Design and implementation for identification of Moisture content in cotton bale by Microwave Imaging

*** Mr.Ashish V.Saywan, ** Mrs. Sonali Damle, *** Prof.A.P.Deshpande**

*P.I.E.T. Nagpur, India, ** D.I.M.A.T Raipur, India,
*** P.I.E.T.Nagpur, India

Abstract- Understanding of cotton quality is important in order to properly identify the moisture content .Measurement of moisture is difficult particularly at harvest and through the gin, because of the influence these processes have different fibre quality. Dry cotton can be harvested cleanly and efficiently but may suffer undue damage in the gin. On the other hand harvesting and ginning wet cotton leads to significant issues in processing and quality. A number of methods are used to measure moisture in seed cotton, lint and fuzzy seed, each has its varying advantages. As moisture variation of the bales that is not monitored from the outside of the bale. This research examines a new microwave imaging technique to view the internal moisture variations of cotton bale. Tests on the developed imaging sensor showed the ability to resolve small structures of parameters, against a low standard background, that were less than 1 cm in width. The accuracy of the sensing structure was also shown to provide the ability to accurately determine parameter standards. A preliminary test of the imaging capabilities on a wet commercial bale showed the technique was able to accurately image and determines the location of the wet layer within the bale.

Index Terms- Bales, fibre, gigging, moisture, microwave imaging.

I. Introduction

In cotton grading the quality of cotton is identified by steple length, moisture level strength of cotton thread present all these parameter are identified manually, by the operator. In order to standardize this process the cotton project is intended. This project is focused on identification of moisture level in the cotton bale and generates appropriate result. The final stage in the cotton processing stream is the cotton bale packaging system. Recent innovations have shown that the use of cotton moisture restoration systems both reduce stress on the bale packaging system as well as add additional weight to the bales. As cotton is sold on a wet basis, these systems were beginning to proliferate through the ginning industry. The research is needed because the excess moisture in the bales will cause fiber degradation and color-grade changes. This issue has become so important that it prompted the Cotton industry to make a recommendation for bales to be limited not to be less than 7.5% moisture.

II. Approaches in measuring moisture

The methods for measuring moisture in cotton lint can be classified into six groups based on the technique and on the type of cotton material being tested, such as compacted or loose seed cotton, loose lint moved by air in ducting or compressed baled lint. Moisture measurement methods can be based on:

1. Thermal drying.
2. Chemical.
3. Spectroscopy.
4. Measurement of electrical or dielectric properties.
5. Compression properties of cotton lint.

In Thermal drying methods involve heating a pre-weighed fibre or seed-cotton sample to dryness for a prescribed period and then weighing the dried sample. The regain or moisture regain is then expressed as the ratio of mass of absorbed water to oven-dry mass of fibre. Moisture content is the ratio of mass of absorbed water to the total fibre mass on wet-basis.

In Chemical analysis for moisture content involves a colorimetric or volumetric titration measurement of moisture that has been extracted from the fibre and/or seed. The most widely used chemical method is the Karl Fischer titration measurement of moisture content, which allows the moisture content of the captured specimen to be maintained and measured in sealed test bottles. But these automated versions are expensive and not trivial in their methodology.

In Spectroscopic method for moisture determination involve the use of a spectrometer to measure the amount of electromagnetic energy of particular wavelengths absorbed (or reflected) by water molecules in different bonding states within the sample. The quantity of moisture is measured by the intensity of the moisture absorption (or reflectance) spectra.

In Electrical methods for measuring moisture in lint or seed-cotton specimens are based on measuring changes in electrical charge due to the moisture content of cotton and to some extent the presence of mineral salts in water and on the cotton. Electrical charge is typically measured in terms of resistance or permittivity (measured in relation to micro and radio-wave transmission).As conductivity is low (resistance is high) in very dry cotton but is higher in cotton with some moisture.

In compression method the measurement of pressure differences required to compress dry and wet cotton bales has also been used to predict the moisture content of cotton in bales as moisture content affects the compressing ability and resilience of cotton.

III. Microwave imaging method

This method involving the transmission of microwaves (electromagnetic radiation) signal of range between 2400-2480 MHz signal through the bale to determine change of signal in

ISSN 2250-3153

order to penetrate the these signal through a cotton bale without interrupting of signal to detect the change in phase and signal strength at receiver end.

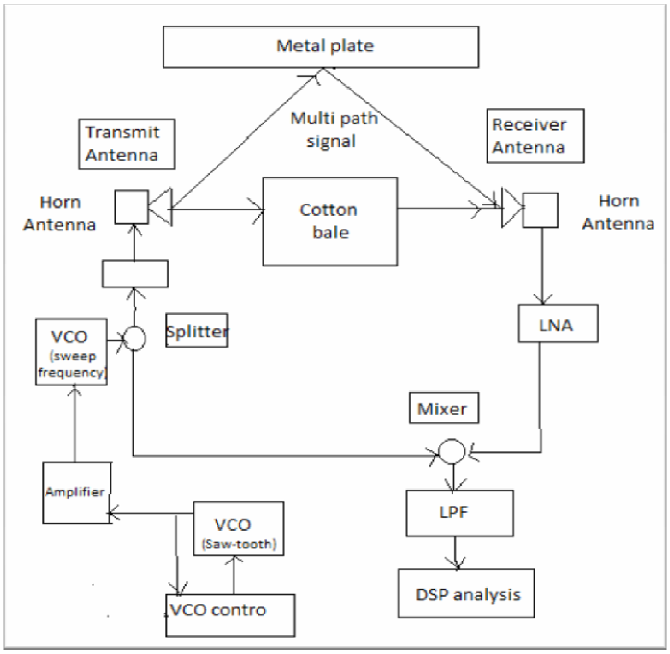

Fig.1 Schematic layout of detection of moisture content in cotton bale using microwave method.

Role of CC2500 module

C2500 is a Low-Cost Low-Power RF Transceiver.
It functions in 2400- 2483.5 MHz frequency band and provides an excellent option for WSN applications because of its low-power characteristics and SRD (Short Range Device) frequency band
This chip has 20 pins as,

- 2 for connecting a (mandatory) 26MHz external Crystal oscillator.
- 2 for connecting the antenna.
- 10 for powering the chip.

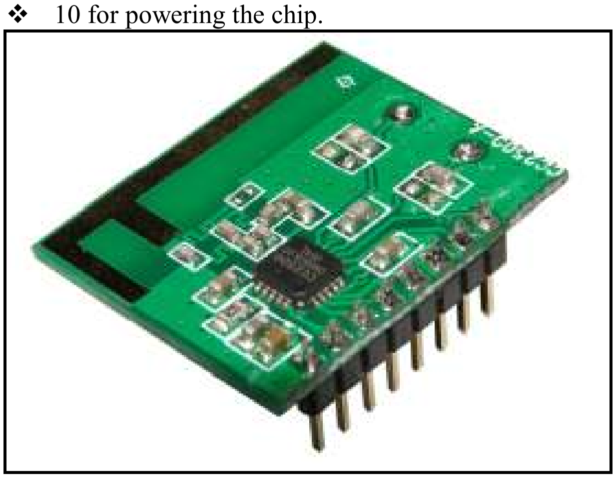

Figure CC2500: Transceiver module

- 6 for digital communication with the Microcontroller.
- The chip contains 47 registers to configure operating frequency, modulation scheme, baud rate, trans- mission power, etc. Because these registers are erased during power down, the MSP430 should configure all of them at startup.
- 13 commands allow the Microcontroller to control the state of the CC2500 (transmit, power Down, receive, etc.).

The RF transceiver is integrated with a highly configurable baseband modem. The modem supports various modulation formats and has a configurable data rate of up to 500 k Baud. CC2500 provides extensive hardware support for packet handling, data buffering, burst transmissions, clear channel assessment, link quality indication, and wake-on-radio. The main operating parameters and the 64- byte transmit/receive FIFOs of CC2500 can be controlled via an SPI interface. In a typical system, the CC2500 will be used together with a microcontroller and a few additional passive components.

Pin Configuration of CC2500

Pin No.	Name of Pin
1.	SCLK
2.	SO(GD01)
3.	S1(GD02)
4.	GVDD
5.	DCOUPLE
6.	GD00(ATEST)
7.	CSn
8.	XOSC_Q1
9.	AVDD
10.	XOSC_Q2

ISSN 2250-3153

Pin diagram of CC2500

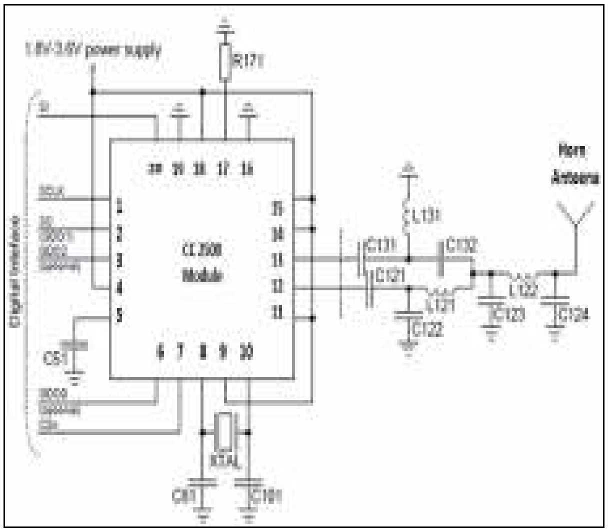

Figure 2: Pin diagram of CC2500 module.

What is SPI-Interface

Most of the communication between the controller and the CC2500 is done using industry standard SPI-interface. Controller provides SPI-master hardware blocks that work reliably with CC2500. However, the SPI-interface of the CC2500 requires a chip select -signal which must be generated on software. In addition to the SPI-interface, the CC2500 also provides two extra signals GD0 and GD2. Function of these signals can be selected rather freely (see datasheets of the CC2500 for details). In the most basic design hese signals are used to signal the Controller when a) a valid packet has been received and b) transmit is complete. In this design, handling these signals is done completely using software. Among other options, these signals can also be used to transmit and receive asynchronous data up to 250 kbps.

RF Performance

- High sensitivity (–104 dBm at 2.4 kBaud, 1% packet error rate).
- Low current consumption (13.3 mA in RX, 250 kBaud, input well above sensitivity limit).
- Programmable output power up to +1 dBm.
- Excellent receiver selectivity and blocking performance.
- Programmable data rate from 1.2 to 500 kBaud.
- Frequency range: 2400 – 2483.5 MHz.

Analog Features

- OOK, 2-FSK, GFSK, and MSK supported.
- Suitable for frequency hopping and multichannel systems due to a fast settling frequency synthesizer with 90 us settling time.
- Automatic Frequency Compensation (AFC) can be used to align the frequency synthesizer to the received centre frequency.
- Integrated analog temperature sensor.

Digital Features

- Flexible support for packet oriented systems: On-chip support for sync word detection, address check, flexible packet length, and automatic CRC handling.
- Efficient SPI interface: All registers can be programmed with one “burst” transfer.
- Digital RSSI output Programmable channel filter bandwidth.
- Programmable Carrier Sense (CS) Indicator.
- Programmable Preamble Quality Indicator (PQI) for improved protection against false sync word detection in random noise.
- Support for automatic Clear Channel Assessment (CCA) before transmitting (for listen-before-talk systems).
- Support for per-package Link Quality Indication (LQI).
- Optional automatic whitening and de-whitening of data.

Low-Power Features

- 400 nA SLEEP mode current consumption
- Fast startup time: 240 us from SLEEP to RX or TX mode (measured on EM design)
- Wake-on-radio functionality for automatic low-power RX polling
- Separate 64-byte RX and TX data FIFOs (enables burst mode data transmission)

General

- Few external components: Complete on chip.
- Frequency synthesizer, no external filters or RF switch needed.
- Green package: RoHS compliant and no antimony or bromine
- Small size (QLP 4x4 mm package, 20 pins)
- Support for asynchronous and synchronous serial receive/transmit mode for backwards compatibility with existing radio communication protocols.

IV. CONCLUSION

The design and implementation of this project is helping the cotton industry to design a particular criterion to purchase the moisture free cotton from the market and accordingly increasing the quality, accuracy and precision of the cotton for further processing.

The use of microwave imaging is becoming more prevalent for detection of interior hidden defects in manufactured and packaged materials. In applications for detection of hidden moisture, microwave imaging technology can be used to image a bale and then perform an inverse calculation to derive an estimate of the variability of the hidden interior moisture, thereby alerting personnel to damaging levels of unseen moisture before fibre degradation occurs.

The use of sensors is very costly and sensor based technic is with the packaging utilizes metal strapping ties, as the metal bale ties combine to create significant Mie scattering that causes destructive and constructive interference as the material is conveyed past the imaging antenna array, where the use of cc2500 module is that work on radio frequency act as a trans

ISSN 2250-3153

receiver and gives precise and accurate response.

In the previous technics used the different manually operated chemical methods are used so it makes it complicated from the efficiency point of view. The previous methods are some where dependent methods of operations which will make the process poor in detections of moisture in the bale. The measurement of moisture via microwave transmission through modules and bales stands as a relatively accurate and robust method. Accurate, in-line methods for measuring the moisture of material during harvesting and particularly ginning will become increasingly important as energy costs and fibre quality premiums rise.

References

[1] Anthony, W.S. 2003a. Impact of Moisture on Baled Cotton. American Society of Agricultural Engineers Meetings Papers. Paper No. 031167, 37pp.

[2] Anthony, W.S. 2003b. The Impact of Excess Moisture in The Bale On Fiber Quality. National Cotton Council Belt wide Cotton Conference.

[3] Baker, K.D., Hugh's, S.E., McAlister, D.D. 2005. Bale moisture addition with a rotor spray system. In: Proceedings of the Belt wide Cotton Conference, January 4-7, 2005, New Orleans, Louisiana. p. 808-812. 2005

[4] R.K. Byler and W.S. Anthony, 1995. Development of a moisture sensor for gin use. Proc. Belt wide Cotton Conf., San Antonio, TX. 4-7 Jan. 1995. Natl. Cotton Counc. Am., Memphis, TN.

[5] R.K. Byler and W.S. Anthony, 1997. Measurement Concepts in a gin process control system, Proc. Belt wide Cotton Conf., New Orleans, LA. 7-10 Jan. 1997. Natl. Cotton Counc. Am., Memphis, TN.

[6] Byler, R.K., Anthony, W.S. 2003. Measurement Of Bale Moisture Content Based On Bale Compression Pressure. 2003 Belt wide Cotton Conference.

[7] Mangialardi, G. J. Jr., and A. C. Griffin, Jr. 965. Moisture restoration to cotton at the gin: effects n fiber and spinning properties. USDA Report o. 08. Washington, D.C.: USDA.

[8] Mangialardi, G. J. Jr., and A. C. Griffin, Jr. 1977. A method for restoring moisture to cotton at gins. Transactions of the ASAE 20(5).

[9] Shepherd, J. V. 1972. Standard procedures for foreign matter and moisture analytical tests used in cotton ginning research. USDA Agricultural Handbook No. 422. Washington, D.C.: USDA.

[10] Pelletier, M.G. 2005b. Bale moisture sensing: Field Trial. 2005 Belt wide Cotton Conference.

A. First Author -
Mr.Ashish V.Saywan
M.Tech. Electronics (Communication)
P.I.E.T., Nagpur
ashishvsaywan@gmail.com
Mob.No.-9403308708

B. Second Author-
Mrs. Sonali Damle
M.Tech VLSI and Embedded system
D.I.M.A.T Raipur
sonali8damle@gmail.com
.

C. Third Author -
Prof.A.P.Deshpande
Asst.Professor.E&C Dept.
P.I.E.T.Nagpur
abhay_pd@rediffmail.com