Lego Spike Accessibility

Daniel Nieland, Aren Aguas, Alex Chavez,
Richard Mendoza, Gregg Salonga

What is LEGO Spike?

- Programmable Lego Toys
- Mindstorms (older) & Spike (newer) kits
- Designed to run only Python and Scratch

The Problem: Inaccessibility

- LEGO Mindstorms & Spike robotics kits **do not** have native support for the blind or visually impaired.
- The Quorum programming language **has** native support for the blind or visually impaired.

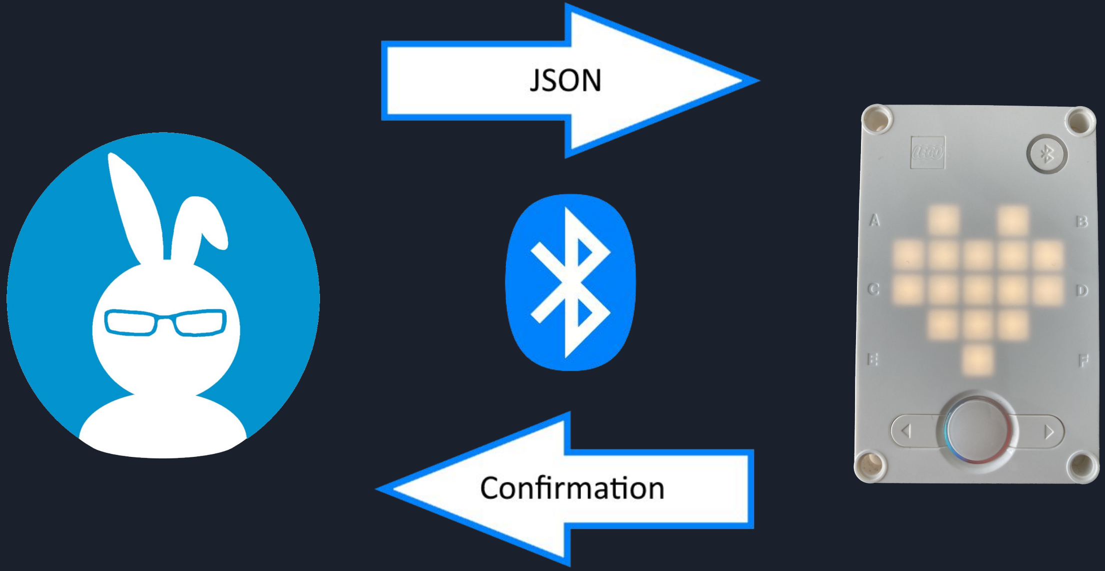
The Purpose

- Schools For The Blind
- Blind and Visually Impaired Support
- Equal Opportunities at Competitions

LEGO Spike kit accessibility for the blind and visually impaired.

Introduction Requirements Design Prototype Conclusion

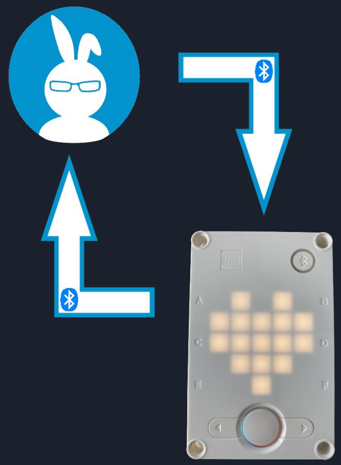
Our Proposed Solution



JSON

Confirmation

Functional Breakdown



- System Port List - list ports for bluetooth communications
- Java Send Command - send JSON formatted commands
- Python Read, Parse, and Execute - takes received JSON, parse and execute locally
- Outcome Report - sends back success or error message

Introduction Requirements Design Prototype Conclusion

Non-Functional

Operating System:

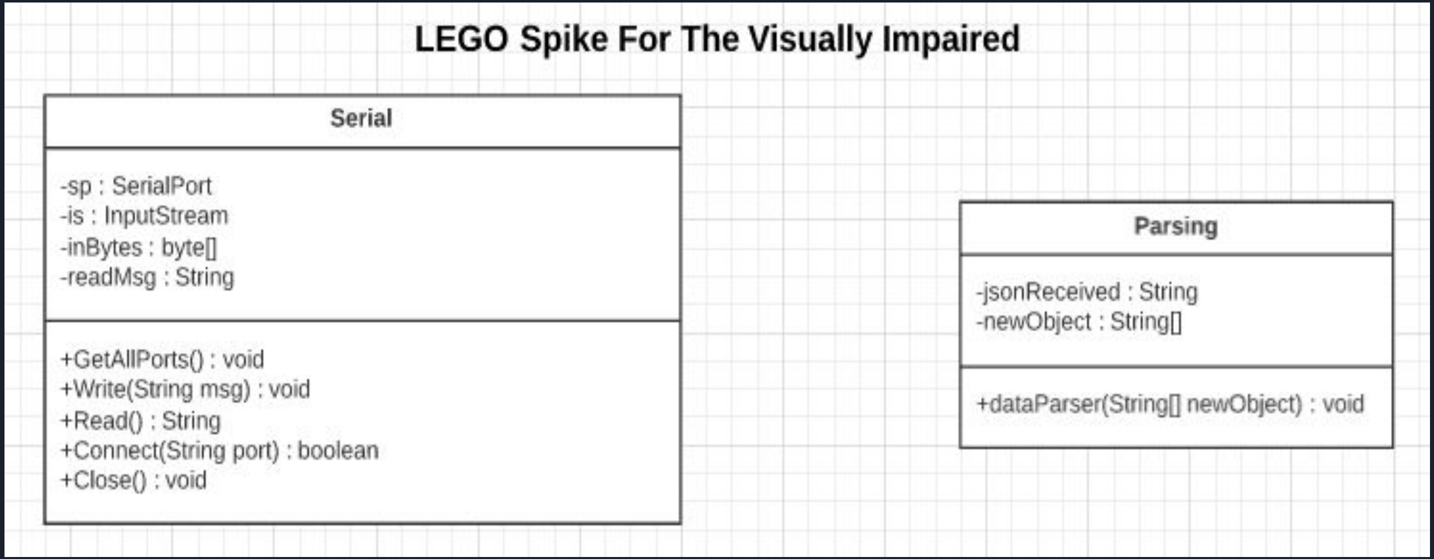
Programming Languages:

Device:

External Library:

jSerialComm

UML Diagram



LEGO Spike For The Visually Impaired

Serial

-sp : SerialPort
-is : InputStream
-inBytes : byte[]
-readMsg : String

+GetAllPorts() : void
+Write(String msg) : void
+Read() : String
+Connect(String port) : boolean
+Close() : void

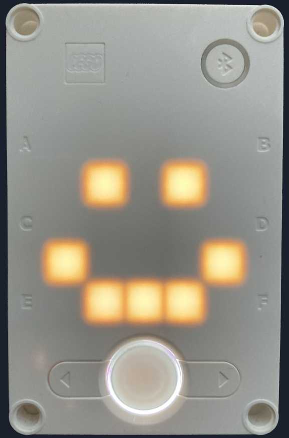
Parsing

-jsonReceived : String
-newObject : String[]

+dataParser(String[] newObject) : void

- Connect computer and Lego Hub through a Bluetooth port
- Run separate programs on computer and Lego Hub
- Both can send and receive messages which may be used to execute commands

Closing Thoughts



We currently have only implemented the Motor and MotorPair classes. Ultimately, we want to implement the full functionality of the LEGO Spike with Quorum.

Thank you for your time.

UNLV

LEGO SPIKE Accessibility

Aren Aguas, Alex Chavez, Richard Mendoza, Daniel Nieland, Gregg Salonga
Instructor: Dr. Andreas Stefik
Dept of Computer Science

Abstract

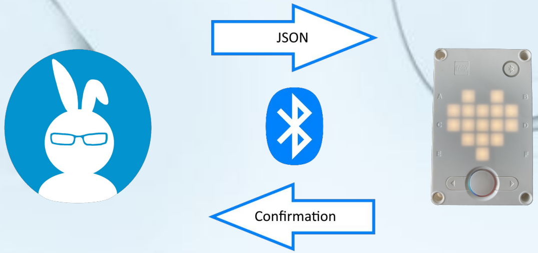
We plan to find a way to successfully connect to the LEGO SPIKE kits via Bluetooth and integrate it with Quorum to provide and implement accessibility features, primarily for blind and visually impaired users. Once the kit is connected and set up with the Quorum environment, blind and visually impaired users will be able to use screen readers to program the LEGO SPIKE kit.

Motivation

The LEGO SPIKE kit provides an engaging entryway into basic programming using a block-based programming language and Python. These implementations in the LEGO SPIKE app do not natively have accessibility support for the blind and visually impaired, limiting the LEGO SPIKE's usefulness and preventing upcoming robotics students such as those from the Maryland School for the Blind from participating the First LEGO League, a LEGO robotics competition.

Materials

The LEGO SPIKE kit provided everything we needed physically for this project. The hub itself and a PC are the only componentes needed to establish the connection.



Implementation

Our approach to this was to create two programs that act as a transmitter on the user's device, and a receiver on the LEGO SPIKE kit's hub.

On the Java side, we access the serial port created after the LEGO SPIKE hub is paired using the Java library jSerialComm and open it to read and write data over the connection.

From the LEGO SPIKE hub, we use a built-in module to read and write data to a connected device on a virtual communication port. Read data are parsed to execute commands on the hub and then the connected device is responded to with a confirmation message expressing a successful or unsuccessful command parse.

Results

We were able to establish a serial connection with the LEGO SPIKE hub and a computer using a Java program and send commands as JSON strings, which were then parsed by the LEGO SPIKE hub and executed. An implementation of this Java program was added to a beta branch of Quorum as a plugin for serial connections.

In addition, we successfully implemented parsing of the Motor and MotorPair commands the LEGO SPIKE hub has access to.

Future Direction

- Further development of the hub's selection of acceptable JSON commands.
- Possibly switch the JSON parsing if-tree to a dictionary based approach for modularity.
- Iron out the Quorum to JSON translation.
- Possibly automate port search and connection to make setup easier on user.