Silicon Wearable Body Area Antenna for Speech Enhanced IOT and Medical Applications

N Arun Vignesh (✉ arunvignesh44@gmail.com)

Gokaraju Rangaraju Institute of Engineering and Technology <https://orcid.org/0000-0002-1026-2958>

Kanithan S

MVJ College of Engineering

Jana S

Vel Tech Rangarajan Dr Sagunthala R&D Institute of Science and Technology

Gokul Prasad C

SNS College of Engineering

Konguvel E

Vellore Institute of Technology

Asisa Kumar Panigrahy

Gokaraju Rangaraju Institute of Engineering and Technology

Research Article

Keywords: Silicon wearable antenna, wireless body area network, Speech enabled IOT, Microstrip antenna.

Posted Date: August 25th, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-825439/v1>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Abstract

We propose in this paper a reduction in the size of wearable antennas on silicon (Si) for medicinal frameworks and Internet of things (IoT). This research also introduces one more type of dynamic patch antenna designed in favor of speech-enhanced healthcare applications. The most significant impediment to the adoption of smart correspondence and medical services frameworks is voice-enabled IoT. The primary objective of a body area network (BAN) is to give ceaselessly clinical information to the doctors. Actually wireless body area network is flexible, dense, trivial and less expensive. On the other hand the main disadvantage is low efficiency for small printed antenna. Microstrip silicon antenna recurrence is changed because of ecological conditions, distinctive reception apparatus areas and diverse framework activity modes. By using tunable antenna the efficiency of bandwidth usage can be increased. Amplifiers are associated with the feed line of antenna in order to build its dynamic range. In this study, a dynamic polarized antenna is constructed, analysed and attempted for fabrication. The gain of the antenna is 13 ± 2 dB for the frequency range of 390 to 610 MHz. The output of the polarized antenna is roughly 19 dBm. At different environmental conditions the performance and ability to control the antenna could vary. To achieve stable performance, we have used varactor diode and voltage controlled diode. This silicon wearable antenna can be fabricated and tested for many medical applications like health monitoring system, pacemakers etc. Furthermore, Micromachining techniques can be used to lower the practical dielectric constant of Silicon and hence improve radiation efficiency.

I. Introduction

Wearable frameworks have a few applications in close to home specialized device and clinical device as introduced in [4–9]. WBAN and healthcare systems frequently use printed antennas in wearable applications [1–3]. Printed antennas are also cost-effective, flexible, and can be utilized in many medical and IoT applications. These antennas are analysed and studied in [10–14]. Examination of radio transmission that occurs when a wearable antenna is working near a human system has been analysed in [15–20]. Notwithstanding, little printed antenna experience the ill effects of low productivity [21–24]. Dynamic reception apparatuses for correspondence frameworks are introduced in [25–31]. This research introduces a unique dynamic and tunable wireless antenna for WBAN applications. Acquiring and transmitting information, as well as healthcare setups, could benefit from dynamic patch silicon antennas. Accepting antenna is related with a low noise intensifier in destination channels. The application and uses of silicon to fabricate a patch has also been analysed [32]. The increase in the dynamic circle radio wire is 26 ± 2.6 dB at frequency ranges from 360 to 590 MHz. The dynamic circle receiving wire commotion recurrence goes from 410 to 910 MHz and is 0.75 ± 0.25 dB. In different location, the electric parameter should be monitored by varactor diode [31]. All of the dynamic antenna and devices discussed in this study are based on an acceptable interpretation of the recorded and estimated values.

II. Wearable Technology

The physiological boundaries of a patient are ceaselessly checked by a far off observing station with the assistance of wearable receiving antenna. This observing framework implants a variety of sensors in the body. The sensors are put in a specific location and linked to the information gathering architecture in standard wearable properties. In any event, the texturing links pick up commotion from power line obstacles, signals from adjacent transmitting sources, and the biological parameters are harmed as a result. When the texture is incorporated, repositioning is exceptionally troublesome. Progressively number of sensors is coordinated into the texture to frame a system (Personal Area Network) and associates with the human framework to procure and send the physiological information to a wearable information obtaining framework. Wearable antennas can be made from microstrip antennas. In the last 20 years, patch antennas are being discussed widely in various articles. Users of mobile devices, Internet - of - things, vehicles, and diagnostic implants could all benefit from printed antennas. This can be an excellent alternative for some of the non-wearable high radiating sensitive antennas. For VSWR greater than 2:1, few of the printed dipole antennas have very narrow bandwidth of around one percent. The dipole can be anything from a quarter to a half wavelength in length. Wearable innovation can be predicted in the next few years, as there are more studies being conducted in the subject due to strong demand.

lil. Signatures Of Body Area Network

Wearable body area network (BAN) and antenna:

The dynamic antenna is a device that consolidates antennas with dynamic segments, as shown in this study. The emanating component is intended to give the ideal burden to the active components. The antenna and dynamic segments were reconciled, which drastically reduced the coordinating system's volume, complexity and weight. The dynamic antenna has been used in wireless and clinical correspondence systems in the last few years [25–31]. The significant utilization of dynamic antenna is electronically filtering clusters and staged exhibits. At times, half and half electromechanical exhibits, consolidating mechanical controlling with electrical directing forming, are utilized.

By limiting electrical inspection to only single plane, this method is widely utilised to reduce the number of dynamic parts. It's particularly common for compact interfaces, where azimuth filtering is accomplished through pneumatic disturbance as well as rising capability is determined via a direct ordered display. Staged clusters are a lot quicker for bar exchanging than precisely checked antenna. Early staged cluster antenna was latent reception apparatuses. The front finish of the antenna was made out of cluster components with stage shifters. Strong enhancers with close to zero amplifiers can be attached to each radiating section and placed close towards the front end. The staged cluster engineering permits noteworthy force improvement and better productivity. Power dividers, phase changers, and oscillators may be included in the enhancer modules. Compact spectrum dynamic reception apparatuses could benefit the overall presentation of smart setups. In this work, the radiation pattern, bandwidth and frequency response of the dual polarized antenna and printed silicon wearable patch antenna are analysed.

IV. Wban With Loop Antenna

In Fig. 1, the block diagram of the receiving antenna section of speech enhanced IOT is shown which is the fundamental piece of the reception apparatus. A business E PHEMT LNA, a low commotion intensifier, is associated with the printed circle antenna. On a Silicon wafer with a layer of .005mm, the circle gathering contraption is etched with antenna breadth of 50mm.

Through an information coordinating system, the emitting component is linked to the LNA. A yield coordinating system interfaces the speaker yield port to the recipient. Low noise amplifier frequency range is 0.45 to 3.5 GHz and gain is 25 dB to 0.3 GHz maximum input power is 18 dBm at the time of operating temperature is -40°C to -80°C storage temperature is -45°C to -90°C.

a. Active WBAN with Dual polarized antenna

Figure 2 shows an active wearable body area network with double polar transmitter, which has since been introduced on [4]. On a 0.3mm wide silicon dielectric substrate, the antenna feed arrangement is imprinted. Followed by the substrate, an emanating component of 0.3mm thickness is imprinted. Finally the thickness of the antenna is 0.006mm and its size is 50 50mm.

b. Active Transmitting WBAN with Dual polarized antenna

The ports and S_{ij} parameters of dual polarized antenna are shown Fig. 3a and 3b. The antenna level is 50mm × 50 mm × 0.005mm. The transmitting component is associated with the HPA by means of a yield HPA coordinating system. The HPA input coordinating system associates the enhancer port to the transmitter. At 410 to 450 MHz, the flexible communicative dual dipole antenna's S_{11} boundaries have been evaluated and estimated to be 3:1. In Fig. 4a, the WBAN block diagram of sending antenna with level oscillator, control and dynamic control unit is shown. The dual polarized antenna has a gain of roughly 17 dBm. In Fig. 4b, the WBAN with active transmitting antenna is shown.

High power amplifier frequency range is 0.5 to 3.5 GHz and gain is 16 dB to 0.5 GHz maximum input power is 12 dBm at the time of operating temperature is -40°C to -80°C storage temperature is -60°C to -100°C. The output of the dual polarized transmitting antenna around 12 dBm as shown in Fig. 4 (c).

c. Wearable Body Area Network for Medical Application

A wearable material CPW antenna is accommodated Medical Body Area Network (MBAN) programs at 2 GHz, in light of on an electromagnetic band-hole structure and recurrence specific surface. Without EBG-FSS the essential reception apparatus has unidirectional radiation design, and keeping in mind that worked near human tissue, the general execution and productivity corrupt, and there is an unnecessary Specific Absorption Rate. To overcome this problem, the antenna contains EBG-FSS which lessens the retrogressive radiation, with SAR diminished by method of 95.5%. The preferred position is improved to 6.6 dBi and the front to returned proportion is improved with the guide of thirteen dB when contrasted

with the essential receiving antenna. The overall components of the included structure are $50 \times 50 \times 2.4 \text{ mm}^3$. Recreation and test considers show that the receiving wire coordinated with EBG-FSS can endure stacking by method of human tissue notwithstanding twisting. Consequently, the structure is a decent possibility for MBAN programs.

A conservative conformal wearable CPW reception apparatus utilizing EBG-FSS for Medical Body Area Network bundles at 2.4 GHz is provided. The radio wire and EBG-FSS are planned dependent on texture substances that can be incorporated with our step by step garments. The antenna becomes concentrated in free territory, on multilayer model tissues and on a genuine body. The results show that when a receiving wire all alone, without EBG-FSS, is stacked with the guide of human tissue, the recurrence detunes: the reception apparatus plays inadequately because of the lossy human tissues. Besides, the reception apparatus creates a high charge of SAR that surpasses as far as possible, because of its unidirectional radiation test resulting in huge in reverse radiation. Integrating the CPW radio wire with an EBG-FSS structure presents disengagement among the body and the receiving wire. Along these lines, the detuning because of human edge stacking, and furthermore the results of twisting, are definitely diminished. Besides, the impacts show that the FBR is ventured forward with the guide of thirteen dB, the bit of leeway by methods for 6.55 dBi and the SAR diminished with the guide of extra than 95.5% when contrasted with the reception apparatus alone. Thusly, the offered CPW antenna is good for medical body area network.

d. Design and antenna performance

So as to think about the variety in designing antenna with desirable impedance matching, a design that imitates a helix structure is chosen at receiving side. The radiation effect over the human body had to be kept in consideration rather than the structure. A compact structure with 9 turns is shown in Fig. 5. The microstrip is insulated with copper and it resembles the helix structure and hence it could receive the signals from the system that has been fixed over the human body. It has reduced interference and adjustable radiation with power. The received signals are to be processed as shown in the receiving antenna block diagram of Fig. 1. The system can then be linked to IoT and medical systems where again the signals can be studied and proper treatment can be given. With respect to design, a strip line has been planted on Ro4003 with thickness ranging from 10-30mm.

At the frequency range of 450MHz to 460MHz, the antenna has a VSWR over 3:1 and with antenna measurement of $40 \times 40 \times 6 \text{ mm}$. Figure 6 represents S_{11} boundaries over the human skin. If there is wind intrusion between the antenna and body, there could be an approximate expansion in the size from 0mm to 1mm. In this way the dislocation of the reception apparatus could be anywhere between 0 to 3 percent. Though this will not affect the performance, it should be considered as it can lead to undesirable signal interventions which could anyway be removed with necessary filters. The design and performance analysis is carried out with the help of computer simulation technology software. As we analyse the dB with frequency, it has been found that with increase in the frequency the S_{11} decreases. As the desirable reflection coefficient represented as S_{11} parameter is around -11 to -13dB, the values obtained at 420-

450MHz is promising with the values of -10dB to -12dB. This study shows that over human body, the antenna will be able to transmit with reflection coefficient of -11dB.

e. Change of S_{11} parameter from human body

Advanced design system coding was used to analyze the antenna's insertion loss, which acts on the body with minimal distance from the surface. Figure 7 represents the S_{11} analysis of the distinctive strap and chemise depth, in addition to space separation amid radio wires with the person. On the off chance of space separation was found to be expanded around 4mm. There is acceptable understanding among estimated and determined outcomes. The volt control varactor might be utilized for tuning receiving wire resounding recurrence because of various radio wire areas put over the person.

f. Far field Analysis

The force flexibly for these segments should be kept to a minimum, and they should be light and robust. Distributed computing administrations are used to evaluate and validate information gathered from the far field. Also, speech-enhanced silicon patch can communicate data with clinical center, as well as back it to consumers. Clinical centers, patients, doctors, and sports centers all benefit from remote correspondence systems because they allow continuous estimating and observation of clinical data. The far field analysis shows that the Wearable wellbeing checking frameworks, as appeared in Fig. 8 (a), permit the radiation to intently follow changes in significant wellbeing boundaries, and give criticism to keeping up ideal wellbeing status at each area of the body. The Fig. 8 (b) shows the radiation in a constrained and desirable manner which do not permit in omni directional pattern of radiation. The principle objective of WBANs is to persistently give biofeedback information. WBANs with such radiation pattern can pass information and can record electrocardiograms, measure internal heat level, circulatory strain, vessel pulse, and some social boundaries effectively. Body Area Network (BANs) incorporates various advantages with specialized gadgets utilizing the remote systems. The remote body zone system is a specific purpose remote sensor system that integrates multiple systems and remote gadgets to enable remote checking under diverse settings. In clinical focuses, such systems can be used with silicon fabricated body antenna where states of an enormous number of patients can be continually observed.

Human well-being monitoring is becoming an increasingly important use of implanted sensor systems. A WBAN can monitor basic indicators, providing constant input for a variety of patient diagnostics procedures that rely on constant observation in changing situation and help in the process of patient's recovery.

g. Fabrication flow of Silicon Wearable Body Area Antenna

The Silicon wearable body area antenna can be fabricated using inkjet printing. The fabrication process flow of wearable antenna is illustrated in Fig. 9. The process flow is similar to the modern fabrication style [33], [34]. Wafer selection plays an important role for design of wearable antenna, it mainly effects the antenna parameters. 4-inch, P-type, double side polished, 300 μm thick, high resistivity ($> 5000 \Omega\text{-cm}$)

Si < 100 > wafer was used as the substrates to fabricate the antenna. Then the wafer is diced to 12 x 12 μm^2 area die. Afterwards, oxide growth using standard thermal oxidation was preferred for proper dielectric constant of wearable antenna. The printing parameters initially can be improved by using simulation. In our work we have used CST simulator. Inkjet printing has emerged as a viable alternative to traditional production methods like etching and milling. It's an additive technology that allows the design to be directly copied onto the substrate without the use of masks, resulting in reduced waste. Prior to inkjet printing substrate treatment is preferred.

Conclusion

Dynamic apparel body networks will revolutionize the medical stream by aiding in receiving and sending data. In sending block, signal intensifier associated with the transmitter will enhance the signal strength. At reception, a low commotion intensifier associated with the reception apparatus will acquire the signal and will be sent to the end device. Ultra-wideband printed antenna might be utilized in medical IoT applications. All radio wires introduced in this paper are minimal wideband dynamic receiving wires for getting and sending wearable speech enabled IoT device and 5G correspondence frameworks for clinical application in an effective manner. Wearable innovation gives an amazing new apparatus to clinical and careful recovery administrations. A complete analysis using the acquired data will be aided by early detection of anomalous conditions, regulated restoration, and possible information. A dynamic polarised antenna is built, analysed, and attempted production in this paper. For the frequency range of 390 to 610MHz, the antenna gain is 13 2dB. The output of the polarised antenna is roughly 19 dBm. The reduced tunable radio wire data transmission is around 14% for a reflection coefficient lower than - 9dB. The tunable receiving wires gain is around 3dBi. Hence the results of this work are satisfying the current medical needs for the silicon wearable antenna in applications such as pacemakers, health monitoring system etc.

Declarations

Acknowledgements: The authors are thankful to GRIET, Hyderabad for their cooperation and support during this research work.

Consent to Participate: Yes

Funding statement

The authors did not receive support from any organization for the submitted work.

Conflict of Interest

The authors declare that they have no conflict of interest.

Author contributions

N Arun Vignesh and S Kanithan: Conceptualization; N Arun Vignesh and S Jana: investigation; N Arun, Vignesh, S Kanithan, S Jana, C Gokul Prasad, E Konguvel, Asisa Kumar Panigrahy : resources; N Arun Vignesh, C Gokul Prasad, E Konguvel and Asisa Kumar Panigrahy: data curation; N. Arun Vignesh, S Kanithan and Asisa Kumar Panigrahy : writing—original draft preparation; N. Arun Vignesh, S Jana, C Gokul Prasad and E Konguvel: writing—review and editing; N. Arun Vignesh, S Kanithan and Asisa Kumar Panigrahy: visualization; N. Arun Vignesh and Asisa Kumar Panigrahy: supervision.

Availability of data and material

No supplementary materials

Compliance with ethical standards

This article does not contain any studies with human or animal subjects.

Consent for Publication

Author(s): N Arun Vignesh

Author's signature:

Funding: No funding received to carry out this research work.

References

1. Analysis and Design of Dual-Band Folded-Shorted Patch Antennas for Robust Wearable Applications.” Rahil Joshi; Symon K. Podilchak ; Dimitris E. Anagnostou ; Constantin Constantinides ; Muhammad Nazrin Ramli ; IEEE Open Journal of Antennas and Propagation Page(s): 239–252, 29 April 2020.
2. Channel Analysis and Performance Evaluation for Inter-Vehicle Communication in 700 MHz Band at Intersection with Low Visibility,” 2018 16th International Conference on Intelligent Transportation Systems Telecommunications (ITST), 15–17 Oct. 2018
3. Wideband Horizontally Polarized Omnidirectional Antenna With a Conical Beam for Millimeter-Wave Applications,” Kuikui Fan; Zhang-Cheng Hao ; Quan Yuan ; Jun Hu ; Guo Qing Luo ; Wei Hong, IEEE Transactions on Antennas and Propagation (Volume: 66, Issue: 9, Sept. 2018)
4. Ultra-wideband printed-circuit array antenna for medical monitoring applications,” Hung-Jui Lam; Jens Bornemann, 2009 IEEE International Conference on Ultra-Wideband 9–11 Sept. 2009
5. Efficiency measurement of the flexible on-body antenna at varying levels of stretch in a reverberation chamber,” Md Abu Saleh Tajin; Oday Bshara ; Yuqiao Liu ; Ariana Levitt ; Genevieve Dion ; Kapil R. Dandekar, IET Microwaves, Antennas & Propagation (Volume: 14, Issue: 3, 26 2020)

6. Small New Wearable Metamaterials Antennas for IOT, Medical and 5G Applications,” 2020 14th European Conference on Antennas and Propagation (EuCAP), 15–20 March 2020
7. A Low-Profile Dual-Polarized Microstrip Antenna Array for Dual-Mode OAM Applications,” Hui Li; Le Kang ; Feng Wei ; Yuan-Ming Cai ; Ying-Zeng Yin, IEEE Antennas and Wireless Propagation Letters (Volume: 16), 3022–3025, 02 October 2017
8. A Wideband Circularly Polarized Conformal Endoscopic Antenna System for High-Speed Data Transfer,” Rupam Das; Hyongsuk Yoo, IEEE Transactions on Antennas and Propagation (Volume: 65, Issue: 6, June 2017)
9. A Low Profile, Dual-band, Dual Polarized Antenna for Indoor/Outdoor Wearable Application,” kashif Nisar Paracha; Sharul Kamal Abdul Rahim ; Ping Jack Soh ; Muhammad Ramlee Kamarudin, IEEE Access (Volume: 7) 33277–33288, 01 February 2019.
10. Novel Wideband Microstrip Monopole Antenna Designs for WiFi/LTE/WiMax Devices,” Hussein Hamed Mahmoud Ghouz; Mohamed Fathy Abo Sree ; Muhammad Aly Ibrahim, IEEE Access (Volume: 8) 9532–9539, 01 January 2020 .
11. Novel Microstrip Antenna Design Upon Transformation Medium,” Zhan Zhang; Shouliang Li ; Junhong Wang, IEEE Antennas and Wireless Propagation Letters (Volume: 14) 543–546, 04 November 2014.
12. Characterization of radiation loss from microstrip discontinuities using a multiport network modeling approach,” A. Sabban; K.C. Gupta, IEEE Transactions on Microwave Theory and Techniques (Volume: 39, Issue: 4) 705–712, Apr 1991
13. Wideband Compact Comb-Line Antenna Array for 79 GHz Automotive Radar Applications,’ Mohammad Mosalanejad; Ilja Ocket ; Charlotte Soens ; Guy A. E. Vandenbosch, IEEE Antennas and Wireless Propagation Letters 1580–1583 (Volume: 17, Issue: 9, Sept. 2018)
14. Spectral domain iterative analysis of single- and double-layered microstrip antennas using the conjugate gradient algorithm,”R. Kastner; E. Heyman ; A. Sabban IEEE Transactions on Antennas and Propagation 1204–1212 (Volume: 36, Issue: 9, Sep 1988)
15. Compact Wideband Circularly Polarized Microstrip Antenna Array for 45 GHz Application,” Zheng Gan; Zhi-Hong Tu ; Ze-Ming Xie ; Qing-Xin Chu ; Yue Yao, IEEE Transactions on Antennas and Propagation, 6388–6392 (Volume: 66, Issue: 11, Nov. 2018)
16. Variation of Radiation Effects and Signal Efficiency with Distance between Electromagnetic Source and Trunk Model,” Lisheng Xu; Max Q.-H. Meng ; Dacheng Wei ; Hongliang Ren, 2007 29th Annual International Conference of the IEEE Engineering in Medicine and Biology Society, 22–26 Aug. 2007.
17. Tissue Electrical Property Mapping From Zero Echo-Time Magnetic Resonance Imaging,” Seung-Kyun Lee; Selaka Bulumulla ; Florian Wiesinger ; Laura Sacolick ; Wei Sun ; Ileana Hancu, IEEE Transactions on Medical Imaging 541–550 (Volume: 34, Issue: 2, Feb. 2015)
18. An Implantable and Conformal Antenna for Wireless Capsule Endoscopy,” Jingchen Wang; Mark Leach ; Eng Gee Lim ; Zhao Wang ; Rui Pei ; Yi Huang, IEEE Antennas and Wireless Propagation Letters 1153–1157 (Volume: 17, Issue: 7, July 2018)

19. Multiband wearable textile antenna for I.S.M body center communication systems," Mujeeb Abdullah; Adam Khan, 2015 XXth IEEE International Seminar/Workshop on Direct and Inverse Problems of Electromagnetic and Acoustic Wave Theory (DIPED), 21–24 Sept. 2015
20. Design and performance analysis of complex Planar Triangular Monopole Textile Antenna in vicinity of human body for wearable applications," Fatma Dhaouadi; Sabri Beldi ; Rachida Bedira ; Ali Gharsallah, 2015 IEEE 15th Mediterranean Microwave Symposium (MMS), 30 Nov.-2 Dec. 2015.
21. Embroidered Wearable Multiresonant Folded Dipole Antenna for FM Reception," Jung-Sim Roh; Yong-Seung Chi ; Jae-Hee Lee ; Youndo Tak ; Sangwook Nam ; Tae Jin Kang, IEEE Antennas and Wireless Propagation Letters 803–806 (Volume: 9) 05 August 2010
22. Analysis of the Split Ring Resonator (SRR) Antenna Applied to Passive UHF-RFID Tag Design," Simone Zuffanelli; Gerard Zamora ; Pau Aguilà ; Ferran Paredes ; Ferran Martín ; Jordi Bonache, IEEE Transactions on Antennas and Propagation 856–864 (Volume: 64, Issue: 3, March 2016)
23. Kanithan S, ArunVignesh N, E.Karthikeyan and N.Kumaresan "An intelligent energy efficient cooperative MIMO-AF multi-hop and relay based communications for Unmanned Aerial Vehicular networks", Journal of Computer Communication, Elsevier, and online published on 21 January 2020. Volume 154, 15 March 2020, Pages 254–261
24. Senthilkumar R, Tamilselvan GM, S.Kanithan and N ArunVignesh "Routing in WSNs Powered by a Hybrid Energy Storage System through a CEAR Protocol Based on Cost Welfare and Route Score Metric", International Journal of Computers Communications & Control, CCC Publications Volume14, Issue 2, Pages 220–239
25. Securing On-Body IoT Devices By Exploiting Creeping Wave Propagation," Wei Wang; Lin Yang ; Qian Zhang ; Tao Jiang, IEEE Journal on Selected Areas in Communications 696–703 (Volume: 36, Issue: 4, April 2018)
26. Securing On-Body IoT Devices By Exploiting Creeping Wave Propagation," Wei Wang; Lin Yang ; Qian Zhang ; Tao Jiang IEEE Journal on Selected Areas in Communications 696–703 (Volume: 36, Issue: 4, April 2018)
27. Ellingson SW, Simonetti JH, Patterson CD (2007) Design and evaluation of an active antenna for a 29–47MHz radio telescope array. IEEE Trans Antennas Propag 55:826–831
28. Hand JW, Van Leeuwen GMJ, Mizushina S, Van de Kamer JB, Maruyama K, Sugiura T et al (2001) Monitoring of deep brain temperature in infants using multifrequency microwave radiometry and thermal modeling. Phys Med Biol 46(7):1885–1903
29. Design of an Ultra-wide Band Active Antenna for Medical Microwave Radiometry," Sathya Priya Sugumar; Kavitha Arunachalam ; C.V. Krishnamurthy, 2019 URSI Asia-Pacific Radio Science Conference (AP-RASC), 9–15 March 2019.
30. Chang K, York RA, Hall PS, Itoh T, "Active integrated antennas", IEEE Trans. Microw. Theory Tech., vol. 50, no. 3, pp. 937–944, Mar. 2002
31. McKinney JD, Lin IS, Weiner AM, "Shaping the power spectrum of ultra-wideband radio-frequency signals", IEEE Trans. Microw. Theory Tech., vol. 54, no. 12, pp. 4247–4255, Dec. 2006

32. Varshney G (2021) Tunable Terahertz Dielectric Resonator Antenna. Silicon 13:1907–1915

33. Sreenivasulu 16VB, Narendar V, A Comprehensive Analysis of Junctionless Tri-gate (TG) FinFET Towards Low-power and High-frequency Applications at 5-nm Gate Length. Silicon (2021) <https://doi.org/10.1007/s12633-021-00987-8>

34. Sreenivasulu 17VB, Narendar V, Design and Temperature Assessment of Junctionless Nanosheet FET for Nanoscale Applications. Silicon (2021) <https://doi.org/10.1007/s12633-021-01145-w>

Figures

Figure 1

Receiving antenna with IOT

Figure 2

Frequency vs dB S11 human body 25 dB to 90 MHz

Figure 3

(a) Two ports of the polarized antenna (b) Dual polarized antenna Sij parameters

a

b

c

d

Figure 4

(a) WBAN Block diagram of transmitting antenna (b) Wireless body area network with active transmitting antenna (c) Frequency vs dB curve of active dual polarized antenna (d) CPW Resonance Frequency vs Capacitor

Figure 5

Antenna setup

Figure 6

Measured S11 human body

Figure 7

WBAN framework in air medium

Figure 8

Far field vs Angle for Fmax of dual dipole and patch

Figure 9

Fabrication Process flow for wearable body area network antenna.