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Ultra Wide Band MIMO Antenna for Vehicular Communication

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Abstract: *Vehicle to Vehicle (V2V) communication is continually gaining importance for road safety and different applications. so as to style economical V2V systems, associate degree understanding of realistic V2V propagation channels is needed. The Intelligent installation (ITS) initiative was invoked by congress in 1991 to advance the control systems by fostering development of Advanced Traffic Management System (ATMS). Multiple antenna systems conjointly called Multiple Input Multiple Output (MIMO) is wide wanted technology for its outstanding contribution in increasing the data rate compared to the standard approach of Single Input Single Output (SISO) systems. MIMO systems offer the pliability of antenna choice, creating the method economical and fewer advanced. A multiple-input-multiple-output (MIMO) antenna with ultra-wideband (UWB) performance is bestowed within the existing paper. The reliable Ness of the antenna within the automotive surroundings is investigated, with housing effects taken into consideration. The housing effects show that the antenna performs systematically even within the presence of an outsized metal object. Within the planned paper a UWB MIMO antenna for automotive communications is intended and developed. Stubs square measure integrated into the UWB monopole antenna part to realize resonance at three.1 GHz and one0.6 GHz. The antenna is fictional and tested for diversity performance. The planned antenna are designed, analysed victimisation 3D magnetic force simulation tools. The designed antenna are fictional and characterised for conveyance communication.*

Keywords: Antenna, MIMO, Vehicular Communication, Diversity

I. INTRODUCTION

The quest for high data rates has semiconductor unit to inflated analysis into ultra-wideband (UWB) and multiband antennas. UWB antennas unit used for a spread of automotive applications, including keyless entry, safety, free driving, vehicle-to-vehicle (V2V) communication, digital keys, and finding a vehicle in jammed parking lots [1].UWB technology can also be used for vehicle pursuit, localization, and parking guidance. The transport antenna is also mounted in varied locations, just like the car window, windshield, roof, or aspect mirror. The antenna is additionally at once fitted with the help of a shark-fin casing and chassis cavity [2]. Modern vehicles became loads of intelligent, providing comfort and safety to drivers by sanctioning machine-controlled driving facilitate and motion-picture show systems. Vehicle to everything (V2X) communication technology provides period of time traffic updates and safer driving by act directly with various vehicles[3].Signals among the automotive setting unit received from multiple ways that, resulting in multipath attenuation and interference. Diversity techniques like abstraction, pattern, and polarization unit accustomed encounter multipath interference. Therefore, a multiple-input-multiple-output (MIMO)/diversity antenna is also advantageous for transport communications [4].This paper proposes a UWB MIMO antenna for automotive applications. The proposed antenna half includes a straightforward maths that covers a decent vary of frequencies. Resonances at 1.5 rate and 2.45 rate achieved by incorporating stubs in the patch of the antenna half. The antenna components unit organized orthogonally to develop the projected MIMO antenna[5]. The projected quad-port MIMO antenna offers polarization and abstraction diversity. The MIMO antenna is dense in dimensions, covers many frequency bands, and offers smart dependability among the automotive setting. it should be merely integrated into a vehicle practice the shark fin mounting offered among the market. the range parameters evaluated to grasp the performance of the MIMO antenna, and the results unit satisfactory.

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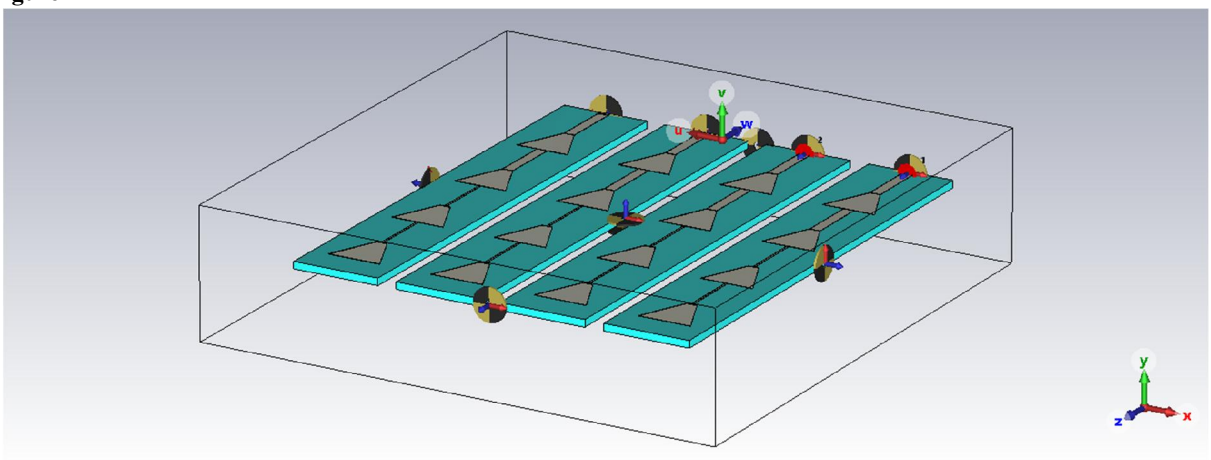
II. Antenna Design

The below diagram shows the layout of the projected antenna component. The antenna is developed on the FR-4 substrate with relative permittivity of 4.3 and a thickness of 5.8 mm. A simple rectangular monopole radiator is combined with a 2.2 feeding line width and to create the antenna component. The EM computer simulation technology Microwave Studio® is employed to perform simulations of the projected antenna. The dimensions of the antenna component is 10 millimetre × 25 millimetre.

Figure 1



2.1 On Car Scenario

The antenna will be mounted on the bumper, roof, car window, or side mirrors. The space between the antenna and therefore the ground ought to be larger to avoid ground losses. Therefore, the roof of the vehicle is that the best place for antenna mounting. The antenna will be mounted on the roof employing a shark-fin mounting system. Furthermore, the antenna is imported into an open-source CAD model to gauge its directionality for on-vehicle conditions. to boot, the far-field performance of the proposed antenna is investigated for an on-car situation. The results showed that the
Antenna has spatial relation characteristics over the specified frequencies.

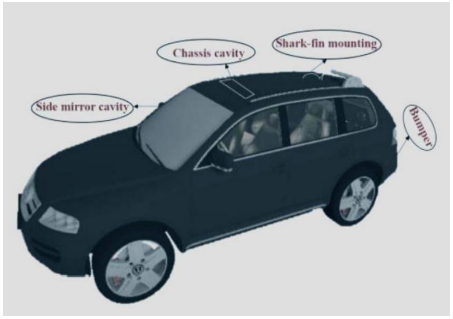


Figure 2: Antenna mounting location

III. Literature Review

[1] **Alsath, M.G.N.; Kanagasabai, M. Planar pentaband antenna for vehicular communication application. IEEE Antennas Wirel. Propag. Lett. 2014, 13, 110–113.**

In 2014 Alsath, M.G.N.; Kanagasabai, M. projected a paper planar pentaband antenna for transport communication application.The projected antenna is linearly polarized and is designed to hide the navigation and communication frequencies. This associate degreetenna utilizes a sq. patch radiator loaded with an inverted U-slot and a coupled C-slot to supply resonance at thenavigation frequencies. Furthermore, a constant study has been administered to research the impact caused by the amendment in slot parameters within the antenna aperture

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[2] **Madhav, B.T.P.; Anilkumar, T.; Kotamraju, S.K. Transparent and conformal wheel-shaped fractal antenna for vehicular communication applications. AEU-Int. J. Electron. Commun. 2018, 91, 1–10.**

In 2018 Madhav, B.T.P.; Anilkumar, T. Kotamraju, S.K. proposed a paper clear and conformal wheel-shaped pattern antenna for transport communication applications. In this article, a low cost, compact conformal antenna is projected for transport communications applications. The idea of geometry is applied to make the model additional enticing in its look likewise on attain desired bands within the vehicular communication spectrum.The characterization of the antenna is performed in its each platelike and versatile versions.

[3] **Raheja, D.K.; Kumar, S.; Kanaujia, B.K. Compact quasi-elliptical-self-complementary four-port super-wideband MIMO antenna with dual band elimination characteristics. AEU-Int. J. Electron. Commun. 2020, 114, 153001.**

In 2020 Kumar, S.; Lee, G.H.; Kim, D.H.; Mohyuddin, W.; Choi, H.C.; Kim, proposed a paper A compact four-port UWB MIMO antenna with connected ground and wide axial ratio bandwidth. A new style technique of ultra-wideband circularly-polarized platelike multiple-input-multiple-output (MIMO) antenna is bestowed during this paper. The planned MIMO antenna consists of 4 unit antennas, being comprised of a microstrip feed line and a sq. slotted ground plane. Within the planned unit style, a circular stub is protruded from the bottom plane strip for achieving circular polarization.

[4] **X. Ge, J. Yang, H. Gharavi, and Y. Sun, "Energy Efficiency Challenges of 5G Small Cell Networks," IEEE Communications Magazine, 2017**

In 2017 a paper was projected on Ultra-Wideband Diversity MIMO Antenna System for Future Mobile Handsets. In this paper, Each antenna set consists of an open-ended circular-ring slot radiator fed by a couple of free semi-arc-shaped microstrip-feeding lines exhibiting the polarization diversity characteristic. Therefore, in total, the projected smartphone antenna style contains four horizontally-polarized and 4 vertically-polarized parts. The projected UWB-MIMO smartphone antenna system offers smart isolation, dual-polarized perform, full radiation coverage, and abundant efficiency.

[5] **Kola, K.S.; Chatterjee, A. Design of a right-handed circularly polarized printed antenna for vehicular communication. Wirel. Pers. Commun. 2021, 1–22.**

In 2021 Kola, K.S.; Chatterjee, A.proposed a paper Design of a right-handed circularly polarized printed antenna for vehicular communication. In this paper, the authors introduced a brand new 3-D microstrip patch antenna for Dedicated Short vary Communication (DSRC) (5.850–5.925 GHz) (IEEE 802.11p) service band. The planned structure is obtained by etching the Minkowski boxes altogether the four corners of a square shape. The final structure is obtained by superimposing this existing one with its 45◦ turned version. The article conveys a replacement approach of analysing the S11 parameter of the antenna from its circuit equivalent model, that comes from the construct of nodal quality issue

IV. Results and Discussion

The proposed antenna array was fabricated. The simulated results of the proposed antenna array were obtained through CST Microwave Studio Version 21, and its S-parameters were measured and the corresponding results will be presented below.

4.1 S –Parameter

Fig 3 depict the measured S- Parameter. Apparently, the simulation and measurement validate well with each other. However, slight deviations are still discovered, that is maybe because of the fabrication tolerances and measuring errors.

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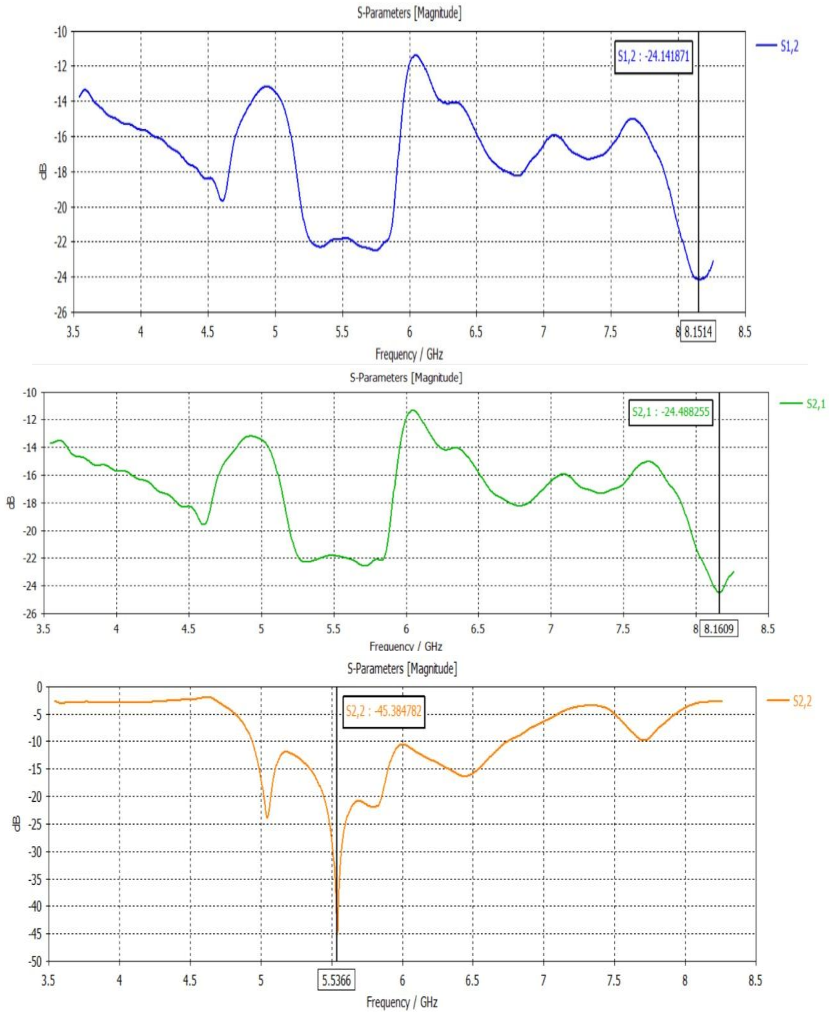

Figure 3: S-Parameter of the proposed antenna

4.2 Radiation Pattern

The radiation patterns E-plane and H-plane of the antenna in 3D and polar view are displayed in Figure 4. Figure 5 depicts the gain and efficiency of the planned antenna. The utmost gain is found to be 10.9 dB, and therefore the most efficiency is 59%.

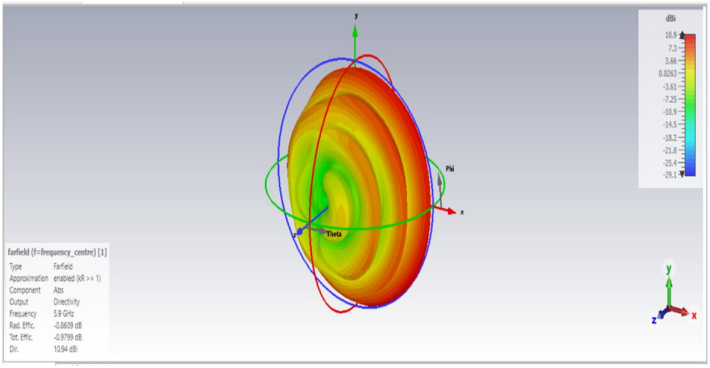

Figure 4: Radiation pattern in 3D view

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Figure 5: Radiation pattern in polar view

V. CONCLUSION

MIMO/diversity antenna for automotive communications is meant and developed during this paper. Stubs square measure integrated into the UWB monopole antenna component to attain resonance at one.5 GHz and a 2.45 GHz. The automotive antenna should receive signals from all directions; thus, the antenna parts organized orthogonally to every alternative. The planned MIMO antenna may well be useful for GPS, Bluetooth/Wi-Fi, and V2V communications.

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