Wireless-Keyless Electronic Door Lock
Hardware Description
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Introduction:

The Wireless-Keyless Electronic Door System is a door lock system designed to help the user to never have to worry about forgetting their keys again. The lock system has two main parts: the keypad/transmitter and the receiver/lock. The keypad will attach in a place of convenience close to the door, and the lock will be installed into the door that you wish to secure. If you want to unlock the door, simply enter choose the unlock option and enter your code and the door will unlock. If you want to unlock/lock the door, chose the lock option, enter your security code, and the door will lock without the use of traditional keys.

Transmitting Side:

Microcontroller:

The door lock system uses a 9S12C32 microcontroller from Freescale Semiconductor. It has 32kbytes of Flash and 2kbytes of RAM. It will be powered by 5V, regulated from 4AA batteries. I will be using the SPI pins as well as an SCI pin. The SPI will interface with my RF modules, and the SCI is what writes to the LCD screen. I will also be using PAD0:6 to take the input from the keypad.

Oscillator and BDM:

The microcontroller has a built in 8 MHz crystal oscillator that is connected to EXTAL and XTAL. A 6 pin BDM connector is used for programming. It is connected to the MODC/BKGD pin and RESET_L pin using active low setups for both.

Liquid Crystal Display(LCD):

The LCD I am using is called the SerLCDv2.5. It is from Sparkfun Electronics. The main reason this module was chosen was its simplicity. Only three wires are required to interface with it, 5V, GND and the signal. All commands are sent using hex numbers over the serial port. To output something to the screen, you just have to send that character, (eg. If you send an ASCII ‘r’, an ‘r’ is displayed on the screen). The display is 2x16 characters and the backlight will be disabled to reduce power consumption.

Keypad:

The keypad is a simple 3x4 numeric keypad. Pins 7,6,5 and 3 are tied through 1kΩ resistors to 5V. It is connected to pins 27-33 on the microcontroller which is PAD0:6.
RF Modules:

My RF modules are from Nordic Semiconductor. They are a single chip 2.4GHz transceiver, product number nRF24L01+. It has programmable data rates and several power saving modes. It is specifically designed for low power applications. It will be powered by 3.3V that will come from a switching voltage regulator. It also has internal voltage regulators to insure a wide supply range. The modules use Gaussian frequency-shift keying (GFSK) modulation. They interface with the microcontroller using the SPI. When transmitting, the modules only consume 11.3mA at 0dBm output power. Output power is programmable and can be reduced to just 7mA at -18dBm. Using the “standby-I” mode the modules consume just 26µA and if set to power down mode, the consumption drops even further to 900nA. The power saving modes are very important due to the fact that the lock is battery powered.

Voltage Regulators:

The Voltage Regulators I use are made by Linear Technology. They are the LTC3417A-2 step down DC/DC switching regulators. You can get them in fixed 5V and 3.3V outputs.

Receiving Side:

CPLD:

The brain on the receiving side is a Xilinx CPLD (complex programmable logic device). The XC2C256 is utilized to decode the incoming signal and control the lock. The CPLD has 256 macrocells and 64 I/O signals. I will only be using about 10 of the I/O signals, but will be utilizing over half of the macrocells, most of them used in the implementation of an SPI interface in VHDL. The SPI interface will communicate with the RF module on the receiving side. If an acceptable code has been received, then it sends the signal to the driver to activate the lock. The CPLD is powered with 3.3V that will be regulated from the 4AA batteries using the Linear Technology switching regulators.

RF Modules:

They are the same as transmitting side.

Motor Driver:

The driver that I am using is from ON Semiconductor. The MDC3105 is designed to provide a robust driver interface between loads and sensitive logic circuits. It has an internal Zener diode which eliminates the need for a free-wheeling diode. It also requires a low input drive current which will help conserve power.
Door Lock:

The physical lock I purchased is from Anaconda Universal Products Inc. I am only using the lock and motor from this and am replacing most of the circuitry with my own parts. It was originally designed to run off of 4AA batteries, which made it perfect for my project.

Voltage Regulators:

The Voltage Regulators I use are made by Linear Technology. They are the LTC3417A-2 step down DC/DC switching regulators. The will be fixed 3.3V outputs.