Chapter 11
Design of IoT-Based Automatic Rain-Gauge Radar System for Rainfall Intensity Monitoring

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ABSTRACT

The occurrence of climate change has become a global problem. These environmental problems then cause many problems for human life such as crop failure in the agricultural sector, the loss of many animal species that are beneficial to human life either directly or indirectly, seasonal changes, and even the occurrence of droughts and irregular season, so this will be difficult activity of human life. Therefore, a rain gauge is needed, which is a tool used to measure rainfall in a location at a certain period of time. This information can be used for various purposes in the community. However, the information generated by these devices also affects the quality of wireless signal transmissions such as free space optics (FSO), GSM, satellite, and outdoor WiFi. This research project aims to create prototypes of IoT-based devices and systems to detect and record rainfall that occurs using a tool created in this research project. The resulting data can be utilized by the community through the website and mobile application.

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INTRODUCTION

High rainfall is one of the most common hazards of adverse weather and can produce a variety of disasters such as floods and landslides. This can result in a disaster and significant damage to the affected area. To avoid the damage caused by heavy rain, timely response and prevention actions are more crucial. Frick, J., & Hegg, C. (2011) argue that additional consequences of heavy rain include the development of disease as a result of stagnant flood waters for an extended period of time, damage to community housing, major traffic congestion, and even more economic consequences.

Rainfall is the amount of water that falls to the earth during a rainstorm and can be measured in millimeters. Another definition of rainfall is the amount of rainwater that accumulates in a flat area without evaporating, seeping, or overflowing. Indonesia is a country with a humid tropical climate. In Indonesia, the average rainfall is not uniform but still abundant, averaging 2500-3000 mm/year (Narulita & Ningrum, 2017). Even yet, there are many variations in the average rainfall that happens in various regions, which will be varied.

According to several studies, floods kill more people than any other type of weather threat because the water level rises so quickly that victims are caught off guard and have little time to leave. Emam et.al. (2016) argue that floods have a detrimental influence on human health, the environment, cultural heritage, and economic activity. While Kusumastuti et.al. (2017) said that heavy rainfall is less likely to infiltrate and run into rivers, lakes, or other bodies of water. The sooner the water reaches a river or body of water, the greater the likelihood of flooding. As Aryastana and Tasuku (2010) said that water is diverted straight into rivers through drainage systems and gutters, increasing the risk of flooding. There is a lot of land that runs into one big river or, in this example, several smaller rivers or streams. The stream will overflow, resulting in extensive flooding.

Flooding is a long-term phenomenon that can last up to a week. Even a minor delay in taking precautions can hinder rescue operations since treading on flood water without a protective covering can expose you to infection and other ailments. Water is an important resource. However, ordinary people today think that there is no longer a rainy and dry season. Rain can fall anywhere, whether you are in a "rainy month" or not. Many people also notice that the rain is not evenly distributed; rain can fall just in one portion of the territory; and there are certain areas that are genuinely dry and have not been visited by rain. Many research have been undertaken to better understand rain. Rainwater's travel through a specific area is a dynamic process that changes the intensity and shape of rain.

The measuring and sensing of the amount and type of rain allows us to construct detailed physical and dynamic descriptions of rain. As a result, it is preferable to research our environment and plan for potential environmental calamities such as droughts or floods. The primary goal of rainwater management is to reduce economic consequences and life dangers. The majority of underdeveloped countries rely on rainfall to meet their water needs. However, if rainwater management is inadequate, it is difficult to estimate water loss to the earth, water recharge, and how much is still accessible, among other things. As a result, rainfall measurement and monitoring are critical. The rainfall monitoring system will continuously measure rainfall and communicate the data to a platform where emergency services or weather specialists will be able to inform local citizens who are at risk of a rain-related disaster/tragedy.

However, due to the relatively low quality of wireless signal transmission, this information is often limited and only offers aggregate data in the form of rainfall per day/month/year without essential and comprehensive rainfall intensity information. As a result, an IoT-based rain gauge (Internet of Things)