Faculdade de Engenharia da Universidade do Porto

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Final project

Control of a lamp lightness

Sistemas Baseados

em Microprocessadores

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SUMMARY

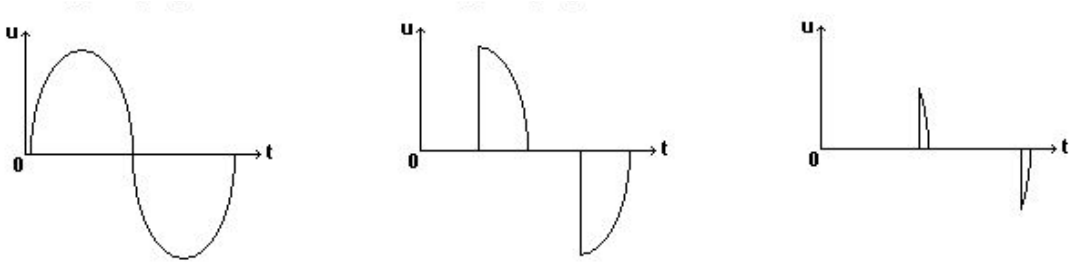
Introduction

Different method to control the lightness of a lamp with an electronic circuit and an arduino have been tested and presented in this final project report. In a first part a simple presentation of the parameters that affect lamp lightness. Then in a second part the first solution will be presented after in another part the control with a computer keyboard and a TV remote and finally we will think about fonction that can be add to our program in the future .

Background

On what depends a lamp lightness and how can we change it?

The lightness of a lamp depends on power supplied so V*I*cos(phi) and the fact that a lamp can be seen as a purely resistive load the power is only V*I. Thanks to that we need to reduce the input power, for example we can turn on the input power only a part of the period of the signal that is a AC signal and the lightness will be proportional to the duty cycle.



If the duty cycle is close to 0 the light will turn off and if it's 1 the lamp will turn fully on.

But after all there is a crucial point, can only turn off the input when the current signal passes to 0v unless a pic of current will broke the light bulb.

So to change the brightness we will use a signal provided by the electrical control circuit. this signal is a Zero Cross Detection so when the sinus cross zero this signal goes from one to zero

First mode only with button

The goal was to design system that controls a lamp in synchronism with the voltage of the 230V electrical network, using a push-button Each press of the push-button should increase the brightness of the lamp by 25%. That is, in the sequence 0-25-50-75-100-0-25 ....

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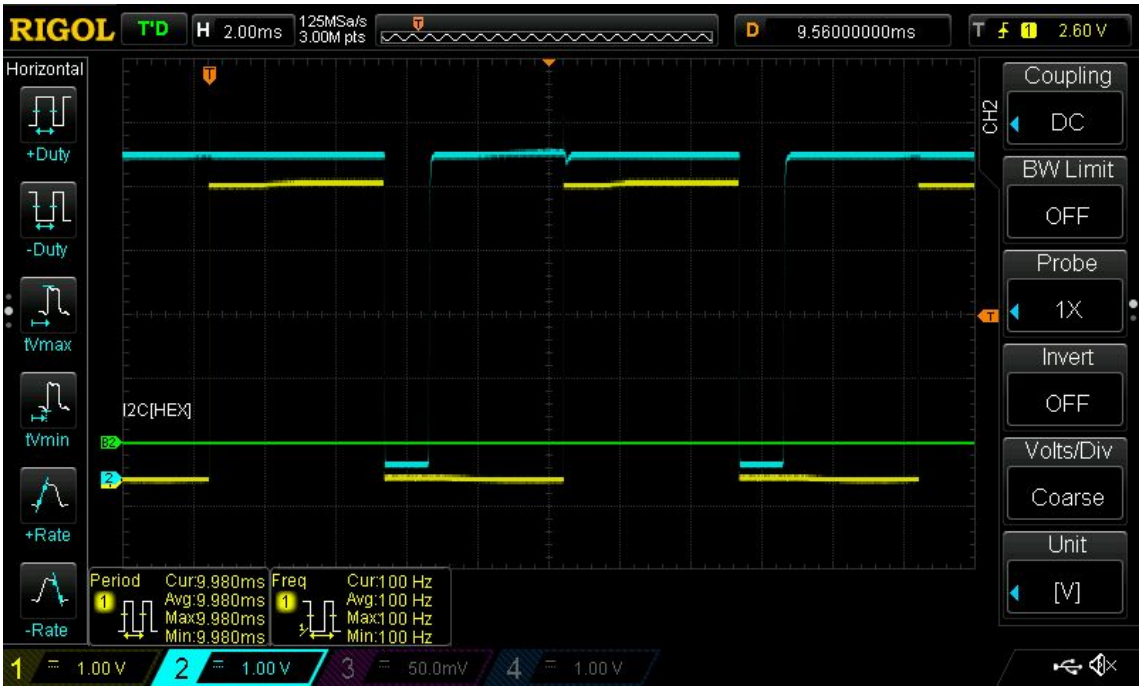
The push button (PD4) is an active low component and each press is detected in the main while loop,after which is duty cycle increased

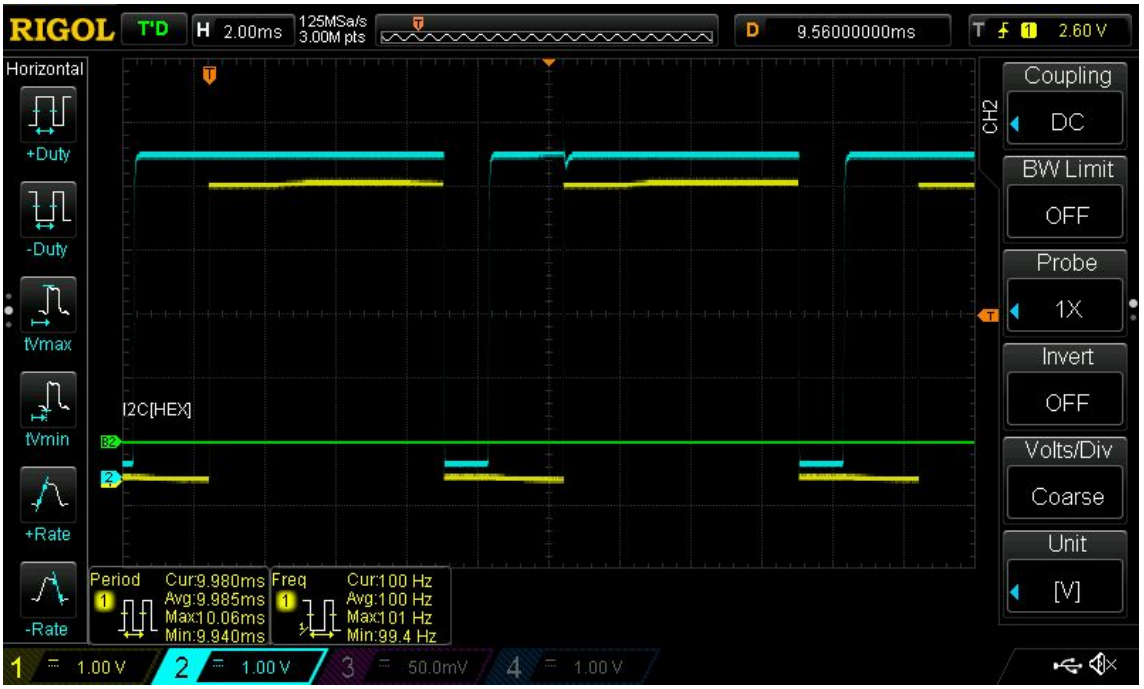
Zero Cross Detection (ZCD) wire is connected to a tmega328p as input at PD3 which serves as an external interrupt pin1 (INT1). Upon detecting the zero cross of a sine wave, the lamp is turned off. At the same time, we put value stored in variable 'duty' into timer 2, which is working in normal mode, with a prescaler of 1024. Since power of the lamp is not linear function, value of duty cycle was calculated while taking into consideration area under sin^2(t) function. At timer2 overflow lamp turns on and waits next falling edge of ZCD signal after which it turns off again and the program repeats.

In the following table we can see the time OFF corresponding to each light level.

% lightness	time off
0%	0ms
25%	3,7ms
50%	5ms
75%	6,3ms
100%	10ms

In the next figure we can see the ZCD signal in blue and the control signal in yellow. The first one is with a power of 50% and the second one with power of 75%.





Control SERIAL with PC keyboard

In our project we also add the possibility to control the lamp in the above sequence by pressing 'space' key on keyboard which is received through serial port of atmega328p as an USART_RX interrupt. So the “space” act like the button in the first mode.

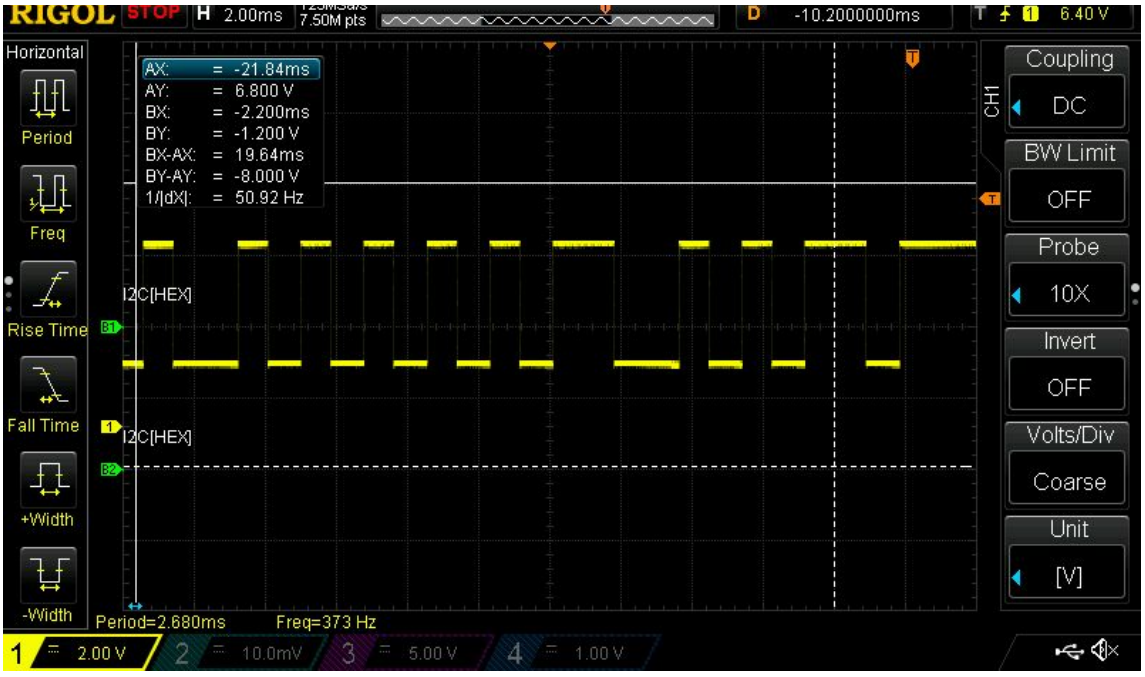
Control TV remote

Additionally, IR receiver (TSOP2236) was connected to atmega328p. To control the lamp we used a smartphone equipped with an IR transmitter and an application (SURE TV REMOTE) download on the play store under android. This application uses standard RC5 IR coding protocol. The RC-5 protocol was developed by Philips in the late 1980s as a semi-proprietary consumer IR remote control communication protocol for consumer electronics. However it was also adopted by most European manufacturers, as well as many US manufacturers of specialty audio and video equipment.The command comprises 14 bits:

- Two start bit, which is always logic 1 and allows the receiving IC to set the proper gain.
- A control bit, which toggles with each button press. This allows the receiving device to distinguish between two successive button presses (such as "1", "1" for "11") as opposed to the user simply holding down the button and the repeating commands being interrupted by a person walking by, for example.
- A five-bit system address, that selects one of 32 possible systems.

- A six-bit command, that (in conjunction with the field bit) represents one of the 128 possible RC-5 commands.

By receiving certain command from IR remote it will increase brightness in the same sequence as described above. In the figure under the signal send by the smartphone corresponding to the up key of the virtual remote that is equivalent to a value of 16 and each key of the remote send a different value.



All the three modes are active at the same time so when the system is turned on we can change the light value with the button or the space key or the up key of the remote.

Possibilities of amelioration

It will be possible to add many fonction to our program :

- The light is always increasing so we can add a button to decrease it.
- We can enter the exact value off the light we want on the keyboard. For example if we press 4 and 5 the light will turn on with 45% of its maximum power
- We can do the two previous function with the tv remote.

Annexes