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TRANSMISSION CODING SYSTEM USING HAMMING ENCODING FHSS

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Abstract: *Current issues facing many communication systems, especially the unauthorized interception requires solving by various methods against jamming type. These methods range from sub-level coding and coding to mixed. In this article I present a mixed method that can be used in various transmission systems.*

Keywords: *jamming, hamming, coding level.*

1. INTRODUCTION

In current systems need the possibility of transmission observed "hide" or encoding information using different coding elements.

This signal encoding is required when sending confidential data or maximum security, such as a military system.

In this article I will try to present their own contribution and that makes a double coding of data, which provides a good security system to intercept and a small cost. The system presented below is an experiment conducted on a small scale but can be extended to other professional type systems using other modules such as performing Intel Intel Edisson or Galileo.

2. SYSTEM DESCRIPTION

The system is based on two elements modular development board Arduino Leonardo [6] and Pololu Wixel radio [7].

Leonardo Arduino development board is made by people from Arduino and is a board based on ATMEGA32U4. It has 20 pin digital input / output (of which 7 can be used as PWM outputs and 12 analog inputs and a micro USB connection. It also has 6 analog inputs / outputs that can connect different sensors, figure 1:

Figure 1. Arduino Leonardo parts.

Pololu Wixel transceiver type plate, Figure 2 [6] is a development board radio operating at 2.4 GHz frequency and allows multiple applications among which one you will use this material, i.e. FHSS (Frequency Hopping Spread Spectrum). Implementation plate modulation is done by programming the micro

USB port and then the communication between Arduino board and Wixel.

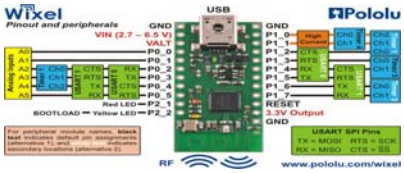


Figure 2. Pololu Wixel Board.

Block diagram of the proposed system is given in Figure 3:

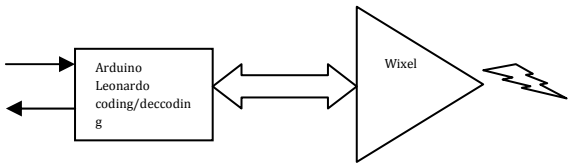


Figure 3. Block diagram.

3. CODING SYSTEM IMPLEMENTATION DECODE Hamming FHSS

From the block diagram it can be seen that the application source coding system is the module Arduino Leonardo. Following tests using NRZ coding or Hamming [1] revealed that only encoding that provides secure is indeed a model Hamming coding.

Hamming encoding is defined in the literature as correcting code and error detector and two errors.

The code contains four data bits d1, d2, d3, d4 and 3 parity bits p1, p2, p3. Parity bits are calculated as follows:

p1 sums d1, d2, d4
p2 sums d1, d3, d4
p3 sums d2, d3, d4

Organize bits in the code-word is:

p1 p2 d1 p3 d2 d3 d4

The encoding: code-word is determined by calculating the corresponding parity using both look how odd parity and parity.

The decoding: Calculated parity check with the appropriate and correct actually sums and correct parity and check showing 0.

An example of Hamming coding based on which system you implement an algorithm for Arduino Leonardo is:

The encoding enters the code-word 1001. We calculate:

p1 = 1+0+1 = 0
p2 = 1+0+1 = 0
p3 = 0+0+1 = 1

resulting Hamming code 0 0 1 1 0 0 1 s are represented by the underlined parity bits.

The decoding: 0011001. We assume that you received without errors. We will reconstruct the data bits: 1 0 0 1

Parity should be checked:

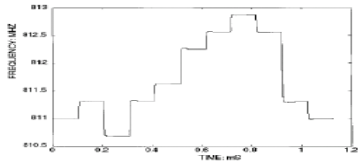
p1 + d1 + d2 + d4 = 0 + 1 + 0 + 1 = 0
p2 + d1 + d3 + d4 = 0 + 1 + 0 + 1 = 0
p3 + d2 + d3 + d4 = 1 + 0 + 0 + 1 = 0

How these values are 0 results that there was error. We implemented an application that supplied after running the Arduino environment Arduino Sketch_apr17a [2], the example shown above, the result provided below:

this works for message of 4bits in size
enter message bit one by one: 1 2 3 4
the encoded bits are given below:
1 2 3 0 4199040 7 6 4201166 4

Code will be forwarded obtained board transceiver type Pololu Wixel is scheduled to work FHSS mode. Spread Spectrum modulation techniques such techniques are defined as the bandwidth of the transmitted signal is much larger than the bandwidth of the original message, and the bandwidth of the transmitted signal is determined by the message to be transmitted and an additional signal known as the spreading code. Spectrum technology was first used during World War II by the army, which has experienced extended spectrum, low interference because it offered much-needed security. Are two ways to achieve spread: frequency hopping and direct sequencing? Frequency hopping is one of the variants of spread spectrum techniques that allow the coexistence of multiple networks (or other devices) in the same area. Frequency hopping is resistant to attempts to decode multiple frequencies by multiplying mechanism. Frequency hopping radio transmission is a technique where the signal is divided into several parts and then transmitted through the ether using a random pattern of jumping or "jump" frequencies. The frequency hopping may be several times a second to a few thousand times per second. Frequency

hopping is the most easy to use spread spectrum modulation model. Any radio with digital control type frequency synthesizer can theoretically be used in a radio system with frequency hopping. This conversion requires the addition of a generator pseudo noise (PN) code to select frequencies for transmission or reception. The best type FHSS systems using a uniform frequency hopping band. FSS subsystem produces an effect of spreading pseudo random jump RF carrier frequency over disponibile. The RF frequencies are denoted f1 ... FN where N may represent several radio harmonics made or more. An illustration of a FHSS system type is given in Figure 5:



4. EXPERIMENTAL RESULTS

To achieve a real implementation of a software module to perform a FHSS Pololu Wixel [7] we started from a dedicated algorithm which comply with the elements of Figure 5, Figure 6:

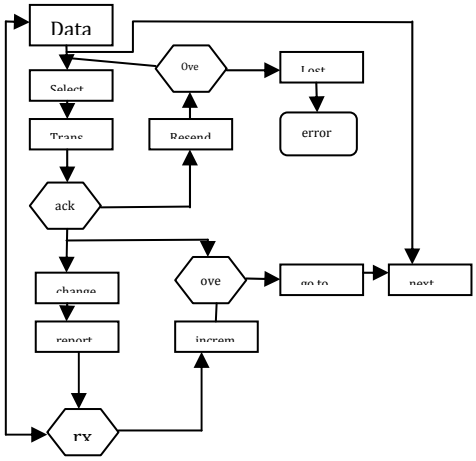


Figure 6. Algorithm model FHSS WIXEL.

The implementation of this algorithm translates as the workings of the FHSS Wixel plate. So the result is a signal output which theoretically cannot be decoded unless known mathematical models applied, where it can be seen mixing Hamming coded signal over-bearing.

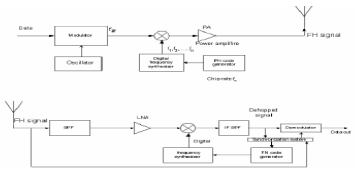


Figure 7. Wixel signal output.

If assume 1-bit error:

1. If 1 check bit bad:
   Data is good, check bit itself got corrupted.
   Ignore check bits. Data is good.
2. If more than 1 check bit bad:
   Data in error (single-bit error in data). *Which* check bits are bad shows you exactly where the data error was. They point to a *unique* bit which is the bit in error. In figure 9 is the FHSS over Hamming function of time.

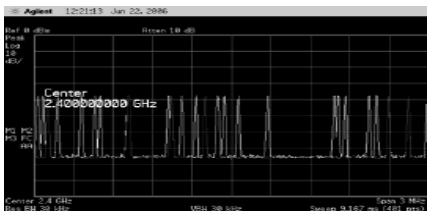


Figure 9. Wixel output signal.

Implementation scheme is illustrated in Figure 10 and can see two basic components development board Arduino Leonardo Pololu Wixel.

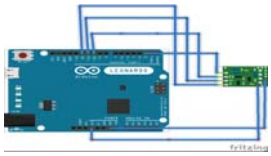


Figure 10. Schematics implementation.

Software implementation results in part described in chapter three of this article are measurable and can be highlighted and achieve primary receiving system that logically plays decoder. To achieve a simulation of the transmission system described in the article we used a number of lines of code containing information that a wanted transmitted. View information from the system I viewed it on the Arduino Leonardo serial interface, results are outlined in chapter 3, figure 11:

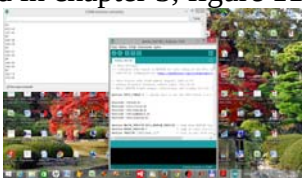


Figure 11. Data representation Serial Terminal.

The implementation of this algorithm and combining with FHSS modulation coding type Hamming we got a system that is difficult to decode, at least theoretically but can be studied and implemented other more advanced systems such as Intel development board Galileo or Intel Edison. Such a system can provide a coding system to satisfy the requirements of civil and military.

5. CONCLUSIONS & ACKNOWLEDGEMENT

Applying this dual coding system can be very useful because FHSS is highly resistant to both the jamming systems, simply because the algorithm to achieve the “frequency hopping” allows "insurance" in front of potential intruders but also because of coding Hamming type that allows error correction.

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