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Design and Development of Wearable Antenna: A Literature review

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Abstract: ***Wearable electronics and its related technologie's demand is growing tremendously in recent years .The major developments that accelerated this growth are decrement in the size of wireless devices, advancement of high-speed wireless networks, accessibility of ultra-compact, evolving battery technologies. Most of the Wearable electronic devices for example smart watches, wristbands, rings etc; we use various types of antennas to sense, fetch, and exchange data wirelessly. As one of the best antennas in many terms like compact size, flexibility and easy design is the micrpstrip patch antenna, therefore designing of the same is done. We are designing a microstrip patch antenna as a wearable antenna for its main usage in WBAN (Wideband Body Area Network). The software of CST studio suite which is a 3D electromagnetic analyzer is udes to design the required antenna, where the methodology of cascading of two antennas is taken into account for the design with required gain.***
Keywords: Wearable antenna, microstrip patch antenna, gain.

I. INTRODUCTION

One of the most common technologies developed now a days in recent era is the Wearable technology. And there is an exponential increase in the demand for wearable devices in a wide range of fields like personal and public which includes sports and fitness, medicine and health and in the defense forces or military. The examples for such applications are a smart watches,contactless payment devices, smart soldier,bio-sensors etc. Antennas have great importance in wearable communication devices and as a result there is a significant value for wearable antennas..

This paper mainly aims at the literature review of the existing wearable antennas to identify the present research developments in wearable antenna design ,their methodologies followed for designing the antennas, the materials used in their process and helps for the engineers to innovate or renovate their design ideas.

II. EXISTING DESIGNS AND ANALYSIS

Ref No.[1]

Focus: A wearable antenna design for Bluetooth/WiFi connectivity is offered in this research. The suggested antenna is made of conductive fabric and is sewn inside a pair of jeans. A human body was fitted with four Bluetooth wearable antennas. In addition, a hearing aid antenna was constructed and simulated. The antenna system's S parameters, gain, and specific absorption rate (SAR) were all computed. All simulations were run in the frequency domain with ANSYS HFSS commercial software and the ANSYS Human Body Model. An average SAR simulation is done at 1mW.

Ref No [2]

Focus: In comparison to previously developed antennas, the newly designed antenna is small. All of the features of the planned antenna have yielded positive results. The antenna's dimensions are 40*34*1.26mm, making it ideal for wearable applications. In addition, the developed antenna is a multiband antenna with a large operating frequency range. Within the frequency ranges of 2.1GHz to 2.7GHz and 3.6GHz to 4.3GHz, this antenna delivers a greater bandwidth. The antenna has a 94 percent efficiency. The SAR(specific absorption rate) of the designed antenna which is 1.25, indicates that it will not create any radiating problems while it is placed on a human body because its value is less than the SAR limit

Ref No [3]

Focus: This paper mainly proposed a meander-shaped micro strip patch anten na that can be used in wearable technology on a textile substrate. Various textiles with different dielectric values are taken into account in this situation. The feeding technique used here is coaxial feeding technique.

The analysis is carried out with the help of the CAD FEKO software

Table: Design Specifications

SPECIFICATIONS	MEASUREMENTS
LENGTH OF SUBSTRATE	60mm
WIDTH OF SUBSTRATE	60mm
LENGTH OF PATH	120mm
WIDTH OF PATH	120mm
HEIGHT OF PATH	3mm
FEEDING POSITION	5.5mm

The values of various parametrs obtained in the designing of meander line antennas are mentioned below:
The substrate's length and width are 60mm and 60mm ;the length,breadth and height of the patch are 120mm*120mm*3mm ; the position of feed is given with 5.5mm ;and the dielectric value assumed is 1.6;the frequency with which the antenna is designed is 2.6GHz;S11 parameter value obtained is 29.21; most important parameter the gain obtained is 6.17db in the bandwidth of 0.2% with the impedence of 33.2ohm.

Ref No [4]
Focus: In this paper**,**Two antennas of frequencies 2.4ghz were simulated using a soware tool: one -a basic rectangular patch on FR4 substrate, while the second- a soft textile antenna. The bending performance of soft textile antennas have been investigated.
The patch antenna parameters for FR4 are: The width and length of patch are 39.7mm and 26.55mm respectively; the length and width of the substrate are 67.05mm and 66.9mm respectively; the length and width of Quarterwave transformer are 17.5mm and 0.4mm respectively; thickness of substrate ,metal are 2mm and 0.035mm respectively. Relative permittivity (no units) 4.8.
*The textile patch antenna parameters are:*The width and length of patch are 49.4mm and 39.3mm respectively; the length and width of the substrate are 66.95mm and 85.78mm respectively; the length and width of Quarterwave transformer are 23.9mm and 1.5mm respectively; thickness of substrate ,metal are 2mm and 0.035mm respectively. Relative permittivity (no units) 2.2.
Patch antennas have a reasonably high gain, which is their main advantage. The biggest disadvantage would be the increased expense as a result of the additional copper material. Second, the patch antenna's performance on textile material (which often have a low dielectric constant) can be comparable to that of the traditional substrates. Finally, bending has a slight effect on the reflection coefficient as well on the radiation pattern

Ref no[5]
Focus: in this paper, various geometries of the wearable microstrip patch antennas are designed and analyzed. These antennas are designed at WI-FI frequencies. Simulation is done in CST microwave studio platform.it is done by initially fixing the dielectric constant and then varying other parameters. Rectangular patch antenna is designed based on transmission line mode and line feeding technique is used here It is designed in 2GHz and 5GHz frequencies

antenna	2.4GHz frequency(gain)	5GHz frequency(gain)
Microstrip patch	2.78	0.07
Symetric Edge slot	2.33	-0.23
Coupling parallel slot	2.44	0.97
Double L slot	2.44	-0.36

Ref no [6]

Focus: For an on-body communication two types of rectangular microstrip patch antenna are designed. They are desined in 2.4GHz WLAN band. As the dielectric substrate three distinct materials were used in each design type. plane, as well as a tissue layer with skin-like characteristics. Polyester, cordura, and lycra were employed as the substrate and the superstrate for the three antennas. Copper was used for the patch and ground plane in each of the three antennas. The simulation was carried out with the help of the IE3D software

substrate	polyester	cordura	lycra
s-parameter (db)	-22.283	-31.588	-31.733
z-parameter (ohm)	53.625	48.024	49.463
total field directivity	7.7497	7.9899	8.0354
total field gain	4.7863	3.222	3.7117

Ref no[7]

Focus: New technologies such as Meta material and fractal antennas are applied to improve the efficiency of small antennas. This research introduces new wearable meta materials and high efficient fractal antennas. 3D full-wave software was used to examine all of the antennas. The antenna with Split-ring resonators, SRR, has 2.5dB more gain and directivity than the microstrip patch antenna without SRR. The antennas with SRR have a resonance frequency that is 5% to 10% lower than the antennas without SRR. Fractal antennas are small, multiband antennas that can be used in wireless communication systems. Wearable slot antennas with a band-width of 57 percent and a voltage standing wave ratio (VSWR) of less than 2:1 are also shown

Ref no[8]

Focus: In comparison to other existing wearable antennas, this antenna which is proposed is designed for a purpose to achieve better gain, VSWR, better return loss and a low value of specific absorption rate (SAR). At 2.45 GHz, the antenna return loss is around -10.52 dB, with a gain 7.81 dB.

At 2.45 GHz, the VSWR is 1.84, which is acceptable in terms of impedance matching

Other antenna field metrics such as 2D and 3D gain, radiation pattern, and SAR value have been calculated.

The High-Frequency Structure Simulator is used to develop and model the proposed antenna (HFSS).

Ref no[9]

Focus: A flexible, compact monopole antenna on a Kapton polyimide is designed and manufactured here which is made to be in contact with biological breast tissues across the S-Band. It utilizes a Computer Simulation Technology simulator (CST) and MEMS technology in the frequency band of (2-4 GHz).At the working frequency of 3.5 GHz, the suggested antenna exhibits better imped-ance matching with a return loss of roughly -32dB

Ref no[10]

Focus: The suggested wearable electronic modules on textile are based on antennas magnetically connected to active circuitry and are suited for garment integration.

A patch antenna with a transformer made of textile materials and the range of frequencies with which it operates is between 2.4 to 2.48 GHZ and this design is conceived, built, and tested. This aided the development of clothing RFID, wearable electronics, and body-centric communications systems in the industries

- Radiation efficiency = 1.96dB(63.6%)
- Maximum gain = 6.49 dBi at 2.45 GHz
- The measurement of reflection coefficient is done by VNA=80-j103.2ohms
- Reflection coefficient’s magnitude remained less than 10db within the frequency band of 2.4 to 2.48GHz

III. CONCLUSION

In this paper ,we described the study of researches which were carried out for the designing of the wearable micro strip antenna ,and also the materials used for its designing the patch and substrate are studied as well as the applications are understood well. The feeding techniques used and the frequency ranges in which the antennas are designed are studied.

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