

WIRELESS SENSOR TRANSMISSION SYSTEM USING CIRCULAR POLARIZED ANTENNA AT 2.4 GHz FREQUENCY

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Abstract:

Sensors in the electronic world are parts that are used to detect changes in the physical or chemical environment. The output from the sensor is converted into an electrical quantity that represents the change in the environment. Sensors are widely used in agriculture, especially to detect changes in the physical or chemical environment related to plant growth, for example: temperature sensors, light sensors, soil moisture sensors, and so on. In agricultural applications that have a large area, the problem of location and distance from the sensor to the control center is a problem in itself. To solve this problem, a sensor system is designed that does not use wired (wireless) connections. In the application of wireless communication systems there is an antenna part which is very important which can affect the rate of sending sensor data. To improve the performance of wireless sensors in sending data, it is necessary to integrate the appropriate antenna with the sensor transceiver system. So this research was conducted to integrate circular polarized antennas with sensors to increase the gain in the transmission. From this integration, measurements are then taken to obtain the value of the radiation pattern, gain and bandwidth. From the resulting measurements, it can be seen that there is an increase in the gain of the wireless sensor transmission using the 2.4 GHz frequency.

Keywords: Antenna; Radiation Pattern; Gain; Bandwidth.

INTRODUCTION

Sensors in the electronic world are parts that are used to detect changes in the physical or chemical environment (Basuki et al., 2022). The output from the sensor is converted into an electrical quantity that represents the change in the environment (Purwadi et al., 2023). Sensors are widely used in agriculture, especially to detect changes in the physical or chemical environment related to plant growth, for example: temperature sensors, light sensors, soil moisture sensors, and so on. In agricultural applications that have a large area, the problem of location and distance from the sensor to the control center is a separate problem that must be resolved (Balanis, 2016). To solve this problem, a sensor system is designed that does not use

wired (wireless) connections. Because it is wireless in its transmission, this type of sensor is part of a wireless (wireless) communication system (Rahmat & Hizriadi, 2018). In the wireless communication system application, there is an antenna part which is a very important part that can affect the rate of sending sensor data. To improve the performance of wireless sensors in sending data, it is necessary to integrate the antennas that match the sensors.

The purpose of this research is to design a circular polarized antenna that has good performance with the parameters of measuring radiation pattern, gain and bandwidth (Dewi & Vitria, 2012). Looking for the gain value of circular polarized antennas that are integrated in wireless sensors that are applied in agriculture that operate at a frequency of 2.4 GHz (Purwadi et al., 2023). Contributing to society to provide additional knowledge about sensor technology in wireless communication. Contribute to study programs to provide additional knowledge to computer engineering students about wireless communication technology (Kurnianto, 2019).

This research is expected to provide additional information or knowledge for people who are gathered in community groups (farmer groups) who are involved in agriculture, especially about sensor and transducer technology in wireless communication which is very useful for helping the productivity of the agriculture they cultivate. Additional knowledge for Information Technology majors about sensors and antenna planning and manufacturing both in theory and practice (Purwadi & Utomo, 2021). In computer networks that already use wireless technology in access point devices and wireless sensors, antenna devices are an important part because the function of the antenna can resonate with free air. So from the results of this study it is hoped that it can be applied as a learning model about the design and planning of antennas that are integrated with wireless sensors, the aim of which is that the community is expected to be able to take advantage of sensor technology in agriculture and wireless devices on computer networks (Milligan, 2005).

Many mistakes in choosing the antenna used resulted in the data communication system not working optimally (Charlie et al., 2021). So this research provides an analysis to increase the gain of wireless sensors in integrating and designing circular polarized antennas properly and correctly (Purwadi et al., 2023).

From the designed circular polarized antenna, it is hoped that it will get a high and efficient gain resulting from antenna measurements and tests including: radiation pattern measurement, gain and bandwidth.

METHOD

This study uses a literature study, this step is carried out to examine matters relating to the design and testing of the system based on research or the work of other people that have been carried out and supporting theories, namely the characteristics of the antenna and the emission pattern (radiation pattern) of the antenna, sensor and wireless sensor transceivers and arduino control systems from the research hypothesis states that all of these parameters have an inseparable relationship in wireless communication systems because they support each other, especially for antenna applications in linear polarization.

RESULTS AND DISCUSSION

Design Helix antenna

The steps for designing a helix antenna can be described as follows: (a) Calculating Middle Frequency. (b) Calculating Wavelength. (c) Calculating Helix Diameter. (d) Calculate Around Helix. (e) Calculating Helix Angle of Scale. (f) Calculating Helix Spaces. (g) Calculating the Length of a Helix Round. (h) Calculating Helix Shaft Length. (i) Calculating the Number of Helix Windings. (j) Calculating the Ground Plane Plate



Antenna design results





Measurement Results

Resonance Frequency

This resonance frequency is used to see the working frequency of the antenna that is designed (Ramanda et al., 2020), as shown figure 3.

Figure 3 Resonance Frequency Helix antenna



Information:

Band Width (BW) is obtained from the equation (4) Band Width helix = 693 MHz – 688 MHz Band Width helix = 5 MHz

Radiation Pattern

The antenna radiation pattern is a graphical statement that describes the radiation properties of an antenna in a far field as a function of direction [2] (Channa & Sahito, 2022), as shown figure 4.



Figure 4 Resonance Frequency Helix antenna

Antenna Gain

At 2.4 GHz frequency measurement, the received Quarter wave omni directional antenna power level is -53 dBm. The received Yagi antenna power level is -44 dBm. The received Helix antenna power level is -52 dBm. For the ½ Dipole antenna power as the comparator antenna, the gain power is -51 dBm.

The measurement results can be calculated the antenna gain (P1) to the λ ½ dipole antenna (P2), follow the equation (5).

Gain Quarter wave omni directional = -53 - (-51) = -2 dBm = 0,14 dBiGain Yagi antenna = -44 - (-51) = 7 dBm = 9,14 dBi

Gain Helix antenna = -52 – (-51) = - 1 dBm = 1,14 dBi

Sensor Transmission Gain Measurement

Measurement of radio wave transmission by taking data transmitted by the transmitter (TX) and data received at the receiver (RX) with a frequency of 2.4 GHz with specifications: **RF Power** : 0.5 Watts Antenna : circular polarization (Helical) TX and RX positions : Line Of Sight (LOS / without obstruction)

Table 1							
2.4 GHz Radio Wave Transmission Range							
No	Distance (m)	Signal to Noise Ratio	Transmission	signal	imamming		
		(dB)	(position on receiver)				
1	200	40	Good				
2	400	35	Good				
3	600	20	Good				
4	750	17	Unclear tone				
5	800	15	Unclear tone				
6	850	12	Unclear tone				
7	900	9	Unclear tone				
8	950	7	Unclear tone				
9	1000	4	Unclear tone				
10	1050	2	Unclear tone				

10	

CONCLUSION

From the measurement results, it can be concluded that the helical antenna radiation pattern has a unidirectional radiation pattern. In computer network applications depending on the user's needs in communication whether broadcast communication or point to point. Measurement of radio wave transmission by taking data transmitted by the transmitter (TX) and data received at the receiver (RX) with a frequency of 2.4 GHz is at a maximum distance of 600 meters.

BIBLIOGRAFI

Balanis, C. A. (2016). Antenna theory: analysis and design. John wiley & sons.

- Dewi, R., & Vitria, R. (2012). Penguatan Sinyal Global System For Mobile Communication (GSM) Menggunakan Antena Yagi 14 Elemen. *Elektron: Jurnal Ilmiah*, 4(2), 25–36.
- Kurnianto, I. (2019). Penerapan Antena Double Biguad untuk Transmisi Data Monitoring Ketinggian Air pada Frekuensi 2.4 GHz.

Milligan, T. A. (2005). Modern antenna design. John Wiley & Sons.

Purwadi, A., & Utomo, D. T. (2021). Radio waves-based landslide mitigation system. IOP Conference Series: Earth and Environmental Science, 672(1), 12081.

Purwadi, A., Utomo, D. T., & Harahap, P. (2023). Sistem Mitigasi Bencana Tanah Longsor Berbasis Gelombang Radio. *RELE (Rekayasa Elektrikal Dan Energi): Jurnal Teknik Elektro*, *5*(2), 1–6.

Rahmat, R. F., & Hizriadi, A. (2018). *Implementasi Real Time Monitoring Lahan Pertanian pada Tanaman Padi Menggunakan Smart Sensor*. Universitas Sumatera Utara.

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