REVIEW ARTICLE

SAMRIDDHI Volume 13, Issue 1, 2021 Print ISSN: 2229-7111 Online ISSN: 2454–5767

Triangle Shaped Antenna Design for Internet of Things (IoT)-based Lorawan Applications

M. Vamshi Krishna[1*], G S N Raju[2]

[1]Department of Electronics and Communication Engineering (ECE), Dhanekula Institute of Engineering & Technology, Vijayawada, Andhra Pradesh, India

[2]Centurion University of Technology and Management, Gidijala, Andhra Pradesh, India.

Abstract

The antenna has a massive potential in the world of the Internet of Things (IoT). However, the miniaturized antenna design is a massive task as lorawan applications consume relatively lesser power. The design in this paper is a miniaturized E-shaped patch antenna for LoRa devices. The patch's physical dimensions for the proposed antenna are 160mm*170mm*1.6mm on the FR-4 board. The simulated results were found satisfactory and can operate over the 868 MHz frequency band.

Keywords: Miniature Antenna, Patch Antenna, LoRa, Lorawan, Internet of Things (IoT).

SAMRIDDHI : A Journal of Physical Sciences, Engineering and Technology (2021); DOI: 10.18090/samriddhi.v13i01.3

Introduction

In the digital era of modern communications, human beings' communications are essential and how things communicate is also a vast area, leading to a new technology called IoT. Few existing communications like Bluetooth, Wifi, 3G, 4G communications have their advantages and disadvantages. There are few basic criteria such as data rate, low power, and long-distance communication to evaluate a system.[1]

A machine-to-machine communication (M2M) requires both long ranges and low power to work for more hours, and it can compromise at data rates, so a new novel solution is demonstrated called LoRa technology.[2,3] Lora system is a Low Power Wide Area Network (LPWAN) that serves IoT in large areas. It uses Semtech's spread spectrum modulation scheme and holds many advantages compared to conventional mechanisms, including low power, high efficiency, long-range, etc.[4]

LoRa's work over the range of frequencies 433MHz, 868MHz in Europe, and 915MHz in American.[5] A narrow bandwidth of 5MHz could be expected because of low traffic and low data rates. The size of the antenna depends on the frequency chosen. IoT devices should be of low cost, compact in size, and should have high mobility. In considering the above facts, the size of the antenna should be miniaturized.[6] Miniaturization of antennas can increase the overall performance of antennas in terms of quality factor, narrow bandwidth,[10] and also reduces interference effects which are important characteristics in the design of IoT antennas.

In the present work, a LoRa antenna is designed and examined for Lora frequencies. Their sizes are accustomed to a rectangular box, and antennas are used for radiating signals of LoRa devices. These devices can be used for things to communicate. First, we will discuss some previous literature in the Next section, and then, we show antenna design and its simulated results. Finally, in the last section, we will see the research and mention its orientation.

Corresponding Author: M. Vamshi Krishna, Professor, Department of Electronics and Communication Engineering (ECE), Dhanekula Institute of Engineering & Technology, Vijayawada, Andhra Pradesh, India, e-mail: vamshi51@yahoo.co.in

How to cite this article: Krishna, M. Vamshi, Raju, G.S.N., (2021). Triangle Shaped Antenna Design for Internet of Things (IoT)-based Lorawan Applications. *SAMRIDDHI: A Journal of Physical Sciences, Engineering and Technology,* 13(1), 8-11.

Source of support: Nil

Conflict of interest: None

Previous Work

LoRa is a technology with high prospects, but very few people are working on its antenna design. Nevertheless, the antenna holds a prominent position in communicating devices. LEAT is a dynamic organization that is developing the technology related to LoRa. A design of miniature antennas is inspired by F. Ferrero and L. Lizzi of LEAT. Its geometry involves an Inverted F Antenna, which works at LoRa 868MHz.[7] Considering there is no limit in LoRa bandwidth, their antenna has acceptable UNB.

The antenna[7] also achieved multi-band; the other is Global Positioning System (GPS) band of 1.575GHz. Small antenna dimensions are considered by R.W. Ziolkowski and A. Erentok have made a summary in their work,[8] focussed on the effects of meta-material.

© The Author(s). 2021 Open Access This article is distributed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and non-commercial reproduction in any medium, provided you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made. The Creative Commons Public Domain Dedication waiver (http://creativecommons.org/publicdomain/zero/1.0/) applies to the data made available in this article, unless otherwise stated.

Gareth A. Conway made another significant work by William G. Scanlon to measure the design parameters at 868MHz band antenna for Wireless Medical Vital Monitor device and a micro-strip patch antenna. Meanwhile, several researchers have done significant work to qualify LoRa system operations. For example, Juha Petajajarviet al has tested the range and channel attenuation model of LoRasystems in reference.[9] Together with other researchers, they determined huge applications and advantages in this technology.

Antenna Design

A triangular-shaped Microstrip patch antenna is chosen because of its low cost, low profile, and ease of integration on any device. The substrate considered (FR-4) is of low cost. The Transmission line model drives the dimensions of the proposed design.[10]

Proper impedance should be maintained between the feed line and patch to transfer full power. Antennas efficiency depends a lot on how much amount of power is transferred. The patch is excited by a feeder point. A center feeding technique excites the antenna, and characteristic impedance is set to 50 ohms.

Table 1: The Physical Dimensions of the proposed structure.

S.No	*Parameter*	*Dimensions in mm*
1	Ground plane length	200
2	Ground plane width	240
3	Patch length	160
4	Patch width	170
5	Substrate height	1.6
6	Substrate	FR-4 Epoxy

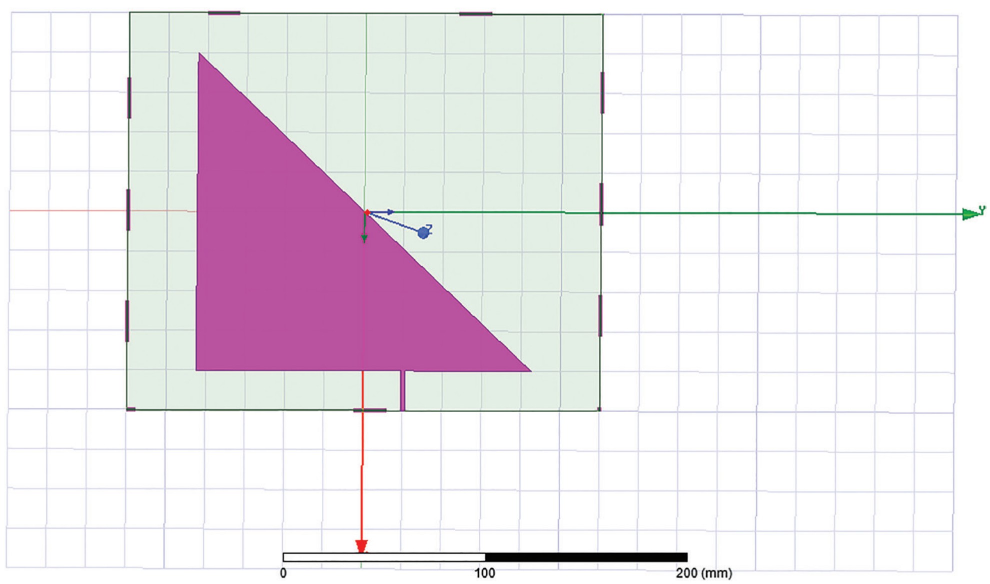

Figure 1: Triangle shaped antenna

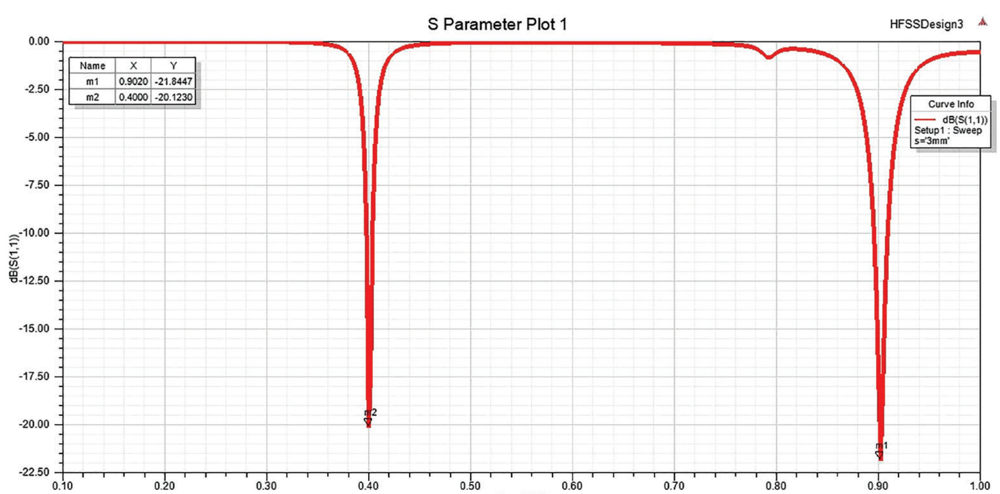

Figure 2: Return Loss

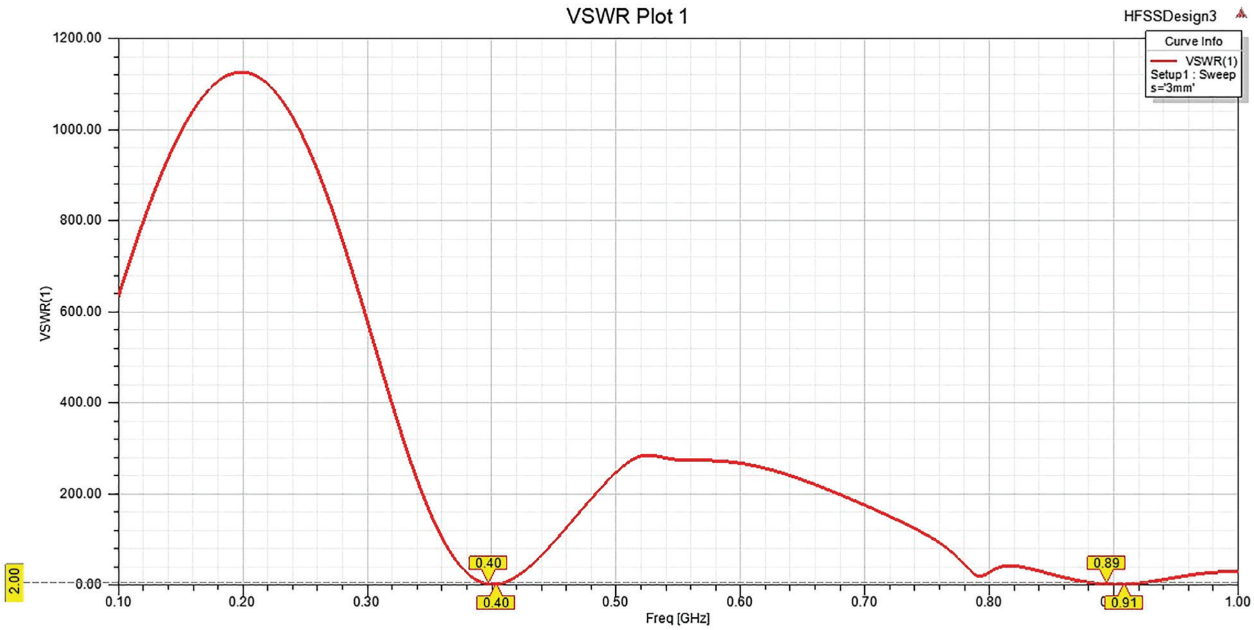

Figure 3: VSWR

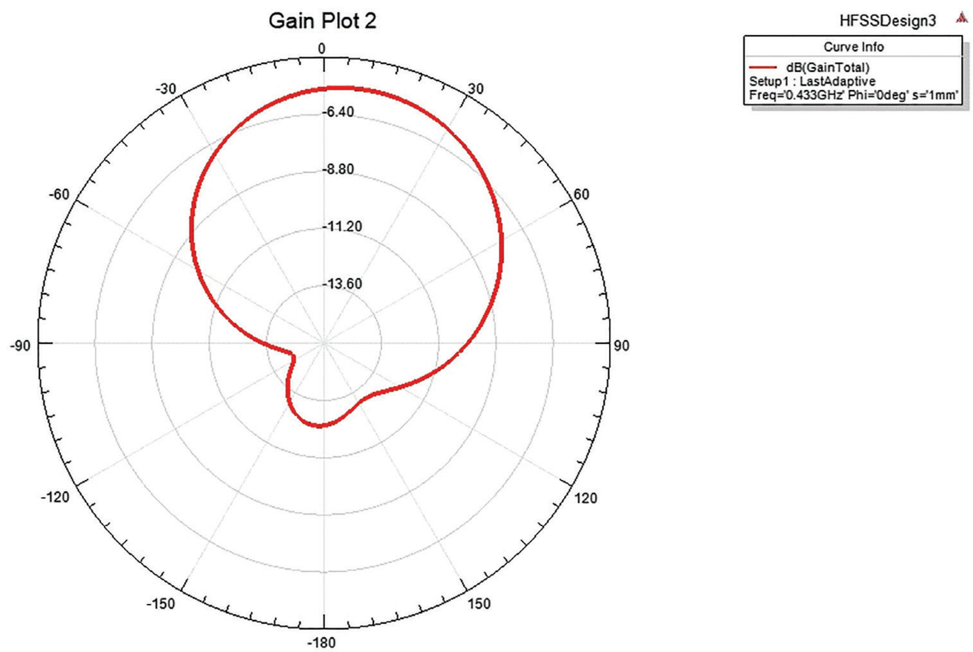

Figure 4: Gain

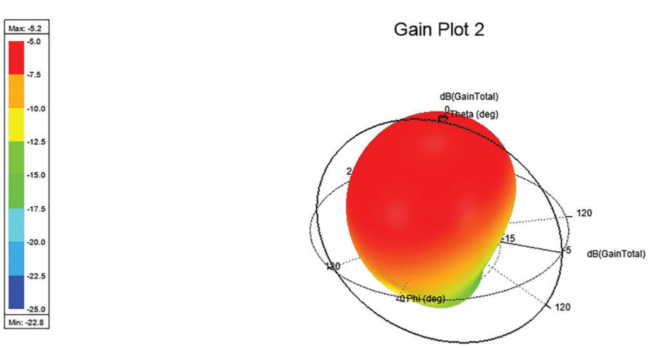

Figure 5: 3D Gain Plot

Figure 6: 3D Gain Plot

Results and Discussion

The simulation of the antenna is performed using Ansoft HFSS, and the measured operating frequencies are 400MHz and 900.2MHz, and the desired operating frequency bands are successfully excited. The return loss is around 20 dB at the desired frequencies, indicating 99% of the power in the antenna. Figure 3 indicates VSWR, and Figures 4, 5, 6 represent the gain of the proposed antenna.

Conclusion

In this paper, a dual-band antenna is presented to operate at lorawan frequencies for a given LoRa system. While modifying the antenna's dimensions and geometries, some useful observations were noted, and the antenna's performance is satisfactory. Due to the simplicity in design and easily mountable on any surface, it has found many advantages and applications in IoT.

References

[1] P. Marinier, S. Aridhi, V. Roy, J.-L. Gauvreau, V. Sampath, M. Poirier. (2001). Performance impact of limited downlink dynamic range of power controlon 3G WCDMA, Vehicular Technology Conference Proceedings, Tokyo.

[2] C. Bisdikian. (2001). An overview of the Bluetooth wireless technology, *IEEE Communications Magazine*, Vol. 39, Issue 12, December.

[3] Heikki Karjaluoto.(2006) An Investigation of Third Generati on (3G) MobileTechnologies and Services, Contemporary Management Research, P. 91-104,Vol. 2, No. 2.

[4] R. W. Ziolkowski, and A. Erentok. (2006) . Metamaterial-Based Efficient Electri-cally Small Antennas, *IEEE Transactions on Antennas and Propagation*,Vol. 54, No. 7.

[5] J. Villanen, J. Ollikainen, O. Kivekas, P. Vainikainen.(2006.) Coupling element based mobile terminal antenna structures, *IEEE Transactions on Antennas and Propagation*, vol.54, no.7, pp.2142,2153, July .

[6] G. Breed. (2007). Basic principles of electrically small antennas, High Frequency Electronics, February.

[7] Juha Petjjrvi, Konstantin Mikhaylov, Antti Roivainen, Tuomo Hnninen,and Marko Pettissalo. (2015). On the Coverage of LPWANs: Range Evaluationand Channel Attenuation Model for LoRa Technology, 14th International Conference on ITS Telecommunications (ITST), Copenhagen, December.

[8] L. Lizzi and F. Ferrero. (2015). Use of ultra-narrow band miniature antennas for internet-of-things applications, Electronics Letters 51, October .

[9] M. Bor, J. Vidler, and U. Roedig. (2016).LoRa for the Internet of Things, 16Proceedings of the 2016 International Conference on Embedded Wireless Systems and Networks, p.361-366, Austria, February .

[10] F. Ferrero, L. Lizzi, C. Danchesi, and S. Boudaud. (2016) Environmental Sensitivity of Miniature Antennas for IoT Devices, *IEEE International Symposium on Antennas and Propagation (APSURSI)*, Puerto Rico.

[11] LoRa, https://www.lora-alliance.org/, accessed: 19-06-2017.