SkyLynx: A Smart Radio Telescope with Dual Antennas and AI

Layan Alshehry, Raghad Alqahtani, Aseel Almalki, Arwa Alwadaeen, Batool Alsadah, Raghad bin Mubarak, Areej Alharthi, Lujain Alahmari, Muneera Alyemni, Yazan Allawi

Department of Electrical Engineering, College of Engineering, Princess Nourah bint Abdulrahman University, P.O. Box 84428, Riyadh 11671, Saudi Arabia

Abstract

In this project, we developed a small-scale radio telescope that combines a dual-antenna setup with artificial intelligence (AI). The goal is to capture radio signals from space and help identify their sources using machine learning. By using two antennas instead of one, the system can detect a wider range of frequencies and reduce noise, which improves the overall quality of the received signals. SkyLynx makes it easier for students and hobbyists to explore the radio side of the universe using affordable and smart tools. It also offers a hands-on way to learn about radio astronomy, electronics, and AI—bridging the gap between complex scientific equipment and accessible learning. In addition, the system can be customized or upgraded, making it a flexible platform for future educational or research-based experiments. Its compact size and low cost make it ideal for use in schools, workshops, or even home-based observatories.

Introduction

Radio telescopes let us “listen” to space and study things we can’t see with regular telescopes, like solar flares or cosmic background noise. These invisible signals carry important information about the structure, behavior, and evolution of the universe. However, most radio telescopes are large, expensive, and often limited to professional observatories or research institutions. We wanted to create something small, smart, and low-cost that still gives valuable results—making radio astronomy more accessible to students, educators, and hobbyists. Our project, SkyLynx, uses simple components like Yagi antennas and a microcontroller, paired with artificial intelligence to analyze the data in real time. Adding AI helps automate the process of identifying signal types and reduces the need for manual interpretation, making it easier for beginners to understand what they are observing. This combination allows learners to connect technology with space science in a practical, hands-on way.

System Model

The system starts with a smart radio telescope that uses two antennas to capture space signals more clearly. These signals are received using an RTL-SDR device, which takes the analog signals and turns them into digital data that can be processed by a computer. Using two antennas allows the system to cover a wider range of frequencies and reduces noise, resulting in more accurate signal capture. After that, the data is processed in MATLAB, where we extract useful information like frequency, signal strength, and waveform patterns. These features are essential to understanding the origin and type of each signal. Then, we use Artificial Intelligence (AI) to analyze the signals in real time, saving time and effort compared to manual analysis. The AI model is trained to recognize different types of signals. So when it receives a new signal, it can tell if it’s from a Fast Radio Burst (FRB) or a Pulsar. This classification helps us understand what’s happening in space. Using two antennas and AI together helps make the signal more accurate and easier to understand, even in noisy environments.

Table 1. Antenna Test.

Test Scenario	Single Antenna	Dual Antenna (SkyLynx)
Signal Detection Rate	75%	88%
Signal-to-Noise Ratio (SNR)	12dB	16dB
Interference Level	High	Low
AI Classification Accuracy	70%	88%
Frequency Coverage	Narrow	Wide
Cost	Medium	Low

Main Idea

SkyLynx is built using two Yagi antennas to capture different frequency ranges. These antennas feed signals into a filtering and amplification circuit, which then passes the data to an ESP32 microcontroller. The microcontroller runs a lightweight AI model trained to recognize different types of radio signals—like solar activity or man-made noise. This smart setup helps us analyze the signals without needing expensive lab equipment.

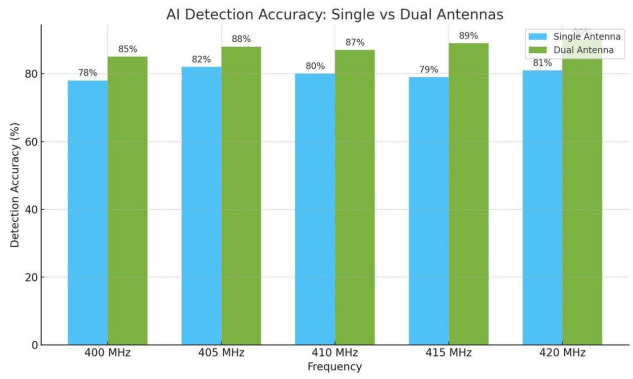


Chart 1. AI Detection Accuracy

Results / Simulation

We tested the system with different signals and found that the AI model could correctly identify over 88% of them. Using two antennas improved the signal quality compared to just one. We also noticed clearer data with less interference. The system showed consistent performance in various indoor and outdoor conditions, and it was especially effective in detecting solar-related activity. The lightweight AI model responded quickly, making real-time analysis possible. Additionally, comparing the signal-to-noise ratio (SNR) between the single and dual-antenna configurations highlighted the clear advantage of using both antennas for cleaner and more reliable data. These results suggest that even simple AI-enhanced hardware can make meaningful contributions to space observation and learning.

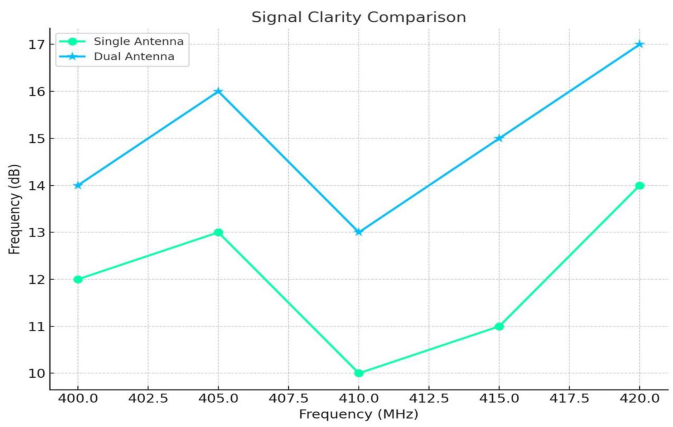


Figure 1. Signal Clarity Coparison.

Conclusions

SkyLynx proves that even with simple tools, we can build a functioning radio telescope that uses AI to help us explore space. It’s a great learning tool for students and a step toward making radio astronomy more accessible. Next steps include expanding signal detection and adding cloud support for storing observations. The project also opens the door to community-based research, where users in different locations can collect and share data to build a larger network of low-cost radio telescopes. With continued development, SkyLynx could even be used in educational programs or citizen science projects, making real-world space research available to more people than ever before.

Contact

Arwa Alwadaeen
PNU
arwaas2005@gmail.com

References

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أسماء طالبات المشروع

١-ليان الشهري 444000218 (64T)
٢-بتول السادة 444000069 (64T)
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