

# Wireless Programming of an Exoskeleton

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Lower Limb Exoskeleton.

The LEX system was developed to help soldiers carry heavy loads. The LEX is unique because it uses a pneumatic system which recycles energy from the knee and ankle and feeds it back into the hip and ankle which provides 10% of the needed power for the exoskeleton.

## Objective

Create a system to wirelessly program the microcontroller on a lower limb exoskeleton (LEX).

Benefits:

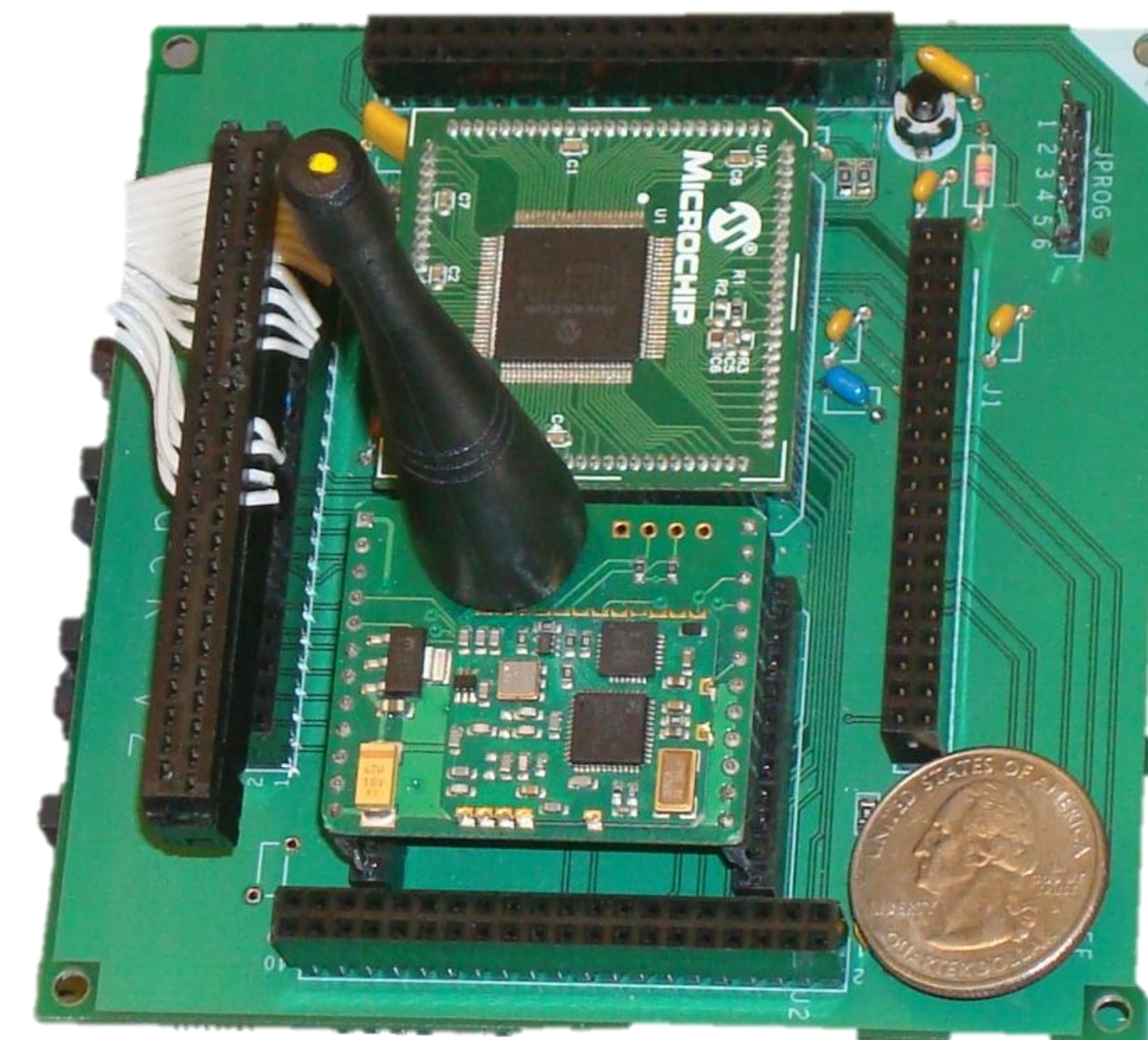
- If a bug in the code is encountered while in use, the program can be fixed and written to the chip without having to come back to the lab or take off the exoskeleton.
- Easier reprogramming from the lab, less chance of injuring equipment by bending pins.

## Programming the Microcontroller

- A bootloader is a program that is used to write user applications to a microcontroller.
- The ds30 Loader was the bootloader chosen for this project because of its simple user configurations and accessible GUI.
- A dsPIC33FJ256GP710 was used as the microcontroller.
- Test programs were developed using Simulink and Lubin Kerhuel's blockset for dsPIC.



Picture from <http://buffalocomputerconsulting.com/virus-removal.html>



Microcontroller and Radio on the LEX.

## Results

- A delay was applied to the reset signal to obtain the right timing between the signal and the bootloader.
- The application download and reset now occur in consecutive order.
- To reduce the chance of accidental resets a program was developed that utilizes a long string to trigger a reset.

Concept of Wireless LEX System.

## Wireless Reset

- To program the LEX microcontroller the chip must be manually reset before downloading a new user application. For wireless programming a wireless reset must be designed.
- To avoid remanufacturing, a software reset was chosen over a hardware reset.
- A Simulink program was developed to produce a software reset. The reset is triggered from a signal sent from the computer.
- To program the PIC the user application must be downloaded immediately after the chip is reset. This created a problem because the reset signal and the application being written are both sent through the serial port.

