**ABSTRACT**

In recent years, the frequent occurrence of safety accidents in large-scale building structures has caused serious economic and property losses and casualties. In these accidents, in addition to the simple because of structural damage and lead to such as wall, building collapse and other types of accidents, hazardous chemicals caused by improper storage of malignant explosions are also common. However, the traditional sensors used in structural health monitoring still pay more attention to the change of mechanical properties, such as strain, crack, acceleration, etc., other environmental characteristics such as temperature, humidity, pH value, etc. did not arouse attention. In addition, at present, the detection of RFID passive sensor is mainly carried out by Vector Network Analyzer (VNA), which is heavy and expensive, and the effect of wireless interrogation is poor.

In order to solve these problems, this paper designs a multifunctional RFID microstrip patch antenna and a broadband transceiver antenna matching its working frequency band, and tests the performance of the designed sensor, then a wireless detection system was built using the newly emerging portable vector Network analyzer, and the consistency was demonstrated by comparing the detection data of the two different measurement methods, it is proved that the system is feasible and can replace the traditional vector Network analyzer for more economical and flexible frequency domain monitoring.

The main research contents of this article are as follows:

1. A precise quantifiable coding model based on microstrip bandstop circuit is proposed. In this paper, the accurate modeling of microstrip coding is realized by constructing microstrip blocking circuit, and the flow chart of derivation and design is given. It is easy to increase and decrease the coding unit by high-precision quantization coding, which can improve the utilization ratio of RFID band resources.
2. the influence of special parameter-sensitive coating on the electric parameters of the encoding unit in the form of microstrip line is investigated. The change of the electric flux model of the coating is given, and the result that the resonance frequency of the coating decreases with the increase of the dielectric constant is deduced. It is explained that the impedance mismatch caused by the change of the equivalent dielectric constant affects the performance of the resonance frequency.
3. The integration of chip-free RFID sensor coding, humidity and strain is realized, and a broadband antenna is designed to match the working frequency band of the integrated sensor. The three functions of the designed sensor are independent of each other and can be flexibly combined. The results show that the coding is stable and the strain sensitivity is-0.3543 khz/με, and the relative error is 14.65%. With the increase of temperature and humidity, the resonant frequency decreases faster and faster, which can realize the early warning function of high temperature and high humidity.
4. A method of passive RFID sensor location based on phase feature is attempted. The Euclidean distance between the reference data and the positioning point is calculated by using LANDMARC algorithm and interpolation method, and the feasibility of phase positioning is discussed.
5. The wireless detection system based on NanoVNA and Bluetooth is built. By integrating MCU controller, Bluetooth transceiver module, NanoVNA and PC, an economical and flexible wireless detection system of multi-parameter sensor is realized. Compared with the measurement data of traditional VNA, the system can replace the expensive and heavy traditional vector Network analyzer under certain conditions, a preliminary monitoring solution for the application of multi-parameter sensors is proposed.

**Key words:** Multi-parameter sensor, Passive wireless RFID, Humidity detection, Resonance frequency, NanoVNA, Wireless detection system