The New Graphic Tools In The Easy-Learning Platform

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Abstract

The present paper aims to present the new graphics tools module developed for the Easy-Learning online platform. The Tools module is very useful in the study of waveforms, coding and modulation, which requires for learning a well-defined and suggestive graphic display. It can be used as a laboratory segment on its own or as a part of a practical session of any study discipline involving graphic tools.

Keywords: e-learning, modulation, waveform, coding, amplitude, phase, frequency

1. Introduction

This article aims to present the new graphics tools module developed for the Easy-Learning platform. The Tools module can be used as a laboratory segment on its own, presenting binary coding types and digital modulations. The tools module represents an application created with ActionScript 3.0. This dynamic application includes 3 parts: Wave shapes, Binary codes, and Digital modulations.

As shown in the paper entitled The New Mail And Newsletter Modules In The Easy-Learning Platform, the interaction between the user and the Easy-Learning platform is achieved using three specific interfaces: administrator, tutor and student. With their help, you can manage common objects that are stored in the database, with the mention that each interface provides certain rights of access to these objects, depending on user type.

2. The Tools module in the Easy-Learning platform

This module contains an application designed in AS3, this module is found only in the student interface.

The application is formed of three parts:

- A wave generator;
- Examples of binary codes: NRZ (Non Return to Zero), FM (Frequency Modulation), and Manchester or PE (Phase Encoding);
- Examples of modulations: ASK (Amplitude Shift Keying), FSK (Frequency Shift Keying), and PSK (Phase Shift Keying).

This application is a dynamic one, designed specially to ease the coding and modulation representations module. As shown in Figure 1, the menu is formed from the three already mentioned parts: Wave Shape, Binary Codes and Modulations.

2.1. The Wave Shape module

In this part of the application, the generation of sinusoidal, triangular and rectangular waves can be visualized. The interface is similar to a rudimentary oscilloscope. The goal of this part is to exemplify wave shapes, being a preparatory part for the following sections of the application. In
order to be an interactive part, it does not just show the wave shapes, but it has two sliders that can be used to modify the amplitude and frequency of the generated waves. In addition, the module contains three buttons that change the type of wave to generate.

Figure 1. The Main Tools menu

Figure 2. The Wave generator (sinusoidal wave)

As shown in Figure 2, the maximum amplitude is of 20mV and the maximum frequency is of 20Hz. A button returns the user to the main menu.

2.2. The Binary Codes module

Binary codes are a string of values formed of 0 and 1, necessary to the data storage on the memory supports of the electronic systems. The strings of binary values the represent the data wanted for storage are transformed in rectangular wave shapes.

From a menu, one can select (see Figure 3) the type of coding to be studied. The application contains four types of binary coding: NRZ (Non Return To Zero), NRZI (Non Return To Zero Inverted), FM (Frequency Modulation) and Manchester or PE (Phase Encoding).

a) NRZ (Non Return to Zero) and NRZI (Non Return to Zero Inverted)

In telecommunications, a NRZ sequence is a binary code, where a positive voltage represents 1, and a negative voltage represents 0, without a neutral or rest condition. When this code is used to represent data in an asynchronous communication system, the absence of neutral states requires other mechanisms for the synchronization of bits if a separate clock signal is not available.

For the NRZI code, the 1 bit represents a transition of signal and the 0 bit represents a non-transition signal.

The application allows the user to enter a code sequence of up to 30 characters (see Figure 4). You can select the sequence to be automatically covered or bit-by-bit (step-by-step) covered. By choosing automatic browsing, it will run until the end and then start over again, but if the bit-by-bit browsing is chosen then it will run each bit by waiting for the step-by-step button to be pressed.

The NRZI code advantage is a good value for the density ratio and the disadvantage is that this code does not allow long strings of void symbols because of the loss of auto-synchronization.

b) FM (Frequency Modulation)

This code codes a data symbol in two data symbols (see Figure 5). The first symbol is always a transition, assuring the auto-synchronization, and the last bit corresponds to the coded information (transition for 1 and no transition for 0). The FM code meets the registration form in simple density (SD)
As the NRZ or NRZI codes, the interface for FM offers the possibility of introducing a string of characters to be encoded.

c) **Manchester or PE (Phase Encoding)**

In telecommunications and data storage, the Manchester code (also known as the phase encoding or PE) is a line of code in which encoding each data bit has at least one transition and occupies the same time period. It does not have a continue component but has an internal clock, which means that it can be inductively or capacitive coupled, and the clock signal can be recovered from the encrypted data (see Figure 6). This code is widely used (e.g.: the Ethernet standard).

Manchester encoding is a special case of the BPSK encoding (Binary Phase Shift Keying), where data controls the phase of a rectangular signal whose frequency is represented by the data rate. Such a signal is easy to generate.

The introduction of test data is also possible here; pressing the step-by-step button makes the bit-by-bit execution.
2.3. The Modulations module

The modulation is the electronic method of signaling used by modems. They have to use the same method of modulation to communicate with each other. The most spread digital modulation methods are:

- **Amplitude Shift Keying** (ASK);
- **Frequency Shift Keying** (FSK);
- **Phase Shift Keying** (PSK).

The application and exemplify these three modulations (ASK, FSK, PSK). The modulation type is chosen from a very simple menu (see Figure 7).

Each component of the menu is represented by a title and a suggestive image for every type of modulation. Like the other menus, this one also respects the layout that has been chosen for the menus.

a) **ASK (Amplitude Shift Keying)**

In digital communications, ASK modulation is a process that gives to a sinusoid two or more levels of discrete amplitude. These are related to the number of levels adopted by the digital message. For a binary message sequence, there are two levels, one of which is usually zero (see Figure 8).

A disadvantage of the ASK modulation compared with PSK and FSK is the fact that it does not have a constant envelope. This makes signal processing (e.g.: amplification power) more difficult, because linearity is an important factor. The portion of each bit is bounded by one vertical line. Like at the binary encoding, the user can enter a string of maximum 30 bits. A sinusoid represents the 1 value and a continuous line (0-amplitude) represents the 0 value. The user is given the opportunity to automatically run the entire sequence (by pressing the start button) or bit-by-bit (by pressing the step-by-step button).

b) **FSK (Frequency Shift Keying)**

As the name suggests, a FSK transmitter has its frequency modulated by the message. Although there may be more than 2 frequencies involved in a FSK signal, the designed application only supports a stream of binary data, so that two frequencies are involved. The spectrum of FSK signal is difficult to obtain. Considering the case in which the message consists of a binary sequence of 0 and 1, it can be represented by a periodic function (see Figure 9).
c) PSK (Phase Shift Keying)

PSK is a digital modulation system that transmits data by changing or modulating the phase of the reference signal. Any digital modulation scheme uses a finite number of distinct signals to represent digital data. PSK uses a finite number of stages, each stage having assigned a unique pattern of binary digits. Usually, each phase encodes an equal number of bits. In this case, the 0 bit is assigned a sinusoid of 0 phase, and the 1 bit is assigned a sinusoid of $\pi$ or 180° phase.

As shown in Figure 10, the introduced bit string is modulated in phase. It is also observed that the phase modification of 180° from the bit transition, each signal afferent to a bit is delimited by a vertical line.

3. Conclusions

The Easy-Learning platform started as a simple project, but as years go by it has become extremely useful from the point of view of the student. During the 7 years of development and maintenance, it has undergone major changes. In 2009, this platform has been restructured and has started using Symfony's framework. The Easy-Learning platform is very useful not only for students, but also for tutors. The platform has reached a stage where we can say that it has many useful parts, but it can be sustain the addition of new modules and features.

The Tools module is proving very useful in the study of waveform, coding and modulation, which requires for learning a well-defined and suggestive graphic display. Adding new functionality and new tools tailored to specific types and disciplines and to applications at which these graphic tools are used can also expand this module.

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