Arduino & Open Source Design

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In four years of research in Italy interviewing top designers and companies, we have found little evidence of active interaction design emerging in Italy. But as with all things in Italy, designers by and large work within a closed network (see Simon Kwok's paper on this subject, ItaliaDesign 2006). Our program in Canada at SFU SIAT was one of the first to begin using the Arduino platform and contributing to its open source development. So, it was a natural that we would begin our investigations into Italian Interaction Design here. And given that we had been such long-standing supporters of Arduino, we were welcomed into the network and have opened a new chapter of our project with access to the Italian design community who is involved with Interaction Design. It is a growing community who may well be fortuitously placed, brining an Italian sensibility to computing design. And from everything we've learned about Italian Design and its positive contributions, this may be of great importance. As we begin this part of our study, one we will certainly follow up on in 2008, we sense great promise. In the 1970's Italy has ceased to be a major player in computing, after the decline of Olivetti, the last great Italian technology company. But in the short life-span of the Interaction Design Institute Ivrea a new chapter may prove to have been opened. It is a remarkable piece of irony and perhaps kismet that the Ivrea program was housed in the old Olivetti campus buildings and that out from the town Olivetti built a new technology sector may be building. Olivetti, still alive but nowhere near the powerhouse it was mentioned next to IBM seems to have provided the host for a new unanticipart of all of this were a handle of designers, teachers and programmers, and one of those who seems to have made the deepest impact by sheer will of his desire to teach and work openly, is Massimo Banzi who was at Ivrea the entire time. We interviewed Massimo at his design office in Milan in July, 2007. What follows is what we learned in year one of our work with Massimo attempting to get a bead on just where this might all go, what the prospects for Italy and Italian Design might be and whether this might yet propel Italy back into the computing high technology sector. After Olivetti Italians have not even tried to compete in this market, leaving to the Americans and Japanese, and others more recently. Have they fallen behind? Or have they found their design niche? Is that traditional Italian design niche still stable? Is it open to threat in the next 10-20 years? And though they dominate in other areas still, might this new type of design (interaction) augment what they do, and in combination, in fact be a new strength? Open source is a new idea elsewhere. But in many ways the basis of the working methodology, apart from computing, is a native Italian way of

working – companies working with outside designers, designers working for multiple companies, companies sharing technologies. Will it work in Italy? Or is Italy's traditionally closed networking (family-out) a barrier to working globally? Only time will tell at this point. These are the larger questions we're interested in. For this year, we begin by laying the groundwork of what Arduino is, where it came from and how it works as open source design.

The Arduino platform is fast becoming a platform of choice for interaction designers, and open source is a big part of that choice, even if it is an unintentional (or unknown) part of that choice. Open source allows for effective iterative design and creates a community out of the users. Physical computing specifically is not interaction design, but it is becoming more and more an integrated part of interaction design. During the summer of 2007, the Italy Design SFU Field School went to Italy and interviewed several top Italian designers. Among them was Massimo Banzi, an interaction designer who helped to design the Arduino. He took the time to tour the field school participants through the manufacturing process, the factory where the boards are made and assembled, gave a lecture on his previous (and current) works and finally, agreed to be interviewed for the project. Much of this paper derives from those tours and interviews. It is clear that around Massimo a community of young designers is growing, working in ways unfamiliar in Italy. This is yet another place where we see new growth in Italian Design.

So, what is *Arduino*? The Arduino is a tool. A little computer that can help designers interact with the physical world. Ostensibly though, it's not much more than any other similar platform; what makes it special is how it's been designed and supported. "Arduino is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software. It's intended for artists, designers, hobbyists, and anyone interested in creating interactive objects or environments" (Arduino, 2007). The key is its intention – intended for artists and designers, two groups of people whose backgrounds aren't necessarily technical ones (or if they are, they aren't likely to be deep in embedded computing). So, in the city where Olivetti once stood (it is now a part of Telecom Italia), the designers of Arduino substituted corporate ownership and support with community and openness. This shift is what makes the Arduino accessible, and it is what has caused its rapid growth and popularity in the communities using it. So why was it developed?

"Physical computing is about creating a conversation between the physical world and the virtual world of the computer" (O'Sullivan & Igoe, 2004, pp xix). The Arduino was developed initially to help students at Interaction Design Institute Ivrea to develop projects of their own. The students needed a platform to build their interactive projects on which would ease the burden of entering into the physical computing realm. Students with limited computing knowledge could program working prototypes themselves

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and take radical ideas developed in the hothouse of a good design school into stuff that actually worked and could be used and played with by an audience. Traditionally physical computing has been the domain of computer science students, professional programmers and hardware developers who use other kinds of basic hardware (such as a basic stamp, a kind of hardware platform with basic components sufficient to run an application, CPU, memory, etc.) to deal with sensor input and output to devices. However, now the barriers to entry have been significantly reduced with the Arduino, as the hardware is very cheap and readily available and the software is much more forgiving and user-friendly than that of other hardwares. Using Arduino, students can get up and running quite a bit faster than they otherwise could. And for many that becomes addictive and professionally valuable. The Ivrea students for instance have had great success getting work at Interaction Design stalwarts such as IDEO London. And of course, all these people using the boards has fed back into the production process for improving the boards through the company's open source development.
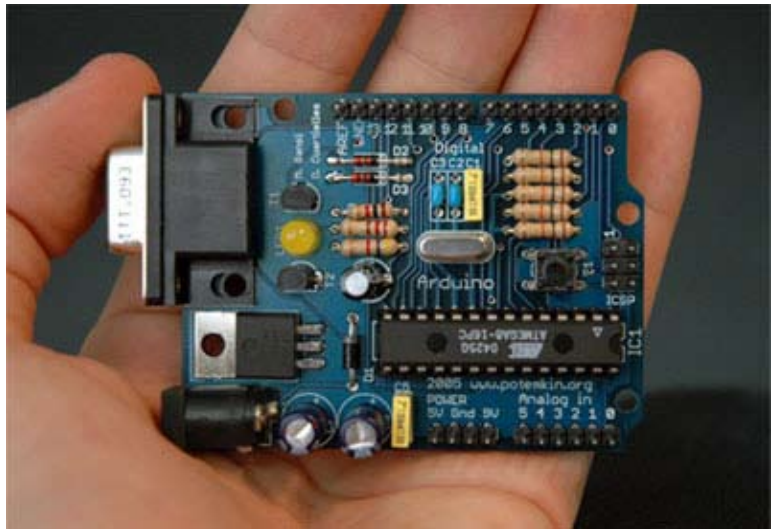
Arduino Board (image source: www.arduino.cc)

So, let's be clear: what is open source? Open source development is a method in which a project (normally a software project) is made public and free. This means that projects can be used and changed by users and developers to fit their needs. Ideally (but not necessarily), these changes are put back into the public domain so that others can reuse them for their projects. The development of open source software usually includes a quick release cycle where changes are made and released to the public for testing, and feedback and changes are put back into the project so that it can be

released for testing again. During our interview with Massimo Banzi he described his view on open source development, and created the following scenario to describe how it works:

> "... Suppose I've developed this code. I've developed this hardware. I know the code is crap - it's terrible; it's badly done, but it works. And I'm going to give it to you, and you do something with it, and you give it back to me after you've fixed it. ...If enough people work on it, it's like hundreds and thousands of people polishing a sculpture. Everybody's got a bit of a sand paper, and together they make a beautiful thing. It's a group effort" (Banzi, 2007).

Massimo Banzi

Open source hardware development is much less common than open source software development. The same principles tend to apply, the quick prototyping turnaround time, the community support making changes and suggestions. In the case of hardware, it is harder to do because the community has to have some physical prototyping systems in order to participate. The way through which the Arduino developed this requirement has been mitigated somewhat by the attempt to make the parts that are required to build the Arduino as common and as inexpensive as possible (Massimo Banzi, 2007). The Arduino was able to be developed in the market initially without a driving concern for quality or a designerly fetish for *finish*, and as more people saw the product and submitted changes back to the project, the Arduino got better and better through a process of "get[ting] a lot of feedback, making a lot of prototypes [and] constantly improving" (Banzi, 2007). Open source is therefore not a new manufacturing idea, but how it's being applied is.

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Open Source lends itself to the idea of iterative design, which is a key methodology for all design today. Organized, continuous self-improvement is what the Japanese in the 1980's called *Kaizen*; its aim is to improve each product or service until it becomes a truly different product or service (Drucker, 1993, pp 59-60). Open source changes this idea of Kaizen only slightly, where Kaizen specifically seeks self-improvement, open source seeks community improvement. The Arduino is constantly being used, and each time it is used there is a chance that it may need to be changed in order to facilitate the needs of the project. Each time there is a change to the Arduino for use in a specific project, there is a chance that that change will be passed back to the community so it can be incorporated into another project. This evolution of the Arduino may be what enables interaction designers (like the students that it was originally developed for) to rapidly make physical prototypes, which are robust enough to translate into projects of professional quality. In the design studio work we do in SFU SIAT, we have seen this change create an entirely new paradigm for the technology+design student. In the past we encouraged them to think about projects that did not exist, to design for a future that does not yet exist. They could propose such projects and use scenarios to make them believable and merely lacking development, but with the Arduino we can create cutting edged ideas and then see them actually built, extremely rapidly, as working prototypes. And all of this can be done within a paradigm that does not rely on computing professionals to realize - which has been traditionally a difficult match to make. Now we can take a working prototype to computing experts and get the beautiful code they insist on after the ideas have been realized and proved as viable. Bruce Sterling said in *Shaping Things*, and in close proximity to thoughts on paradigmatic designer Raymond Loewy and his MAYA acronym (a core tenet of Industrial Design practice),

> "Designers create objects, products, processes and symbols that anticipate the future…(they) mine raw bits of tomorrow. They shape them for the present day. Designers acts as gatekeepers between status quo objects and objects from the time to come" (Sterling, 2005, pp. 61-62).

One of the questions that we then ask is whether this might lead to a new kind of design process itself. For instance, it may be possible for a project built on the Arduino platform to take its open source copyright and be passed back to the community as a whole, which in turn may be modified or used as a part of another project, and that may lead to a sort of an open source, community-based design. Though the designers that we spoke to thought that this model would be very unlikely within the exiting paradigm of design. But a new generation, who embrace technology and content sharing, may not see these old barriers. Massimo Banzi describes the Arduino as being "composed of three elements: The hardware, the software and the

user experience, and the education system – the way they teach it to others (word-of-mouth, free workshops)" (Banzi, 2007), and this is why the Arduino is so popular among young interaction designers.

The designers that we went to interview in Milan in 2007, by and large, did not think that open source concepts could be applied to design. The model that designers tend to work from is that what they build is theirs; they want to be inspired by others, but they don't want to literally build something new from something someone else has started (or finished). But it depends who you speak to in Milan and how your frame the question. In 2006 in our interview with thoughtful architect Cino Zucchi, speaking of architecture and cities, Zucchi said,

> "…you always operate on a text that's already existing (or the palimpsest). But much more importantly, is the idea that you add something on, like in a collective artifact, and it changes your point-of-view because you see yourself and your work as a contribution, as something that [has] to interpret something else" (Zucchi, 2006).

Interestingly, Banzi foresees a time when *interaction design* may be folded into *design* (i.e. lose its distinction) and may become simply a part of design as a whole (Massimo Banzi, 2007). Milanese Industrial Designer Isao Hosoe went as far as to say that when applied to design, the open source philosophy may in fact lead to a low quality of thinking (Hosoe, 2007). Design by committee, or design by amateurs, can certainly lead to uninspiring or poor design, and that versus design by the educated, understanding designers, can very well lead to a lower quality of product. This however does not speak to what might happen if educated understanding designers worked together on an open project. Banzi also offered his opinion on open source being applied to design

> "First of all, I think that the classically trained pure designer is not going to get the idea of open source. … Maybe I am just generalizing a lot. It just doesn't tie in with their mentality because we worked with people [who] developed physical computing platforms that were like more designers, and they … resist[ed] very much publishing anything that wasn't finished, sleek. And, that's the complete opposite of open source" (Banzi, 2007).

But we suspect that, as in our conversation with Cino Zucchi that designers do get it, just that it needs to be shown that they in many ways already do it. Not all of course, but in Milan, open-minded designers are not difficult to find.

OneOff, a prototyping company in Milan, shows their technology

to everyone, not just their designers, through their innovative company *Industreal*. This sets up an open source type relationship "so there is really a communication between the designer that have ideas and the market, that if they like [them], they will buy these ideas" (Calvetti, 2007). Costanza Calvetti of OneOff furthers the idea of open source design when she says "designers, through technology, with [the] means of the Internet, and through software that [is] really the same all over the world, can send [out] their culture. ... This is a way for designers to interact and to communicate directly with the market, the global market" (Calvetti, 2007). OneOff shares their technology and allows designers to work together on projects that may not be their own, in much the same way an open source application would be designed, prototyped, tested by others, changed by others, and prototyped again. Calvetti suggests that it is "for this reason, [that] we have ideas that are sometimes different, and the market likes these ideas very much" (Calvetti, 2007).

Costanza Calvetti

OneOff's concept of design is stated very simply by Calvetti, and can be extended to design in general: "Design is to share something; design for the new generation is to find value in their work. Design is about sharing, making a project that relates to the surroundings" (Calvetti, 2007). Their core business itself in rapid prototyping techniques, though not specifically open, also really lets designers work in the open source model, where changes can be made quickly, shared with the consumer or client, and then changed again very quickly based on the feedback given to the designer. We have interviewed OneOff twice now and seen their business grow and carve out a unique position in Milanese design. We saw form the start that they were the first to enter into the area of outside prototyping for designers and to maximize the potential of the new 3D printers and laser

cutters for application to design prototyping. And design prototyping is rapidly becoming a core new area in design process itself. OneOff is not merely a model-maker, who bring finish to design presentations, they are helping designers prototype things which otherwise would not get developed because of prohibitive tooling costs, among numerous other issues. And the best firms in Milan are grasping this distinction. Their *Industreal* initiative is evidence of company seeing that designers with ideas can get work realized, and for young designers this is particularly important. And as with other open-source projects in Milan, it is creating a network of designers, a center for discourse, and in that classic Italian way, a place to find people who can do what you need and build relationships face to face. So though OneOff may not be involved directly in Interaction Design and Massimo Banzi and Costanza Calvetti may not yet know each other, it seems inevitable that they will. OneOff is engaged in open-source, networking and prototyping, and those are three key attributes of the design process emerging in Milan's interaction design community and they are of course central to design development globally in this sector. So, why is prototyping emerging as such a key?

Prototyping is a central tenant of interaction design. IDEO's Tom Kelly includes in his *Art of Innovation* book a quote: "Never go to a meeting without a prototype" (Kelly & Littman, 2001, pp 106) and Banzi echoes these sentiments. "To my design students I push the concept of prototypes. Even if it's a fake prototype [but] it's doing something, go for it, because it generates trust, generates confidence in the client that says you can pull it off" (Banzi, 2007). The Arduino has some interesting properties when it comes to a discussion of prototyping, in that it is itself a changing object subjected to being improved by others who want to adapt it to their projects, and it is also a platform for people to use to prototype those same projects. The attractiveness of the Arduino lies in these two properties, openness and adaptability – its openness allows it to be used by anyone, and modified by anyone who cares to (or knows how), which opens up possibilities that do not present themselves with normally copyrighted materials. Its openness also encourages the creation of a community, which can be used as a resource to help with prototyping (i.e. overcoming technical details which might otherwise be very difficult to surmount). The community can also be used as a population to test out prototypes made with the Arduino. So, Arduino and Interaction design can achieve prototypes extremely successfully. But can they achieve the sort of timelessness we often associate with good design? This was one of the questions we thought a lot about in regards to this part of our study, as it is such a key part of much of the rest. The success of the Italian Design industry, that industry that keeps Italy in the top ten industrial nations and has made Milan the largest city-region in all of Europe, is premised directly on values of quality and often of timelessness. So, it seemed natural to ask whether Arduino as an Italian product shared

these characteristics: perhaps even yet another link to the traditional design paradigm.

Quality does not directly or implicitly imply timelessness – something of quality may not achieve timelessness – but without quality something cannot be timeless. Timelessness may in fact *not* be attainable for electronic devices. Moore's law, which states that processor speeds will double every eighteen months, suggests that electronics do not age gracefully. Old electronics show their age and feel slow and limited. It is conceivable that an object with electronics can be designed and built such that its electronics are suited so well to the task that its speed or age do not affect the experience. But then the question becomes, what happens when we put the latest technology into this object? Does its experience become better, or cheaper or more enjoyable, or even easier? Classic objects and devices become nostalgic, while their modern counterparts become what get used for everyday use.

Massimo Banzi being interviewed in 2007

Despite the opportunities, we feel at present that it is likely that an open source methodology is not going to be applied widely to design, and perhaps less likely in Italy. Though some companies are toying with the idea of opening their design processes to young designers, the majority of the companies are sticking with the traditional ways of designing, hiring a team and going through a design process that has been honed for years, and that has been financially successful so far. If it's not broken, why fix it. Open source does have a place in design however, and that place has been shown to be in the somewhat traditional field of computer science. Open source hardware is an innovation that the Arduino designers have developed. It will help designers become more productive, and perhaps more creative; even if

the projects made with the Arduino aren't made open, the fact remains that an open platform has made an open project possible.

Open and rapidly changing hardware is a new paradigm that can lead to intelligent designs modified and contributed to by non-designers in a way that hasn't been possible until very recently. The simple popularity of duct tape is a testament to how people enjoy modifying objects. Now with objects being made on the basis of open source, perhaps the opportunity is available for people to take what they buy and really modify it to fit their specific needs. Hacking has always been a consumer right - you buy something physical, like a shelving unit, and you can get a saw and change it to fit the space you want to put it into. But now we may start to see (like we have seen in the software sector) people buying electronic objects and not only changing them physically, but changing them functionally to fit needs that designers may not have foreseen.

So, at present a wide-spread embrace of Interaction Design and rebirth of a computing Industry (a la Olivetti) seems unlikely. It really would require the governments at various levels to support such a prospect – and this unfortunately, from everything we've heard in Italy is without a doubt the weakest area of the Italian economy, Banzi himself suggested that "with this system, there's no innovation. Students can't get their hands on the material, so [they] don't really understand how things are made" (Banzi, 2007). Where agglomerated innovation economies are springing up around the world, that are supporting new technology initiatives (see Heather Chiang's paper on this topic ItaliaDesign 2007), Italy's government is just not getting it. If the design industry fails in Italy in the next 30 years, and it is by our reckoning a reasonable possibility, it will have occurred for this reason almost exclusively. Alternatively, if the small group forming around Massimo Banzi and others in Milan at this time can continue to gain momentum, how remarkable it would be if an new industry (centered around probably Torino we suspect) sprang up despite the bureaucratic cesspool of Italian governance. That's how Italian Design got here in the first place – tough Milanese survivalists rebuilding their unstoppable city.

What seems more likely however, after Ivrea trained these young minds in this new field, that as with most young designers in Italy today, they will not be able to find enough opportunity in Italy and will take their innovation, their new knowledge and processes away to London or elsewhere. Massimo Banzi himself, seems to be as vulnerable to this new reality as much as any. While this paper was being completed, we checked in with our new friend and colleague in Milan, and after confirming that he would be available for us to continue this research next year, in 2008, Massimo said, "About next summer I'll be happy to meet you again, we'll have some new things to show as now we have opened an office in

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London... I guess new Italian design means going out of Italy looking for the clients that are disappearing here...." (Banzi, personal communicaiton, 2007) It seems that in Italy these days, *if you build it, he will go*.

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2007 INTERVIEWS CITED:

Most quotes used within this paper are available in video and text format on the ItaliaDesign Website: http://www.sfu.ca/italiadesign/2007/index.html

Massimo Banzi – Arduino
    http://www.sfu.ca/italiadesign/2007/interviews/massimo/banzi.html

Costanza Calvetti – OneOff
    http://www.sfu.ca/italiadesign/2007/interviews/oneoff/oneoff.html

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