanical speed-breaker energy harvesting model**, designed to demonstrate how the vertical movement of a vehicle over a speed breaker can be converted into usable electrical energy. The setup includes two vertical shock-absorber-type pistons mounted in parallel, which act as the main mechanical input system. When pressure is applied—similar to a vehicle passing over the speed breaker—these pistons depress and return to their original position, converting linear motion into mechanical work.

The central platform houses basic electrical components such as a small generator or motor, switches, wires, and possibly a battery or display unit, which together form the energy conversion and storage part of the system. The yellow racks on the sides suggest a rack-and-pinion arrangement, often used to convert vertical motion into rotational motion for driving a generator. Overall, this model effectively demonstrates a renewable energy concept where wasted kinetic energy from road traffic is captured and converted into electricity, making it suitable for educational and project-based demonstrations.



4. FT Old Fogey MKR2

The **FT Old Fogey MKR2** is a simple, slow-flying park-flyer RC airplane designed by Flite Test for beginners and casual hobbyists who enjoy relaxed, stable flight. Built from lightweight foam board, it offers an easy and quick assembly process while remaining durable enough for regular flying practice. With a wingspan of about 38 inches and a gentle airfoil, the Old Fogey is known for its “floaty,” forgiving behavior, making it ideal for small open fields, parks, or school grounds. It operates on a basic 3-channel setup—throttle, elevator, and rudder—so even new pilots can control it confidently. To complete the model, users typically equip it with a small 24-gram brushless motor (around 1300 kV), a 9×4.7 propeller, two 9-gram servos, a 10–18 A ESC, and a 3S 1300 mAh Li-Po battery. While it flies exceptionally well in calm weather, its lightweight design means it struggles in strong winds. Overall, the FT Old Fogey MKR2 is an affordable, easy-to-build, and enjoyable RC plane perfect for beginners and park-flyer enthusiasts looking for smooth, slow, and stable flight.

SPECIFICATIONS

- UW: 550gms
- Weight Without Battery: 425gms
- Wingspan: 1410mm
- Length: 775mm
- CG Location: 76-89mm from the leading edge of the wing
- Control Throws: Elevons: 12° EXPO: 30°

RECOMMENDED EQUIPMENT

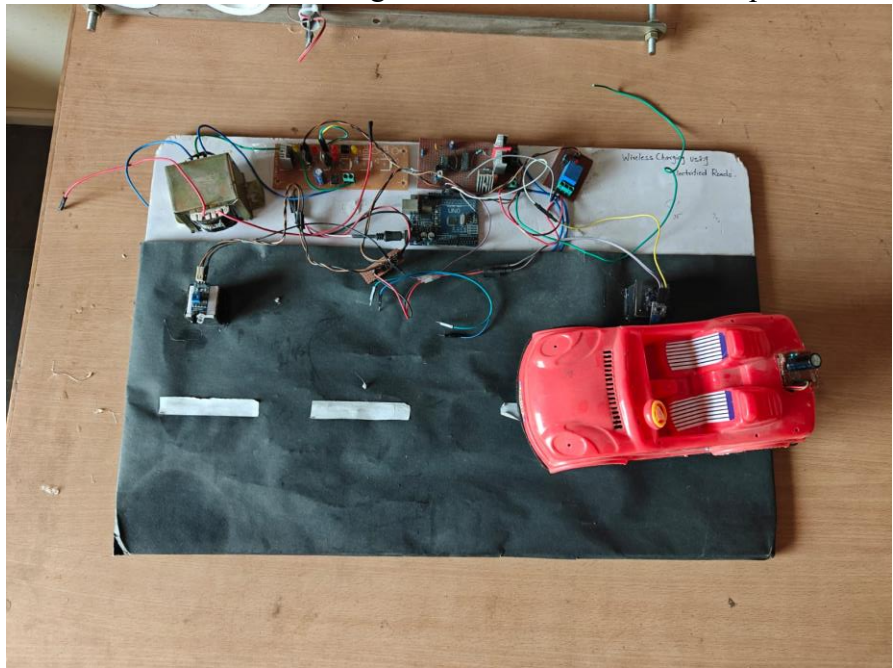
- Motor: 1200kv Motor
- ESC: 20 amp
- Battery: 500-1000 mAh 3s
- Servos: (2) 9 gram servos
- Prop: 8×4.5 – 9×4.7



1. Wireless Charging using Electrified Roads

Wireless charging using electrified roads is an innovative technology designed to charge electric vehicles (EVs) dynamically as they move. In this system, special coils or conductive tracks are embedded beneath the road surface, creating an electromagnetic field. When an EV equipped with a corresponding receiver coil drives over these sections, electrical energy is transferred wirelessly through inductive or conductive coupling. This allows the vehicle's battery to recharge without stopping or plugging in. Electrified roads help reduce range anxiety, lower the need for large onboard batteries, and enable continuous, uninterrupted travel. This technology represents a major step toward sustainable transportation, offering an efficient, eco-friendly solution for future smart cities and high-traffic routes.

This circuit represents a **miniature working model of wireless charging using electrified roads**, designed to demonstrate how electric vehicles can be charged while in motion. The setup includes a small roadway model on the left, with a toy car placed on it to represent an electric vehicle. On the right side, the circuit components are mounted on a board, including a transformer, driver circuitry, and control modules. These electronic components generate an electromagnetic field beneath the road surface. As the car passes over the embedded coils or conductive pads, energy is wirelessly transferred to its



receiving coil, simulating dynamic charging. Various wires, modules, and relays in the circuit help regulate power transfer, ensuring safe and efficient operation. Overall, this model effectively showcases the concept of inductive power transfer for on-road EV charging and highlights the future potential of sustainable transportation technologies.

2. Van De Graaff Generator

A **Van de Graaff Generator** is an electrostatic device designed to produce extremely high voltages using the simple principle of charge accumulation. It consists of a moving belt inside a tall insulating column, driven by a motor. As the belt moves, it carries electric charge—usually generated through friction or induction—to the large metallic dome at the top. Because the dome is a good conductor and isolated from the ground, the charge continues to build up, resulting in very high electric potentials, often reaching tens or even hundreds of thousands of volts.

This generator is widely used in physics laboratories, classrooms, and science demonstrations to illustrate key concepts such as static electricity, electric fields, charge distribution, and spark formation. Experiments like making hair stand on end, attracting small objects, or creating visible sparks between two domes are commonly performed with it. The Van de Graaff Generator is a simple yet powerful educational tool that helps students understand electrostatic phenomena in an engaging and hands-on way.

This image shows a **Van de Graaff Generator**, a classic electrostatic device used for producing very high voltages through charge accumulation. The generator consists of a tall cylindrical column mounted on a wooden base, with a large polished metallic dome at the top. Inside the vertical tube, a motor-driven belt moves continuously, carrying electric charge from the bottom to the top. As the belt transfers charge to the dome, the dome begins to accumulate a high electrostatic potential, often reaching tens of thousands of volts.

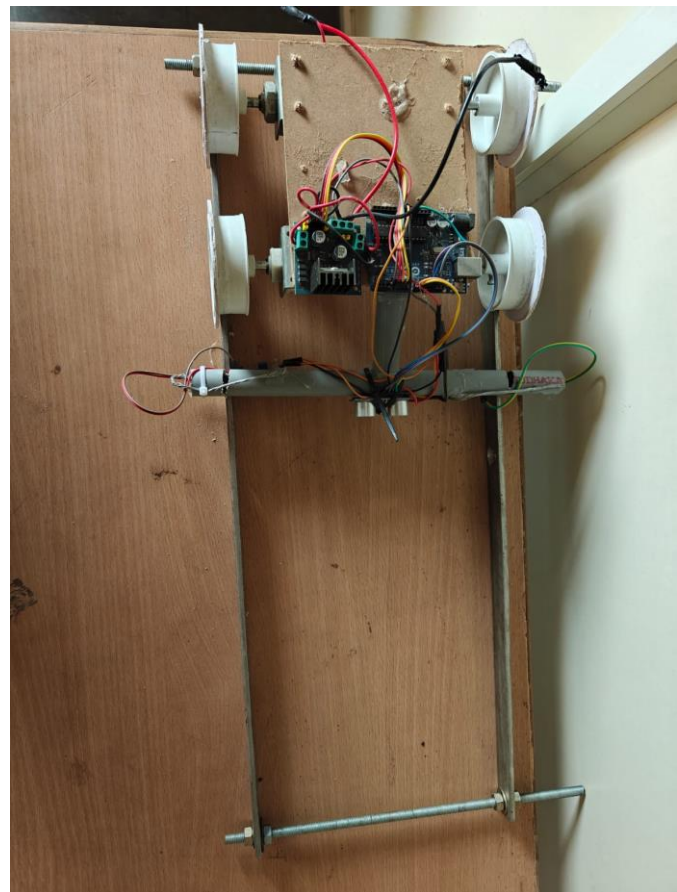
The small metallic sphere connected by a wire at the bottom acts as a grounding or discharge sphere, allowing demonstrations of spark formation when brought near the main dome. This setup is commonly used in physics laboratories and educational demonstrations to show phenomena such as static electricity, electric fields, charge induction, and hair-raising effects on people who touch the dome. The Van de Graaff Generator remains one of the most effective and visually engaging tools for teaching electrostatics.



1. Railway Track Crack Inspector

A Railway Track Crack Inspector is a safety-focused system designed to detect cracks, fractures, or structural faults in railway tracks before they can cause accidents. The model typically uses sensors such as IR (Infrared), ultrasonic sensors, or vibration sensors mounted on a small inspection vehicle that moves along the track. These sensors continuously scan the rails, and if a crack or gap is detected, the system immediately triggers an alert through a buzzer, LED, or communication module. Advanced versions may send wireless alerts to a monitoring station for real-time action. This technology helps prevent derailments, ensures smooth train operations, and significantly enhances railway safety by enabling early detection and maintenance.

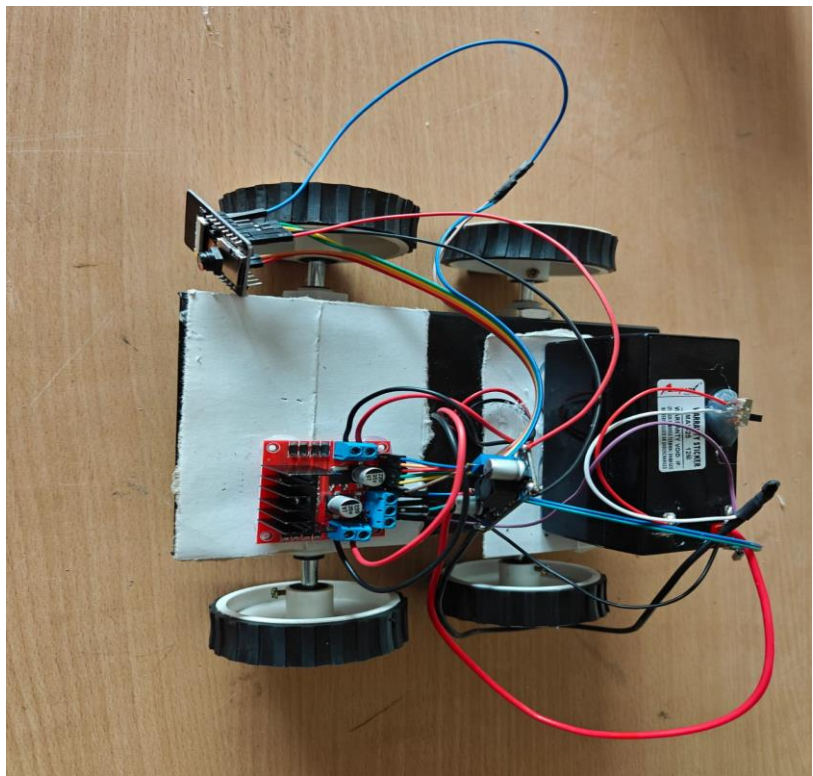
The image shows a prototype of a **Railway Track Crack Inspector**, a small robotic system designed to move along railway tracks and detect cracks or structural faults. The setup is built on a wooden base that holds the entire mechanism. It uses four specially fabricated pulley-type wheels mounted on metal bolts, allowing the device to stay aligned with the rail and travel smoothly. At the top, the control electronics include an Arduino microcontroller, a motor driver, and connecting wires that manage the movement and sensor operations. A long metal frame extends downward in a U-shape, which keeps the robot aligned with the track. Attached to this frame is a sensor module that scans the rail surface for cracks using methods such as IR sensing, ultrasonic detection, or magnetic field monitoring. As the robot moves, the sensors continuously examine the track and send the data to the microcontroller, which identifies any gaps or abnormalities. This prototype demonstrates how automation can be used for railway safety, enabling early detection of cracks and helping prevent accidents or derailments.



2. Robotic Car

A **Robotic Car** is an intelligent, self-driven vehicle designed to operate using sensors, microcontrollers, and motor drivers instead of human control. It typically consists of a lightweight chassis mounted with DC motors or geared motors for movement, controlled through an onboard microcontroller such as Arduino, Raspberry Pi, or ESP32. Sensors like ultrasonic, IR, or line-following modules help the car detect obstacles, follow paths, or navigate autonomously. A motor driver regulates power to the motors, while a battery pack supplies energy to the entire system. Depending on the design, the robotic car may include wireless modules such as Bluetooth, Wi-Fi, or RF for remote control via a smartphone or transmitter. These cars are widely used in robotics learning, automation research, obstacle-avoidance systems, and smart vehicle demonstrations, showcasing how embedded systems and sensors work together to achieve autonomous mobility.

This is a DIY four-wheeled robotic car built on a simple cardboard or foam-board chassis, powered by DC motors connected to large rubber wheels. The motors are controlled through an L298N motor driver module, visible at the center of the setup with multiple colored jumper wires connecting it to the rest of the circuit. A front-mounted sensor module allows the car to detect obstacles or gather input for autonomous movement. The system is powered by a rear battery pack, and the wiring shows integration with a microcontroller that manages motor direction and speed based



on sensor data. Overall, the car demonstrates a basic but functional example of a student-level robotics project combining mechanical assembly, electronics interfacing, and simple automation.