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U-Shaped CPW-Fed Monopole Loop Antenna for Enhanced Dual-Band Reception

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ABSTRACT
A novel coplanar waveguide fed dualband antenna for wireless application is discussed in the paper. Primary focus is on the 2.45GHz and 5.2GHz WLAN band. The presented configuration has 25 x 35.5mm dimensions with U shaped loop radiation structure and a capacitivelycoupled ground plane. The proposed design mainly focusses on FR-4 Epoxy as the substrate. Other materials like RT Duroid and zelt was used for performance comparison. For FR-4 Epoxy, the first band was obtained at 2.45GHz and a second band was obtained at 3.8 to 5.9 GHz. The return loss obtained for the first band is -18 and the second band has appreciable return loss. The proposed design produces two bands which are in compliance with the current microwave standards for mobile communications.

KEYWORDS: Coplanar waveguide, R T Duroid, Radiation pattern, Return loss

1. INTRODUCTION
All Wireless communication devices have been playing a very important part in our daily life especially for past 15 years. Due to this reason, antennas designed for wireless applications have attracted much attention from researches all over the world. Multiband antennas are capable of providing multiple reception and transmission functionalities.[1] It is therefore much desirable to have a single antenna using a single feed point that covers multiple frequency bands. The designed antenna is expected to be compact and simple and such as to be integrated well with other communication devices. In applications where size, weight, cost, performance, ease of installation and that of aerodynamic profile are constraints, low-profile antennas like microstrip and printed slot antennas are required. Because microstrip antennas inherently have narrow bandwidths and, in general, are half-wavelength structures operating at the fundamental resonant mode, researchers have made efforts to overcome the problem of narrow bandwidth, and various configurations have been presented to extend the bandwidth by introducing slots in the microstrip patch.

Printed slot antennas that are fed by coplanar waveguide (CPW) have several advantages over microstrip patch antennas. Slot antennas exhibit wider bandwidth, lower dispersion, and lower radiation loss than microstrip antennas, and CPW also provides an easy means of parallel and series connection with active and passive elements required for matching and gain improvement, and with ease of integration with monolithic microwave integrated circuits (MMIC).[2]

Wireless Fidelity, commonly known as Wi-Fi is defined under the IEEE 802.11x standards and WiMAX, stands for worldwide interoperability for microwave access. Wi-Fi networks have a bandwidth of 20MHz, whereas WiMAX networks have a flexible bandwidth option which ranges from 1.25MHz to 20MHz

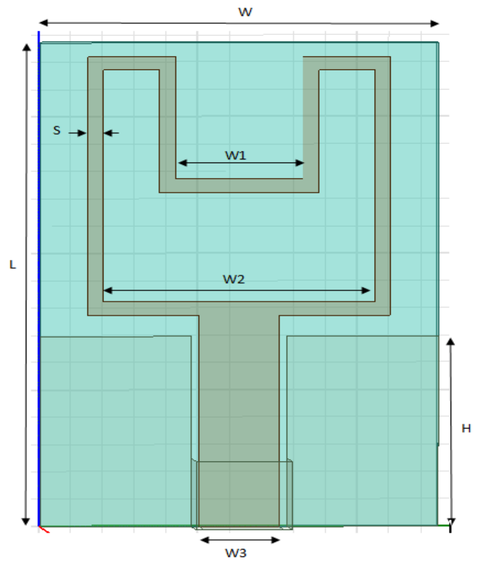
2. MATERIALS AND METHODS

Coplanar Waveguide Antennas
CPW-fed antenna designs presented here are suitable for WiFi and WiMAX operations. These antennas are suitable for practical portable devices. A coplanar waveguide (CPW) is a strip transmission line defined as a planar transmission structure for transmitting microwave signals. It consists of at least one flat conductive strip of small thickness, and conductive ground plates. A CPW structure consists of a median metallic strip of deposited on the surface of a dielectric substrate slab with two narrow slits ground electrodes running adjacent and parallel to the strip on the same surface. Apart from the microstrip line, CPW is most frequently used as planar transmission line in RF/microwave integrated circuits. It can be considered as two coupled slot lines. Hence, similar properties of a slot line could be expected. It consists of three conductors with the exterior ones used as ground plates. These need not necessarily have same potential.[3]

Proposed Antenna Design
The proposed dual band CPW antenna consist of a compact coplanar field printed on 1.6mm thick flexible flame retarded epoxy (FR-4 epoxy) FR-4 glass epoxy is a popular high-pressure thermoset plastic laminate grade

having good strength to weight ratios. The material is known to retain its high mechanical values and electrical insulating qualities in both dry and humid conditions. These properties, along with good fabrication characteristics, gives utility to this grade for a wide variety of electrical and mechanical applications, with relative permittivity of 4.4 .The conducting components such as coplanar feed line radiating elements and ground plane are on same plane. The antenna overall size is 35.5 × 25mm.

Figure 1:



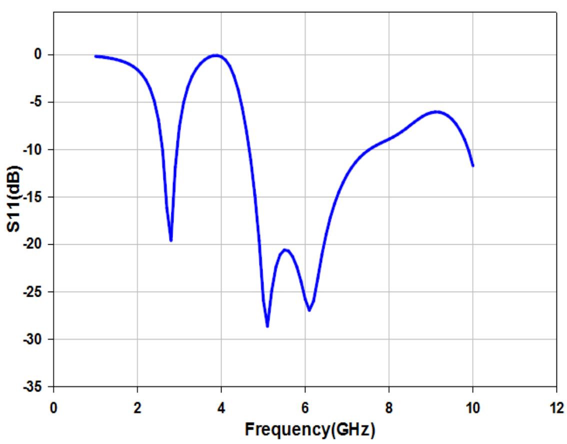
Proposed Dual-band coplanar antenna model is featured by the following specifications W1=8,s=1,w2=17,w3=5

We have used three popular substrates for performance comparison of the proposed antenna. The antenna is originally designed using FR-4 epoxy with the substrate height of 1.6mm. The comparison of the antenna is made for different substrate thickness as well as substrate material. The other materials which is used for comparison is RT Duroid and Zelt. RT Duroid is characterized by low dielectric loss,superior electrical and mechanical properties. They are mechanically reliable and electrically stable choice for substrate.Zelt is a high-quality nylon based substrate. It is durable, tear resistant, and is easy to form andhandle.[4]

3. RESULTS AND DISCUSSION

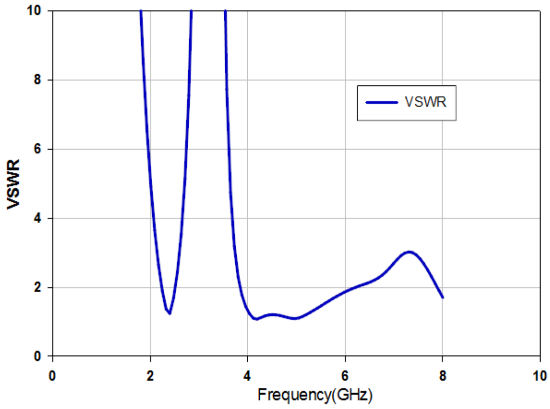
Return loss, realized gain and radiation patterns measurements are used to characterize a manufactured prototype.[5] The return loss and VSWR plot for the proposed antenna with FR4 epoxy substrate of height 1.6mm is shown in figure 2 and 3.

Figure 2:



return loss plot for h=1.6mm

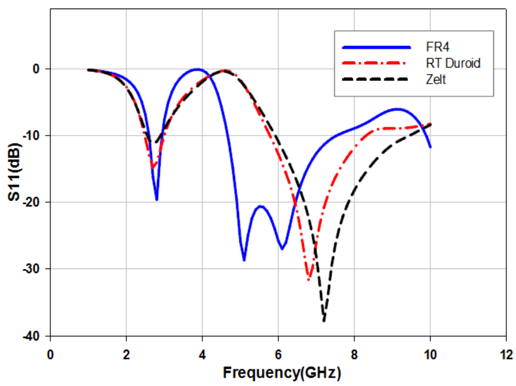
Figure 3:



VSWR plot for h=1.6mm

The performance of the antenna was evaluated at two instances. Firstly the comparison was made with substrate thickness of 1.6mm for three different materials namely FR4 epoxy, RT Duroid and Zelt. It is indicative from figure 4, that the return loss plot that antenna with FR4 epoxy substrate gives good return loss at 2.4 GHz and from 4.4 to 7.2 GHz, which is suitable for wireless application. The adoption of RT Duroid and Zelt in the same design did not provide with the required dual band. They resulted in a shifted bandwidth with reduced return loss.

Figure 4:

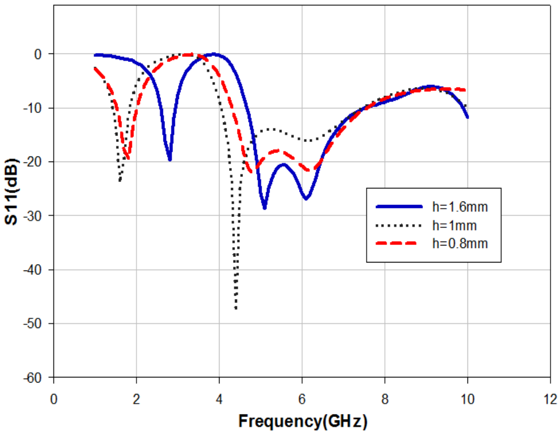


Comparison plot of return loss with different substrate materials

The second comparison was on the basis of different substrate thickness for FR4 epoxy substrate material. From figure 5, it is evident that changing the height of the substrate would cause a change in the return loss patterns. When substrate thickness is 0.8mm and 1mm, the lower frequency of the antenna is centered around 1.8GHz ,not suitable for WiFi applications. Also the second band has shifted more to the right, hence not useful in

WiMAX applications aswell. It is evident that FR4 substrate with thickness 1.6mm is more suitable for the intended applications.

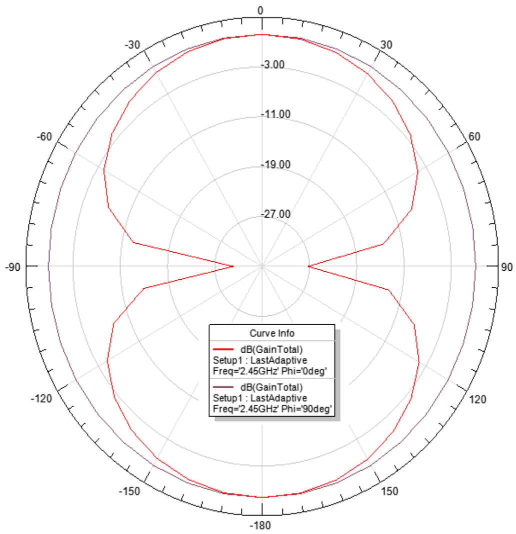
Figure 5:



Comparison plot of return loss with different substrate thickness

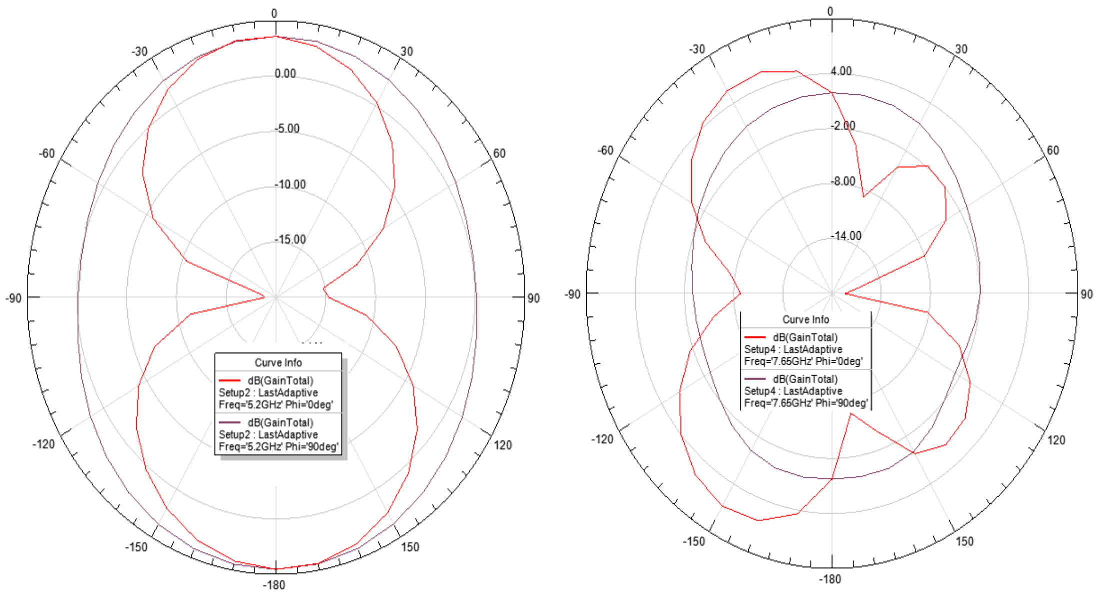
The radiation patterns for FR4 epoxy substrate of thickness 1.6mm is depicted in figures 6,7.

Figure 6:



Simulated radiation pattern at 2.45GHz

Figure7:

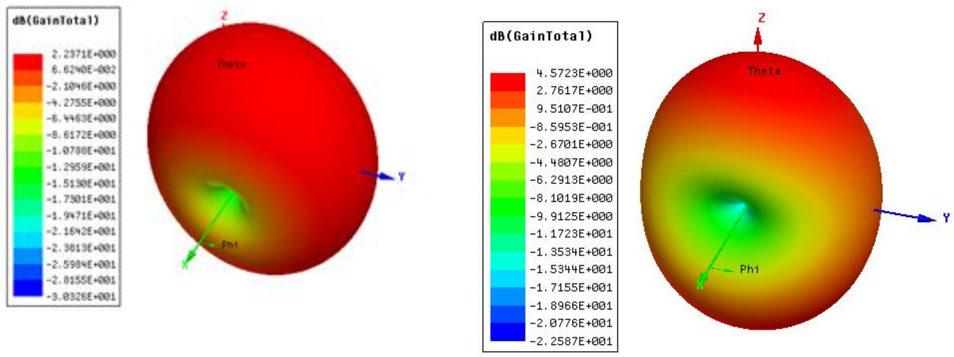


(a) *(b)*

Simulated radiation pattern at a)5.2GHz b)7.85GHz

The 3D polar plot which is obtained after simulation in Ansys HFSS software at two centre frequencies of 5.2GHz and 2.45GHz is shown in figure 9.

Figure 9:



(a) *(b)*

3D Polar plot of the proposed antenna of thickness 1.6mm ,FR 4substrate at a) f=2.45GHz b) f=5.2GHz

4. CONCLUSION

A dualband antenna has been designed for wireless mobile applications. The performance comparison of the antenna has been made by using different substrate materials as well as by changing substrate thickness. From this it can be observed that better performance of the antenna is obtained when the substrate material is FR4 epoxy rather than with RT Duroid or Zelt. The design yielded two usable bands, the first band is centered around 2.4 GHz which is used for WiFi applications and the second band between 4.4 and 7.2 GHz which is for WiMAX applications.

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REFERENCES

[1] N. Chahat, M. Zhadobov, R. Sauleau and K. Mahdjoubi, "Improvement of the on-body performance of a dual-band textile antenna using an EBG structure," *2010 Loughborough Antennas & Propagation Conference*, Loughborough, 2010, pp. 465-468.

[2] T. Shanmuganantham, K. Balamanikandan, and S. Raghavan, “CPW-Fed Slot Antenna for Wideband Applications,” International Journal of Antennas and Propagation, vol. 2008, Article ID 379247, 4 pages, 2008.

[3] SarawuthChaimool and PrayootAkkaraekthalin (January 18th 2012). CPW-Fed Antennas for WiFi and WiMAX, Advanced Transmission Techniques in WiMAX, Roberto C. Hincapie and Javier E. Sierra, IntechOpen, DOI: 10.5772/28456

[4] Shaozhen Zhu and R. Langley, "Dual-Band Wearable Textile Antenna on an EBG Substrate," Antennas and Propagation, IEEE Transactions on, vol. 57, pp. 926-935, 2009.

[5] M. Mantash, S. Collardey, A. Tarot and A. Presse, "Dual-band WiFi and 4G LTE textile antenna," *2013 7th European Conference on Antennas and Propagation (EuCAP)*, Gothenburg, 2013, pp. 422-425.

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Current Trends in Vehicle Detection Using Digital Image Processing Techniques

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ABSTRACT

The Video Based investigation for traffic surveillance has been a vital part of ITS (Intelligent Transportation System) .The traffic surveillance in urban environment have become more challenging compared to the highways due to various factors like camera placement, cluttered background, pose variation, object occlusion and illumination changes. This paper provides review on video based vehicle surveillance for detection, tracking and behavior analysis with systematic description. We need to classify the dynamic attributes of vehicle with respect to vehicle motion and appearance characteristics, including velocity, direction of movement, vehicle trajectories on a single camera. The common existing surveillance system collects traffic flow information that mainly includes traffic parameters and traffic incident detection. The system developed is able to capture vehicles visual appearance and extract more information about them through vehicle detection, tracking, recognition and behavior analysis.

KEYWORDS: Vehicle Counting **,** Vehicle Tracking ,Vehicle Detection, Traffic Analysis, Video image Processing.

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1. INTRODUCTION

The escalation of vehicle in urban areas made traffic surveillance a greater challenge in the medium and large sized cities. The advancements in computer vision, computing and camera technologies have raised the interest in video based traffic surveillance applications, which has become the key part of intelligent transportation systems (ITS). The existing surveillance system collects traffic flow information that mainly includes traffic parameters and traffic incident detection . The system developed is able to capture vehicles visual appearance and extract more information about them through vehicle detection, tracking, recognition and behavior analysis.
To improve video based traffic surveillance systems many efforts have been devoted by various researchers, but they still face many challenges and issues in real traffic scenes for an ITS application. The typical scenes include vehicle occlusion, pose variations, all day surveillance and behavior understanding of a vehicle on a single camera network. The variability in vehicle types, size color and pose limits vehicle tracking to specific scenes . An investigation on vehicle detection, tracking and on road behavior analysis can be found in . A review on various techniques used in video based traffic surveillance is discussed from a computer vision perspective. These techniques include vehicle detection, tracking and behavior understanding on single camera. This paper also includes improvements, modifications, highlight the advantages and disadvantages.

2. MATERIALS AND METHODS

2.1 VEHICLE DETECTION : The localization of an image and robust vehicle detection is the first step in video processing. The efficiency & accuracy of vehicle detection is of importance for vehicle tracking, vehicle movement expression, and behavior understanding and is the basis for video processing .The vehicle detection process was then divided into appearance based and motion based techniques . The appearance based techniques mainly uses the appearance features like shape, color & texture of the vehicle to detect the vehicle or separate it from the background, whereas the motion based techniques uses mostly the moving characteristic to distinguish vehicles from the stationary background image.

2.1.1 Motion-Based Features : Motion detection is a very important task in computer vision. In traffic scenes, the most common characteristic of interest is that whether a vehicle is “moving” since it is typically only the moving vehicles that are of interest (traffic counts, safety, etc.).Motion detection aims to separate the moving foreground objects from the static background in the image. The motion cues are used to distinguish moving the vehicles from stationary background and it can be classified as : temporal frame differencing [28] that depends on the last two or three consecutive frames, background subtraction , which require frame history to build background model and finally optical flow [24] is based on in stantaneous pixel speed on image surface.

Table 1 Representative Work In Vision Based Vehicle Detection

Techniques	**Methods**	**References**
Motion-Based Features	Frame Differencing	[28] [11] [25]
	Background Subtraction	[33] [30]
	1.Median Filter 2. Kalman Filter	[29] [34]
	Single Gaussian pixel distribution	[4] [16]
	Gaussian Mixture Model	[35] [36] [5]
	Optical Flow	[24] [12]
Appearance-Based Features	Feature Based Technique	[37] [14]
	1.SIFT 2.HOG 3.Haar-like	[15][38] [6] [21]
	Part-Based model	[32] [15] [8]

2.1.2 Frame Differencing : The pixel wise difference is computed between two consecutive frames in temporal frame differencing method. The moving foreground regions are determined by using a threshold value . Street parking vehicles were detected using frame differencing in with noise suppression. The use of three consecutive frames improves detection as in where dual inter frame subtraction are calculated and followed by a bitwise AND to extract the moving target region.

2.2 BACKGROUND SUBTRACTION: Background subtraction methods are the most widely used approach for motion detection. Foreground objects are extracted by calculating the difference by pixel between the current image and a background image . In the simplest common case, the background image is constructed by specific known background images, e.g., background averaging method, in which a period of image sequences, are averaged to obtain a background model [30]. However, in real traffic scenes, the background are usually changing; therefore, this kind of methods are not suitable for dynamic traffic scenes. Thus, the background is constructed without any known background image, which make the following assumptions.

1) Background is always the most frequently observed in the image sequence.
2) The background pixel has the maximum appearance time at a steady state.

Using provided threshold, the static parts of sequential video frames must be cleaned. The main challenge here is that the performance of image analysis algorithms suffers from darkness, glare, long shadows or bad illumination at night,that is which may cause strong noises. Therefore, the grayscale image might be unspecified in such situations and make the detection task a bit more complex. Edges essentially separates the two various