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NPSB Logo Patch Antenna Using Conductive Thread –UWB

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ABSTRACT: Wearable antenna is fabricated using conductive Electronic (E-Thread) are highly attractive for applications requiring conformality , flexibility and robustness .In this paper an E-Thread is embroided in an cotton substrate an low resistive and high conductive material operating in Ultra Wide band frequency range of (3.1GHz - 10.6GHz). This conductive thread is embroided in form logo which can be used for automatic registration of attendance in schools and universities.

KEYWORDS: Ultra Wide Band (UWB), Stainless steel E-thread, cotton, Computer Simulation Technology (CST), Dielectric constant.

I.INTRODUCTION

Antenna is used to transmit or receive electromagnetic waves. An antenna or aerial is an electrical device which converts electric power into radio waves, and vice versa. It is usually used with a radio transmitter or radio receiver. Wearable antennas are essentially any antenna that is specifically designed to function while being worn. Examples include smart watches, glasses and action cameras. Textile antennas fabricated using conductive E-threads are highly attractive for applications requiring conformality, flexibility and robustness.[1]. The idea behind the logo antenna is to use institute logo as part of the antenna [2]. CST STUDIO SUITE 2014 is the leading edge tool for the fast and accurate 3D simulation of high frequency devices and market leader in Time Domain simulation which is used for obtaining the simulation results.

UWB is a radio technology that can use a very low energy level for short-range, high-bandwidth communications over a large portion of the radio spectrum UWB has traditional applications in non-cooperative radar imaging. Most recent applications target sensor data collection, precision locating and tracking applications. This paper describes the design of antenna in logo shape used for automatic entry registration In this a stainless steel conductive thread is used which is 2 ply, a little thicker than every day polyester or cotton thread but still thin enough to be sewn by hand in medium-eye needles or with a sewing machine that can handle 'heavy' thread. Because it is strong and smooth, it is ideal for any wearable/textile project.

II. METHODOLOGY

In this paper, we propose a new Ultra Wide-Band (UWB) antenna with ground-slot. A micro strip patch radiator is chosen as an example of low-profile wearable antenna, as it can be made conformal for integration into clothing [5]. In this paper, a textile micro strip circular disk antenna for such body centred Wireless Local Area Network (WLAN) has been developed and tested. The conductive cotton fabric has been chosen as its substrate material [7].Handmade embroidery is possible in this project due to the usage of stainless conductive thread.

An UWB frequency is chosen to cover the wide range of frequency by which this can be used in institutions and even in large universities. The early proposed antenna has been fabricated by using a conductive non-woven textile on a layer of jeans [4] which is complex and hard to fabricate the thread but as in this project we use commercially available textile substrate cotton which can be easily sew able in machines as well as handmade embroidery.

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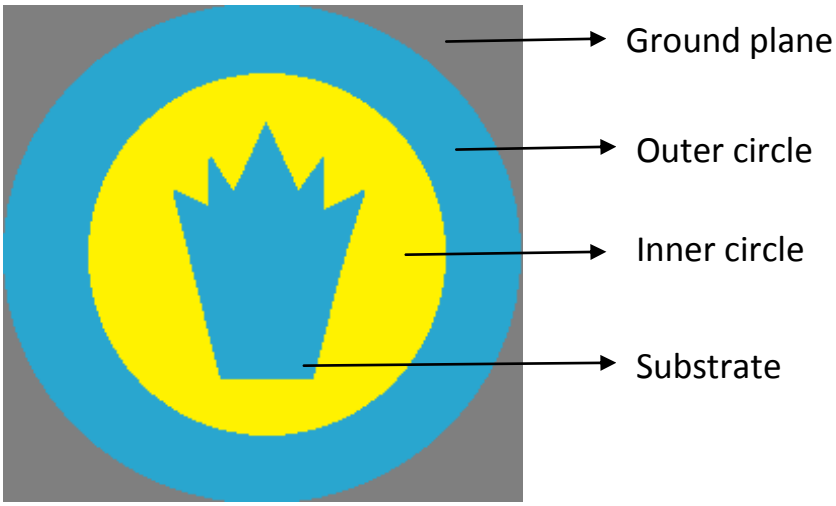
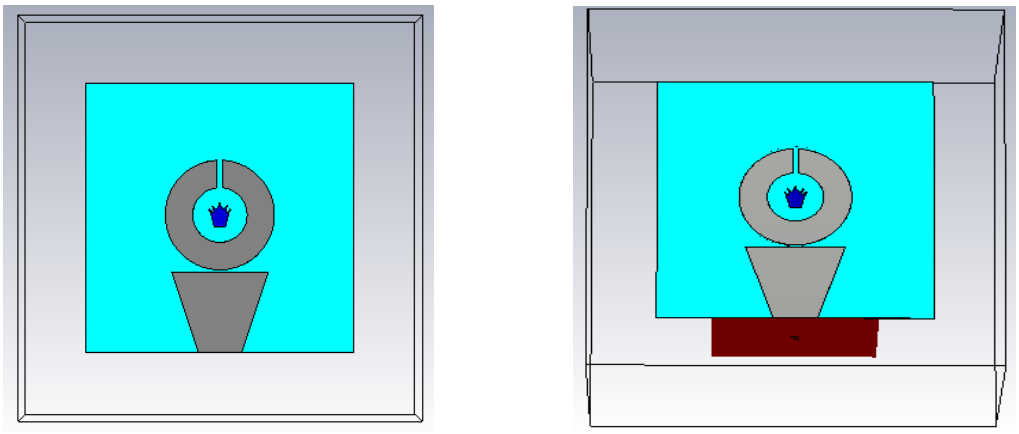


Fig.1. Design of logo antenna

This feature differentiates this conductive thread antenna from normally used patch antennas. By this type of logo design these type of antennas can be used in institution and schools to be used for entry exit automated registration .The design of antenna can be varied based on the logo design but the design will not affect much of parameters .A slot can be inserted in design to improve the gain but it will affect the entire design. The patch antenna, micro strip transmission line and ground plane are made of high conductivity metal (stainless steel). The patch is of length L, width W, and sitting on top of a substrate (some dielectric circuit board) of thickness h with permittivity ε_r . The thickness of the ground plane or of the micro strip is not critically important. Typically the height h is much smaller than the wavelength of operation.

The frequency operation of antenna is determined by the length 'l' and it is given by the centre frequency,

In this design a logo is designed for simulation by designing a ground plane in which a substrate of 5x5cm is placed and the diameter of outer circle is 4cm and inner circle is 3cm.



(a) (b)

Fig.2. NPSB logo antenna (a) Front view (b) Front view with feed

In this an antenna E-thread is designed in the form of NPSB (our college) logo is simulated in CST software and a feed input is given to work the antenna in specified frequency. By this NPSB logo these antennas can be embroided in dress and uniforms which will be not much complicate as RFID and wearables.

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In this the various antenna parameters are analyzed using the designed logo antenna in the CST suite 2014 the gain of an patch antenna is usually ranges from 3-5 dB in this paper an gain of 3.2dB is obtained in an Omni directional pattern as the antenna radiates in all direction it decrease gain value but it can work in wide frequency (3.1-10.6). A cotton substrate is used for embroidery which as higher dielectric by which an increased bandwidth is obtained which is UWB range.

Table.1.Various cotton material dielectric value

Types of cotton	**Dielectric**
Wash Cotton	1.45
Curtain Cotton	1.47
Poly Cotton	1.50
Jean Cotton	1.59

This dielectric constant value determines the gain value of the antenna if the dielectric value is high then the gain value also increases thus the substrate material plays an important role in antenna gain.

(a) (b)

Fig.3. Conductive threads (a) Copper thread (b) stainless steel thread

Since the conductive thread is made of stainless steel fibres, it will not oxidize like silver does, the project will not stop working because of oxidation after a few months and it is safe to wash. However, this thread is a little 'stiff', it feels a little like 'waxed thread' and is not ideal for making i-Phone -compatible gloves.

An stainless steel antenna as been used instead of normal copper E-thread the properties of stainless steel antenna was compared with existing thread in the below table.

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Table.2. Copper Vs Stainless steel E-thread

Properties	Copper E-Thread	Stainless Steel E-Thread
Substrate	Jeans ,Teflon	Cotton
Fabrication	Printed	Hand Made Sew-able
Maintance	Easily Tear able	Flexible And Washable

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III.PERFORMANCE ANALYSIS

The various antennas parameters are simulated and the corresponding outputs are displayed. In this figure-3 shows the S-parameter of the antenna. The return loss for the antenna is minimum at 10 GHz.

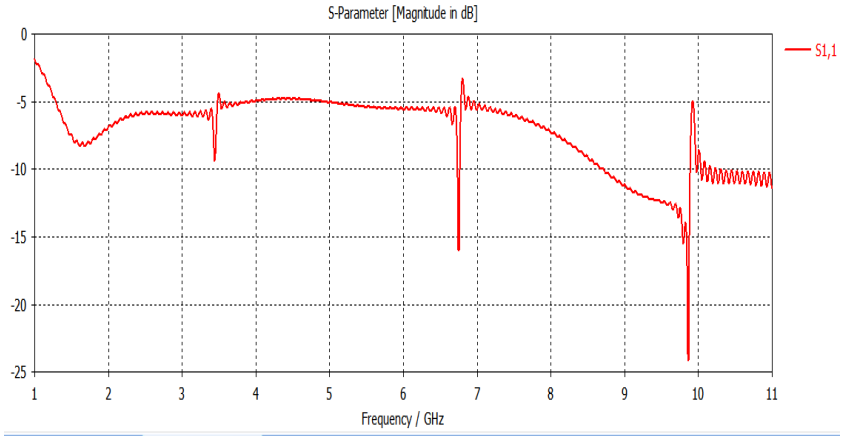

Fig. 3. S-paramter for simulated logo antenna

VSWR is a function of the reflection coefficient, which describes the power reflected from the antenna. In this simulation result explains an constant value in an UWB range of (3.1-10.6GHz).From which the designed antenna works in the UWB frequency.

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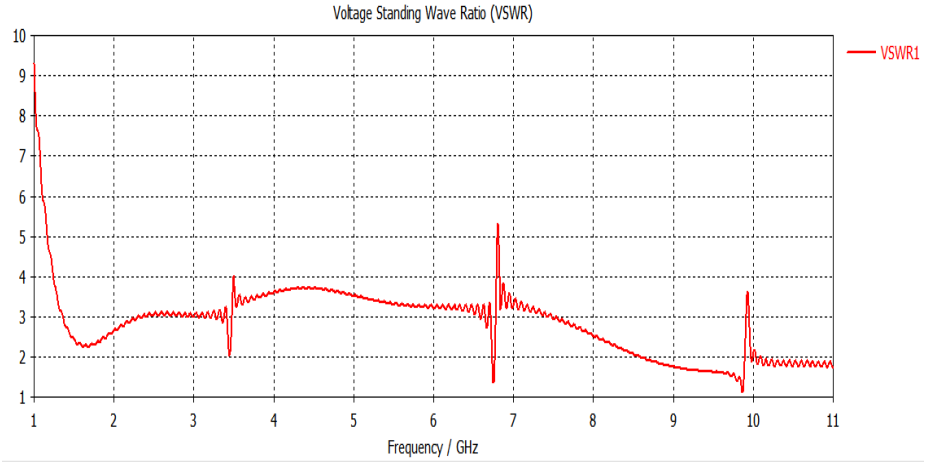

Fig. 4. VSWR for simulated logo antenna

This figure shows the Voltage Standing Wave Ratio (VSWR) versus frequency graph of the designed antenna. The VSWR is minimum (equal to 1.1) at 9.8 GHz.

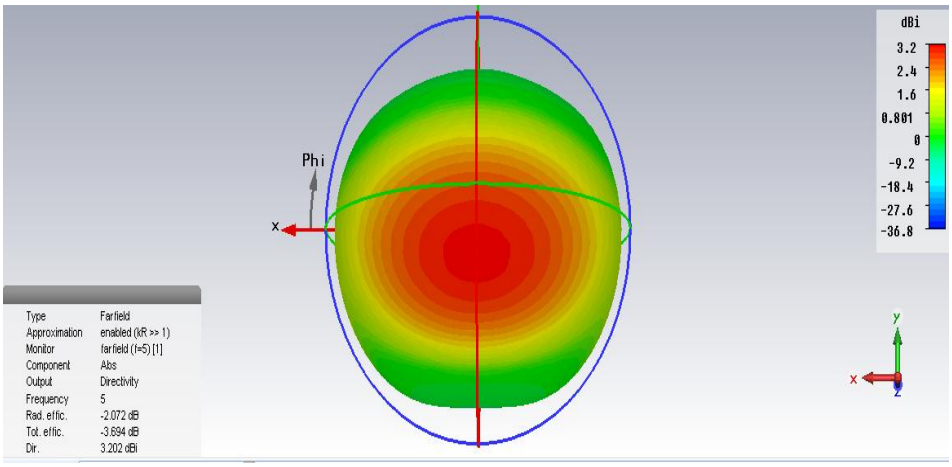

Fig 5. Simulated radiation pattern

An antenna radiation pattern is a mathematical function or a graphical representation of the radiation properties of the antenna as a function of space coordinates .In this radiation pattern is obtained for the Omni directional antenna is an apple shape for the frequency of 5GHz with a gain of 3.2dB.

IV.CONCLUSION

The textile antennas fabricated using embroidery technology are typically limited to operate at the frequency of less than 3 GHz but our project on wearable logo antenna design has frequency more than 3GHz in UWB range. In this paper we explained that even a thread can act as an antenna which can be more flexible and easy to wear. The material substrate cotton makes the fabrication more easy in an handmade embroidery and also makes the antenna to work in higher frequency range and the stainless steel conductive thread gives flexibility and high conductive property which makes to design NPSB logo in an wearable form.

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In this E-thread antenna an omni directional gain of 3dB is obtained and also various antenna parameters are also reasonably obtained .Further enhancement of using this antenna in real time purpose and also increasing the gain upto 5dB by this the performance can also be increased.

V.FUTURE ENHANCEMENT

In future this project can be used in military as to identify the missing soldiers in the borders by improving the gain value more security in camp can be improved.

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