ANALYSIS OF MOISTURE SENSOR BASED ON MICROSTRIP PATCH ANTENNA: A REVIEW

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Abstract

The paper summarize that moisture sensor based on microstrip patch antenna. Microstrip patch sensors have become useful and widely used in every fields such as agricultures, industrials, food products, medicals communication etc. It have been more useful for detecting i.e., broken rice detection, Impurities detection in water, Soil moisture measurement, Rice Grain moisture, Rice quality detection, etc. The Moisture sensors have been used for detecting the soil moisture, cereals moisture, which is useful for human beings. It had been analyzed by CST software and for measuring by the vector network analyzer.

Index Terms: Moisture content, Printed circuitry board, Vector network analyzer, CST software.

I. INTRODUCTION

Moisture sensor techniques have found many applications such as for detecting rice moisture, grain moisture, soil moisture, fruit moisture etc.

Rice is an important nutrition for human beings especially for Asiatic population [1]. It provides minerals, vitamins, fiber etc. The quality of rice, moisture content & broken rice percent can be determined by microstrip patch sensor. The moisture levels were measured by the sensors based on resonance frequency & discussed the moisture content and relative complex permittivity measurements.

Now days, diseases are increasing day by day & affecting the human health such as food poison, liver failure etc. due to excessive intake of food products that highly contains of impurities. Some techniques have been proposed to detect the impurities in the food products [2] using the microwave measurement techniques.

Many people are suffering from sleep apnea syndrome which is respiratory problem. Due to the problem, increase the chances of accidents during the driving [3].

The patch array antenna was proposed as a non-contact sensor to detect respiratory movement. The sensor is also being demanding for ambulatory cardiac monitoring [4]. Such as patient monitoring, physical therapy, sports-fitness training etc & long term monitoring of various chronic health conditions so, it have been also proposed as a wearable sensor which was based on a microwave Doppler techniques. It was directly measured the heart beat.

It also has become widely used in fruits moisture which is very useful for human beings who get the vitamins, proteins, carbohydrates, etc which is very important role in blood coagulation, cancer etc [5].

II. PRINCIPLE OF OPERATION

Microstrip patch antenna consists of three components: a ground plane, a substrate, and a radiation patch [6] and can be used the different types of substrate i.e., RT Duroid, FR4, TLY-5, etc.

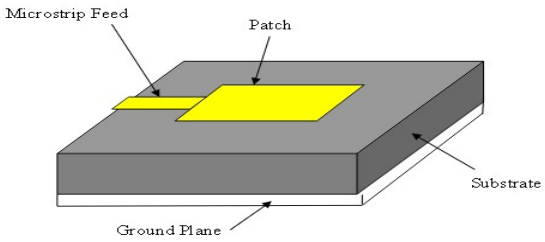

Fig.1: Microstrip configuration

Microstrip patch antennas radiate primarily because of the fringing fields between the patch edge and the ground plane [7].

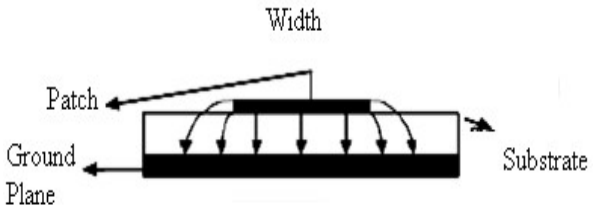

Fig. 2 Electromagnetic wave fringing from the top patch into the substrate

According to design of patch sensor calculated the dimensions of parameters and shape i.e., rectangular, circular, square, triangular, etc. and using the formula [6-7] & designed by the CST software [8].

III. Moisture measurement methods

Many different types of the moisture measurement method were used such as evaporation method, chemical reaction method, gas production method, etc. These were very cheap and easy to use but some drawback from these method i.e., time consuming as well as energy consuming which was very destructive [9]. One method was spectroscopic method which determined the microwave techniques. The techniques was very useful as well as widely used in many fields and it had become boom for human beings also because it was used for a moisture sensing for a long time for food products as well as suitable for real time monitoring and control.

An approach was proposed to find the moisture content in fruits by using the free space technique. The free space technique was useful to find moisture content and it was used for measure the dielectric properties of moist papular materials at microwave frequencies. It was very useful in terms of non-destructive and non contact measurement of the moisture content. But here is one drawback it was so bulky. After drawback proposed the planar resonators which used the ring structure. The ring structure was measured the complex permittivity which was widely used in agricultures fields as well as used for rice quality detection [10]. It was neither the bulky nor destructive.

The complex permittivity was essential parameters to find the moisture content of cereals. Complex permittivity technique was classified into transmission reflection and resonance techniques. Some of the grain moisture determined with the lack of complex permittivity by using the transmission technique the main drawback of this technique it was operated at higher frequencies 9GHz-10GHz with the higher cost of microwave components. On the other hand a resonance technique was measured accurately low loss material with a low loss factor as compared to transmission reflection.

The one more parameter was used to find the moisture content in cereals i.e., insertion loss. Insertion loss is the loss of signal power it means when signal is transmitted with high insertion power the transmitted signal will become very low. Due to the low transmitted signal some of the low cost measurement devices are unable to detect the transmitted signal.

IV. Sensor Configuration

The sensors have been designed with different shapes for complex permittivity measurement at desired frequency as well as designed with resonators such as minkowski fractal resonator, fractal resonator, multi split ring resonators (SRRs) etc .It was etched using the different substrates FR4, RT/Duroid 5880 etc and designed simulate using the CST software for an operate of different frequency ranges. It was performed at 50Ω coaxial cable and measured by the vector network analyzer. The vector network analyzer was used to measure the transmission parameter S_{12} of the sensor with and without at the desired frequency.

The different types of the moisture content in percentage as given below-

- The relative moisture content of sample, in percentage dry basis and wet basis as:

$$m.c\ (\%) = (m_w / m_w + m_d) * 100$$

Where, m_w and m_d are the mass of water and weight of dry cereals or the clod.

- The high moisture content M on a dry weight basis as:

$M = (W_w / W_d)*100$

Where W_w and W_d are the masses of water and dry materials respectively.

- The moisture content MC using the weight of sample before dry and after dry as:

MC (%)= (mBefore_Dry-mAfter_Dry/mBefore_Dry)*100

V. APPLICATION EXAMPLES

The antenna sensors were widely used in agricultures fields, food products etc. which is very useful for human beings due to the impurities of food products or the cereals diseases are increasing day by day It have been detected with the help of microstrip moisture sensor. Some applications are given below –

- Microstrip patch sensor has been designed for high moisture content which was used in production area [11] i.e., tea leaves with the help of sensor detected the leaves moisture content in the range from 190% to 350% on a dry wet basis by using the microwave transmission line technique.
- Microstrip ring sensors and microstrip coupled line sensors were designed for grain moisture content which is very useful for human beings. It was designed for low insertion loss and proper transmitted the signal as well as non destructive. The complex permittivity measured with a different moisture levels by using the resonance techniques. It can be applied with different application such as latex.
- Microstrip fractal resonator sensors have been designed for food products such as cardamom. It is the part of food which is the queen of the food. It was operated for non-destructive and applications in industry by using the microwave sensor. The uniqueness of this structure is reduced the area.
- The microstrip patch sensor designed for moisture content in soil [12]. It was designed compact and low cost rectangular patch antenna as a sensor for real time agriculture measurements. It was fabricated on FR4 printed circuit board at frequency from 1.5GHz to 3GHz.

VI. CONCLUSION

The sensors have been designed, tested and fabricated compact as well as used to at desired frequency. In the present era microstrip patch antenna as a sensor have become boom in terms of moisture which is almost used for detecting the cereals moisture as well as used different fields. It will be more focused on some parameters i.e., small in size, easy to install, durable, low cost & more accurate. It will be a great potential to benefit many application as well as useful for human beings.

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