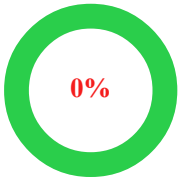
SmallSEOTools

Plagiarism Detection Report by SmallSEOTOOLS



Plagiarism	0%	Partial Match	0%
Exact Match	0%	Unique	100%

Scan details

Total Words	Total Characters	Plagiarized Sentences	Unique Sentences
448	3461	0	21 (100%)

#1 100% Unique

Abstract: - Increasing pollution and its serious health implications demand more accessible and hyperlocal air quality monitoring solutions. This paper presents an IoT-enabled, low-cost air quality monitoring and prediction system using the ESP32 microcontroller, MQ135 gas sensor, and DHT22 temperature–humidity sensor. The system records environmental parameters at regular intervals and uploads them to a cloud database for real-time visualization through a custom online dashboard. A Long Short-Term Memory (LSTM) based recurrent neural network is incorporated to generate short-term air quality predictions, providing early insights into short-term AQI variations. The proposed system is cost-efficient, scalable, and suitable for residential and academic deployment.

Keywords: ESP32, Hyperlocal AQI, IoT, MQ135, DHT22, Machine Learning, Cloud Dashboard.

I. Introduction

Air pollution continues to rise globally, making localized monitoring systems essential for effective environmental awareness. Traditional air quality monitoring stations, although accurate, are limited in number and unable to capture micro-level variations caused by traffic congestion, indoor emissions, or localized industrial activity [1], [2]. As a result, large-scale monitoring infrastructures often fail to represent actual exposure levels experienced by individuals at a community scale.

Recent advancements in Internet of Things (IoT) technologies have enabled the development of low-cost, distributed sensing nodes capable of real-time environmental monitoring and cloud-based data access [3][5]. In this work, an ESP32-based hyperlocal air quality monitoring system is proposed, integrating MQ135 and DHT22 sensors to measure gas concentration, temperature, and humidity. The collected data is transmitted to a cloud platform and visualized through a live dashboard.

sensor data, enabling proactive environmental awareness and decision-making [7], [9]. The system aims to offer an affordable and scalable solution suitable for community-level and academic applications.

II. Literature Review

Several studies have demonstrated the effectiveness of IoT-based environmental monitoring systems for achieving low-cost and scalable air quality assessment [1][3]. MQ135 sensors, despite their moderate absolute accuracy, have been widely adopted for trend analysis and relative air quality monitoring when combined with appropriate calibration techniques [4][8]. Similarly, ESP32 microcontrollers are frequently used in IoT applications due to their integrated Wi-Fi capabilities, low power consumption, and sufficient processing performance for real-time data acquisition and transmission [5][10].

Machine learning techniques such as Linear Regression, AR models, and Long Short-Term Memory (LSTM) networks have been extensively applied for short-term AQI forecasting [7][9][11]. Among these, LSTM networks are particularly suitable for air quality prediction due to their ability to capture short-term dependencies in time-series environmental data. However, many existing systems focus either on monitoring or prediction independently and lack a unified framework integrating sensing, cloud visualization, and machine learning-based forecasting. This work addresses these limitations by presenting an end-to-end hyperlocal monitoring pipeline.