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Research paper

Reconfigurable antenna design for soil testing to improve soil quality

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Abstract

The Multi-band Reconfigurable antenna used to achieve the different frequency with low return loss. It achieves the variety applications like soil testing using the antenna data transmission and makes the quality of the soil to improve the production. Effectiveness of the work used to propose that the antenna designed to sense the chemical content of the soil and report the data with the frequency of 2.4 GHz to the operator, which makes the operator to have good crop at the right time. This antenna design also used to have the different frequency of data transmission in the single structure, it produces the frequencies likeWLAN at 1.5GHz, GPS at 2.4GHz, WiMAX at 3.27 GHz and Wi-Fi at 5.17 GHz, which designed using the T-shaped stub and two E-shaped stubs. The Existing antenna can transmit only three frequencies with 70% output efficiency but the proposed antenna design can transmit four different frequencies with 80.5% output efficiency. The simulated and the measured results of four investigated bands are lies between -12.3 dB and -15.5 dB with the Bandwidth of 10KHz which show that the antenna has better performance in all frequency bands. It offers the radiation Patten, return loss, peak gain and efficiency at low cost with high accuracy using microstrip patch antenna.

Keywords: *GPS, WLAN, multiband antenna, planar antenna, quad-band antenna, reconfigurable antennas, Worldwide Interoperability for Microwave Access (Wi-MAX), Spectrum Sensing, Wi-Fi.*

1. Introduction

The micro strip patch antenna normally used to configure the single antenna for the different applications i.e. for multi-band applications. It used to achieve different frequencies like 1.575 GHz, 2.4 GHz, 3.27 GHz and 5.17 GHz. To achieve the antenna design we have studied, the design of four-band slot antenna for the GPS, WiMAX which also used to propose the Wireless-Area-Network (WLAN) using the Reconfigurable antenna [1] Monopole antenna operates only at two frequencies, a multi-band planar inverted F-antenna used for the wireless-wide-area-network for different frequencies [2]. A multi-band patch antenna used for varying the polarization states in different bands [3], dual-band loop antenna used to achieve the frequencies of 2.4/5.2/5.8 GHz [4]. A tuneable Multiband Micro strip Antenna is designed, capable of turning its operating frequency in 5GHz band which has two slots of E & U shape are etched to achieve multiband resonance [6]. The antenna designed to produce the significant efficiency to have Wi-MAX application; the tri-band antenna structure and it will be generated from the ground planes from the three folded slots etched from the antenna design is described in [5-9]. In the proposed antenna, we designed a four-band slot antenna for the GPS/Wi-MAX/WLAN systems. The proposed antenna consists of a T-shaped feed patch structure, the inverted T-shape stub structure and two E-shaped stub structure to produce four frequency bands at about 1.575 for the GPS, 2.45 IEEE 802.11b, 3.5 Wi-MAX and 5.4 GHz for IEEE 802.11a systems, respectively. The gain achieved by this antenna is much higher than the other antennas that are it has up to 80.5% output efficiency so that it can used for the Wi-MAX application. The antenna design used to sense the soil quality by absorbing the radiation generated by the soil. The major function of this antenna used to sense the chemical content in the soil and absorb the radiation generated in it which transmit the absorbed data to the operator, so that the operator can able to have the organic crop. The Mean, Median, Crest factor, Standard Deviation, VSWR value and efficiency are measured using Sigview software. The antenna parameters are measured using the ADS Software.
The ADS is the simulation tool used to design the antenna in the simpler structure. The radiation pattern and design structure can easily verify, test and simulated effectively using this software. The feed given to the antenna so it is effective to have the design result with required efficiency, peak gain radiation pattern and the reflection coefficient S11of the antenna.

2. Antenna structure

The key comments of the antenna analyzer of the micro strip patch structure with frequency recognition have different applications. Here the rectangular antenna slot has four stubs one which has T-shaped stub, the inverted T-shaped stub, the E-shaped stub to generate four different bands which are used to produce the frequencies 1.575, 2.4, 3.27 and 5.17 GHz concludes using the ADS software with the design parameters which used to implement the design structure. The patch connected using the SMA connector and the result in the antenna measuring equipment, which compared with the simulated results of the S11. The measured result tested and verified using the Vector Network Analyzer (N9925A). Through this VNA, we can able to calculate the S-Parameter, VSWR, Impedance, gain and the Phase Shift.

2.1. Design parameters

To the design of multiband reconfigurable Microstrip antenna for different frequencies. The present techniques available in the open literature include the modification of the main radiator via bending, folding, meandering and wrapping. The designed antenna used to sense the radiation of the soil, fruits and vegetables. To improve the quality of the organic foods, it absorbs the data and information of the soil quality using the antenna and transmits it to the vendor to have a quality crop. The single antenna used for multi band applications. It also used for Wi-Max applications.

This Antenna designed using the modulation of the length and the width statistics of the designing which is to be used to have the switching the various frequencies.

The systematic figure1 can be used to design the length and width of the antenna the outer width of the slot is consist of rectangular slot loaded with the size of L1xW1=48x18 mm^2 on the one side substrate. Here the antenna has the E-shaped and T-shaped slot used have the feed line width of W_f=1.76mm to get the impedance of 50Ω. The T-shaped feed patch on the lower side has the best impedance matching. By using this impedance matching, the antenna can be able to generate the variable frequencies like 1.57, 3.5, 2.45 and Wi-Max (5.4) GHz in the different bands like band 1,2,3,4 in the wireless standards. The figure2 shows that the entire shape of the antenna designed in the ADS software, which represents the actual structure of the antenna in a possible structure.

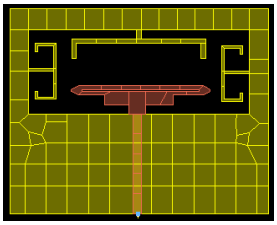

Fig. 1: Antenna design in ADS

2.2. Design structure of the antenna

The reconfigurable antenna designed to have the different frequencies like GPS, Wi-MAX, and WLAN. It gives peak gain, efficiency, and the return loss can be analyzed using measured and simulated results in the ADS software design. The results of the antenna for the required frequencies are 1.599, 2.074, 3.562 and 5.218 GHz in the different bands of the antenna patch. These frequencies used to configure the applications like GPS, Wi-MAX, and WLAN Etc. This antenna design is more reliable and advanced type because it has generated the different frequencies at the same time and the efficiency is more than 90 percent compared to the other antennas.

3. Antenna structure and design

The antenna designed using ADS software by using different parameters for various applications. The Designed structure and function of the antenna based on the technical parameters and formulations to have the required frequencies. The antenna shown in Figure.3, has the feed line placed symmetrically on the ground plane, which can block the way of the other electronic components placed on the PCB. However, the power line be designed to be placed asymmetrically on the ground plane to give more space for other components. In most other designs, we have the feed lines placed symmetrically on the ground plane. The feed lines are symmetrical on the ground plane in this design to have an easy comparison made by other antenna designs.

The designed antenna studied with a relative permittivity of €r=3.5, the thickness of the antenna 0.8 mm, and the tangent loss is 0.004. The figure 2 shows the radiation emitted by the antenna in the simulation done by the ADS Software.

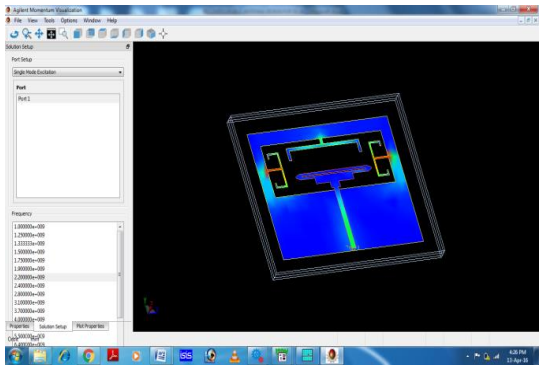

Fig. 2: Simulated radiation pattern

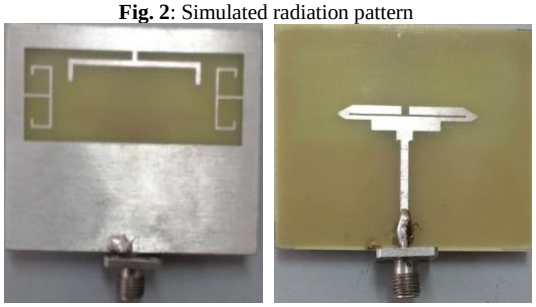

Fig. 3: The hardware design of the antenna

The figure4 shows the simulated result of the designed antenna where it has the different frequencies in the different bands. It shows the efficiency of the antenna to transmit the signals in the wireless transmission medium. The absorbed signals can be transmitted in the frequency range of 3.45 GHz. The system frequency remunerates the dip in the circular polarization graph has the current dissipation and power distribution in various Band structures. This antenna has the two ports one for the antenna and another for the patch where these two ports are connected in the same place so that the gain of the antenna will be easily measured.

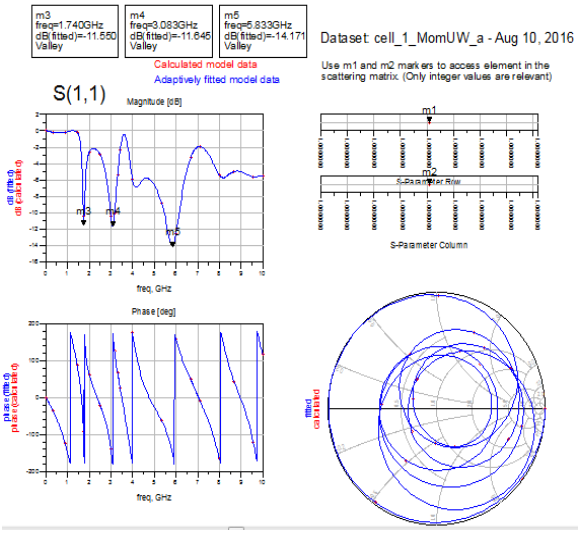

Fig. 4: Simulated result in graphical representation

3.1. Sigview output

The antenna designed to analyze the quality of the food items and sense the quality of the soil to make the organic crops. It used to identify the potassium content in the soil and used to recover the quality products for the society and also used as a sensor to scan the soil plant and leaves to acquire energy. This antenna used to absorb the radiations from the plants and it converts the radiations as voltage to transmit the signal to the system.

This antenna used to identify the radiation of the soil quality and the signal generated by it absorbed by the sigview software. The voltage can be generating by soil radiation energy, which can be viewed by using the multi meter.

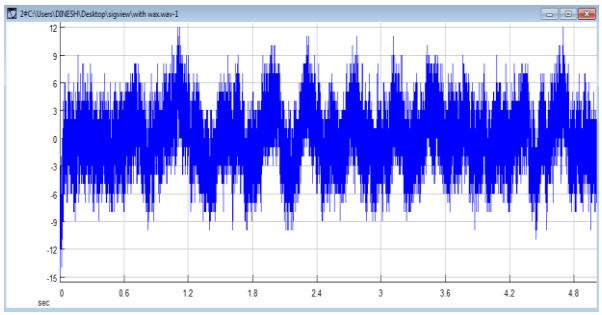

Fig. 5: Antenna radiation in the cultivate soil

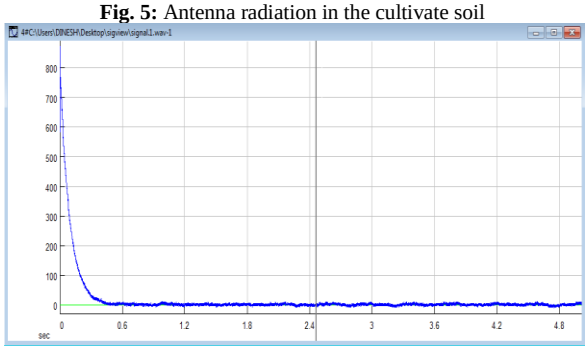

Fig. 6: Antenna sense the chemical content in the Soil

The figure 5 shows the soil radiation of the cultivate soil absorbed by the antenna. the figure 6 shows the soil radiation when the chemical content is mixed with it.

The antenna designed to analyze the quality of the food items and sense the quality of the soil to make the organic crops. It used to identify the potassium content in the soil and used to recover the quality products for the society and also used as a sensor to scan the soil plant and leaves to acquire energy. This antenna used to absorb the radiations from the plants and it converts the radiations as voltage to transmit the signal to the system.

This antenna used to identify the radiation of the soil quality and the signal generated by it absorbed by the sigview software. The voltage can be generating by soil radiation energy, which can be viewed using the multi meter.

4. Antenna geometry and design

This antenna designed with the frequencies of different Bands in the radiation produced in the various portions of the antenna.

The antenna been designed to sense the radiation of the soil by varying the Mean value, Median value, Crest factor, Standard Deviation, VSWR value and efficiency. These variations are measured using Sigview software, the absorbed data can be energizing by the antenna and it transmits the information to the operator. This product be used in two ways

1. To absorb the chemical content in the soil for example if the soil has more potassium, plants give the good yield but it is more dangerous to our body because it gives the inorganic yield. Therefore, it does not give the organic crop. The antenna design will sense the chemical content in the soil easily. So that we can able to yield the organic crop and have the quality foods from the quality soil.
2. This antenna be used to absorb the radiation of the crop when the crop gets spoiled in the unfortunate conditions like floods and in dry conditions. The soil requires the sufficient amount of water to sustain the good yield if the yield has more water or it has no water then the crop be destroyed. In such case the proposed antenna will absorb the radiation of the soil whether it has more wet condition or else dry condition. Then it indicates the operator to take care of the crops before it gets destroyed. In this way, the antenna design used in the possible conditions to safeguard the crop that is the essential things for the future life.

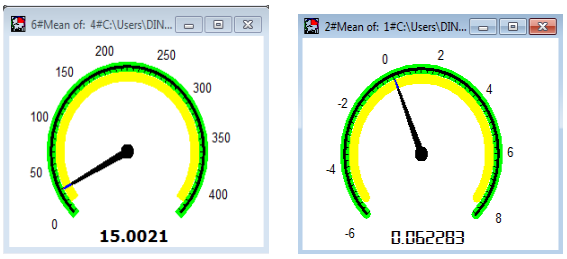

Fig. 7: Mean value of the soil (a) with and (b)without potassium

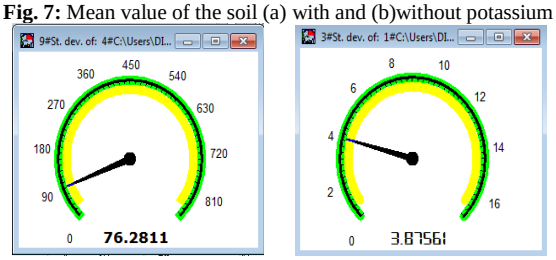

Fig. 8: S.D. value of the soil (a)with (b) without potassium

The tested soil data can be transferred Using IOT technology. The antenna is connected with the Lanch pad where the absorbed data are transferred from the source to the destination point using wireless technique. The Lanchpad is a type of Wi-Fi device, which can be programmed using the Proteus software and designed using antenna design structure. The antenna will receive the entire information, then collected data is transferred using the IOT device. The function of the IOT device is to connect with the Internet, so that the information given to the online services using the IP address. If we need the information means, we want to see through online. The difference between the earlier system and our system is that to send the message we need GSM for mobile communication and it will be the chargeable but our system has IOT, which activated using online so it is not charged. If the Sensor is identified the soil Quality and Message is given to the operator using IOT.

The entire system designed in the Single chip, which placed in the same antenna structure. Using this antenna, we can test the soil and transmit the data through source networking using IOT. The entire system minimized in a small chip, which is useful for the farmer peoples.

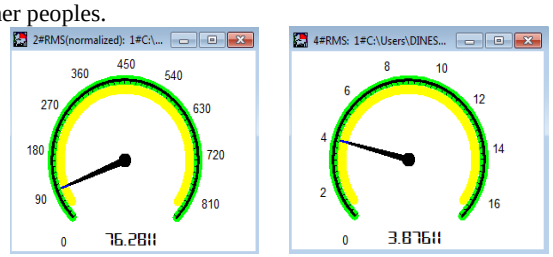

Fig. 9: RMS value of the soil (a) with (b) without Potassium

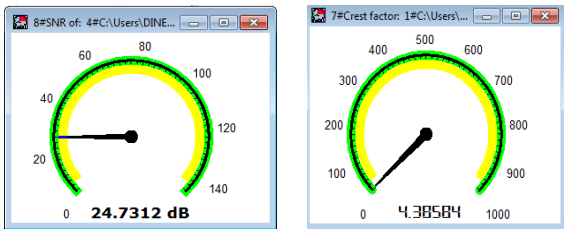

Fig. 10: Crest factor of the soil (a) with (b) without Potassium

5. Hardware design of the antenna

The hardware developed by using the ceramic material like FR4 and the copper material. This antenna has the thickness of 1.6mm; the antenna specially designed using the automated tool, which used to report the design with a certain structure and used to have the specific frequencies like 5.8GHz that is more useful for the

Wi-Max application. The frequencies achieved from this antenna are more helpful to the 5G technology.

The antenna placed in the soil and the voltage can be measured using from the port connected in the antenna. The antenna wirelessly connected with the operator, used to absorb the radiation from the soil where the frequency converted as voltage. Then the generated voltage variation absorbed by the Sigview software. So that we can get the good yield in the right time.

The variation can be absorbing the variation in the Mean value in figure 7. The Standard Deviation of the soil can be absorbed in the Figure 8. The RMS value of the soil can be calculated with potassium content and without potassium content in the soil be produced in the Figure 9. The Crest Factor of the soil can be calculated with potassium content and without potassium content in the soil be produced in the Figure 10.

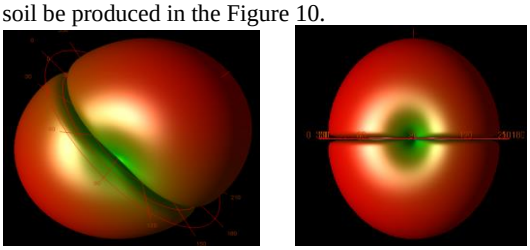

Fig. 11: the radiation pattern of the designed antenna

The antenna designed and tested using the ADS software and the radiation pattern is recognized and produced in the Figure 11, which shows the dipole structure with the responding parameters.

5.1. Hardware and software Comparison

Comparing the results of the hardware and software, we have the efficiency of 90 percentages. It has the achieved results of

Band	Simulated result	Hardware result
1.	1.74 GHz	1.599 GHz
2.	2.43 GHz	2.07 GHz
3.	3.083 GHz	3.56 GHz
4.	5.833 GHz	5.218 GHz

6. Conclusion

The reconfigurable antenna designed to have the different frequencies like GPS, Wi-MAX, and WLAN. The radiation pattern of the antenna realized peak gain, efficiency, and the return loss could be analyzed using measured and simulated results in the ADS software design.

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