

# Carbon Nanotubes for Quantum-Dot Cellular Automata Clocking

<sup>1</sup>Dr A.V.Prathap Kumar, <sup>2</sup>J.Lavanya, <sup>3</sup>B. Nirisha, <sup>4</sup>K.Vikram

<sup>1,2,3,4</sup>TKREC, Hyderabad, India

## Abstract

The antenna used in these communication systems should possess multi frequency capabilities but should be compact and less bulky. The most common antenna used for this purpose is the microstrip patch antenna because of their less bulkiness, low cost and easy to fabricate.

## Keywords

Single Band, Dual Band, Multi Band, Microstrip Patch Antenna

## I. Introduction

Modern day communication devices are required to smaller in size and should be able to perform various functionalities. The antenna used in these communication systems should possess multi frequency capabilities but should be compact and less bulky. The most common antenna used for this purpose is the microstrip patch antenna because of their less bulkiness, low cost and easy to fabricate.

It is observed that the superstrate permittivity has significant effect on the resonant frequency and half power bandwidth. This effect is dominant when the superstrate permittivity is higher as compared to the substrate material [1]. In order to achieve higher order of miniaturization, shape modification process was used which drastically reduced the antenna efficiency, without any significant effect on the directivity. On the other hand, if relative permittivity is varied with a principal patch shape, directivity remains unchanged as well. (Principal patch shape and relative permittivity has no effect on directivity). If other parameters of antenna are to be varied then the combination of shape modification and high permittivity substrates is a primary technique rather than using then either alone [2]. For cellular communication system dual band antennas were designed which can be made to work with a single input port by electrically shorting the radiating element, which proved to have good decoupling between two radiating element due to the reduction of electric field by three to four times of the non resonant element than that of resonant one [3]. Further developments in the design of circular microstrip antenna which was when fed from an open ended coplanar waveguide proved that the parameters of the antenna are similar to rectangular microstrip antenna [4]. Wide investigation on the circular patch microstrip antennas have proved them to be light weight, small dimension and can be easily manufactured compared to the parabolic ones. The gain of these antennas can be increased by increasing the number of elements and also by changing parameters like substrate thickness, tangent loss and dielectric constant [5]. Apart from circular patch antenna, research is ongoing towards the semi circular feeding structures with multilayer structure showing improved impedance bandwidth and also reduced effect of ground plane [6]. For multi frequency applications antenna with inner semi circle and a number of external semi circular rings have been developed with the advantage of generation of new excitation modes which can be used in radiation, due to which the radiation efficiency of the antenna is improved [7].

## II. Proposed Work

In this paper a semicircular antenna with three semi circular rings has been simulated. In order to achieve similar parameters as that of rectangular microstrip antenna, microstrip waveport feeding has been used. The antenna resonates at three different frequencies of 1.71 GHz, 1.96 GHz and 2.41 GHz.

## III. Simulated Examples

### A. Circular Patch Antenna

First of all, a basic circular microstrip antenna is presented. This is a single band antenna with a radius of 10 mm. Waveport feeding is used for the excitation of the antenna. The substrate dimensions are 50 mm x 50 mm x 1.6 mm. The relative permittivity of the substrate is 4.4 and resonant frequency of the antenna is 1.65 GHz as shown in the fig. 1 (a), (b), (c) and (d).

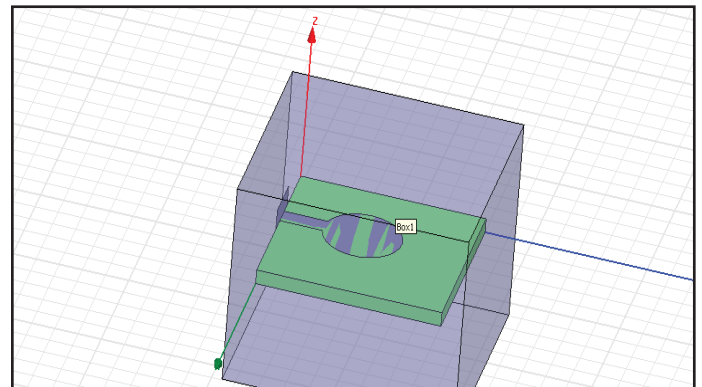


Fig. 1: (a) Circular Patch Antenna

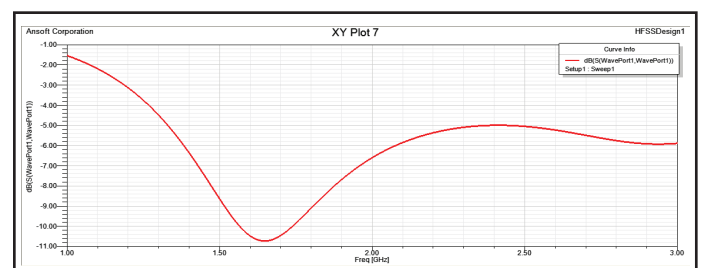


Fig. 1: (b). Return Loss Parameter V/s Frequency

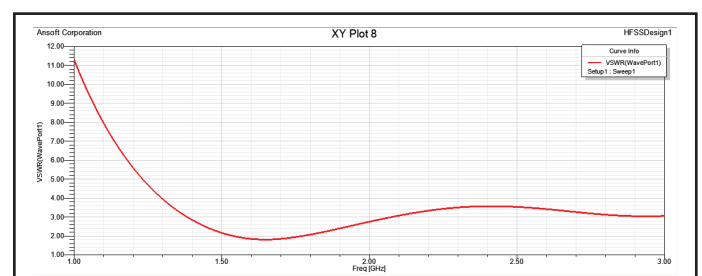


Fig. 1 (c) VSWR V/s Frequency.

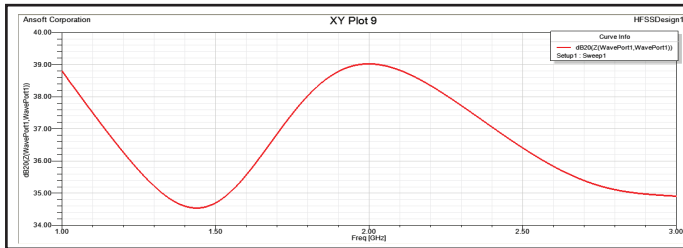


Fig. 1(d): Impedance V/s Frequency

### B. Semi circular Patch Antenna

To reduce the size of the antenna a semi circular antenna is presented. This is also a single band antenna with a radius of 20 mm. Waveport feeding is used for the excitation of the antenna. The substrate dimensions are 50 mm x 50 mm x 1.6 mm. The relative permittivity of the substrate is 4.4 and the resonant frequency of the antenna is 2.2 GHz as shown in the fig. 2 (a), (b), (c) and (d).

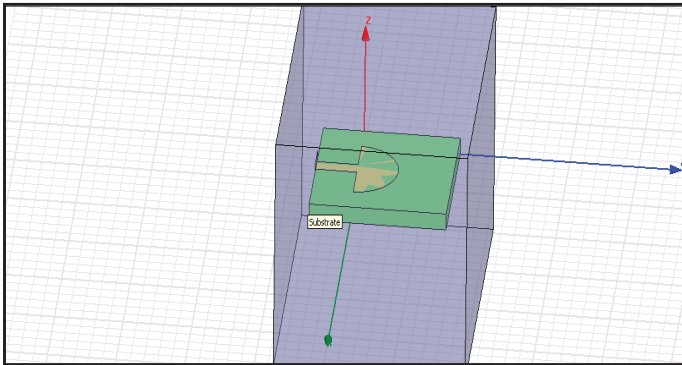


Fig. 2: (a). Semi Circular Patch Antenna

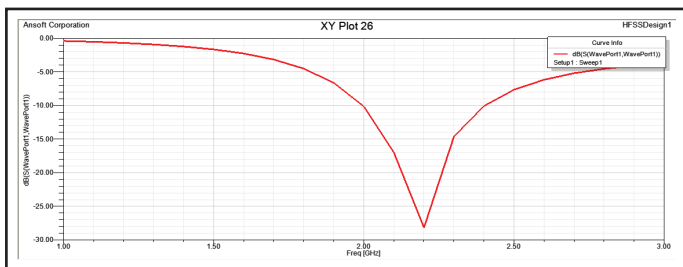


Fig. 2: (b). Return Loss Parameter V/s Frequency

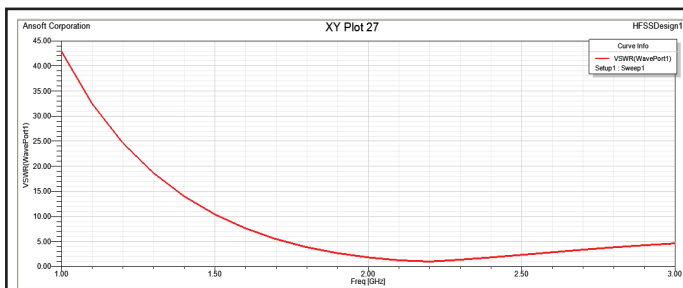


Fig. 2: (c). VSWR V/s Frequency

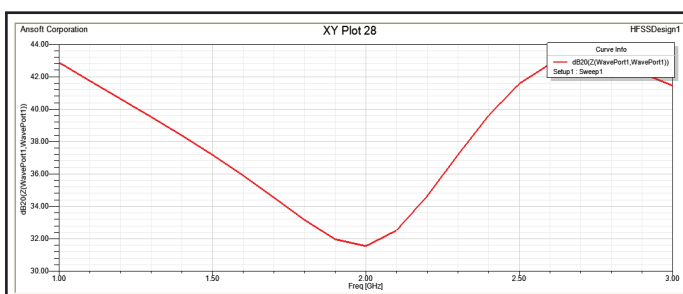


Fig. 2: (d) Impedance V/s Frequency.

### C. Semi circular Patch Antenna with one Semi Circular Ring

To introduce dual band properties a semi circular arc is introduced in the semicircular antenna. This is a dual band antenna with a radius of 20 mm and the semicircular arc has a radius of 19 mm with a gap of 1 mm. Waveport feeding is used for the excitation of the antenna. The substrate dimensions are 50 mm x 50 mm x 1.6 mm. The relative permittivity of the substrate is 4.4 and the resonant frequencies of the antenna are 2.1 GHz and 2.6 GHz as shown in the fig. 3 (a), (b), (c) and (d).

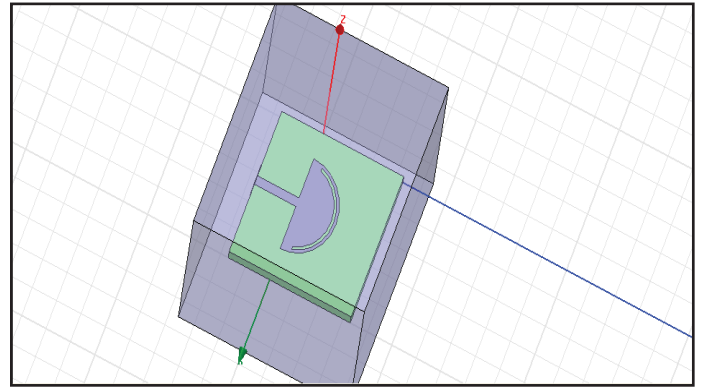


Fig. 3: (a) Semi Circular Patch Antenna With One Semi Circular Ring

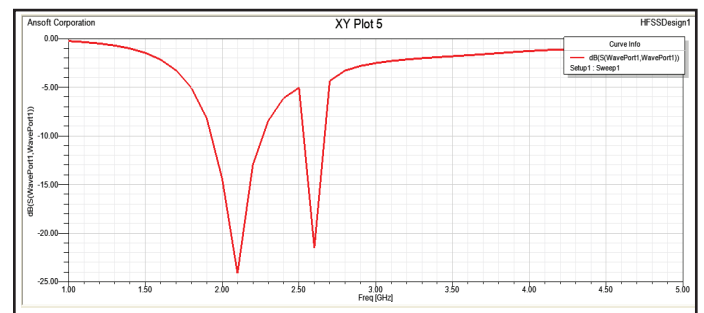


Fig. 3: (b). Return Loss Parameter V/s Frequency

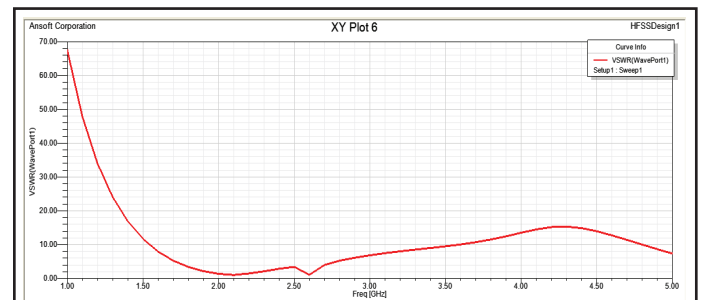


Fig. 3: (c). VSWR V/s Frequency

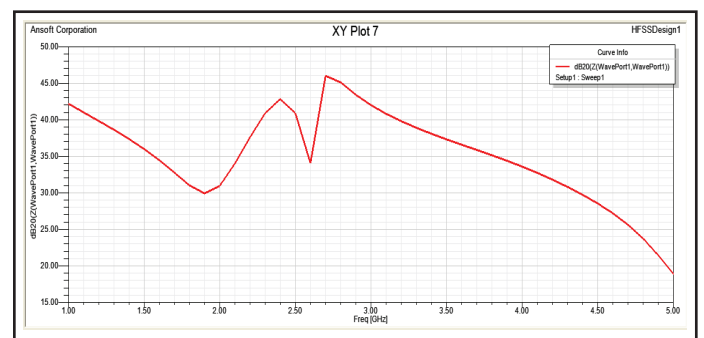


Fig. 3: (d) Impedance V/s Frequency

### D. Semi circular Patch Antenna With Two Semi Circular Rings

To introduce more prominent dips one more semi circular arc is introduced in the semicircular antenna. This is a dual band antenna with a radius of 20 mm and the semicircular arc has a radius of 19 mm and 17 mm with a gap of 1 mm each. Waveport feeding is used for the excitation of the antenna. The substrate dimensions are 50 mm x 50 mm x 1.6 mm. The relative permittivity of the substrate is 4.4 and the resonant frequencies of the antenna are 1.86 GHz and 2.13 GHz as shown in the fig. 4 (a), (b), (c) and (d).

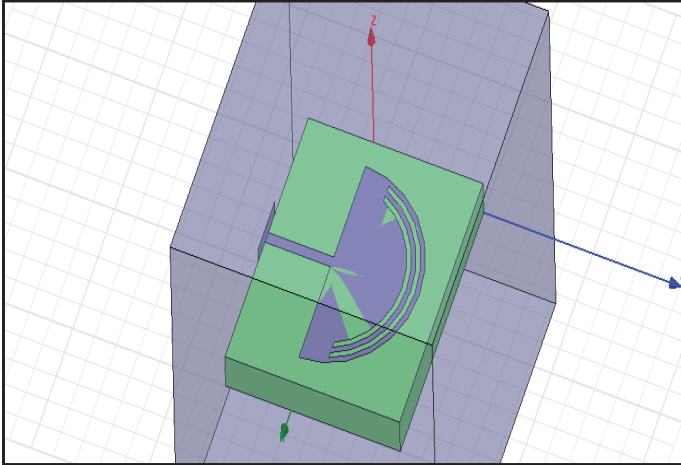


Fig. 4: (a). Semi Circular Patch Antenna with Two Semi Circular Ring

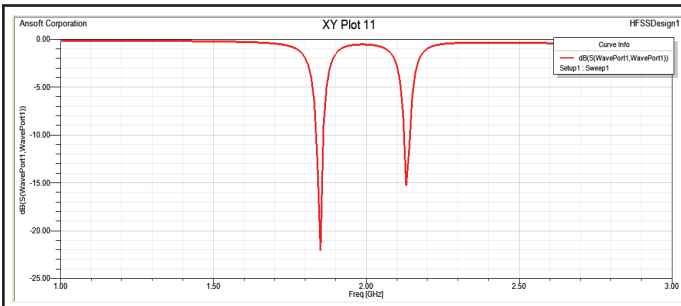


Fig. 4: (b). Return Loss Parameter V/s Frequency.

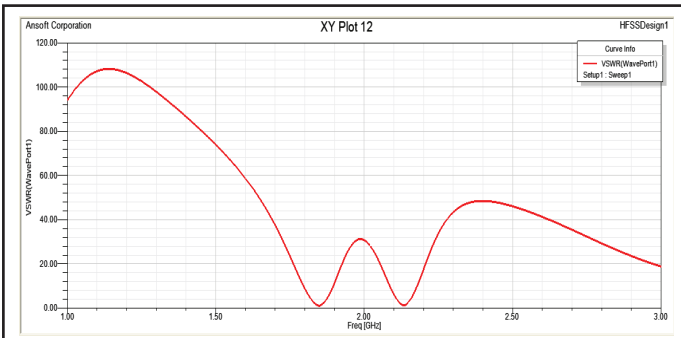


Fig. 4: (c). VSWR V/s Frequency

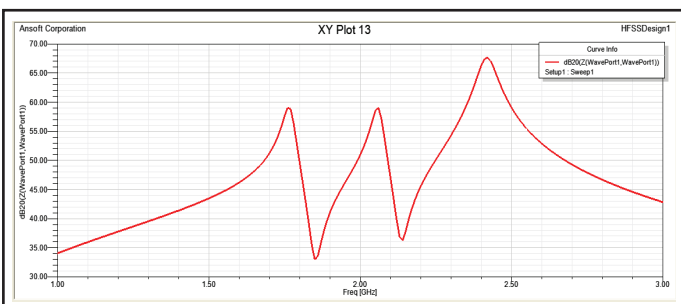


Fig. 4: (d). Impedance V/s Frequency

### E. Semi circular Patch Antenna With Three Semi Circular Rings

To introduce triple band of operation one more semi circular arc is introduced in the semicircular antenna. Now there are all total three arcs in the antenna. This is a triple band antenna with a radius of 20 mm and the semicircular arc has a radius of 19 mm, 17 mm and 15 mm with a gap of 1 mm each. Waveport feeding is used for the excitation of the antenna. The substrate dimensions are 50 mm x 50 mm x 1.6 mm. The relative permittivity of the substrate is 4.4 and the resonant frequencies of the antenna are 1.71 GHz, 1.96 GHz and 2.41 GHz as shown in the Fig. 5 (a), (b), (c) and (d).

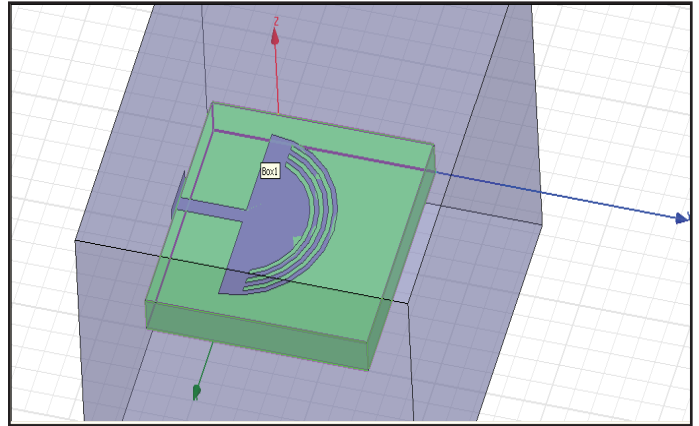


Fig. 5: (a). Semi Circular Patch Antenna With Two Semi Circular Ring

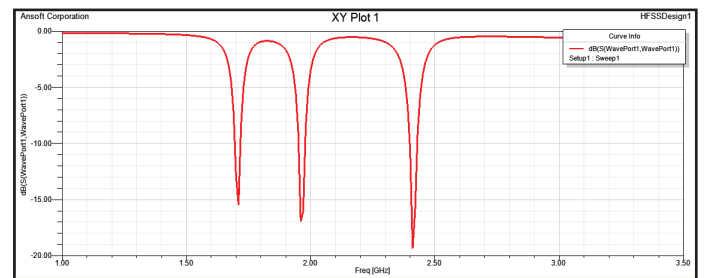


Fig. 5: (b). Return Loss parameter V/s Frequency

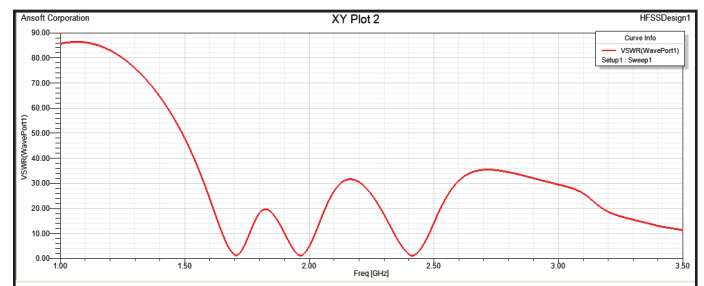


Fig. 5: (c). VSWR V/s Frequency

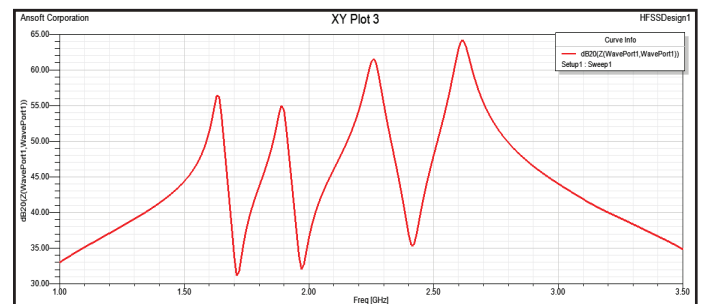


Fig. 5: (d). Impedance V/s Frequency

#### IV. Conclusion

A compact semicircular microstrip antenna is presented in this paper which is capable of producing triple band of operation depending on the application. The antenna has multiple semi circular arcs to produce dual and triple band of operation. Five different antennas have been simulated. The first was a circular antenna with single band operation. The second was a semi circular antenna with single band operation. The third was a semicircular antenna with a semicircular arc with a dual band operation. The forth was a semicircular antenna with two semicircular arcs with more prominent dual band operation. And the last was a semicircular antenna with three semicircular arcs with triple band of operation. These five examples were studied with simulations in terms of return loss, VSWR and impedance with waveport feeding technique.

#### V. Acknowledgment

Our sincerest appreciation must be extended to the Gyan Ganga Institute of Technology and Management, Bhopal for supporting the simulation work of the antenna. We wish to thank GGITM, Bhopal (MP) and K L University, Vijaywada (AP), Department of Electronics and Communication Engineering, which give a support and approval for the paper.

#### References

- [1] Kin-Lu Wong, Sun-Fu Hsiao, Hong-Twu Chen, "Response and Radiation of a Superstrate-Loaded Spherical-Circular Microstrip Patch Antenna," IEEE Trans. Antennas Propagat., Vol. 41, pp. 686–690, May 1993.
- [2] S. A. Bokhari, J. F. Ziircher, J. R. Mosig and F. E. Gardiol, "A Small Microstrip Patch Antenna with a Convenient Tuning Option," IEEE Trans. Antennas Propagat., Vol. 44, pp. 1521–1528, Nov 1996.
- [3] Z. D. Liu, P. S. Hall, D. Wake, "Dual-frequency planar inverted-F Antenna," IEEE Trans. Antennas Propagat., Vol. 45, pp. 1451–1458, Oct 1997.
- [4] Sheng-Ming Deng, "A Coplanar Waveguide-Fed Circular Microstrip Patch Antenna," IEEE Antennas and Propagation Society International Symposium, Vol. 2, pp. 920-923, 1998.
- [5] T. F. Lai, Wan Nor Liza Mahadi and Norhayati Soin, "Circular Patch Microstrip Array Antenna for KU-Band," World Academy of Science, Engineering and Technology, pp. 298-302, 2008.
- [6] Jiahui Chu, Chengli Ruan, Chaoyuan Ding, Xuncal Yin, "A Miniature Broadband Semi-circular Fed Patch Antenna on a Small-Size Ground Plane," 8th International Symposium on Antennas, Propagation and EM Theory 2008 (ISAPE 2008), pp. 251–253, 2008.
- [7] Oscar Quevedo-Teruel, Elena Pucci, Eva Rajo-Iglesias, "Compact Loaded PIFA for Multifrequency Applications," IEEE Trans. Antennas Propagat., Vol. 58, pp. 656–664, Mar 2010.



Dr. A.V. Prathap Kumar is working as a professor and Dean of academics in TKR Engineering College. He published many National and International journals and he received best teacher award. He conducted many workshops and international conferences. Under his Guidance 6 Research Scholars doing in different areas. He worked as a R&D Head in K.L. University. And also he worked as Principal in Various Colleges affiliated to JNTUA. He also act as IEEE, Conference Judge. He is life member of ISTE.



Miss J. Lavanyas has been working in TKREC as a Asst. Professor in ECE Dept. She is strong in this research paper. She is Co-author of This Research Paper.



Miss B. Nirisha has been working in TKREC as a Asst. Professor in ECE Dept. She is strong in this research paper. She is Co-author of This Research Paper.



Mr. K. Vikram is working as a Professor in TKR Engineering College, Hyderabad, India. He has published and presented good number of Technical papers in National and International Conferences. His main research interest areas are Software Engineering, Data Mining, and Networks. Image Processing He Worked as a I/C Principal in in various Engineering colleges. He is life member of IETE, CSI. He published 30 International Papers and 05 International Conferences and published 03 Text Books.