

ABSTRAK

RANCANG BANGUN DETEKSI HUJAN DI WILAYAH PERSAWAHAN MENGUNAKAN *LOOP* ANTENA BERBASIS *MACHINE LEARNING*

(2026: xii ± 72 HALAMAN + 26 GAMBAR + 13 TABEL + 8 LAMPIRAN)

Wilayah persawahan memiliki karakteristik iklim tropis intensitas hujan dan aktivitas atmosfer yang cukup tinggi. Kondisi tersebut menuntut adanya sistem pemantauan hujan yang dapat bekerja secara kontinu dan efisien. Penelitian bertujuan merancang dan membangun sistem deteksi hujan berbasis *loop antenna* yang memanfaatkan perubahan medan elektromagnetik atmosfer sebagai indikator terjadinya hujan. *Loop antenna* digunakan sebagai sensor pasif menangkap sinyal elektromagnetik frekuensi rendah yang timbul akibat aktivitas atmosfer dan petir yang sering menyertai hujan. Sistem yang dirancang terdiri dari *loop antenna*, rangkaian *front-end* penguat sinyal, modul konversi analog ke digital, serta unit pemrosesan berbasis *Raspberry Pi*. Data sinyal yang diterima diolah melalui proses penyaringan dan ekstraksi fr mengidentifikasi pola sinyal yang berkaitan kejadian hujan. Selanjutnya, data tersebut diproses menggunakan algoritma *Random Forest* data BMKG sebagai *ground truth* sehingga hasil klasifikasi memiliki acuan yang jelas dan dapat dipertanggungjawabkan. Pendekatan diharapkan mampu meningkatkan keandalan sistem dalam membedakan kondisi hujan dan tidak hujan berdasarkan karakteristik *signal power* yang diterima antena. Hasil pengujian menunjukkan bahwa sistem mampu mendeteksi adanya perubahan karakteristik sinyal elektromagnetik saat terjadi hujan tingkat sensitivitas yang memadai. Sistem diharapkan dapat menjadi solusi alternatif pemantauan hujan yang sederhana, berbiaya rendah, mudah diimplementasikan, serta berpotensi mendukung kegiatan pertanian melalui penyediaan informasi kondisi hujan secara *real-time*, khususnya di wilayah persawahan..

Kata kunci: *loop antena*, deteksi hujan, medan elektromagnetik, *Raspberry Pi*, Persawahan.

ABSTRACT

DESIGN AND DEVELOPMENT OF RAIN DETECTION SYSTEM IN PADDY FIELD AREA USING LOOP ANTENNA BASED ON MACHINE LEARNING (2026:XII ± 72 PAGES + 26 IMAGES + 13 TABELS + 8 APPESENDICES)

ice field areas have tropical climate characteristics with high rainfall intensity and significant atmospheric activity. These conditions require a rainfall monitoring system that can operate continuously and efficiently. This study aims to design and develop a rainfall detection system based on a *loop antenna* that utilizes changes in the atmospheric electromagnetic field as an indicator of rainfall. The *loop antenna* functions as a passive sensor to receive low-frequency electromagnetic signals generated by atmospheric activity and lightning, which commonly accompany rainfall. The proposed system consists of a *loop antenna*, a *front-end* signal amplification circuit, an *analog-to-digital converter* module, and a *Raspberry Pi* as the processing unit. The received signals are processed through filtering and feature extraction to identify signal patterns associated with rainfall events. Furthermore, the extracted data are classified using the *Random Forest* algorithm with BMKG data as the *ground truth*, providing a reliable reference for the classification process. This approach is expected to improve the system's capability to distinguish between rainy and non-rainy conditions based on the characteristics of the received *signal power*. The experimental results demonstrate that the proposed system is capable of detecting changes in electromagnetic signal characteristics during rainfall with satisfactory sensitivity. Therefore, the proposed system has the potential to serve as a simple, low-cost, and easily deployable alternative for rainfall monitoring, particularly in *rice field* areas, while supporting agricultural activities through the provision of *real-time* rainfall information.

Keywords: *loop antenna, rain detection, electromagnetic field, RTL-SDR, Raspberry Pi, machine learning, paddy field.*