Project Title: A Smart Dimmable Electronic Ballast

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Abstract

The objective of this project is to implement a fluorescent lamp control system, based on an electronic ballast.

The electronic ballast was invented a couple of decades ago, but only recently has it become popular. Its objective is to solve the problems raised by the magnetic ballast, such as noise, heat, weight, low efficiency, blinking, dimming; this was accomplished by changing the lamp-supplied frequency from 50HZ to 20–70KHZ. Since the electronic ballast provides a suitable solution to the problems mentioned, it has started to take an increasing share of the ballast market.

Our project will implement a fluorescent lamp control system based on an electronic ballast and its dimming ability. This system is convenient to use and is necessary in places with multiple lamps, due to its ability to save energy.

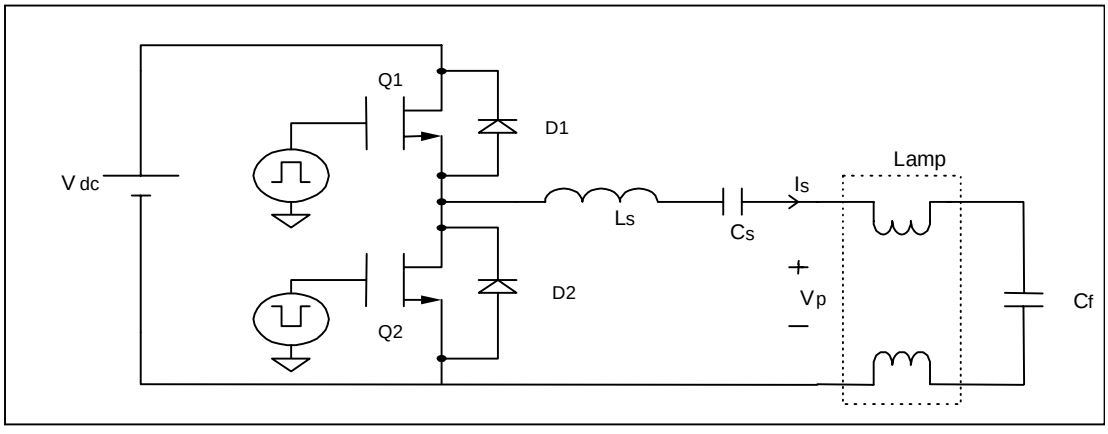
The design of the new fluorescent light control system is based on a sensor which will translate the light's intensity to voltage which will be converted to a digital value (with an A/D converter). According to this value, a CPU will decide if there is need to increase or decrease the light intensity. The CPU's decision will be transmitted with an infra-red transmitter towards the fluorescent ballast. A second CPU will supervise the electronic ballast's operation (by changing the supplied frequency). The option to create a group of lamps which will be controlled simultaneously by the remote control unit will also be available.

The project will suggest an implementation of the system and eventually implement it, based on the primary design which will include the possibility of controlling either a single lamp or groups of lamps.

The Electronic Ballast transforms the network frequency (50 Hz) to higher frequency (20–70 KHZ). Compared with the magnetic ballast, the Electronic Ballast has many advantages:

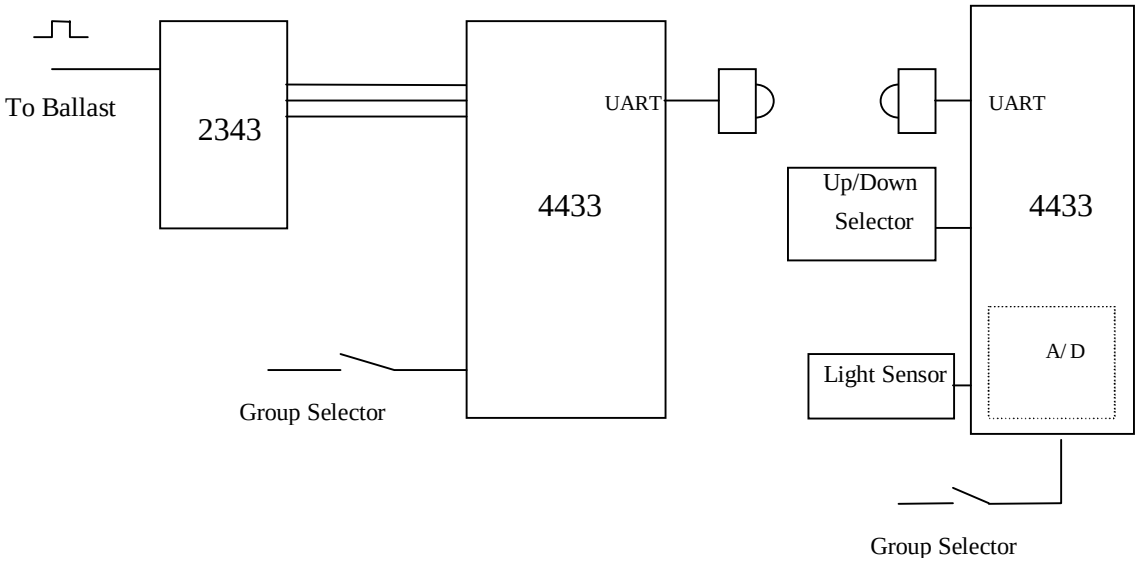
- Smaller dimensions
- Higher frequency (above the frequency that we hear) – silent operation
- Higher frequency – no visible flickering.
- 10% more efficient.
- Longer lamp life, since the Electronic Ballast can supply higher current when the electrodes are getting old.
- One ballast can supply voltage and current to 1, 2, 3, or 4 lamps
- The price is no higher than the Magnetic Ballast

Dimming principles



The series capacitor eliminates the DC current. The higher the frequency, the higher impedance of the inductor will decrease the current to the lamp. The lower the frequency, the lower impedance of the inductor will increase the current to the lamp.

Overview of our system

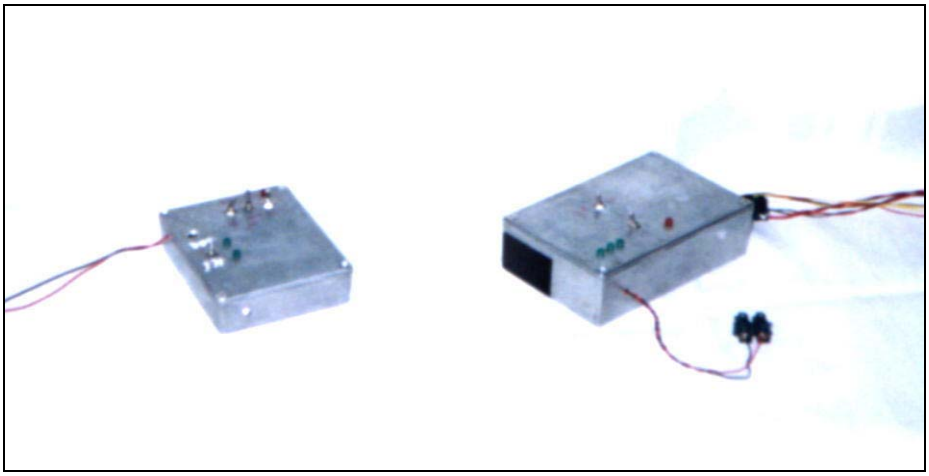


Overview

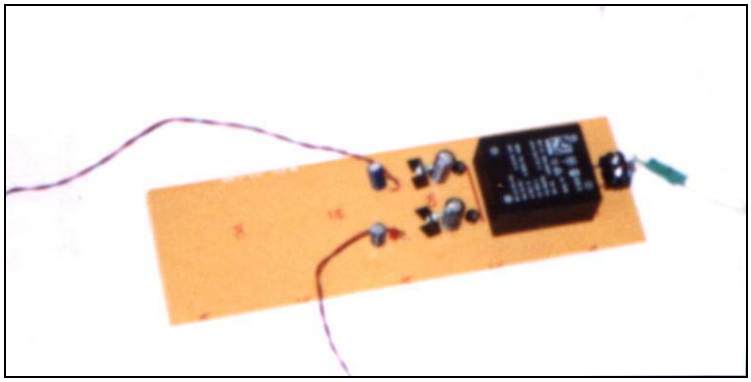
The final configuration of our system includes 2 microcontrollers (AT90S4433). One will sample the intensity of the light using a photodiode and an A/D, and compare the result to a reference value determined by the user (using the UP/DN switch). This switch will increment/decrement a value of a register. According to the remote control algorithim, only if 31(!) consecutive samples of the intensity of light imply that we need to increase/decrease the intensity of light, will the microcontroller send UART message to the 2nd microcontroller. The base station microcontroller receives the UART message and drives 3 bits to an output port. These 3 bits are read by a 3rd microcontroller (AT90S2343), that is programmed to drive an output square wave to the Electronic Ballast (in different frequencies). The output frequency was programmed by us to 20–70KHz.

Presentation

The remote control (left) and the base station (right)



Power Supply



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