SOLAR PANEL FORECASTING

TEAM ID : NM2023TMID09433

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Chapter	Table Of Content	Page No.

Chapter 1

Introduction

1.1 Project Overview

The Solar Panel Forecasting project is a comprehensive endeavor aimed at revolutionizing the way we harness solar energy. By leveraging cutting-edge predictive modeling, the project seeks to provide precise forecasts of energy generation from photovoltaic (PV) solar panels. Its multifaceted objectives encompass optimizing energy production, streamlining grid management, and reducing our reliance on non-renewable energy sources. To achieve these goals, the project entails an extensive data collection process, sourcing historical weather data, solar panel performance records, and an array of environmental variables, including cloud cover, temperature, and sunlight duration.

The heart of the project lies in the development of robust predictive models that utilize a range of advanced machine learning techniques. These models will take into account a multitude of factors, such as weather conditions, solar panel efficiency, and geographical variables, to deliver highly accurate forecasts of solar energy output. To ensure the models' reliability, rigorous validation procedures will be implemented, including k-fold cross-validation and testing with independent datasets.

To make the benefits of this forecasting accessible to the masses, the project will also include the development of a user-friendly interface. This interface will empower end-users, such as solar farm operators and grid managers, to obtain real-time or future predictions for solar energy generation. The project will also focus on seamless integration into existing energy management systems and smart grids, ensuring that these forecasts are not just accurate but also actionable.

Crucially, the journey doesn't end with model deployment. Continuous monitoring and maintenance will be integral components of the project, enabling the forecasting models to adapt to changing environmental conditions, evolving data, and improved algorithms. This adaptability will ensure that the project remains relevant and effective over time.

In conclusion, the Solar Panel Forecasting project represents a pivotal step towards a more sustainable energy landscape. It will significantly enhance the efficiency and reliability of solar energy generation, ultimately contributing to the global effort to transition towards cleaner, renewable, and more eco-friendly energy sources.

1.2 Purpose

The Solar Panel Forecasting project serves a multifaceted and critical purpose within the realm of renewable energy and sustainability. At its core, the project seeks to harness the power of predictive modeling to accurately anticipate solar energy generation from photovoltaic (PV) solar panels. In doing so, it fulfills several pivotal roles in the broader context of the energy landscape and environmental responsibility.

First and foremost, the project endeavors to optimize solar energy production. Through the development of accurate forecasting models, it enables the efficient utilization of solar power resources. This, in turn, reduces energy waste and minimizes the reliance on backup power sources, ultimately enhancing the overall efficiency of solar energy systems.

Furthermore, the project plays a vital role in grid management. Accurate forecasts of solar power generation empower grid operators to make informed decisions. They can anticipate fluctuations in energy supply, enabling them to balance supply and demand more effectively. This results in a more stable and reliable energy grid, reducing the risk of power outages and enhancing energy security.

A crucial aspect of the project's purpose is its contribution to the integration of renewable energy sources into the existing energy infrastructure. The ability to predict solar energy generation with precision aids in the seamless incorporation of solar power into the grid. It fosters the shift toward a more sustainable energy landscape, decreasing our dependence on fossil fuels and mitigating the environmental impact of energy production.

Economically, the project enhances the feasibility of solar power. Businesses, solar farms, and individual consumers can better plan their operations and investments with accurate forecasts at their disposal. This, in turn, leads to cost savings and improved economic sustainability in the renewable energy sector.

Beyond economic considerations, the environmental implications of this project are profound. By promoting the use of clean, renewable energy sources, it contributes significantly to environmental sustainability. Reductions in greenhouse gas emissions, fossil fuel consumption, and reliance on non-renewable resources are outcomes directly linked to the project's success. In the broader context of addressing climate change, the project's role is undeniably significant.

From a technological perspective, the Solar Panel Forecasting project represents a pioneering effort. It involves the application of cutting-edge machine learning, data analysis, and modeling techniques to solve a real-world problem. The project's advancements are not only instrumental in its success but also have the potential to benefit a range of other applications and industries.

In the grand scheme of the global energy transition, the project aligns with a critical mission. It is part of the collective effort to reduce carbon emissions, combat climate change, and transition to cleaner, more sustainable energy sources. As such, it embodies the spirit of progress and innovation in the quest for a greener, more environmentally responsible future.

In conclusion, the Solar Panel Forecasting project, by fostering efficient solar energy production, enhancing grid management, promoting renewable energy integration, improving economic feasibility, mitigating environmental impact, advancing technology, and contributing to the global energy transition, stands as a pivotal force in the pursuit of a more sustainable and responsible energy landscape.

CHAPTER 2
LITERATURE SURVEY

2.1 Existing problem

The existing problems in solar panel forecasting stem from the intermittent and variable nature of solar energy production, challenges in accurate weather predictions, spatial variability across installations, seasonal and diurnal fluctuations, the influence of shadows and obstructions, panel aging and degradation, inverter and system efficiency factors, data availability and quality issues, modeling complexity, limited historical data, forecasting horizons, and economic considerations. These challenges collectively complicate the task of predicting solar energy output accurately, making it essential for ongoing research and technological advancements to improve forecasting methods, enabling the efficient integration of solar energy into the energy grid and a reduced dependence on fossil fuels.

2.2 Reference

1. Academic Journals: Search for academic journals related to renewable energy, solar power forecasting, and meteorology. Some prominent journals include "Solar Energy," "Renewable Energy," and "Applied Energy."
2. Government Agencies: Websites of government agencies such as the National Renewable Energy Laboratory (NREL), the U.S. Department of Energy (DOE), and the International Energy Agency (IEA) often provide valuable reports and research on solar forecasting.
3. Research Papers: You can use academic search engines like Google Scholar, IEEE Xplore, and ResearchGate to find specific research papers on solar panel forecasting.
4. Solar Industry Reports: Reports from industry organizations, such as the Solar Energy Industries Association (SEIA) and the International Solar Energy Society (ISES), can provide insights into the state of solar energy forecasting.
5. Books: Look for books on renewable energy forecasting and meteorology, as they may contain comprehensive information on the subject.
6. University Websites: Check the websites of universities and research institutions, as they often publish research findings and reports related to renewable energy and solar forecasting.

7. Renewable Energy Conferences: Proceedings and papers presented at conferences like the American Solar Energy Society (ASES) Annual Conference and the European Photovoltaic Solar Energy Conference and Exhibition (EU PVSEC) can be valuable sources.
8. Online Forums and Communities: Participating in online forums, such as Reddit's renewable energy or solar energy subreddits, can also lead to discussions and references from experts in the field.

Problem statement definition

The problem of solar panel forecasting is a critical challenge in the field of renewable energy. Solar energy production is inherently variable and intermittent, primarily due to the reliance on sunlight, which can be influenced by various factors such as cloud cover, atmospheric conditions, and time of day. Accurate forecasting is essential to optimize energy generation, grid integration, and energy storage planning in solar power systems. However, it is a complex task plagued by several persistent issues. Weather predictions, a fundamental component of solar forecasting, are inherently uncertain, with small errors in weather forecasts leading to significant discrepancies in solar energy production predictions. The spatial variability of solar installations across different geographical locations, with variations in shading, sunlight exposure, and other local factors, adds a layer of complexity to forecasting. Seasonal and diurnal variations in solar irradiance, coupled with the challenge of accurately predicting the occurrence of shadows from structures or obstructions, further complicate the matter.

Moreover, solar panels age over time, and this aging process can lead to a reduction in energy production due to factors like dust accumulation and wear and tear. Accurate forecasting must account for these panel degradation effects, which vary based on the age and maintenance of the panels. In addition to these factors, the efficiency of inverters and other components within a solar energy system can have a significant impact on overall energy production. These efficiencies, which can fluctuate over time, need to be factored into forecasting models for a more accurate estimation of energy output. Data availability and quality pose another challenge; reliable historical performance data and real-time weather data are essential for precise forecasting, but their availability and quality can vary significantly depending on the location and the data sources.

The complexity of modeling all these interrelated variables presents an ongoing challenge. Developing forecasting models that take into account all of these factors requires a deep understanding of the system, as well as access to large datasets and the use of sophisticated algorithms, often based on machine learning and statistical techniques. Further complicating the issue is the limited availability of historical data for newly installed solar panel systems, which hampers the development of accurate forecasting models for these setups. Forecasting horizons also matter; short-term forecasting (ranging from hours to a few days) is generally more accurate than long-term forecasting (weeks to months), which introduces another layer of complexity. Finally, economic considerations must be integrated into forecasting, as it's not only about predicting energy production but also about optimizing energy use and storage, and taking into account market conditions. Thus, addressing these challenges and advancing solar panel forecasting is crucial for the efficient integration of solar energy into the grid and the reduction of our dependence on fossil fuels, thereby promoting a sustainable and cleaner energy future.

CHAPTER 3

IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas

Ideation Phase
Empathize & Discover

Date	19 September 2023
Team ID	NM2023TMID09433
Project Name	Solar Panel Forecasting
Maximum Marks	4 Marks

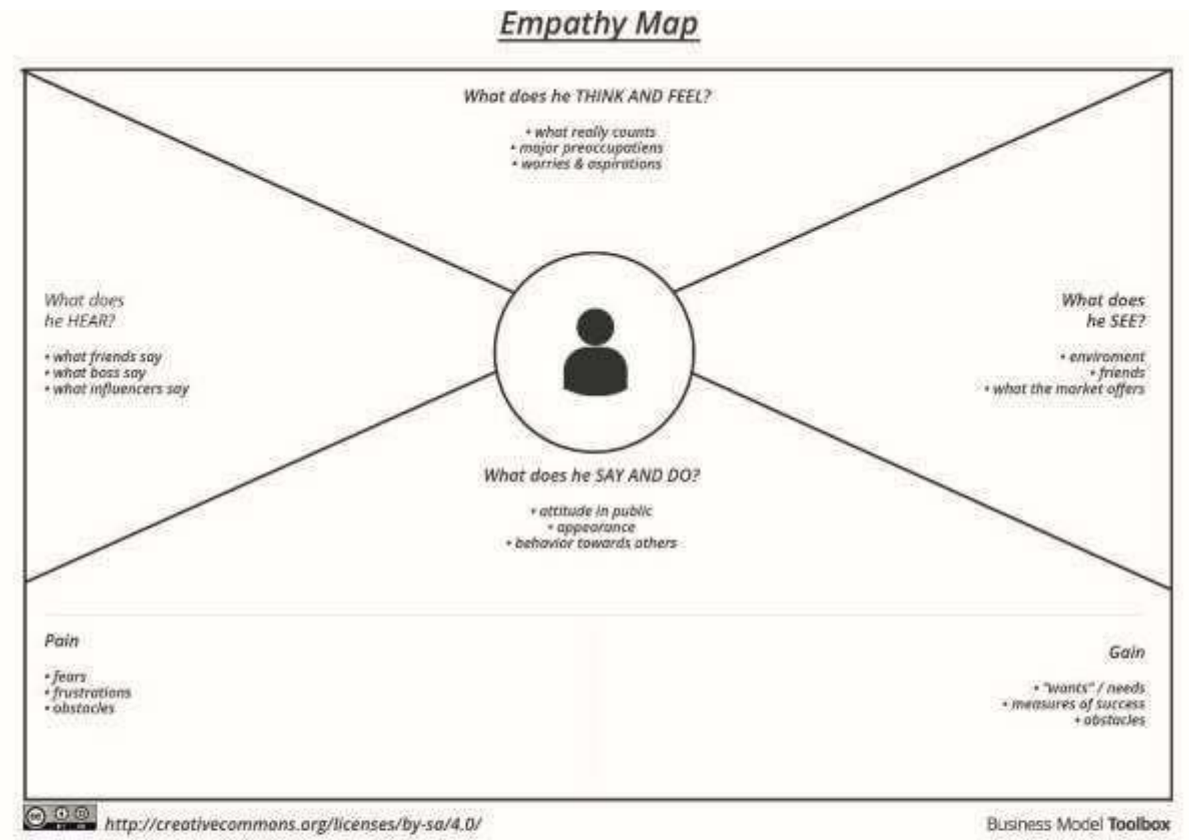
Empathy Map Canvas:

An empathy map is a simple, easy-to-digest visual that captures knowledge about a user's behaviours and attitudes.

It is a useful tool to helps teams better understand their users.

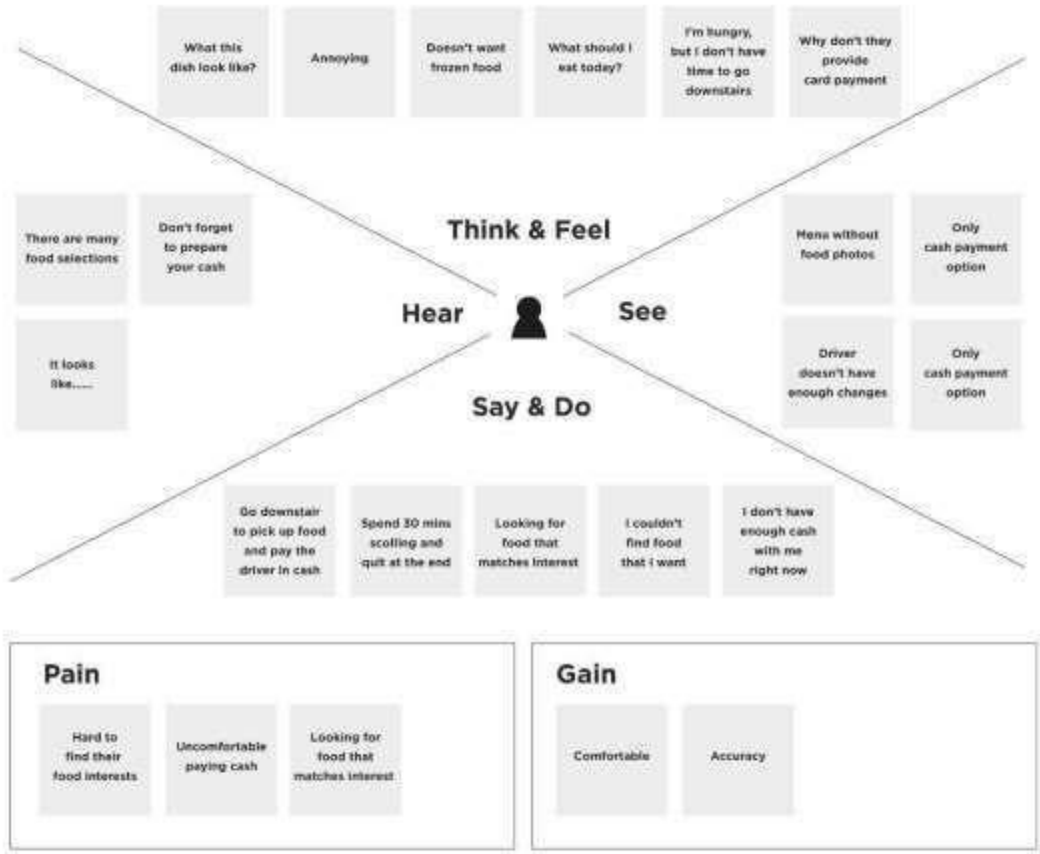
Creating an effective solution requires understanding the true problem and the person who is experiencing it. The exercise of creating the map helps participants consider things from the user's perspective along with his or her goals and challenges.

Example:



Reference: https://www.mural.co/templates/empathy-map-canvas

Example: Food Ordering & Delivery Application



Ideation Phase
Brainstorm & Idea Prioritization Template

Date	19 September 2023
Team ID	NM2023TMID09433
Project Name	Solar Panel Forecasting
Maximum Marks	4 Marks

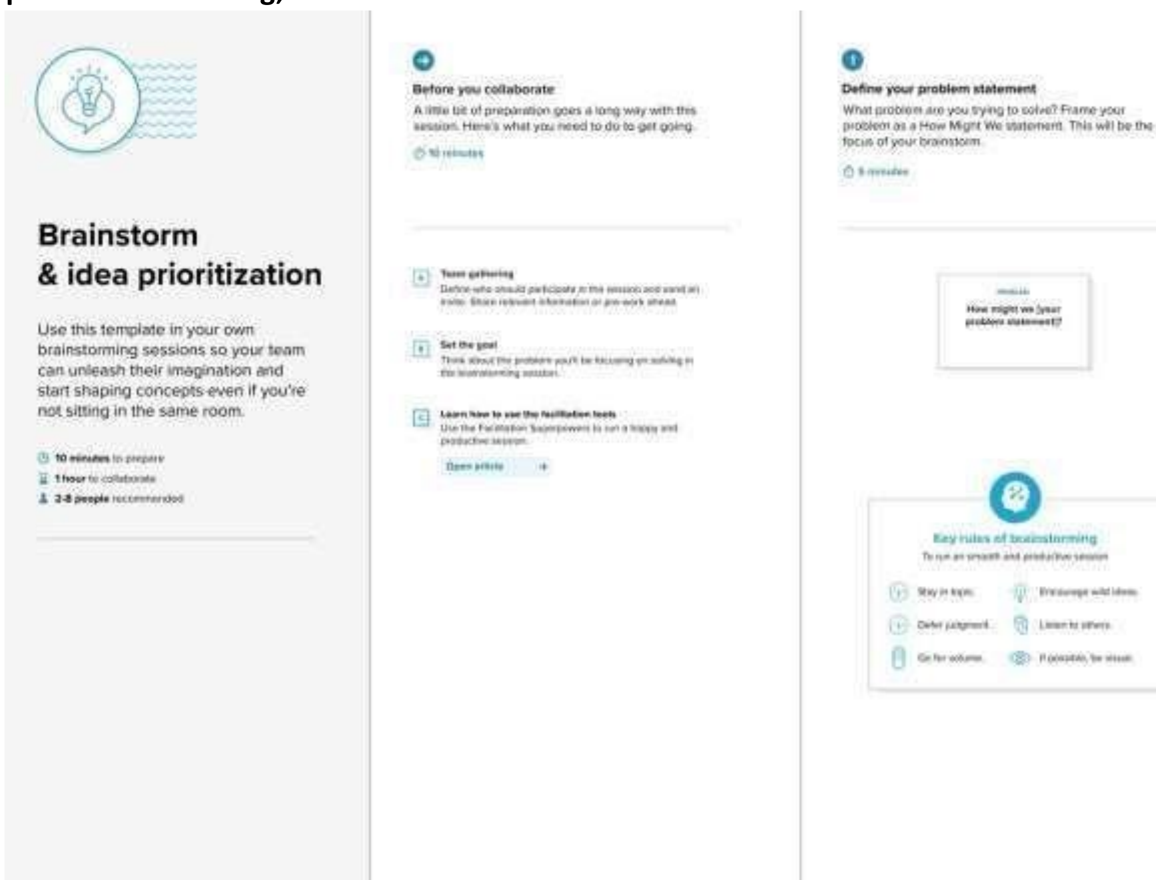
Brainstorm & Idea Prioritization Template:

Brainstorming provides a free and open environment that encourages everyone within a team to participate in the creative thinking process that leads to problem solving. Prioritizing volume over value, out-of-the-box ideas are welcome and built upon, and all participants are encouraged to collaborate, helping each other develop a rich amount of creative solutions.

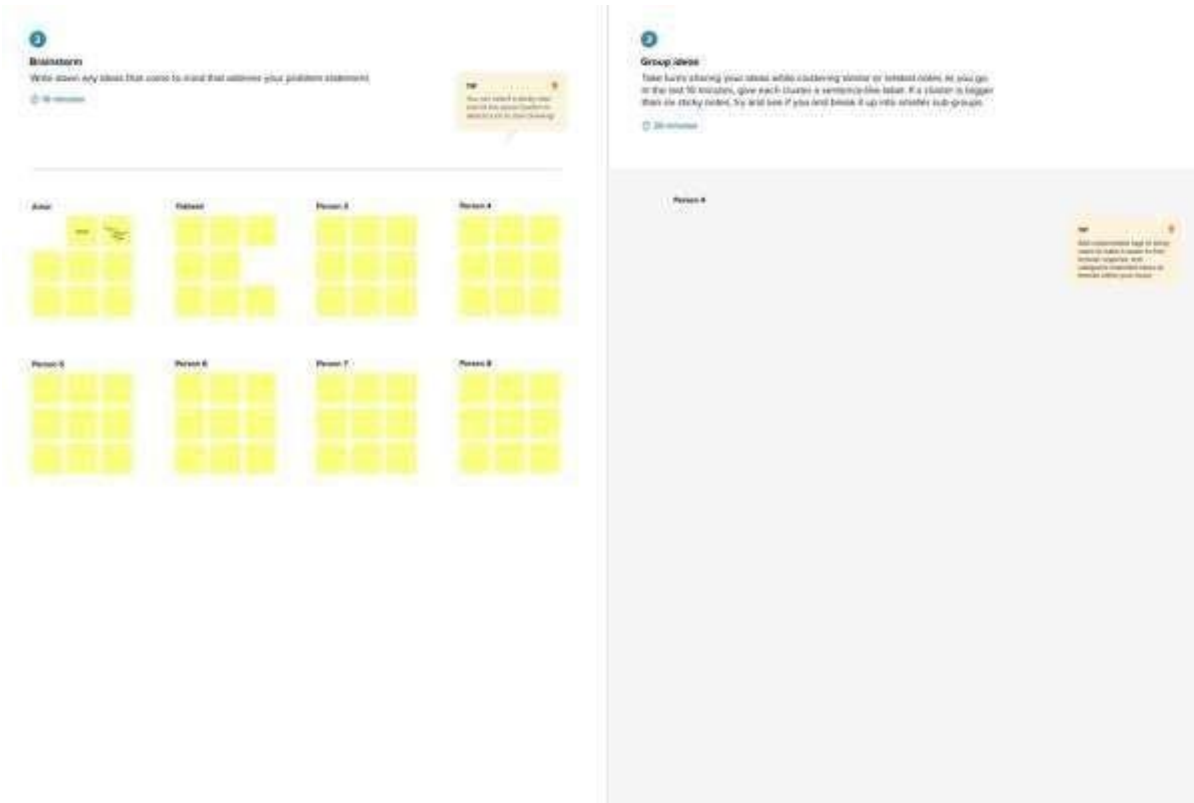
Use this template in your own brainstorming sessions so your team can unleash their imagination and start shaping concepts even if you're not sitting in the same room.

Reference: https://www.mural.co/templates/empathy-map-canvas

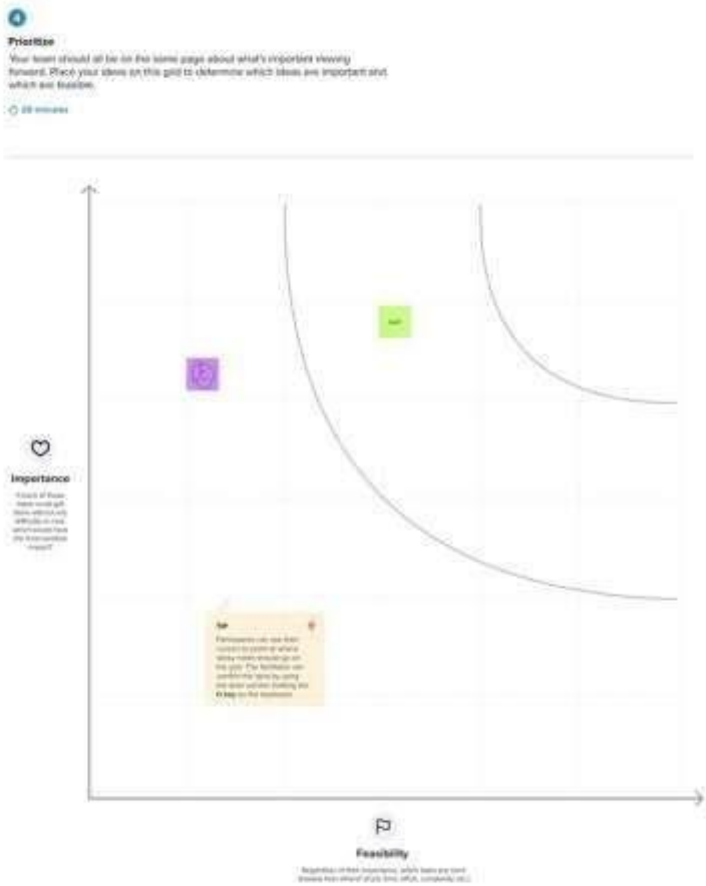
Step-1: Team Gathering, Collaboration and Select the Problem Statement



Step-2: Brainstorm, Idea Listing and Grouping



Step-3: Idea Prioritization


4
Prioritize
Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.
Importance
Feasibility

CHAPTER 4
REQUIREMENT ANALYSIS

4.1 Functional requirement

1. **Features and Capabilities**: Functional requirements outline the features and capabilities that the software system must have. For example, in a word processing application, a functional requirement might specify that it must support the ability to create, edit, and save documents.
2. **User Interactions**: They describe how users will interact with the system. This includes user interfaces, inputs, and outputs. For instance, a functional requirement for a banking application might specify that users can log in with a username and password and view their account balance.
3. **Use Cases and Scenarios**: Functional requirements often include use cases or scenarios that describe how the system should behave in various situations. These use cases provide detailed descriptions of specific interactions and outcomes.
4. **Data Handling**: Functional requirements specify how the software should handle data, including data input, storage, retrieval, and processing. This ensures that data is managed effectively and securely.
5. **Performance Requirements**: Functional requirements can define performance criteria, such as response times, data processing speed, and system resource usage, to ensure the software meets performance expectations.
6. **Constraints and Dependencies**: They may also include constraints and dependencies, such as compatibility requirements with specific hardware or software, regulatory compliance, and integration with external systems.
7. **Error Handling and Reporting**: Functional requirements address how errors and exceptions should be handled by the system, including error messages, logging, and recovery mechanisms.
8. **Security Requirements**: These requirements specify how the software should protect data and maintain security, including authentication, authorization, and encryption mechanisms.
9. **Reporting and Output**: Functional requirements detail the types of reports and outputs that the system should generate, as well as how and when they should be delivered to users or other systems.

10. **Business Rules**: They may include business rules or logic that the software must adhere to. These rules often reflect specific business processes or regulations that the system needs to follow.
11. **Integration Points**: Functional requirements can specify how the software should integrate with other systems or external APIs, including the protocols and data formats to be used.
12. **State Transitions**: For systems with state-based behavior, functional requirements describe how the system transitions between different states and the conditions that trigger these transitions.

4.2 Non-Functional requirement

1. **Performance**: Performance requirements specify how the system should perform in terms of response times, throughput, and resource utilization. For example, a performance requirement might state that the system must respond to user requests within two seconds or handle a certain number of concurrent users without degradation.
2. **Scalability**: Scalability requirements address the system's ability to handle increased loads and data volumes. This can include requirements for horizontal scalability (adding more servers) or vertical scalability (upgrading hardware resources).
3. **Reliability**: Reliability requirements define the system's ability to maintain its functionality and data integrity over time. This may include requirements for uptime, availability, fault tolerance, and mean time between failures (MTBF).
4. **Availability**: Availability requirements specify the percentage of time the system should be operational and accessible to users. For critical systems, high availability requirements are essential.
5. **Security**: Security requirements focus on protecting the system and its data from unauthorized access, breaches, and vulnerabilities. This includes authentication, authorization, encryption, and compliance with security standards.
6. **Maintainability**: Maintainability requirements address how easily the system can be maintained and updated. This may involve requirements for code readability, modularity, and documentation.
7. **Usability**: Usability requirements pertain to the user-friendliness of the system. They specify how easily users can learn and navigate the system and can include requirements for accessibility, internationalization, and user support.

8. **Compatibility**: Compatibility requirements ensure that the system works with specified hardware, software, browsers, and operating systems. This is particularly important for systems with diverse user environments.
9. **Interoperability**: Interoperability requirements define how the system should interact and exchange data with other systems or external services. They often specify protocols, data formats, and integration points.
10. **Compliance**: Compliance requirements refer to adherence to regulatory and industry standards. This can include legal and ethical compliance, data protection regulations, and industry-specific standards like HIPAA for healthcare systems.
11. **Portability**: Portability requirements deal with the ability to move the system from one environment to another. This might include requirements for cross-platform compatibility or support for different cloud providers.
12. **Load and Stress Testing**: Non-functional requirements often involve specific tests, such as load testing to verify performance under heavy loads and stress testing to evaluate system stability under extreme conditions.
13. **Data Handling**: Data-related non-functional requirements cover aspects like data retention, data privacy, and data encryption for secure storage and transmission.
14. **Environmental Constraints**: Some projects, especially in IoT or embedded systems, must consider environmental constraints, like operating temperature ranges or power consumption.
15. **Cultural and Ethical Factors**: In some cases, non-functional requirements may encompass cultural and ethical considerations, such as the need for systems to respect cultural norms or ethical principles.

CHAPTER 5
PROJECT DESIGN

5.1 Data flow diagram

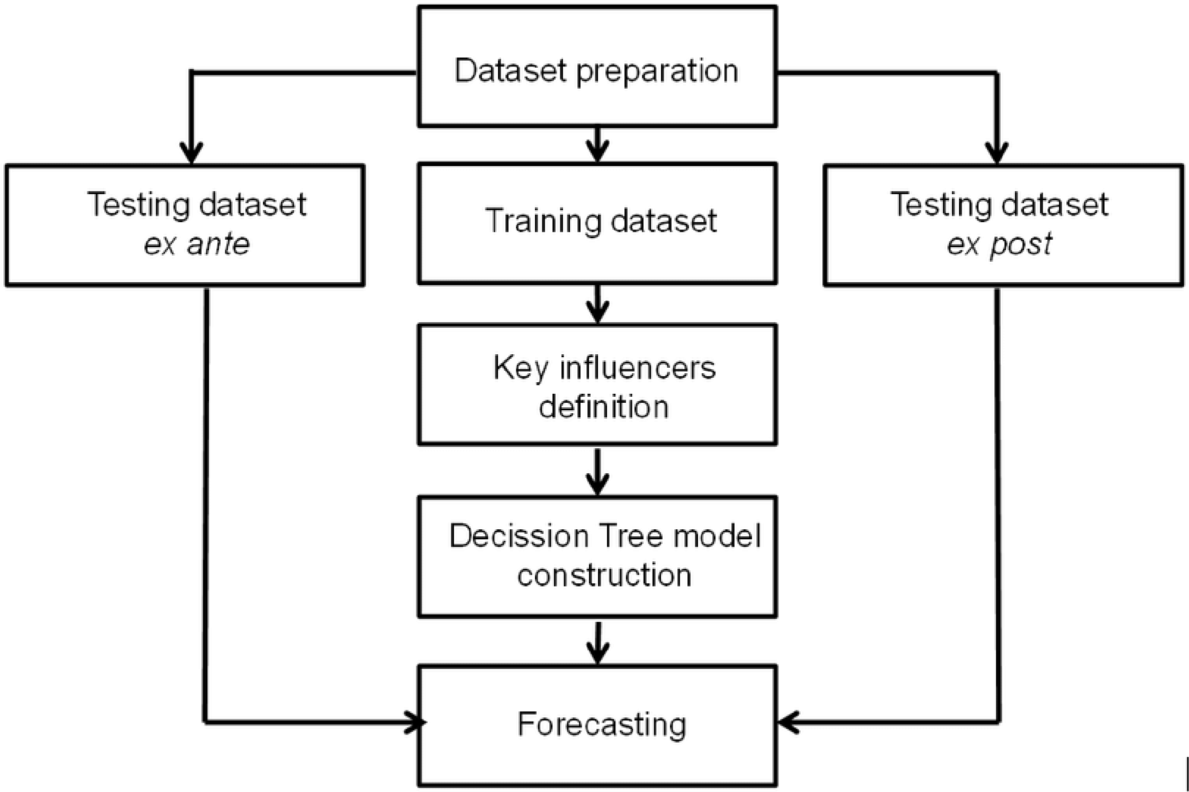
Project Design Phase-II

Data Flow Diagram & User Stories

Date	9 October 2023
Team ID	NM2023TMID09752
Project Name	Solar panel Forecasting

Data Flow Diagrams:

A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.



User Stories

Use the below template to list all the user stories for the product.

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Team Member
Customer (Mobile user)	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	I can access my account / dashboard	High	sanjai
		USN-2	As a user, I will receive confirmation email once I	I can receive confirmation email & click confirm	High	Arul kumar

			have registered for the application			
		USN-3	As a user, I can register for the application through Facebook	I can register & access the dashboard with Facebook Login	Low	Ashwath narayanan
		USN-4	As a user, I can register for the application through Gmail		Medium	yogeshwar
		USN-5	As a user, I can log into the application by entering email & password	I can login with my mobile phone	High	sanjay
		USN-6	I can register using my own mail id	I can access my account/ dashboard	Medium	Arul kumar
Customer (Web user)	Login	USN-7	User is asked to input a username and password. Validate using the text file created from the register option.	User will receive a notification email after successfully registration.	High	Yogeshwar
Customer Care Executive	Dashboard	USN-8	As a user gives executives a hostistic overview of its performing.		Low	Arul kumar

5.2 Solution Architecture

Project Design Phase-I
Solution Architecture

Date	9 October 2023
Team ID	NM2023TMID09752
Project Name	Solar Panel Forecasting

Solution Architecture:

Solution architecture is a complex process — with many sub-processes — that bridges the gap between business problems and technology solutions. Its goals are to:

Find the best tech solution to solve existing business problems.

Describe the structure, characteristics, behavior, and other aspects of the software to project stakeholders.

Define features, development phases, and solution requirements.

Provide specifications according to which the solution is defined, managed, and delivered.

Example - Solution Architecture Diagram:

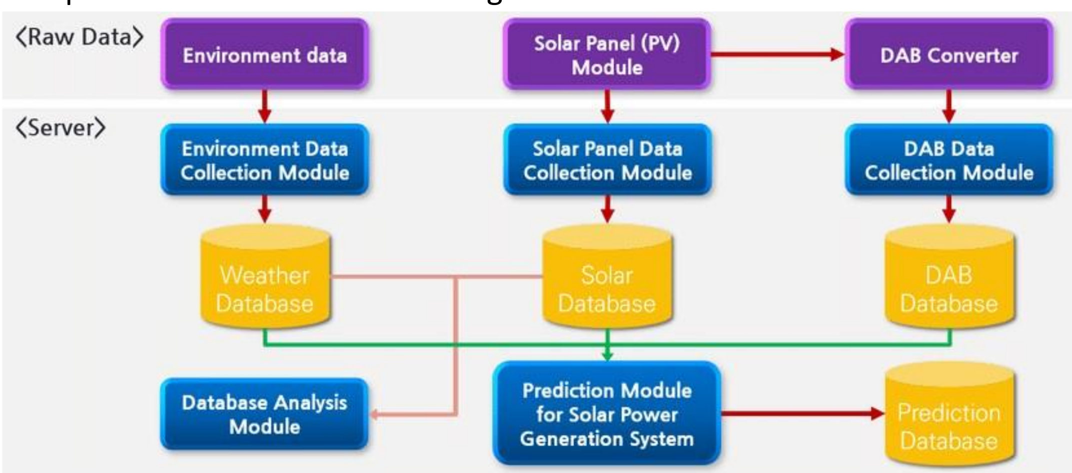


Figure 1 : Architecture and data flow of solar panel forecasting

CHAPTER 6

PROJECT PLANNING & SCHEDULING

6.1 Technical Architecture

Project Design Phase-II
Technology Stack (Architecture & Stack)

Date	03 October 2023
Team ID	NM2023TMID09433
Project Name	Solar Panel Forecasting
Maximum Marks	4 Marks

Technical Architecture:

The Deliverable shall include the architectural diagram as below and the information as per the table1 & table 2

Example: Order processing during pandemics for offline mode

Reference: https://developer.ibm.com/patterns/ai-powered-backend-system-for-order-processing-during-pandemics/

The picture can't be displayed.

Guidelines:

1. Include all the processes (As an application logic / Technology Block)
2. Provide infrastructural demarcation (Local / Cloud)
3. Indicate external interfaces (third party API's etc.)
4. Indicate Data Storage components / services
5. Indicate interface to machine learning models (if applicable)

Table-1 : Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	How user interacts with application e.g. Web UI, Mobile App, Chatbot etc.	HTML, CSS, JavaScript / Angular Js / React Js etc.
2.	Application Logic-1	Logic for a process in the application	Java / Python
3.	Application Logic-2	Logic for a process in the application	IBM Watson STT service
4.	Application Logic-3	Logic for a process in the application	IBM Watson Assistant

5.	Database	Data Type, Configurations etc.	MySQL, NoSQL, etc.
6.	Cloud Database	Database Service on Cloud	IBM DB2, IBM Cloudant etc.
7.	File Storage	File storage requirements	IBM Block Storage or Other Storage Service or Local Filesystem
8.	External API-1	Purpose of External API used in the application	IBM Weather API, etc.
9.	External API-2	Purpose of External API used in the application	Aadhar API, etc.
10.	Machine Learning Model	Purpose of Machine Learning Model	Object Recognition Model, etc.
11.	Infrastructure (Server / Cloud)	Application Deployment on Local System / Cloud Local Server Configuration: Cloud Server Configuration :	Local, Cloud Foundry, Kubernetes, etc.

Table-2: Application Characteristics:

S.No	**Characteristics**	**Description**	**Technology**
1.	Open-Source Frameworks	List the open-source frameworks used	Technology of Opensource framework
2.	Security Implementations	List all the security / access controls implemented, use of firewalls etc.	e.g. SHA-256, Encryptions, IAM Controls, OWASP etc.
3.	Scalable Architecture	Justify the scalability of architecture (3 – tier, Micro-services)	Technology used
S.No	**Characteristics**	**Description**	**Technology**
4.	Availability	Justify the availability of application (e.g. use of load balancers, distributed servers etc.)	Technology used
5.	Performance	Design consideration for the performance of the application (number of requests per sec, use of Cache, use of CDN's) etc.	Technology used

References:

https://c4model.com/

https://developer.ibm.com/patterns/online-order-processing-system

CHAPTER 7

CODING & SOLUTIONING

Index.html

```
<!DOCTYPE html>
<html lang="en">

<head>
  <meta charset="utf-8">
  <meta content="width=device-width, initial-scale=1.0" name="viewport">

  <title>Solar Panal Forcasting</title>
  <meta content="" name="description">
  <meta content="" name="keywords">

  <!-- Favicons -->
  <link href="assets/img/favicon.png" rel="icon">
  <link href="assets/img/apple-touch-icon.png" rel="apple-touch-icon">

  <!-- Google Fonts -->
  <link
href="https://fonts.googleapis.com/css?family=Open+Sans:300,300i,400,400i,600,600i,700,700i|
Raleway:300,300i,400,400i,500,500i,600,600i,700,700i|Poppins:300,300i,400,400i,500,500i,600
,600i,700,700i" rel="stylesheet">

  <!-- Vendor CSS Files -->
  <link href="/static/assets/vendor/aos/aos.css" rel="stylesheet">
  <link href="/static/assets/vendor/bootstrap/css/bootstrap.min.css" rel="stylesheet">
```

```
  <link href="/static/assets/vendor/bootstrap-icons/bootstrap-icons.css" rel="stylesheet">
  <link href="/static/assets/vendor/boxicons/css/boxicons.min.css" rel="stylesheet">
  <link href="/static/assets/vendor/glightbox/css/glightbox.min.css" rel="stylesheet">
  <link href="static/assets/vendor/remixicon/remixicon.css" rel="stylesheet">
  <link href="static/assets/vendor/swiper/swiper-bundle.min.css" rel="stylesheet">

  <!-- Template Main CSS File -->
  <link href="/static/assets/css/style.css" rel="stylesheet">
  <script type="text/javascript">
      function zoom() {
          document.body.style.zoom = "90%"
      }
</script>

</head>

<body onload="zoom()">

  <!-- ======= Header ======= -->
  <header id="header" class="fixed-top">
    <div class="container d-flex align-items-center justify-content-between">

      <h1 class="logo"><a href="index.html">Solar Panel Forcasting</a></h1>
      <!-- Uncomment below if you prefer to use an image logo -->
      <a href="index.html" class="logo"><img src="/static/assets/img/logo.png" alt=""
class="img-fluid"></a>

      <nav id="navbar" class="navbar">
        <ul>
```

```
        <li><a class="nav-link scrollto active" href="#hero">Home</a></li>
        <li><a class="nav-link scrollto" href="#about">Dashboard</a></li>
        <li><a class="nav-link scrollto" href="#counts">Story</a></li>
        <li><a class="nav-link scrollto o" href="#rep">Report</a></li>

        <li><a class="getstarted scrollto" href="#about">Get Started</a></li>
      </ul>
      <i class="bi bi-list mobile-nav-toggle"></i>
    </nav><!-- .navbar -->

  </div>
</header><!-- End Header -->

<!-- ======= Hero Section ======= -->
<section id="hero" class="d-flex align-items-center">
  <div class="container position-relative" data-aos="fade-up" data-aos-delay="100">
    <div class="row justify-content-center">
      <div class="col-xl-7 col-lg-9 text-center">
        <h1>Solar panel Forcasting</h1>
        <h2>Solar is used for converting light to Electricity</h2>
      </div>
    </div>
    <div class="text-center">
      <a href="#about" class="btn-get-started scrollto">Get Started</a>
    </div>

    <div class="row icon-boxes">
      <div class="col-md-6 col-lg-3 d-flex align-items-stretch mb-5 mb-lg-0" data-aos="zoom-
in" data-aos-delay="200">
```

```
          <div class="icon-box">
            <div class="icon"><i class="ri-stack-line"></i></div>
            <h4 class="title"><a href="">Dashboard</a></h4>
            <p class="description">Solar panel forcasting visualization</p>
          </div>
        </div>

        <div class="col-md-6 col-lg-3 d-flex align-items-stretch mb-5 mb-lg-0" data-aos="zoom-
in" data-aos-delay="300">
          <div class="icon-box">
            <div class="icon"><i class="ri-palette-line"></i></div>
            <h4 class="title"><a href="">Story</a></h4>
            <p class="description">Story of an solar panal forcasting</p>
          </div>
        </div>

        <div class="col-md-6 col-lg-3 d-flex align-items-stretch mb-5 mb-lg-0" data-aos="zoom-
in" data-aos-delay="400">
          <div class="icon-box">
            <div class="icon"><i class="ri-command-line"></i></div>
            <h4 class="title"><a href="">Report</a></h4>
            <p class="description">Detail report on solar panal forcasting</p>
          </div>
        </div>

        <div class="col-md-6 col-lg-3 d-flex align-items-stretch mb-5 mb-lg-0" data-aos="zoom-
in" data-aos-delay="500">
          <div class="icon-box">
            <div class="icon"><i class="ri-fingerprint-line"></i></div>
```

```
          <h4 class="title"><a href="">Get Started</a></h4>
          <p class="description">To get started a Solar panal Forcasting</p>
        </div>
      </div>


    </div>
  </div>
</section><!-- End Hero -->


<main id="main">


  <!-- ======= About Section ======= -->
  <section id="about" class="about">
    <div class="container" data-aos="fade-up"><center
      ><h1>Dashboard</h1>
<iframe
src="https://us1.ca.analytics.ibm.com/bi/?perspective=dashboard&amp;pathRef=.my_folders%2
Fsolardashboard&amp;closeWindowOnLastView=true&amp;ui_appbar=false&amp;ui_navbar=f
alse&amp;shareMode=embedded&amp;&CAMNamespace=i101573AD337D40AF9117C479E
DBE6A53&CAMUsername=ajkjkamesh0@gmail.com&CAMPassword=Kameshwaran1234567
8@ action=view&amp;mode=dashboard&amp;subView=model0000018814d38408_00000000"
width="1250" height="900" frameborder="0" gesture="media" allow="encrypted-media"
allowfullscreen=""></iframe></center>
    </div>
  </section><!-- End About Section -->


  <!-- ======= Counts Section ======= -->
  <section id="counts" class="counts section-bg">
    <div class="container">
      <center><h1>Story</h1>
```

```
<iframe
src="https://us1.ca.analytics.ibm.com/bi/?perspective=story&amp;pathRef=.my_folders%2FSO
LARSTORY&amp;closeWindowOnLastView=true&amp;ui_appbar=false&amp;ui_navbar=fals
e&amp;shareMode=embedded&amp;&CAMNamespace=xYmlkOnU6ZDljNmQ3ZjQtZTE4YS
00YTU2LWIxMDktMDg5M2ZjNjg1MTdlLTNjNGY1ZDVlLTE5NjEtNDNiZi04NTM2LWM0
OTU5Yzg0NTQwYg__&CAMUsername=kamesh
waran&CAMPassword=Kameshwaran12345678@

action=view&amp;sceneId=model0000018814ea2c5a_00000000&amp;sceneTime=0"
width="1250" height="900" frameborder="0" gesture="media" allow="encrypted-media"
allowfullscreen=""></iframe>

 </div>


</div>

</section><!-- End Counts Section -->

<section id="rep" class="counts section-bg">

<div class="container">

 <center><h1>Report</h1>

<iframe
src="https://us1.ca.analytics.ibm.com/bi/?pathRef=.my_folders%2Fsolarreport2&amp;closeWin
dowOnLastView=true&amp;ui_appbar=false&amp;ui_navbar=false&amp;shareMode=embedde
d&amp;&CAMNamespace=iD35C58DC816344B598084F094A2978FF&CAMUsername=ajkjk
amesh0@gmail.com&CAMPassword=Kameshwaran12345678@action=run&amp;format=HTM
L&amp; prompt=false" width="1250" height="800" frameborder="0" gesture="media"
allow="encrypted-media" allowfullscreen=""
CAMNamespace=xYmlkOnU6ZDljNmQ3ZjQtZTE4YS00YTU2LWIxMDktMDg5M2ZjNjg1M
TdlLTNjNGY1ZDVlLTE5NjEtNDNiZi04NTM2LWM0OTU5Yzg0NTQwYg__&CAMUsernam
e=ajkjkamesh0@gmail.com&CAMPassword=Kameshwaran12345678@></iframe>

</center>

 </div>


</div>

</section>


<!-- Vendor JS Files -->
```

```html
  <script src="/static/assets/vendor/purecounter/purecounter_vanilla.js"></script>
  <script src="/static/assets/vendor/aos/aos.js"></script>
  <script src="/static/assets/vendor/bootstrap/js/bootstrap.bundle.min.js"></script>
  <script src="/static/assets/vendor/glightbox/js/glightbox.min.js"></script>
  <script src="/static/assets/vendor/isotope-layout/isotope.pkgd.min.js"></script>
  <script src="/static/assets/vendor/swiper/swiper-bundle.min.js"></script>
  <script src="/static/assets/vendor/php-email-form/validate.js"></script>

  <!-- Template Main JS File -->
  <script src="/static/assets/js/main.js"></script>

</body>

</html>
```

Dashboard.html

```html
<!DOCTYPE html>
<html>
<head>
   <meta charset="utf-8">
   <meta name="viewport" content="width=device-width, initial-scale=1">
   <title>DAshboard</title>
</head>
<body background="https://cdn.pixabay.com/photo/2017/11/11/17/08/solar-system-
2939560_640.jpg" >
   <center>Dashboard</center>
```

```
<iframe
src="https://us1.ca.analytics.ibm.com/bi/?perspective=dashboard&amp;pathRef=.my_folders%2
Fsolardashboard&amp;closeWindowOnLastView=true&amp;ui_appbar=false&amp;ui_navbar=f
alse&amp;shareMode=embedded&amp;&CAMNamespace=i101573AD337D40AF9117C479E
DBE6A53&CAMUsername=ajkjkamesh0@gmail.com&CAMPassword=Kameshwaran1234567
8@ action=view&amp;mode=dashboard&amp;subView=model0000018814d38408_00000000"
width="1450" height="900" frameborder="0" gesture="media" allow="encrypted-media"
allowfullscreen=""></iframe></center>


</body>
</html>
```

Report.html

```
<!DOCTYPE html>
<html>
<head>
		<meta charset="utf-8">
		<meta name="viewport" content="width=device-width, initial-scale=1">
		<title>Report</title>
</head>
<body background="https://cdn.pixabay.com/photo/2017/11/11/17/08/solar-system-
2939560_640.jpg" >
		<center><h1>Report</h1></center>
		<iframe
src="https://us1.ca.analytics.ibm.com/bi/?pathRef=.my_folders%2Fsolarreport2&amp;closeWin
dowOnLastView=true&amp;ui_appbar=false&amp;ui_navbar=false&amp;shareMode=embedde
d&amp;&CAMNamespace=iD35C58DC816344B598084F094A2978FF&CAMUsername=ajkjk
amesh0@gmail.com&CAMPassword=Kameshwaran12345678@action=run&amp;format=HTM
L&amp; prompt=false" width="1250" height="800" frameborder="0" gesture="media"
allow="encrypted-media" allowfullscreen=""
CAMNamespace=xYmlkOnU6ZDljNmQ3ZjQtZTE4YS00YTU2LWIxMDktMDg5M2ZjNjg1M
TdlLTNjNGY1ZDVlLTE5NjEtNDNiZi04NTM2LWM0OTU5Yzg0NTQwYg__&CAMUsernam
e=ajkjkamesh0@gmail.com&CAMPassword=Kameshwaran12345678@></iframe>
```

```
</body>

</html>
```

Story.html

```
<!DOCTYPE html>

<html>

<head>

  <meta charset="utf-8">

  <meta name="viewport" content="width=device-width, initial-scale=1">

  <title>Story</title>

</head>

<body background="https://cdn.pixabay.com/photo/2017/11/11/17/08/solar-system-
2939560_640.jpg" >

  <center><h1>Story</h1></center>

  <iframe
src="https://us1.ca.analytics.ibm.com/bi/?perspective=story&amp;pathRef=.my_folders%2FSO
LARSTORY&amp;closeWindowOnLastView=true&amp;ui_appbar=false&amp;ui_navbar=fals
e&amp;shareMode=embedded&amp;&CAMNamespace=xYmlkOnU6ZDljNmQ3ZjQtZTE4YS
00YTU2LWIxMDktMDg5M2ZjNjg1MTdlLTNjNGY1ZDVlLTE5NjEtNDNiZi04NTM2LWM0
OTU5Yzg0NTQwYg__&CAMUsername=kamesh
waran&CAMPassword=Kameshwaran12345678@

     action=view&amp;sceneId=model0000018814ea2c5a_00000000&amp;sceneTime=0"
width="1250" height="900" frameborder="0" gesture="media" allow="encrypted-media"
allowfullscreen=""></iframe>


</body>

</html>
```

CHAPTER 8

PREFORMANCE TESTING

Project Development Phase
Model Performance Test

Date	10 November 2023
Team ID	NM2023TMID09433
Project Name	Solar Panel Forecasting
Maximum Marks	10 Marks

Model Performance Testing:

Project team shall fill the following information in model performance testing template.

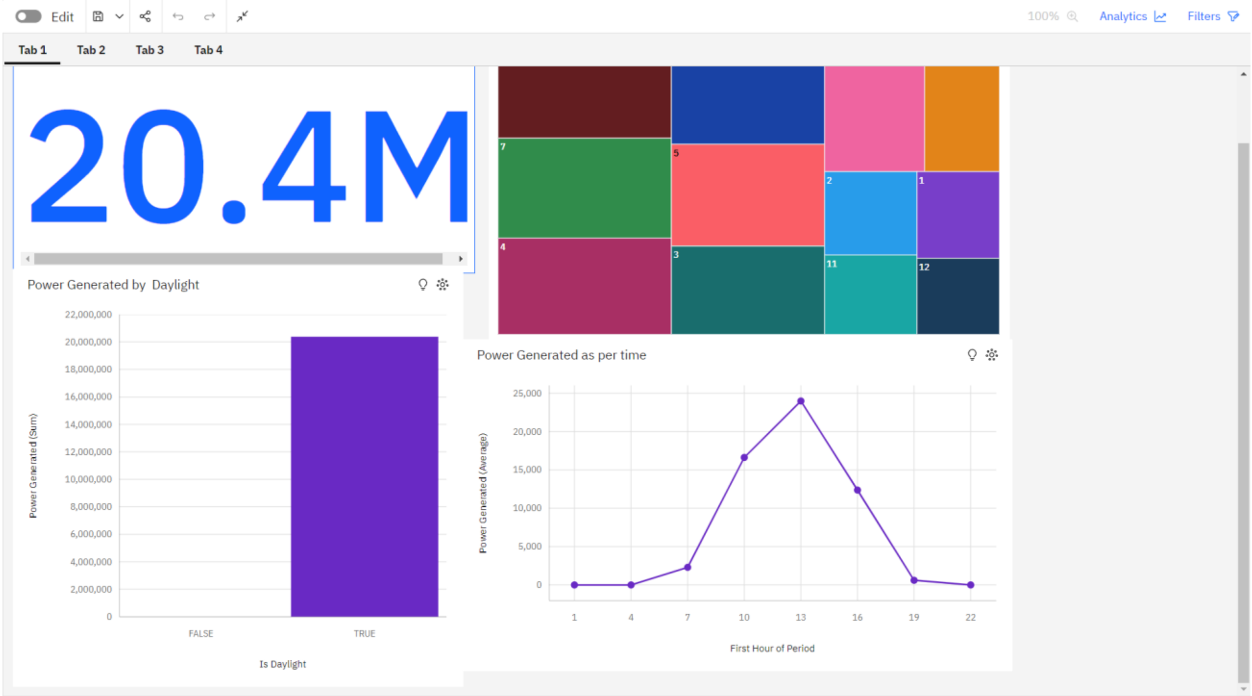
S.No.	Parameter	Screenshot / Values
1.	Dashboard design	
2.	Data Responsiveness	
3.	Amount Data to Rendered (DB2 Metrics)	2

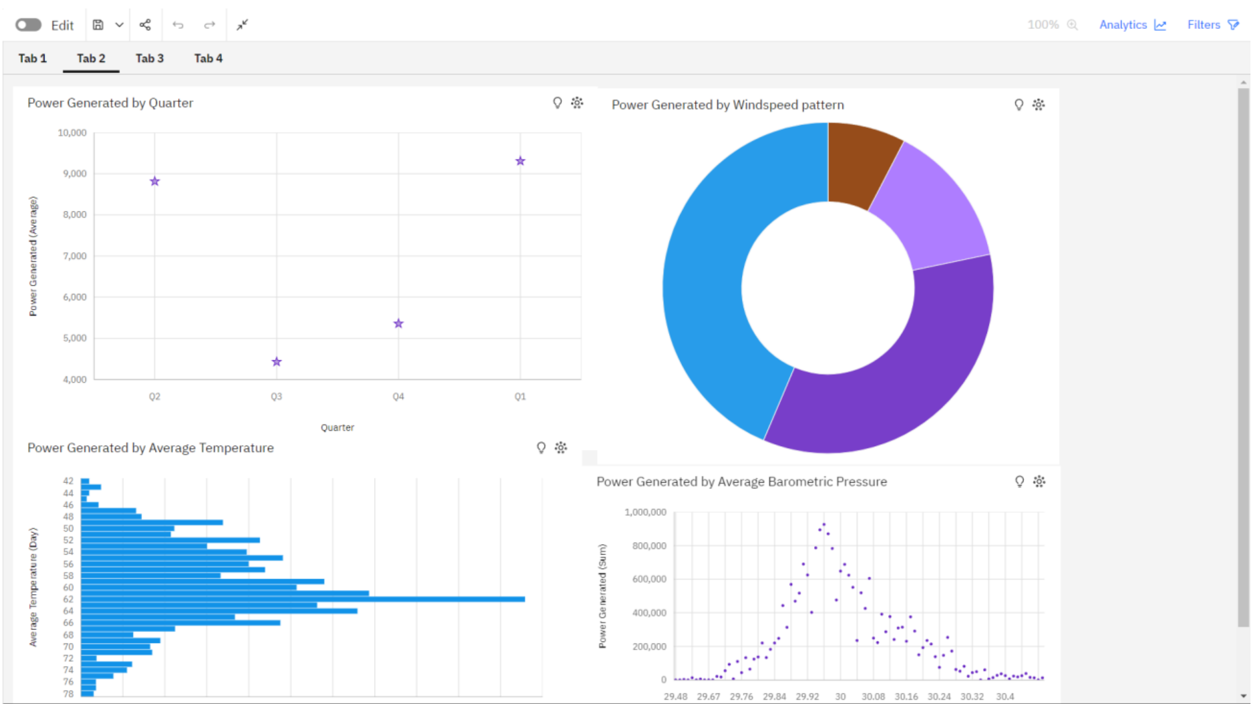
4.	Utilization of Data Filters	
5.	Effective User Story	No of Scene Added - 8
6.	Descriptive Reports	No of Visulizations / Graphs - 4

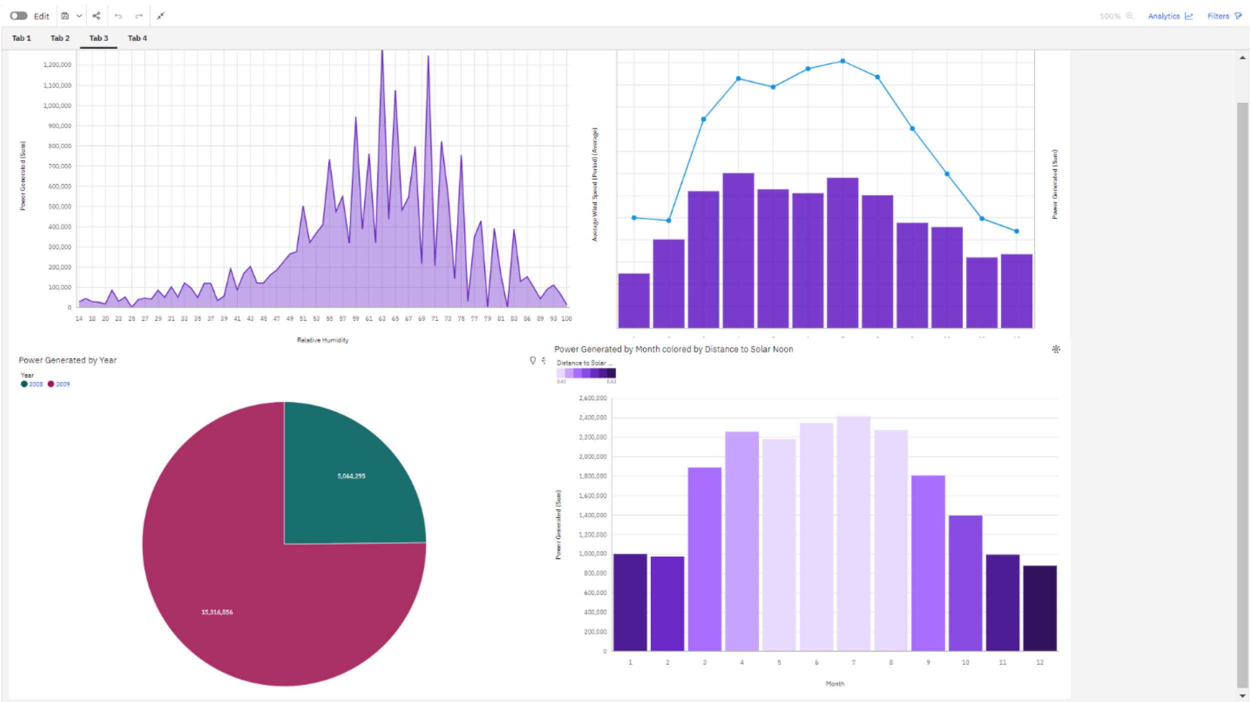
CHAPTER 9

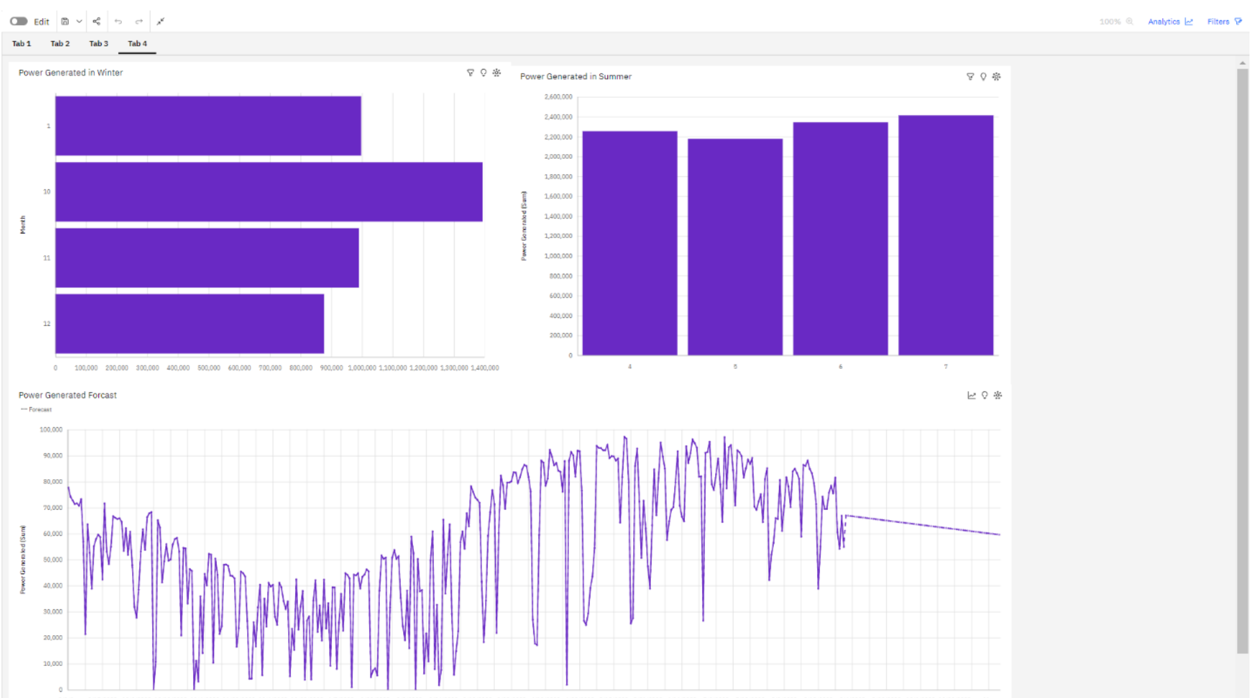
RESULT

9.1 Output Screenshots

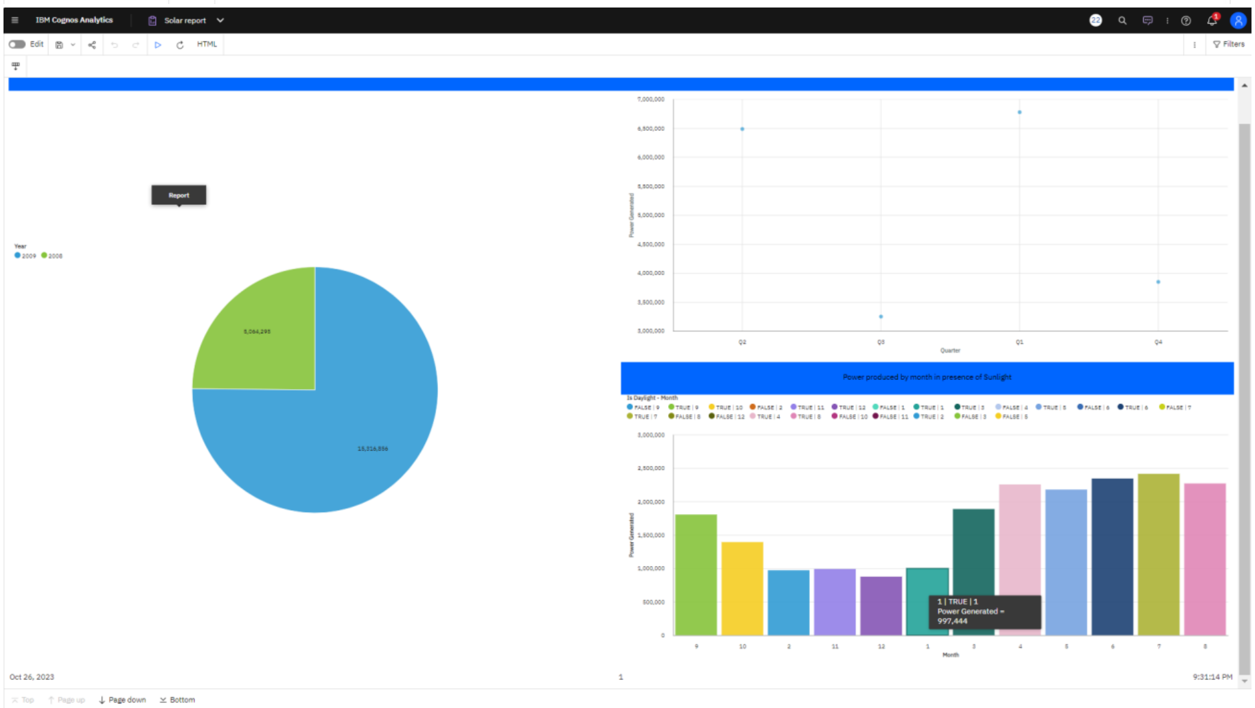

Edit
100%
Analytics
Filters
Tab 1
Tab 2
Tab 3
Tab 4
20.4M
Power Generated by Daylight
Power Generated (Sum)
Is Daylight
FALSE
TRUE
Power Generated as per time
Power Generated (Average)
First Hour of Period


Edit
100%
Analytics
Filters
Tab 1
Tab 2
Tab 3
Tab 4
Power Generated by Quarter
Power Generated (Average)
Quarter
Power Generated by Windspeed pattern
Power Generated by Average Temperature
Average Temperature (Day)
Power Generated by Average Barometric Pressure
Power Generated (Sum)


Edit
Tab 1
Tab 2
Tab 3
Tab 4
Analytics
Filters
Relative Humidity
Power Generated by Year
Power Generated by Month colored by Distance to Solar Noon
Month


Edit
Tab 1
Tab 2
Tab 3
Tab 4
Analytics
Filters
Power Generated in Winter
Power Generated in Summer
Power Generated Forcast


Edit
Analytics
Filters
Solar power is a heat radiation from the sun that is converted into electric power
Story
Solar power forcasting is the process of gathering and analyzing the data in order to predict solar power generation on various time zone
Factors affecting solar panel forcasting-weather condition,time,and date,location,shading and panel orientation
Prev scene
Next scene
Scene 1 of 8


IBM Cognos Analytics
Solar report
Edit
HTML
Filters
Report
Year
2009
2008
Power Generated
Quarter
Power produced by month in presence of Sunlight
Month
Oct 26, 2023
9:31:14 PM
Page down
Bottom

CHAPTER 10
ADVANTAGES & DISADVANTAGES

Advantages of Solar Panel Forecasting:

1. **Optimizing Energy Production:** Solar panel forecasting helps in optimizing energy production by predicting when the panels will generate the most electricity. This allows for better utilization of renewable energy resources.
2. **Grid Integration:** Accurate forecasting can assist in integrating solar energy into the electrical grid more effectively. Grid operators can plan for fluctuations in energy supply and demand.
3. **Reducing Energy Costs:** Solar panel forecasting can help reduce energy costs for consumers by allowing them to use more of their generated electricity when it's most beneficial, such as during peak periods or when electricity prices are high.
4. **Enhanced Energy Storage:** When combined with energy storage systems, forecasting can improve the efficiency of energy storage by ensuring that excess energy is stored during periods of high generation and used during periods of low generation.
5. **Maintenance Planning:** It helps in scheduling maintenance for solar panels, as you can anticipate when they might need cleaning or repairs based on predicted energy production.
6. **Environmental Benefits:** Reducing the need for backup fossil fuel power generation by better predicting solar energy production can lead to reduced greenhouse gas emissions.

Disadvantages of Solar Panel Forecasting:

7. **Accuracy Challenges**: Weather conditions can be highly unpredictable, and even the best forecasting models may have limitations in accuracy. Slight inaccuracies can impact energy production and grid stability.
8. **Data Requirements**: Accurate forecasting often relies on a lot of data, including historical weather patterns, panel specifications, and geographic information. Gathering and maintaining this data can be time-consuming and costly.

9. **Resource-Dependent**: Solar panel forecasting is highly dependent on the availability of sunlight. During cloudy or nighttime periods, it may not be effective, and alternative energy sources or energy storage systems are required.
10. **Technology Costs**: Implementing forecasting systems can be costly, especially for small-scale installations. This includes the cost of sensors, weather data access, and the computational infrastructure required for modeling.
11. **Complexity:** Forecasting models can be complex, and their accuracy may vary with the quality of the model and the data used. This complexity can make it challenging for some users to implement and utilize effectively.
12. **Energy Market Dynamics**: Energy markets can be influenced by various factors, including government policies and incentives. Changes in these factors can impact the financial benefits of solar panel forecasting.

CHAPTER 11
CONCLUSION

In conclusion, solar panel forecasting is a valuable tool in the realm of renewable energy, offering a range of benefits and advantages, while also presenting certain challenges. It plays a critical role in the efficient integration of solar energy into our electrical grids and offers the potential to reduce energy costs, lower greenhouse gas emissions, and enhance overall energy sustainability. However, it's important to be aware of the limitations and disadvantages associated with solar panel forecasting, such as accuracy issues, data requirements, and the inherent dependence on weather conditions.

Despite these challenges, advancements in forecasting technology, coupled with ongoing research and development, continue to improve the accuracy and reliability of these predictions. As a result, solar panel forecasting remains an essential component of our transition to a cleaner and more sustainable energy future.

To make the most of solar panel forecasting, it should be used in conjunction with complementary technologies like energy storage systems and alongside a diversified energy mix. Additionally, sound policies and incentives are essential to promote the adoption of forecasting systems and encourage the broader adoption of solar energy.

Ultimately, solar panel forecasting is a key tool in the pursuit of a greener and more sustainable energy landscape, helping us harness the power of the sun more effectively and contributing to a cleaner environment and a more resilient energy infrastructure.

CHAPTER 12
FUTURE SCOPE

1. Improved Accuracy: Advancements in machine learning, artificial intelligence, and weather modeling will lead to more accurate solar panel forecasting. The integration of more data sources, including satellite imagery and real-time weather data, will enhance the precision of predictions.
2. Enhanced Data Accessibility: Future developments may simplify data collection and accessibility, making it easier for individuals and organizations to access the necessary data for forecasting. Open data initiatives and improved data-sharing mechanisms will play a role in this.
3. Integration with Energy Storage: As energy storage technologies continue to advance, solar panel forecasting will become increasingly important in optimizing when to charge and discharge energy storage systems. This will contribute to grid stability and reduce the need for backup power sources.
4. Grid Management: Solar panel forecasting will play a crucial role in grid management and integration of renewable energy sources. Grid operators will rely on forecasting to balance supply and demand, reducing the need for fossil fuel-based backup power.
5. Resilience and Reliability: The future will see more emphasis on making solar panel forecasting systems resilient to extreme weather events and other disruptions. Ensuring reliable predictions during adverse conditions will be a priority.
6. Consumer Adoption: As more individuals and businesses invest in solar panels, the adoption of solar panel forecasting at the local level will increase. Consumers will seek to maximize the benefits of their solar installations, and forecasting will help them achieve this.
7. Policy and Incentives: Government policies and incentives will continue to shape the future of solar panel forecasting. Increased support for renewable energy and initiatives to promote accurate forecasting will further drive its development and adoption.
8. Global Expansion: Solar panel forecasting will extend its reach to regions beyond those with abundant sunlight. As solar technology becomes more efficient and economical, even areas with less solar potential will benefit from accurate forecasting to make the most of the available sunlight.
9. Environmental Impact: The future of solar panel forecasting will focus on reducing the environmental footprint of the technology itself. This includes efforts to create more sustainable solar panel manufacturing and disposal processes.

10. Integration with Other Renewable Sources: The integration of solar panel forecasting with other renewable energy sources, such as wind and hydroelectric power, will become more common. This holistic approach will help in managing energy generation and distribution more efficiently.

CHAPTER 12

APPENDIX

GitHub & Project Demo Link

GITHUB LINK : **https://github.com/Arul-1505/Solar_System_Forcasting**

VIDEO LINK :
https://drive.google.com/drive/folders/1YeECxfvwLaHwdFCpUSBdp1YH5whlreLw