Ujjwal Bajpai

ECE @RVCE

He/Him

I'm a **pre-final year Electronics and Communication Engineering student at RV College of Engineering** with a keen interest in bridging the gap between hardware and software. Currently, I'm gaining practical experience as an **IT Intern at Indian Farmers Fertiliser Cooperative Limited (IFFCO)**, contributing to real-world technological solutions.

Education & Experience

2025

Vocational Trainee

IFFCO

Contributed to web development tasks for the HRMS portal, enhancing user interface and functionality. Participated in instrumentation and plant visits to gain insights into industrial automation systems and their IT integration. Gained hands-on exposure to the IT infrastructure supporting large-scale manufacturing and administrative operations.

2023-2027

ECE UG Student

RV College of Engineering

8.52 grade

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ACKNOWLEDGEMENT

I had the opportunity to work as an IT Intern at Indian Farmers Fertiliser Cooperative Ltd. (IFFCO), Aonla, Uttar Pradesh, from July 2025 to September 2025. This internship gave me practical exposure to both web development tasks and the industrial instrumentation systems used at IFFCO's fertilizer plant. The experience allowed me to understand how modern IT solutions integrate with large-scale manufacturing and industrial automation.

During the internship, I received valuable mentorship and guidance from Mr. Harish Rawat, Head of the Internship and Training Department, who acted like a mentor to me and consistently provided tips on how to approach tasks effectively. Mr. Sudhanshu assigned me the project of creating the IFFCO informative and login website, which I developed using HTML, CSS, and Vanilla JavaScript. This helped me strengthen my practical web development skills.

I also had the opportunity to learn from various experts across different plant units. Ms. Samriddhi guided me through the Ammonia processing units and demonstrated the working of the DCS (Distributed Control System) in the Ammonia control room. Mr Jaskaran Singh gave me the insights about the electronics dept and Mr S.K Singh told me about the electronics devices used in urea 2. Mr. Abhishek gave me insights into the Urea processing unit, while Mr. Sahil explained the functioning of the Power Plant. Additionally, Mr. Ganesh shared knowledge about the Control Room operations, which deepened my understanding of industrial monitoring systems.

Overall, the internship not only enhanced my technical skills in IT and web development but also gave me meaningful exposure to the integration of IT with industrial automation, making it a highly enriching learning experience.

Introduction to IFFCO

During my internship, I came to know that the Indian Farmers Fertiliser Cooperative Limited (IFFCO) is one of the largest cooperative societies in the world, founded in 1967 and headquartered in New Delhi. IFFCO was established with the main objective of empowering Indian farmers by providing them with high-quality fertilizers at affordable prices. Over the years, it has grown into a massive organization that operates several large fertilizer plants across the country, including ammonia and urea manufacturing units. These plants play a vital role in strengthening India’s agricultural productivity and food security.

IFFCO not only produces fertilizers but also contributes to rural development, sustainable agricultural practices, and the integration of modern IT systems into its operations. Through its cooperative model, IFFCO directly reaches millions of farmers, ensuring their participation in the growth process. I realized during my internship that IFFCO is not just a fertilizer manufacturer, but a complete ecosystem that combines technology, industrial operations, and farmer welfare for the nation’s progress.

Objectives

The main objective of my internship at IFFCO was to gain practical exposure to how IT solutions and web technologies are applied in real-world industrial environments. I wanted to bridge the gap between my classroom learning and actual implementation in a large-scale organization. Through this internship, I aimed to contribute to web development tasks such as improving the HRMS portal and creating an informative and login-based website using HTML, CSS, and JavaScript. Another important objective was to understand the IT infrastructure that supports a large fertilizer manufacturing unit and to explore how digital systems integrate with plant operations. By participating in plant visits, I also wanted to gain knowledge of industrial instrumentation, Distributed Control Systems (DCS), and automation processes. Overall, my objective was to learn both the software development side and the industrial IT side, while building skills that will help me in my future career as a web developer.

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Work Done During Internship

During my internship at IFFCO, I had the opportunity to contribute to the development of the HRMS portal, where my tasks primarily focused on improving the user interface and functionality. In addition, I designed and implemented an informative and login-based website for IFFCO using HTML, CSS, and Vanilla JavaScript. This project not only enhanced my practical knowledge of frontend web development but also gave me experience in creating user-friendly, responsive web applications tailored to industrial requirements.

Alongside my IT-related work, I had the privilege to visit the Ammonia-I, Ammonia-II, Urea-I, and Urea-II,power plant and bagging plant units of the plant.There are 2 streams of ammonia having capacity of and 4 streams of urea having capacity of 1515 metric ton/day capacity each, highlighting the large-scale operations involved in fertilizer production. These industrial visits provided me with invaluable exposure to both the production processes and the instrumentation systems that ensure safe and efficient plant operations.

Some of the key systems and devices I studied include:

- Distributed Control System (DCS): The central automation platform enabling seamless communication between operators and plant machinery.
- Control Valves: Critical components that regulate flow, pressure, and temperature across various process pipelines.
- Flow Meters: Including Orifice Plates, Turbine Flow Meters, Magnetic Flow Meters, and Ultrasonic Flow Meters, used for precise flow measurement.
- Pressure & Temperature Devices: Such as Pressure Transmitters, Bourdon Gauges, RTDs, and Thermocouples, which continuously monitor process conditions.
- Level Measurement Instruments: Radar-based sensors and Differential Pressure transmitters deployed for accurate tank-level monitoring.
- Process Analyzers: Equipment used to assess gas and liquid composition, ensuring product quality, process efficiency, and safety compliance.

This blend of hands-on technical work in web development and industrial exposure to plant operations significantly broadened my learning. I gained a clear understanding of how IT systems, automation, and instrumentation come together to support large-scale fertilizer manufacturing.

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Instrumentation & Control Valve System

During my internship at IFFCO, I had the opportunity to gain practical exposure to the instrumentation and automation systems that form the backbone of process control in large-scale fertilizer plants. A major focus of my learning was on control valves, which are considered the final control elements in industrial processes. These valves play a vital role in regulating the flow of fluids, gases, or steam based on real-time process requirements.

Importance of Control Valves in Industries

In a continuous process industry such as ammonia-urea production, accurate regulation of parameters like flow, pressure, temperature, and level is essential for maintaining both product quality and plant safety. The control valve, being the device that directly manipulates the process fluid, ensures that signals from the Distributed Control System (DCS) are executed precisely on the plant floor. Without reliable control valves, the entire automated process would fail to respond effectively to dynamic process conditions.

Signal Flow Mechanism

The operation begins with the DCS (Distributed Control System), which generates an electrical control signal based on process requirements and sensor inputs. Typically, this signal is in the range of 4–20 mA. Since control valves often require pneumatic actuation, this electrical signal must be converted into a pneumatic signal.

- This conversion is carried out by an I/P Converter (Current-to-Pressure Converter), which translates the electrical input into a proportional pneumatic output.
- The pneumatic signal is then used to actuate the control valve by applying air pressure to the diaphragm or piston inside the actuator.

Role of the Positioner

A key device associated with control valves is the valve positioner. During my learning, I observed how the positioner works as an intermediary between the input signal and the valve stem. Its function is to ensure that the valve moves to the exact position as instructed by the control signal.

- For example, if the DCS instructs the valve to open 40%, the positioner verifies and adjusts the stem movement until it achieves precisely 40%.
- This eliminates common issues like friction, hysteresis, or air leakage, ensuring accuracy in valve positioning.

Pneumatic Actuation and Feedback Loop

The pneumatic actuator is the device that uses compressed air to physically move the valve plug or disc. Depending on the design, the valve may be air-to-open or air-to-close. This makes control valves highly versatile and suitable for critical plant operations.

During plant visits, I was able to observe how signals transmitted from the control room are executed by the control valves across different units such as the Ammonia plant, Urea plant, and Power plant. Seeing the synchronization between DCS screens in the control room and the actual valve movements in the field gave me a clear understanding of how theory translates into practice. I also noticed how alarms and interlocks are configured to take corrective actions if a valve fails to respond or if process conditions exceed safe limits.

DISTRIBUTED CONTROL SYSTEM (DCS) AND INSTRUMENTATION VISIT

My visit to the central control room and instrumentation facilities at IFFCO provided invaluable exposure to modern industrial automation and control technologies. The plant utilizes state-of-the-art Distributed Control System (DCS) for monitoring and controlling multiple process units simultaneously.

DCS Architecture and Components

Control Room Setup: The main control room houses multiple operator stations with large display monitors showing real-time process data. I observed operators managing the entire ammonia-urea complex from this centralized location. Each workstation provides access to different process units including ammonia synthesis, urea production, and utilities.

Hardware Components: During the technical tour, I examined various components of the DCS infrastructure:

- Field-mounted transmitters for pressure, temperature, flow, and level measurements
- Control valves with pneumatic and electric actuators
- Input/Output (I/O) modules distributed throughout the plant
- Communication networks connecting field devices to control systems
- Redundant controllers ensuring system reliability

Instrumentation Systems Observed

Analytical Instrumentation: I was shown sophisticated analytical systems including:

- Gas chromatographs for composition analysis
- pH meters and conductivity analyzers
- Spectrophotometers for quality control
- Online analyzers for ammonia concentration monitoring

Process Measurement Devices: The plant employs various measurement technologies:

- Differential pressure transmitters for flow measurement
- RTD (Resistance Temperature Detector) sensors for accurate temperature monitoring
- Pressure transmitters with smart technology and HART communication
- Level measurement using guided wave radar and ultrasonic systems

Control Strategies and Algorithms

Advanced Process Control: I learned about the implementation of cascade control loops, feedforward control strategies, and model predictive control (MPC) systems. The DCS incorporates advanced control algorithms to optimize:

- Feed rate control for maximum efficiency
- Temperature profile optimization in reactors
- Pressure control in high-pressure systems
- Quality control through continuous monitoring

Safety Instrumented Systems (SIS): The plant maintains separate safety systems including:

- Emergency shutdown systems (ESD)
- Fire and gas detection systems
- Safety relief valve monitoring
- Critical alarm management systems

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AMMONIA PRODUCTION PLANT VISIT

Overview of Ammonia Manufacturing Process

During my visit to the Ammonia production unit at IFFCO Aonla, I gained comprehensive insights into the industrial-scale synthesis of ammonia using the Haber-Bosch process. The plant operates with a design capacity of 38 kg/cm² and processes natural gas as the primary feedstock.The ammonia plant in Aonla unit uses Halder Topsoe technology from Denmark for ammonia production and urea plant in Aonla unit uses Snam-Progetti from Italy

Process Flow Observation

Primary Reforming Stage: The process begins with natural gas (NG) containing hydrocarbons, which undergoes desulfurization in the Hydrodesulfurization (HDS) unit. I observed that the HDS reactor operates at elevated temperatures to remove sulfur compounds from the natural gas by converting them to hydrogen sulfide (H_2S), which is subsequently removed. The purified natural gas then proceeds to the primary reformer.

In the primary reformer, I witnessed the steam reforming process where natural gas reacts with steam at temperatures around 800-900°C in the presence of nickel-based catalysts. The reaction produces a synthesis gas mixture containing hydrogen, carbon monoxide, carbon dioxide, and unreacted methane.

Secondary Reforming: The partially reformed gas from the primary reformer enters the secondary reformer along with compressed air. Here, I observed the combustion of remaining hydrocarbons at temperatures exceeding 1000°C, which provides the necessary hydrogen-to-nitrogen ratio (3:1) required for ammonia synthesis.

Gas Processing and Purification: Following reforming, the hot gas mixture passes through the RG boiler for heat recovery. The gas then undergoes a series of purification steps:

- High Temperature Shift (HTS) reactor for CO conversion
- Low Temperature Shift (LTS) catalyst system for further CO removal
- CO_2 absorption in the MDEA (Methyldiethanolamine) unit
- Methanator for trace CO and CO_2 removal

Ammonia Synthesis: The purified synthesis gas (H_2 + N_2) enters the ammonia converter operating under high pressure (150-300 bar) and moderate temperature (400-500°C). I observed the catalytic conversion process using iron-based catalysts, where approximately 15-20% conversion per pass is achieved. The unconverted gases are recycled back to maximize efficiency.

Product Recovery: The ammonia product undergoes cooling and refrigeration systems operating at -30°C to separate liquid ammonia from unreacted gases. The final product is stored in pressurized vessels and transported via pipeline or rail.

Technical Observations

The plant's instrumentation and control systems impressed me with their sophistication. Temperature, pressure, and flow measurements are continuously monitored through distributed control systems (DCS). I noted the critical importance of maintaining precise H_2:N_2 ratios and the energy integration schemes that make the process economically viable.

Safety and Environmental Considerations

During the visit, I observed stringent safety protocols including emergency shutdown systems, gas leak detection systems, and personal protective equipment requirements. The plant's environmental management includes flue gas treatment and ammonia slip monitoring to minimize atmospheric emissions.

UREA PRODUCTION PLANT VISIT

During my visit to the IFFCO Aonla urea production facility, I gained firsthand exposure to the integrated process of urea manufacturing, starting from ammonia synthesis to urea prills

1. Synthesis Section

Urea production begins with liquid ammonia and carbon dioxide. These react in a high-pressure environment to form ammonium carbamate, which is then dehydrated to form urea:

- Reactions:
  - $2NH_3 + CO_2 \rightarrow NH_2COONH_4$
  - $NH_2COONH_4 \rightarrow NH_2CONH_2 + H_2O$
- Operating Conditions:
  - Pressure: ~180–200 kg/cm^2
  - Temperature: ~180–190°C

CO_2 is compressed (0.6 kg/cm^2 → 160 kg/cm^2) and ammonia is pumped (17 kg/cm^2 → 235–240 kg/cm^2) before entering the reactor.

2. Decomposition & Recovery

Unreacted NH_3 and CO_2 are recovered in decomposers at decreasing pressure levels:

- H.P. Decomposer: ~33% urea
- M.P. Decomposer: ~45% urea
- L.P. Decomposer: ~60% urea

This staged recovery improves conversion efficiency and minimizes waste.

3. Concentration & Vacuum Evaporation

The urea solution is then concentrated through multi-effect evaporation under vacuum:

- Vacuum Section-I: Achieves 70–76% urea concentration
- Vacuum Section-II: Final urea purity reaches ~99.7%

Steam integration from the ammonia plant improves energy efficiency.

4. Prilling & Finishing

The concentrated urea melt is sprayed from the top of a prilling tower where it solidifies into prills (2–4 mm) using counter-current air flow. These prills are:

- Screened and size-graded
- Coated with neem oil for anti caking
- Transferred via belt to the bagging plant

5. Utilities & Safety

- Cooling Water System: Ensures process temperature control
- Steam Systems: Used for heating and evaporation
- Emission Controls: Minimize ammonia slip and dust
- Safety Measures: Include leak detection, pressure relief, and emergency protocols

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Power Plant

During my internship at IFFCO, I had the opportunity to study the working of the captive power plant, which plays a critical role in ensuring the uninterrupted operation of the entire fertilizer production complex. The power plant not only generates electricity but also supplies steam, which is equally important for both process requirements and for driving turbines. Observing the working of the power plant gave me a comprehensive understanding of how energy systems support industrial-scale operations.

Fuel and Gas Turbine Generators (GTGs)

The primary fuel used in the power plant is Natural Gas (NG), which is supplied directly to Gas Turbine Generators (GTG-1 and GTG-2). These GTGs form the backbone of power generation at IFFCO. When NG is combusted in the turbine chambers, the high-temperature, high-pressure gases expand rapidly, driving the turbine blades and producing mechanical power.

This conversion of chemical energy (from natural gas) into mechanical energy is the first step in the power generation cycle. The use of NG ensures cleaner combustion compared to coal or oil, aligning with environmental sustainability and efficiency goals.

Steam Generation Process

Apart from natural gas combustion, steam plays a major role in power production at IFFCO. Steam is generated by feeding De-Mineralized (DM) water into boilers. This DM water is obtained from the DM water plant, where raw water undergoes several treatments to remove dissolved salts, hardness, and impurities.

To ensure boiler safety and efficiency, the DM water is dosed with chemicals such as:

- Phosphates – to prevent scaling.
- Hydrazine – to remove dissolved oxygen and reduce corrosion.

This treated DM water, when heated in boilers, produces high-pressure steam, which is then utilized for rotating turbines and for other process requirements in the fertilizer plant.

Turbine Operation and Combined Cycle

The IFFCO power plant follows a combined cycle process, which significantly improves efficiency. The cycle operates as follows:

1. Gas Turbine Stage: Natural Gas is burned in GTG units, rotating the turbines.
2. Steam Turbine Stage: The exhaust heat from GTGs is utilized to produce steam. This steam is then used to rotate steam turbines.

The combination of NG combustion and steam turbine operation ensures that the plant runs at a high thermal efficiency (over 85%), making full use of available energy resources.

Power Output and Distribution

The total power generated by the system is more than 118 MW, which is a substantial amount required to support large-scale fertilizer manufacturing. The electricity produced is stored in generators and distributed across different plants within the IFFCO complex, such as the Ammonia Plant, Urea Plant, Bagging Plant, and Instrumentation facilities.

This captive power generation ensures that the fertilizer production process does not depend on external grid power and can operate continuously, even in case of external power outages.

Bagging Plant

During my internship at IFFCO, one of the most informative experiences was my visit to the bagging plant, where I observed how the final product (urea) is packed, weighed, and distributed to meet large-scale market demands. This section of the plant is critical as it ensures that the fertilizer produced in bulk is handled efficiently and delivered in standardized, consumer-ready units.

Capacity and Storage

The bagging plant is designed for high-volume operations. I learned that the plant can handle nearly 34,00 tons of urea-1 per day in continuous 24-hour operation,same stats goes for urea 2 In addition, the facility has a storage capacity of approximately 45,000 tons in situations when transport vehicles are not available. To meet growing demand, another line is also capable of managing around 30,000 tons, ensuring uninterrupted operations and a steady supply chain.There are 2

Bagging and Weighing Process

Each bag is filled with 45 kilograms of urea, and precision is maintained throughout the process. The bags themselves weigh about 125 grams, and the weighing systems are highly accurate to ensure consistency. I observed how strict quality checks are implemented to guarantee that every bag contains the exact specified amount, which is important both for farmers and for compliance with distribution regulations.

Lump Formation and Handling

One of the issues with urea storage and handling is the formation of lumps due to moisture or compaction. The plant has lump breaking machines (de-lumpers) installed, which crush the hardened urea lumps into fine particles before bagging. This ensures that the fertilizer quality is not compromised and that it remains suitable for agricultural use. Seeing this process in action gave me a clear understanding of how industries tackle real-world material handling challenges.

Process Flow and Automation

I closely observed the automation system in the bagging unit. The urea is transported through a series of belt conveyors (BC-1, BC-2, BC-3, BC-4) and mechanical systems before reaching the weighing and bagging stations. Advanced conveyors, lump breakers, and distribution lines streamline the process, reducing manual labor and increasing efficiency.

The process is designed to operate under controlled temperature and humidity conditions, as these factors play a crucial role in maintaining the quality of urea during handling. This also gave me insight into how environmental factors are controlled in fertilizer industries to prevent product degradation.

Dispatch and Distribution

After filling and sealing, the bags are stacked and prepared for dispatch. I got to see how the finished bags are loaded into vehicles for distribution across different regions. The smooth operation of the bagging and dispatch system reflects the scale and discipline of IFFCO’s supply chain.

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IFFCO WEBSITE

As part of my internship at IFFCO, I developed a secure, responsive, and modern web-based Employee Portal to streamline employee login processes. The application integrates modern UI/UX principles and third-party authentication for an improved user experience.

🛠️ Project Overview

This portal serves as a secure entry point for IFFCO employees, allowing them to log in using either traditional credentials or their Google account. The focus was on creating a visually appealing, fast, and secure interface.

🔐 Key Features

- Username & Password Authentication
- Google Sign-In Integration (OAuth 2.0)
- Glassmorphism UI Design with animated particle background
- Responsive Layout – Compatible with desktop and mobile
- Login Validation with real-time error and success messages

🎨 UI/UX Design Highlights

- Clean and minimal interface inspired by modern design trends
- Interactive feedback for better user flow
- Particle animation background for a dynamic feel
- Responsive design built using Flexbox and CSS Grid

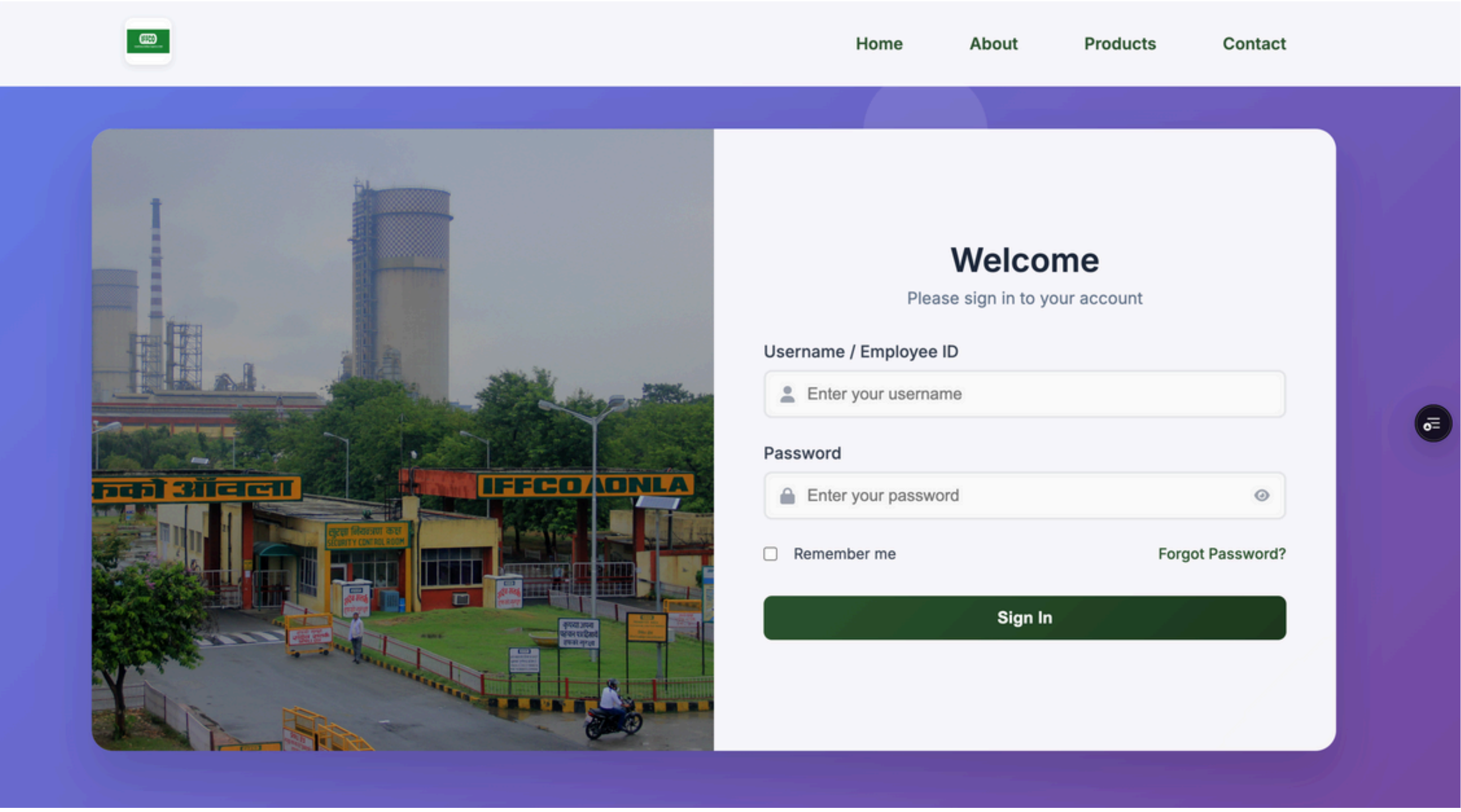
💻 Tech Stack

- Frontend: HTML5, CSS3, Vanilla JavaScript
- Styling: CSS Animations, Flexbox, Grid, Glassmorphism
- Authentication: Google Identity Services (OAuth 2.0)
- Icons & Fonts: Font Awesome, Google Fonts (Inter)

🚀 Learning Outcome

Through this project, I enhanced my understanding of:

- Frontend development and responsive design
- Secure authentication methods using OAuth 2.0
- UX principles in real-world enterprise applications
- Deploying and hosting web apps on platforms like Vercel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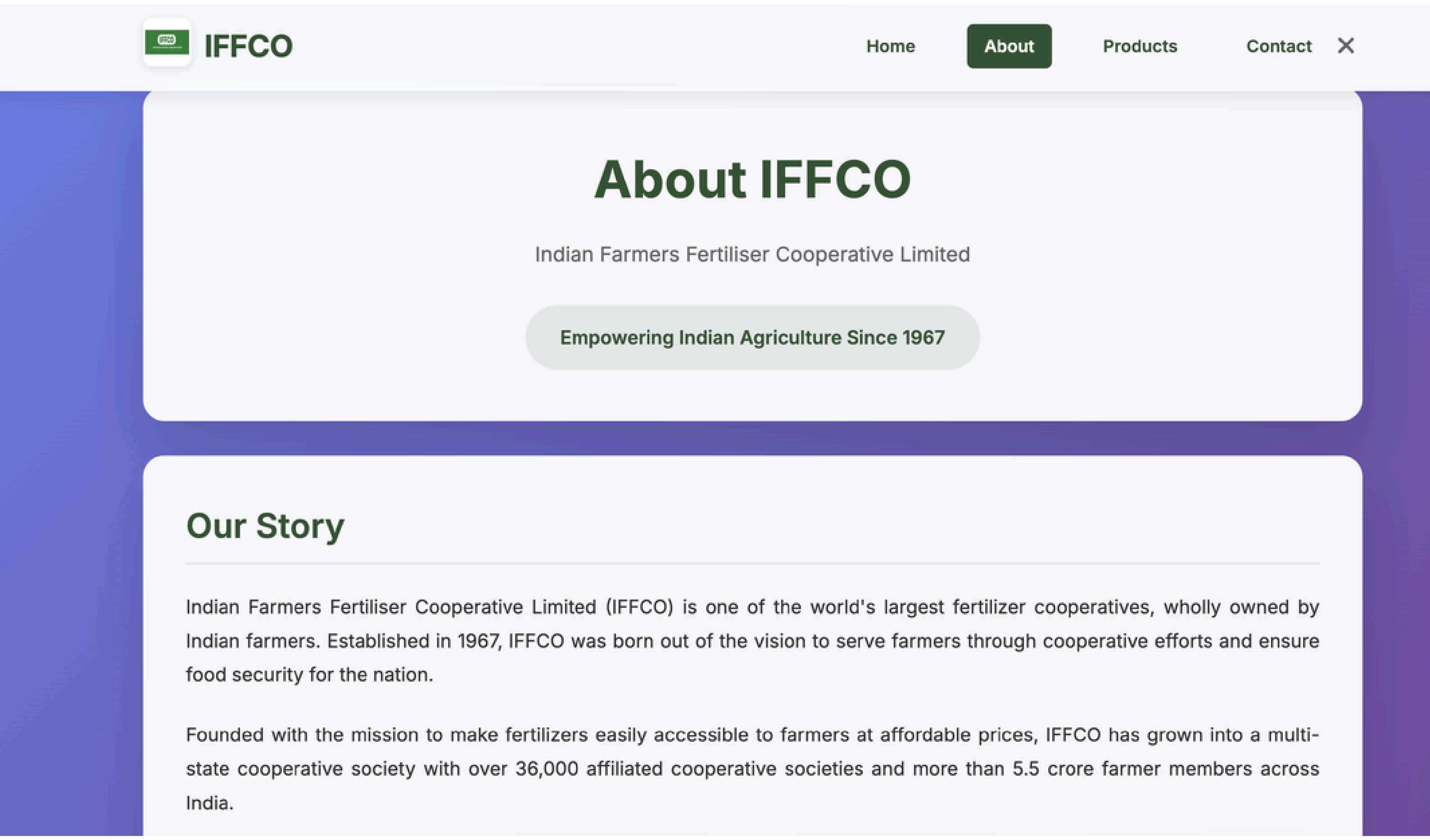
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About IFFCO
Indian Farmers Fertiliser Cooperative Limited
Empowering Indian Agriculture Since 1967
Our Story
Indian Farmers Fertiliser Cooperative Limited (IFFCO) is one of the world's largest fertilizer cooperatives, wholly owned by Indian farmers. Established in 1967, IFFCO was born out of the vision to serve farmers through cooperative efforts and ensure food security for the nation.
Founded with the mission to make fertilizers easily accessible to farmers at affordable prices, IFFCO has grown into a multi-state cooperative society with over 36,000 affiliated cooperative societies and more than 5.5 crore farmer members across India.

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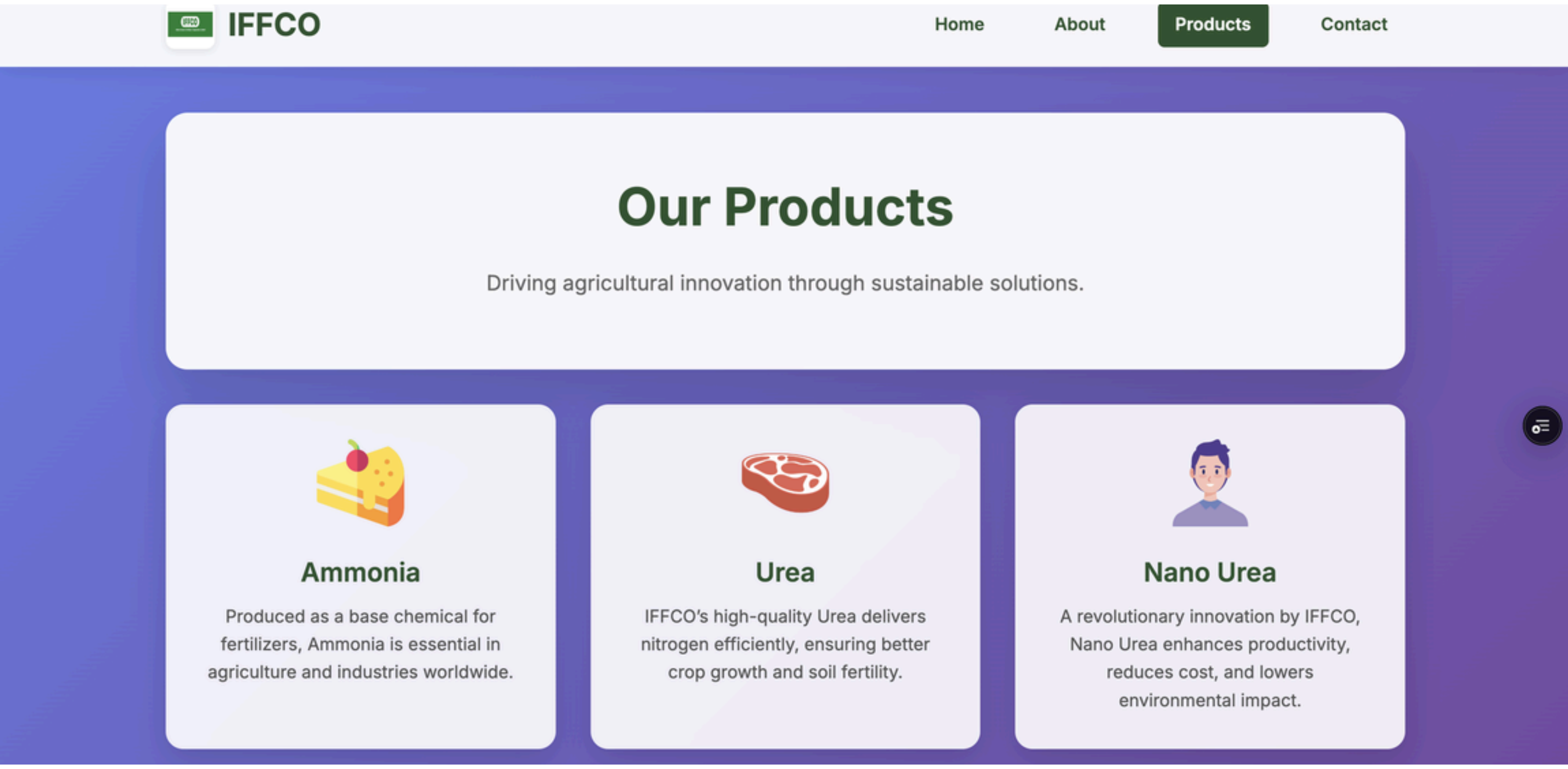

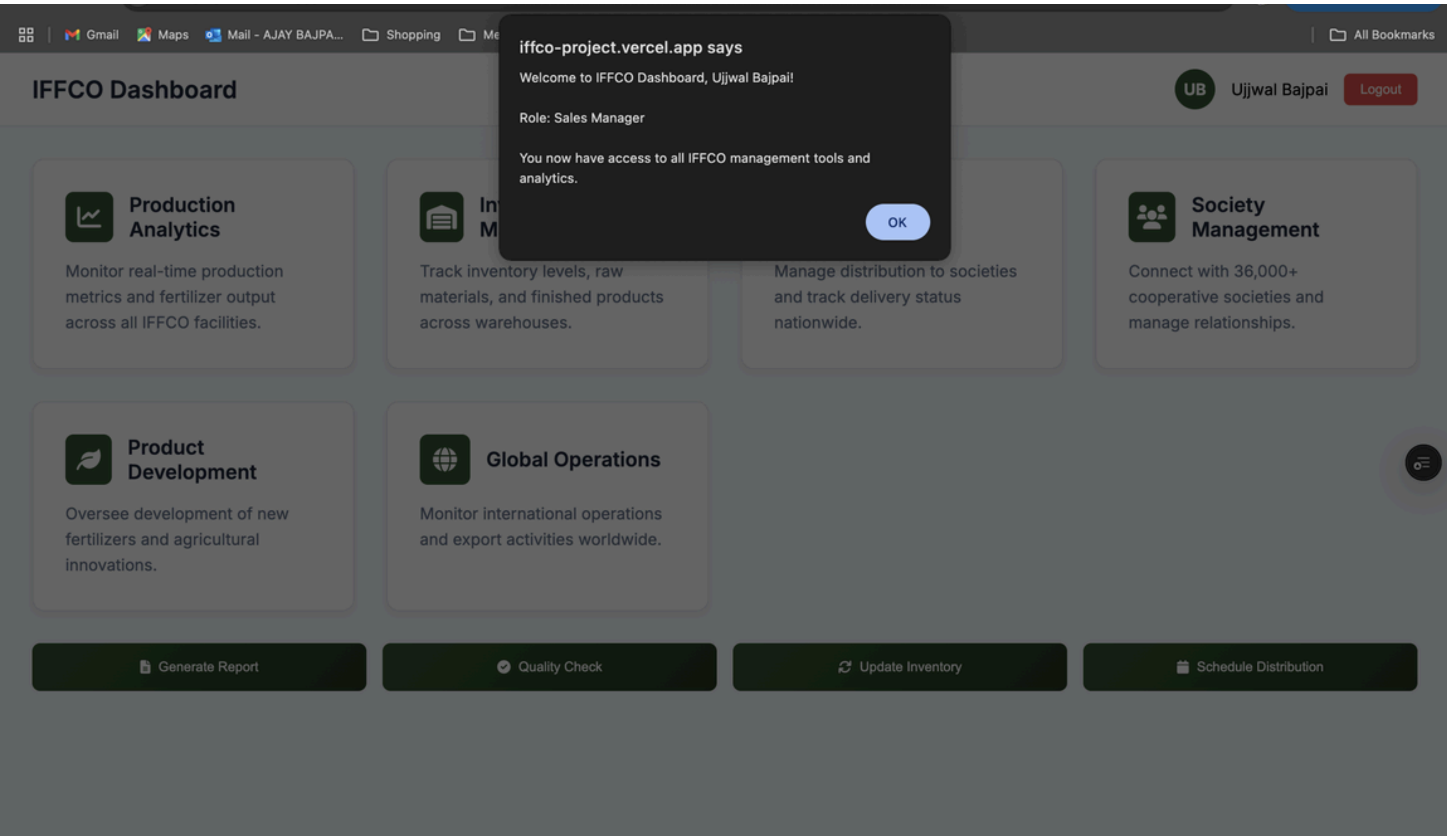

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CONCLUSION

Overall, my internship at IFFCO was a valuable experience. I not only improved my web development skills but also gained first-hand exposure to industrial automation, instrumentation devices, and large-scale fertilizer production. This experience has enhanced my technical knowledge and given me insights into how IT and instrumentation work together in real-world industries.