

Advanced Programming

FIT3140

Assignment 3

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Analysis of alternatives

1 Criteria

We will examine a variety of different technologies that will allow us to complete the task under the following criteria:

- Ease of use: How easy is it to get up and running with a particular technology?
- Simplicity of understanding: How easy is it to understand what is going on in the code when using this technology?
- Speed: How performant is the technology? Is it too slow for our purposes? Does it have too much delay?
- Reliability: Does the service break down often? Do we lose data?
- Support: Can we acquire support from the internet or from the company/person that creates the product? Will the people responsible for the technology fix bugs when they occur? How easy it is to get access to free educational sources?
- Portability: How well can we port these technologies to other platforms or environments. Does the technology require anything in particular?
- Experience: How much does each of the team members know the technology?
- Open source: Is the technology open source? Closed source projects may cause issues in the future if they cease to exist.

2 Options

We have prepared three spikes using 4 different technologies.

1. Spike 1: Firebase and SerialPort
2. Spike 2: Firebase and Johnny-Five
3. Spike 3: SocketIO and Johnny-Five

With each of the 3 spikes, we noticed no significant difficulties in connecting the two technologies. Firebase was very compatible with SerialPort and Johnny-Five, and Socket.IO was very compatible with Johnny-Five. We therefore assume that it would also be quite trivial to connect Socket.IO with SerialPort. As a result, instead of discussing each spike individually, we will discuss the pros and cons of each technology with regards to the criteria above.

- Firebase

Pros:

- Simple, powerful API: Firebase is a very easy to use technology with a large variety of powerful features.
- Reliable: none of the communications to the server from the IoT device were lost.

- Supported: Google has set up very large, detailed documentation and is almost certain to fix any bugs they can find in Firebase^[1].
- Experience: Both team members are familiar with Firebase.

Cons:

- Long latency: The speed when compared to Socket.IO is very slow (200ms vs 1ms) due to firebase needing to communicate with an intermediary server at Google. See Appendix.
- Requires internet: Firebase will always require an internet connection. This means the software could not be ported to work on a LAN without internet access.
- Closed source: If Firebase closes down, the software will no longer function.

- Socket.IO

Pros:

- High speed: Socket.IO requires no intermediate server. Latency will be around 1ms on a LAN.
- Reasonable support: The last commit on the source code was 20 April 2017^[2], so bugs are still being cleaned up. It also has reasonable documentation
- No internet required: The software will work on a LAN without internet access.
- Experience: Both team members are familiar with Socket.IO
- Open source: Since Socket.IO is open source, the software will work regardless of the status of the "Socket.IO" project.

Cons:

- Unreliable: Data from the IoT device may be lost if the client loses connection for a short time.
- Difficult API: Socket.IO uses a message based system rather than a shared-state based system. Not all clients are guaranteed to be up-to-date with the latest information and we have to synchronise them ourselves.

- Johnny-Five

Pros:

- Simple, declarative API: Johnny-Five provides a simple, neat way to interact with arduino board. To control a specific piece of electronics component, several lines of code is all we need do. Each component class is equipped with function explanations and one or more sample usages. It provides the programmer hands-on experience of how to interact with electronics like Arduino board.
- Reliability: Johnny-Five is the JavaScript Robotics & IoT platform maintained by a community of 75 experienced developers. It is robust, extensible and composable. It has been tested with a variety of Arduino-compatible boards. Its IO plugins allow Johnny-Five code to communicate with hardware in whatever language that platform uses.
- Open source: Johnny-Five is open source, Firmata protocol based, IoT and robotics programming framework. It is free and maintained regularly.

Cons:

- Speed: Johnny-Five is slightly slower than Johnny-Five because it needs to be calibrated first.
- SerialPort
 - Pros:
 - Speed: SerialPort is slightly faster than Johnny-five because it does not need to calibrate the motion sensor.
 - Support: For support one can open a github issue. Any questions, discussions related to SerialPort can be directed to Gitter Chat room^[3]. Two open source projects written in SerialPort are there for educative purposes.
 - Cons:
 - Not easy to use: If we do not wish to write a firmware for our Arduino, we must write code to speak to the Arduino using a standard protocol (like Firmata). Writing this code is very prone to errors, and is quite a pain to deal with.
 - Unportable: SerialPort is only as portable as the firmware it communicates with. If we write a custom firmware for the Arduino to simplify the code we have to write in SerialPort, we are forced to use only Arduino devices or port the firmware to another device. This locks us into a specific IoT device.
 - Unreliable: The entirety of the Firmata protocol will need to be implemented, and any mistakes may cause a crash.
 - Experience: None of the team members have good experience using SerialPort.

3 Recommendations

We recommend to implement the “Morse Code Decoder” project in Firebase and Johnny-Five.

Despite the fact that socket.io has a far lower latency, there is a chance that important data may be lost if the client loses connection to the server for a short time. Furthermore, Firebase is easier to setup and use than Socket.IO. When choosing between Johnny Five and Serial port, the choice is clear. Serial port is far too low-level to make development easy, and if not used correctly, is very prone to bugs. Finally, we think the “Morse Code Decoder” has no obvious requirements for client response time. Even though SerialPort offers a response time as fast as 1ms - hundreds times faster than Firebase, client can receive data from server at any time for interpretation purposes(Appendix Spike 1, 2, 3). For a human to perceive the interpretation results, 1ms and 200ms interpretation delay makes no obvious difference. Therefore, we highly recommend the “Morse Code Decoder” to be implemented in Firebase and Johnny-Five toolchains.

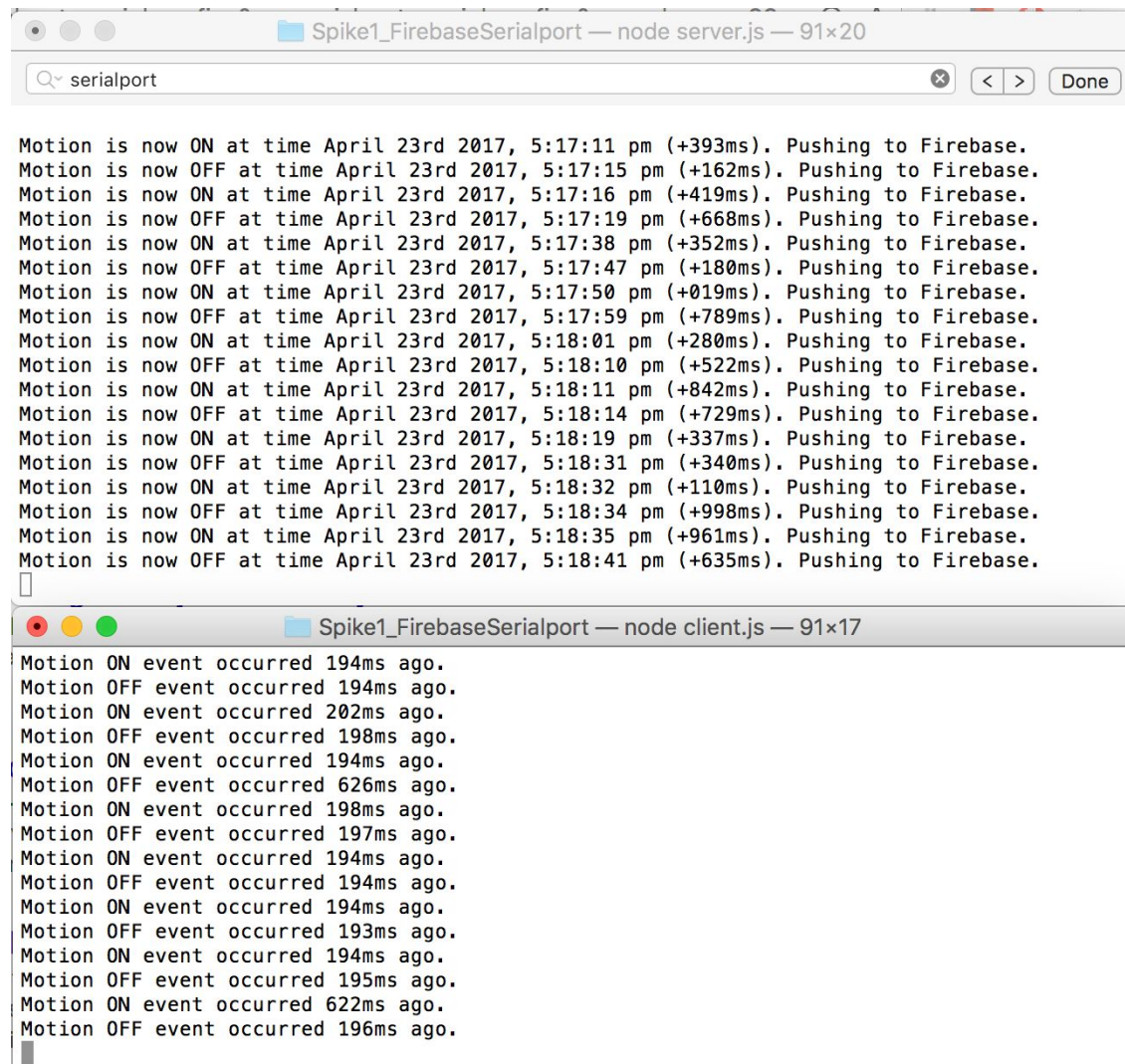
4 Bibliography

1. <https://firebase.google.com/docs/>
2. <https://github.com/socketio/socket.io>
3. <https://github.com/EmergingTechnologyAdvisors/node-serialport>

5 Appendix

Evidence of conducting the spikes

Spike1 Firebase and SerialPort



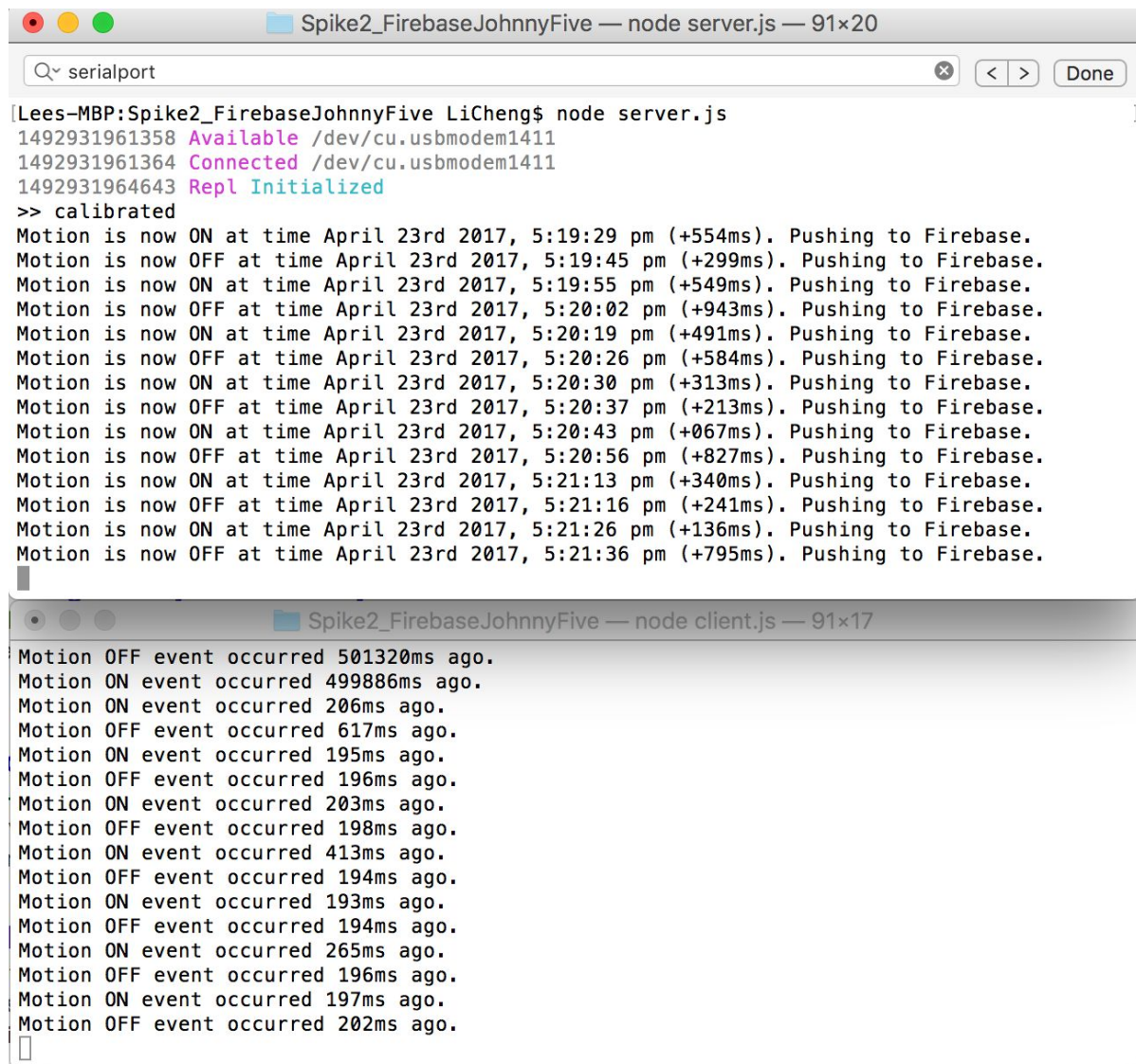
The image shows two terminal windows from a macOS environment. The top window, titled 'Spike1_FirebaseSerialport — node server.js — 91x20', displays a series of log messages indicating motion events being pushed to Firebase. The messages alternate between 'Motion is now ON' and 'Motion is now OFF' at specific times on April 23rd, 2017, with timestamps relative to the previous event (e.g., '+393ms', '+162ms'). The bottom window, titled 'Spike1_FirebaseSerialport — node client.js — 91x17', displays a list of received motion events, each with a timestamp indicating how long ago the event occurred (e.g., 'Motion ON event occurred 194ms ago.').

```
Spike1_FirebaseSerialport — node server.js — 91x20
serialport

Motion is now ON at time April 23rd 2017, 5:17:11 pm (+393ms). Pushing to Firebase.
Motion is now OFF at time April 23rd 2017, 5:17:15 pm (+162ms). Pushing to Firebase.
Motion is now ON at time April 23rd 2017, 5:17:16 pm (+419ms). Pushing to Firebase.
Motion is now OFF at time April 23rd 2017, 5:17:19 pm (+668ms). Pushing to Firebase.
Motion is now ON at time April 23rd 2017, 5:17:38 pm (+352ms). Pushing to Firebase.
Motion is now OFF at time April 23rd 2017, 5:17:47 pm (+180ms). Pushing to Firebase.
Motion is now ON at time April 23rd 2017, 5:17:50 pm (+019ms). Pushing to Firebase.
Motion is now OFF at time April 23rd 2017, 5:17:59 pm (+789ms). Pushing to Firebase.
Motion is now ON at time April 23rd 2017, 5:18:01 pm (+280ms). Pushing to Firebase.
Motion is now OFF at time April 23rd 2017, 5:18:10 pm (+522ms). Pushing to Firebase.
Motion is now ON at time April 23rd 2017, 5:18:11 pm (+842ms). Pushing to Firebase.
Motion is now OFF at time April 23rd 2017, 5:18:14 pm (+729ms). Pushing to Firebase.
Motion is now ON at time April 23rd 2017, 5:18:19 pm (+337ms). Pushing to Firebase.
Motion is now OFF at time April 23rd 2017, 5:18:31 pm (+340ms). Pushing to Firebase.
Motion is now ON at time April 23rd 2017, 5:18:32 pm (+110ms). Pushing to Firebase.
Motion is now OFF at time April 23rd 2017, 5:18:34 pm (+998ms). Pushing to Firebase.
Motion is now ON at time April 23rd 2017, 5:18:35 pm (+961ms). Pushing to Firebase.
Motion is now OFF at time April 23rd 2017, 5:18:41 pm (+635ms). Pushing to Firebase.

Spike1_FirebaseSerialport — node client.js — 91x17
Motion ON event occurred 194ms ago.
Motion OFF event occurred 194ms ago.
Motion ON event occurred 202ms ago.
Motion OFF event occurred 198ms ago.
Motion ON event occurred 194ms ago.
Motion OFF event occurred 626ms ago.
Motion ON event occurred 198ms ago.
Motion OFF event occurred 197ms ago.
Motion ON event occurred 194ms ago.
Motion OFF event occurred 194ms ago.
Motion ON event occurred 194ms ago.
Motion OFF event occurred 193ms ago.
Motion ON event occurred 194ms ago.
Motion OFF event occurred 195ms ago.
Motion ON event occurred 622ms ago.
Motion OFF event occurred 196ms ago.
```

Spike 2 Firebase and Johnny-Five



The image shows two terminal windows from a macOS environment. The top window, titled 'Spike2_FirebaseJohnnyFive — node server.js — 91x20', shows the execution of 'node server.js'. It displays a series of status messages: '1492931961358 Available /dev/cu.usbmodem1411', '1492931961364 Connected /dev/cu.usbmodem1411', and '1492931964643 Repl Initialized'. After the user enters '>> calibrated', the terminal shows a continuous stream of motion status updates, such as 'Motion is now ON at time April 23rd 2017, 5:19:29 pm (+554ms). Pushing to Firebase.' and 'Motion is now OFF at time April 23rd 2017, 5:19:45 pm (+299ms). Pushing to Firebase.', alternating between ON and OFF states.

The bottom window, titled 'Spike2_FirebaseJohnnyFive — node client.js — 91x17', displays a list of motion events received from the robot, each with a timestamp relative to the current time, such as 'Motion OFF event occurred 501320ms ago.', 'Motion ON event occurred 499886ms ago.', and 'Motion ON event occurred 206ms ago.'.

```
[Lees-MBP:Spike2_FirebaseJohnnyFive LiCheng$ node server.js
1492931961358 Available /dev/cu.usbmodem1411
1492931961364 Connected /dev/cu.usbmodem1411
1492931964643 Repl Initialized
>> calibrated
Motion is now ON at time April 23rd 2017, 5:19:29 pm (+554ms). Pushing to Firebase.
Motion is now OFF at time April 23rd 2017, 5:19:45 pm (+299ms). Pushing to Firebase.
Motion is now ON at time April 23rd 2017, 5:19:55 pm (+549ms). Pushing to Firebase.
Motion is now OFF at time April 23rd 2017, 5:20:02 pm (+943ms). Pushing to Firebase.
Motion is now ON at time April 23rd 2017, 5:20:19 pm (+491ms). Pushing to Firebase.
Motion is now OFF at time April 23rd 2017, 5:20:26 pm (+584ms). Pushing to Firebase.
Motion is now ON at time April 23rd 2017, 5:20:30 pm (+313ms). Pushing to Firebase.
Motion is now OFF at time April 23rd 2017, 5:20:37 pm (+213ms). Pushing to Firebase.
Motion is now ON at time April 23rd 2017, 5:20:43 pm (+067ms). Pushing to Firebase.
Motion is now OFF at time April 23rd 2017, 5:20:56 pm (+827ms). Pushing to Firebase.
Motion is now ON at time April 23rd 2017, 5:21:13 pm (+340ms). Pushing to Firebase.
Motion is now OFF at time April 23rd 2017, 5:21:16 pm (+241ms). Pushing to Firebase.
Motion is now ON at time April 23rd 2017, 5:21:26 pm (+136ms). Pushing to Firebase.
Motion is now OFF at time April 23rd 2017, 5:21:36 pm (+795ms). Pushing to Firebase.

Motion OFF event occurred 501320ms ago.
Motion ON event occurred 499886ms ago.
Motion ON event occurred 206ms ago.
Motion OFF event occurred 617ms ago.
Motion ON event occurred 195ms ago.
Motion OFF event occurred 196ms ago.
Motion ON event occurred 203ms ago.
Motion OFF event occurred 198ms ago.
Motion ON event occurred 413ms ago.
Motion OFF event occurred 194ms ago.
Motion ON event occurred 193ms ago.
Motion OFF event occurred 194ms ago.
Motion ON event occurred 265ms ago.
Motion OFF event occurred 196ms ago.
Motion ON event occurred 197ms ago.
Motion OFF event occurred 202ms ago.
```


Spike3 SocketIO and Johnny-Five

```
Spike3_SocketioJohnnyFive — node server.js — 89x24  
calibrated  
Motion is now ON at time April 23rd 2017, 5:21:55 pm (+533ms). Pushing to Firebase.  
Motion is now OFF at time April 23rd 2017, 5:22:00 pm (+333ms). Pushing to Firebase.  
Motion is now ON at time April 23rd 2017, 5:22:18 pm (+254ms). Pushing to Firebase.  
Motion is now OFF at time April 23rd 2017, 5:22:21 pm (+938ms). Pushing to Firebase.  
Motion is now ON at time April 23rd 2017, 5:22:22 pm (+808ms). Pushing to Firebase.  
Motion is now OFF at time April 23rd 2017, 5:22:27 pm (+698ms). Pushing to Firebase.  
Motion is now ON at time April 23rd 2017, 5:22:28 pm (+115ms). Pushing to Firebase.  
Motion is now OFF at time April 23rd 2017, 5:22:46 pm (+243ms). Pushing to Firebase.  
Motion is now ON at time April 23rd 2017, 5:23:19 pm (+662ms). Pushing to Firebase.  
Motion is now OFF at time April 23rd 2017, 5:23:22 pm (+570ms). Pushing to Firebase.  
>> Motion is now ON at time April 23rd 2017, 5:23:23 pm (+465ms). Pushing to Firebase.  
>> Motion is now OFF at time April 23rd 2017, 5:23:26 pm (+371ms). Pushing to Firebase.  
Motion is now ON at time April 23rd 2017, 5:23:27 pm (+170ms). Pushing to Firebase.  
Motion is now OFF at time April 23rd 2017, 5:23:34 pm (+322ms). Pushing to Firebase.  
Motion is now ON at time April 23rd 2017, 5:23:37 pm (+155ms). Pushing to Firebase.  
Motion is now OFF at time April 23rd 2017, 5:23:40 pm (+043ms). Pushing to Firebase.  
Motion is now ON at time April 23rd 2017, 5:24:07 pm (+481ms). Pushing to Firebase.  
Motion is now OFF at time April 23rd 2017, 5:24:12 pm (+993ms). Pushing to Firebase.  
Motion is now ON at time April 23rd 2017, 5:24:24 pm (+386ms). Pushing to Firebase.  
Motion is now OFF at time April 23rd 2017, 5:24:43 pm (+879ms). Pushing to Firebase.  
Motion is now ON at time April 23rd 2017, 5:24:44 pm (+744ms). Pushing to Firebase.  
Motion is now OFF at time April 23rd 2017, 5:24:51 pm (+972ms). Pushing to Firebase.  
  
Spike3_SocketioJohnnyFive — node client.js — 89x24  
Motion OFF event occurred 2ms ago.  
Motion ON event occurred 1ms ago.  
Motion OFF event occurred 1ms ago.  
Motion ON event occurred 5ms ago.  
Motion OFF event occurred 2ms ago.  
Motion ON event occurred 1ms ago.  
Motion OFF event occurred 1ms ago.  
Motion ON event occurred 1ms ago.  
Motion OFF event occurred 1ms ago.  
Motion ON event occurred 2ms ago.  
Motion OFF event occurred 1ms ago.  
Motion ON event occurred 1ms ago.  
Motion OFF event occurred 1ms ago.  
Motion ON event occurred 2ms ago.  
Motion OFF event occurred 1ms ago.  
Motion ON event occurred 1ms ago.  
Motion OFF event occurred 1ms ago.  
Motion ON event occurred 1ms ago.  
Motion OFF event occurred 1ms ago.  
Motion ON event occurred 1ms ago.  
Motion OFF event occurred 1ms ago.  
Motion ON event occurred 1ms ago.  
Motion OFF event occurred 1ms ago.
```