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Design and Analysis of H-Shaped Micro-Strip Patch Antenna

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***Abstract*— Microstrip antennas are widely used in modern wireless communication systems due to their low profile, light weight, low manufacturing cost, and easy integration with microwave circuits. Among the different patch antenna geometries, the H-shaped microstrip antenna has gained significant attention because of its enhanced bandwidth, improved gain, and compact size compared to conventional rectangular patch antennas. This paper presents the design, structure, working principle, advantages, limitations, and applications of the microstrip H-shaped antenna. The H-shaped slot configuration helps in modifying the current distribution on the patch, thereby improving the antenna performance in terms of impedance bandwidth and resonant frequency control. Such antennas are suitable for wireless communication, satellite communication, Wi-Fi, WLAN, and modern compact RF devices.**

***Keywords*— Microstrip Antenna, H-shaped antenna, Patch Antenna, Bandwidth Enhancement, Wireless Communication and Compact Antenna..**

I. INTRODUCTION

Wireless communication systems have increased the demand for compact, low-cost, and high-performance antennas. Microstrip patch antennas have emerged as one of the most popular antenna types because of their simple planar structure and compatibility with printed circuit board (PCB) technology. However, conventional microstrip patch antennas suffer from limitations such as narrow bandwidth and low gain.

To overcome these limitations, various modified patch shapes have been proposed, such as U-shaped, E-shaped, L-shaped, and H-shaped antennas. Among them, the **H-shaped microstrip antenna** is an effective design that improves bandwidth and reduces antenna size without significantly increasing fabrication complexity. The H-shaped slot or patch structure changes the effective current path and introduces additional resonant modes, which enhances the operating characteristics of the antenna.

A. Microstrip Antenna

A microstrip antenna generally consists of three basic layers:

1. Radiating Patch – the top conducting element.
2. Dielectric Substrate – placed between patch and ground plane.
3. Ground Plane – bottom conducting layer.

The antenna radiates due to fringing fields between the patch edges and the ground plane. Microstrip antennas are preferred in many communication systems because of their:

- Low profile
- Light weight
- Ease of fabrication
- Low cost
- Conformal nature
- Easy integration with active and passive devices

Despite these advantages, the traditional rectangular microstrip patch antenna has a limited impedance bandwidth, typically in the range of 2–5%.

B. Advantages of H-Shaped Microstrip Antenna

The H-shaped microstrip antenna offers several advantages:

- Enhanced bandwidth
- Compact size
- Improved impedance matching
- Possibility of multiband operation
- Simple fabrication
- Low profile structure

Suitable for modern wireless systems

II. LITERATURE REVIEW

A. Previous Work Done

Asif Ali Bhoot et.al (2019) - various advantages such as: easy to configure, low weight and low cost make microstrip patch antenna (MPA) the first choice for

wireless communication system. The structure of the patch antenna consists of dielectric material in between radiating patch and ground plan. In this paper we present the comparative performance analysis of 4 different shaped antennas. The shapes taken into consider are E, T, H and F. The antenna is designed to operate at is 2.4 GHz. The results of different antenna parameters such as return loss VSWR, radiation pattern, gain and directivity are analyzed on different frequency bands. The E-shaped patch antenna is found much better than the others with overall gain of 7.2 dB at 2.4 GHz. Which is suitable for RFID reader application. Simulation is done using High Frequency Structure Simulator (HFSS) antenna simulation tool [01].

M.Paranthaman et.al (2019) - The reconciliation of innovative advancement and medicinal types of gear lead to the usability implantable bio devices for the checking of patients. These implantable gadgets lessen the hospitalization time of the patient. The implantable gadgets speak with nature by means of receiving wires .Thus planning of radio wires for an implantable gadget assumes a noteworthy job. The Microstrip feed rectangular fix double band radio wire which works in the 2GHz, 2.45GHz and 4.5GHz MICS Band and ISM Band is displayed for the implantable gadgets. The planned radio wire offers better return loss and gain values [02].

M. Meena et.al (2018) - In general, antenna is designed for transmit or receive electromagnetic waves. Among different kinds of antenna Microstrip patch antenna is most widely used antenna because of its low profile, easy fabrication and inexpensive. The microstrip patch antenna has another advantage that it can be designed for any shape. There are four different shapes are taken for this analysis. But the major problem with these antennas is narrow bandwidth. In this paper microstrip patch antenna is designed for four different shapes and substrates. The substrate materials are taken according to the dielectric constant values. And the antenna parameters such as gain, directivity, bandwidth and returnloss are variable with different shapes and substrates. Then the antenna parameters are noted and compared using Advanced Design System (ADS) software [03].

Uzma Uddin et.al (2018) - The design and performance analysis of a rectangular microstrip patch antenna and its array in E and H plane. The antenna is designed at a centre frequency of 5.9GHz for Wi-Fi applications. The simulated return loss, directivity, side lobe level and radiation efficiency of simple patch has been achieved as −26.91dB, 6.862dB, −20.3dB and 77% respectively. An Improved directivity up to 9.6dB and 9.308dB with better matching also has been achieved in case of E and H plane array. Simulated result has been listed and comparative analysis has been done which reveals the fact that with help of array performance characteristics of antenna can be easily enhanced [04].

L. C. Paul et.al (2017) - The primary objective this work is to design and analysis the simulation of different shaped (E, H and Combined E-H) compact and planar MPA array for multiband wireless applications. The ADS is used as the simulation tool for all the proposed antennas. Different antenna performance parameters like return loss, bandwidth, directivity, gain, radiation efficiency and axial ratios were analyzed for the proposed antennas. In future work, different types of feeding techniques can be used to analyze the overall performance of the antenna. Therefore, antennas can be fabricated practically and compared with the experimental results and simulated results [05].

S.Kannadhasan et.al (2017) – A U Shaped micro strip antennas with improved bandwidth operate at 3.8GHz. The proposed antenna will be in light weight, smart and compact unit compare with consists of metallic patch and ground between which is a dielectric medium called the substrate. The Proposed antenna also presents the detail steps of designing the U shaped micro strip antenna and the simulated result. U shaped antenna is used for military, wireless and civil applications. ADS software is used to compute the gain, power, radiation pattern, and S11 of the antenna. The gain of the designed antenna is 7.74 dB and antenna efficiency of 99.6% [06].

Md. Khaliluzzaman et.al (2015) - A H-shaped wide band micostrip patch antenna at 4 GHz for WLAN applications. Performance is improved by inserting a pair of slits in an appropriate radiating edge to form H-Shaped patch antenna. The proposed antenna designed in this paper exhibits enhanced bandwidth with multi resonant frequencies. In this work a geometric H-shaped is developed from a rectangular patch of the width (W=29.6 mm) and length (L=24.5 mm). The antenna was fabricated using Rogers RT-5880 substrate with a dielectric constant εr of 2.2 and a thickness of 1.574 mm respectively. The result of proposed antenna was obtained in terms of Return Loss and bandwidth. The simulated result shows that the H-shaped patch antenna has the highest bandwidth in comparison with Parasitic patch antenna, Stacked patch antenna, Proximity coupled patch antenna and E-shaped patch antenna [07].

Table-1 Compression Table of Previous Method

Author(s) & Year	Objective / Focus	Antenna Type / Shape	Operating Frequency	Parameters Analyzed
Asif Ali Bhoot et.al (2019)	Comparative performance analysis of different shaped micro strip patch antennas for wireless communication	E, T, H, and F-shaped MPA	2.4 GHz	Return loss, VSWR, radiation pattern, gain, directivity
M. Paranthaman et.al (2019)	Design of implantable antenna for biomedical monitoring devices	Microstrip-fed rectangular patch dual-band antenna	2 GHz, 2.45 GHz, and 4.5 GHz	Return loss, gain

M. Meena et.al (2018)	Comparative study of different patch shapes and substrate materials	Four different shaped MPAs	Not specifically fixed (varied by design)	Gain, directivity, bandwidth, return loss
Uzma Uddin et.al (2018)	Design and analysis of rectangular patch antenna and its array for improved performance	Rectangular MPA and E-plane / H-plane arrays	5.9 GHz	Return loss, directivity, side lobe level, S-11
L. C. Paul et.al (2017)	Design and simulation of compact planar multiband MPA arrays	E-shaped, H-shaped, and Combined E-H shaped MPA arrays	Multiband (not explicitly specified)	Return loss, bandwidth, directivity, gain, radiation efficiency, axial ratio
S. Kannadhasan et.al (2017)	Design of U-shaped microstrip antenna with enhanced bandwidth	U-shaped microstrip patch antenna	3.8 GHz	Gain, power, radiation pattern, S11, efficiency
Md. Khaliluzzaman et.al (2015)	Design of wideband H-shaped microstrip patch antenna for WLAN	H-shaped microstrip patch antenna	4 GHz	Return loss, bandwidth

III. H-SHAPED MICROSTRIP ANTENNA

The **H-shaped microstrip antenna** is a modified form of the rectangular patch antenna in which two rectangular slots are cut into the patch, forming an "H" geometry. This modificat
ion changes the surface current distribution and increases the effective path length of the current flow.

A. Structure of H-Shaped Antenna

The H-shaped antenna generally includes:

- H-shaped radiating patch
- Dielectric substrate (e.g., FR4, Rogers RT/Duroid)
- Ground plane
- Feeding mechanism (microstrip line feed, coaxial probe feed, or inset feed)

B. Design Principle

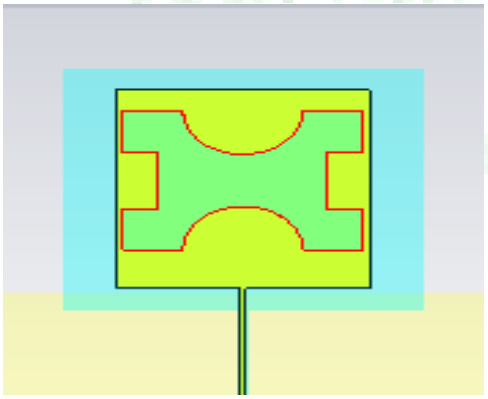

Fig. 1: Shows the design of proposed H shape

In the research work present a multilayer microstrip monopole fractal patch antenna for integration into flexible and conformal devices, it is good step for flexible technology. During this evolution two vital standards are Wi-MAX and Wireless local area network antennas are standard for its well-known engaging options, like a small size, easy to fabricate and easy to use. The demand of flexible antenna is increasing rapidly due to its good properties such an easy to fabricate, easy to fit any communication device and also use in different places where require flexible technology structure. For the flexible technology in antenna use different type of substrates such as Graphene, copper indium gallium.The next generation of technology is based on flexible electronics, for the growth of this technology, proposed flexible antenna shows a vital role.

IV. VALIDATION DISCUSSION

The multi layer flexible patch based microstrip patch antennas have gaining importance in the applications of Wireless Local Area networks (WLAN), Wireless Fidelity. The simulated results such as Return Loss (S_{11}), VSWR and Radiation Pattern, Bandwidth and Mesh field.

Return Loss:

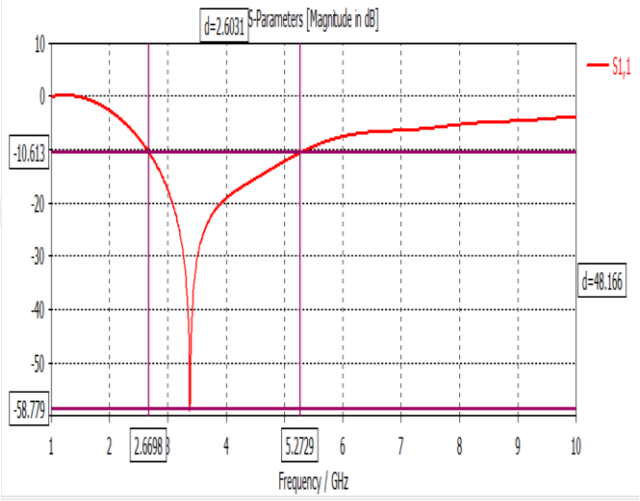

Table- II Validation Compare with Previous Method

Parameter	Previous design	Proposed Design
Sub. Height (m.m.)	0.245	**0.125**

Relative B.W.	5.10%	**82.35%**
Return Loss	-25 db	**-58 db**
Sub. Constant	3.4	**2.2**
Covered Range	4.8 to 5.1 GHz	**2 to 6**

Table- III Advantages of H shape Design

Parameter	**Rectangular Patch Antenna**	**H-Shaped Microstrip Antenna**
Bandwidth	Low	Higher
Size	Standard	More compact possible
Gain	Moderate	Improved
Impedance Matching	Moderate	Better
Multiband Capability	Limited	Better
Fabrication Complexity	Simple	Slightly higher

V. Conclusion

This presented work shows the design of multi-layer monopole patch antenna with rectangular slots. The proposed design shows good result as compared to other previous method's results on the basis of basic antenna parameters such as VSWR, gain, Return Loss and bandwidth. The proposed antenna shows a wide band and cover Wi-Fi [13] and Wi-Max [13] ranges whose frequencies is between 1 to 6 GHz. The range of proposed design cover the wireless fidelity and Wi-Max range. The overall gain of proposed antenna is above 4db. Also shows the good result in terms of return loss that is (S-11) -37.11 dB as well as VSWR that is 1.02 and important parameter is percentage bandwidth is 77.01%.

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References

[1] Bhoot, Asif Ali, Sajjad Ali Memon, Aqeel Ahmed, and Saqib Hussain. "Comparative study of microstrip patch antenna with different shapes and its application." In *2019 2nd international conference on computing, mathematics and engineering technologies (iCoMET)*, pp. 1-8. IEEE, 2019.

[2] Paranthaman, M., and S. Palanivel Rajan. "Design of H Shaped Patch Antenna for Biomedical Devices." *International Journal of Recent Technology and Engineering, ISSN* (2019): 2277-3878.

[3] Meena, M., and P. Kannan. "Analysis of microstrip patch antenna for four different shapes and substrates." *ICTACT Journal on Microelectronics* 4, no. 1 (2018): 519-530.

[4] Uddin, Uzma, W. Akaram, and Md Rashid Anasri. "Design and analysis of microstrip patch antenna and antenna array for vehicular communication system." In *2018 Second International Conference on Inventive Communication and Computational Technologies (ICICCT)*, pp. 1746-1751. IEEE, 2018.

[5] Paul, L. C., M. S. Akhter, M. A. Haque, M. R. Islam, M. F. Islam, and M. M. Rahman. "Design and analysis of four elements E, H and combined EH shaped microstrip patch array antenna for wireless applications." In *2017 3rd international conference on electrical information and communication technology (EICT)*, pp. 1-6. IEEE, 2017.

[6] Kannadhasan, S., and A. C. Shagar. "Design and analysis of U-Shaped micro strip patch antenna." In *2017 third international conference on advances in electrical, electronics, information, communication and bio-informatics (AEEICB)*, pp. 367-370. IEEE, 2017.

[7] Khaliluzzaman, Md, D. Kumar Chy, and Md Rezanul Haque Chowdhury. "Enhancing the Bandwidth of a Microstrip Patch Antenna at 4 GHz for WLAN using H-shaped Patch." *International Journal of Innovative Science, Engineering & Technology (IJISET)* 2, no. 2 (2015): 231-237.

[8] Durmuş, Ali, and Zafer Yıldırım. "Design and comparative analysis of E-Shape and H-Shape microstrip patch antenna for IoT application." *Mühendislik Bilimleri ve Araştırmaları Dergisi* 6, no. 1 (2024): 88-97.

[9] Saeed, Noor Haider, Malik Jasim Farhan, and Ali Al-Sherbaz. "Design and analysis of microstrip antenna for 5G applications." *Journal of Engineering and Sustainable Development* 28, no. 02 (2024): 285-293.

[10] Bedra, Mohamed, Djemai Arar, Djamel Benatia, Sami Bedra, and Akram Bediaf. "Design of superconducting H-shaped microstrip antennas on anisotropic substances using hybrid cavity model." *Progress In Electromagnetics Research Letters* 120 (2024): 23-29.

[11] Pauliah Nadar, Kannan, Vanitha Jeyaprakasam, Inbamalar Tharcis Mariapushpam, Chettiyar Vani Vivekanand, Anna Devi Eswaralingam, Magthelin Therase Louis, Jasmine Xavier Arul Raj et al. "Design and analysis of microstrip patch antenna array and electronic beam steering linear phased antenna array with high directivity for space applications." *ACS omega* 8, no. 45 (2023): 43197-43217.

[12] Kumar, Abhishek, Abhishek Kushwah, Aman Anand, Kumar Mangalam Patel, and Anshu Kumar. "Design & Analysis of HShape Microstrip Patch Antenna." *International Journal of Applied Science and Research Technology* 10, no. 5 (2022): 2422-2425.

[13] Nahas, Mousaab M. "Gain enhancement of a microstrip patch antenna with quasi H-shaped slot for UHF RFID reader." *Journal of Applied Science and Engineering* 26, no. 4 (2022): 565-569.
[14] A. Bansal and R. Gupta, (2020) "A review on microstrip patch antenna and feeding techniques" International Journal of Information Technology 12(1): 149–154. DOI: 10.1007/s41870-018-0121-4.
[15] M. U. Khan, M. S. Sharawi, and R. Mittra, (2015) "Microstrip patch antenna miniaturisation techniques: a review" IET Microwaves, Antennas & Propagation 9(9): 913–922. DOI: 10.1049/iet-map.2014.0602.
[16] D. Gupta, A. Duvey, and S. Agrawal, (2019) "A review: microstrip antenna" International Research Journal of Engineering and Technology 6(7): 1238–1241.
[17] M. M. Nahas and M. Nahas, (2019) "Bandwidth and efficiency enhancement of rectangular patch antenna for SHF applications" Engineering, Technology & Applied Science Research 9(6): 4962–4967. DOI: 10 . 48084/etasr.3014.
[18] M. J. Hakeem and M. M. Nahas, (2021) "Improving the performance of a microstrip antenna by adding a slot into different patch designs" Engineering, Technology & Applied Science Research 11(4): 7469–7476. DOI: 10.48084/etasr.4280.
[19] M. Nahas, (2022) "A super high gain L-slotted microstrip patch antenna for 5G mobile systems operating at 26 and 28 GHz" Engineering, Technology & Applied Science Research 12(1): 8053–8057. DOI: 10.48084/etasr. 4657.
[20] J. Zaid, M. Farahani, A. Kesavan, and T. A. Denidni. "Miniaturized microstrip patch antenna using electromagnetic band gap (EBG) structures for multiport passive UHF RFID-tag applications". In: 2017 IEEE International Symposium on Antennas and Propagation & USNC/URSI National Radio Science Meeting. 2017, 2459–2460. DOI: 10.1109/APUSNCURSINRSM.2017. 8073272.
[21] P. Y. Lau, C. Qingxin, and W. Yueshan. "Review on UHF RFID antennas". In: 2017 International Workshop on Electromagnetics: Applications and Student Innovation Competition. 2017, 53–55. DOI: 10.1109/iWEM. 2017.7968764.
[22] T. Aleong and K. Fai Pun, (2021) "Advancing the ultra high frequency RFID in industrial applications: a review" The West Indian Journal of Engineering 44(1): 40– 52. DOI: 10.47412/PWPG5760.

