Project Plan
Product-based Capstone Project

Problem Statement :

Climate change, air pollution, and the transition to cleaner energy (fossil-based) have become global concerns. However, a significant challenge lies in accurately predicting and utilizing solar energy, which is crucial for achieving sustainable energy transition. The lack of accurate and location-specific information is a major obstacle to harnessing the potential of solar energy. This hinders individuals and professionals in planning, understanding, and optimizing the use of solar energy. Therefore, we aim to develop an application that can provide precise predictions of solar energy production using location-specific data and parameters to empower both personal and professional users. Creating such an application is essential to drive the transition towards cleaner and sustainable energy sources while addressing urgent issues like climate change and air pollution.

Question :

1. How to implement accurate location based on the year and time?

Team ID **:** CH2-PS316

Team Member **:**

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Final Selected Themes:
Sustainable Living

Title of the Project:
Sustainable Living Solar Energy Based / Sustainable Living Natural Resources Based
SObright (SOLAR for Brighter Renewable Energy)

Executive Summary/Abstract:

Global warming is a major challenge facing humanity in the 21st century. This phenomenon results from an escalation of greenhouse gas emissions, including carbon dioxide (CO2), methane (CH4), and nitrogen oxides (NOx). The main drivers of this increase in emissions are the burning of fossil fuels and deforestation.

The resulting increase in global temperature is causing a variety of environmental impacts. For instance, the melting of polar ice caps and glaciers contributes to rising sea levels. Additionally, global warming leads to increased extreme weather patterns, including more frequent storms and droughts. The destruction of natural ecosystems caused by global warming also threatens biodiversity. Marine organisms,
like coral reefs, are particularly susceptible to bleaching and mass mortality due to rising water temperatures.

The effects of global warming are also being felt by humans. Starting with its impact on health, food, and education, Global warming has resulted in significant changes in the patterns of human life, presenting significant challenges in various areas of life. In other words, global warming is causing multidimensional
multidimensional impacts on human life. Therefore, appropriate mitigation and adaptation efforts are needed to reduce greenhouse gas emissions and protect the planet.
One way to mitigate the effects of global warming is by utilizing renewable energy sources. Renewable energy can be an alternative to fossil energy sources because it has a lower environmental impact and is regenerative. One of the potential renewable energy sources is solar power.

The utilization of solar power offers a sustainable solution to meet energy demands and has a significant impact on reducing greenhouse gas emissions. Our capstone project focuses on enhancing Indonesia's solar energy potential by creating a solar energy forecasting app that calculates the electrical output from photovoltaics based on installation site coordinates. Through this app, users can efficiently plan the use of solar energy, maximize their use of solar power, and contribute to worldwide efforts to reduce carbon emissions.

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How did your team come up with this project?

Motivated by global concerns about climate change, we aim to address the pressing need for cleaner energy sources through an innovative project. Focusing on solar energy, We are dedicated to creating a more effective solution. However, challenges like accurate solar energy prediction hinder progress. The absence of precise, location-specific information impedes harnessing solar potential. Committed to advancing sustainable energy, our goal is an application offering accurate predictions based on location data and parameters. By overcoming these challenges, we hope to contribute significantly to the transition to cleaner and more sustainable energy sources, ultimately mitigating the impacts of climate change.

Project Scope & Deliverables:

Project Boundaries:

- Timeframe
  - The project is limited to one month
- Data Sources
  - Utilize open source data that is related to calculation about solar energy production.
- Machine Learning Model
  - Implementing an LSTM-based model for time-series (solar energy) prediction.
  - Consider the model's complexity within the given time and prioritize optimization of results.
- User Interface
  - Provide a user interface that is clear, effective, and compliant with the project schedule.
  - Prioritize the display of crucial features and steer clear of unnecessary intricacies.
- Forecasting Horizon:
  - This application will specifically predict daily solar energy production for the coming year within the boundaries of the D.I.Y. region.
- Device Compatibility:
  - Our Capstone Project is limited to mobile apps.

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The table below details the tasks and responsibilities of our team each week to complete the Capstone Project.

- MD Team

Week	Tasks and Responsibilities	Deliverables
Week 1	• Create rough sketches or digital representations of key screens within the mobile app. • Generate wireframes that effectively communicate the app's structure and user flow.	Comprehensive wireframes for key screens, illustrating the app's layout and user interaction.
Week 2	• Specify data storage, access, and retrieval mechanisms. • Generate a system design plan that meets project specifications and requirements	Detailed system architecture documentation, illustrating components, data flow, and interactions.
Week 3	• Design the architecture and user interface of the mobile app. • Ensure the app meets design and functionality specifications.	Fully functional mobile application with the specified features.
Week 4	• Execute manual and automated tests to identify bugs, errors, and usability issues. • Ensure the quality and reliability of the mobile application through rigorous testing.	Detailed test cases covering various aspects of the application's functionality.

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- ML Team

Week	Tasks and Responsibilities	Deliverables
Week 1	• Research and collect historical solar energy production data • Preprocess and clean the collected datasets	Preprocessed datasets ready for model development
Week 2	• Design the architecture for the LSTM-based machine learning model. • Implement the LSTM model for solar energy production prediction	Initial implementation of the LSTM model
Week 3	• Optimize and tune the LSTM model based on initial testing results • Conduct thorough testing and evaluation of the LSTM model	Optimized LSTM model with comprehensive testing results
Week 4	• Integrate the LSTM model into the mobile application's backend • Ensure communication between the mobile apps and the model.	Mobile application with fully integrated and functional LSTM model

- CC Team

Week	Tasks and Responsibilities	Deliverables
Week 1	• Set up a cloud server to host the application. • Establish the database structure, create tables, and set up initial configurations.	A fully configured and operational cloud server.

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Week	Tasks and Responsibilities	Deliverables
Week 2	• Plan and design the overall architecture of the application, including frontend, backend, and database components. • The system architect or lead developer.	App architecture documentation outlining the components and their interactions.
Week 3	• Develop the backend logic and API endpoints based on the designed architecture. • Deploy the application on the previously set up cloud server.	Deployed application accessible on the cloud server.

Project Schedule:

Division	Tasks	Week 1					Week 2					Week 3					Week 4				
		20	21	22	23	24	27	28	29	30	1	4	5	6	7	8	11	12	13	14	15
MD TEAM	Wireframing																				
	System Design Planning																				
	App Development																				
	App Testing																				
ML TEAM	Data Collecting & Cleaning																				
	Architecturing ML Model																				
	ML Model Testing & Evaluation																				
	Model Integration With the App																				

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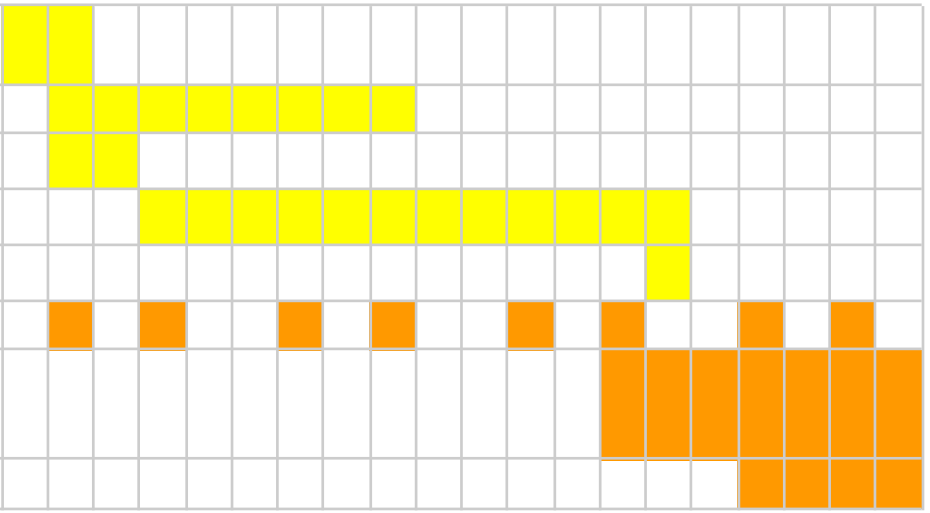
CC TEAM	Create and Setup Cloud Server	
	Designing App Architecture	
	Create Database & Table	
	Create Back-end/API	
	Deployment	
ALL TEAM	Weekly Team Meeting	
	Connecting back-end services with front-end and ML models	
	Documenting Project	



Based on your team's knowledge, what tools/IDE/Library and resources that your team will use to solve the problem?

1. Machine Learning
   - Tensorflow (Primary library for time-series forecasting)
   - LSTM (LSTM is used to model and predict solar radiation patterns from time series data)
   - Google Colab (Execute code, visualize data, and build and train machine learning models)
   - Tensorflow Serving (Utilized for serving real-time machine learning model where the model is distributed in the cloud)
   - Python
     - pandas (data processing and analysis)
     - numpy (processing and analysis storing and manipulating numerical data, operations on arrays, matrix operations, scrambling data and other mathematical operations)
     - matplotlib (visualize the predicted data)
2. Cloud Computing
   - Google Cloud (Creating server/instance machine)
   - Node.js (Creating Backend Rest API)
   - Visual Studio Code (Tool for coding)
   - Postman (Tool for testing APIs to ensure proper functionality)

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3. Mobile Dev
    - Android Studio (An integrated development environment (IDE) for creating Android Applications.)
    - Kotlin (The Official programming language for Android app development)
    - Glide(an image loading library to efficiently handle and display images)
    - API Google Maps (an application programming interface to integrate Google Maps services into applications.)
    - Figma (a collaborative design tool for creating prototypes and user interface design)
    - Room (a persistence library to simplify access and manipulation of SQlite databases on Android)
    - Retrofit2 (As an HTTP client library, Retrofit2 enables Android applications to communicate with a backend server through HTTP network requests and process their responses.)

Based on your knowledge and explorations, what will your team need support for?

- Mentor can integrate ML-MD-CC
- GCP monthly subscription.
- An experienced mentor in building end-to-end machine learning models with a focus on forecasting cases and handling time series datasets
- Time series datasets for solar radiation prediction, especially those encompassing solar intensity, weather conditions, geographical information, and historical data.

Based on your knowledge and explorations, tell us the Machine Learning Part of your Capstone!

We'll employ TensorFlow's LSTM for solar radiation prediction, leveraging its ability to grasp intricate temporal patterns. After training, the model will be deployed using TensorFlow Serving for a mobile app. This enables users to access solar radiation forecasts swiftly, aiding solar power management decisions.

Based on your knowledge and explorations, tell us the Mobile Development Part of your capstone?

The Mobile Development team uses the Kotlin Language, focusing on Geo-Location for map views. Responsibilities include fetching data through the Cloud Computing team's

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API. Features comprise map display, a year dropdown and a time dropdown. the team designs the interface with Figma to later generate .xml code

Based on your knowledge and explorations, tell us the Cloud/Web/Frontend/Backend Part of your capstone?

The Cloud Computing team will develop a backend using node.js to create a comprehensive Rest API. This API will integrate an ML model into FrontEnd (Mobile Development). We will document every API used.

Based on your team's planning, is there any identifiable potential Risk or Issue related to your project?

- **Environmental Changes:**
  Risks associated with changes in environmental conditions, such as weather or topography changes, that can affect the effectiveness of solar panels.
- **Regulations and Permits:**
  Challenges related to regulations and permits that may be required to install solar panels in specific locations.
- **Costs and Budget:**
  Potential risks of cost overruns or exceeding the budget set for the development of the application and installation of solar panels.
- **Technological Changes:**
  Risks that solar panel technology or related technologies may change rapidly, requiring adjustments or updates to the application.
- **User Acceptance:**
  Challenges in gaining user acceptance and participation in using the application.