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Design of Circularly Polarised Patch Antenna Using Polygonal Slot

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ABSTRACT:

A novel single-feed (SF) circularly polarized (CP) micro strip antenna with polygonal slot on the radiating patch is designed. The proposed antenna is used to provide a small axial ratio over a relatively large frequency range and the CP quality is used for a wider range of radiation angle. The structure consists of a single layer with easy fabrication at low cost. HFSS tool used to verify the proposed structure in terms of gain, return loss and axial ratio measurements.

INTRODUCTION:

A fractal antenna optimizes length and perimeter for transmitting or receiving electro magnetic radiation.

Fractal antennas are also known as multilevel and space filling curves, but the salient aspect lies in the repetition of the design over scale sizes or iterations greater than two, or "iterations". Fractal antennas are very compact. They can also be multiband or wideband. It is used in cellular telephone and microwave communications applications. A fractal antenna's response varies from traditional antenna designs based on the ability of performing with good-to-excellent performance at various frequencies simultaneously. Usually, standard antennas have to be "cut" for the frequency in which they are to be used—and therefore, the standard antennas work well only at that frequency.

The fractal nature of the antenna reduces its size, without the use of components like inductors or capacitors.

RELATED WORK :

A low-profile high-directivity circularly-polarized patch antenna is proposed. Two orthogonal slots are engraved within the scale of a square patch. The size of can increase directivity to some degree and efficiently prevent radiation pattern from tilting tendency. Finally, a prototype antenna is fabricated[1].

A Four dual-band shorted patch antennas (SPAs) with a low profile of 1 mm (0.008λ at 2.4 GHz) together with a square-ring structure with the size of 66 mm x 66 mm (about 0.53λ x 0.53λ at 2.4 GHz) for 4 x 4 multi-input-multi-output (MIMO) operation is designed. A bigger patch is used to provide the 2.4 GHz band over a spread of 2400-2484 MHz.

Shorter patch is to generate 5.8 GHz band in the range of 5725-5875 MHz for dual-band wireless local area network operations.[2]

The design of a compact SIW cavity-backed circular-polarized antenna with the aid of a slow-wave structure in PCB technology has been proposed. A physical separation of fields is provided by

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holes at the bottom which has metalized blind on the inside[3].

A method for designing wideband Fabry-Perot resonator antennas (FPRAs) using multilayer partially reflective surfaces (PRSs) is proposed. The structure consists a pair of closely spaced PRSs to derive a positive phase gradient over a wide range of frequencies. Each PRS layer consists of complementary square apertures and patches which is printed on any one side of the thin dielectric substrate[4].

A new circularly-polarized (CP) microstrip patch antenna with conical radiation pattern is examined. The proposed CP antenna has a single feed with a low profile and a very simple structure. The patch has an octagon-star shape, and can be obtained as a superimposition of two square patches[5].

Pin-loaded circularly-polarized (CP) patch antennas with wide 3-dB axial ratio beam width (ARBW) is proposed. The ARBW of a CP patch antenna is dependent on electrical width at a frequency. The patch size at resonance can be totally controlled by the shunt inductive load[6].

A single-fed micirostrip patch antenna (MPA) with loading of shorting pins for high-gain circularly polarized (CP) radiation is designed. Initially, the metallic pins are placed symmetrically a square patch radiator along the two orthogonal diagonals of.As the shunt inductive effect is caused by the shorting pins, the resonant frequency of the dominant mode in this antenna is progressively tuned up .Hence, the electrical size of this pins-loaded patch resonator are increased, so as to enhance its radiation directivity[7].

A ground radiation antenna with circularly polarized (CP) properties for biomedical applications has been proposed. A square ground with a small clearance is executed in the proposed antenna. Reactive components are added to realize the impedance matching. There are certain requirements for the generation of CP waves. Simulations are conducted within a single-layer tissue model to evaluate and calculate the antenna's performance for the design[8].

A wide-beam circularly polarized asymmetric microstrip antenna with circular-patches of different parameters is proposed .This antenna is used in global navigation system applications[9].

Reduced-size single-feed circularly-polarized (CP) patch antennas is proposed.The examination is based on the strategy of combining meta-surfaces and meta-resonators with some strong space-filling capability[10].

A small, asymmetric\symmetric-slotted or slit-micro strip patch antennas is designed .It was implemented on reactive impedance surface (RIS).Circularly polarized (CP) radiation was analysed[11].

A new compact wideband circularly polarized (CP) antenna is proposed . The CP square-loop with sequential phase (SP) characteristics are in the form of square-loop .Four strip-lines are given as driven elements. Parasitic elements consists of four L-shaped patches with I-slots and four I-shaped patches. The two pairs of parasitic patch arrays are fed using the square-loop in a coupled way (capacitively)[12].

A compact circularly polarized (CP) antenna for wearable passive UHF RFID tags is presented. A square-shaped microstrip patch antenna which has applied corner. Truncation and slotting techniques in the conductors are used for obtaining the circularly polarized property and a

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shorting pin is used for impedance matching techniques[13].

PROPOSED SYSTEM:

A circularly polarized patch antenna with Dodecagonal slot was designed, and analyzed for various applications in wireless communications .In this project a novel low profile circularly polarized patch antenna with Dodecagonal is designed for wireless communication systems. A new design analysis for patch antenna has been designed with abilities of both bandwidth enhancement and harmonic suppression.

Parameter	Simulation
GAIN	5.2
Resonant frequency (GHz)	2.45 Ghz

PARAMETER	CIRCULAR P[ATCH ANTENNA WITH EKLLIPTICAL SLOT	CIRCULARLY POLARISED PATCH ANTENNA WITH POLYGONAL SLOT
CENTRE FREQUENCY	2.45Ghz	2.45Ghz
RETURN LOSS	19	24
GAIN	3.45	5.2

In patch antenna design, air gap or substrate with low dielectric constant can help to increase and enhance the bandwidth of the antenna. This results in increased patch's size, close to half wavelength, which is too large for satisfying miniaturization size requirements.

In order to miniaturize the size of the antenna, substrate with high dielectric property was used for the antenna design. In addition, a stacked patch setup was utilized for wide S11 bandwidth. A dual fed configuration was also applied in the proposed antenna design as dual fed or multiple fed techniques are used to provide wider axial ratio bandwidth. The driven patch and the parasitic patch were printed on the top of the substrates and the driven patch was fed by two copper probes from the bottom. There was a tiny air gap in between the substrate layers. The air gap is used for fabrication purpose, which gives space for the solder to bind the driven patch and the copper probes together. To determine which dielectric material is more applicable for the antenna design, different dielectric materials with high dielectric constant were examined, which includes FR4, TC600 (Rogers), and TMM10i (Rogers). Simulations of the patch antenna with different dielectric materials were performed using HFSS. The dimensions were adjusted and varied accordingly so that the operating frequency of the antenna is close to the center frequency of the targeting frequency band. The simulation of the patch antenna design on different substrate materials is performed.

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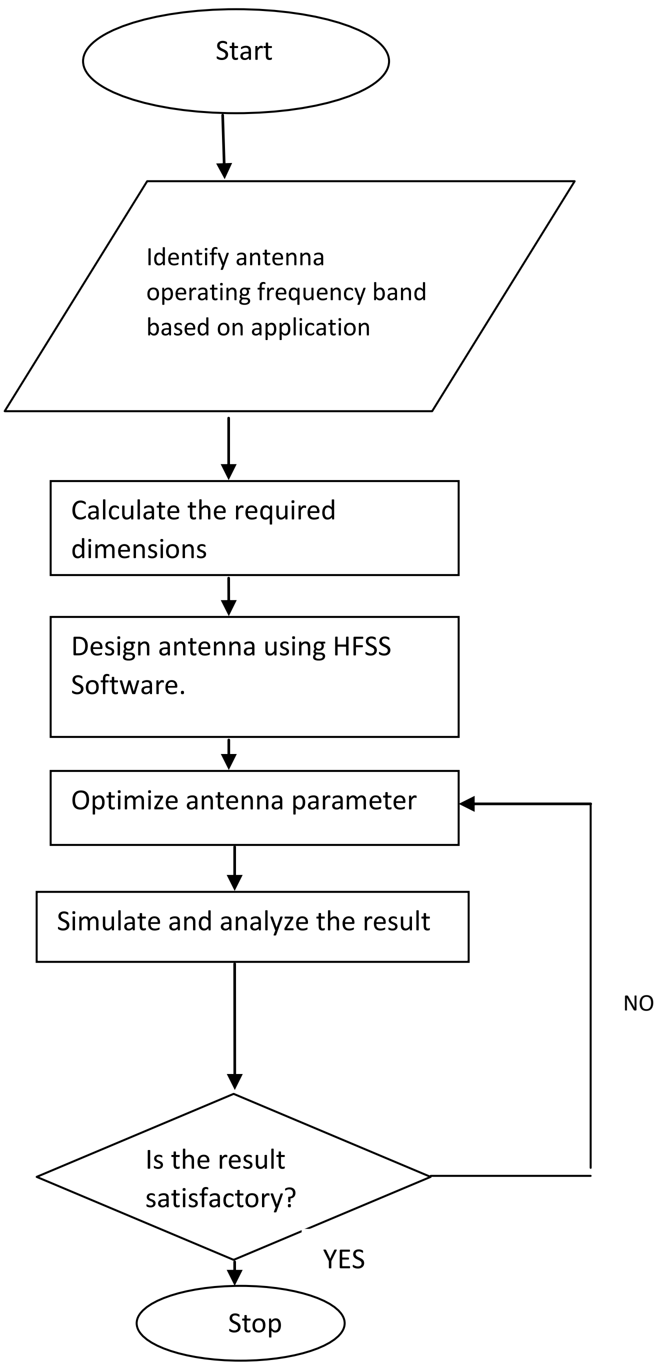
The antenna design using FR4 has the widest bandwidth. But, for a slight reduction in size and for avoiding the variation of FR4, the TC60 substrate was chosen in the further development in antenna design.



WORKFLOW OF PROPOSED SYSTEM

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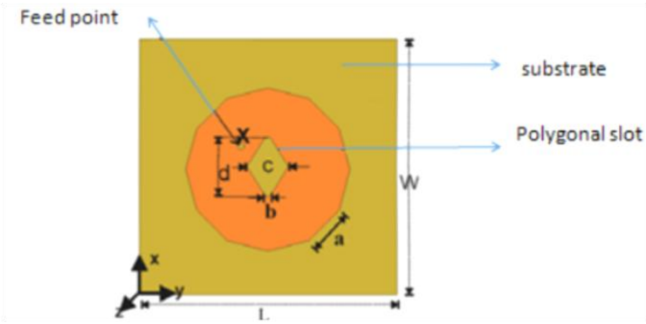
DESIGN PARAMETERS:



FR4 substrate of size 50mm×50mm×1.6mm Dielectric constant =4.4
Thickness=1.6mm
tan δ = 0.02.a = 8.28mm (0.137λg), b = 1mm (0.0166λg), c = 8mm (0.1325λg),
d = 1.4mm (0.189λg), k = 1.425,
$L = W$ = 50mm (0.8278λg).
where L=length and W is the thickness .
b,c,d-dimensions of the slot(b<c<d)

The design of patch antenna starts with the selection of substrate and its height for a required frequency of operation.

The set of equations for antenna design is given as :$W = \frac{C}{2f_r}\sqrt{\frac{2}{(\varepsilon_r+1)}}$

$$BW = 100 \times \frac{F_H - F_L}{F_C}$$

Where F_H is the highest frequency in the band, F_L is the lowest frequency and F_C is the center frequency and BW is the Beam width.

$$\epsilon_{reff} = \frac{(\epsilon_r+1)}{2} + \frac{(\epsilon_r-1)}{2}\left(\sqrt{1+\frac{10h}{W}}\right)$$

$$\lambda_g = \frac{\lambda}{\sqrt{\epsilon_{reff}}}$$

$$\text{Return Loss (in dB)} = 20\log_{10}\frac{SWR}{SWR-1}$$

λg -> the guided wavelength(mm).
$\varepsilon reff$→ the effective dielectric constant The effective electrical length of patch extends ΔL on each end owing to the fringing effect which is a function of the dielectric constant.

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SIMULATION RESULTS:

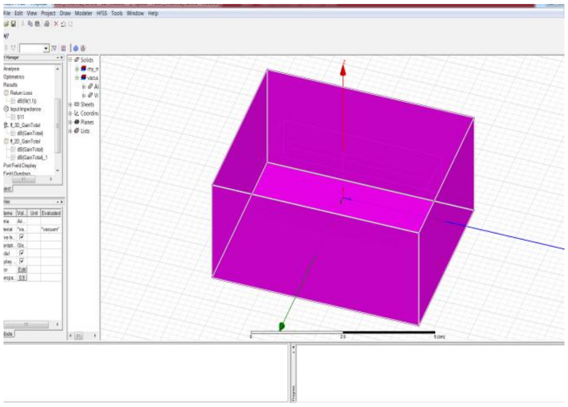

Fig.1 AIR BOX CREATION

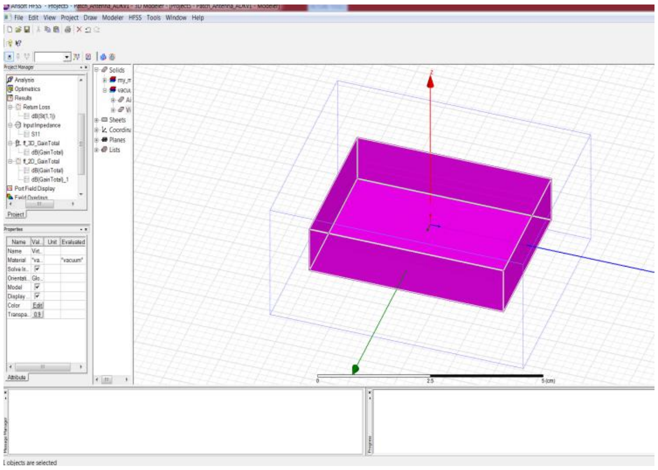

Fig.2 VIRTUAL RADIATION

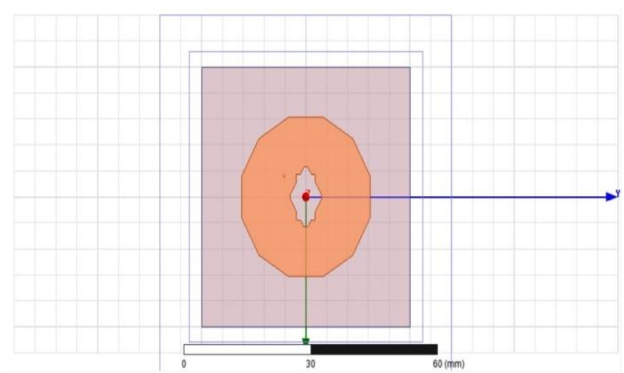

Fig .3 OUTER DESIGN

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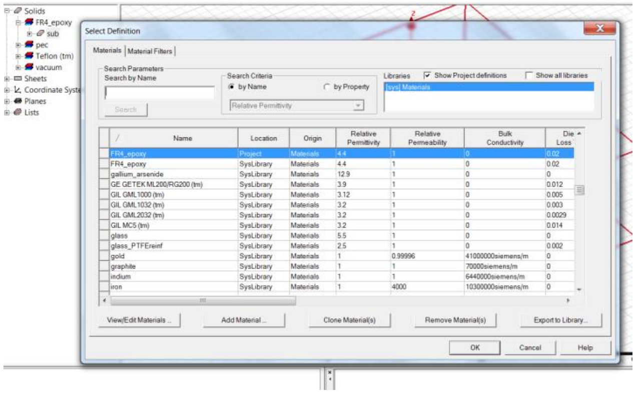

Fig.4 SUBSTRATE LOADING

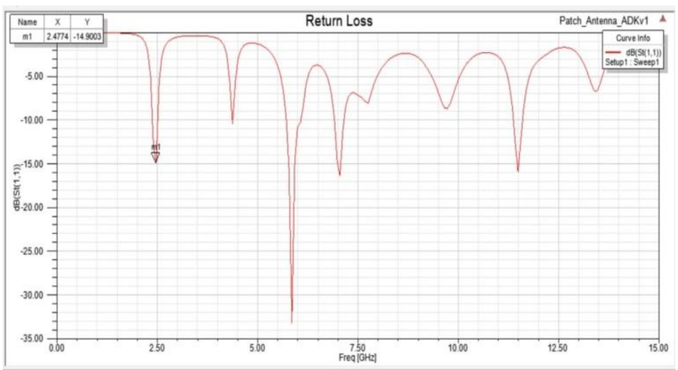

Fig.5 RETURN LOSS GRAPH

(RETURN LOSS-A logarithmic ratio measured in dB that compares the power reflected by the antenna to the power that is fed into the antenna from the transmission line.)

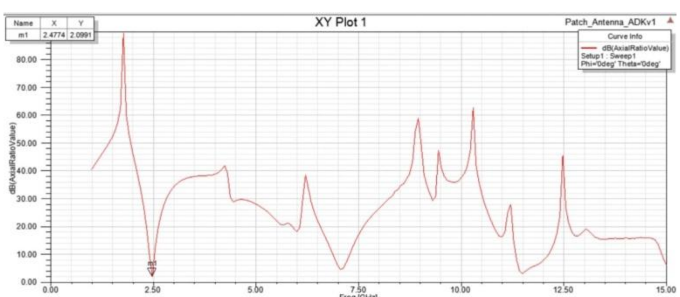

Fig.6 AXIAL RATIO MEASUREMENT

(The axial ratio is defined as the ratio between the minor and major axis of the polarization ellipse).

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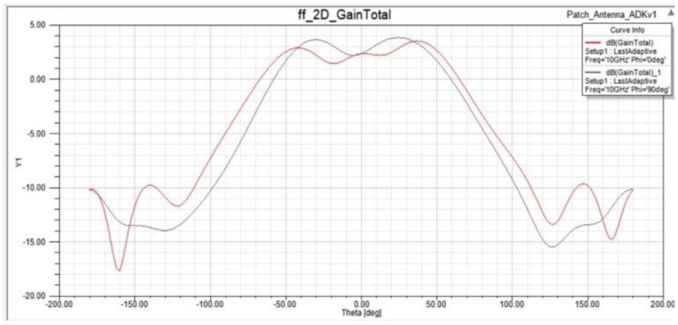

Fig.7 2D GAIN TOTAL

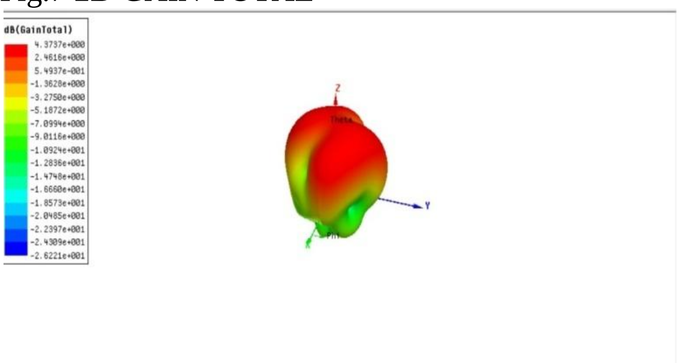

Fig.8 3D GAIN TOTAL

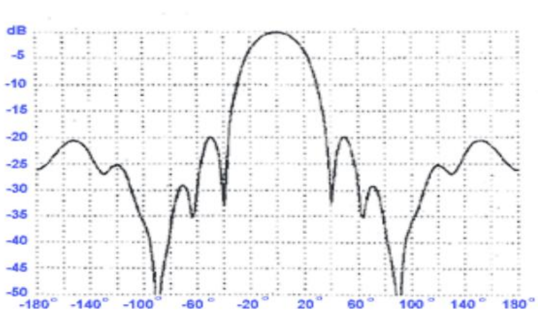

Fig.9 RADIATION PATTERN

CONCLUSION:

A single feed circularly polarized irregular hexagonal slotted regular dodecagonal patch antenna is designed. The structure is considered to be novel due to the choice of dodecagon shape for the patch and the use of central hexagonal slot perturbation method. The antennas cover RFID band with a center frequency of 2.45 GHz, with broadside radiation characteristics. The measured 10 dB impedance and 3 dB axial ratio bandwidths confirm and depict the usefulness of the structures to industrial, scientific and medical (ISM) bands in handheld RFID reader applications.

REFERENCES:

1. Lin, J.-F., & Zhu, L. (2020). Low-Profile High-Directivity Circularly-Polarized Differential-Fed Patch Antenna With Characteristic Modes Analysis. IEEE Transactions on Antennas and Propagation, 1–1.
2. Wong, K.-L., Chen, C.-J., & Li, W.-Y. (2020). Integrated Four Low-Profile Shorted Patch Dual-Band WLAN MIMO Antennas for Mobile Device Applications. IEEE Transactions on Antennas and Propagation, 1–1. doi:10.1109/tap.2020.3037797
3. AnhTu HO, Emmanuel PISTONO, Nicolas CORRAO, Philippe , Circular polarized square slot antenna based on Slow-Wave Substrate Integrated Waveguide, ,pp- 1 – 1.
4. Muhammad WasifNiaz; Yingzeng Yin; Rashid Ahmad Bhatti; Yuan-Ming Cai; JingdongChen ,Wideband Fabry-Perot Resonator Antenna Employing Multilayer Partially Reflective Surfaces, IEEE Transactions on Antennas and Propagation (Early Access),**pp.**1 - 1
5. Shi, Y., & Liu, J. (2018). A Circularly Polarized Octagon-Star-Shaped Microstrip Patch Antenna With Conical Radiation Pattern. IEEE Transactions on Antennas and Propagation, 66(4), 2073–2078.
6. Zhang, X., & Zhu, L. (2016). High-Gain Circularly Polarized Microstrip Patch Antenna With Loading of Shorting Pins. IEEE Transactions on Antennas and Propagation, 64(6), 2172–2178.
7. Zhang, X., Zhu, L., & Liu, N.-W. (2017). Pin-Loaded Circularly-Polarized Patch Antennas With Wide 3-dB Axial Ratio Beamwidth. IEEE Transactions on Antennas and Propagation, 65(2), 521–528.
8. Lei, W., Chu, H., &Guo, Y.-X. (2016). Design of a Circularly Polarized Ground Radiation Antenna for Biomedical Applications. IEEE Transactions on Antennas and Propagation, 64(6), 2535–2540.
9. Nasimuddin, Anjani, Y. S., &Alphones, A. (2015). A Wide-Beam Circularly Polarized Asymmetric-Microstrip Antenna. IEEE Transactions on Antennas and Propagation, 63(8), 3764–3768.
10. Xu, H.-X., Wang, G.-M., Liang, J.-G., Qi, M. Q., &Gao, X. (2013). Compact Circularly Polarized Antennas Combining Meta-Surfaces and Strong Space-Filling Meta-Resonators. IEEE Transactions on Antennas and Propagation, 61(7), 3442–3450.
11. Agarwal, K., Nasimuddin, &Alphones, A. (2013). RIS-Based Compact Circularly Polarized Microstrip Antennas. IEEE Transactions on Antennas and Propagation, 61(2), 547–554.
12. Wang, L., &En, Y.-F. (2020). A Wideband Circularly Polarized Microstrip Antenna With Multiple Modes. IEEE Open Journal of Antennas and Propagation, 1–1.
13. Le, D., Ukkonen, L., &Bjorninen, T. (2020). Circularly Polarized Corner-Truncated and Slotted Microstrip Patch Antenna on Textile Substrate for Wearable Passive UHF RFID Tags. 2020 14th European Conference on Antennas and Propagation (EuCAP).
14. Muhammad WasifNiaz; Yingzeng Yin; Rashid Ahmad Bhatti; Yuan-Ming Cai; JingdongChen ,Wideband Fabry-Perot Resonator Antenna Employing Multilayer Partially Reflective Surfaces, IEEE Transactions on Antennas and Propagation (Early Access),**pp.**1 - 1
15. Ta, S. X., & Park, I. (2015). Low-Profile Broadband Circularly Polarized Patch Antenna Using Metasurface. IEEE Transactions on Antennas and Propagation, 63(12), 5929–5934.
16. Asok, A. O., &Dey, S. (2020). A CPW-Fed Square Slot Circularly Polarized Antenna WithAsymetrie Stubs For Ultra Wideband Applications. 2020 IEEE International IOT, Electronics and Mechatronics Conference (IEMTRONICS).
17. Nguyen, A. N., Radfar, M., Ebrahimi, A., Ngo, D. V., Bervan, A., Le, H. V., & Desai, A.

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 6, 2021, Pages. 1954 - 1963
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(2020). Wideband Compact Triangle Slot Antenna with Out-Of-Band Rejection. IEEE Antennas and Wireless Propagation Letters, 1–1. doi:10.1109/lawp.2020.2982177

18. Murugan, S., Jayarajan, P., & Sivasankaran, V.Majority Voting based Hybrid Ensemble Classification Approach for Predicting Parking Availability in Smart City based on IoT.
19. Efficient Contourlet Transformation Technique for Despeckling of Polarimetric SyntheticApertureRadarImageRobbi Rahim, S. Murugan, R. Manikandan, andAmbeshwarKumarJ. Comput. Theor. Nanosci. 18, 1312–1320(2021)
20. Eye blink controlled virtual keyboard using brain sense B kavitha vp, janani meganathan, sreehoshini j, mounika International research journal of engineering and technology (irjet) 7,08-2020
21. A new algorithm for optimization of quality of service in peer to peer wireless mesh networks M Gheisari, J Alzubi, X Zhang, U Kose, JAM Saucedo Wireless Networks 26 (7), 4965-4973