

## Final Year Project Proposal

Sr #	Student Name	Roll Number	Signature
1	Muhammad Ahmed Raza	19P-0070	

### Suggested Supervisor:

Faculty Member's Name: Dr. Omar Usman Khan Signature: \_\_\_\_\_

Date: (07-Feb- 2024)

### Project Details

Project Title	Habitable Planet Explorer		
Project Area of Specialization	The project specializes in astronomy and astrophysics, focusing on understanding exoplanets and their host stars. It involves robust data science for collecting, preprocessing, and analyzing data, with machine learning used to predict habitability based on stellar and exoplanet features. The implementation phase includes web development for an interactive tool. Ethical considerations of experts in astrobiology and exoplanet science are integral. The project subtly aims to advance cosmic understanding by identifying potential habitable exoplanets, fostering collaboration, and instilling curiosity about humanity's place in the cosmos.		
List Related Core Subjects	1) Artificial Intelligence 2) Software Engineering 3) Design and Analysis of Algorithms 4) Data Structures		
List Related Elective Subjects	1) Applied Machine Learning 2) Data Science 3) Web Technologies		
Project Start Date	14-02-2024	Project End Date	14-11-2024

<b>Project Summary (less than 2500 characters)</b>	<p>The project, a fusion of astronomy, data science, and machine learning, centers on understanding exoplanets and their host stars. It begins with rigorous data collection and analysis, preparing a clean dataset for further investigation. Stellar classification and habitable zone calculations follow, providing insights into potential life-supporting conditions. The project advances into refining exoplanet characterization algorithms, incorporating atmospheric analysis to enhance habitability assessments. The novel inclusion of machine learning aims to predict habitability based on various features. The culmination involves developing an interactive web tool for user-friendly exploration of habitable exoplanets. Ethical considerations and collaboration with experts in astrobiology underscore the project's commitment to responsible scientific exploration.</p>
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<b>Project Implementation Method (less than 2500 characters)</b>	<ol style="list-style-type: none"><li><b>1. Data Acquisition and Prep:</b> Gather exoplanet data (e.g., NASA's Kepler) using Python and space agencies' APIs. Clean and preprocess data for a refined dataset.</li><li><b>2. Habitable Zone Identification:</b> Categorize stars by spectral type. Calculate habitable zones based on stellar properties.</li><li><b>3. Exoplanet Characterization:</b> Enhance algorithms using (Optional: Bayesian inference and MCMC). Include atmospheric data for precise habitability assessments.</li><li><b>4. Machine Learning for Prediction:</b> Train a Python-based machine learning model (Scikit-learn, TensorFlow) for habitability prediction.</li><li><b>5. Model Evaluation and Fine-Tuning:</b> Optimize the model, addressing biases and overfitting through cross-validation and hyper parameter tuning.</li><li><b>6. Visualization and Outreach:</b> Develop an interactive web app for user-friendly exploration.</li></ol>
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<b>Benefits of the Project (less than 2500 characters)</b>	The project holds significant benefits across multiple dimensions. Scientifically, it contributes to our understanding of exoplanets and their potential habitability, advancing astrobiology research. The creation of an interactive visualization tool fosters public engagement, inspiring interest in space exploration and our cosmic surroundings. By collaborating with experts, the project ensures scientific rigor and contributes valuable insights to the broader community. Ethically, it addresses the implications of potential habitable exoplanet discoveries, emphasizing responsible exploration, and potential life outside our home planet. Overall, the project aligns scientific advancement with public outreach, promoting curiosity about our place in the vast universe.
<b>Technical Details of Final Deliverable (less than 2500 characters)</b>	The final deliverable is an intuitive web app with (Optional: D3.js and Plotly), enabling interactive exploration of habitable exoplanets. It integrates a machine learning model, developed using Python with Scikit-learn and TensorFlow, for habitability prediction. Data accuracy is ensured through meticulous preprocessing using Python libraries. Technical evaluations, including cross-validation and hyper parameter tuning, guarantee the model's robustness. This tool synthesizes stellar and exoplanet features, providing a comprehensive visualization tailored for both scientific analysis and public engagement.
<b>Final Deliverable of the Project</b>	The project's ultimate output is an easy-to-use website where users can explore potentially habitable exoplanets. Think of it like an interactive map of the cosmos. This website uses the latest technology to predict whether these planets might support life. The information comes from various space missions, ensuring accuracy. In essence, it's a visually appealing and informative tool designed for both scientists and anyone curious about the wonders of space.
<b>Type of Industry</b>	The project pertains to space exploration, astronomy, and scientific research, with potential applications in astrophysics and data science. While not directly tied to a specific commercial industry, its outcomes may impact space agencies, research institutions, and organizations fostering public interest in space and science.

<b>Technologies</b>	<ol style="list-style-type: none"> <li>1. Data Science and Analysis:</li> <li>2. Machine Learning</li> <li>3. Web Development</li> <li>4. Spectral Analysis and Modeling:</li> </ol> <p>Note: The technologies might alter later as the project progress. Alternative technologies may be used specific requirements and goals of the project.</p>
<b>Sustainable Development Goals</b>	<ul style="list-style-type: none"> <li>• SDG-4: Quality Education</li> <li>• SDG-9: Industry, Innovation, and Infrastructure</li> <li>• SDG-13: Climate Action</li> <li>• SDG-17: Partnerships for the Goals</li> </ul>

Elapsed time in (days or weeks or month or quarter) since start of the project	Milestone	Deliverable
1st Quarter (Approximately 1 month)	<ul style="list-style-type: none"> <li>• Data Collection Completed</li> <li>• Initial Data Preprocessing Finished</li> <li>• Stellar Classification Implemented</li> </ul>	Compiled and Cleaned and Categorized Dataset
2 <sup>nd</sup> Quarter (Approximately 2 months)	<ul style="list-style-type: none"> <li>• Habitable Zone Calculation Completed</li> <li>• Advanced Exoplanet Characterization Algorithms Developed</li> <li>• Atmospheric Analysis Incorporated</li> </ul>	Defined Habitable Zones, Enhanced Exoplanet Characterization
<b>Conclusion of FYP-1</b>		

3rd Quarter (Approximately 2 months)	<ul style="list-style-type: none"><li>Machine Learning Model Trained</li><li>Model Evaluation and Fine-Tuning Completed</li><li>Web App Development Started</li></ul>	Trained Machine Learning Model, Optimized for Habitability Prediction
4th Quarter (Approximately 2 months)	<ul style="list-style-type: none"><li>Model Evaluation and Fine-Tuning Concluded</li><li>Web App Completed</li><li>Final Project Review and Validation</li></ul>	User-Friendly Interface for Exploring Habitability, Project Validation

### Project Key Milestones

<ul style="list-style-type: none"><li>Data Collection and Preprocessing</li><li>Stellar Classification and Habitable Zone Calculation</li><li>Exoplanet Characterization</li><li>Machine Learning Model Development and Optimization</li><li>Interactive Visualization Tool Development</li><li>Project Validation and Final Review</li></ul>
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### Project Equipment Details

Item Name	Type	No. of Units	Per Unit Cost (in Rs)	Total (in Rs)
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