Star Wars Boost Droid Orchestra:
The making of

by HispaBrick Magazine®

Images by Look Mum No Computer

R2-D2 is ready to strike, and so is the R2-D2 right next to him, and the next one… There are 46 of them! Some carry mallets, others are poised to race through tubular bells. On the next table 26 mouse droids are armed with bows which they pull across violins. And right behind them a contingent of 23 Gonk droids punch keys on synthesisers and trigger electronic drums. The Star Wars Droid Orchestra is ready and waiting for their leader and conductor and HispaBrick Magazine® sat down to have a chat with him.

May the 4th is Star Wars day and LEGO® traditionally launches new Star Wars sets. This year one of the big surprises was the Star Wars Boost Droid Commander set.

The first LEGO® Boost set was launched in 2017 with the name Creative Toolkit (#71101). It contains parts to build 5 different models and, in true LEGO® style, the parts are recycled between models, meaning you can build one at a time. It turns out that while that is a great selling point, a considerable proportion of buyers build one mode and basically stick with it. How does LEGO® know that? That's one of the wonders of modern technology. The Boost set requires the use of an app and each time the app connects to the Internet it not only looks for updates but also sends (anonymous) user data about the use of the app. With that in mind LEGO® decided their second Boost set should have models that can be built all together. The only concession to reuse (and price) is the fact that all 3 models - R2-D2, Mouse Droid and Gonk - rely on the use of the same electronics (Boost hub, Boost motor and Colour/Distance sensor).

In order to promote this set in a special way, LEGO® contacted inventor and musician Look Mum No Computer who set about making an orchestra of Droids to play the Star Wars tune.

**Had you ever played with LEGO® before doing this?**

Yes. When I was a kid I had quite a bit of LEGO®. I had the first LEGO® MINDSTORMS set (edit: Robotics Invention System, RIS, #9719). I got really nostalgic doing this project and I bought the same box again a couple of weeks ago. I still need to find the cable to connect the IR tower to a computer running Windows 95 - that will be lots of fun! After doing all this Boost stuff I am looking forward to see how "older" it is and how limited in comparison.

One thing the Boost set doesn't allow is for you to upload the commands to the robot. It's OK have to control it from the app when there is only one robot, but when there are lots of robots it becomes a bit of a nightmare.

At one point I was trying to use the colour sensor on the R2D2 droid. I wanted it to stop turning when it saw a red dot. It worked great and it was really cool. The issue that arose was that when it sees the dot it sends some code back to the tablet over bluetooth. That would delay the code by a couple of milliseconds each time and there is no way to quantify exactly how much time that takes on each iteration. That's fine for any other sue, but in this case it caused drift in the program and the sounds wouldn't synch correctly. So I had to go for more simple mechanisms where I knew I always had the exact same delay between pushing the button on the iPad and the droid making the movement to create the sound.

How did this collaboration start?

I got a phone call out of the blue one day - somebody mentioned to somebody else that I existed - because they were trying to find somebody who could solve a problem like this. They were looking for either an engineering solution or a musical solution, but none of them really intertwined. There are a few people out there who do this kind of thing, but I got the phone call. My first thought was "I get to play with LEGO® for a couple of months!". That sounds like a yes! It was a great excuse to get back into LEGO® because I hadn't touched LEGO® for years, but it all came back to me. Things like the spacing on Technic bricks and all the different quirks of the bricks - all those things that frustrated me so much when I was a kid.
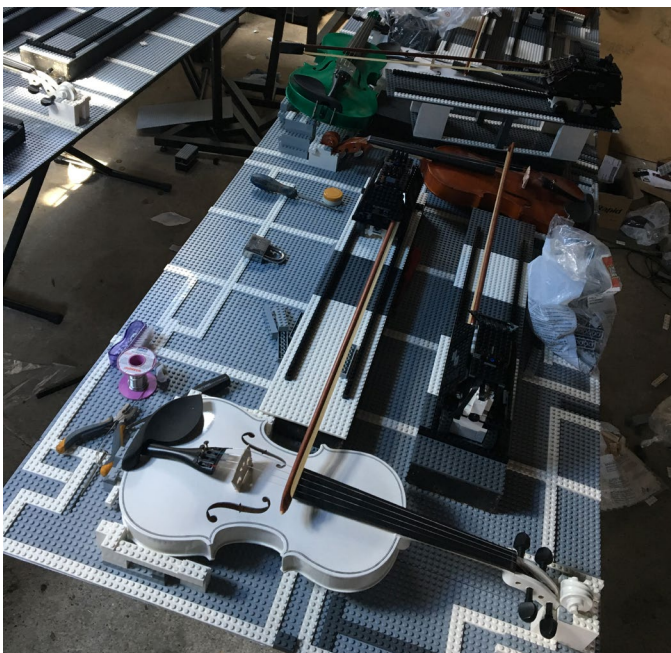
Did you have a lot of help from LEGO® designers to make the mechanisms?

I went for a meeting once, to see what the droids were like and I had a chance to talk to the developer of the program. I then went back and created all the mechanisms I needed. On the day of the shoot I did have one of the main model designers (edit: Carl Merriam) to help me pair the robots and put them back together if they fell off the table. He knew these robots by heart! I used very simple mechanisms for most of them and they were quite easy to figure out.

I particularly liked the solution you used on the cellos, which have a revolving drum or wheel to make the string vibrate.

I tried a lot of materials on the LEGO® wheel to figure out what would get the best sound, and amazingly the best solution to make the note was just the plastic.

What was the most fun part of the project?

Pulling everything apart when the project was finished. Then I started thinking I probably should have taken it apart in such a way that I could put it back together, but I've got all the plans. There are a lot of things I would do differently if I had to do it again, to make it more reliable, so it is good it was just a one-off build and most of the mechanisms are still pretty much in one piece.

The whole project was like walking up a big hill. There were a lot of struggles and then you get to a certain plateau where you say "yes!". I think I got to the first plateau when the droids played the melody in time. I had programmed them all and taken into account all the delays in the movement of the arms. Each arm needs to play a note at a different time and you need to create a different delay for each robot. That was a great day and I was very happy.

What was the hardest part?

I'd say solving the problems, overall. From the first time chatting about it and seeing the Boost droids to the actual finished thing the hardest part was figuring out the solutions. The violins were particularly difficult. Initially they weren't playing very well. I had to play around with the angles of the bows a lot and putting weights at the end of the bows. I ended up not putting any weights on the bows. For some reason the simplest option worked out the best.

Did you get to build any of the droids yourself?

Only the ones that I dropped. Thankfully LEGO® sent them assembled, but a lot of them were broken up inside the box so I spent quite some time rebuilding them, but I never built any of them from scratch. It would have driven me mad to build that many. Hopefully one day I will put one together - that's a good point!

With the Gonk droid I was a little worried about having to change the batteries all the time, but it turns out changing the hubs in the droids is actually quite simple once you get the hang of it. Batteries were a concern though. I didn't want to go through tons of batteries so I got a very large amount of rechargeables so now I've got rechargeable batteries everywhere! I had 10 different charging stations so at any one time I had batteries on stand-by and recharging. The battery life in the Boost hubs was very reasonable. At the start of the project I was worried that the bluetooth connections

would drop out, so I set up all the R2-D2 droids I had and connected them to the iPads and went to bed. When I got back the next morning they were all on and still connected to their iPads. So the connectivity is really good and you can get a surprisingly long amount of time with a set of batteries. I thought rechargeables were going to be awful compared to new batteries, but no. If anybody uses Boost I recommend they use 1100mAh rechargeable batteries.

When things get to a certain scale, the most time consuming thing is repeating all of the simple things - setting up, changing batteries etc. The initial idea was to put each robot in a Faraday cage to isolate and pair it. The only way to reliably pair the droids was to do 1 robot, 1 iPad, wait 30 seconds and then on to the next pair. Every single time we needed to start and pair the robots it would take 30 minutes just to start and pair them all.[1]

How did you decide on the instruments you would use?

In the plans there were a lot of different instruments. Until the very last moment, when I ran out of time, there were going to be guitars, but we figured it was probably overkill. The other thing is, I never actually tested the whole machine all at once until we went over to the place where the video was shot because I didn't have enough space. So I had to build one section, put it away to build the next one and kind of imagine them all playing in time. It was quite a nightmare :) But it worked! I've done a similar approach before and nothing was going to go wrong.

In the first iteration LEGO® showed me a presentation with an animation of what they were trying to achieve and it was like an orchestra. There were violins, there were cymbals, and I seem to remember the violin was somehow played by the mouse. I decided to use the xylophones because of the mechanism for those was the first one I thought of and it seemed the easiest one to do. I don't know when the rest of them came about.
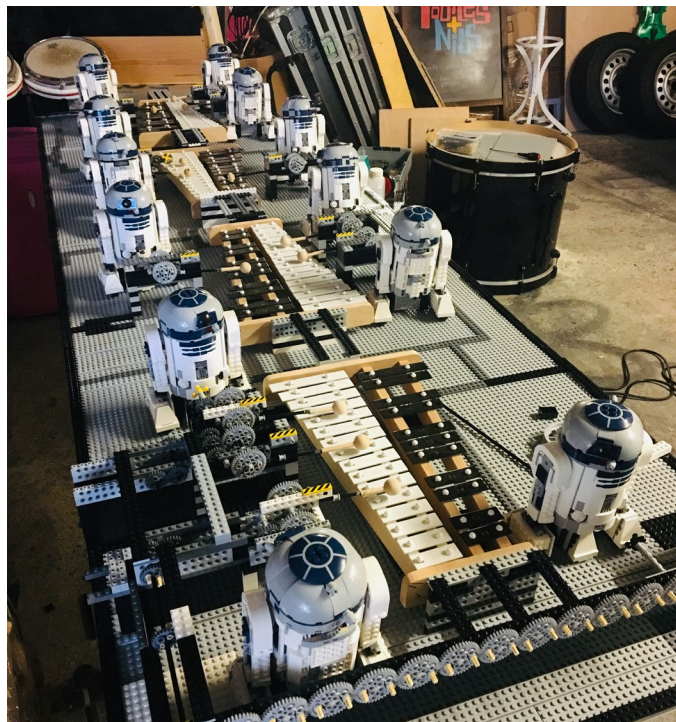
One of the most interesting solutions you have applied is the Mouse droids shooting arrows at a standing xylophone

Yes, and they play incredibly quietly! That was a last minute thought because I felt I needed to include more Mouse droids. There weren't enough of them, so I decided to have them shoot at a xylophone. It was in time, but it was very quiet so I had to really boost the microphone on that section.

Did you discard any ideas you had?

Yes, a lot of them. I didn't include the guitar as I mentioned before. There were also going to be a lot more drums but I ended up using the sample pad drummers because for the real drums I couldn't make a mechanism that was quick enough and strong enough to play a drum loud enough. And I would probably have needed a lot more LEGO® to make that happen because I had used all the pieces I had on everything else. U kept on emailing "I need more of these and I need more of those".

Did you think about building musical instruments out of LEGO®?

I did mention the idea, but the LEGO® team I was working with wanted the droids to play actual instruments. Initially the actual idea was that the rest of the mechanisms were not going to be made out of LEGO® - it was all going to be just Droids and instruments. But I am happy I was able to use so much LEGO® in the end.

Now that you have built this project using Boost, with the limitation of having to run the programs from iPads, would you consider doing something similar with MINDSTORMS EV3 where you can run the code from the robot itself?

Yes, I would be very curious to see how that would work. I knew the LEGO® RCX so initially I thought the code would be uploaded to the Boost hub, but Boost is of course aimed at a different market. If it were ever asked I probably would be interested in doing it.I've got quite a bit of LEGO® now so I've just got to figure out what to build. I'm really back into LEGO® building right now - the nostalgia!

Are you going to publish the code you use on this project?

While I built the project I kind of made it up as I was going so documentation isn't my strongest point. I might make a post about the codes, but it's a very silly way of doing it. I told someone how I was doing it and they told me "that's a really stupid way of doing it" :D Because I'm not very good at coding I had these two different pieces of code from previous

projects I did with modular synthesisers. There was one code that turned MIDI into a trigger to lights on and off and there was a thing that received those 5 Volts and turned that into servo movement and I just recycled them. I don't think there is anything else in there that you can't see. The gears and stuff are just the first thing I could think of clicking bricks together and I didn't really build it with robustness in mind - it just had to work.

[1] In the current app you can change the name of your Boost hub. That way, when you have more than 1 hub you can easily choose which one to connect to from the app. That would have simplified things considerably though it would of course still take time to connect all 95 droids!
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