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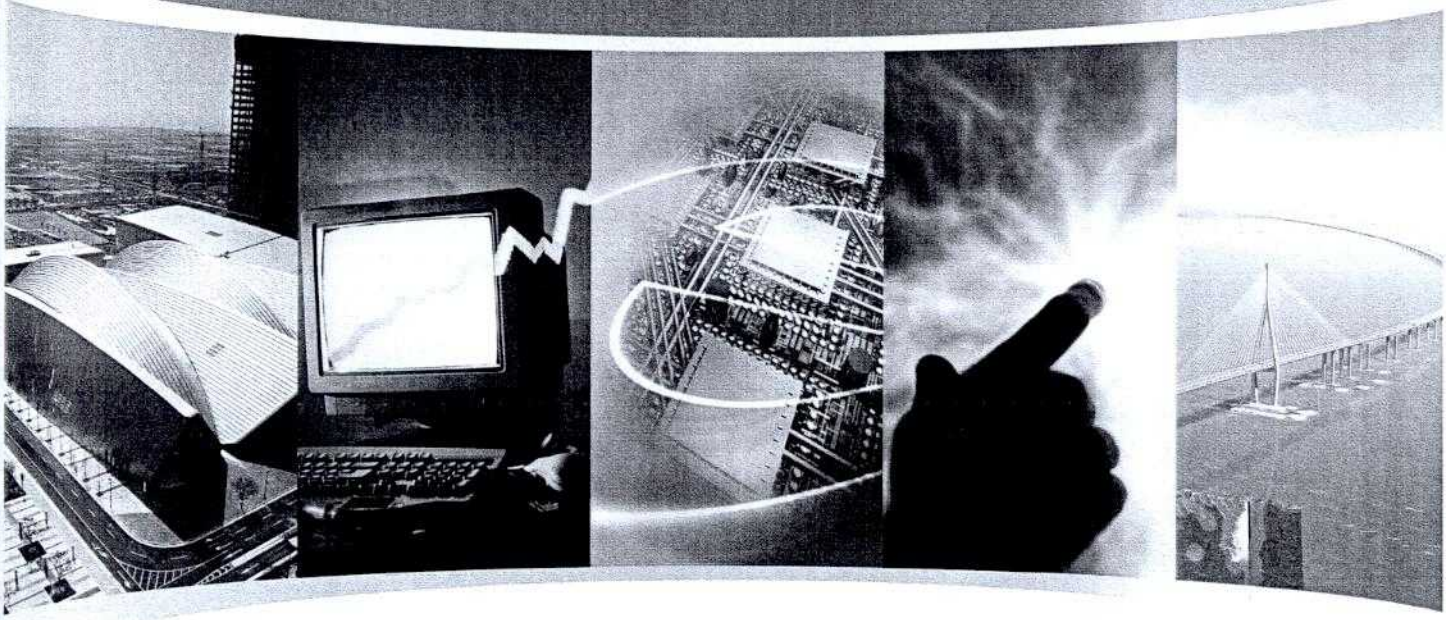

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FOLDED PLANAR DIPOLE ANTENNA FOR WIDEBAND WBAN APPLICATIONS

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1. INTRODUCTION

The wireless body area network (WBAN) is a short-range communication network around a human body. By using the WBAN technology, various body-surrounding devices (for example, body-attached sensors, telecontrolling medical devices, wearable computers, and PDA) can communicate with each other, so many kinds of service (such as a medical healthcare and various non-medical services) can be provided [1],[2].

Offering multimedia service is one of the WBAN applications and usages. In this case, a wireless communication network between a transmitting device for providing contents (such as a MP3 player) and a receiving device for human sensing (such as a headset) is needed. However, the relative position of a transmitter and a receiver is not deterministic. So, an antenna with an omni-directional radiation pattern is required for WBAN multimedia applications. And a wideband characteristic is also needed, because most multimedia services occupy a wide spectral bandwidth.

In this paper, a new antenna which can be integrated within a conventional headset structure is proposed. This antenna is designed for transmitting a wideband multimedia signal using 3~4GHz or 7~8GHz UWB bands. The proposed antenna is modified form of a planar dipole antenna, which has a wide bandwidth characteristic and an almost omni-directional radiation pattern.

2. PLANAR DIPOLE ANTENNA STRUCTURE

The typical structure of a planar dipole antenna is given in figure 1. The structure is composed of two radiating elements, which are printed on the opposite sides of the substrate. Because the radiating elements are fed by the structure of parallel plate from the microstrip line, the radiation currents of each element are in opposite direction [3]. The substrate is Duroid 5880 which is 10-mil thick and has dielectric constant of 2.2. The feed structure is composed of four sections which have different width and the parameters (width/length) of each section are tuned for impedance matching. L and W denote the length and height of the dielectric substrate, and their maximums are limited to reasonable range which is acceptable for integration into the headset structure. The parameters are: W=45mm, L=45mm, W1=0.75mm, W2=0.75mm, W3=0.5mm, W4=0.3mm, L1=7mm, L2=20mm, L3=7mm, H=0.5mm, R=8.8mm.

Figure 2 and figure 3 shows the simulation results of the planar dipole antenna. The radiation pattern simulation is evaluated at 3.5GHz and 7.5GHz, which are the center frequencies of the bandwidth for

which we design the antenna. From the simulation results, it can be shown that the return loss characteristic is satisfied in two operating bandwidths based on the simulation results, and there are null points on E-plane pattern at the z-axis direction (θ=0°/180°) while its H-plane radiation pattern is almost omni-directional (slightly distorted due to the effect of ground plane).

3. PROPOSED ANTENNA STRUCTURE

For a BAN application, an antenna of omni-directional radiation is strongly required because the relative position of mating equipments is not deterministic. For this application, the above typical dipole antenna can be a good solution, because of its simple structure, easy fabrication, and almost omni-directional radiation pattern. However, its usage is somewhat limited because null points exist at the z-axis direction. For example, if the receiver is placed in the z-axis direction of the transmitter, the received signal level strongly is weakened due to the radiation null of the transmitting antenna.

To reduce the radiation null at the z-axis direction, the modified structure of a planar dipole antenna is proposed by folding the typical planar dipole antenna structure. Because the radiating current flows along the edge of the radiating patch, the direction of current flow is distorted. Using the proposed structure, the new current element normal to the z-axis direction, which is the radiating component at the z-axis direction, is generated and the radiation null in the direction is reduced. And, because this antenna structure is in echelon, it is easy to integrated within a headset when we use the exterior of a headset is used.

The proposed antenna structures are illustrated in figure 4. The radiation patterns of the antennas from EM simulation results are shown in figure 5 and 6. The geometrical parameters of the antennas are same to those of the above planar dipole antenna. From the result, it can be shown that the E-plane radiation is getting omni-directional as the folding angle is increased and the variation of radiation pattern at 7.5GHz according to the folding angle is more distinct than at 3.5GHz. In contrast, the H-plane radiation pattern is almost same irrespective of folding angle at both frequencies. However, the larger the folding angle is, the worse the input matching characteristic is.

The variation of radiation pattern is also influenced by the folding position offset from the feed point. The simulation results for different offsets with 45° folding angle are shown in figure 7 and 8. In these cases, the E-plane radiation is getting omni-directional as the folding offset is reduced. Similar to the above simulation, the variation of radiation pattern at 7.5GHz is more distinct than at 3.5GHz, and the H–plane radiation pattern is almost invariable.

4. CONCLUSION

The new antenna structure for the WBAN multimedia application is proposed and investigated. This antenna makes the more omni-directional radiation pattern than a planar dipole structure, because the new components of radiation current which make the radiation at z-axis direction is generated by folding the antenna with a proper offset and angle. This antenna is composed of two circular radiating patches and designed for 3~4 GHz and 7~8 GHz. From the simulation results, it can be shown that the radiation pattern is getting omni-directional as the folding angle is increased or the folding position offset is reduced.

ACKNOWLEDGEMENTS

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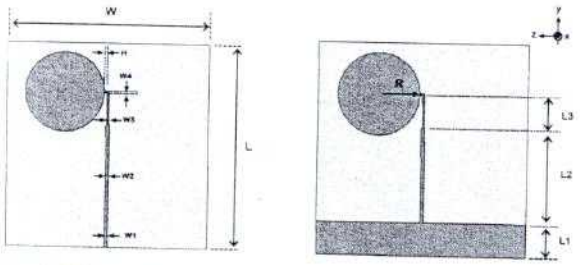


(a) front view (b) back view

Fig. 1. Planar Dipole Antenna

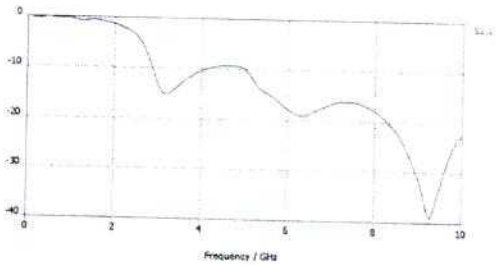
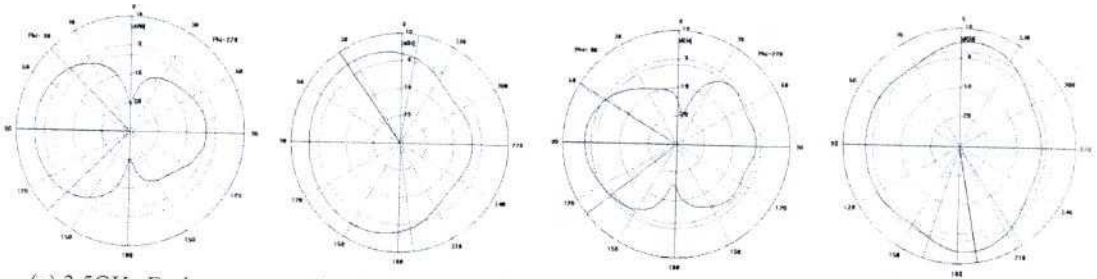


Fig. 2. Return Loss characteristics of a Planar Dipole Antenna



(a) 3.5GHz E-plane (b) 3.5GHz H-plane (c) 7.5GHz E-plane (d) 7.5GHz H-plane

Fig. 3. Radiation Pattern of a Planar Dipole Antenna

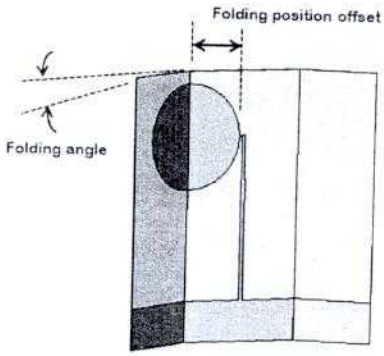
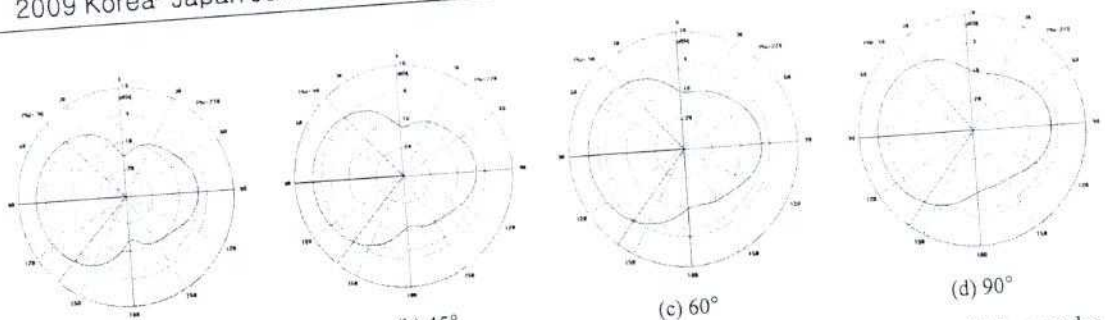
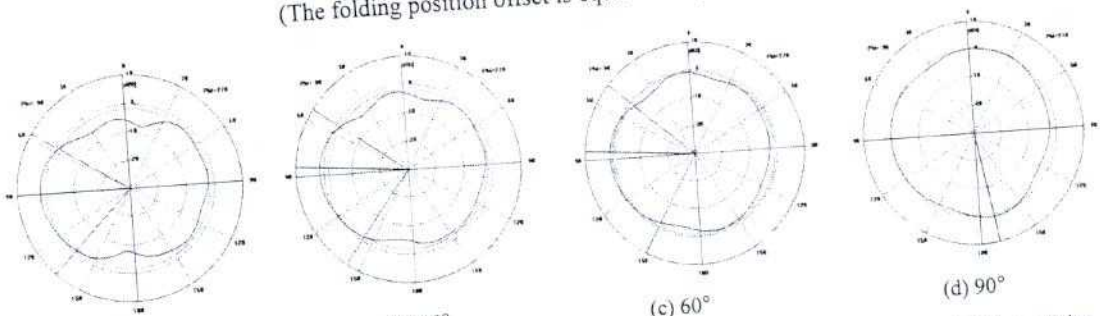


Fig. 4. Proposed antenna structure



(a) 30° (b) 45° (c) 60° (d) 90°

Fig. 5. E-plane Radiation Pattern of the Proposed Antenna at 3.5GHz with different folding angles (The folding position offset is equal to the patch radius)

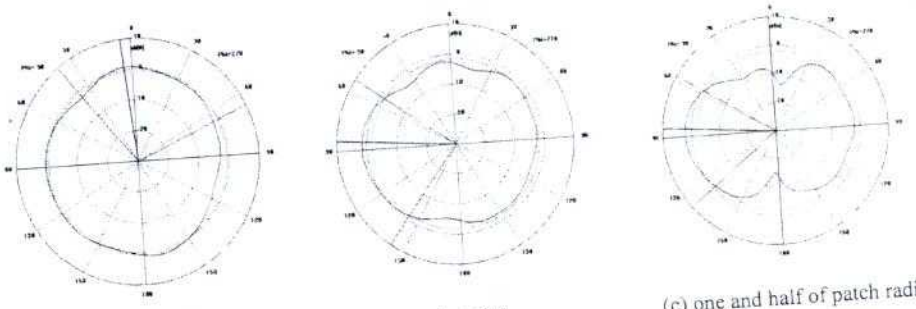


(a) 30° (b) 45° (c) 60° (d) 90°

Fig. 6. E-plane Radiation Pattern of the Proposed Antenna at 7.5GHz with different folding angles (The folding position offset is equal to the patch radius)

(a) half of patch radius (b) patch radius (c) one and half of patch radius

Fig. 7. E-plane Radiation Pattern of the Proposed Antenna at 3.5GHz with different folding position offsets (The folding angle is 45°)



(a) half of patch radius (b) patch radius (c) one and half of patch radius

Fig. 8. E-plane Radiation Pattern of the Proposed Antenna at 7.5GHz with different folding position offsets (The folding angle is 45°)