Q&A With David Cuartielles

(Co-Founder of Arduino)

The Rise of Arduino

An Interview with David Cuartielles

David Cuartielles, Co-Founder of Arduino. (Source: https://bit.ly/Cuartielles)

By Jens Nickel (Elektor)

Arduino boards are everywhere. In fact, it is hard to imagine walking into an electronics workspace, makerspace, high-tech trade show, or university EE/ECE lab and not seeing an Arduino. David Cuartielles talks about Arduino's history as well as the world of electronics in the 2000s.

Invented for artists and other non-programmers about 15 years ago, the Arduino project platform has become incredibly popular amongst both makers and professionals. I recently had the opportunity to interview David Cuartielles — who founded Arduino with Massimo Banzi and a few other microcontroller enthusiasts — about Arduino's past, present, and future.

Elektor: Massimo Banzi, you, and some others developed the first Arduino board in 2005. It was named after a bar in Ivrea, Italy, where you regularly met. Could you describe the mood you guys had that time? What were your goals?

David: When I came to Ivrea as a visiting researcher, I had just had the experience of working for several years with a research project on indoor positioning originally developed by Prof. Jorge Falco and Dr. Roberto Casas (among others) at the university of Zaragoza in Spain. I was engaged in designing applications in the field of soundart to that system. The group had made a fantastic discovery and technical development. With our technology we could locate tagged objects with less than 5 cm accuracy in a 10 m sided cubic space with only 3 beacons. We had this in our hands since 2003 (as a matter of fact I made a presentation at the PDC04 conference in Toronto of a 3D sound space using it). The group didn't know how to proceed with the work after having made this technology. I advocated for open-sourcing it and letting other research groups explore its applications, others wanted to make a company and sell the technology for warehouse applications and the like. Nothing came out of this. People in the team were unable to come to a decision ... it was very frustrating to have such a powerful tool and not being able to do anything out of it.

Therefore, my state of mind was the one of making all of my academic work open. When I arrived in Ivrea, the school was at a high point in its production. It was world-known as the "monastery and the airport school". Students were in a monastery of sorts with paid accommodation near the Alps, and yet teachers flew in from all over the world to run the most amazing design sessions on interactive technology. Ivrea was making a huge impact in the design world; there were other schools like ITP, IAMAS, or my own (K3), but Ivrea's approach to dissemination, its history, and being

2001 — *The Segway transporter released*

2002 — *Blu-ray Disc launched*

in Italy made it much more known than the others in record time.

That said, when Massimo, Dave, and myself talked about what to do with the first Arduino boards, we wanted to make an impact in the academic community. We wanted cheap tools for students. I joked paraphrasing the famous sentence of "one man, one vote" with "one man, one board" referring to the fact that every student in the world should be having access to their own laboratory. If education was moving towards the use of laptops and mobility was becoming the rule, we should make labs smaller, personal, and inexpensive. We made 300 boards, Ivrea kept half, I sent half to my school for my students to use. I used to have 15 students per year back then, so I thought I had enough boards for 10 years … in a couple of months I had run out of boards.

In this atmosphere, there were different projects working with boards back then. The big forgotten in this discussion is chip45 who produced the GNU licensed *ATmegaBOOT* bootloader code (based on an original by Jason P. Kyle) and that we used to make the Arduino bootloader in the first place [1]. Dave Mellis' core software together with a version of ATmegaBOOT that we (Dave and myself) hacked together became the full Arduino toolchain. Projects at the time were not offering the full stack as an open source piece. Some were hiding the bootloader, some were hiding the board design, some were having proprietary upload tools. We decided that the real impact would be achieved if all of the bits and pieces of the process were put together as an open source block.

To answer your question then, our goal was to make all of those parts available to everyone for them to make their own boards, projects, and derivative products.

Elektor: Fifteen years ago, the world of electronics was different. We all remember that dev boards with price tags of several hundreds of dollars were quite common. And then there were software licenses. What were your favorite tools at that time?

David: With my students I used Basic Stamp, but had tried out things like the Javelin Stamp because of teaching Java as a programming language and the disconnect between Java and Basic (the language of the Basic Stamp) when it comes to syntax and overall mental model, what made things complicated in class. Javelins were not as robust as Basic Stamps and we burned a bunch of them in 2004. For my own development I used Microchip parts and was experimenting with the 18F family at the time in order to make a board that would have native USB and be very inexpensive. It was when I made it to Ivrea that we started to discuss using the Atmel family of processors because of the open compiler tools.

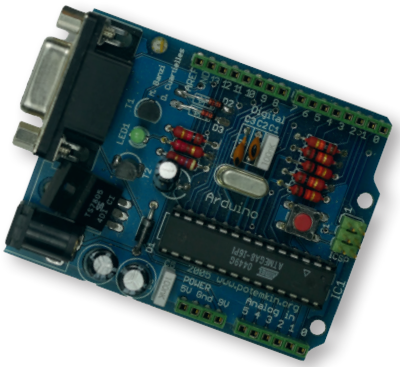
At the engineering schools people were using PICs because of the free sample policy, but Atmel had a free software approach that in our opinion was a lot better. Time did show that we were right about this.

Elektor: Because of all the AVR controllers you used for the different types of (early) Arduino boards, did you have some connection to Atmel? Did you know some engineers there? How did they support what you were doing?

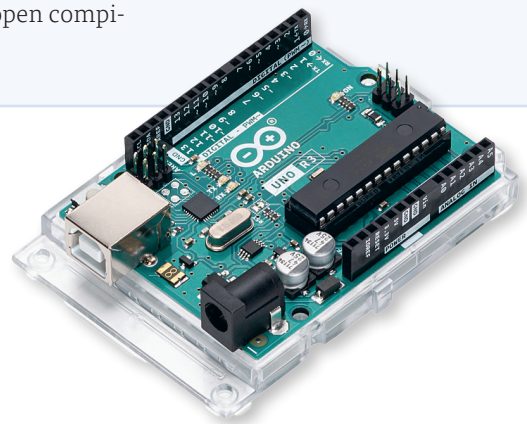
David: We had no connection until much later. I would not say that the connection between Atmel and the design/art world was great by the time we started with Arduino. Once we met, many years later, the collaboration worked great. But no, there was no help in the beginning.

Elektor: Because the Arduino platform was meant for people who were not typical programming nerds or engineers, you were one of the pioneers of the 21st-century maker movement. Do you remember some really weird Arduino-based projects from the early days?

David: I was (and still am) very involved in the creation of art pieces working with Arduino technology. One of my favorites still is Daniel Palacio's open source Waves. You can see more about it at [2]. When it comes



The Arduino Serial from 2005 was one of the first Arduino boards.



The Arduino Uno is probably the most well-known Arduino board. Released in 2010, it integrated USB and made programming very easy. It was followed by many clones, some of them cheap, but bad copies from the far east.

2004 — GMAIL announced on April 1

2005 — YouTube founded

to the projects made by my students, I still like the very first one we ever made with Arduino: the Involuntary Dance Machine, a machine that would electroshock a dancer at the rhythm of a techno song. You can see the video on YouTube [3].

Elektor: At the beginning of the last decade, Raspberry Pi and its clones hit the market — small computers running Linux, with very low prices. What was your reaction to the Raspberry Pi when it came out?

David: When we started, and for about five years, there was nobody doing anything like we were doing. Not to the full extent. When RPi came along, my personal reaction was of respect. I mean, I really wanted to make an open source computer, and they made a super cheap one (not open source, at least not back then, but still). They made a huge impression in the community and brought a different approach to governance by making the foundation and everything around it. Something that was later replicated by MicroBit which followed the same approach.

Besides the governance model, users were confused about what they could do with RPi and what they could do with Arduino. I think that both parties had to work hard to present the main features, advantages, and disadvantages for people. There is some convergence nowadays, but not back then.

Elektor: Over time, Arduino has become tremendously famous. In addition to the maker community, Arduino has also made waves in the world of professional embedded developers, which was certainly not expected at the beginning. Many of the traditional semiconductor companies have copied your connectors and put them on their (sometimes very special) eval boards. Do they pay you a fee for that? What is your relationship with those companies?

David: Part of our proposition to the community is to produce open form factors. If people like them and adopt them, then it becomes easier to build better projects. We never charged for the use of the form factor, and it is so stated in our license. When it comes to our relationship to companies, we have been working with many companies both in the semiconductor business, but also in other areas like cloud. We have plenty of professional projects where we either consult other companies or we collaborate in making complex projects. While we do not charge for using our form factors, we do have contracts with companies we work with in other projects.

Elektor: Do you have an idea of how many Arduino-compatible boards are in existence?

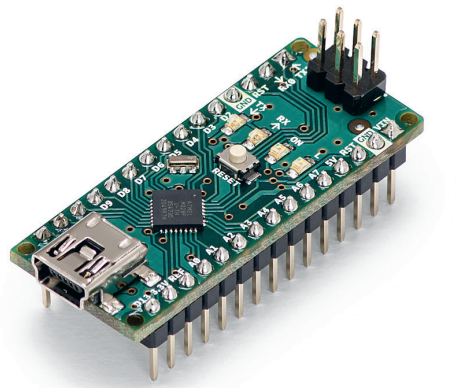
David: I stopped counting. In my personal collection, I have over 150. And then there are many shields and sensor boards.

Elektor: You left the Arduino Uno form factor and the famous connector some years ago, for the latest boards — for example, the MKR boards. What was the reason for this?

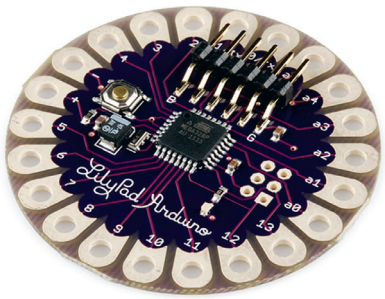
David: While Uno still remains as the most sold board in the history of open source hardware, people need smaller form factors and more features in order to experiment with new modalities of interaction, making connected projects, etc. Currently my favorite board is the Nano 33 BLE Sense, and I use it in all of my courses. Having an IMU, microphone, color sensor, etc allows for a very rich pedagogical experience with my students at an unbeatable price. When we design, we keep on thinking about how much people will have to pay for things. One human, one board.

Elektor: What led to the 2017 announcement of Arduino's partnership with ARM? What has it meant for Arduino?

David: It was something meant to happen. We were in a position where we needed to grow in our portfolio and had to make a jump in features. Atmel 8 bit processors are really close to our hearts (I can cite pages of the ATmega 328 300+ pages datasheet), but ARM had introduced a new architecture set that was scalable, offered a great way to continue with Arduino's philosophy of keeping the codebase while increasing memory and peripherals in your CPU. ARM offered some help and we took it. Things are



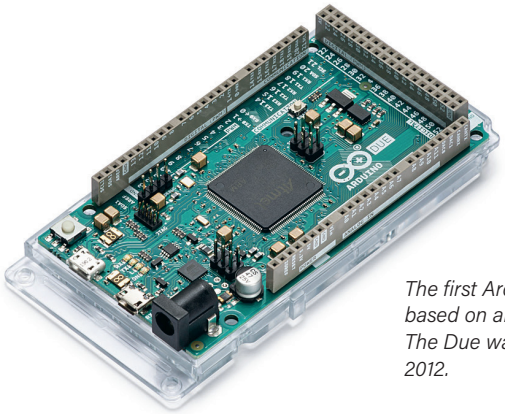
The Arduino Nano was announced in 2008, with a compact format, to be used as a brain for small devices.



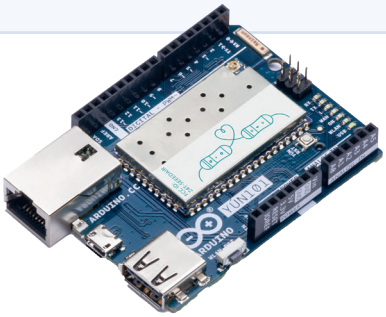
The LiliPad Arduino was released in 2007 for wearable applications.

2005 The Arduino project

2008 Blockchain invented



The first Arduino Board based on an ARM processor: The Due was released in 2012.



The Arduino Yun (2013) integrated an ATmega32U4 and a SoC for WiFi-capabilities, running a tiny Linux variant.

much better (and they were already good) since then.

Elektor: Let's turn to the present day and even the future. The global chip shortage has been big news throughout 2021. How has this affected Arduino?

David: We stocked processors because we had planned for growth. The Chipageddon has affected us in our sensor offering a little bit, but not much. We were lucky.

Elektor: An Arduino IDE 2.0 is in beta state, with colorful syntax highlighting and some other comfort functions, which other IDEs have had for decades. Why did it take that long to come to a version 2.0?

David: Making something open source and respecting the legacy of a community like ours is hard. Transitioning to a new IDE is a process that takes years and hundreds of thousands of Euros of investment. We have been working with this for a while, because it takes time to move the simplicity features of the classic IDE to this new one made in modern programming languages. I would not look at the basic features of the new IDE, but at the new exciting ones that are to come. It is not just catching up with the times, it is going to bring some new user experience improvements ... but then again, making it open source requires some time.

Elektor: What products can we expect from Arduino in the next one or two years? More boards with the new RP2040 controller, for example?

David: You know I cannot talk about that. However, you should expect to see us growing in the professional sector.

Elektor: Arduino revolutionized the development board market in the last 15 years. Where do you see this market 15 years from now?

David: ML is starting to play a really big role in terms of new programming paradigms. I can imagine that, in 15 years, many processors will have incorporated sections dedicated to run specific algorithms like smart power management and the like that will be implemented on commonly accepted optimal ML models.

On the other hand, there is a growing trend of making dedicated processors, thus much more optimal in terms of power consumption, or communication management, at silicon level at smaller foundries. The question remains on whether the tools will catch up to enable people making these processors faster and at a lower price. If that was the case, prototyping boards will include more and more of these dedicated processors and less general purpose ones.

Finally, airing some concerns around the Chipageddon situation we live in, there is a line of thought defending that the way we design for some contexts like automotive is not sustainable since there are too many small processors running separate tasks in a mainframe model of sorts. According to some sources we should experience a migration towards having less processors per design, but with more computing power. Simplifying the designs, relying more on software and minimizing the risks that emerge from the shortage of parts. If this was the scenario, we should see more general purpose processors, larger, and with specialised peripherals like computer vision, sensor fusion management, etc.

Which one of these paradigms will be the one to become more permanent is a question that only the future will tell!

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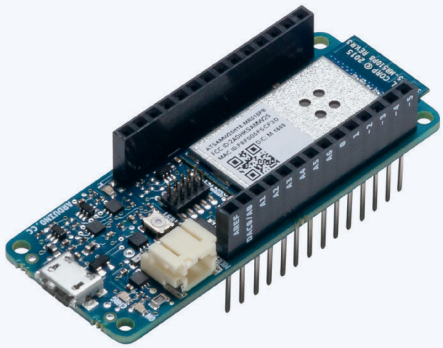
About the Author

Jens Nickel is Elektor's Editor in Chief. In addition to programming, he enjoys electronic music and video production. You can read his recent Elektor articles at www.elektormagazine.com/nickel.



The Arduino MKR1000 was announced in 2016 and has the new form factor.

WEB LINKS

[1] ATmegaBOOT: https://bit.ly/3FCo0SH
[2] Waves - How Does Sound Move?: https://danielpalacios.studio/portfolio/waves/
[3] Involuntary Dance Machine: https://www.youtube.com/watch?v=l4zwKJhjRNo

2008 — *2008 HTC Dream, the first Android smart phone*

2009 — *Minecraft released*