Design Of Wearable Antennas

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Abstract— Micro strip patch antenna paves the way for upcoming technology. It poses attractive features like low profile, flexible, light weight, small volume and low production cost. This paper presents a micro strip patch antenna of meander design that can be incorporated with wearable technology with a textile substrate. In this case different fabrics are taken into consideration with different dielectric values. The antenna is fed with a coaxial feed. The different parameters like radiation pattern, return loss, gain which are the critical parameters of wearable antenna for motivating and diagnosing certain conditions. The analysis is carried using CAD FEKO software.

I. INTRODUCTION
The increasing demand for remote health care systems gives rise to this new evolution. Wearable antenna is nothing but a micro strip patch antenna if textile is used as substrate flexibility, nominal weight, resistant to shock and vibrations are the main advantage of these body wearable antenna.

Not only for medical field even for military applications requires integrating this technology into clothing to enhance the performance of soldiers and for their survivability at the time of war.

THE STATE-OF-ART OF WEARABLE ANTENNA
A. PATCH
These are different kinds of path available like rectangular, circular, triangular etc but here most of the analysis are done using rectangular patch because of its large surface area. It also has higher bandwidth and ease of fabrication when compared to others. An elliptical patch is also designed for comparison with other types of patches.

B. SUBSTRATE
The value of dielectric constant ranges from 2.2<ɛr<12. Here textile acts as the substrate and we have chosen different cotton fabric material like jean cotton, poly cotton, polyester and bed sheet. The radiation characteristics greatly depends the type of substrate considered.

C. FEEDING
A feed line is used to excite to radiate by direct or indirect contact. These are different techniques of feeding and for most popular techniques are coaxial probe feed, micro strip line, aperture coupling and proximity coupling. Coaxial probe feeding is a feeding method in which the inner conductor of the coaxial is attached to the radiation patch of the antenna while the outer conductor is connected to the ground plane. Advantages of coaxial feed is easy of fabrication, easy to match, low spurious radiation and its disadvantage is narrow bandwidth. Micro strip line feed is one of the easier methods to fabricate as it’s just a conducting strip connecting to the path therefore can be considered extensions of patch. But the disadvantage of this method is that the thickness of the substrate increases and thereby spurious feed radiation increases which limit the bandwidth.

DESIGN SPECIFICATIONS
The design specifications for the proposed Wearable antenna are shown below in TABLE 1.

<table>
<thead>
<tr>
<th>SPECIFICATIONS</th>
<th>MEASUREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of substrate</td>
<td>60mm</td>
</tr>
<tr>
<td>Width of substrate</td>
<td>60mm</td>
</tr>
<tr>
<td>Length of patch</td>
<td>120mm</td>
</tr>
<tr>
<td>Width of patch</td>
<td>120mm</td>
</tr>
<tr>
<td>Height of patch</td>
<td>3mm</td>
</tr>
<tr>
<td>Feeding positions</td>
<td>5.5mm</td>
</tr>
</tbody>
</table>

TABLE 1 DESIGN SPECIFICATIONS

The proposal wearable type as micro strip rectangular patch is modeled using CAD FEKO 5.5. It is a method of moments (MOM) tool that is used to calculate the radiation pattern impedance and gain of an antenna while mounted on a defined geometry. It can also calculate isolation or coupling of the antenna the near fields and the electric current that flow on an antenna or the surrounding structure.

RESULT AND CONCLUSIONS
A. RETURN LOSS
The antenna performance greatly depends on return loss. If the return loss increases the antenna performance also increases from the results it is clear that wash cotton has greater return loss.
B. RADIATION PATTERN

The patch’s radiation at the fringing field results in a certain far field radiation pattern. This radiation pattern shows that the antenna radiates maximum power in a certain direction than another direction. The antenna is said to have certain directivity expressed in db

![FIG 1) Return loss with wash cotton as a substrate.](image)

C. GAIN

It relates the intensity of an antenna in a given direction to the intensity that radiates equally in all directions or isotropic ally has no losses. Since radiation intensity from a lossless isotropic antenna equals the power into the antenna divided by a solid angle of 4pi. Hence the following equation can be written as

\[ G = \frac{\text{Power radiated by an antenna}}{\text{Power radiated by a reference antenna}} \]

![FIG 2) 3d Radiation Pattern with was](image)

D. BANDWIDTH

An important parameter of any antenna is the bandwidth it covers. Only impedance bandwidth is specified most of the times. Directivity and efficiency combined as gain bandwidth.

E. IMPEDANCE BANDWIDTH RETURN LOSS

This is the frequency range where in the structure has a usable bandwidth compared to a certain impedance usually 50ohm. The impedance bandwidth depends on a large number of parameters related to the patch antenna element itself and the type of feed used.

F. SIMULATED RESULTS

The simulation is done by varying feeding positions and S-parameters are recorded. As it is given in table 2 the results show the various parameters on which the performance of the antenna depends.

1) MEANDER LINE ANTENNA’S

These antennas allows physically small an electrically large antenna. Antenna as that perform comparable to Meander line antenna’s (MLA) are typically much larger are more expensive. These type of antenna are figured into 2 distinct classes. Narrow band class exhibits extreme compactness for a given operating bandwidth. The broad class boasts extreme bandwidth capability, capable of covering multiple octaves without the need of tuning. Another advantage of MLA is the ability to achieve multi-mode operation in one antenna structure. It can be used in 2 radiation modes that can be exited simultaneously.

1.1) DESIGN

The design parameters include same as that of a polygon on a rectangular patch. The gain of meander line antenna are comparable to that of a u-slot antenna.

<table>
<thead>
<tr>
<th>SNO</th>
<th>PARAMETERS</th>
<th>MEANDER LINE ANTENNAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Length of Substrate(mm)</td>
<td>60</td>
</tr>
<tr>
<td>2.</td>
<td>Width of Substrate(mm)</td>
<td>60</td>
</tr>
<tr>
<td>3.</td>
<td>Length of Patch(mm)</td>
<td>120</td>
</tr>
<tr>
<td>4.</td>
<td>Width of Patch(mm)</td>
<td>120</td>
</tr>
<tr>
<td>5.</td>
<td>Height of Patch(mm)</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>Feeding Position(mm)</td>
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</tr>
<tr>
<td>7.</td>
<td>Anomol Dielectric</td>
<td>1.6</td>
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<tr>
<td>8.</td>
<td>Simulated Frequency(GHz)</td>
<td>2.6</td>
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<tr>
<td>9.</td>
<td>S11 Parameter</td>
<td>29.2</td>
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<tr>
<td>10.</td>
<td>Gain(db)</td>
<td>6.17</td>
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<tr>
<td>11.</td>
<td>Impedance(ohm)</td>
<td>33.23</td>
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<tr>
<td>12.</td>
<td>Bandwidth(kHz)</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Design Of Wearable Antennas
DISCUSSIONS
The measured and simulated values of gain for all the types of antenna with different textile substrates wash cotton with uslot antenna, the gain is greater. This is because our aim is conservative design of wearable antenna with greater loss with ISM band frequency range. The size of ground plane also influence the radiation pattern and other characteristics of antenna. It is evident from the observed reading that u-slot antenna for wash cotton fabric gives the best result demonstrating the correctness of our approach for medical applications.

ACKNOWLEDGMENT
The authors would like to thank Assistant Prof.T.MARY NEEBHA (Karunya University) for her valuable contribution of time and talent in the course of our project. We also thank all our well-wishers and supporters who helped to carry our project in each analysis. Above all we thank the almighty God.

FUTURE SCOPE
Along with medical applications its also been discussed that antennas can be used into clothing. That allows the elderly or disabled people to communicate during emergency without the help of assistive devices.

CONCLUSION
In this paper, we are discussing the technique of obtaining various parameters in the design of meander line antennas. The conclusion is based on different analysis done using several fabrics taken into consideration, which is incorporated on several antennas such as U-slot, elliptical, rectangular, parabola and different shapes such as E and H shaped rectangular patch antennas. Out of all the analysis wash cotton is considered to have low return loss which indicates less backward radiation when worn on the body.

REFERENCES