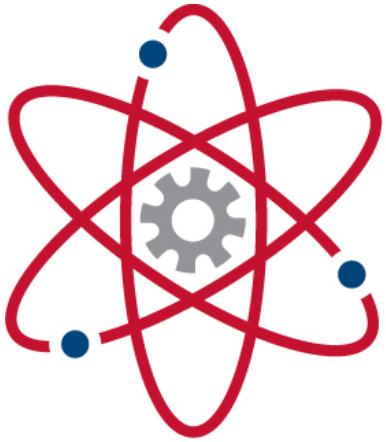


PROJECT LEAD THE WAY

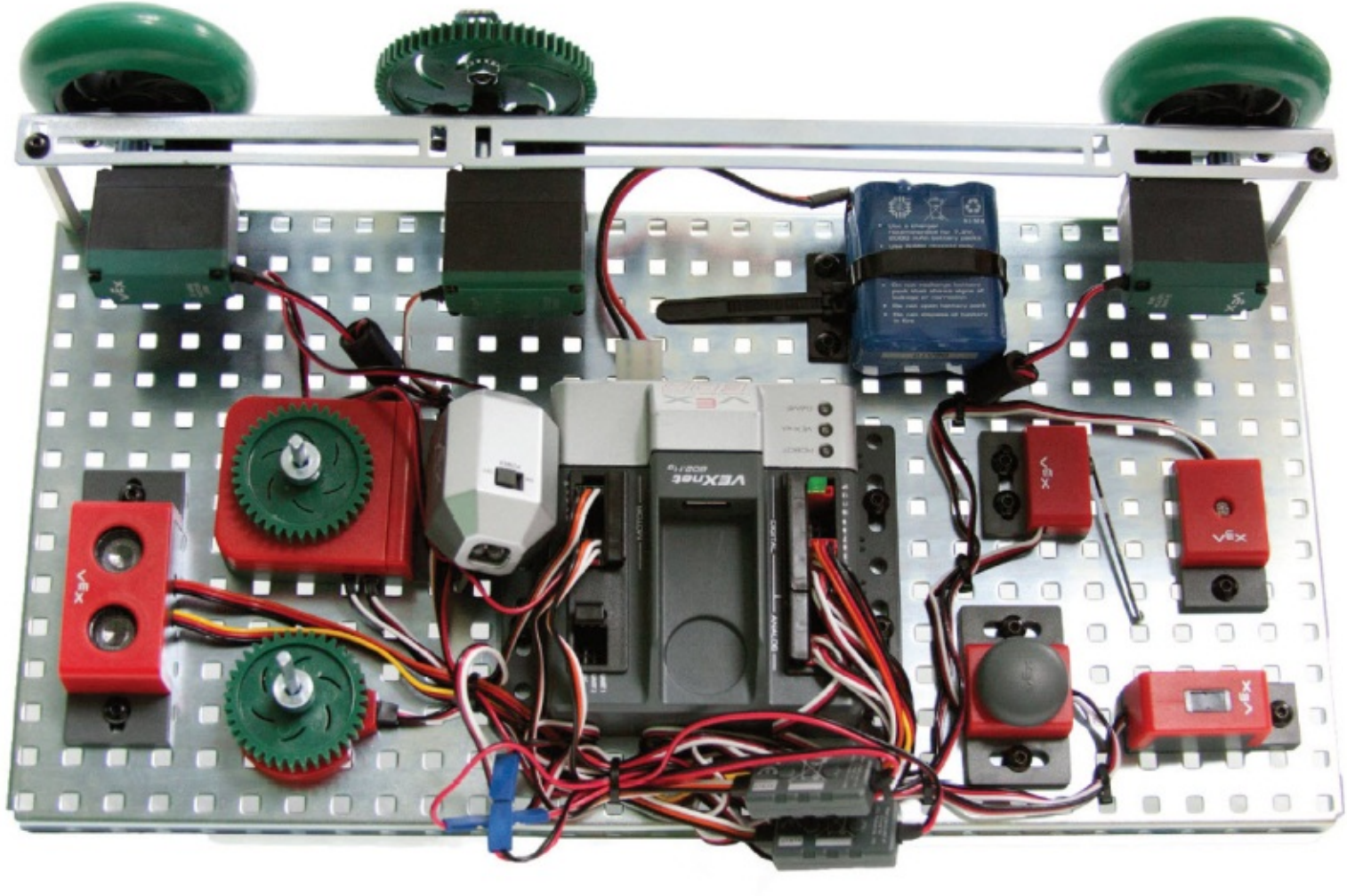
PLTW

Igniting imagination and innovation through learning.

VEX Robotics Platform and ROBOTC Software

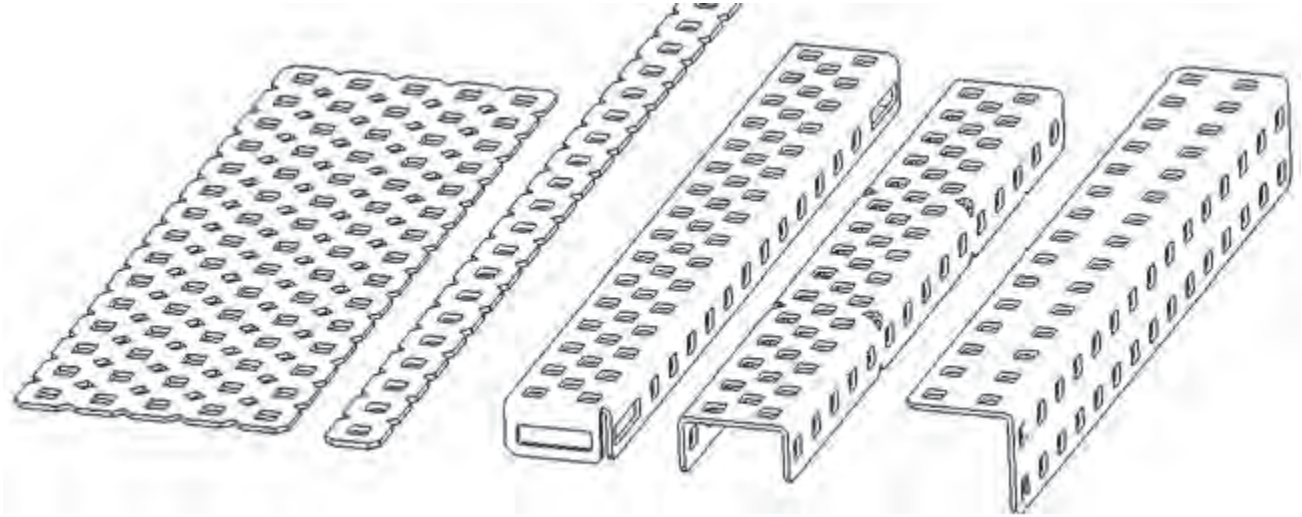
Introduction

VEX Robotics Platform: Testbed for Learning Programming



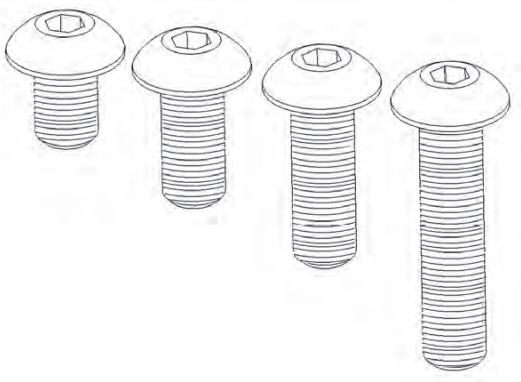
VEX Structure Subsystem

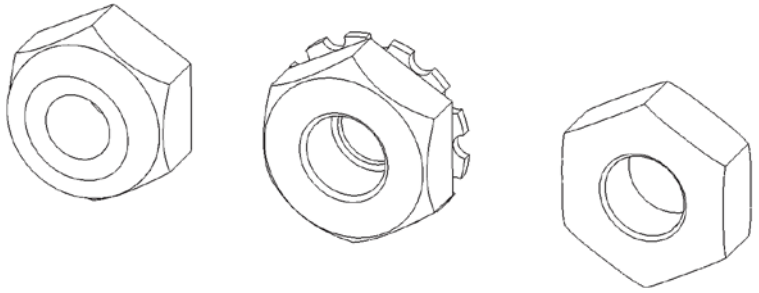
- VEX Structure Subsystem forms the base of every robot
- Contains square holes (0.182 in. sq) on a standardized ½ in. grid
- Allows for VEX parts to be connected in almost any configuration



VEX Structure Subsystem

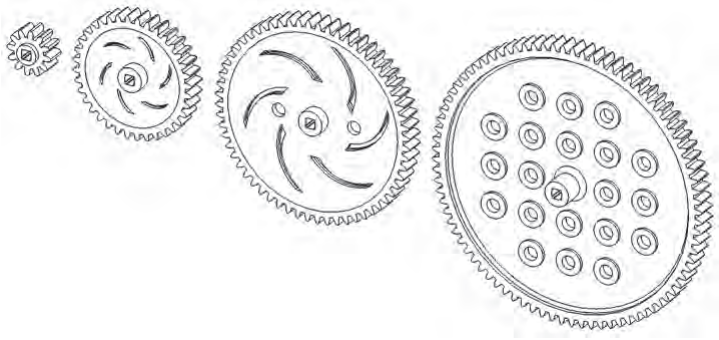
- Metal components directly attached using 8-32 screws and nuts
  - Nylock nuts have a plastic insert to prevent them from unscrewing
  - KEPS nuts have a ring of “teeth” on one side to grip the piece being installed
  - Regular nuts have no locking feature

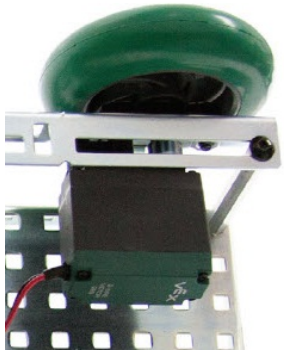


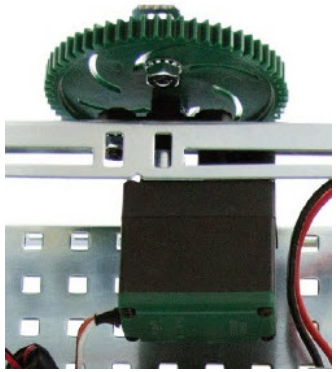


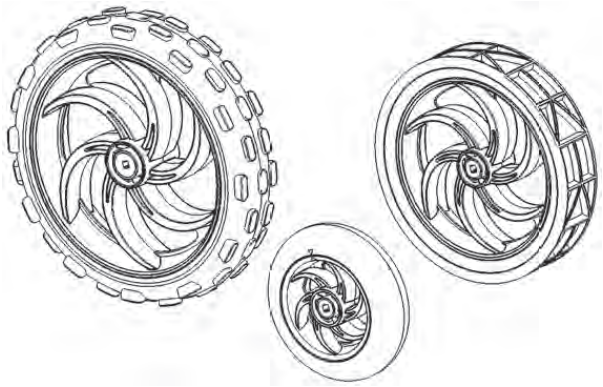
VEX Motion Subsystem

- Components which make a robot move
  - Gears
  - Wheels
  - Motors
  - Servos



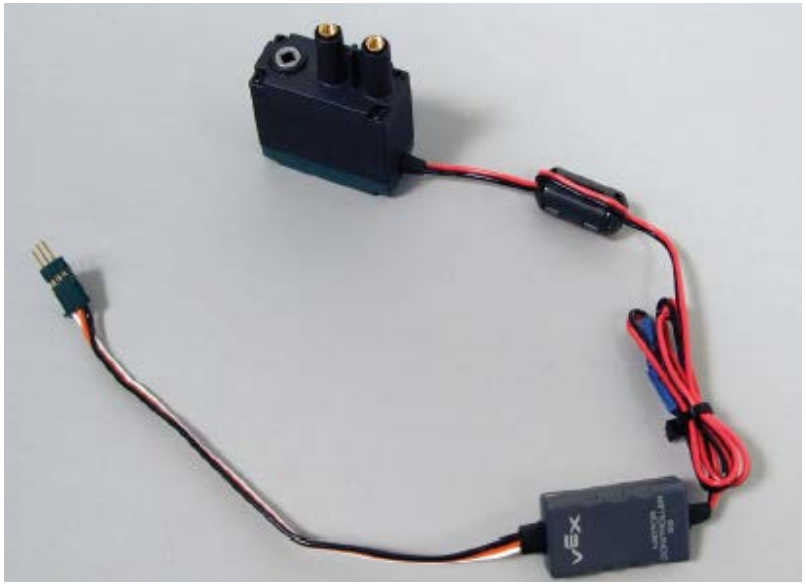






VEX Motion Subsystem – Motors

- 2-wire motor 269
  - Two methods to connect to Cortex
    - Motor ports 1 and 10
    - Motor port 2-9 using Motor Controller 29
- 2-wire motor 393



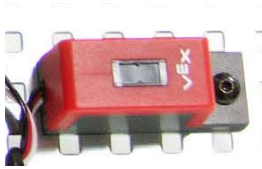
VEX Motion Subsystem – Servos

- Similar in appearance to the 3-wire motor
- Very different in operation
  - Rotates between 0 and 120 degrees
  - Motor is set to a “power value”
  - Servo is set to a “position value”
  - -127 = 0 degrees, 0 = 60 degrees, 127 = 120 degrees, etc.
  - Natural Language command
    - setServo()

VEX Sensors Subsystem

- Provide inputs to sense the environment

- Digital Sensors:
  - -Bumper Switch 
  - -Limit Switch 
  - -Optical Shaft Encoder 
  - -Ultrasonic Range Finder 

- Analog Sensors:
  - -Light Sensor 
  - -Potentiometer 
  - -Line follower 

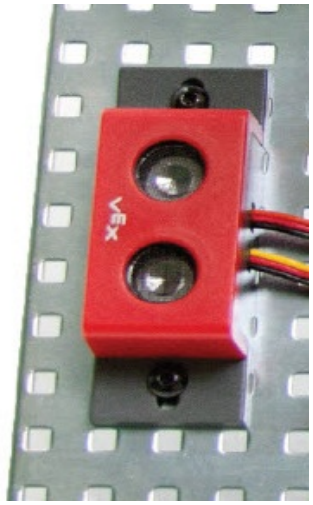
Potentiometers

- How it Works
  - Analog sensor
  - Measures rotation of a shaft between 0 and ~265 degrees
  - Cortex returns values 0 - ~4095
- Caution
  - Internal mechanical stops prevent potentiometer from turning a full revolution
  - Excess torque against the internal mechanical stops will cause them to wear away

Quadrature Shaft Encoders

- How it Works
  - Digital counting sensor
  - Inner shaft spins as the encoder counts
- Capabilities and Resolution
  - 360 counts per revolution
  - Counts up and down
  - Allows you to control the distance a robot moves by monitoring how much the wheels spin

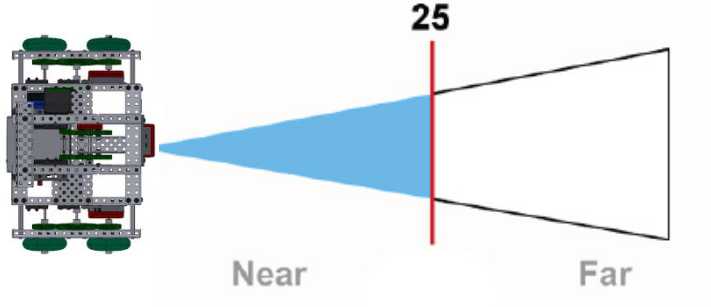
Ultrasonic



- How it Works
  - Similar to how bats and submarines sense distance
  - Digital sensor that returns distance values between 0 and 255 inches
  - Returns values of -1 or -2 if used improperly
  - Cortex resolution can be in inches, cm, or mm

Ultrasonic Range Finder

- Ultrasonic Range Finder detects objects in a “cone” field of view
- Sensor detects object distance from the center of the sensor
- Sensor distance calculations based on sound waves
  - Objects that may not be detectable include soft objects that absorb sound, sharp objects that deflect sound, etc.



VEX Cortex Microcontroller

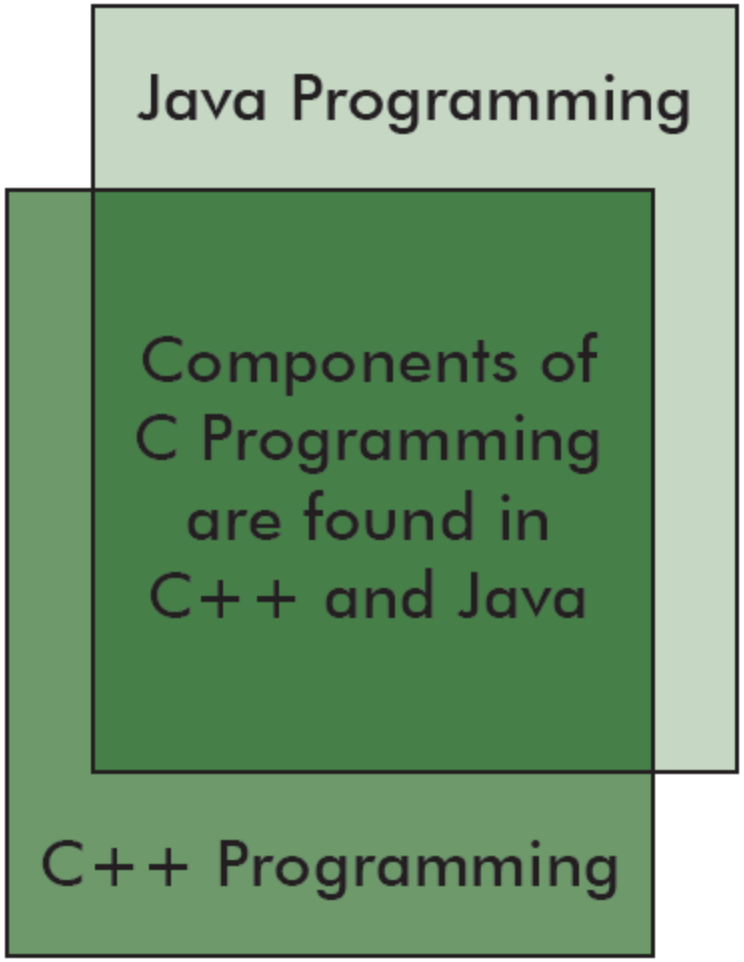
- VEX Cortex (VEX 2.0)
- 12 Digital Ports
  - Touch sensor, ultrasonic range finder, shaft encoder
- 8 Analog Inputs
  - Light sensor, line tracking sensor, potentiometer
- 10 Motor Ports
  - Ports #1 and 10: 2-wire DC ports
  - Portsa #2 through: 3-wire wulse width modulated (PWM)
- VEXnet Connection
  - Fits USB cable or wireless key for remote control and wireless programming
- Capabilities beyond POE kit
  - Supports external LCD screen, video, …

ROBOTC Software

- ROBOTC developed specifically for classrooms and competitions
- Complete programming solution for VEX Cortex and several other popular robot platforms
- Real-time debugger
- Similar to industry-standard C programming

Industry Standard Coding

- ROBOTC programming is a key components of industry standard programming languages

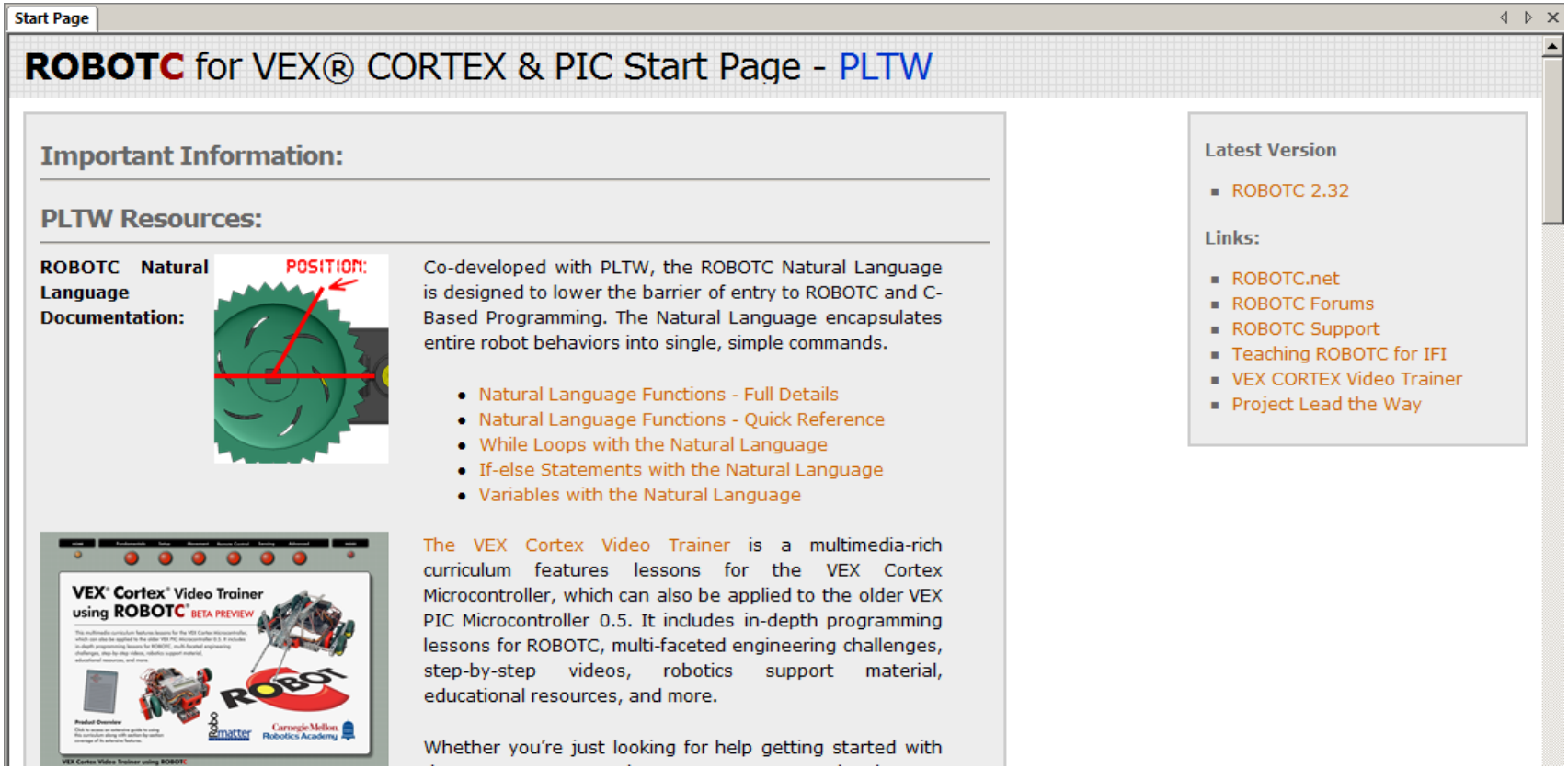


Industry Standard Skillsets

- Java and C++, along with the Eclipse and Visual Studio IDEs, have been used to program:
  - Microsoft Windows
  - Mac OSX
  - US Navy UAV Drones
  - Flight Simulators
  - DVD Player Firmware
  - Video Games
  - Microwaves
  - CAT Scanners
  - Smart Cars
  - Satellites
  - Cell Phones
  - Electronic Toys
  - ROBOTC
  - Much, much more

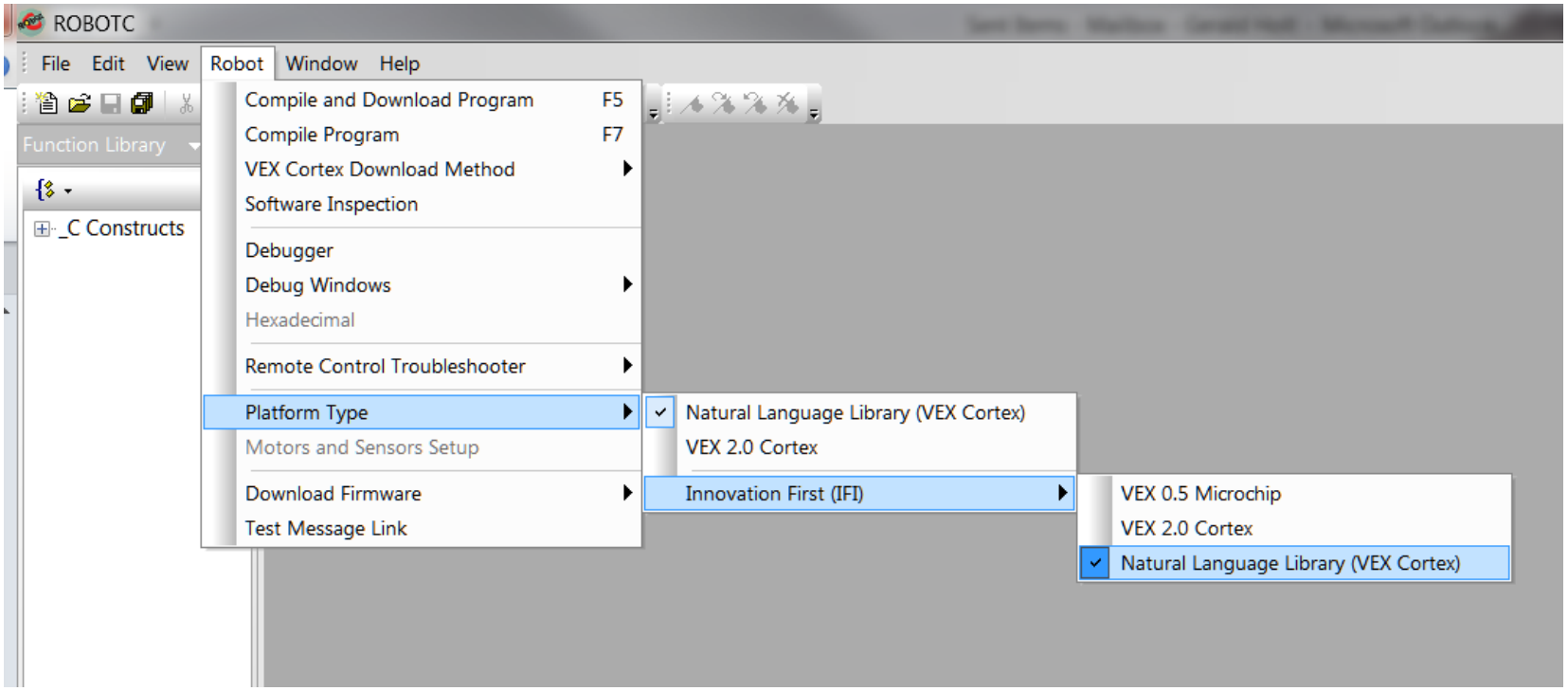
ROBOTC Start Page

Displays the latest ROBOTC news, version of ROBOTC, and ROBOTC Resources



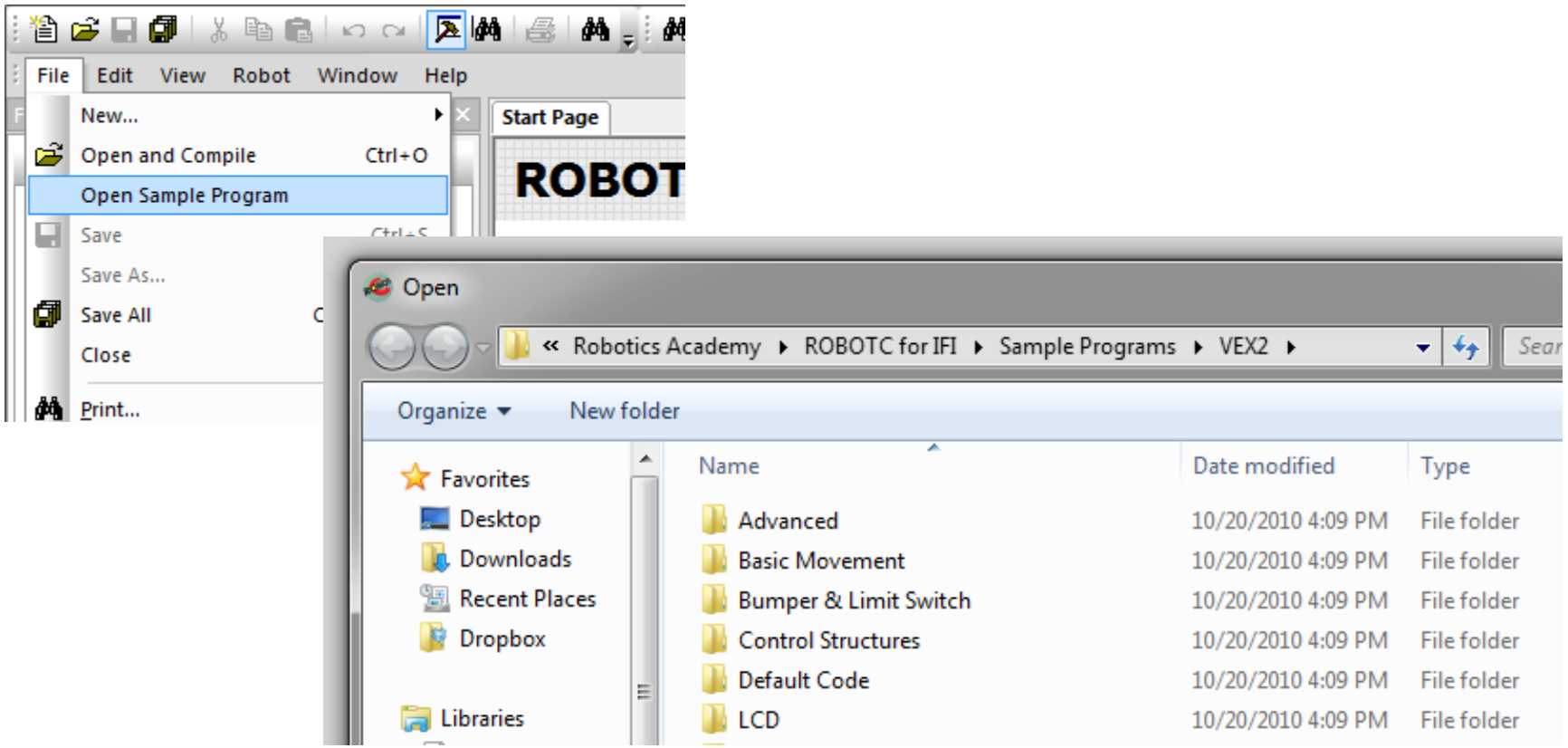
Platform Type

Allows you to toggle ROBOTC programming mode between the VEX PIC and VEX Cortex, which will enable features and commands for the system



Sample Programs

Over 75 ROBOTC Sample programs, organized by robot behavior

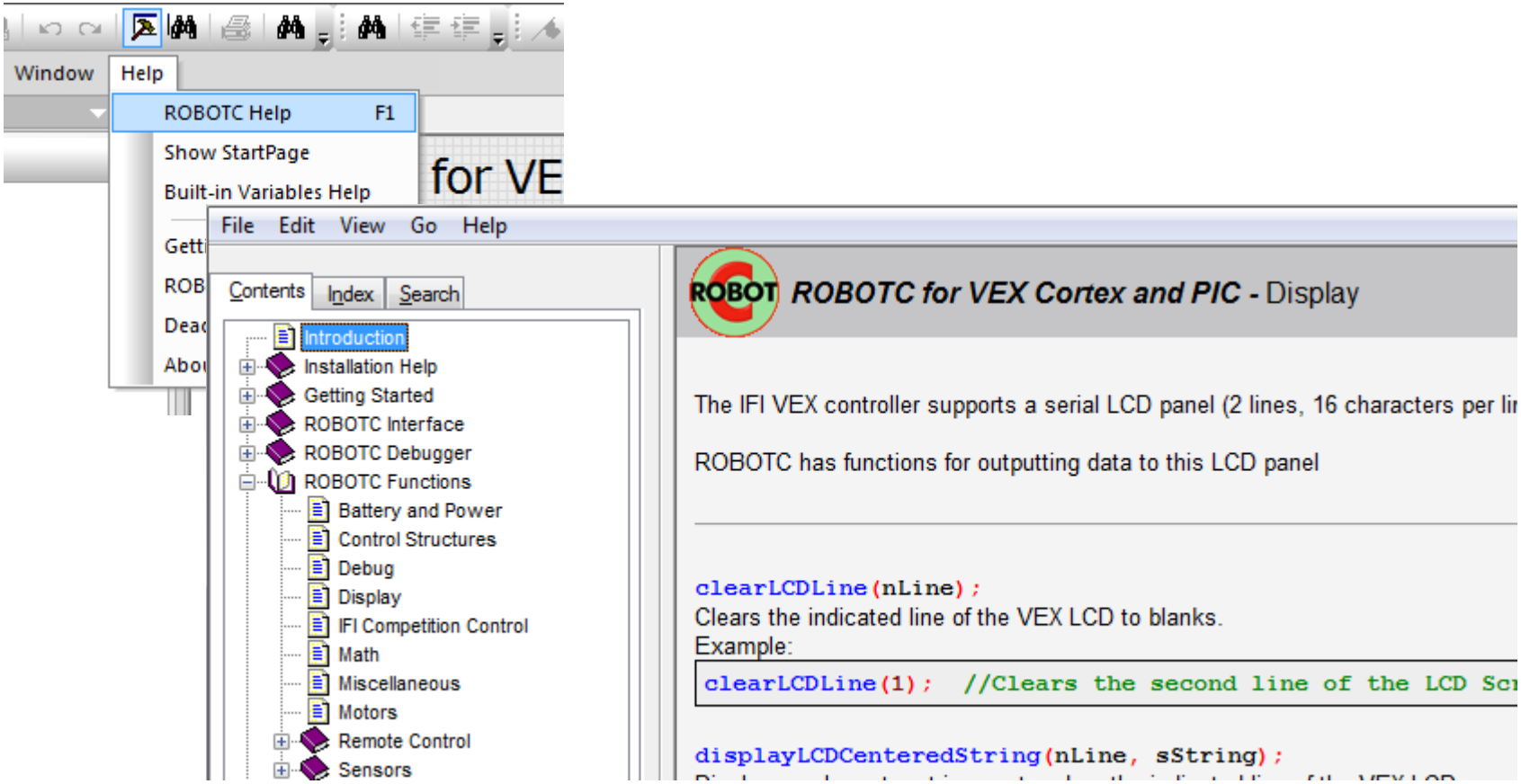


Comments

- Comments are used to make notes in code for the human programmers
- Every sample program contains comments pertaining to robot configuration, ROBOTC commands, robot behavior, etc.
- // Single line comment – All material after "//" is ignored by the ROBOTC compiler
- /* Multi-line comment*/ – All material between the "/*" and "*/" symbols is ignored by the ROBOTC compiler

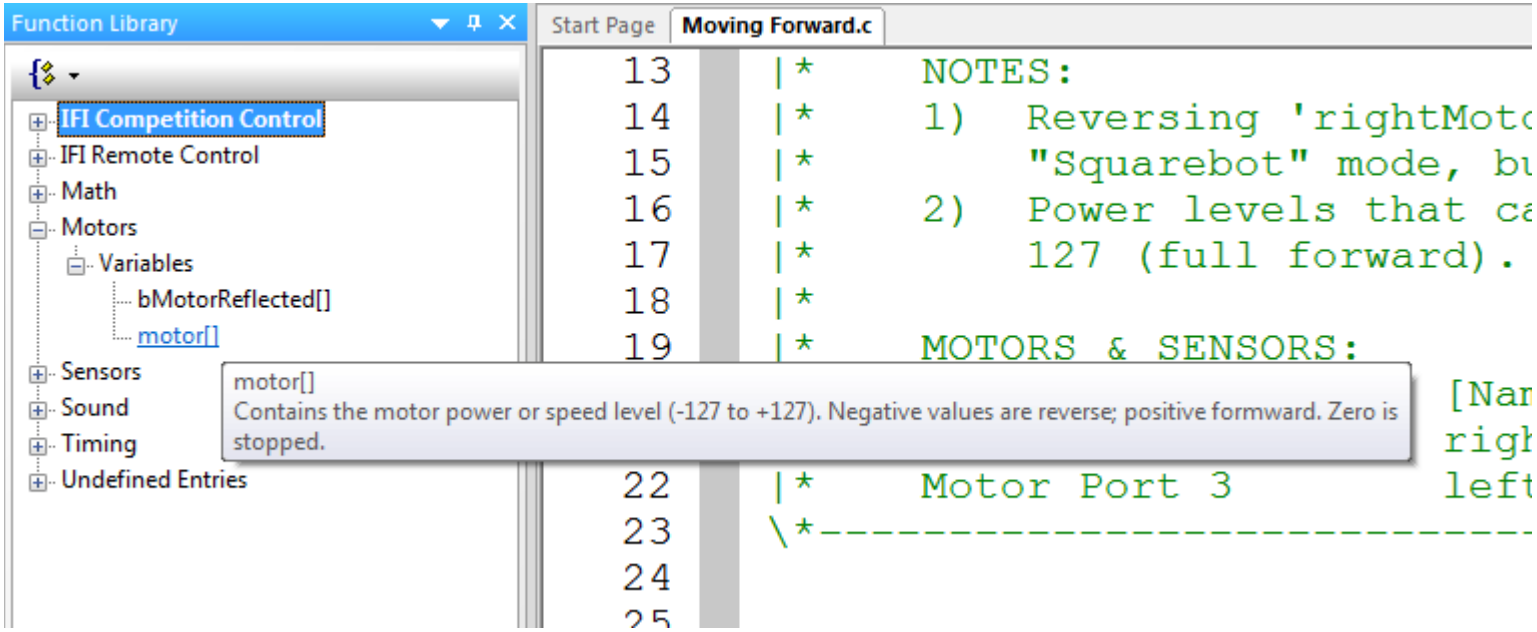
ROBOTC Help

In-depth explanations about ROBOTC interface, commands, debugger, etc.



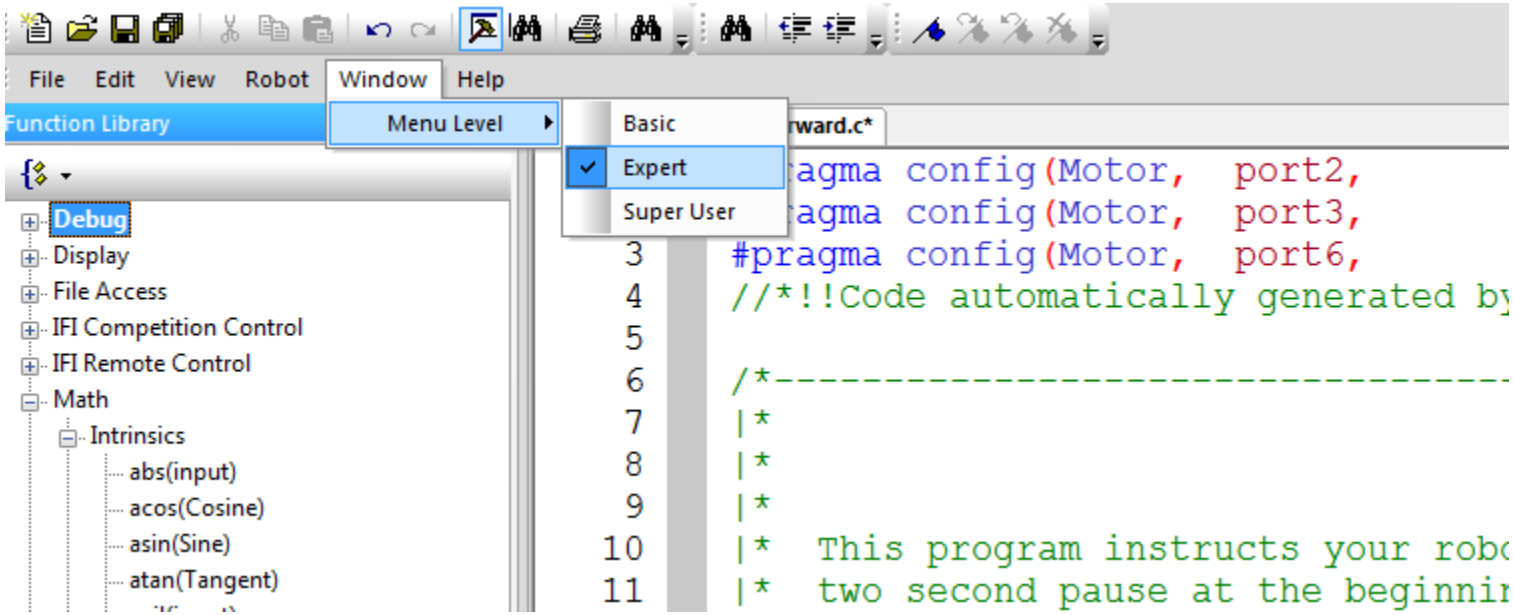
Function Library

- Available functions are listed with a description
- List of available functions will expand or shrink depending on the Menu Level



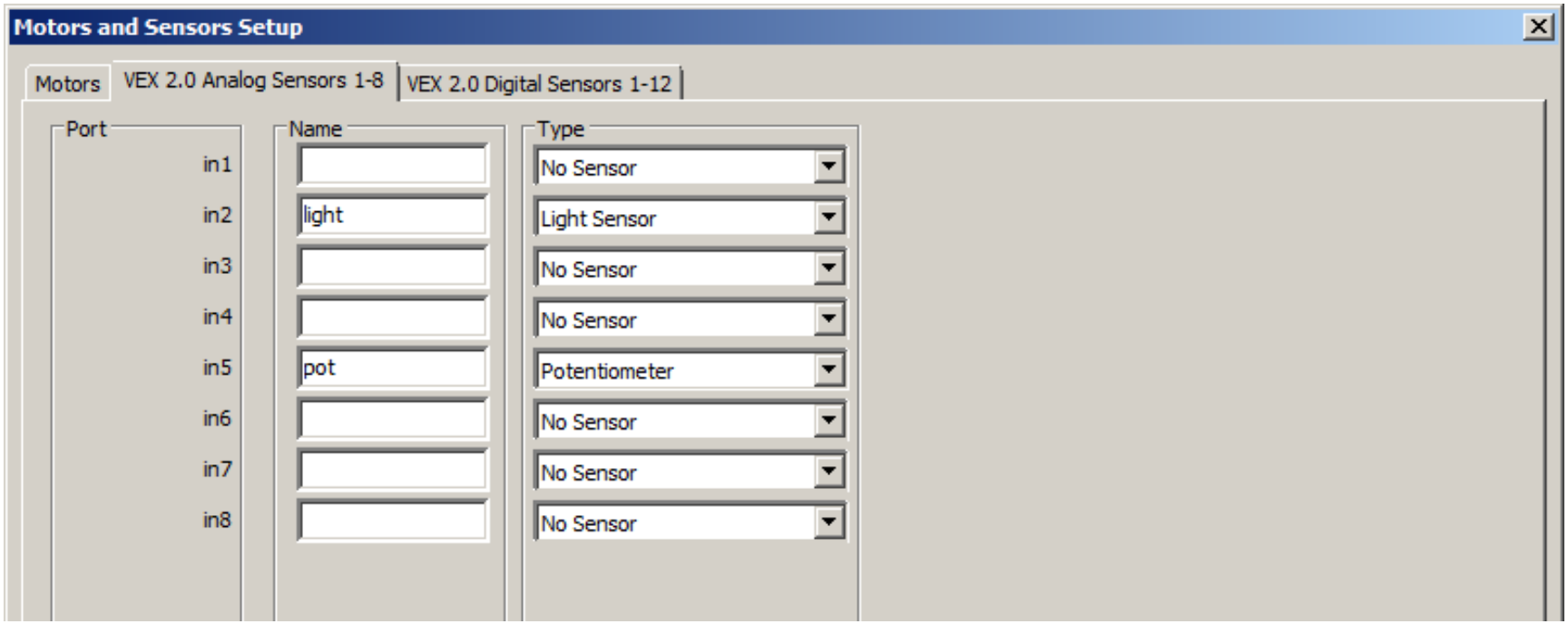
Menu Level

Customizes the ROBOTC interface and Function Library based on user's experience level



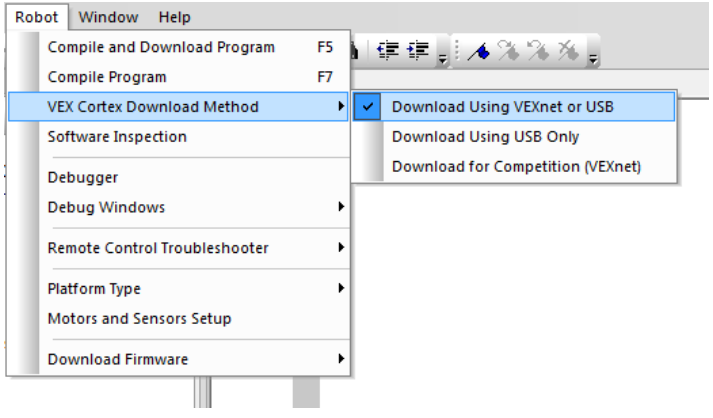
Motors and Sensor Setup

Central place to configure and name all of the motors and sensors attached to your Cortex



VEX Cortex Download Method

- Allows you to specify:
  - How programs are downloaded
  - Whether Cortex looks for VEXnet connection when it starts up
- Allows you to download Using VEXnet or USB; however, the Cortex will look for a VEXnet connection for up to10 seconds before running code



References

Carnegie Mellon Robotics Academy. (2011). ROBOTC. Retrieved from http://www.robotc.net