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Design and Parametric Study of Microstrip-fed Vivaldi Antenna for Body Area Network

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ABSTRACT:

Vivaldi antenna with high-frequency selectivity is organized and examined. This paper consolidates the effects of antenna plan parameters on its execution. 3D electromagnetic generation programming CST was used to reenact distinctive sizes of three important structure parameters. By looking at a couple of antenna basic parametric results, including return loss (S-parameter), voltage standing wave ratio (VSWR), reference impedance and substrate parameters expect a basic occupation in antenna execution. Results exhibit that incredible frequency selectivity of the multiband from 4.546GHz to 5.784GHz is recognized, and the antenna shows extraordinary impedance arrange, high radiation gain, and wonderful radiation directivity in the multiband. Both the proliferation and estimation results give incredible understanding.

KEYWORDS - *CST, VSWR, S-Parameter, FR4, Return loss, 3D*

I. INTRODUCTION

Body area network (BAN), additionally alluded to as a remote body region arrange (WBAN) or a body sensor arrange (BSN) or a restorative body zone arrange (MBAN), is a remote system of wearable registering gadgets. Boycott gadgets might be installed inside the body, inserts, might be surface-mounted on the body in a settled position Wearable innovation or might be went with gadgets which people can convey in various positions, in garments pockets, by hand or in different sacks. While there is a pattern towards the scaling down of gadgets, specifically, systems comprising of a few scaled down body sensor units (BSUs) together with a solitary body focal unit.

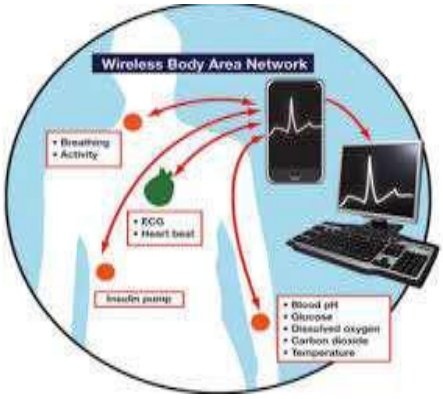


Fig. 1: Wireless body area network

Introductory utilizations of BANs are required to show up principally in the human services space, particularly for persistent observing and logging essential parameters of patients experiencing perpetual ailments, for example, diabetes, asthma and heart assaults. A Boycott arrange set up on a patient can alarm the doctor's facility, even before they show at least a bit of kindness assault, through estimating changes in their fundamental signs. A Boycott organize on a diabetic patient could auto infuse insulin through a siphon, when their insulin level decays.

A. WEARABLE ANTENNA

Later improvements and innovative headways in remote correspondence, Micro Electro Mechanical Systems (MEMS) innovation and coordinated circuits has empowered low-control, smart, scaled down, obtrusive/non-intrusive small scale and nano-innovation sensor hubs deliberately put in or around the human body to be utilized in different applications, for example, individual wellbeing observing. This energizing new territory of research is called Remote Body Zone Systems (WBANs) and use the developing IEEE 802.15.6 and IEEE 802.15.4j models, explicitly institutionalized for therapeutic WBANs. The point of WBANs is to streamline and enhance speed, precision, and unwavering quality of correspondence of sensors/actuators inside, on, and in the quick nearness of a human body. The huge extent of difficulties related with WBANs has prompted various distributions. In this paper, we overview the present condition of-specialty of WBANs dependent on the most recent measures and productions. Open issues and difficulties inside every region are additionally investigated as a wellspring of inspiration towards future improvements in WBANs.

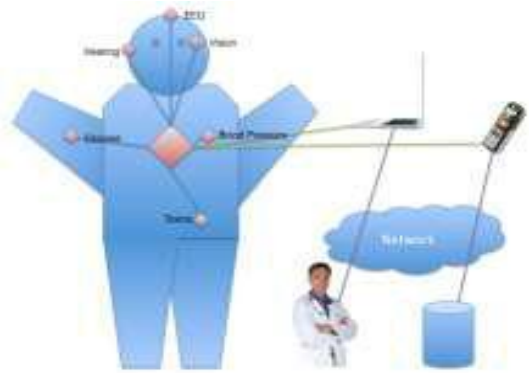


Fig. 2: Wearable antenna

Wearable contraptions have to a great degree wide application. Before it was familiar with customer exhibit, wearable devices are used as a piece of the military development. By then, it has been associated in other field, for instance, gaming, music, preparing, transportation, ineptitudes, health and prosperity. In these fields, the need is to merge the limits expected to a device that can be used effectively in step by step lives.

II. LITERATURE SURVEY

D. Yang, J. Hu and S. Liu [1] propose a position of safety ultra-wideband (UWB) antenna for remote body territory systems. The proposed antenna is low-weight and simple to deliver by printed circuit board producing. Improved state of the radiation patch and shorted top-stacking patches are acquainted with expanding the bandwidth and lessen the profile of the antenna. The tallness of the antenna is 0.05λ 0 , where

λ 0 is the free-space wavelength at the most minimal working frequency. The reproduced and estimated results demonstrate that an upgraded impedance bandwidth of about 162% in the scope of 2.5 to 24 GHz (S 11 <; - 10 dB) is accomplished. Furthermore, the impact of the human body to the proposed antenna is negligible. The time-area conduct of the position of the safety UWB antenna is tried, and the outcomes demonstrate a palatable execution in transmitting and getting beat signals.

W. Amer, Gui Yun Tian [2] shows a novel antenna plan for the ultra wideband body territory arrange applications. The plan is made out of two Vivaldi shapes put inverse to one another on a similar substrate, which accomplishes steady impedance coordinating over a wide band and uniform radiation design. To decrease the retrogressive radiation, two kinds of reflector were utilized: level and bended. Results demonstrate that utilizing a bended reflector improves the radiation design on a large portion of the UWB with less impact on the antenna impedance contrasted with the level reflector.

M. Y. ElSalamouny [3] proposes two novel conservative plans of low-profile multi-band microstrip antennas. The first can work in ISM bands (2.4 GHz and 5.8 GHz), which makes it reasonable for Remote Body Zone System (WBAN) medicinal applications. Then again, the second structure executes stacking of antenna to such an extent that the subsequent novel plan

works ideally at 3.5GHz and 7.5GHz, which makes it reasonable for Ultra-Wide-Band (UWB) applications. The two antenna plans are minimal in size, that is, the general size of the primary antenna is just 11.54 mm3, while the second is 25.16 mm3. The two antenna structures are reenacted on skin radiation box, so as to permit progressively exact forecast of the antenna execution when utilized in medicinal implantable gadgets. Aside from the minimized size, both antenna structures deliver a base Explicit Assimilation Rate (SAR) which conforms to IEEE standard wellbeing rules, which is essential for shielding patients from electromagnetic harm.

W. Jeong and J. Choi, [4] proposes a position of safety UWB antenna with cone shaped radiation for on-body correspondences is proposed. The antenna has generally speaking elements of 64 mm × 64 mm × 6 mm (0.64 λ 0 × 0.64 λ 0 × 0.06 λ 0 at 3 GHz) in the Motivation Radio UWB (3.1 GHz - 10.6 GHz) band. The proposed antenna is made out of a mono-cone and a TM41 higher-arrange mode shorted ring patch. The reenacted outcomes demonstrate that the proposed antenna acquires monopole-like radiation exhibitions in the entire working frequency band. The radiation example of the proposed antenna on the apparition is like that in free space so that the on-body WBAN application can be practical.

A. Zaric, J. R. Costa [5] shows an extremely minimized low-profile (37.6 mm×27 mm×3.1 mm) unidirectional UWB antenna is proposed for remote body territory organize (WBAN) confinement applications by concentrating on its running execution and motivation constancy in time area notwithstanding frequency space attributes. The antenna is insusceptible to coordinate skin contact, and furthermore shows great frequency and time area properties in free space or at any separation to a body: reflection coefficient and radiation design versatility to body impact; level exchange work plentifulness and straight stage over the ideal frequency band from 6 GHz to 9 GHz. Prevalent time area execution is shown in reenactment and estimations with normal drive constancy of 97% in both free space and when put at 0 mm or 3 mm over the body.

A. Zaric, J. R. Costa [6] sows a position of safety unidirectional UWB antenna for WBAN (Remote Body Zone Systems) Motivation Radio (IR) applications is proposed with useful band from 7 GHz to 10.7 GHz. Reproduced reflection coefficient in free space and when 0 mm, 3 mm, or 7 mm over a human body display demonstrate that the body impact is negligible. Time area investigation of heartbeat devotion, of vital significance for IR-UWB, demonstrates normal loyalty of 98% in free space and when 3 mm or 0 mm over the body.

Table 1: Summery of reviews

Author name	Year of Publication	Frequency Range(in GHz)	Objective
B. Sivasha	Dec 2017	2.5 to 24	Low-weight and easy to produce by printed circuit board manufacturing
R. Herzi	Nov 2017	2 to 5	Novel antenna design for ultra wideband body area network applications.
D. Yang	July 2018	2.4 to 5.8	Novel compact designs of low-profile multi-band microstrip antennas
J. Shan	Nov 2017	3.1 to 10.6	Monopole like radiation

			performances
W. Jeong	Nov 2015	3.1 to 12	Novel folded ultra wideband antenna for Wireless Body Area Network

III. PROBLEM FORMULATION

From the above writing survey, it can reasoned that the primary issue with the Vivaldi microstrip patch antenna is Thin bandwidth, bring down gain (6 dB), extensive ohmic loss in the feed structure of cluster, polarization virtue is hard to accomplish, bring down power taking care of ability and so forth in the light of writing study it can detail an issue of lower bandwidth and low return loss is the fundamental weaknesses. No proficient antenna structure for wearable antenna over body zone organize applications.

IV. PROPOSED DESIGN

In figure 3, demonstrating top perspective of proposed Vivaldi microstrip patch antenna, one side of a dielectric substrate goes about as a transmitting patch and opposite side of substrate goes about as ground plane. Top perspective of a rectangular patch antenna with coaxial feed has. Patch and ground plane together makes bordering fields and this field is in charge of making the radiation from the antenna.

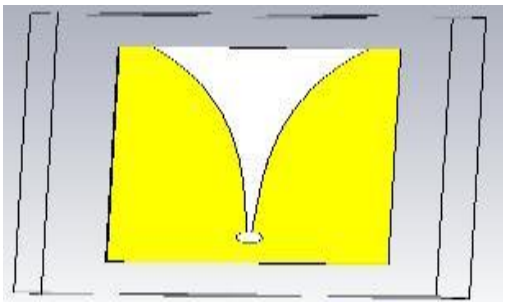


Fig. 3: Top view of proposed Vivaldi antenna

The structure of a vivaldi microstrip antenna which has a wide bandwidth with directional radiation design takes a shot at 3.1 to 10.7 GHz and utilizing less expensive substrate. Substrates utilized for vivaldi microstrip antenna vivaldi is FR4 with a dielectric steady of 4.3 and a thickness of 1.6 mm. In view of the reenactment results we acquired that the antenna configuration has frequency extend 3.1-10.7 GHz for return loss not exactly - 10 dB with a directional radiation design. This antenna gain is 4.8 to 8 dBi with the biggest measurement is 50 mm x 40 mm.

V. SIMULATION RESULT

So as to acknowledge multiband antenna, a wide assortment of antenna types, which utilizes diverse multiband systems, is utilized. The most broadly utilized procedure for acquiring multiband antenna system is the use of different resounding structures. The different full structure strategy is likewise frequently utilized in body zone arrange correspondence systems .

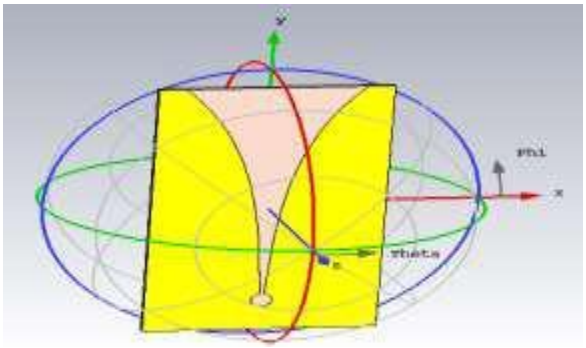


Fig. 4: Simulation and fields of proposed antenna

Figure 4, demonstrating reproduced proposed antenna in CST microwave studio, it is a particular device for the quick and precise 3D EM reenactment of high frequency issues. Alongside a wide application run in various field.

A. S11 PARAMETER AND RETURN LOSS

Return loss is the distinction, in dB, among forward and reflected power estimated at some random point in a RF system and, as SWR, does not differ with the power level at which it is estimated. Figure 5, demonstrates the Return Loss (S11) parameters for the proposed antenna, which speaks to the multiband bands of frequency for which the antenna structured is advanced i.e. frequencies going from 4 GHz to 7 GHz with S11 esteem past - 10 dB and the scope of frequencies according to the outcomes demonstrates that it has a decent bandwidth when contrasted with other microstrip antenna. The got estimation of S11 for 4.546GHz is - 36.37 db and 5.784GHz is - 34.45db. Here 4.546GHz and 5.784GHz is thunderous frequency, where antenna proficiency is higher. Qualities - 36.37 db and - 34.45db are return loss openly, it is more prominent than - 10db, so it's great estimation of return loss.

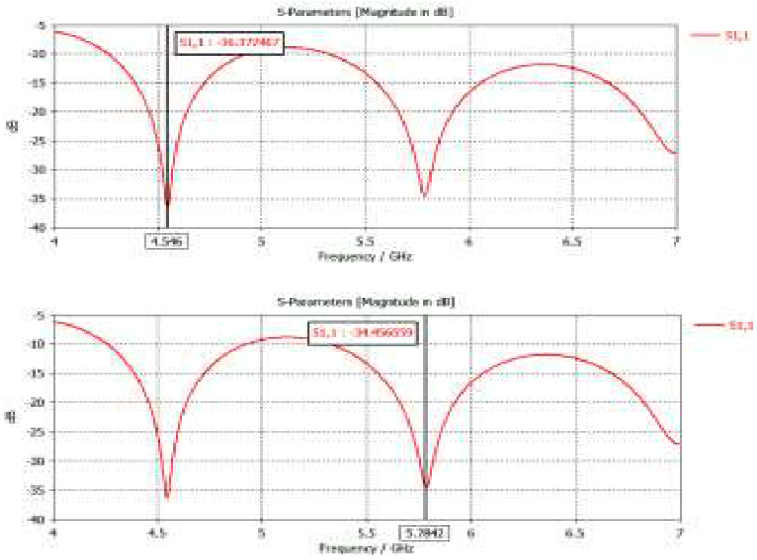


Fig. 5: S parameter and Return loss

B. BANDWIDTH

Bandwidth, for a system, could be the scope of frequencies over which the system delivers a predefined dimension of execution. A not so much strict but rather more essentially valuable definition will allude to the frequencies past which Execution is corrupted. The bandwidth of an antenna is characterized as "the scope of frequencies inside which the execution

of the antenna, regarding some trademark, complies with a predefined standard." For broadband antennas, the bandwidth is typically communicated as the ratio of the upper-to-bring down frequencies of satisfactory operation.

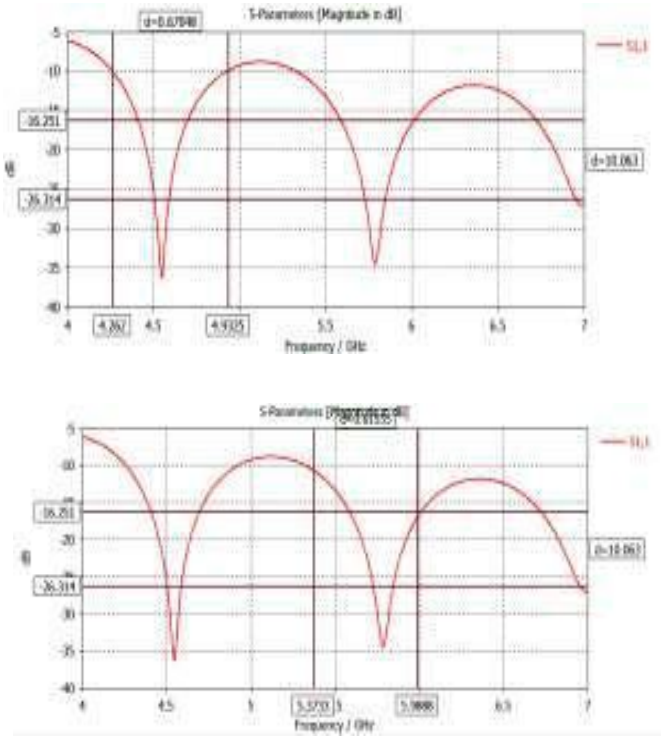
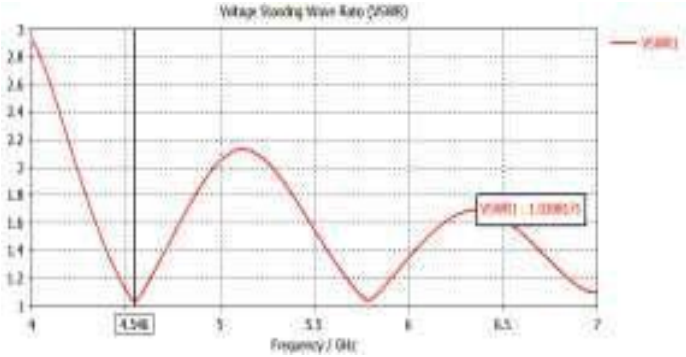


Fig. 6: Bandwidth calculation

For broadband antennas, the bandwidth is communicated as a level of the frequency distinction (upper less lower) over the middle frequency of the bandwidth. The bandwidth of proposed antenna is 670.48 MHz, (4.262GHz-4.9325GHz), for first band and 615.55 MHz, (5.9888GHz-5.3733GHz), for second band.

C. VOLTAGE STANDING WAVE RATIO

VSWR (Voltage Standing Wave Ratio), is a proportion of how productively radio-frequency control is transmitted from a power source, through a transmission line, into a heap (for instance, from a power intensifier through a transmission line, to an antenna). In a perfect system, 100% of the vitality is transmitted.



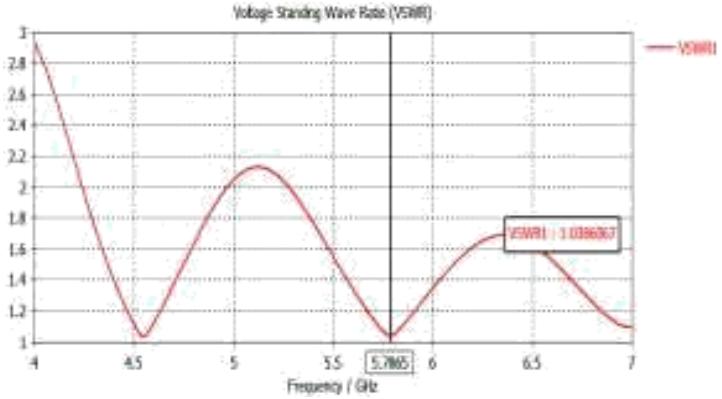


Fig. 7: Voltage Standing Wave Ratios

VSWR must lie in the scope of 1-2, which has been accomplished for the frequencies 4.915GHz and6.018GHz. The incentive for VSWR is 1.030 and1.038 separately.

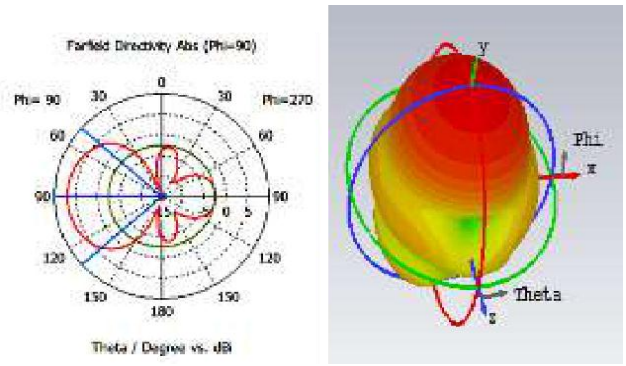


Fig. 8: Radiation pattern

Table II: Result summary of proposed Antenna

S.N.	Parameter	Value (Band-I)	Value (Band-II)
1	S11& Return Loss	-36.37 db	-34.45db
2	Band Width	670.48 MHz	615.55 MHz
3	VSWR	1.030	1.038
4	Resonant Frequency	4.546GHz	5.784GHz
5	Z parameter	49.79 Ohm	48.95Ohm

Table III. Comparison of proposed design result with previous result.

Parameter	Previous work	Proposed Work
Design shape	Vivaldi	Vivaldi
Bandwidth	180 MHz	670 MHz
Return Loss	-29db and -27.5db	-36.37 db and -34.45db
Resonant Frequency	4.35 GHz and 6.59GHz	4.5GHz and 5.7GHz
VSWR	>1	1.009

VI.CONCLUSION

Remote Body Region System (WBAN) is one of created innovation that bolsters telemedical administrations. Up until this point, the antenna's execution is for the most part influenced by a human body when it is connected close to the human body. In the paper, the new sorts of proposed antenna (Vivaldi microstrip patch antenna), which are increasingly fitting for body zone organize applications.

A twofold band, the rectangular microstrip patch antenna is planned and recreated utilizing CST reenactment programming. The reproduction results are displayed and talked about. Structure of proposed antenna is straightforward and conservative in size of approx 40×40 ×1.6 〖mm〗^3. the smaller size of planned antenna makes it simple to be fused in little gadgets. Results demonstrate that the frequency bandwidth covers WBAN (4-7) GHz, at focus frequencies 4.915 GHz and 6.018GHz individually for VSWR under 2, and S11 not exactly - 10 dB. The last outcomes fulfill every one of the parameters of a proficient antenna. The structured antenna works proficiently under all conditions with low return loss and appropriate impedance matching.

REFERENCES

[1]. D. Yang, J. Hu and S. Liu, "A Low Profile UWB Antenna for WBAN Applications", *IEEE Access*, Vol. 6, pp. 25214-25219, 2018.

[2]. W. Amer, Gui Yun Tian and C. Tsimenidis, "A novel, low-profile, directional UWB antenna for WBAN", Loughborough Antennas and Propagation Conference (LAPC), Loughborough, pp. 708-710, 2014

[3]. M. Y. ElSalamouny and R. M. Shubair, "Novel design of compact low-profile multi-band microstrip antennas for medical applications", Loughborough Antennas & Propagation Conference (LAPC), Loughborough, pp. 1-4, 2015

[4]. W. Jeong and J. Choi, "A low profile IR-UWB antenna with conical radiation pattern for on-body communications", IEEE International Symposium on Antennas and Propagation & USNC/URSI National Radio Science Meeting, Vancouver, BC, pp. 2023-2024, 2015

[5]. **A**. Zaric, J. R. Costa and C. A. Fernandes, "Design and Ranging Performance of a Low-profile UWB Antenna for WBAN Localization Applications", IEEE Transactions on Antennas and Propagation, Vol. 62(12), pp. 6420-6427, 2014.

[6]. A. Zaric, J. R. Costa and C. A. Fernandes, "Low profile UWB antenna for Wireless Body Area Networks", 8th European Conference on Antennas and Propagation (EuCAP 2014), The Hague, 2014

[7]. K. Yekeh Yazdandoost, "UWB loop antenna for in-body Wireless Body Area Network" 7th European Conference on Antennas and Propagation (EuCAP), Gothenburg, pp. 1138-1141, 2013

[8]. C. Kang, S. Wu and J. Tarng, "A Novel Folded UWB Antenna for Wireless Body Area Network", IEEE Transactions on Antennas and Propagation, Vol. 60(2), pp. 1139-1142, 2012.

[9]. Q. Wang, R. Hahnel, H. Zhang and D. Plettemeier, "On-body directional antenna design for in-body UWB wireless communication", 6th European Conference on Antennas and Propagation (EUCAP), Prague, pp. 1011-1015, 2012

[10]. J. Shan, A. Xu and J. Lin, "A parametric study of microstrip-fed Vivaldi antenna", 3rd IEEE International Conference on Computer and Communications (ICCC), Chengdu, pp. 1099-1103, 2017

[11]. R. Herzi, M. Bouslama, L. Osman and A. Gharsallah, "Design of a compact antipodal Vivaldi antenna with band- rejected characteristic", Mediterranean Microwave Symposium (MMS), Marseille, pp. 1-4, 2017

[12]. Y. Dong, J. Choi and T. Itoh, "Vivaldi Antenna With Pattern Diversity for 0.7 to 2.7 GHz Cellular Band Applications", IEEE Antennas and Wireless Propagation Letters, Vol. 17(2), pp. 247-250, 2018.

[13]. B. Sivashanmugavalli and B. Vijayalakshmi, "Performance measures of Vivaldi antenna with parasitic elements", International Conference on Wireless Communications, Signal Processing and Networking (WiSPNET), Chennai, pp. 25-28, 2017

[14]. E. N. F. S. E. Embong, K. N. A. Rani and H. A. Rahim, "The wearable textile-based microstrip patch antenna preliminary design and development", IEEE 3rd International Conference on Engineering Technologies and Social Sciences (ICETSS), Bangkok, pp. 1-5, 2017

[15]. S. Ha and C. W. Jung, "Reconfigurable Beam Steering Using a Microstrip Patch Antenna With a U-Slot for Wearable Fabric Applications", IEEE Antennas and Wireless Propagation Letters, Vol. 10, pp. 1228-1231, 2011.