

Sunrise Alarm Clock for the Hearing Impaired

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Senior Honors Project

Motivation

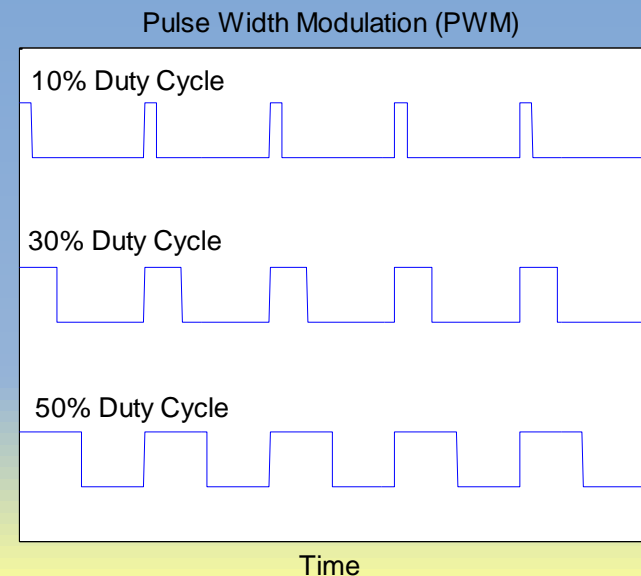
- Waking to sunlight is more natural and gradual
- Applications to assistive technology for the hearing impaired became apparent
- Current alarm clocks for the hearing impaired
 - Flashing lights
 - Bed vibrators
 - Adjustable frequency, high decibel audio alarms
- Project goal: prototype a more effective and pleasant alarm clock for the hearing impaired

Approach

- Three alarm system
 - Visual: sunrise mimicked using bedside lamp
 - Physical: vibrating wristbands
 - Audio: buzzers with two pitch options
- Two user functionality

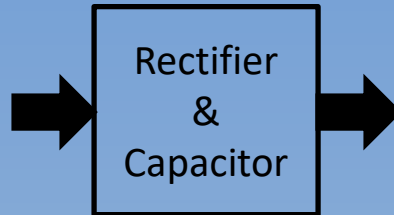
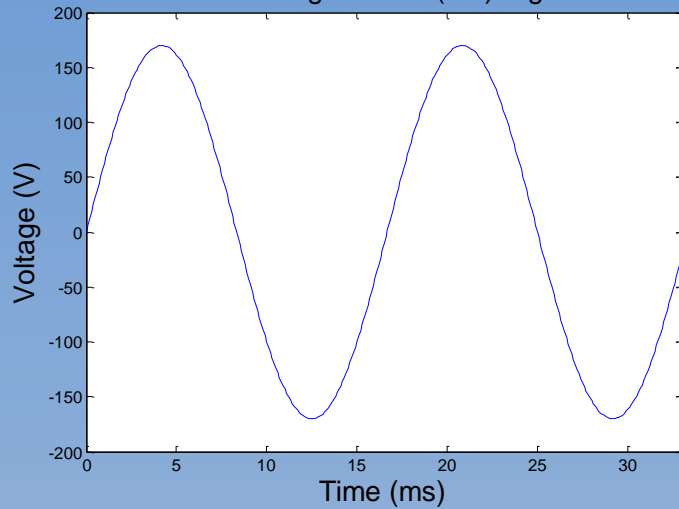
Implementation: Visual Alarm

- Lamps controlled through standard receptacle
- Supplied with pulse width modulated (PWM) direct current (DC) voltage source
 - Frequency: 122 Hz surpasses the eye's ability to perceive flicker
 - Duty cycle: adjusted to control light output

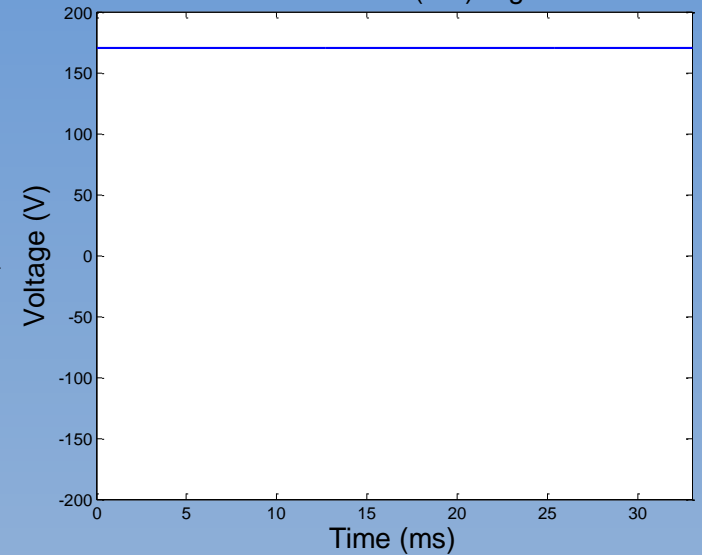


Implementation: AC to DC

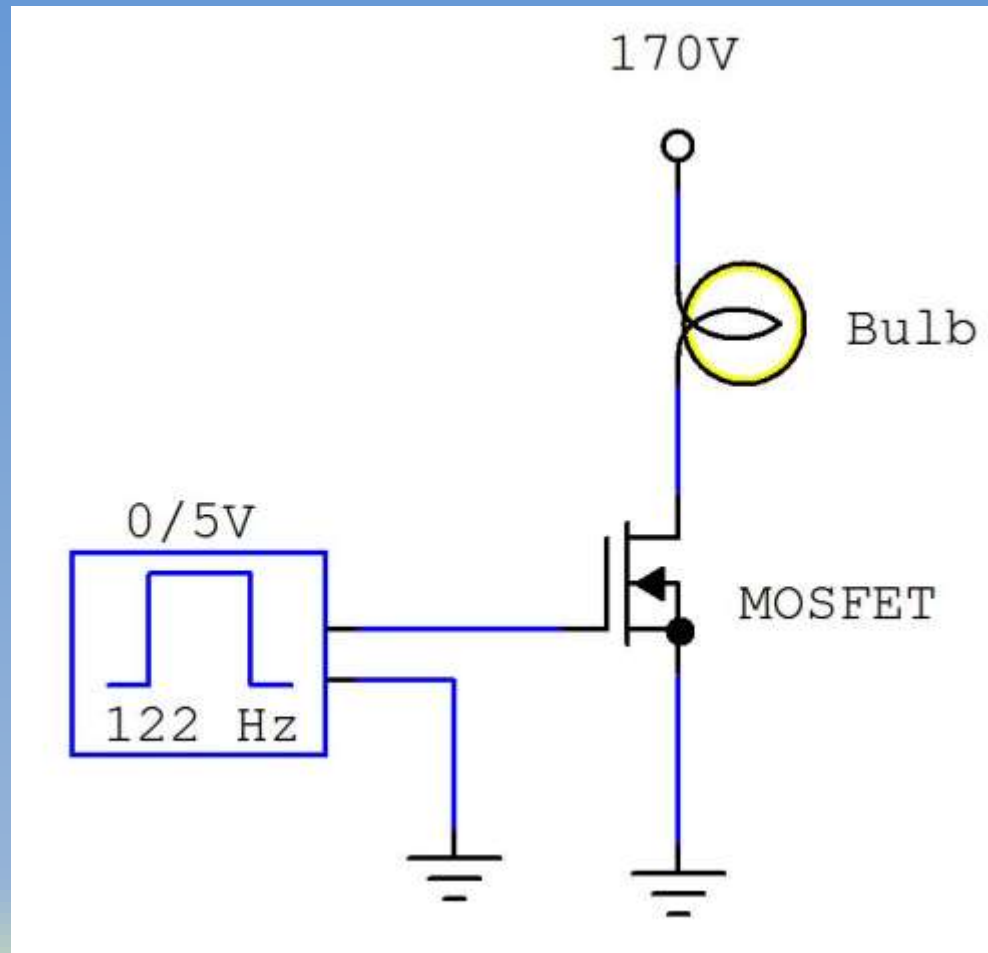
Alternating Current (AC) Signal



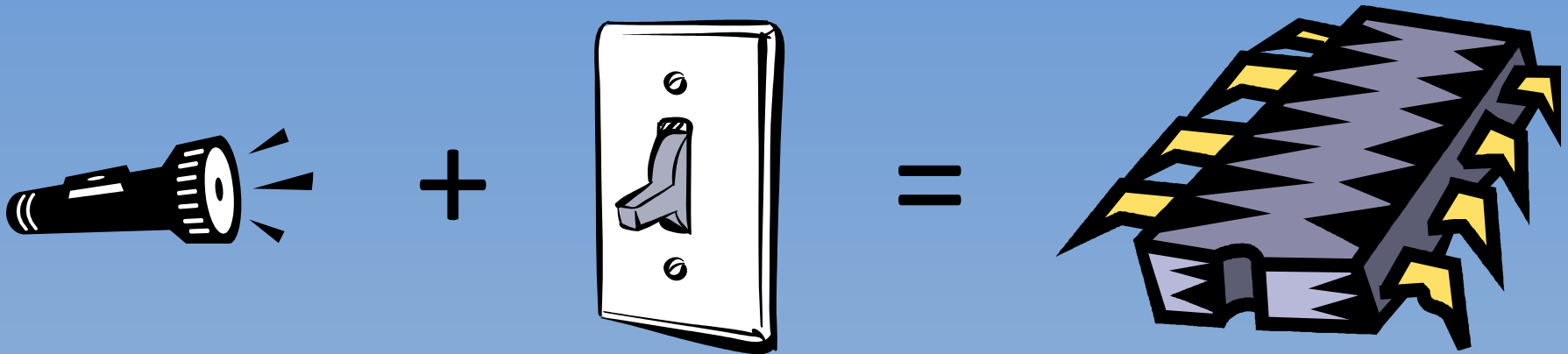
Direct Current (DC) Signal



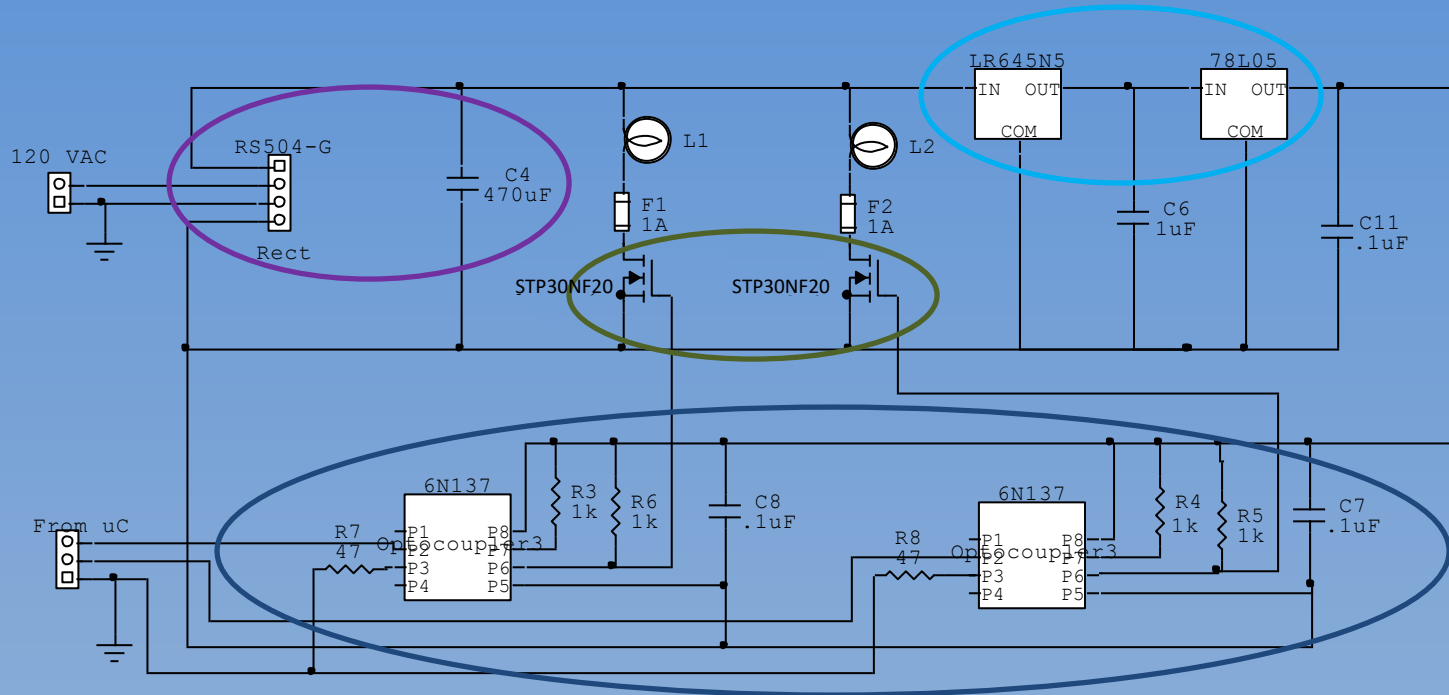
Implementation: Switching



Implementation: Opto-isolation



Implementation: Visual Alarm Circuitry



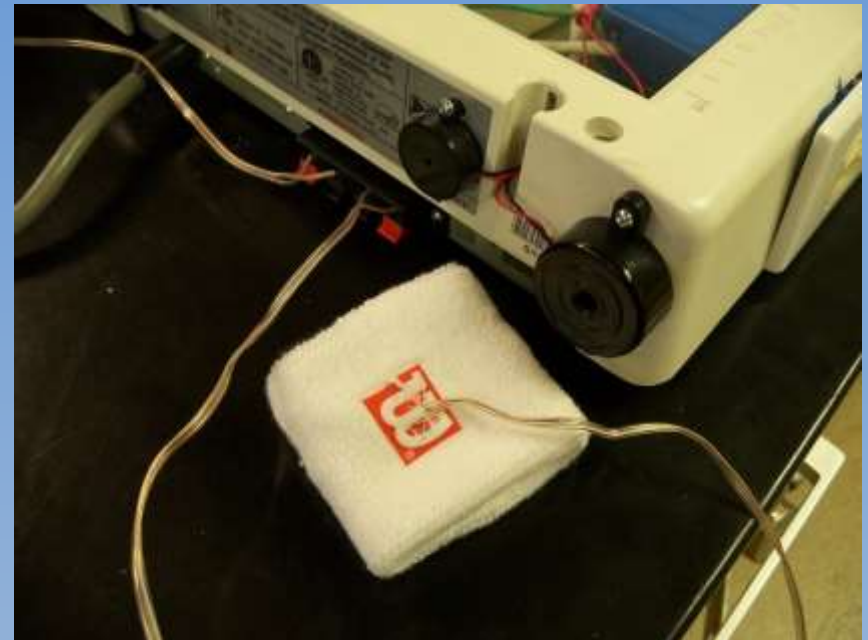
- Full wave bridge rectification with smoothing capacitor for 170 VDC voltage supply
- Power MOSFETs for switching action
- High input voltage regulator in tandem with 5 VDC regulator for MOSFET switch voltage
- Opto-isolation for circuit protection

Implementation: Physical Alarm

- 3 VDC vibrating motors provide stimulation
- Housed in athletic wristband
- Controlled by driving BJT transistors with PWM signal
- Pulse along with audio alarm
- Physically connected to alarm body

Implementation: Audio Alarm

- Two Piezo buzzers provide stimulation
 - 2.7 kHz, 75 dB maximum
 - 3.5 kHz, 86 dB maximum
- Potentiometers provide volume control
- Controlled simultaneously with physical alarm



Results

- Audio and physical alarms fully functional
- One visual alarm operational
 - Effective at waking user
- Time keeping accuracy very poor
 - Delayed by approximately 2 seconds every minute
 - External oscillator began interfering with LCD after damage to circuit board occurred during testing



Future Work and Alternatives

- Visual alarm
 - AC phase modulation to dim bulb
 - Allow use of compact fluorescent and LED bulbs
 - Remove user's access to lamp control signal
- Physical alarm
 - Wireless wristbands
 - Conversion to bed vibrator
- Audio alarm
 - Spectrum pitch control
 - Improved ability to match hearing configurations

Acknowledgement

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Questions?



Audio and Physical Alarm Circuitry

