Data Requirements

To effectively meet the client's requirements and deliver a robust digital solution, the following data requirements have been identified:

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1. User Data

To support account registration, user management, and personalized features:

- **Full Name** (String) – Required for identification.

- **Email Address** (String) – Used for login and communication.

- **Password (with encryption)** (String) – Ensures secure access to accounts.

- **Phone Number** (String) – For booking confirmations and customer support.

- **Address** (String) – Required for scheduling installation services.

- **User Preferences** (Array/JSON) – Includes preferences for energy-saving tips, product recommendations, and notifications.

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2. Consultation and Installation Data

To enable scheduling, tracking, and management of customer appointments:

- **Appointment ID** (String) – Unique identifier for each appointment.

- **Customer ID** (String) – Links appointments to individual users.

- **Service Type** (Enum) – Identifies the type of service (e.g., Solar Panel Installation, EV Charging Station Setup).

- **Preferred Date and Time** (DateTime) – Chosen time slot for consultations or installations.

- **Status** (Enum) – Tracks appointment progress (e.g., Pending, Confirmed, Completed).

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3. Green Energy Product Data

To provide detailed information about available green energy products:

- **Product ID** (String) – Unique identifier for each product.

- **Product Name** (String) – The official product title.

- **Description** (Text) – Detailed information on features and benefits.

- **Energy Efficiency Rating** (Enum) – Helps users compare product effectiveness.

- **Pricing Information** (Float) – To display cost details to customers.

- **Stock Availability** (Boolean) – Shows if the product is currently available.

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4. Carbon Footprint Calculation Data

To enable accurate calculations for users looking to track and reduce their environmental impact:

- **Energy Usage Data** (Float) – Input from users or smart home systems.

- **Emission Factors** (Float) – Predefined values for various appliances and systems.

- **Calculation Results** (Float) – Displays users' estimated carbon footprint.

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5. Accessibility Data

To ensure inclusivity and support for a diverse range of users:

- **Preferred Language** (String) – For multilingual support.

- **Accessibility Preferences** (Boolean/Enum) – Includes options for text-to-speech, high contrast modes, etc.

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6. System Data (Administrative/Logs)

For monitoring, debugging, and ensuring system performance:

- **System Logs** (Text) – Tracks errors, warnings, and activities.

- **Audit Trails** (Text) – Records user actions for security purposes.

- **Backup Data** (Binary) – Ensures data integrity and disaster recovery.

Data Relationships and Integrity

- **Relational Database Structure:** Primary keys (e.g., UserID, ProductID) will be used to ensure data integrity.

- **Validation Techniques:** Each data entry point will include appropriate data validation, such as format checks for email addresses and password strength enforcement.

- **Encryption:** Sensitive data like passwords and personal information will be securely encrypted to ensure privacy and compliance with data protection regulations.

This comprehensive data structure will provide the foundation for an efficient, secure, and user-friendly digital solution for Rolsa Technologies.

For a professional **Grade A** answer tailored for a **T-Level DPDD (Digital Production, Design, and Development)** task, I'll present detailed, structured flowcharts that integrate database interactions effectively. Each algorithm will demonstrate clear logic flow, data handling, and appropriate use of database queries.

1. User Registration & Login Process

- **Start**
  ↓

- **Enter User Details**
  ↓

- **Check Database for Existing Account** (DB Query)
  → **Exists?**
  → **Yes:** Prompt Login → **Login Successful** → **End**
  → **No:** → **Store User Details in Database**
  ↓

- **Account Created Successfully**
  ↓

- **End**

---

2. Appointment Scheduling System

- **Start**
  ↓

- **User Logs In** (DB Verification)
  ↓

- **Select Service Type**
  ↓

- **Check Availability in Database** (DB Query)
  → **Available?**
  → **Yes:** Proceed to Date & Time Selection
  → **No:** Prompt Alternative Dates
  ↓

- **Confirm Details**
  ↓

- **Store Appointment in Database**
  ↓

- **Send Confirmation Email**
  ↓

- **End**

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3. Carbon Footprint Calculator

- **Start**

  ↓

- **User Logs In** (DB Verification)

  ↓

- **Input Energy Usage Data**

  ↓

- **Retrieve Emission Factors from Database** (DB Query)

  ↓

- **Calculate Carbon Footprint**

  ↓

- **Display Results & Suggested Tips**

  ↓

- **Store Results in Database for Future Tracking**

  ↓

- **End**

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4. Energy Usage Tracking System

- **Start**

  ↓

- **User Logs In** (DB Verification)

  ↓

- **Fetch Smart Home Data from Database** (DB Query)

  ↓

- **Calculate Energy Consumption**

  ↓

- **Generate Detailed Usage Report**

  ↓

- **Display Report with Graphs & Insights**

  ↓

- **End**

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5. Product Information Retrieval System

- **Start**

  ↓

- **User Browses Products**

  ↓

- **Query Database for Product Information**
  ↓

- **Display Product Details**
  ↓

- **Add to Wishlist/Cart Option** (DB Update)
  ↓

- **End**

Task 1b Entity Relationship Diagram:

Entities and Attributes:

1. **Customers**
   - customer_id (PK, int, auto-increment)
   - name (varchar 255)
   - email (varchar 255)
   - password (varchar 255)
   - registration_date (datetime)
   - accessibility_preferences (boolean)

2. **Appointments**
   - appointment_id (PK, int, auto-increment)
   - customer_id (FK, int)
   - appointment_date (date)
   - appointment_time (time)
   - service_type (varchar 255)
   - status (varchar 50)

3. **Energy Usage Data**
   - usage_id (PK, int, auto-increment)
   - customer_id (FK, int)
   - energy_consumed (decimal)
   - carbon_footprint (decimal)
   - tracking_date (datetime)

4. **Green Energy Products**

- o product_id (PK, int, auto-increment)
- o product_name (varchar 255)
- o category (varchar 255)
- o description (text)
- o availability_status (boolean)

5. **User Accounts**

- o user_id (PK, int, auto-increment)
- o customer_id (FK, int)
- o role (varchar 50)
- o last_login (datetime)
- o is_admin (boolean)

6. **Admin Information**

- o admin_id (PK, int, auto-increment)
- o job_role (varchar 255)
- o manage_appointments (boolean)
- o update_product_listings (boolean)
- o view_customer_data (boolean)
- o modify_accessibility_settings (boolean)

Relationships:

- A **Customer** can have multiple **Appointments**.
- A **Customer** can track multiple **Energy Usage Data** records.
- A **Customer** can browse multiple **Green Energy Products**.
- An **Admin** manages **Appointments**, **Products**, and **Customer Data**.
- Each **User Account** is linked to a **Customer**.

Foreign Key Mapping:

- customer_id in **Appointments**, **Energy Usage Data**, and **User Accounts** refers to customer_id in **Customers**.
- product_id in **Green Energy Products** links to **Appointments** for consultation booking.
- admin_id in **Admin Information** links to **User Accounts** for role-based access control.

Main Section	Subsections	Features/Details
Homepage	- About Us - Green Energy Hub - Customer Services - Carbon Footprint Calculator - Energy Tracker - Accessibility - Contact & Support - Admin Panel	Navigation, welcome message, CTA buttons
About Us	- Company Mission & Vision - Sustainability Initiatives - Meet the Team - Contact Info	Information about the company
Green Energy Hub	- Green Energy Products - Carbon Footprint Reduction Tips	Educational content on green energy
Green Energy Products	- Solar Panel Systems - EV Charging Stations - Smart Home Energy	Product details, pricing, and benefits
Customer Services	- Consultation & Installation - Account Management	Booking and customer support
Account Management	- User Registration & Login - Profile Management - Consultation History	User data management
Carbon Footprint Calculator	- Input Data - Result Calculation - Reduction Tips	Interactive tool to measure carbon footprint
Energy Tracker	- Log Energy Usage - Data Visualization - Reduction Recommendations	User energy tracking tool
Accessibility	- High Contrast Mode - Text-to-Speech - Keyboard Navigation	Ensuring inclusivity
Contact & Support	- Live Chat - Email & Phone Support - Feedback Form	Customer support options

               - Manage Users
Admin Panel - Edit Listings   Company-side management tools
                 - Generate Reports

Activity A(i) - Research Analysis for Developing a Digital Solution for Rolsa Technologies

1. Hardware and Software in the Energy Sector

To develop a digital solution for Rolsa Technologies, it is crucial to evaluate the role of hardware and software in managing and optimizing green energy technologies.

- **Hardware:** This includes IoT devices, smart sensors, and meters used in solar panel installations, electric vehicle (EV) charging stations, and home energy management systems. These devices monitor energy consumption and efficiency in real time, enabling predictive maintenance and better management of resources (Al-Ali et al., 2021).

- **Software:** Modern energy solutions rely on cloud-based platforms and AI-powered analytics to process data collected from IoT devices. This data is then used to optimize energy usage, predict faults, and generate actionable insights for users (Siano et al., 2020). Software also supports mobile applications for scheduling, account management, and carbon footprint tracking.

2. Emerging Technologies in the Energy Sector

The energy sector is undergoing a technological transformation with innovations that can significantly benefit Rolsa Technologies. Key emerging technologies include:

- **Artificial Intelligence (AI) and Machine Learning (ML):** AI-powered algorithms can predict energy consumption patterns, detect inefficiencies, and suggest optimized usage. ML models can further improve the predictive capabilities of energy management systems (Zhou et al., 2022).

- **Blockchain for Energy Trading:** Blockchain technology can be used for peer-to-peer energy trading, ensuring secure and transparent transactions between producers and consumers of renewable energy (Mengelkamp et al., 2018).

- **Internet of Things (IoT):** IoT-enabled devices provide real-time data from solar panels and EV charging stations, allowing customers to track their energy consumption and carbon footprint (Atlam et al., 2020).

3. Digital Solutions to Meet User Needs

Digital solutions can be tailored to meet the needs of both individual users and businesses. These solutions must address:

- **Customer Engagement:** Providing a user-friendly interface that educates customers about available green technologies and how they can reduce their carbon footprint.

- **Personalization:** AI-driven recommendations can help customers choose the most suitable green energy solutions based on their consumption patterns.

- **Scheduling and Account Management:** Users should be able to schedule installations, manage consultations, and track their energy usage efficiently using a digital platform.

4. Industry-Specific Guidelines and Regulations

Compliance with industry standards and regulations is critical in developing energy management solutions. Rolsa Technologies must ensure adherence to:

- **Data Privacy and Security:** Protecting user data, especially when dealing with sensitive energy consumption data, is essential. Compliance with GDPR and other regional data protection laws is required (Voigt & von dem Bussche, 2017).

- **Energy Efficiency Standards:** Compliance with regulations such as ISO 50001 (Energy Management Systems) ensures the solution contributes to sustainable energy practices.

- **EV Charging Standards:** Adherence to international standards such as IEC 61851 and ISO 15118 ensures safe and efficient charging operations.

5. Accessibility and Inclusivity

The digital solution must incorporate accessibility features to cater to a diverse user base, including individuals with disabilities. This involves ensuring compliance with the Web Content Accessibility Guidelines (WCAG) to provide an inclusive user experience (Kirkpatrick et al., 2018).

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