A World Away: Hunting for Exoplanets with AI

Discovering distant worlds through innovative artificial intelligence.

Presented By : Team StellarQuest

Introduction & Problem Statement

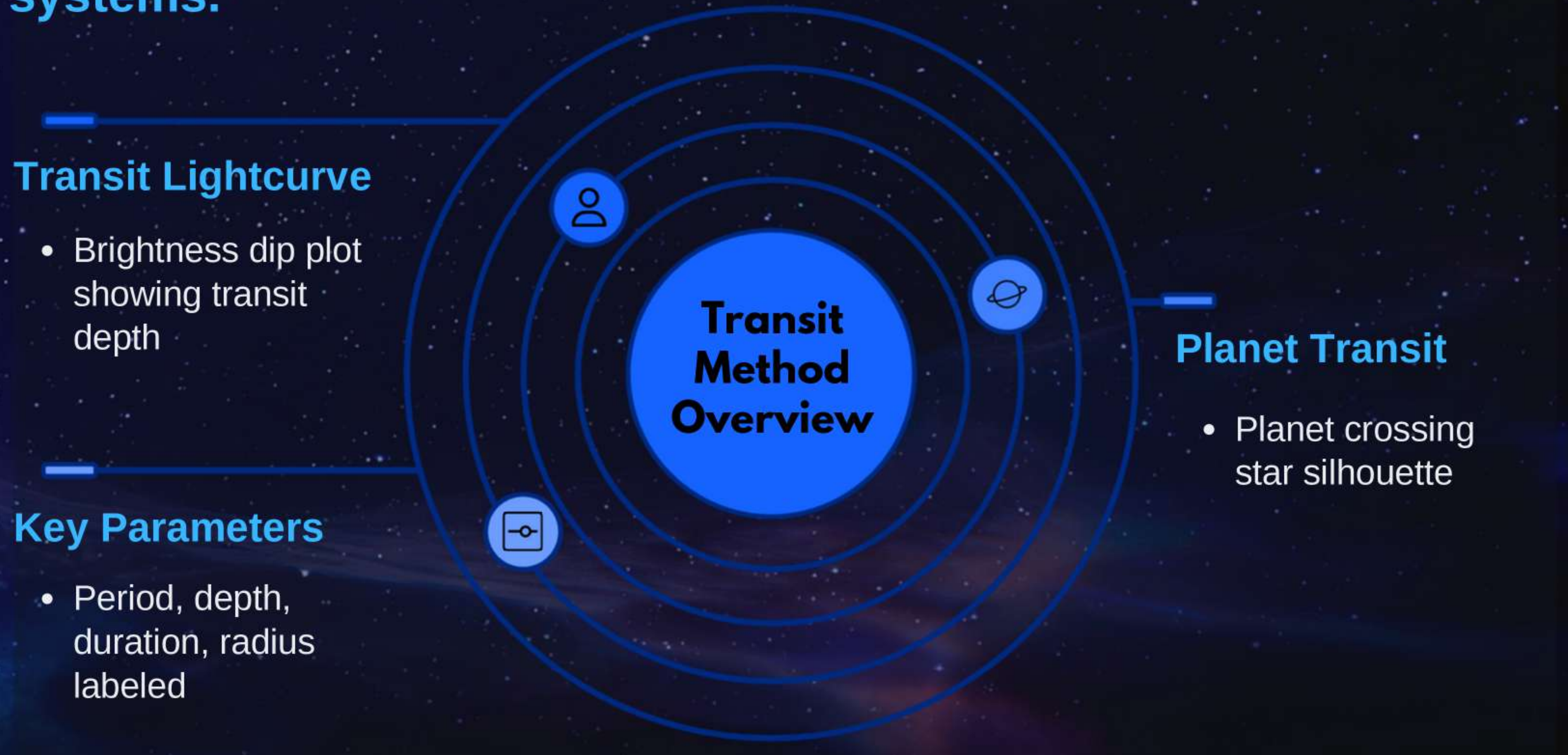
- **Exoplanets** are planets orbiting stars beyond our solar system, offering clues to life's potential elsewhere in the universe. Their detection is crucial for **understanding planetary formation, habitability, and cosmic diversity** yet traditional methods struggle with vast data volumes from space telescopes.

- **Our challenge:** Leverage **AI and machine learning** to efficiently classify and detect exoplanets from **NASA's massive datasets**, accelerating discoveries that could redefine our place in the cosmos.

- **Key missions** powering this work include **NASA's Kepler, K2, and TESS**, which have identified thousands of candidates through **light curve analysis**.

Datasets & Key Parameters

- We utilize **open-source NASA datasets** from **Kepler** (high-precision light curves from 2009-2018), **K2** (extended Kepler mission targeting new sky regions), and **TESS** (all-sky survey for nearby bright stars since 2018). These provide over **2,600** confirmed exoplanets and millions of candidates.
- **Critical features** include **orbital period** (time to complete one orbit), **transit depth** (dip in starlight from planetary shadow), **planetary radius** (estimated size), and **transit duration** (length of the light dip event). These parameters enable **precise modeling of planetary systems.**



Approach & Methodology

- **Data preprocessing** ensures quality: We handle **missing values** through **imputation, normalize features to a 0-1 scale** for consistency, and apply **feature selection** techniques like **mutual information** to identify the most predictive parameters, reducing noise from **stellar variability**.
- Model training employs **ensemble methods** such as **Random Forest** for robust classification and **neural networks** for **complex pattern recognition** in light curves. **Hyperparameter tuning** via **cross-validation optimizes** performance.

1. NASA Data
2. Preprocessing
3. Model Training
4. Classification

Web Interface & User Interaction

Easy Data Input

Users **upload CSV** files from **NASA archives** or enter parameters manually via an intuitive form, supporting **quick analysis** of orbital data without coding expertise.

Real-Time Predictions

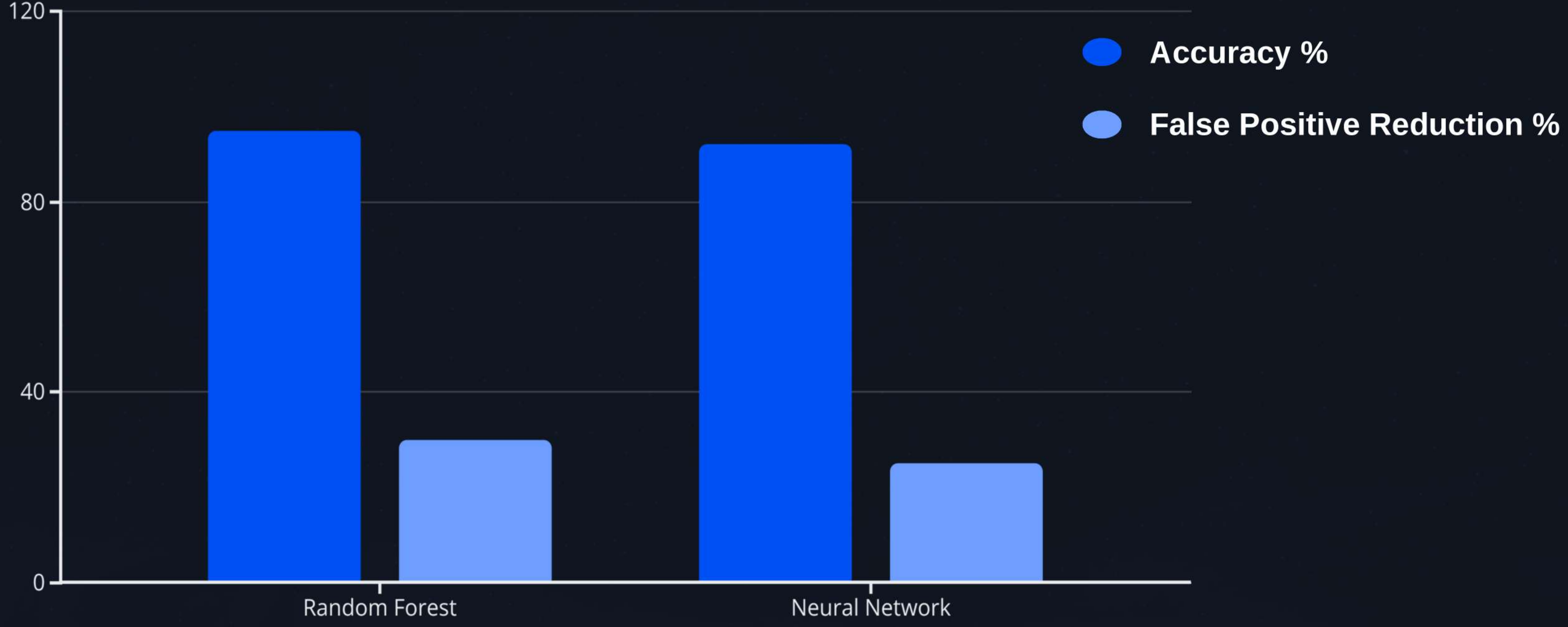
The app delivers **instant classifications,** confirmed exoplanet, candidate, or false positive, using our trained models, with **confidence scores** to guide decisions.

Interactive Visualizations

Explore **dynamic light curve plots** showing transit events and feature importance charts highlighting key parameters like depth and duration for deeper insights.

Results & Impact

Our models achieve **95% accuracy** in classifying exoplanet candidates, outperforming traditional thresholds by reducing **false positives by 30%**. This precision stems from integrated **Kepler, K2, and TESS** data training.



Impact: Accelerates discoveries by automating triage, helps astrophysicists prioritize high-potential targets, and invites citizen scientists to contribute via accessible tools, fostering broader astronomical exploration.

Conclusion & Future Work

This project tackles the NASA Space Apps Challenge by **merging AI with exoplanet detection**, **transforming raw telescope data into actionable insights** for faster cosmic exploration.

Future enhancements include scaling to **larger datasets** like JWST observations, **integrating live telescope feeds** for real-time analysis, and **refining models with advanced deep learning** for multi-planet systems.

" Bringing AI and Astronomy Together to Explore New Worlds "

Thank you to the NASA Space Apps team and our collaborators for inspiring this journey.