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Computer-Aided Design AND APPLICATIONS

Enhancing Landscape Sketching Practice and Teaching in Figurative Oil Painting through Virtual Reality and Intelligent Equipment with 5G Technology

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Abstract. Figurative oil painting is a form of oil painting expression that is inseparable from the development of the times. The figurative oil painting works of different styles and schools also bring more shock to the audience because of their own artistic expression. With the development of 5G and Internet of Things technology, it is possible for people to complete oil painting creation by wearing smart devices. This paper summarizes the key technologies of antenna design, such as broadband technology, MIMO technology and decoupling technology, and provides a theoretical basis for the implementation of 4G antennas and 5G antennas applied to smart wearable devices below. In this paper, the near-field and far-field tests are carried out on the two smart glasses designed. The reflection coefficient of the designed antenna in the target operating frequency band is lower than -6dB and the antenna efficiency is higher than 40%. Also, we study the antenna efficiency and SAR values of the first two antenna loading head models. The results show that the designed smart glasses antenna has great application value. We believe that it can be seamlessly migrated to smart brush devices, which can be widely used in actual oil painting practice and teaching.

Keywords: figurative oil painting, smart device, smart glasses, smart brush, Virtual Reality
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1 INTRODUCTION

Oil painting landscape sketching is one of the high-quality means to improve the artistic ability of students majoring in art, and it is also a course content that students majoring in art must learn. Landscape sketching of oil painting can help students to comprehensively sort out the necessary painting knowledge such as modeling and color, making painting techniques more comprehensive and perfect, and laying a solid practical foundation for students' independent artistic creation [19].

To enhance the practice of landscape sketching, at the same time, it can help students learn to use oil painting language to express their cognition of objective things and scenery, so as to further cultivate students' artistic expression ability and artistic creation ability. In the process of oil painting landscape sketching, how the creators use oil painting language to express objective things and scenery is the core issue for the landscape oil painting sketching course, how can teachers guide students in the teaching process to stimulate students' independent artistic creative thinking, and through The language of oil painting is the key to expressing what you think in your heart and what you see in your eyes. In the long history, we can clearly understand from many painters such as Cezanne, Gauguin and other outstanding oil painting artists; the importance of landscape sketching to oil painting learning and development. Excellent artists are also good at exploring the interesting beauty and creative thinking brought by landscape sketching. With the development of oil painting art in China, more and more artists are paying more and more attention to landscape sketching in oil painting, and more and more artists have seen the important position of landscape sketching in oil painting art creation. But at the same time, in the process of research, we also realized that the formation of oil painting language and the improvement of oil painting artistic level are not simple imitation, nor blind sketching can bring effects, so in practice, how to draw To cultivate and learn the language of oil painting, how to achieve the improvement of artistic creation ability through the correct method has become a general problem of oil painting educators. The language of figurative oil painting has a long history. As a unique and indispensable part of contemporary oil painting art, the language of figurative oil painting plays an irreplaceable role in the teaching of landscape sketching and the creation of sketches. With the continuous progress of society, more advanced interactive equipment and technology should be introduced into the teaching method of oil painting.

The integration of Virtual Reality with 4G and 5G mobile communication systems opens up exciting possibilities for enhancing user experiences.People get a fast, comfortable and convenient life from mobile communication. The symbol of modern mobile communication development is the first generation (1G) analog communication era in 1986, which allows mobile users to make analog voice calls. Later, 2G, 3G, and 4G mobile communication systems also grow rapidly like volcanic eruptions. The fifth-generation mobile communication system (5G), which will be commercialized in 2020, will bring users a new experience of the Internet of Everything. It has a transmission rate ten times faster than 4G (up to 10Gbps) and can support more complex communication data services. In addition to the above communication systems, handheld terminal products used by mobile users also integrate other communication systems such as wireless local area network, global positioning system, Wifi technology and global microwave interconnection access [23]. For the past few decades, we have all searched for information on our desktops and laptops. With the continuous development of technology, people are not satisfied that they have to sit back in front of the computer every time they deal with things, which cannot solve problems in real time. As a result, the era of mobile Internet that can connect to the network through smart terminals anytime, anywhere has come. In recent years, wearable devices, such as smart glasses, smart watches, bracelets, etc., have also gained a good sales market, especially smart glasses, which are loved by consumers because of their stylish and beautiful appearance. Since smart glasses are a typical representative of smart wearable devices, their research content is more extensive, and it is easier to transfer to other devices, such as smart paintbrushes. This paper proposes a 2 x 2 4G loop antenna and a 4 x 4 5G slot antenna for smart devices.

2 RELATED WORK

2.1 Figurative Oil Painting Language

In the art of oil painting, there is a very important form of artistic language that is ------ figurative realism [11]. It has been tempered in the long river of history and has endured for a long time. It has shown its unique charm in different eras. In addition to being an important means of expression

in oil painting, figurative realism also has its own path and ideas [24]. In modern society, we can use mobile phones, cameras and countless other methods to record the scene at that time [2]. But this method of recording is a rigid or mechanical behavior. But when we people see and feel something through our own eyes or our senses, we will add some of our own emotions, consciousness, and some painting techniques and processing methods to it. It gives painting something subtle that photography cannot replace. Figurative realistic oil painting also has some similarities with our traditional Chinese painting. In traditional Chinese painting, we have quoted a sentence as a classic: "The beauty of painting lies between the like and the dissimilarity, too much likeness is kitsch, not likeness is deceiving the world" [7]. This sentence means that the subtlety of the writer's painting lies between the like and the unlike, giving people an imagination. If it is too similar, it will make people feel tacky, and if it is too different, it will It will make people feel that a distortion of objective nature is also an irresponsible behavior. This also summarizes the traditional Chinese artistic concept and realm. When ancient Chinese artists saw the great rivers and mountains, they collided with their own hearts. When they released their minds with brush and ink, they incorporated their own painting styles and expressed their emotions on paper to the fullest [7]. In the realistic oil painting from life, the subject depicted has changed. The realistic oil painting conveys the author's thoughts and emotions through the light and shadow of light and shadow, the virtual and the real, and its fundamental remains unchanged [13].

Among various oil painting forms, figurative oil painting is the art form with the longest history accompanying the development of Chinese oil painting. With the development of our country, oil painting has also grown up, and oil painting technology has grown extremely rapidly [22]. The expression content of our early figurative oil paintings is more of a fascination for nature. Over time, the early imitation forms of expression no longer fit the aesthetics of the artists of the time. So our figurative oil painters also began to make appropriate changes and improvements in their works [18]. This kind of improvement insists on taking some appropriate changes based on the realistic depiction of objective things, so that the whole picture has the uniqueness of some painters' own inner emotions after being figuratively realistic. As shown in Figure 1, in the works of the famous Chinese painter Yu Xiao fu, it can be seen that his works are no longer limited by time and space. He combines the characters of various periods with the characters of the present, and makes clever use of time and space. It expresses the writer's own thoughts and feelings [14]. This method subtly exerts the creativity of the painter, and on this basis, considers the modeling factors to complete the creation. At the same time, after a long period of development, modern figurative oil painting has undergone tremendous changes in its new shape, and its specific transformation is slowly moving closer to flat painting from the previous three-dimensional painting [9]. As shown in Figure 2, among the famous Chinese painters, Cao Li's paintings can fully reflect this transformation. Most of Cao Li's paintings are relatively simple and refined in shape. Basically, it is based on various geometric shapes, which are compared and referenced in the picture to create a strong contrasting atmosphere [5]. Modern and contemporary figurative oil paintings not only tend to be more and more simplified in shape, but also in color, which fully expresses the color artistry of decorative paintings [20]. Modern oil painters have added their own subjective changes to the structure of the picture and the changes of colors. Modern figurative oil painters have widely learned the strengths of hundreds of schools and are constantly promoting the development of figurative oil painting.see Figure 1 and Figure 2.

Figure 1: Yu Xiao fu Modern Oil Paintings.

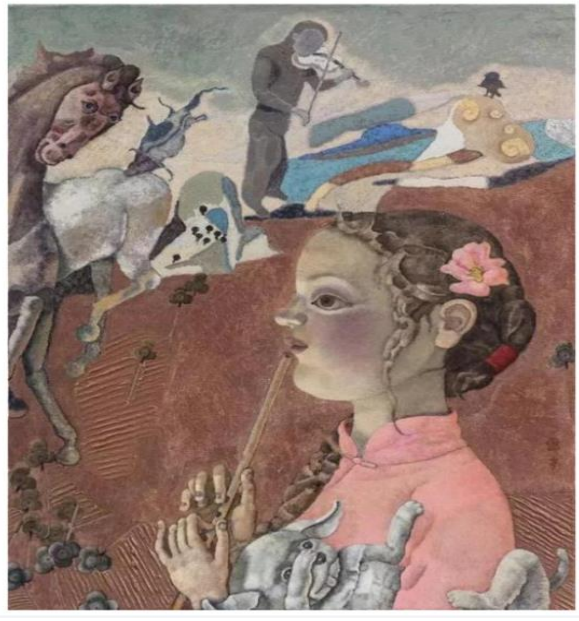

Figure 2: Cao Li's Modern Oil Paintings.

3 METHODOLOGY

3.1 4G Antenna Design

Since the two antennas Ant1 and Ant2 of 4G are symmetrical, Figure 3(b) only shows the detailed dimensions of the 4G antenna Ant1, and Figure 3(c) is a schematic diagram of the equivalent structure of the 4G antenna Ant1. The 4G antenna Ant is forming a ring structure with a path of A1→B1→C1→D1→E1→A1, and there is a parasitic branch F1G1 at the front of the temple to adjust the bandwidth of the antenna. Where A1 is the feed point and E1 and F1 are the ground points. There is a 2mm wide breakpoint at the D1 point of the ring structure, so that the monopole branch A1B1C1D1 formed from the feed point to the breakpoint can adjust the resonance bandwidth of the low frequency band [10]. The effect of the parasitic branch F1G1, the monopole branch A1B1C1D1 and the lumped capacitance cap on the matching of the antenna will be explained and explained in detail in the next section.

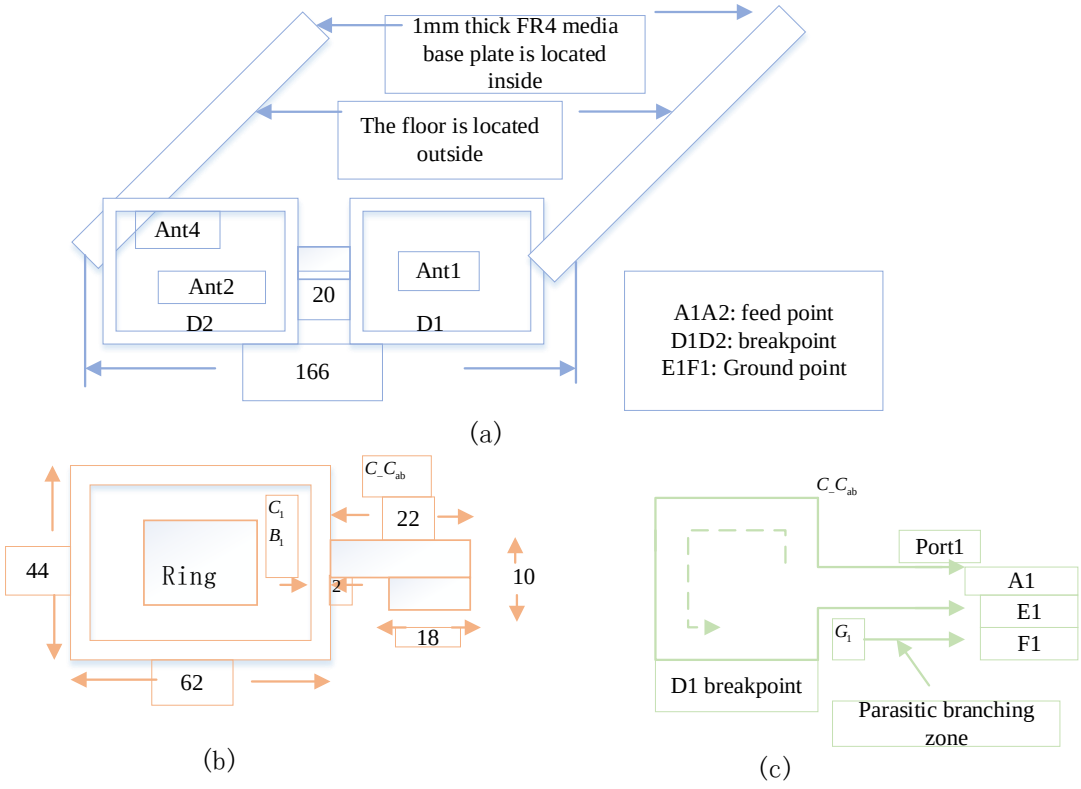

Figure 3: (a) Overall geometric structure of smart glasses antenna; (b) Detailed size and structure of 4G antenna; (c) Equivalent structure of 4G antenna.

3.2 Dual-loop Smart Device Antenna Based on Matching Circuit

Figure 4 is the equivalent structure of the matching circuit of the antenna. It is the current popular large-rimmed glasses [17]. The plane size of each temple area is 100mm x 15mm, with a metal plane of 80mm x 15mm printed on the outside as the floor plane of the antenna. The temple and frame are connected by a 10mm x 15mm "pile head". As shown in Ant1 Ant1 in Figure 4(b), the

resonant path of the loop antenna is A1→B1→C1→D1→F1, and the length is about 191mm, in which point A1 is the feed point of the loop antenna. Similarly, the matching circuit of antenna Ant2 is the same as that of antenna Ant1. For simplicity, the equivalent model of the matching circuit of antenna Ant2 is not given.

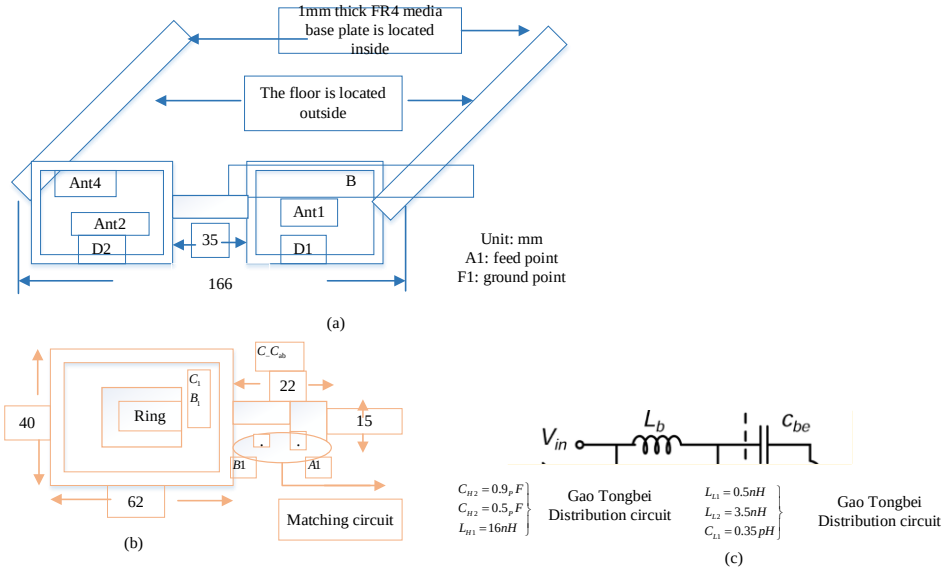

Figure 4: (a) Overall geometric structure of 4G double ring eyeglass antenna: (b) Detailed dimensions of ring antenna; (c) Equivalent model of matching circuit.

3.3 5G Antenna Design

Tn order to enable the open-slot antenna to cover the two frequency bands of 3.3-3.6GHz and 4.8-5.0GHz of Sub-6GHz, the same matching circuit is added to the coupling feed branch of Ant3 and Ant5, and the matching circuits are connected in series first. The inductor L1 of 1.0nH is connected in parallel with the inductor L2 of 2.5nH.

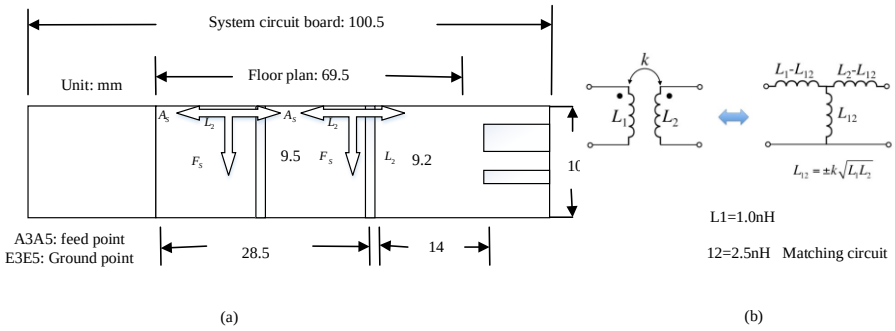

Figure 5: (a) Detailed dimensions of 5G antenna: (b) Equivalent circuit model of matching circuit.

4 EXPERIMENTS

4.1 Physical Test Results and MIMO Performance Evaluation of the Dual Loop Antenna

Figure 6(a) shows the S-parameters tested in free space using the Agilent N5247A vector network analyzer, and compared with the simulated S-parameter results, it can be seen that the tested and simulated S-parameters (S11/S22/S12) are obtained. It is well verified that there is a small bump in the S-parameters in the 1900-2075MHz frequency band, except that mode3 shifts slightly to the low frequency at 1730MHz [12]. Meanwhile, the estimated measured -6dB impedance bandwidth is 810-1070MHz and 1680-2700MHz in the two frequency bands, respectively.

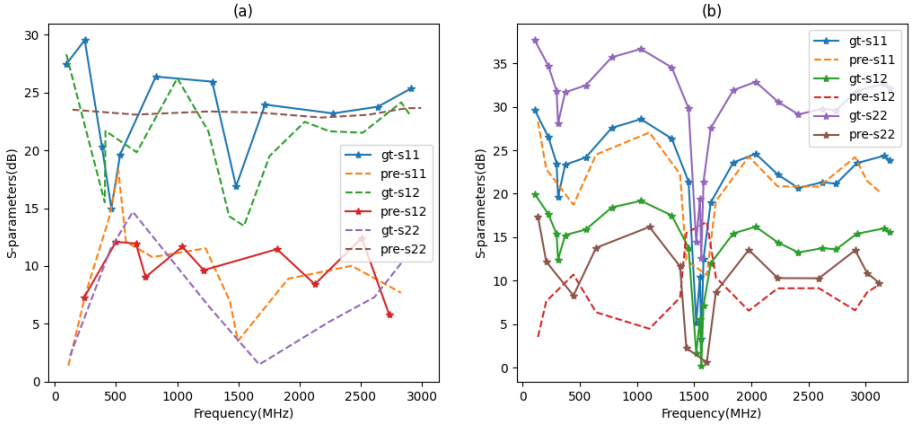

Figure 6: (a) Comparison of antenna test and simulation S-Parameter; (b) Comparison of antenna test and simulation S parameters with head mode.

According to the far-field radiation patterns, Figure 7 (a) - (c) show the radiation patterns of the two antennas, mode1 (880MHz) and mode4 (2420MHz) in the x-y plane, the x-z plane and the y-z plane, respectively. It can be seen from the figure that the radiation patterns of Ant1 and Ant2 are close to omnidirectional, except that the radiation nulls appear in the high frequency mode, which is similar to most reported LTE/WWAN antennas [4]. As mentioned earlier, the tested antenna efficiencies (Ant1 and Ant2) shown in Fig. 7 are slightly lower than the simulated antenna efficiency values due to antenna fabrication errors and coaxial cable soldering errors and mismatches, which are consistent with S in Fig. 6 corresponding to the parameters. The simulated antenna efficiencies are all above 70%, while the tested antenna efficiencies fluctuate between 48%-70% in the low frequency band and 48%-78% in the high frequency band.

Figure 8 calculates the MIMO performance of the dual loop antenna, including envelope correlation coefficient, channel capacity and multiplexing efficiency, respectively. The ECC of the dual loop antenna is lower than 0.1 in the two frequency bands, indicating that the independence of the dual antenna is relatively good, and it is suitable for the application scenario of the MIMO system. Figure 8(b) shows the channel capacity of the dual loop antenna compared with the channel capacity of the ideal 2 x 2 MIMO antenna system and the SISO system. Under the condition of 20dB SNR, the channel capacity of the proposed dual antenna is averaged in the low frequency band The value is about 10.2bps/Hz, which is 1.3bps/Hz lower than the ideal 2 x 2 MIMO antenna; the average high-band channel capacity is about 10bps/Hz, which is 1.5bps/Hz lower than the ideal value.

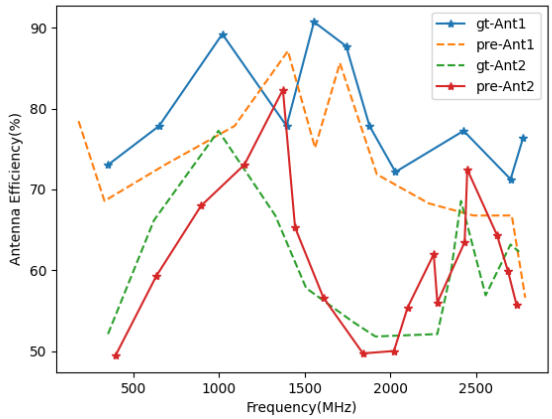

Figure 7: Test and Simulation Values of Double loop Antenna Efficiency.

However, the channel capacity of the proposed double loop antenna is about twice that of the ideal SISO antenna system, and it has the excellent performance of MIMO antenna, which can effectively improve the information transmission rate. Figure 8(c) compares the multiplexing efficiency of the double loop antenna in the simulation and testing environments. The comparison of the two curves shows that the multiplexing efficiency of the test is slightly lower than the simulation value, due to the error caused by the welding problem during the processing, and Mismatch of the coaxial cable used, etc. Therefore, there is an efficiency loss in the test value compared to the simulated multiplexing efficiency.

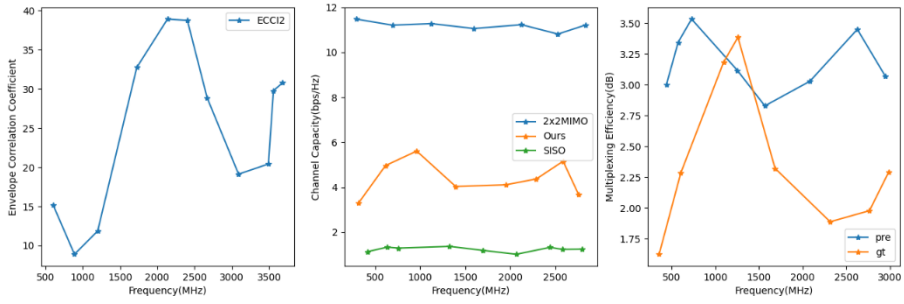

Figure 8: MIMO performance analysis of dual loop antenna: (a) envelope correlation coefficient; (b) Channel capacity; (c) Reuse efficiency.

4.2 Analysis of Antenna Performance with Head Mold Loaded

Figure 9 compares the S-parameters and antenna efficiencies of the 4G dual-loop antenna in free space and under the loading head model. It is worth noting that although the impedance matching of the low-band LB (Low Band) and high-band HB (High Band) of the double loop antenna under the head model loading becomes unsatisfactory, it can be achieved by tuning the low-pass matching circuit LMC and the high-pass matching circuit at the same time. Circuit HMC to correct the impedance matching of the double loop antenna on the head model.

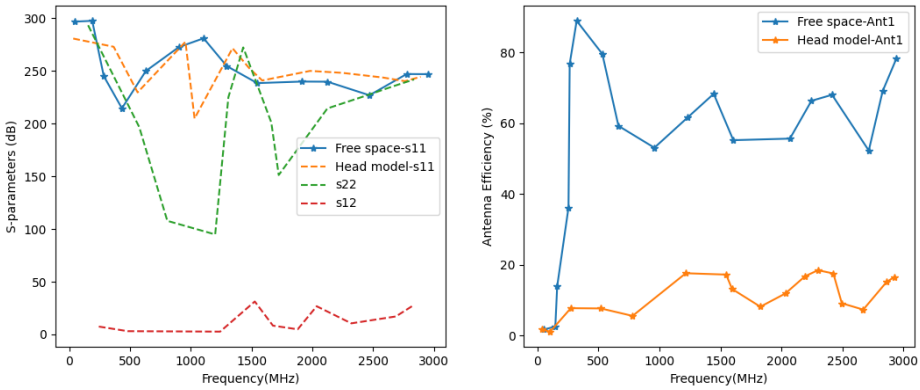

Figure 9: Double loop antenna of loading head model and result analysis: (a) S-parameters; (b) Antenna efficiency.

4.3 SAR Value Analysis of Loaded Head Model

The SAR value of the 4G double-loop antenna loaded head mode is also obtained through the HFSS simulation software, as shown in Table 1. As can be seen from the table, both the 1g SAR and 10g SAR values of Ant1 and Ant2 are well below the limits set by the US and Europe.

Frequency (MHz)	Ant1		Ant2	
	1Gsar (W/kg)	10Gsar (W/kg)	1Gsar (W/kg)	10Gsar (W/kg)
860	1.32	0.96	1.39	0.97
920	1.33	0.92	1.41	0.95
2000	0.44	0.29	0.43	0.23
2300	0.79	0.51	0.87	0.55
LIMIT	1.6	2	1.6	2

Table 1: SAR Value Simulation Results of Double loop Antenna.

5 CONCLUSION

Since the emergence of the art of painting, whether it is the Western oil painting art or the Eastern Chinese painting art, sketching has occupied this very important position. Sketching is an objective expression of nature and a way of realizing the author's unique understanding of nature. Nowadays, the development of wireless communication field is changing rapidly, wearable communication devices have become popular electronic products, especially smart glasses have been sought after by consumers. This paper focus on the design of the double loop antenna for 4G smart glasses, and analyzes the detailed design principle of the double loop antenna. Since the communication and interaction technology of smart glasses includes the realization forms of devices such as smart brushes and smart inks, this paper provides an applicable example for the practice and teaching of oil painting language in landscape sketching.

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