Engineering Portfolio

DRIVEN BY VOLTS, DEFINED BY VISION

VOLT EDGE

National Robotics League
India's Biggest Robotics Championship for Middle & High School Students

Team VoltEdge
Representing at NRL 2025
Team ID: 007

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Team Introduction

Team Story And Vision

VoltEdge began with a moment that wasn't planned — a message sent on the night of 4 October, just before our midterm exams. Omer reached out to Abdullah with the details of the National Robotics League, and within minutes, the idea of forming a team took shape. None of us had a robot, a workspace, or a plan… but we had curiosity. And sometimes, that is enough to begin.

By 9 October, a day before exams, we registered as Team VoltEdge — Team ID 007, trusting that we would figure everything else out along the way. When our BaseBot kit finally arrived in Bhatkal on 20 October, the spark turned into commitment. What followed from 22 to 27 October was six days of continuous building — tightening screws, aligning plates, wiring circuits, testing motors, fixing mistakes, and learning at every step. Those six days shaped our identity more than anything else: a team that learns fast, adapts fast, and moves forward no matter how busy life gets.

Our vision grew from these moments.
VoltEdge was never just about building a robot. It was about proving that a group of students from a small coastal town could enter a national arena with confidence. It was about showing younger students that engineering isn't far away — it's something they can touch, build, and experience. It was about finding a place where each of us could use our strengths: electronics, mechanics, programming, communication, design, and leadership.

Our vision is simple and powerful:
To build engineering talent in our town, to inspire the next generation through robotics, and to step into the NRL arena not only as competitors — but as a team defined by discipline, purpose, and unity.

VoltEdge believes in doing things with honesty, learning through mistakes, and pushing ourselves beyond what we thought possible. Whether it is building a robot in six days, running workshops during a packed college schedule, managing outreach, or preparing a portfolio days before the event — our story is built on action.

And as we submit this engineering portfolio on 30 November 2025, days before stepping into the IIT Bombay arena, our vision remains unchanged:

Build with purpose.
Compete with discipline.
Inspire with impact.
VoltEdge — Driven by Volts, Defined by Vision

Team Roles And Responsibilities

Every member of VoltEdge carries a role shaped by their strengths, their instincts, and the responsibilities they naturally grew into during the journey from 22 October to 27 October. As the robot took form piece by piece, each person became essential to a different part of its creation — some on the mechanical side, some on electronics, some on programming and documentation, and some on strategy and operations. Together, these roles formed the backbone of Team VoltEdge.

Abdullah Saami Sada serves as the team's Documentation Head and a Programming Member in the Pit Team. He is responsible for building the entire engineering portfolio, structuring team communication, maintaining clarity in technical decisions, and shaping the written identity of VoltEdge. During the build phase, Abdullah supported programming tasks, assisted in software setup, and ensured that documentation accurately reflected the team's work from day one.

Mohiddin Ahmed Motiya contributes as both a Human Player in the driver team and the Brand Manager of VoltEdge. On the field, he ensures smooth human-robot coordination, while off the field, he manages branding, identity, and the visual communication of the team. His decisions shape how VoltEdge is represented to the school community, online audiences, and future outreach programs.

Omer Ruknuddin, the Lead Programmer and Primary Driver, is responsible for the robot's software architecture, controller mapping, movement logic, and performance tuning. During matches, Omer takes control of the robot as the main driver, combining technical understanding with field awareness. His role bridges programming precision with real-time decision-making in the arena.

Mohammed Zaid Fareed leads the electronics domain as the Electronics Lead and a Pit Team Electronics Member. He manages wiring, circuit stability, power routing, sensor integration, and all electronic safety checks. His responsibility includes ensuring that every component remains functional under stress, making him the electrical backbone of the robot during both construction and testing.

Ahmed Irfan Akrami, the Mechanical Lead and a Pit Team Mechanical Member, is responsible for the robot's structural integrity. He oversees chassis alignment, arm and gripper assembly, torque balancing, wheel fitting, and all mechanical problem-solving. His precision ensures the robot's stability, strength, and consistency during matches and testing cycles.

Shamveel Bukhari Khateeb serves as the Driver Strategist, Videographer, and Visual Head. On-field, he supports Omer as a strategist, guiding movements, timing, and overall match flow. Off-field, he handles video production, documentation footage, and all visual storytelling for VoltEdge. His footage and media work capture the team's journey and enhance communication with the community and the NRL audience.

Mr. Nuhail Damudi is more than a mentor to Team VoltEdge — he is the person who first opened the door to robotics for us back when we were in 9th grade. What began as a simple introduction has grown into a journey that shaped our skills, our mindset, and ultimately the creation of Team VoltEdge itself. With a strong foundation in robotics and innovation, he guides us with clarity, patience, and a vision grounded in real engineering discipline. His mentorship pushes us to think deeper, design smarter, and approach every challenge with purpose. Under his guidance, VoltEdge evolved from curious beginners into a focused, confident team ready to compete on a national stage.

Together, these roles form the structure of Team VoltEdge.
Each responsibility interlocks with another, creating a cycle of support, precision, and teamwork that defines how VoltEdge builds, tests, documents, and prepares for the National Robotics League.

Team Photos and Work Approach

The visual story of VoltEdge is captured through a series of photos that reflect not just the robot we built, but the way we worked together. Our team's images show late-evening work sessions, the crowded tables filled with screws and tools, moments of collaboration between mechanical and electronics teams, and the quiet focus on screens during programming tests. These photos document our journey from receiving the kit in Bhatkal to assembling the robot step by step through structured teamwork, constant communication, and shared problem-solving.

Our work approach is built around discipline and consistency. From 22 October until the robot was completed on 27 October, the team met regularly—often in the evenings after college hours—to divide tasks, review progress, and solve issues in real time. Mechanical and electronics members worked side by side, ensuring that chassis fitting, wiring, and component placement aligned perfectly. Programmers joined these sessions to test motor response and refine control logic as soon as components were installed. This cycle of "build → test → adjust" repeated continuously, allowing the robot to evolve smoothly across the five-day build window.

During these sessions, every member naturally stepped into their responsibility: Irfan handled the difficult mechanical alignments, Zaid managed the wiring and electronic stability, Omer tested movements and logic on the controller, Abdullah documented each stage while supporting software tasks, Shamveel captured the build through photos and videos, and Mohiddin assisted with coordination and brand presentation. The team's work style focused on precision, clarity, and mutual support—no task was ever done alone.

Our photos display this atmosphere: the concentration around the workbench, the scattered components slowly forming into a complete machine, the late-night energy, and the small celebrations after each successful test. This visual record not only shows the robot's construction but also represents how VoltEdge operates—as a coordinated unit where creativity, discipline, and teamwork merge into one story.

Prototype And Basebot Assembly

Overview Of Basebot Design And Assembly

The BaseBot became the starting point of VoltEdge's entire engineering journey. When the kit arrived in Bhatkal on 20 October, it was nothing more than a collection of acrylic plates, motors, screws, spacers, sensors, and electronic modules — but together, these parts formed a foundation strong enough for a national-level robot. We began assembly on 22 October, knowing that every component we placed would determine how the robot behaved in testing and how reliably it would perform in the NRL arena.

The BaseBot's design follows a simple yet effective architecture: a dual-layer acrylic chassis supported by steel and aluminium brackets, a four-motor differential drive system for movement, and a servo-driven arm and gripper for collecting charges. Each piece has a purpose — the acrylic plates give structure, the brackets ensure motor alignment, the spacers maintain balance, and the electronics mounted on top bring the entire system to life.

During the assembly days from 22 to 27 October, we slowly watched the robot transition from scattered parts into a complete prototype. Irfan aligned the chassis plates and fitted the mechanical pieces, Zaid connected the electronics and routed the wiring cleanly across the robot, Omer and Abdullah tested the initial motor responses through the ESP32, and the rest of the team assisted wherever an extra pair of hands was needed. As each section was completed — the drivetrain, the gripper, the arm linkages, the control hub — the robot began to move, respond, and function the way it was meant to.

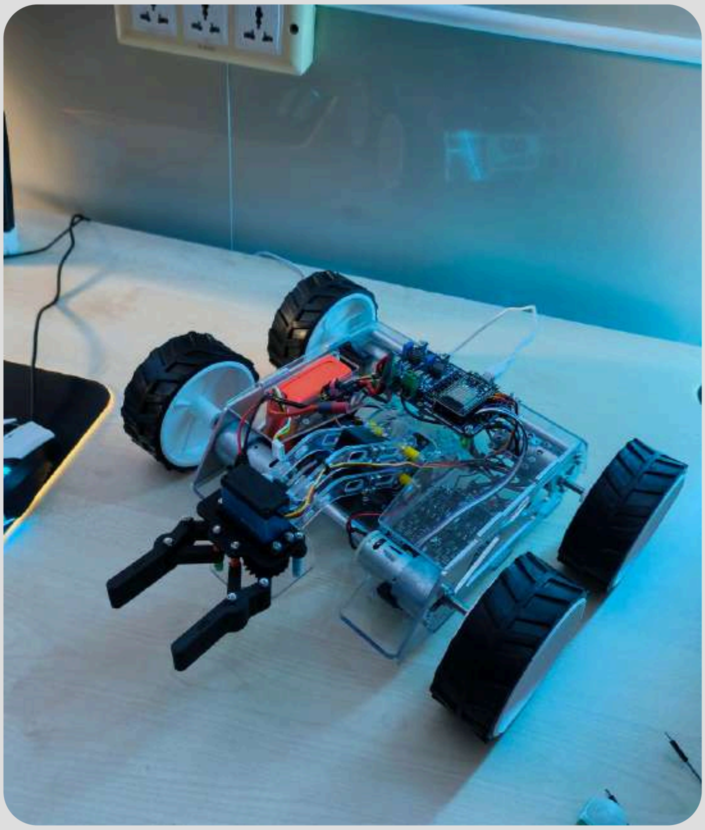
By 27 October, the BaseBot was fully assembled and operational. The design gave us a reliable platform to test, learn, and prepare for modifications. These early days taught us how each subsystem interacted with the others, setting the stage for tuning, autonomous work, and match strategy in the weeks that followed.

Testing And Early Prototype Results

Once the BaseBot assembly was completed on 27 October, the robot entered its most important phase: testing. These early tests were where VoltEdge first understood how the robot behaved beyond the instruction manual. The initial drive test showed us small imperfections — a slight pull toward one side, uneven wheel grip, and minor vibration in the chassis. These weren't failures; they were signals telling us where adjustments were needed. Each test revealed something new about how the robot responded to turns, stops, and quick directional changes.

As we continued testing through the evening sessions, we refined the robot step by step. The drivetrain was inspected repeatedly to correct alignment, the arm's movement checked for smooth lifting, and wiring was tightened where vibration caused loose connections. We tested the motor driver response, ESP32 communication, gripper precision, and wheel stability on different surfaces. With every cycle of "test → observe → fix," the robot became more predictable and more stable.

These early prototype sessions taught us how the robot behaved under real motion. They showed us which parts needed reinforcement, which movements needed refining, and how the robot transitioned from a newly assembled structure into a functional machine. By the end of our testing phase, the BaseBot moved cleanly, lifted consistently, and responded accurately to controller inputs — giving VoltEdge the confidence to progress into strategy planning, programming refinement, and autonomous preparation.



Meet Our Robot

What Is Our Robot? Main Features And Capabilities

EdgeBot is Team VoltEdge’s re-engineered evolution of the standard NRL BaseBot — a machine built not just to move, but to express our engineering character. From the moment we began designing, EdgeBot was imagined as a robot with presence: strong, stable, intelligent, and unmistakably ours. Its structure is wrapped in a custom 3D-printed shell inspired by monster-truck geometry, giving the bot a powerful identity and improved physical rigidity. The signature rear aero wing adds balance and control, working alongside the under-chassis downlights that illuminate the driving surface and provide tactical visibility during testing and matches.

But EdgeBot’s appearance is only the beginning. Internally, the robot carries a set of intelligent sensor systems that elevate its capability far beyond the BaseBot. A gyroscope governs its turning accuracy, maintaining stability and preventing drift during sharp maneuvers. The ultrasonic module at the front gives EdgeBot the ability to detect charges and obstacles even before the driver reacts, allowing for a smoother approach and safer navigation.

For autonomous runs, a set of precisely mounted line-following sensors enable the robot to track paths reliably and execute planned routines with steady precision. Together, these elements make EdgeBot a machine that blends aesthetic impact, mechanical confidence, and smart sensing into a single cohesive system — an authentic VoltEdge engineering product.

Differences From The BaseBot

Although EdgeBot began its life as a BaseBot, nearly every major aspect has been transformed to suit our competitive needs. The most visible difference lies in its physical design. The BaseBot's plain open structure has been replaced with a fully custom 3D-printed monster-truck style body, giving EdgeBot a distinct and robust exterior.

This design strengthens the chassis while allowing for personalized mounting points, cleaner wiring, and better sensor placement. The rear aero wing, absent in the BaseBot, is a notable addition. It stabilizes the bot during acceleration and directional changes, enhancing grip and reducing unwanted lift. Additionally, the improved suspension system offers smoother handling on uneven surfaces. The integration of advanced telemetry systems further aids in real-time performance monitoring.

Internally, the BaseBot's simple electronic layout has been upgraded to a more refined system. The integration of a gyro sensor brings a new level of turning control that the BaseBot simply doesn't possess. The ultrasonic sensor, mounted at the front, adds an intelligent detection capability, enabling the robot to "sense" charges or obstacles — something beyond the BaseBot's default hardware. The autonomous functionality has also evolved through the addition of line-following sensors, giving EdgeBot the ability to perform guided automatic movements, unlike the BaseBot's purely driver-dependent operation.

Impact Of Modifications On Performance

Every modification we made to EdgeBot influences its performance in a meaningful way. The structural upgrades, especially the 3D-printed shell and rear wing, immediately improved stability. The bot now handles sharp turns with less body sway and maintains traction more effectively during rapid acceleration. The wing distributes weight more evenly, keeping the rear end grounded — a noticeable advantage when the bot needs to change direction quickly inside the arena.

The sensing system brought an even greater transformation. The gyroscope has had a major impact on accuracy by reducing drift and allowing our driver to trust the robot's directional control. Even minor turns feel more predictable and controlled. The ultrasonic sensor expanded the robot's awareness, enabling faster and safer charge detection. This not only improves the driver's confidence but also protects the robot from collisions and misalignment during matches.

Autonomous performance also saw a clear improvement. The BaseBot, with no inherent autonomous capabilities, relied heavily on manual control. EdgeBot's line-following sensors now allow it to track lines and execute planned paths with consistency. This transformed the robot's early-game strategy and opened opportunities for autonomous scoring that the BaseBot simply couldn't achieve.

Even the smaller changes made a noticeable difference. Downlights, while visually appealing, doubled as a functional diagnostic tool, letting us observe wheel movement and ground contact while testing. Cleaner wiring and refined controller mapping improved reliability and ease of maintenance, especially during pit operations. Altogether, these modifications created a robot that is faster, more stable, more aware, and far more competition-ready than the BaseBot ever was.

Mechanical Details

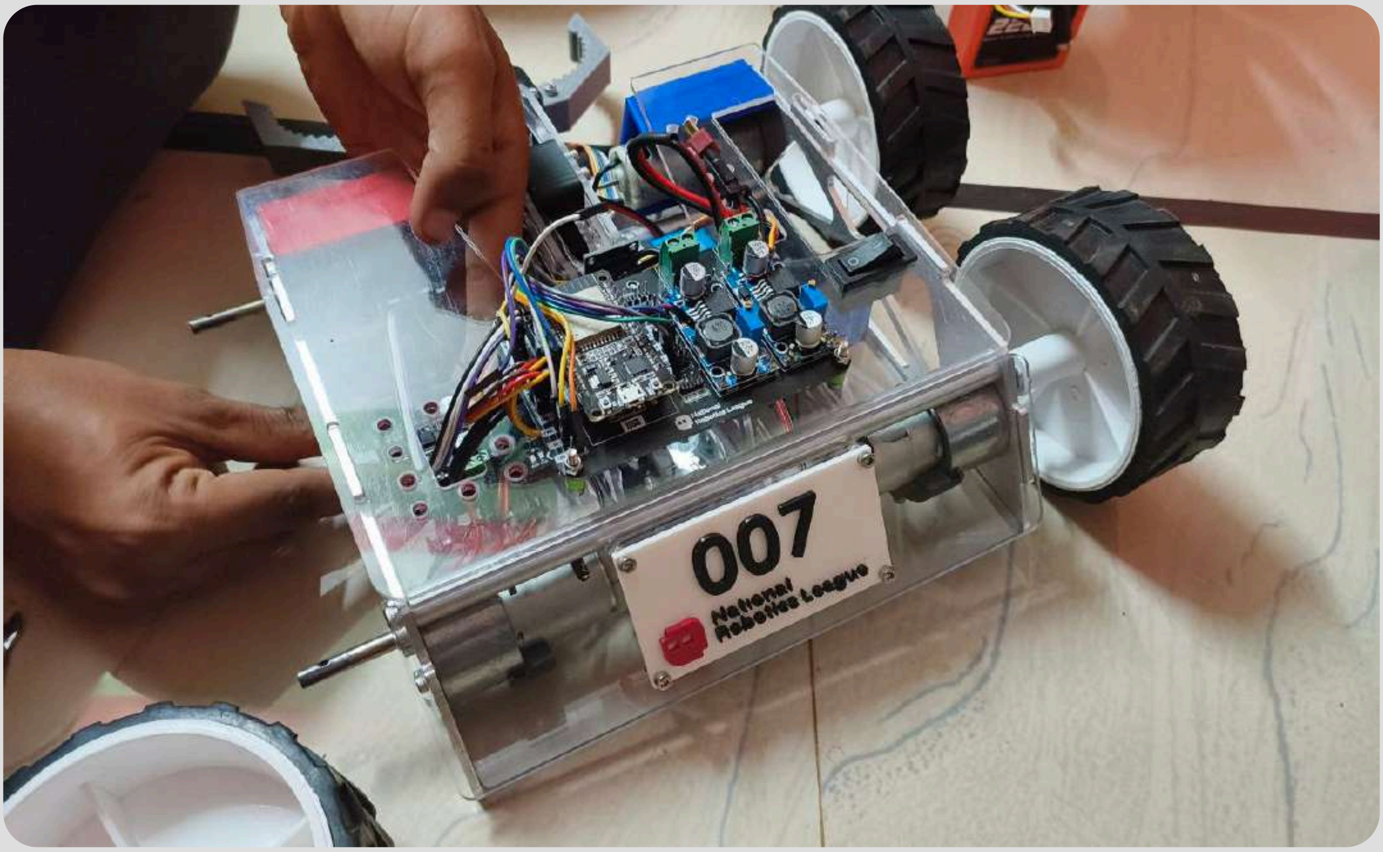
Basebot Chassis Design And Structure

The BaseBot's chassis became the structural backbone of our entire robot — the frame that supported every movement, every lift, and every test that followed. Built using dual-layer acrylic plates, the chassis provided a lightweight yet rigid foundation that made assembly straightforward and movement steady. The top and bottom plates were precisely cut to hold components like the motor driver, battery, ESP32 control hub, and servo mount, while still leaving enough spacing for clean wiring and airflow. These acrylic plates were supported by steel and aluminium side brackets, which ensured that the motors remained perfectly aligned even during fast turns and sudden directional changes.

As we assembled the chassis from 22 to 27 October, we began to understand why the BaseBot design uses this combination of materials. Acrylic offered smooth surfaces, clean fitting, and enough stiffness for the arm and gripper to operate without flex. The steel motor brackets carried the weight and torque of the drivetrain, preventing bending and protecting the motors from shifting under load. Together, they created a stable platform that kept the robot balanced during practice runs.

The final chassis measured 36 cm in width and 26 cm in length, extending to 37 cm when the gripper was fully forward. Its height ranged between 15 to 25 cm, depending on the arm's position. These dimensions gave the robot a compact and manoeuvrable profile, making it easier to navigate tight paths during testing and match strategy planning. Every hole, spacer, and bracket position was placed with purpose — supporting components in a way that made maintenance simple and movement reliable.

By the end of assembly, the chassis was not just a frame; it was the solid foundation that allowed every mechanical, electrical, and programming decision to work smoothly. It held the robot together physically and set the stage for all the improvements that VoltEdge would make in the days ahead.



Modified Mechanical Components

While the BaseBot provided a strong foundation, our mechanical work from 22 to 27 October showed us exactly where small adjustments could improve performance and stability. Under the guidance of our mechanical lead, Ahmed Irfan, we refined several parts of the structure to make the robot smoother, stronger, and more reliable during testing. The chassis plates were re-aligned to reduce minor flexing, ensuring the arm and gripper operated without strain. Wheel mounts were tightened and corrected to prevent uneven traction, helping the robot maintain a straight path during early drive tests. Certain sections of the frame were reinforced with properly balanced torque on screws and spacers, allowing the robot to remain stable even when the arm was lifted forward. These modifications were not redesigns — they were careful corrections and improvements that made the fully assembled BaseBot feel more controlled, predictable, and competition-ready during practice.

Electronic Details

BaseBot Wiring Diagrams And Setup

The wiring of the BaseBot formed the core electrical system that allowed the robot to move, lift, and respond the moment the controller connected. During the build sessions from 22 to 27 October, our electronics lead, Mohammed Zaid, laid out each component with careful planning before making the first connection. The MDD10 motor driver was mounted on the bottom acrylic plate, positioned so the motor inputs and power terminals were easy to reach. From there, each of the four DC motors was wired to its respective output channel, ensuring correct polarity so the drivetrain behaved predictably during early testing.

Above it, the HEXA Command Hub ESP32 acted as the robot's brain, sending PWM and direction signals through color-coded jumper wires that Zaid routed cleanly across the chassis. The servo for the arm was connected directly to its control pin on the ESP32, with enough wire slack to allow smooth vertical movement without strain. The power switch and battery holder were mounted firmly so the robot could be safely turned on and off without disturbing any internal wiring. Throughout the setup, cables were kept clear of the wheels and linkages to prevent tangling or accidental damage during rotation.

Every connection was double-checked before the first power-on: motor directions, servo response, battery terminals, and jumper stability. This careful wiring layout became the electrical backbone of EdgeBot — clean, organized, safe, and reliable during every drive test that followed.

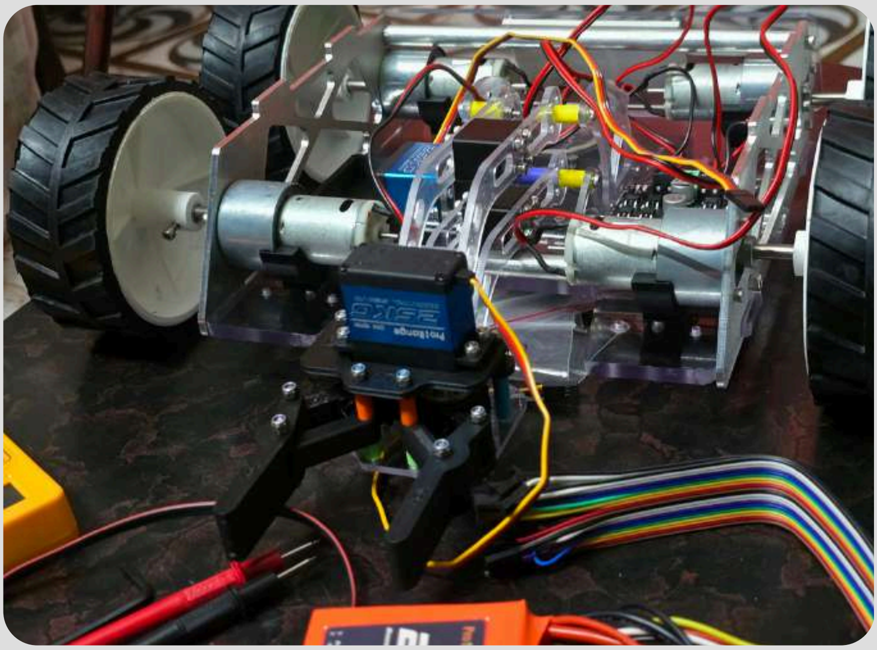
Some minerals in rocks can carry electricity, and Certain metals found in rocks are used to make wires and tiny parts inside circuits.

Modifications To Electrical System

As we began testing the BaseBot after the initial assembly, a few electrical improvements became necessary to make the robot more stable and easier to maintain. These were not major redesigns, but practical refinements led by our electronics lead, Mohammed Zaid, to ensure the wiring remained clean, safe, and consistent during repeated testing. The first adjustments focused on reorganizing cable routes so that none of the wires came close to the wheels, arm joints, or the rotating gripper area. This reduced strain on connectors and prevented loose wires from interfering with movement.

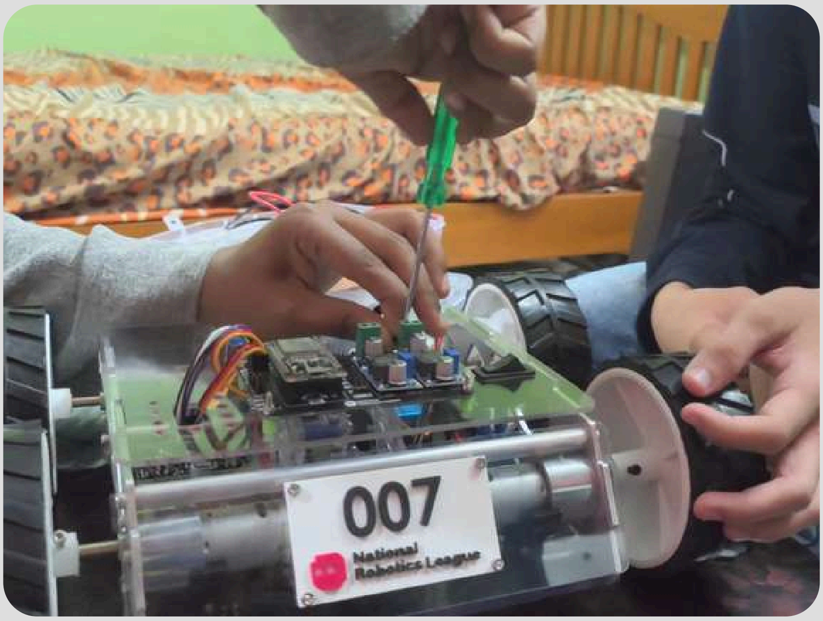
We also refined wire lengths, replacing or rerouting cables that were either too tight or too long, ensuring smoother internal spacing between the top and bottom chassis plates. The motor driver placement was slightly adjusted for better airflow and easier access to terminals during testing. Servo wires were also positioned more carefully to prevent tension when the arm lifted forward. These modifications didn't change the BaseBot's original electrical design — they simply made it more reliable, easier to troubleshoot, and safer for continuous operation.

Through these small but important improvements, the robot's electronic system became more organized and durable, giving VoltEdge the confidence needed for extended testing sessions and match preparation.



Safety Measures And Rewiring Explained

Safety was a constant priority throughout our build from 22 to 27 October, especially as we worked with exposed circuits, rotating motors, and a compact chassis layout. Before powering the robot for the first time, the team—led by our electronics head, Mohammed Zaid—reviewed every connection carefully to make sure no wire crossed moving parts, no terminal was loose, and no connector carried unnecessary tension. We avoided overtightening screws near the motor driver and ESP32 to prevent cracks in the acrylic base or damage to pins. The battery holder was secured firmly so that the robot could be turned and lifted during tests without shifting the power supply.



Whenever a rewiring task was needed, we followed one strict rule: power off before touching anything. Only after disconnecting the battery did we adjust motor wires, re-route jumper cables, or correct servo placement.

During early drive tests, some wires loosened due to vibration, and a few jumpers needed rearrangement for better spacing. Each time, the rewiring was done methodically—checking polarity twice, confirming motor orientation, and ensuring that the new routing kept the cables away from wheels and arm linkages. This careful approach prevented accidental short circuits, protected the components from stress, and kept the robot safe during repeated test runs.

By the end of the assembly phase, these safety habits became second nature to VoltEdge. Clean wiring, controlled rewiring, and constant checks ensured that EdgeBot remained stable and reliable, ready for both autonomous testing and match preparation.

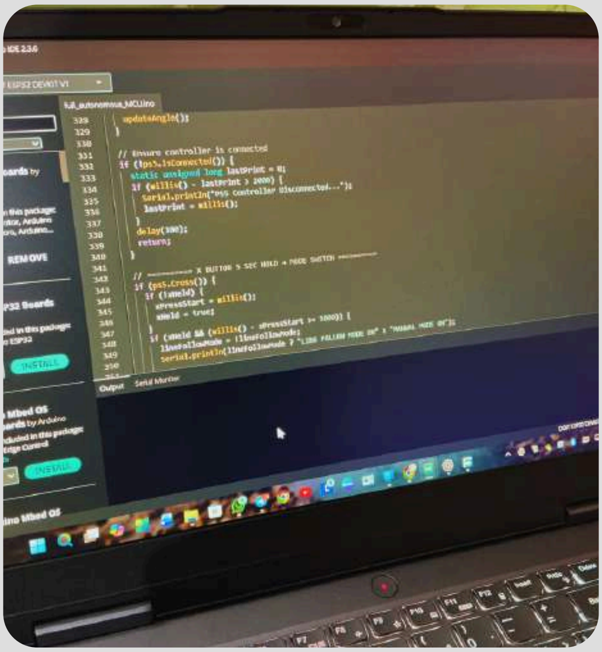
Programming And Controls

BaseBot Software Architecture Overview

The BaseBot software architecture became the digital core of our robot—the system that connected every piece of hardware to the decisions made by the driver. At the centre of this setup was the HEXA Command Hub ESP32, a versatile microcontroller capable of handling motor control, servo movement, Bluetooth communication, and signal processing. Using the Arduino IDE, we uploaded all programs directly to the ESP32, selecting the correct board settings, choosing the right COM port, and ensuring successful compilation before every test run. The Arduino IDE became our programming workspace—where every line of logic, every function, and every movement began.

The software structure communicated through PWM pins and digital signals to the MDD10 motor driver, which controlled the speed and direction of all four DC motors. Meanwhile, dedicated servo pins handled the gripper and arm movements, allowing the robot to interact with scoring elements smoothly. The ESP32 processed real-time controller input from the PS5 gamepad, translating joystick movements into forward motion, turning, lifting, and gripping. This architecture remained simple, clear, and predictable—making it easy for our team to understand how each subsystem responded.

By working within this structure, VoltEdge could focus on refining responsiveness rather than troubleshooting complex communication layers. Every adjustment we made—from speed calibration to turning refinement—began with code written inside Arduino IDE and uploaded to the ESP32. Through this process, the robot developed its digital behaviour, responding cleanly to controls and preparing for advanced autonomous logic. For us, the software architecture was not just code—it was the personality of the machine, built one upload at a time.



Joystick Mapping As Provided By Basebot.

Before creating our own control system, we first learned how the BaseBot behaved using the default joystick mapping provided in the NRL programming guide. The PS5 controller connected to the ESP32 through Bluetooth, and each input was assigned a clear, predefined function. The left joystick controlled forward and backward movement, allowing the robot to accelerate smoothly across the field. The right joystick handled turning, making it possible to rotate or adjust direction with small, precise movements. The basic functional buttons controlled the arm and gripper actions using simple servo commands, giving the robot its ability to lift and release objects.

This mapping gave us a strong foundation for understanding how the robot interpreted driver inputs. Every time we pressed a button or pushed a joystick, the ESP32 translated that signal into motor speed, direction, or servo movement. During early tests, these default mappings helped us observe the robot's natural response—how quickly it turned, how sharply it accelerated, and how the gripper behaved during action. This system became the starting point for VoltEdge, helping us learn the robot's driving personality before we began making custom adjustments tailored to our driver and match strategy.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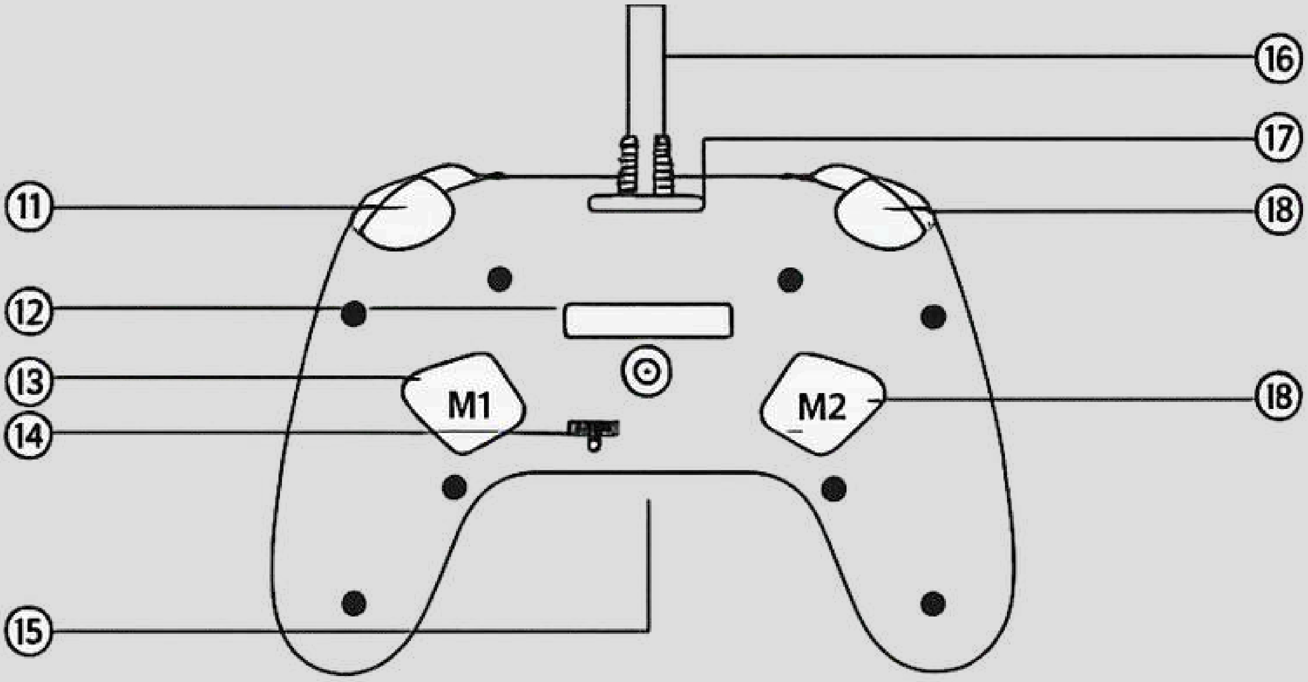
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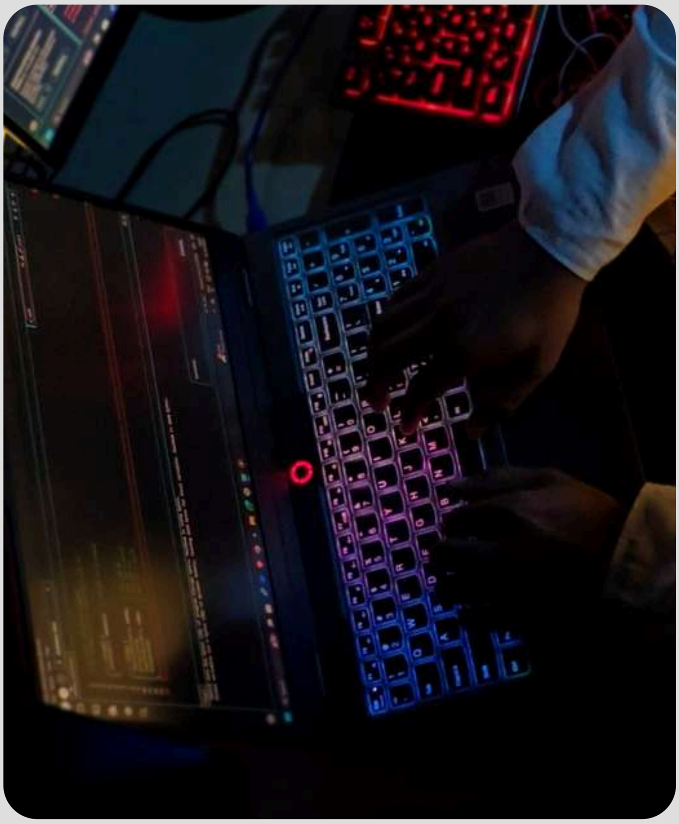
Program Changes, And Controller Customisation

As soon as the BaseBot was assembled and the first drive tests began, VoltEdge realised that the default control layout, although functional, didn't match the pace and precision needed for competition. Under Omer's lead, the team shifted into software refinement, using the Arduino IDE to rebuild the controller mapping into something faster, smoother, and more instinctive for match play. The goal was simple: the driver should never need to think about controls — his hands should respond automatically.

We kept the fundamentals of the BaseBot architecture intact, but customised the mapping to reflect VoltEdge's driving style. The left joystick continued to control forward and backward motion, while the right joystick handled turning and directional adjustments. These remained untouched because they gave Omer the most natural driving flow from the very beginning.

The real transformation came in the mechanism controls. The L2 trigger was assigned as the command to lift the arm up, giving the driver direct finger-based control over elevation without interrupting movement. The R2 trigger became the input for lowering the arm down, allowing quick and controlled repositioning during scoring cycles. To improve object handling speed, the R1 bumper was set to open and close the gripper, giving Omer the ability to react instantly when collecting or releasing charges. This replaced the slower button-based setup and made the robot more efficient during practice runs.

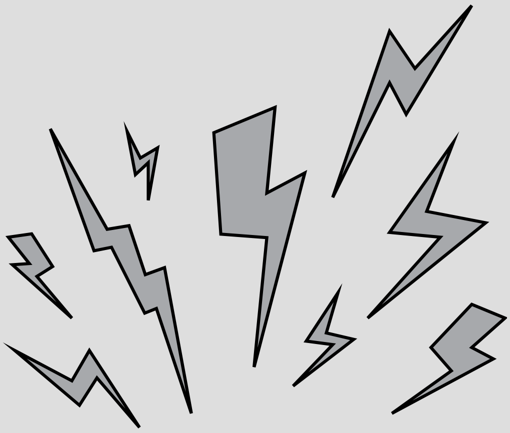
The real transformation came in the mechanism controls. Earlier, the arm moved either fully up or fully down with a single button press, giving the driver no control over stopping midway. After adding PWM and rewriting the movement logic, the arm became far more refined—now it moves smoothly and stops exactly at the point where the driver releases the button. This upgrade alone made handling cycles faster, steadier, and far more predictable during practice.



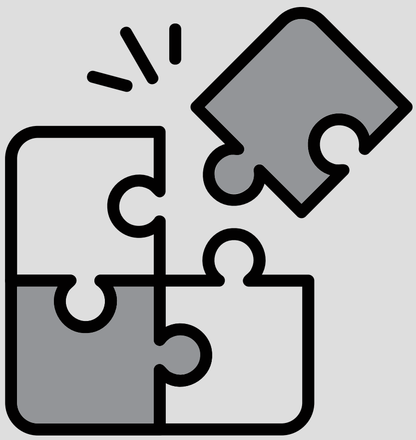
These customisations didn't change the BaseBot — they adapted it to VoltEdge. Through testing, adjustments, and repeated uploads, the robot evolved into a system that moved exactly how the driver thought. The mapping became intuitive, the actions became fluid, and the robot began responding like a natural extension of the driver's hands. By the end of the refinement cycle, EdgeBot no longer felt like a standard build — it felt like our robot, programmed precisely for VoltEdge's rhythm and control.

Troubleshooting And Testing Programs

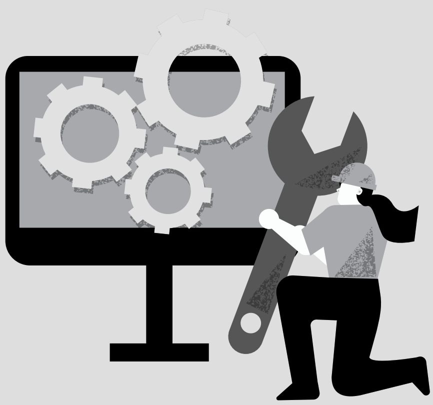
Programming the robot was not a one-time upload — it was a cycle of writing, testing, observing, and correcting. As soon as VoltEdge began experimenting with the BaseBot's controls in the Arduino IDE, small inconsistencies started to appear: a motor turning slightly faster than the opposite one, the arm stopping a bit earlier than expected, or the gripper moving with more force than required. These were not errors — they were cues that the code needed tuning. Under Omer's lead, the team tested drive behaviour repeatedly, adjusting speed mappings, refining turn sensitivity, and recalibrating servo angles until the robot moved smoothly and predictably.



Every evening session became a pattern: upload a version of the code, power on the robot, test the motion on the floor, identify the issue, and head back to the laptop for another correction. Sometimes the robot accelerated too quickly, so the team reduced the response curve of the joysticks. Sometimes the turning radius felt too wide, so the team adjusted the turning factor inside the program. When the gripper required faster reaction time, the servo positions were fine-tuned for cleaner opening and closing. Through this continuous process, EdgeBot gradually became stable, precise, and driver-friendly.



These tests taught the team how every small line of code affected real-world behaviour. Each improvement brought the robot closer to competition readiness. By the end of this phase, the robot was no longer just running code — it was executing movement shaped by VoltEdge's hands, instincts, and problem-solving. The troubleshooting journey became one of the most important learning experiences of the entire build.



Autonomous Skill Challenge

Basebot Autonomous Capabilities

The **Basebot** we received was completely manual.

It had motors, a servo, a chassis, and a controller —
but it had no sensors, no autonomous logic, and no pathway to run on its own.

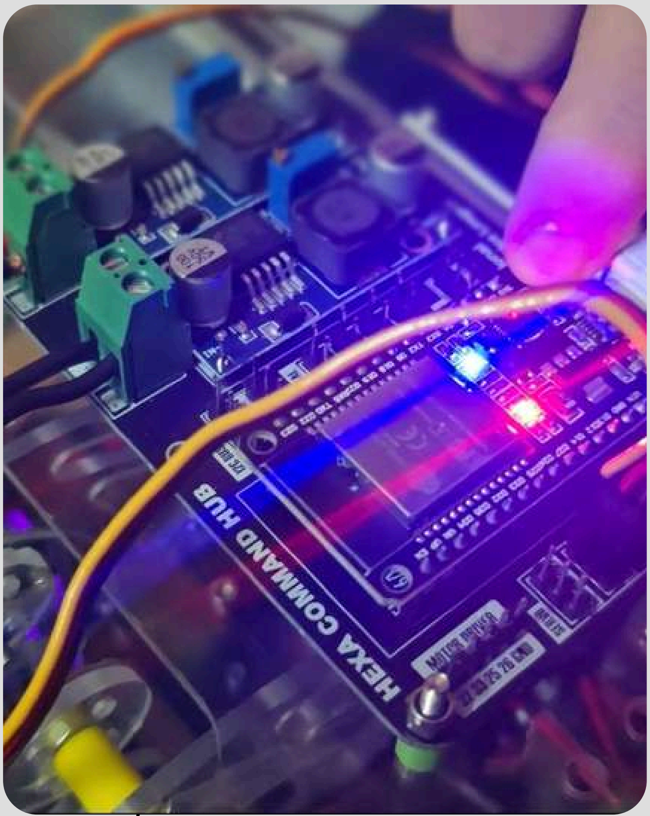
For the Autonomous Skill Challenge, everything had to be built by us from the ground up.

Instead of relying on any built-in features, VoltEdge chose to engineer an autonomous system ourselves. We purchased and integrated our own sensors — a line-following IR array, a gyroscope, and an ultrasonic distance sensor — and transformed a fully manual BaseBot into a robot capable of completing an independent routine.

This meant the BaseBot had zero autonomous capabilities at the start.
Every part of the autonomous system — sensing, logic, reactions, timing — came from VoltEdge's engineering decisions and tests.
The BaseBot did not come with autonomous capabilities.
VoltEdge built them.
Every sensor was chosen by us.
Every behaviour was coded by us.
Every movement in autonomous mode was something we taught the machine ourselves.
This challenge became one of the most defining moments of our engineering journey — because it wasn't just the robot learning a routine...
it was us learning how to make a robot think.

Our Modifications And Programming Improvements

Since the BaseBot lacked autonomous features and sensors, VoltEdge had to develop the entire system from scratch. We began by equipping the robot with the ability to see, sense, and respond—capabilities it didn't have initially. We acquired a 5-sensor IR line array, gyroscope, and ultrasonic sensor, and integrated these components into a robot meant for manual control.



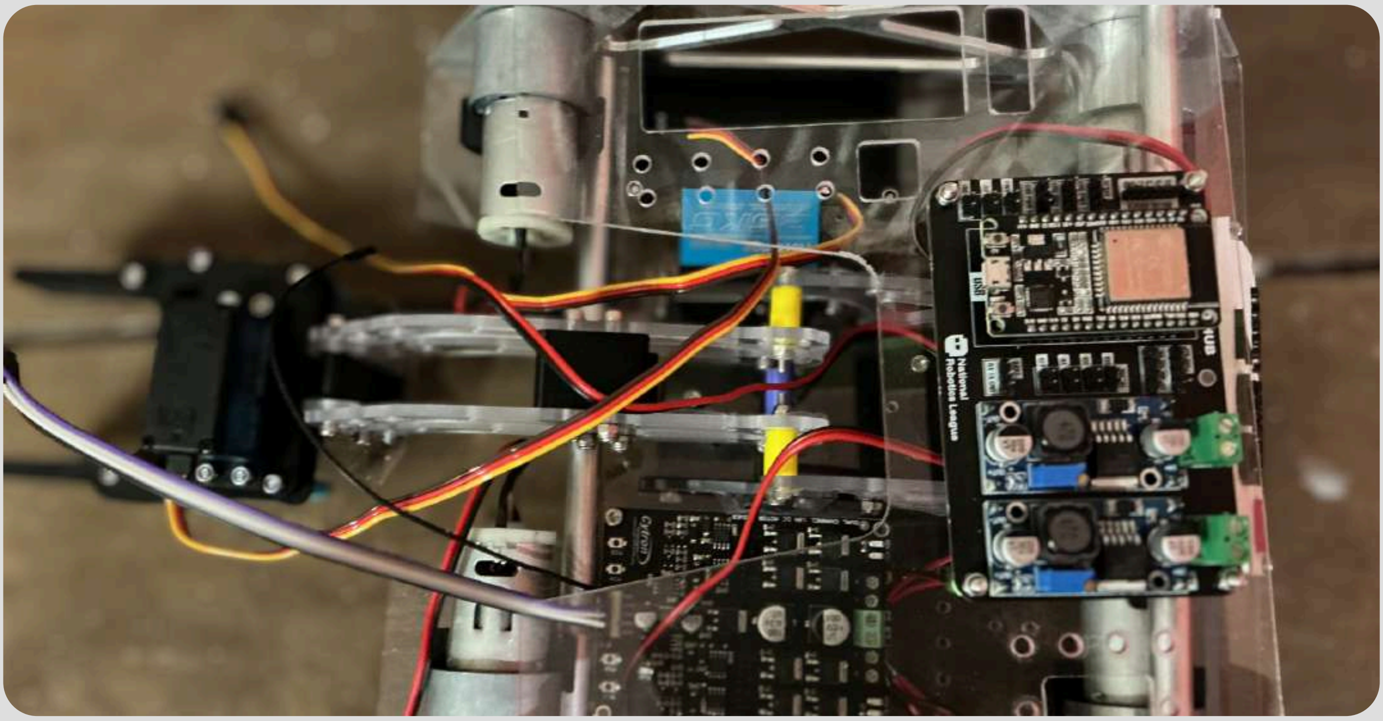
The IR array became the cornerstone of our autonomous navigation. Positioned at the front, it detected light and dark surfaces, enabling the robot to recognize when it was on or off the line. This required meticulous calibration and tailored correction logic to ensure smooth adjustments without jolting or overshooting turns.

We added a gyroscope to stabilize the robot's orientation. Before this, the robot drifted slightly during tests and struggled to maintain consistent angles. With the gyroscope, it could hold its direction, correct rotational errors, and execute accurate turns—essential for completing an autonomous routine.

We also attached an ultrasonic sensor to help the robot detect charging stations from a safe distance. It was programmed to slow down when the ultrasonic reading exceeded a certain threshold and to stop precisely for alignment. This minimized collision risks and ensured a smooth, predictable approach.

All of these abilities were built through programming improvements. We wrote custom logic inside the Arduino IDE to:

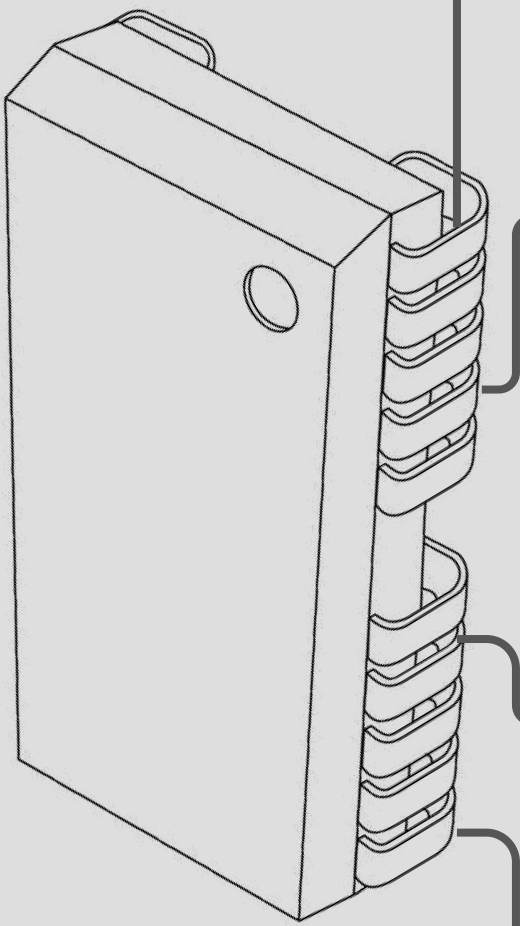
- Read all five IR sensors and determine correction directions
- Use gyro feedback to stabilize turns and straight paths
- Process ultrasonic distance data for slowing and stopping
- Blend timing, sensor readings, and motor responses into one routine



To meet challenge rules, we added a deliberate activation method: holding the X button for five seconds triggers autonomous mode. This ensured safety and avoided accidental starts.

Through repeated uploads, tests, and refinements, the BaseBot evolved from a fully manual machine into a robot capable of running an entire routine independently. Every correction, every angle, every movement in autonomous mode was the result of VoltEdge's own design — a custom-built system shaped by our logic, sensors, and persistence.

Sensor Integration And Testing



Integrating sensors into a formerly manual robot became one of the most challenging and rewarding parts of VoltEdge's autonomous journey. Since the BaseBot lacked sensing hardware, every capability had to be built from scratch. After acquiring the IR line array, gyroscope, and ultrasonic sensor, our team spent days translating these components into a comprehensible system. Loose wires and raw readings gradually transformed into a coordinated sensing network guiding the robot autonomously.

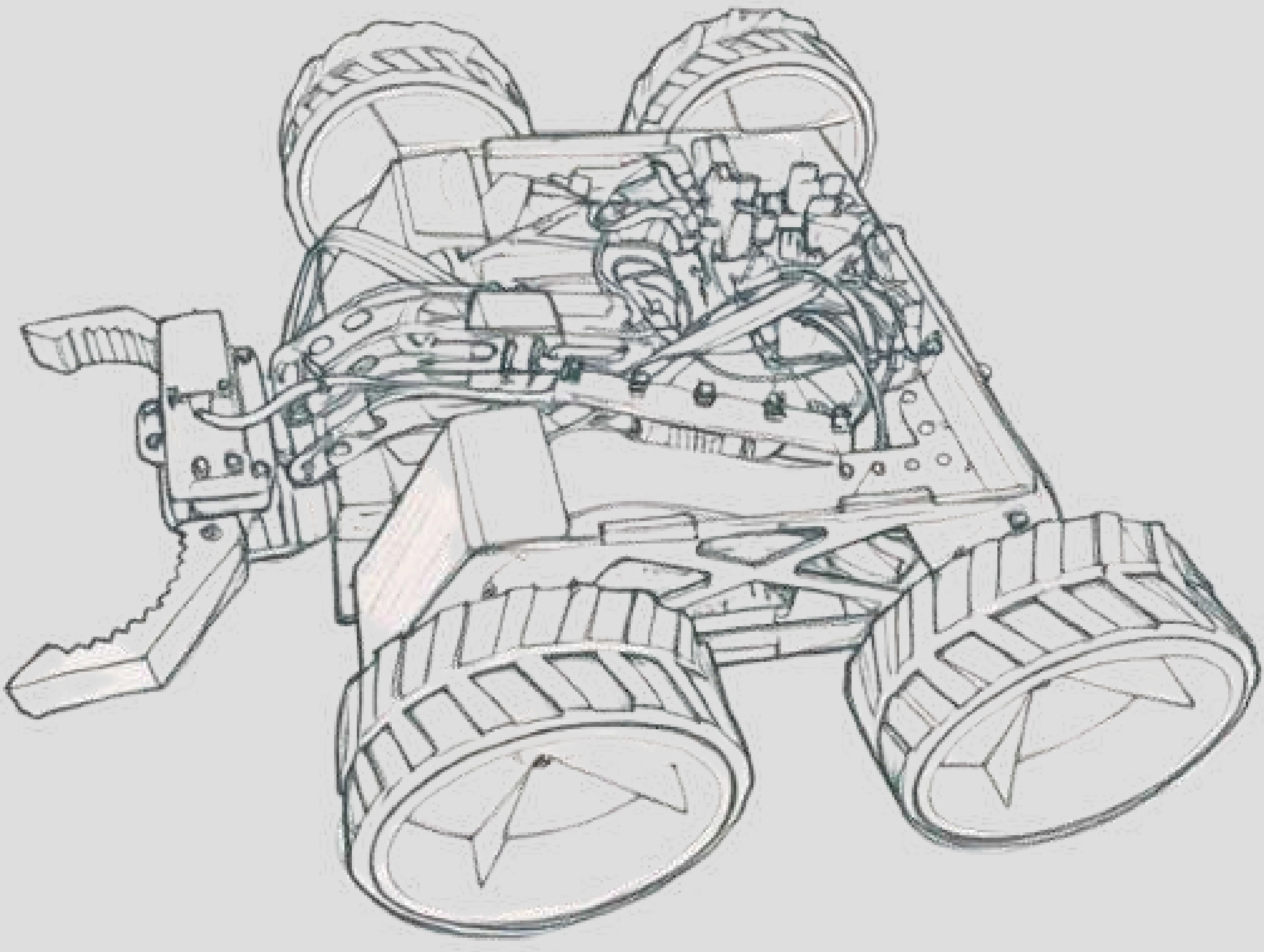
The first major step was IR line tracking. We placed a black tape strip on the floor as a test track. Dozens of attempts were made—sometimes the robot followed smoothly, other times it drifted or overcorrected. Each attempt taught us something new. We adjusted thresholds, correction logic, and sensor spacing until the robot confidently read the tape, evolving the IR array into a reliable guide.

The gyroscope was the second key element. Initially, the robot rotated slightly or took inconsistent turns. Integrating the gyro stabilized orientation, corrected drift, and ensured precise angle turns. This improved straight-line accuracy and predictability.

For distance detection, the ultrasonic sensor was tuned to recognize the charge from the right distance. We tested multiple ranges until the robot consistently aligned correctly, giving it the "awareness" needed to approach objects without collisions.

Throughout this process, VoltEdge received valuable guidance from Danish Gawai Sir, who helped us understand sensor behaviour and refine our autonomous logic over several days. His mentorship, combined with our repeated testing, helped transform raw data into usable decisions the robot could rely on.

By the end of integration, the robot responded not just to code—but to the environment. It followed the black tape confidently, held direction steadily, and slowed down precisely near the charge. These tests were where the robot learned, where we learned, and where autonomous mode truly came to life.



Strategy

Basebot Operational Strategy As Per Guide

The BaseBot was designed with a simple, predictable strategy in mind — a strategy that every team could understand before attempting modifications or advanced maneuvers. According to the NRL guide, the BaseBot's primary purpose is to drive reliably, collect charges, and score them with consistency, using a stable differential drivetrain and a straightforward servo-based arm. Its four-wheel tank-drive system gives it strong traction and smooth directional control, allowing it to move quickly across the field, push charges when needed, and adjust its position during scoring attempts. The gripper mechanism, mounted on the front servo arm, is designed to lift a single charge securely and place it into the scoring zone.

The guide emphasizes simplicity: the BaseBot should first master basic collection cycles. This means approaching a charge cleanly, lifting it with the arm, backing out safely, and driving toward the drop zone without losing grip. Each cycle is meant to be smooth, stable, and repeatable. The robot's low height also allows it to pass under the Charge Station for full parking points, giving teams an additional strategic advantage during endgame situations.

The strategy proposed in the guide encourages teams to focus on control, predictability, and consistency before attempting any complex maneuvers or modifications. Its drivetrain is meant to provide straight, balanced motion, while the gripper's geometry is designed to hold the charge with minimum errors. In simple terms, the BaseBot's operational strategy is built around mastering the fundamentals: drive straight, collect confidently, score cleanly, and repeat.

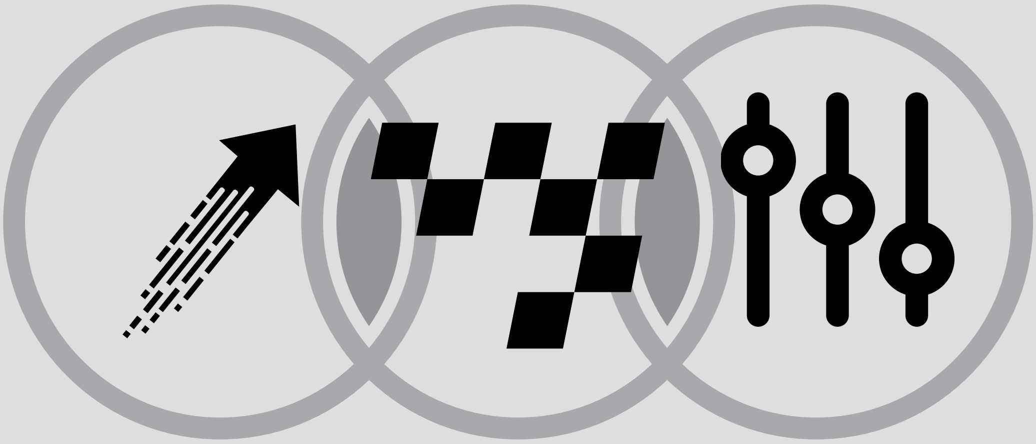
For VoltEdge, this base strategy became the foundation we learned from before evolving into customized controls, autonomous improvements, and advanced match-planning. The BaseBot taught us the rhythm of the arena — one reliable cycle at a time.

Our Team's Match Play Strategy, and Adjustments

For VoltEdge, match play wasn't about taking risks — it was about taking the smartest, shortest, and most reliable path to score. From the very beginning of our testing sessions, we realised that the BaseBot responded best when its movement stayed simple, direct, and controlled. This became the foundation of our match strategy: reduce unnecessary turns, avoid long routes, and always choose the shortest cycle path to the charge and back to the drop zone.

With Omer as the driver, the robot's customised control mapping allowed quick reactions and smooth handling. The left joystick kept the robot moving cleanly in straight lines, the right joystick handled tight directional adjustments, and the redesigned trigger layout gave instant control over the arm and gripper. This meant that our cycles could be fast without sacrificing accuracy.

Our Strategy Inside The Arena Is Built On Three Principles:

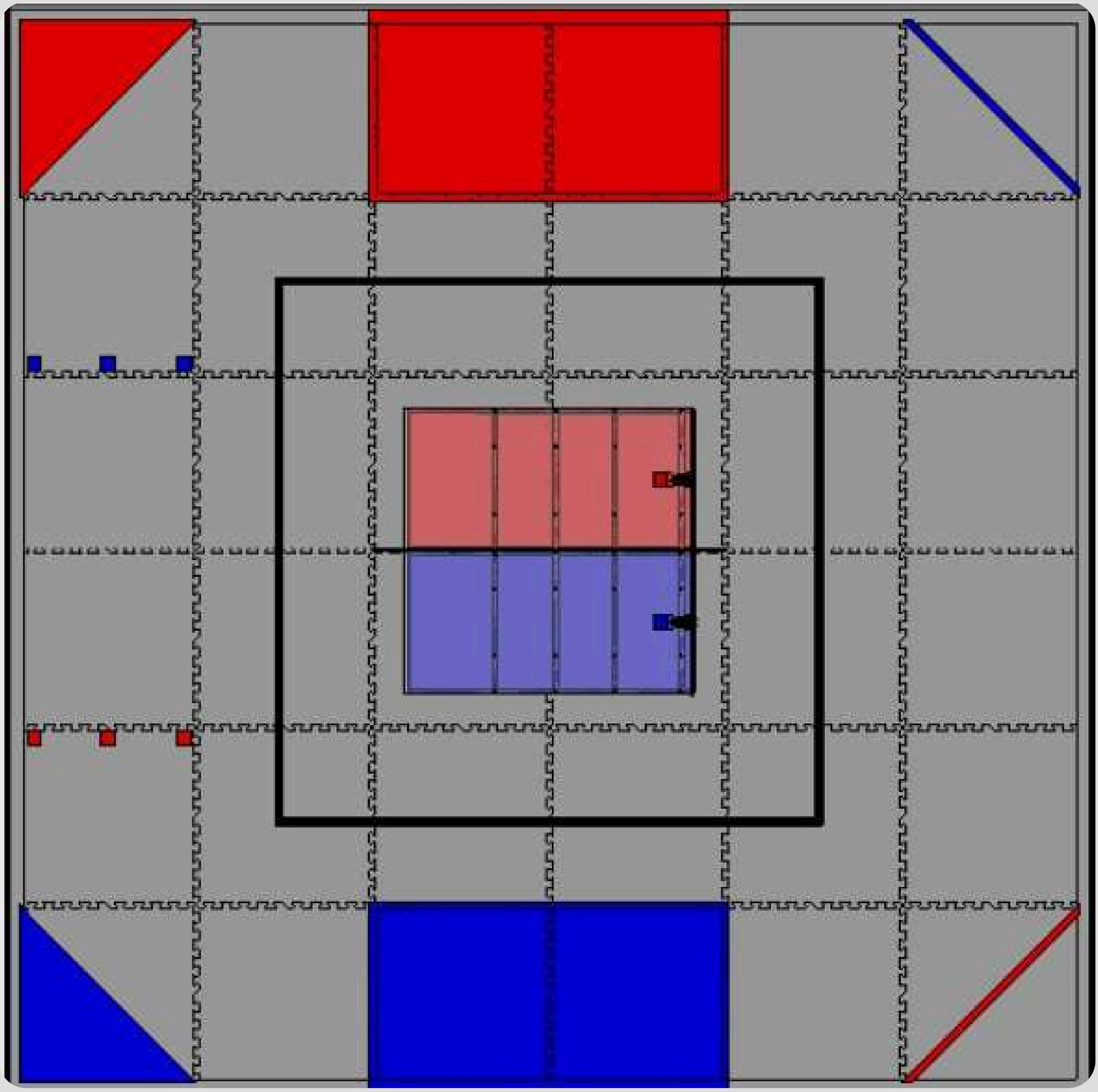


1. Shortest Path First — Instead of navigating wide arcs or complicated turns, we always pick the most direct route from spawn point → charge → drop zone. The robot accelerates, collects, scores, and resets as quickly as possible.

2. Stable Driving Over Speed- Even though the BaseBot can move fast, we prioritise clean control. A stable entry into the charge zone, a steady lift, and a controlled return to scoring always outperform unpredictable speed.

3. Instant Adjustments — Thanks to our custom controls, small joystick inputs allow rapid micro-adjustments. If the robot drifts slightly or a charge is placed at an angle, the driver can correct the alignment immediately.

During testing, we refined this strategy repeatedly — shortening paths, reducing unnecessary movement, and timing each cycle until it became second nature. Our focus remained on consistency, not complexity. A reliable routine, performed over and over with precision, became our competitive advantage.



Every movement inside the arena is shaped by one VoltEdge principle: If there is a shorter route, we take it.

This approach keeps our cycles fast, our scoring consistent, and our strategy simple enough to execute under pressure — giving EdgeBot the best chance to perform confidently when it matters most.

Workshops, And Events Conducted.

One of the most meaningful parts of VoltEdge's outreach journey was the workshop we conducted at Ali Public School on 6th November. As students of Grade 12 balancing midterms, robotics work, and council responsibilities, organising this session was challenging — but it became one of the most impactful moments of our NRL season. The workshop introduced nearly forty students to the world of robotics, turning complex concepts into something they could understand and get excited about.

The session opened with Mohiddin, whose hosting guided the entire flow — welcoming teachers, connecting each segment, and keeping the atmosphere comfortable for students who were experiencing robotics for the first time. Zaid took the stage next, explaining the evolution of robotics from Isaac Asimov's ideas to the robots used today, giving students a timeline of how technology has grown. Omer followed with a simple yet engaging explanation of sensors, helping students understand how robots sense and interact with their surroundings.

To make the learning interactive, Mohiddin led a quiz that tested curiosity and rewarded active participation. After this, Abdullah Saami introduced students to practical robotics concepts, the upcoming hands-on Robotics course, and even showed them the official NRL website and VoltEdge's robot video — making the idea of competing at IIT Bombay feel real and achievable. Finally, Irfan closed the session with a short motivational talk that encouraged students to stay curious and keep exploring engineering.

The workshop concluded with photos, small gifts, and documentation by Shamveel, who captured every key moment through video and pictures. This event became an important part of VoltEdge's outreach mission — not just teaching robotics, but showing students that innovation can begin anywhere, even in a small classroom, even in one afternoon.

On 15th November, Team VoltEdge launched its hands-on Basic Robotics Course at Ali Public School, marking the beginning of a structured learning journey for young students. The course was designed to introduce them to the fundamentals of robotics — understanding components, sensing mechanisms, wiring basics, and simple movement logic — through practical, student-friendly sessions. To ensure every participant could learn by doing, we distributed a Basic Robotics Kit that included essential components for building and experimenting. The goal of the course is not just to teach robotics, but to spark curiosity, build technical confidence, and show students that engineering becomes meaningful the moment they touch, build, and create with their own hands.

Community Involvement, And STEM Promotion.

For VoltEdge, robotics was never meant to stay within our own workspace — it was meant to reach the community around us. From the moment we registered for NRL, we knew that our journey would mean much more if it inspired students who had never seen robotics up close. This vision led to our STEM outreach efforts, where we shared what we learned with younger students and opened a door for them to explore science and engineering.

Our biggest step in community involvement came through the workshop at Ali Public School, where nearly forty students experienced robotics for the first time. We didn't just demonstrate a robot — we explained how technology evolves, how sensors work, how robots think, and how students themselves could start learning with simple circuits. The session became a hands-on introduction to STEM, turning robotics from something "difficult" into something exciting and achievable.

Beyond teaching, the workshop helped build curiosity. Students engaged in quizzes, asked questions, interacted with components, and saw real robot footage from VoltEdge — connecting theoretical concepts to what a real team from their own town was building. This exposure created awareness about engineering pathways, national competitions like NRL, and how STEM fields can shape their future.

Our outreach did not end in one session. Through the upcoming Hands-On Robotics Course at the same school, VoltEdge is continuing to guide students step-by-step — from basic electronics to building small working robots for their science exhibition. This initiative gives younger learners a long-term foundation in STEM and encourages them to pursue engineering with confidence.

Every effort we put into community involvement aims toward one goal: making robotics accessible, inspiring, and real for the next generation.

VoltEdge believes that sharing knowledge is just as important as building a robot — because every mind we spark today might become tomorrow's innovator.

Team VoltEdge: Field Engagement & Tech Outreach Report

Remote Drone-Assisted Research & Innovation Concepts

As part of our commitment to real-world engineering, Team VoltEdge expanded its outreach through a deep dive into agricultural automation. Our research team began exploring the idea of a remote drone-assisted harvesting system, a concept born from long hours of field observation and conversations with farmers who struggle with the danger and difficulty of harvesting fruits from tall trees. The team is now actively working on developing this harvesting drone — a flying tool designed to identify ripe fruits, approach safely, and support farmers where ladders and manual effort fall short. It represents the VoltEdge approach perfectly: innovation that rises from real problems and aims to make real impact.

In the same competition, another innovation emerged from within the team. Irfan, driven by curiosity and a focus on weather challenges faced by farmers, proposed his own research concept — an automated field shutter system. His design used rain and wind sensors to gather real-time environmental data and instantly deploy a protective shutter whenever storm conditions threatened crops. Instead of relying on manual intervention or guessing weather patterns, his system acted automatically, shielding farmland from sudden rain bursts, strong winds, and storm damage.

Together, these concepts showcased the spirit of VoltEdge — different minds solving different problems, yet all driven by the same purpose: using engineering to improve lives. Whether it's a drone that climbs where farmers cannot, or a shutter that responds faster than human reaction, every idea reflects our belief that innovation must be practical, thoughtful, and designed to serve the world beyond the workshop.

In the same competition, Omer and Zaid's drone-harvesting concept earned them the Aspire Scientist Award, recognising their innovation and clarity of research.

Impact For Robotics And NRL

The influence of robotics—and specifically the National Robotics League—extended far beyond our own team. For many students in our community, NRL became their first introduction to a world where engineering feels alive, creative, and achievable. Through our workshop and ongoing robotics course, students experienced robotics not as a distant concept found in textbooks, but as something they could build with their own hands.

For younger students who attended our session at Ali Public School, seeing a real NRL team from Bhatkal changed their perception immediately. Robotics stopped feeling "too advanced" or "only for big cities." Instead, they saw that students from their own town, from their own background, could compete on a national stage in IIT Bombay. This made STEM feel accessible—something they could realistically grow into.

Our demonstrations of sensors, circuits, and real robot footage showed students how engineering could solve problems in daily life. Many of them expressed interest in joining robotics in the future; some even approached us afterward, asking how they could participate next year. By showing them the official NRL website, explaining the challenge, and presenting VoltEdge's own robot video, we connected them directly to a national STEM opportunity.

The upcoming Hands-On Robotics Course strengthened this impact even more. Students now see a path—not just inspiration. They know they can move from learning basic circuits to building small robots for their science exhibition, and eventually step into competitions like NRL.

For our town, NRL became more than a competition.
It became:

- a spark for student curiosity
- a platform that made STEM careers feel real
- a source of confidence for young learners
- a reminder that innovation can begin anywhere

VoltEdge didn't only build a robot.
We helped build interest, awareness, and belief.

The impact of robotics and NRL will continue to grow with every student who decides to explore engineering because of what they saw, learned, and experienced through our outreach

Social Media And Branding

Branding Based On Team Identity

VoltEdge's branding didn't start with colours or logos — it started with who we were as a team. From the first day we registered, we knew our identity had to reflect the energy, precision, and vision that shaped every step of our journey. That identity became the core of our branding: gold, yellow, black, and our signature message — Driven by Volts, Defined by Vision. These colours weren't random choices. Gold symbolised ambition and excellence, yellow represented innovation and learning, while black gave us the clean, sharp foundation that made everything look modern and focused.

Our team name, VoltEdge, captured our personality perfectly. "Volt" represented power, energy, and electronics — the heart of robotics. "Edge" reflected precision, competitiveness, and the sharpness of engineering design. Together, the name told the story of a team that builds with intensity and thinks with clarity. This identity was strengthened through our official team logo, which stayed consistent across posts, videos, documents, and the engineering portfolio. We never altered its colours, because the logo became a symbol of our unity and professionalism.

Every part of our branding was chosen with intention. Our Instagram posts, reveal videos, behind-the-scenes clips, and workshop documentation followed the same colour style — dark backgrounds with sharp golden and yellow accents. Even the Engineering Portfolio cover page and Table of Contents were built around this signature look. Whether someone saw our robot, our graphics, or our uniform visuals, they immediately recognised VoltEdge.

The goal of our branding was simple:
to build a team identity strong enough that even before the robot enters the arena, people know who built it.

For VoltEdge, branding is not decoration — it is identity, discipline, and representation. To build a unified presence on and off the field, we designed and customised our own team apparel, which includes our official VoltEdge team jersey and VoltEdge team jacket. Both pieces were crafted in our signature black-and-gold palette, carrying our logo and tagline with precision. This consistent visual identity strengthens how we present ourselves in workshops, competitions, social media content, and official events, ensuring that wherever VoltEdge stands, our presence is instantly recognisable.

VoltEdge’s brand reflects who we are — focused, disciplined, modern, and driven by a vision larger than the robot itself.

Social Media Strategy.

For Team VoltEdge, social media was never just a place to post — it became our parallel arena.
While the robot was being assembled piece by piece, our identity was being built online, post by post.

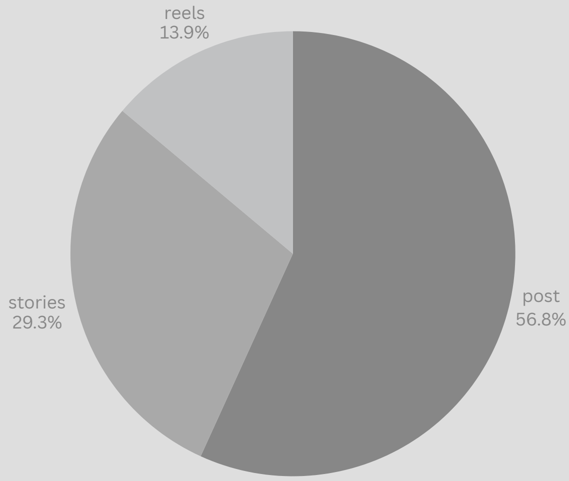
Between 29 October and 28 November, VoltEdge created a consistent digital presence on Instagram that focused on three pillars:

1. Visibility

2. Engagement

3. Community Awareness

Even as a newly-formed team, our page began gaining traction far beyond what we expected.
In just one month, the page recorded:



- 68,385 total views (As of 29Nov)
- 13,603 accounts reached
- 85.3% of viewers were non-followers
- 56.8% of views came from reels
- 29.3% from posts
- 13.9% from stories
- 1,883 profile visits (a +969.9% growth from the previous month)

This meant that almost all of our visibility came from outside our circle — proving that our content wasn't just "seen"... it was noticed.

Even October (before VoltEdge was fully active) gave us an early indicator of potential:

- 12.9K total views
- 80% views from non-followers
- 37 followers gained that month

By November, that momentum transformed into our strongest month so far.

Content Flow And Posting Style

Our content strategy was intentionally simple, clean, and aligned with NRL’s weekly challenge rhythm.
We didn’t chase trends — we posted what represented VoltEdge:

• Team Packing & Chaos

A raw, relatable look into the behind-the-scenes reality — wires on the floor, last-minute fixes, and all the laughter in between.

• Apparel Reveal

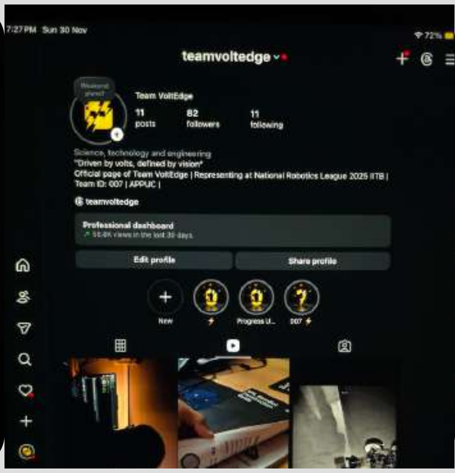
Aesthetic clips showcasing VoltEdge merch and identity — black, gold, bold.

• Workshop Highlights

Special moments from the Ali Public School workshop, capturing students’ reactions and curiosity.

• Memes & Relatable BTS Moments

Our top reel — 20,000+ views — was a simple meme of the team watching other teams make reels.
It showed that authenticity always wins.



Strategic Direction Going Forward

Based on our current data and NRL's weekly challenge flow, VoltEdge continues focusing on:

- High-reach reels (build clips, meme edits, robot POV shots)
- Team-identity posts (logo, apparel, reveal teasers)
- Workshop and community updates
- Consistent brand colors (black + gold)
- Clear captions & NRL hashtags to stay aligned with competition visibility
- Posting remaining high-value content:
- Team Apparel Reveal
- Team Packing Chaos
- Workshop Highlights
- Robot Reveal Video (next to be posted)

VoltEdge Social Media Strategy Summary

In simple words:

We didn't just post.
We built awareness.
We built identity.
And without a single paid promotion, VoltEdge reached nearly 65,000 people in one month.

This is the story our analytics tell —
a team that started small, grew consistently, and positioned itself strongly even before entering the real arena.

@teamvoltedge

Mandatory Upload :Team And Robot Reveal Video

For VoltEdge, the reveal videos weren't just compulsory NRL uploads — they were the public face of our identity. These two videos marked our first official appearance as Team VoltEdge and the first introduction of our robot, EdgeBot, to the world.

Team Reveal Video — Crafted in the Middle of Chaos

The team reveal challenge was announced on 6 November, right when half the team was preparing for an educational tour scheduled that very night. With the clock ticking and only a few hours left before departure, we made the decision to shoot the team reveal early in the morning of 7 November on our school campus.

While the rest of the team left for their tour at 11:15 PM, the responsibility of editing and completing the video fell entirely to Abdullah Saami Sada. Throughout the tour week (7–13 November), Abdullah handled the full post-production alone — stitching clips, refining transitions, matching VoltEdge's brand colors, and ensuring the final video met NRL standards.
Despite the tight schedule, the team reveal went live on time, marking the official digital birth of VoltEdge.

Robot Reveal Video — Scheduled and Strategically Released

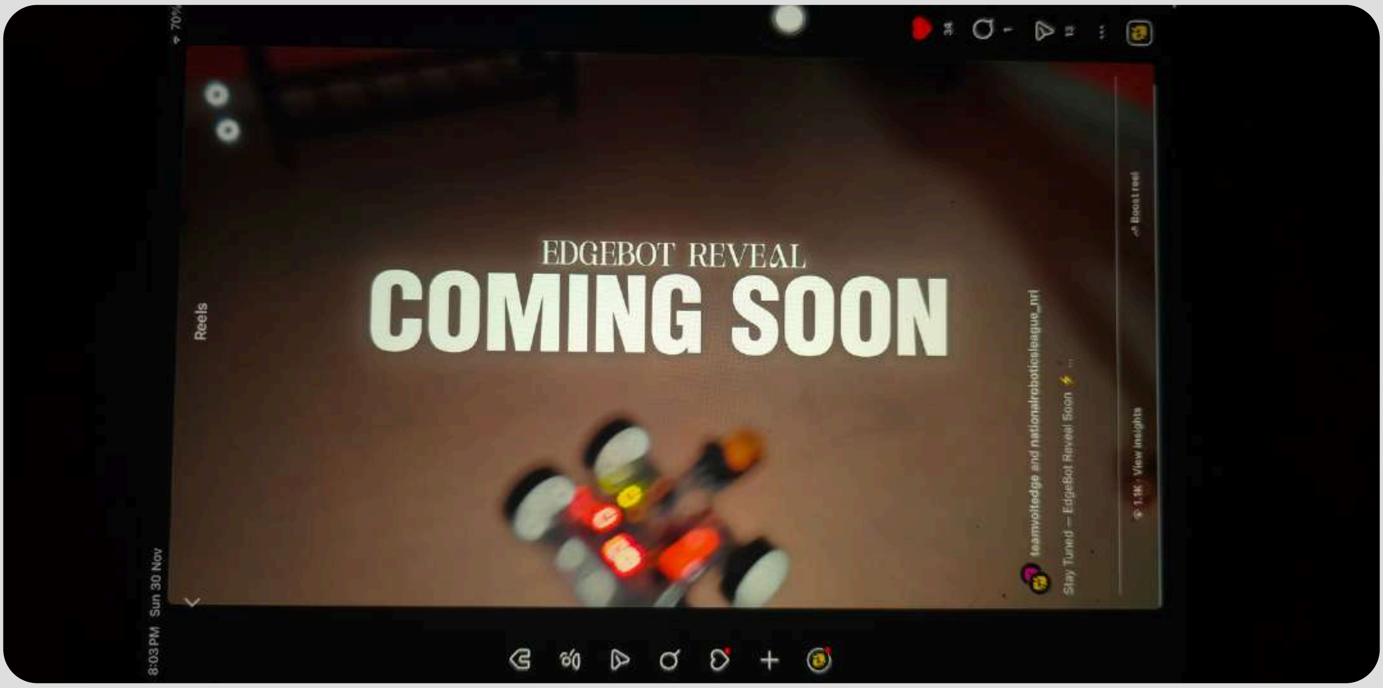
The robot reveal carries more weight — it showcases EdgeBot for the first time and sets the tone for our engineering identity.

Our posting plan is structured and intentional:

- 30 November — Uploaded the Robot Reveal Trailer, giving the audience a cinematic peek at EdgeBot.
- 4 or 5 December — Post the Full Robot Reveal Video, right before portfolio submission and just days before the NRL competition.

The reveal is timed to maximize visibility, maintain engagement, and keep VoltEdge active during the critical pre-event period when teams across India are preparing to travel to IIT Bombay.

Both reveal videos are more than submissions —
they are a reflection of our journey, our coordination, and our commitment to presenting VoltEdge with clarity, style, and discipline



System Design, And Problem Analysis.

The inspiration for our innovation came from observing a simple but dangerous pattern in everyday environments. Transparent glass walls — found in schools, airports, malls, and shopping centres — are built for aesthetics. They make spaces look modern, open, and clean. But their greatest strength is also their greatest weakness:
they are almost invisible.

In schools, students rushing between classes often fail to notice the glass in front of them.
In airports, passengers distracted by screens or luggage walk into clear partitions.
In malls and shopping centres, reflective floors, bright interiors, and heavy foot traffic make the glass blend perfectly with the surroundings.

The problem was not behaviour.
The problem was visibility.

We broke the issue down into two clear causes:

1. Transparent Glass Becomes Invisible During Motion.

When a person is walking or running — especially indoors — their focus shifts forward, not sideways. With no colour, pattern, or contrast, the glass disappears into the background.

2. Modern Distractions Reduce Awareness Even Further.

In public spaces, people use their phones, talk in groups, or hurry to the next task. Even adults in airports or malls experience sudden collisions because they simply didn't see the glass in time.

With this understanding, VoltEdge built the system around a single principle:
make the glass visible only when it needs to be visible.

This led to our three-layer system design:

1. Input Layer — Detecting Approach

We integrated:
- Ultrasonic Sensor (HC-SR04) to detect the distance of the approaching individual
- PIR-based motion logic to interpret walking vs. running

These sensors give the system awareness — the ability to recognise when someone is getting close to the glass and how fast.

2. Processing Layer — Analysing Behaviour

At the centre of the system is the Arduino UNO, which continuously processes:
• distance readings
• motion triggers
• speed changes

This allows the system to classify:
• safe walking
• cautious approach
• or fast, risky movement

The microcontroller decides exactly when and how strongly the alert should activate.

3. Output Layer — Warning the User

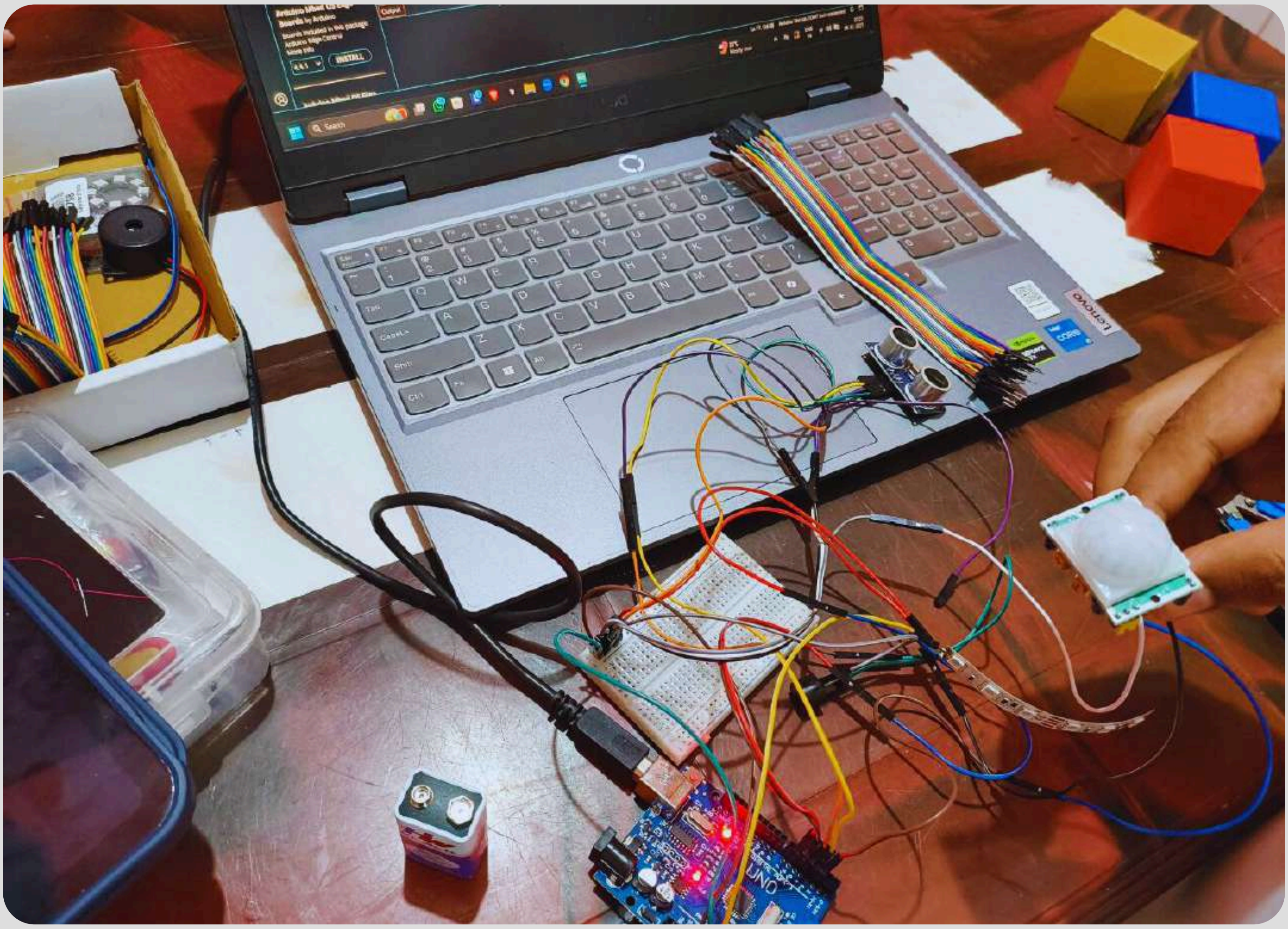
To make the glass visible only when needed, we used:

- LED Strip illumination to highlight the edges of the glass
- Active Buzzer for an audible warning

The response changes based on speed:

- A soft LED glow for slow walking
- A brighter, instant light + louder buzzer for fast movement

This dual alert ensures that even distracted individuals — especially in public spaces — notice the transparent wall and avoid collision.



Implementation & Technical Architecture

Transforming the Smart Glass Safety Wall from an idea into a functioning system required the same disciplined engineering mindset we apply in robotics. VoltEdge approached the project with a layered, structured architecture that allowed each part of the system to build naturally upon the next. This method ensured reliability and accuracy in real-world environments such as schools, airports, malls, and shopping centres — places where transparent glass often becomes invisible, leading to frequent accidents.

The foundation of the system lies in a compact hardware setup built around components we selected deliberately for both reliability and accessibility. At its core, an Arduino UNO acts as the controller, receiving signals and executing decisions. An ultrasonic sensor supplies distance measurements, giving the system a sense of how close a person is to the glass surface. A PIR motion sensor complements this by detecting motion patterns, helping the system determine whether someone is calmly walking or approaching at higher speed. Along the edges of the glass, we integrated a high-visibility LED strip that activates according to the threat level, paired with an active buzzer that provides auditory alerts. These components sit alongside supporting wiring, power regulation, and a diffuser film to ensure the lighting spreads smoothly across the glass frame — all arranged in a discreet configuration that preserves the visual integrity of the space.

The behaviour of the entire setup is governed by Arduino logic structured into a sequence of sensing, decision-making, and action. The first module continuously reads real-time data from the ultrasonic and PIR sensors, giving the system constant awareness of its surroundings. The next layer evaluates this input and interprets it into meaningful categories: normal walking, caution-level proximity, or a high-risk fast approach. Based on this classification, the system activates its outputs with precise intensity — from a gentle LED glow for safe approaches to bright illumination and a strong buzzer response for high-speed movement. This adaptive behaviour ensures that the system reacts not just to presence, but to intent and speed.

VoltEdge designed the architecture in three simple but effective layers. The input layer, made of the ultrasonic and PIR sensors, serves as the "eyes and ears" of the system. The processing layer — the Arduino — functions as the brain, constantly evaluating conditions. The output layer, comprised of LEDs and a buzzer, communicates instantly and unmistakably with the approaching user. Despite the simplicity, the three-layer structure offers clarity, scalability, and ease of installation in public environments.

Once assembled, the system underwent iterative testing on a mock glass frame to refine its accuracy. We validated distance readings across different ranges, observed motion detection for both walking and running, tested light visibility under varied lighting conditions, tuned the buzzer's intensity to match urgency levels, and evaluated the combined response during rapid approach scenarios. Each round of testing allowed us to fine-tune thresholds until the system behaved reliably and consistently across all conditions.

In its final form, the Smart Glass Safety Wall follows a clear behaviour cycle: detect movement, analyse approach speed, and respond with the appropriate visual and auditory alert. Through simple components paired with intelligent logic, VoltEdge created a solution that enhances safety around transparent glass while preserving the architectural beauty of public spaces — a practical example of engineering serving everyday life.

Team Journey Summary

Complete Journey Timeline

4 October — The First Spark

Five days before midterm exams, Omer reached out to Abdullah and shared the details of the National Robotics League. The idea of competing at IIT Bombay lit a spark instantly. Even with exams around the corner, the team didn't hesitate — the possibility felt bigger than the pressure.

9 October — Official Registration

One day before midterms, the team made the decision that defined everything that came after: VoltEdge registered for NRL 2025.
There was no robot yet, no parts, no strategy — just belief.

20 October — The BaseBot Arrives in Bhatkal

The kit finally reached town. Opening the box felt like the real beginning. The parts were new, unfamiliar, and scattered — but for VoltEdge, it felt like opportunity.

22 October — The Build Begins

Right after exams, the full team began assembling the BaseBot. From chassis fitting to wiring to aligning motors, every evening turned into a build session.
This was also when misunderstandings happened but resolved quickly — proving the team was stronger together.

22–27 October — Continuous Build Week

For five straight days, the team worked after classes and through the evenings.
- Ahmed Irfan led mechanical assembly
- Mohammed Zaid worked on electronics
- Abdullah attempted BaseBot programming for the first time
- Omer refined controller logic later

By 27 October, the BaseBot was completely assembled — a full prototype ready for testing.

6 November — The Robotics Workshop at Ali Public School

VoltEdge conducted its first outreach event. Nearly 60 students attended. From sensors to timelines to live demonstrations, the workshop became one of our most important contributions to STEM in our town.

6 November — First NRL Weekly Challenge Announced (Team Reveal)

The challenge arrived the same day as the workshop. With the team preparing for a tour, we shot the team reveal early the next morning.

7 November Morning — Team Reveal Shoot

Before leaving for their educational tour, the team shot the team reveal video in the school campus.
At 11:15 PM, the members left for the tour.

7–13 November — Editing Done in Isolation

While the team was away, Abdullah carried the entire responsibility of editing the team reveal video alone.
This became one of the defining contributions to VoltEdge's online identity.

13 November — Team Returns, Work Resumes

As soon as the team returned, testing, wiring corrections, and programming refinements continued.

15–25 November — Continuous Testing & Autonomous Work

Evening sessions became the norm.
The team tested motor behaviour, servo angles, gripper response, and began integrating their self-purchased IR, gyro, and ultrasonic sensors.
During this time, Danish Gawai Sir guided the team through the most complex autonomous logic challenges.

21–27 November — Social Media Growth Phase

VoltEdge began posting behind-the-scenes clips, apparel reveals, workshop highlights, and memes.
By 28 November, the account crossed 64,000 views in a month — the strongest digital push in our journey.

29–30 November — Robot Reveal Trailer Scheduled

VoltEdge prepared the first trailer for EdgeBot, timed strategically before portfolio submission.

4-5 December — Full Robot Reveal Video

The complete EdgeBot reveal is planned to go live right before the team prepares for their travel and the final event.

30 November — Engineering Portfolio Submission

The deadline that holds together every section, every test, every screenshot, every design decision.
VoltEdge submits its first official engineering portfolio.

6–7 December — NRL IIT Bombay (Event Week)

The final destination.
The arena where everything we learned — every late evening, every fix, every misunderstanding resolved, every test, every decision — will come together.

This timeline is not just a sequence of dates.
It is the story of how VoltEdge was built — moment by moment, test by test, decision by decision.

Obstacles, And Busy Schedule Challenges

The journey of VoltEdge was shaped as much by pressure as by progress. Every advancement we made had to fit into a month already overflowing with academic deadlines, council responsibilities, robotics commitments, and daily student life. The true challenge was not building the robot—it was building it through everything else happening at the same time.

The first challenge appeared early on 4 October, when we discovered NRL just five days before midterm exams. With unfinished chapters to revise and multiple assignment deadlines approaching, we still registered on 9 October, one day before exams began. It was a brave decision, but it meant robotics would now run parallel to academic stress. The BaseBot kit arrived on 20 October, and by 22 October, the full build began even as we continued submitting pending assignments. Every evening from 22 to 27 October was spent assembling the robot piece by piece until the BaseBot was fully completed.

On 6 November, VoltEdge conducted a robotics workshop at Ali Public School, attended by nearly 40 students. Preparing the content, planning the flow, setting up equipment, capturing media, and conducting sessions took significant effort—especially because it happened on the same day NRL released the first weekly challenge: the Team Reveal. The next morning, 7 November, the team filmed the reveal video before several members left for an educational tour at 11:15 PM, remaining away until 13 November. During this entire period, Abdullah handled all editing and coordination for the challenge alone.

Once the team returned, the workload didn't reduce. From mid-November onward, Mohiddin, Zaid, and Omer were responsible for conducting daily afternoon robotics classes, teaching sensor basics, circuits, and robot foundations to younger students. Balancing teaching responsibilities with robotics testing and school work added another layer of pressure. Meanwhile, autonomous development began, requiring us to purchase our own IR sensors, gyro, and ultrasonic modules. We spent multiple evenings testing line tracking on black tape, stabilising turns, arranging sensor placement, and debugging logic—with continuous guidance from Danish Gawai Sir when challenges became too complex.

On 25 November, the Our College Management approved our fest proposal, with the event scheduled for 2 December, placing robotics directly beside council meetings, planning work, budgeting, and department assignments. At the same time, we still needed to manage publishing reels, posters, workshop clips, and behind-the-scenes content to maintain our digital engagement, which crossed 64,000 views by 28 November. Editing and scheduling posts during chaotic days required silent, consistent effort.

On 28 November, VoltEdge completed and tested the Innovation Challenge prototype—the Smart Glass Safety Wall system. This test had to be done between autonomous trials, portfolio writing, and fest planning, adding yet another deadline to an already overloaded week.

Through all of this—assignments, tours, daily robotics classes, workshop management, autonomous testing, innovation development, social media responsibilities, and council duties—the team never stopped working. Every member filled in when someone else was unavailable, every misunderstanding was resolved quickly, and every challenge became another reason to push forward.

These challenges did not interrupt our journey.
They defined it, shaped it, and proved that VoltEdge was built not just with skills—but with discipline, cooperation, and resilience.

Team VoltEdge

Representing at NRL 2025

Team ID: 007

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