SPIKE PRIME & FIRST LEGO LEAGUE

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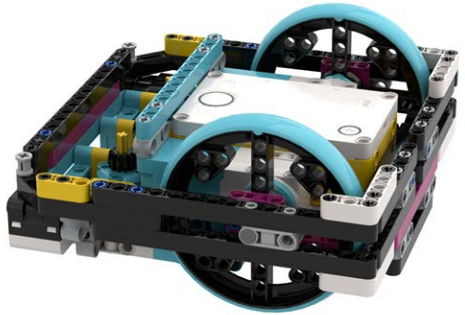
Objectives

- Compare EV3 and SPIKE Prime
- Focus on the needs of FIRST LEGO League teams



Note: We do not represent *FIRST* or LEGO Education. All opinions are our own.

Comparison

SPIKE Prime vs. EV3 Overview

Hub/Ports

- 5 second boot time (convenient for teams if the hub/brick were to crash before or during a run)
- 6 universal ports (can be used for sensors or motors) with a built-in gyro

- 30 second boot time, even longer for MicroPython
- 4 sensor +4 motor specialized ports

Conclusion: You do not lose much in terms of ports by switching to the SPIKE Prime

Sensors used in *FIRST* LEGO League

- Color Sensor (improved with more colors and better recognition)
- Distance Sensor (can be taken apart for custom components– for hobbyists, not FLL)
- Force Sensor (reads pressures from 0-10N)
- Built-in 6-axis gyro and accelerometer (no drift and minimal lag)

- Color Sensor
- Ultrasonic Sensor
- Touch Sensor (binary– pressed or released)
- Gyro Sensor (drift and lag issues)

Conclusion: SPIKE Prime has the same sensors and they are overall better than the EV3's

Programming Languages Available

- Primary: Word Blocks: Scratch-based programming
- Secondary: [Micro-]Python (text-based): built into same App, has basic tutorials and examples available. Has some extra commands and functionality (similar to EV3)
- Can only use Scratch or MicroPython

- Block based: EV3-G/EV3 Lab (LabView-like) or Scratch-based EV3 Classroom (Mac only right now)
- Text based (official): MicroPython. Requires microSD Card, Visual Studio Code IDE (requires additional work/not built-in)
- Can use non-LEGO supported languages (e.g. Java, C++, etc.), but usually require an SD card
- The text based languages generally provide more functionality

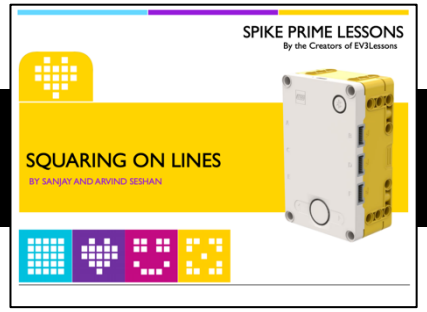
Conclusion: SPIKE Prime's software is easier to switch between block-based and Python, but has fewer languages available

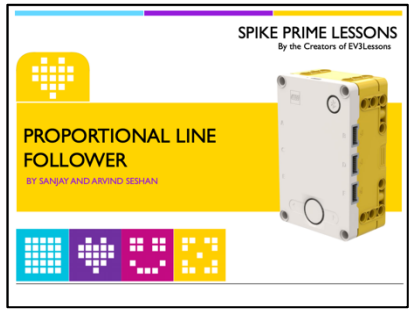
Features and Tradeoffs

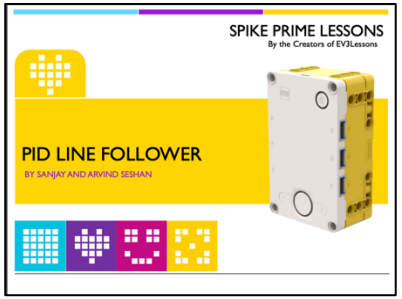
More detailed look at SPIKE Prime

Advanced Programming

- EV3 programming techniques can also be done in SPIKE Prime
- You can use Proportional control, gyro move straight, PID line follower, squaring on a line, etc. in both Scratch and MicroPython
- Videos https://www.facebook.com/PrimeLessons/
- Lessons: http://www.primelessons.org/

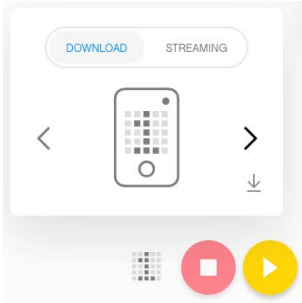


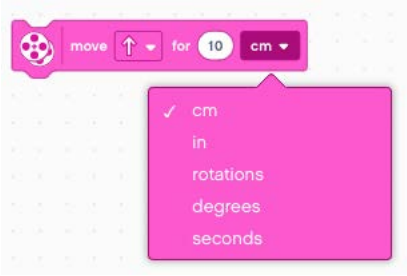




Improvements with SPIKE Prime (Software)

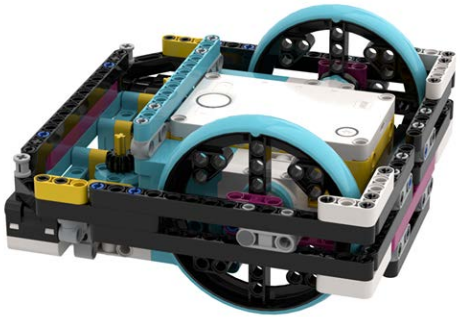
- **Finding and Ordering Programs:** Built in menu with slots for projects (can organize list by run number unlike with the EV3)
- **Monitoring Variables Easily:** Variables monitor allows users to easily view data to debug code – you can easily debug without an LCD screen – write debug data to a variable and it will show up on the PC screen when connected
- **Different Platforms – Same Blocks:** Same software across all platforms (for EV3, Chromebooks, Android, and iPads had a limited version of the software) – allows for mixed-platform programming amongst team members
- **Move_CM:** Movement blocks can take centimeters/inches as an input in addition to degrees, rotations, and seconds – easier to program robot to navigate the field (for EV3, you would have to make a My Block)
- **Stall Detection:** Built in stall detection on motors





Improvements with SPIKE Prime (Hardware)

- **Size:** Smaller form factor for electronic components
- **Shape:** Electrical components have a more rectangular shap and more connection points (overall easier to build with)
- **Wires:** Wires are easier to manage with thinner wires and wire clips
- **Motors:** Built-in absolute positioning on motors
- **Charging:** USB charging for battery–same as download port
- **Color Sensor:** Improved color sensor–more colors and works at a greater distance from the mat



Tradeoffs: My Blocks

- My Blocks are only available for use in the project that they are created in.
  - However, they can be copied and pasted from one project to another
- No outputs from My Blocks
  - There is a work around that uses variables
- In MicroPython, functions can be imported and have outputs
- These are all problems specific to Scratch (also problems with EV3 Classroom)

Tradeoffs: Calibration, Files, Wires

- **Distance Sensor:** Does not work at angles when close to a surface
- **Color Sensor Calibration:** None
  - You can work around this with code
  - The sensor seems to work well without a calibration
- **Files:** No file reading/writing
  - This can be done in MicroPython
- **Battery:** Battery must be connected to the hub to charge - you cannot have extra batteries on the side charging (i.e. you must own another hub to charge extras)
- **Wire length:** Fixed
  - However, for FIRST LEGO League, the wire length is sufficient
  - If the length is too long, you can use the wire clips to easily keep wires out of the way

Tradeoffs: Steering Blocks

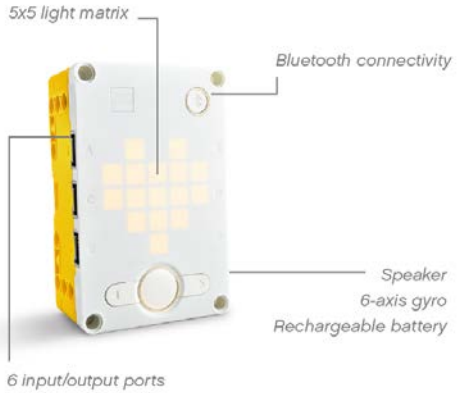
- Steering input is not linear
- The difference between 100 steering and 99 steering is significant
- Workaround: Use Tank Blocks

Tradeoffs: File Size

- Code fails to download with very large programs
- The latest version of the software provides a warning when the limit is reached and does not allow you to download the code to your robot.

Tradeoffs: Gyro

- **There is no Gyro Drift or Lag, but there are other tradeoffs**
- **Gyro Rate:** Cannot access the gyro rate or accelerometer in Scratch, but this can done in MicroPython
- **Gyro Inaccuracies:** E.g. turning the hub 360 degrees produces a gyro reading that is not 360.
  1. This is typically hub specific. E.g. Hub 1 will consistently be 7 degrees off and Hub 2 will consistently be 4 degrees off.
  2. The error is impacted by the complexity of other running code. E.g. updating the light matrix at the same time will increase the error by about 25 degrees per 360 degree turn.
- Workaround: For (1), you may need to scale gyro readings after measuring the error for your hub. For (2), you will need to make sure gyro readings are done less frequently and/or have little code running at the same time.



Common Misconceptions

What people think about SPIKE Prime

Age Level

- SPIKE Prime is only for a beginners and primary school students

- Even though the default software is Scratch and the colors target younger ages, the capabilities of SPIKE Prime match those of the EV3
- There is also MicroPython for older students
- SPIKE Prime has lowered the entry point, but the ceiling is as high as EV3

SPIKE Prime Motors

- SPIKE Prime motors are less powerful and worse for FIRST LEGO League

- It is true that the motors are less powerful
- However, there really is no need for more power than what the SPIKE Prime motors have. If more torque is needed, increasing the gear ratio should be sufficient.

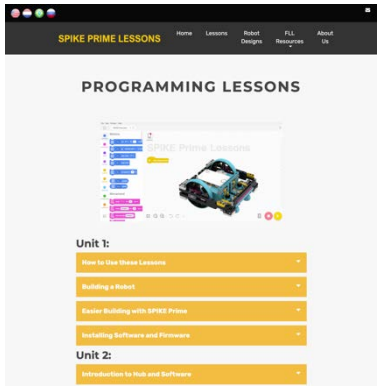
Accuracy and Reliability

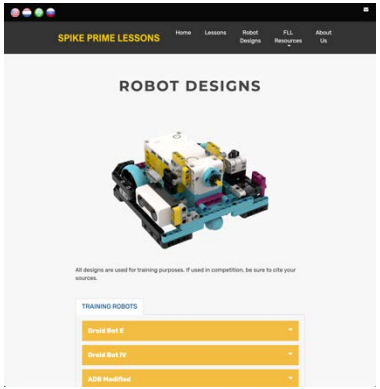
- SPIKE Prime is less accurate and less reliable than EV3.

- SPIKE Prime has built in stall detection, an improved color sensor
- The SPIKE Prime Gyro is less accurate, but it does not have drift and lag
- Regarding accuracy, the SPIKE Prime motors are comparable with the EV3 motors
- All reliability techniques that can be done in EV3 can also be done in SPIKE Prime.

Resources

- There are few resources for SPIKE Prime, but many available for EV3





- PrimeLessons.org will have a complete set of lessons from beginner to advanced
- We will support all teams
- There is an online community to ask for help (LEGO SPIKE Community and FLL Challenge Share & Learn on Facebook)
- New resources are coming out every week.
- Built-in resources in the software for Scratch and MicroPython

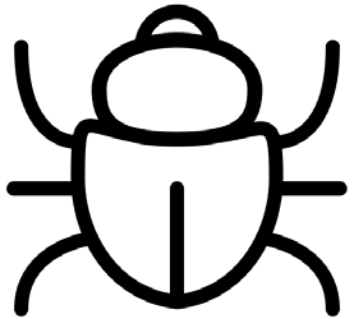
Cost

- SPIKE Prime is expensive or same price as EV3

- SPIKE Prime is actually cheaper than the EV3
- The expansion pack gives you motors and sensors (much better value compared to EV3 expansion)

Bugs

- SPIKE Prime will have bugs



- SPIKE Prime is new.
- There are updates coming all the time to fix bugs. Install the updates.
- EV3 also had bugs. LEGO has historically addressed these quickly in updates but some bugs were only uncovered/addressed after several years.
- The community usually develops workarounds

Overall Conclusions

- If you have EV3s or just bought them, no problem
  - EV3 is a great product
  - *FIRST* always allows multiple platforms
  - Competitions are not geared to a platform (no extra points for one platform over another)
- If you have the budget/just starting out (regardless of age of the students), want a new challenge, you can give SPIKE Prime a try
  - There are limitations in SPIKE Prime. It is not the same as EV3
  - But DO NOT underestimate the capabilities of SPIKE Prime

Thank You!

Do you have any questions?

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