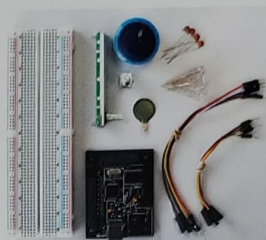


DIY & MAKER

Ever since the first analog synths became available, some users were confident enough to open up and perform repairs or modifications. This willingness to change or even create continues to this day with a thriving DIY and Maker culture. Those involved are dedicated to personalizing their instruments for optimum usability and workflow. Many established brands support this culture with kit assembly, user hacks and by making their instruments, firmware and code open-source. The advantage of doing it yourself is that you gain a device with exactly the interface and features you had in mind – well, hopefully.



Ready-made control grid

Livid Instruments has made it easy for users to create their own MIDI controllers with the Brain circuit board. Up to 128 buttons, 192 LEDs, and 64 analog controls are supported. Components are easily connected with ribbon cables to the Omni Board (shown here), which allows over 30 different configurations using a single circuit board.

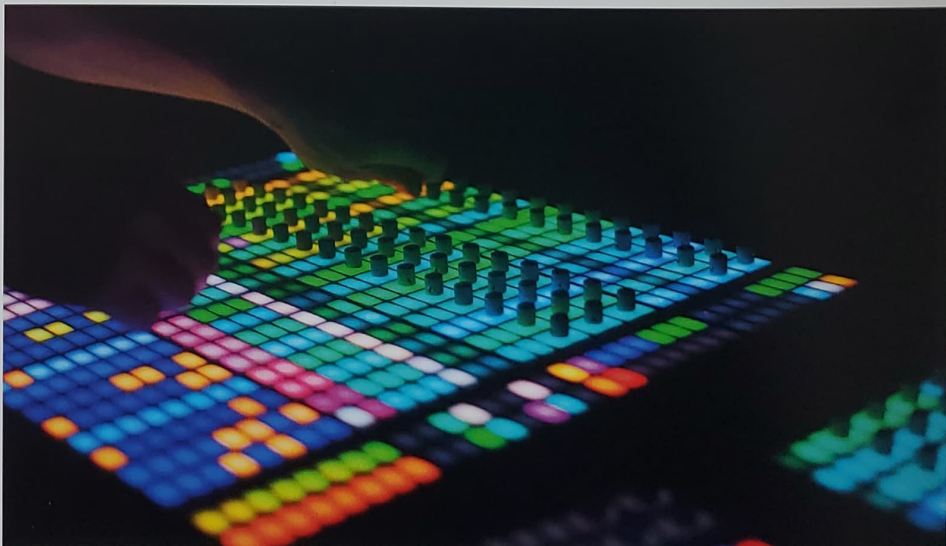
Rubber buttons, LEDs, rotary potentiometers, 30mm and 60mm faders, encoders, accelerometers and arcade buttons can be chosen. The Omni Board's labels make it easy to connect components, and all of the connections are routed to pin headers for easy ribbon cable connectivity.

This sort of DIY framework reduces the skill levels necessary to make customized MIDI controllers and provides a convenient and familiar ready-made grid layout for the controls.



DIY MIDI controller

It took three years for the German producer and live act Ander to design and build his own controller, taking his electronic live performance to new heights. Based on a colorful labyrinth of light, Ander plays his sets on this exclusive instrument, incorporating elements from modular systems, sequencers, synthesizers, digital workstations, and traditional instruments. His controllers earned plenty of attention across the media and clearly demonstrate the potential inherent in DIY for creating a truly personal, unique instrument.



DIY hardware and coding

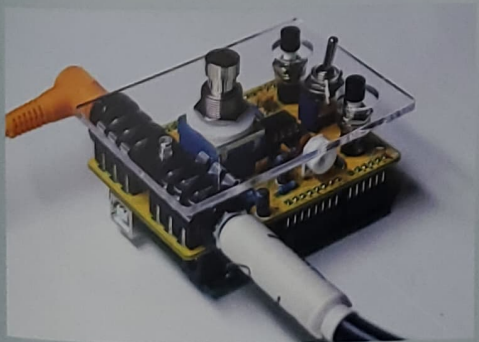
Arduino is one of the most popular open-source electronics prototyping platforms and is based on easy-to-use hardware and software. Attractive to anyone interested in creating interactive objects or environments, the Arduino platform consists of certain elements:

A physical programmable circuit board (micro-controller) and a piece of software or IDE (Integrated Development Environment) that runs on a computer, used to write and upload code to the physical board.

Arduino boards come in several different models, and through programming, users can get data from the physical world, create instruments, controllers or wearable technology. Buttons, knobs, sensors, capacitive touch sensors and the like can be used to send and receive MIDI via USB or mangle audio in different ways. It all depends on imagination – and soldering skills!



Gustavo Silveira from Brazil began making his own MIDI controllers because commercial ones were too expensive to import. He made one for less than \$40 on the basis of an Arduino board and now runs musicnerd.com teaching others to do the same.



The pedalSHIELD UNO is an Arduino UNO programmable guitar pedal made by Electrosplash, which is used to create effects and digital sounds.

DIY Eurorack

The Music Thing Modular Radio Music DIY Kit from Think is one of the popular gateways to DIY in the Eurorack world. It is relatively easy to assemble and comes with everything necessary: a teensy microprocessor board, knobs, rack screws and power cable.

Designed to be a source of 'unexpected audio', the Radio Music module is a digital way to simulate the radio-

powered compositions of John Cage, Karlheinz Stockhausen and Don Buchla's voltage-controlled radio experiments. It does this by playing files from a SD card to simulate a voltage controlled radio. 'Stations' are audio files selected from the microSD card by use of CV input or a knob, and the starting point of an audio file is controlled in the same way – all by a simple and spacious front panel layout.



Assemble your synthesizer

The Moog Werkstatt-01 Moogfest 2014 kit is a patchable and compact single-oscillator analog synthesizer. Users can quickly build a working synthesizer based on classic Moog circuits, and if desired, study the analog circuits. Werkstatt was created to be an educational tool, but it is also a great, semi-modular analog synthesizer.

Moog Music created an interactive learning portal containing project ideas, mod tutorials, parts lists, educational lesson plans, 3D printer files, and more

to let users learn about and modify the Werkstatt. The kit can be assembled without soldering and when complete, it features a clear overview of the different sections like VCO, VCF, LFO, etc. and a small button keyboard. The mini patchbay is placed to the right and an optional CV Expander converts Werkstatt's 20-pin patchable expansion header to 12 grounded 3.5mm jacks. This allows it to easily interface with external CV-equipped analog gear in the Eurorack format.

Circuit bending / Modding

Customizing instruments is usually done to add extra control over parameters and/or expand their sonic potential. Some instruments, like the Korg monotron, are designed to be hacked - they come with unused yet accessible elements on their circuit boards.

This modification of the Roland TR-606 was custom made by AlienizeD Circuits for the French composer Eric Serra, who wanted to extend the sound possibilities of his 606 as well as having a nicely crafted object to admire in his studio.

Each of the the original sounds can now be extensively tweaked. The tweaking includes the pitch and decay for most sounds, plus variations to envelope, filter and noise on some. It also features the option to use the Hi-Tom to control pitch (Bass Drum) or decay (Snare and Cymbal).

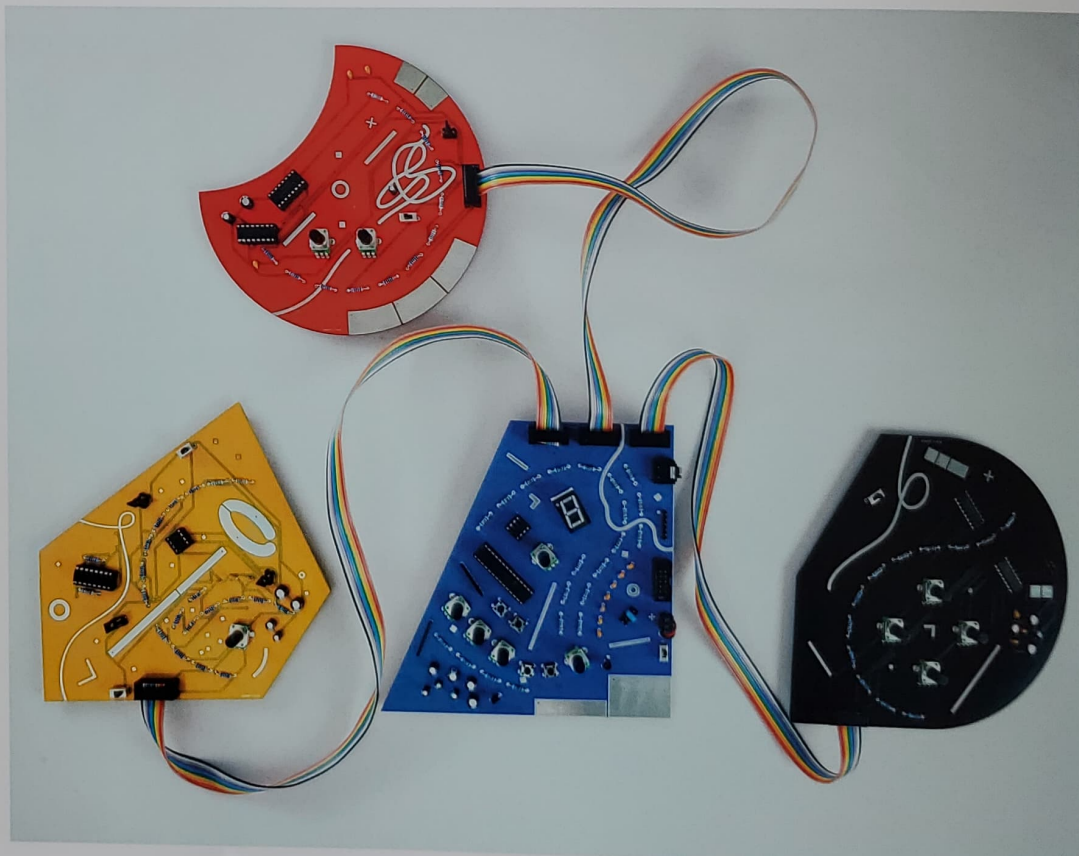


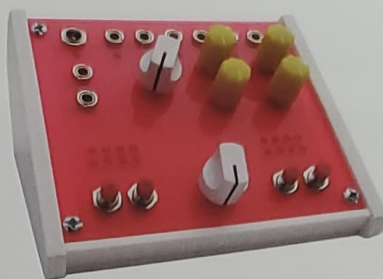
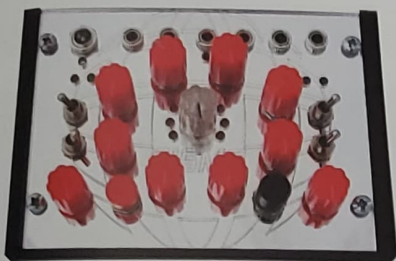
Playing with graphics and sound

The creations of John Richards and Jack Featherstone, POLYTIK is a collection of handheld synth modules exploring the border between play and sound. Born out of a DIY ethos and the maker community, POLYTIK is a series of uniquely designed objects which use open-source hardware. Users are encouraged to devise new modules and hacks. These hybrid analog/digital devices can produce a palette of sounds ranging from rhythmic sequences to abstract noise, pads and drones.

The blue one (CORE) is a sequencer, programmer and mixer. The black one (COMB) features voltage-controlled feedback, an oscillator (VCO) and filtering. The yellow version (NOISE) is a noise generator, with patchable feedback and voltage-controlled filter (VCF), and the red features both a VCO and VCF.

Touching parts of the circuit boards enables the user to physically interact with POLYTIK to produce different sounds and sequences. Designed without any instructive markings, the intention is to encourage the user to explore the synths' capabilities through intuitive play.





Designed by hand

Bringing together inventors, designers, and musicians, Sismo started with an art performance and DIY instruments designed by the artist Cristiano Rosa back in 2007. It is now a South American art project. With the aim of raising awareness of electronic music, Sismo makes handcrafted analog electronic musical instruments.

The instruments are influenced by the bright colors and the rhythms of the tropical environment. The line features noise boxes, synthesizers, sequencers, and more in portable creations realized in wood and acrylic.

Deriving from the DIY culture, simple, colorful and charming designs recall 1970s game stations. The instruments feature interfaces arrived at by several constraints – parts, materials, cost, etc. – and offer explorative fun in a unique style.



Free and open

MeeBlip triode is a project of James Grahame from Blipsonic and Peter Kirm of createdigitalmusic.com. Their first product was the MeeBlip in 2010 and since then, three variations have been made: the SE generation, the original anode, and the special edition anode with wavetables. The triode is the fourth generation MeeBlip and is independently designed, manufactured, and hand-assembled.

The MeeBlip project is fully open-source hardware. It's ready to play, without assembly or hacking required. If users want to learn how it works or

modify it, they can do so. Circuits and code are all available via GitHub, and are covered by a Creative Commons and GPLv3 license, which gives users complete freedom for the future.

Users can get hands-on and tweak sounds from the simple and easily understandable front panel. If more control is needed, hidden parameters like envelope and filter attack, pulse width and envelope modulation are available using MIDI CC.

The MeeBlip line is one of many ways to make affordable quality instruments open and hackable for users to learn and experiment with.



COINING 'CONTROLLERISM'

Interview with Moldover, controllerist and artist

Long before Moldover coined the term 'controllerism', he'd invested a significant amount of time and effort into creating a custom performance system, aimed at helping the world at large recognize its relevance.

"I knew that many others would follow a similar path and by rallying around a new term, information would be shared, communities would be created, and we would all benefit from the growth of the craft. 'Controllerism' as a term works as a convenient (albeit imperfect) analogy to turntablism. The turntable (and the DJ mixer) gradually transformed from relatively basic devices into advanced performance instruments. Conventional MIDI controllers (and the software used with them) have been going through a similar transformation. Although turntablists are generally considered a subset of DJs, I believe controllerists encompass a broad range of music makers including finger drummers, sound tweakers, live loopers, dub mixers, digital DJs, and just about anyone making live music with new technologies."

At the time he was working on establishing the term, Moldover saw limitless potential in the software he was using. Unfortunately, he felt that existing hardware was very limited in quality and expressivity.

"I grew up playing guitar, and I wanted my controller to have more of the slick ergonomics and intuitive nature that guitars have. I started modifying and then building controllers because my instrumental vision had outgrown what was readily available. Making something myself seemed like the path of least resistance and has helped me realize some very unique designs."

Software, hardware, firmware

According to Moldover, he coined the term 'controllerism' during a music software renaissance.

"Production software had already become the norm in modern recording studios, but a new generation of performance software was only just beginning to emerge. I became inspired by tools like Ableton Live and Native Instruments Reaktor that were still tricky to wield in compelling ways, but made it fun, refreshing, and exciting to bring a laptop and a controller to a gig. A key difference between these generations of software is that in the studio, a traditional hardware interface like the combination of mouse, keyboard, and monitor can work rather well, but for



Matt Moldover is a self-producing artist and instrument designer. Before that, he was the catalyst for a sea-change in electronic music performance. European press dubbed him 'The Godfather of Controllerism' and he quickly rose to prominence

as a guru in the flourishing amateur-DJ and hacker/maker scenes around the world. Respected as much for forging new instruments as he is for creating new music, Moldover has worked with renowned artists including Bassnectar, DJ Shadow, and Will.i.am,

as well as music tech companies Native Instruments, Ableton, and Livid Instruments, to realize new designs. Moldover is a frequent guest speaker at industry events and design schools including Stanford, NYU, and MIT.

playing live on stage that kind of hardware is rarely satisfying for audiences or performers."

"The main reason I chose the word 'controllerism' to define these new ways of playing music is because I realized the critical importance of the human interface in performance. If hardware (in the sense of human interfaces) is increasing in popularity, I think it's because others who have followed a similar path to mine have realized the same thing. Controllerists are less interested in drawing envelopes on a screen with a generic computer interface, and are more interested in putting something immediately expressive into their hands."

As long as digital musical instruments have existed, Moldover notes that there has been a tension between what we call "hardware" and "software".

"At one time personal computers were large objects that came without any software installed, and included only simple peripherals like keyboards and monitors. They could only become anything like a musical instrument through the process of installing software and connecting hardware peripherals such as MIDI controllers. With this paradigm, it was easy to know what 'software' and 'hardware' was."

"Most people I know have powerful computers in their pockets, strapped to their wrists, or even attached to their faces. Economies of scale have made it affordable to include compelling hardware interfaces like touch screens, motion sensors, and 3D cameras as standard features bundled into these devices. Many come with pre-installed software for playing virtual instruments, recording, and even generative music-making. When the standard computing device has advanced as far as this, and a casual user can play a mathematically-modeled violin using the touch screen and motion sensors on their tablet computer, it's easy to see how the line between hardware and software has become confusing."

"This confusion persists in the professional realm. Practically every electronic musical instrument you can buy (even including 'analog synthesizers', and devices strictly advertised as 'hardware'), will have a micro-processor inside. It's hard to call any of these devices strictly 'hardware'."

"Currently, it's a popular trend to make sophisticated MIDI controllers that are only really useful when paired with a specific piece of software that requires a Mac or Windows computer. When a conventional

computing device is still at the center of the equation, but the hardware and software are so interdependent, what do we call the sum of the parts? The term 'firmware' is not applicable at all, and in my opinion only really suggests that the software is less likely to exhibit bugs or crash. I think as with language in general, many forces are in play, all moving in different directions, and only history will decide how things are labeled. I just hope instrument makers like myself keep themselves honest and trust the people who play our instruments to learn something about the guts inside them."

The Mojo

Moldover developed his own custom controller, the Mojo, which quickly became a notable element in his performances and videos - but there was a very good reason for it.

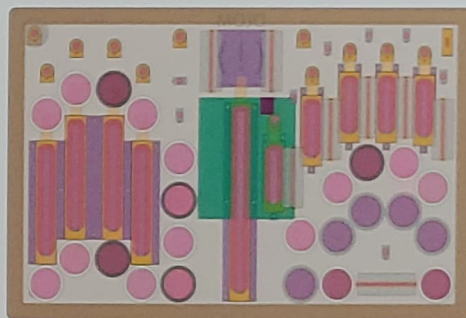
"In the early 2000s, when making music on a computer was quickly becoming the norm, a flood of cheap, mass-manufactured controllers were showing up in every home studio. The Mojo defied that standard in terms of craftsmanship and build quality. Instead of plastic and unrepairable printed circuit boards, it was wired by hand and fitted into a wood and metal enclosure."

The controller as a performance instrument was not yet a popular idea. Those available were generic controllers based on legacy interfaces like the musical keyboard, the mixing console, and the 16 drum pads made famous by the Akai MPC series.

"I went to great lengths to consider how one would actually perform music with the device, and to understand tactile interaction and muscle memory."

As Moldover points out, there are also many factors that go into creating an expressive musical interface and these concepts are at the core of the design of the Mojo.

"My goal was to create an interface using conventional sensors (buttons, knobs, etc.) but with the textures, topography, ergonomics, and interaction methods that would make it feel like an extension of the player's body."



The Mojo was also released as an open source archive for users to build their own - complete with original design files, parts list, MIDI mapping reference and Ableton Live templates.



Collaborative controllers and instruments

The collaborative controllers and instruments called the Jamboxes, the Octamasher (right), Syncomasher (separate units below) and MiniMasher, were developed by Moldover from how people used the Mojo.

"When I designed the Mojo, I would show my friends how to play it and was always struck by their excitement when they began to learn it. It reminded me of how amazing it was as a child to discover a totally new kind of instrument I had never experienced before. I started making Jamboxes as a way to share this joy with more people and to facilitate a new collaborative use of my existing performance instrument designs."

"The reactions I got at the first festival I brought the Octomasher to were so magical, and the opportunities to bring it to all kinds of events appeared so quickly, that I kept making new Jamboxes and developing the concept further. I believe they have a big role to play in the future of collaborative music, and in a new form of folk music being born right now. Folk music in the true sense only emerges when average people (not music-making professionals) are given the confidence, the right sort of instruments, and the cultural context where their musical voices will be heard and appreciated. I think Jamboxes are one path to this kind of music."



Stage vs. studio situations

As Moldover emphasizes, any instrument that is expressive, intuitive, durable, and fun to play, will serve a live performance well.

"It's worth noting, however, that instruments used in studio production are usually aimed at a different list of ideals. If you want to see how different they are, I would suggest comparing a large format studio mixing console to the kind of 2-channel DJ mixer a turntablist would prefer. They are both fundamentally the same thing (a mixer), but one is obviously more appropriate to the studio, and one is more appropriate to the stage."

Speaking of performance, he's not keen on using the computer as a central object in his performances.

"Fifteen years ago it felt like a taboo to have a laptop on stage, and now it's the norm, but I've always found it hard to see them as compelling objects in a

performance situation. I go out of my way to de-emphasize the presence of a computer in my shows and bring focus to the physical interfaces that I use. I don't like to belie the complexity and importance of the software, but I can't sanction having a screen at the center of my stage show. I just don't see people getting excited when they see the backside of a tablet, but they do seem to love watching me wail away on a crazy-looking controller."

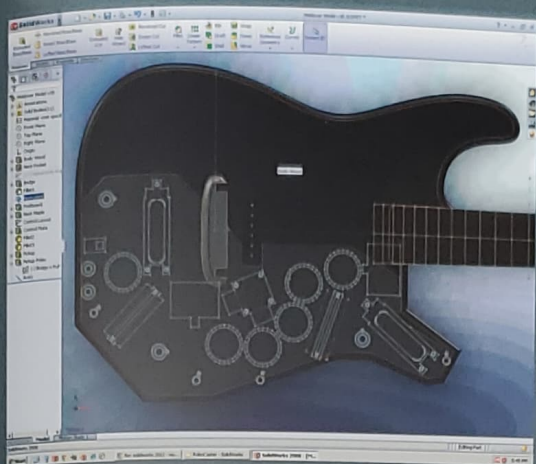
One controller to rule them all?

Some musicians combine several controllers, which has some benefits compared to the all-in-one approach.

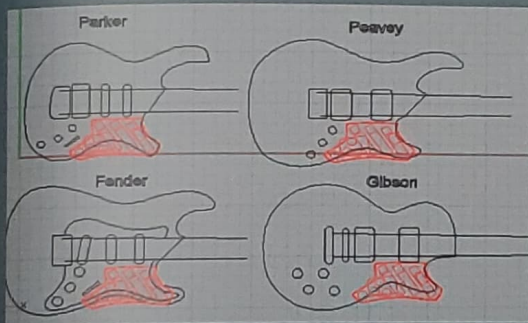
"In general I think the modular environment that exists for digital music making right now is a good one. Some people will complain about the separateness of devices, suggesting that it is cumbersome to have a

computer and an audio interface in addition to one or more controllers. In the end, though, greater modularity means more redundancy and flexibility. One thing can fail, and the others will still function, and one thing can be swapped out or upgraded, and the others can remain. There is a balance to be found here."

"Digital instruments can break all the rules about 'which device controls which sounds' and we might think one interface for everything would be best, but I believe that it's better to have a separate physical object for each musical task. When the guitar and its effects are just one object (i.e. the Robocaster), it's more intuitive for me as a player, and more intuitive for an audience to watch. When I put down the Robocaster and move over to the Mojo to begin manipulating the playback of sounds, it looks right to the audience, it feels right to me, and I think it creates a more dynamic performance overall."



The Robocaster - early 3D model and finished product.



Guitar controllerism

Having picked up the guitar again, Moldover initiated yet another custom-built controller and collaborated with Livid Instruments to make it possible for even more guitarists to explore controllerism.

"I performed with only a single controller and a laptop for about four years. When I started incorporating guitar into that show, it was a success with audiences, but to me, it felt a bit like I had moved from the present to the past. This is when I began developing the Robocaster, which is a custom controller-guitar. It's currently made by Ben Lewry from Visionary Instruments. Ben also did the design implementation, aesthetics, and electrical layout of the instrument."

"The idea was simply to move the interface for guitar effects away from a pedal board and onto the face of the instrument itself. It wound up becoming a fascinating study in how traditional guitar performance techniques can be adapted to and integrated with controller performance techniques."

"The finished Robocaster was compelling enough that Livid Instruments became convinced we could work together to design a more affordable guitar-attachment controller, based on the design principles of the Robocaster. Together we created the Guitar Wing, and now guitar players can experiment with these concepts using the guitars they already own."



The Guitar Wing and early concept drawings. A collaboration with Livid Instruments.

