

# Drone Man



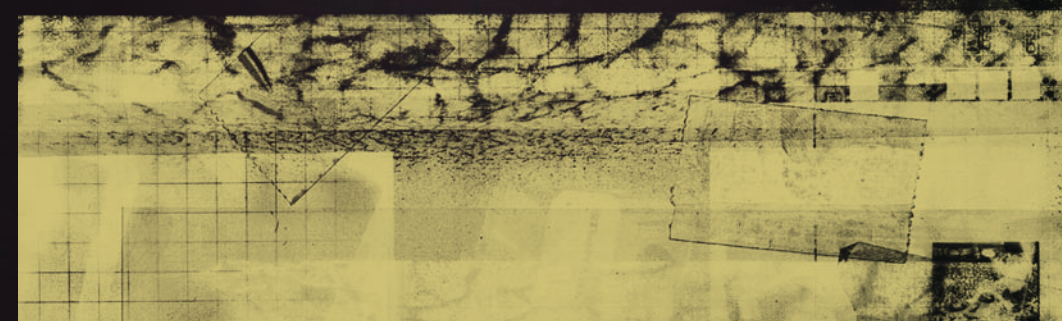
## FUTURE TECH CYBERNETIC ARM INTEGRATES AN ONBOARD DRONE

BY MATT BOYD

The 2012 rail accident that took James Young's left arm and foot could have closed doors of opportunity for his future. It could easily have been fatal. Instead, thanks to James's unique combination of skills, interests, and determination; a generous offer from video-game manufacturer Konami, publisher of the hugely successful *Metal Gear Solid* (MGS) franchise; and the creative forces behind The Alternative Limb Project—in particular, arm designer Sophie de Oliveira Barata—James now stands on the leading edge in prosthetic technology. More than that, he has become an enthusiastic ambassador and spokesperson for—and a walking testimony to—the beneficial merge of tech and human physiology. And James isn't just walking; James is *flying* thanks to the drone, designed by Ben Lyford of London-based drone firm Mobulair, that is integrated into his arm!

How that came to be ties back to Konami and MGS and a lucky set of connections. The first started with a friendship between Barata and a Konami's communications manager for Europe, Su-Yina Farmer. Barata was already successfully established with The Alternative Limb Project, designing customized prosthetics that better fit the needs and personalities of amputees. Coincidentally, the fictional hero of the MGS franchise, "Snake," has a prosthetic arm. The forthcoming release of *MGS V: The Phantom Pain*—the story of which deals with many of the themes confronted by amputees in the real world—presented a unique opportunity for the friends to collaborate, to help someone in need, and to promote the new game in a positive way. A plan was devised to locate a gamer in need of a prosthetic limb and for Konami to underwrite the development of it through The Alternative Limb Project. James—a lifelong video-game enthusiast—was selected, and Barata began designing an arm for him inspired by Snake's own gadget-laden prosthetic in the game. But more than just cosmetic, the arm was to incorporate as many functional bits of tech as they could manage—and that is where Ben Lyford enters the story. I talked with both James and Ben about it, so I'll let them take it from here!

PHOTO BY OMKAAR KOTEDIA





**RotorDrone:** James, as a result of your involvement in this project, you've been exposed to so much technology—in the arm itself, plus the drone and other accessories. How has that affected you? What has been the most surprising/interesting?

**James Young:** I'm a very technologically minded person anyway, so I enjoyed immersing myself in finding out about all the different parts of the arm and the technology behind it that maybe I didn't know completely. Creating this arm has definitely got me thinking more about electronics like when I was a child, and has me purchasing little bits and bobs to put together for limb accessories and other projects using my 3D printer.

**RD:** Ben, how did you come to be involved in this project?

**Ben Lyford:** A happy accident really. Someone overheard my wife mention me and drones in the local park and asked for my number. And then Sophie overheard them on the phone to me and asked to be put in touch herself. Doesn't get much more random than that!

**RD:** How many drones would you say that you/Mobulair have built, and typically what are they used for (aerial cinematography, FPV, etc.)?

**Left:** The first version of the drone used a 150mm frame, but builder Ben Lyford subsequently upgraded to a 122mm Rotor X Atom and fitted the custom canopy to it.

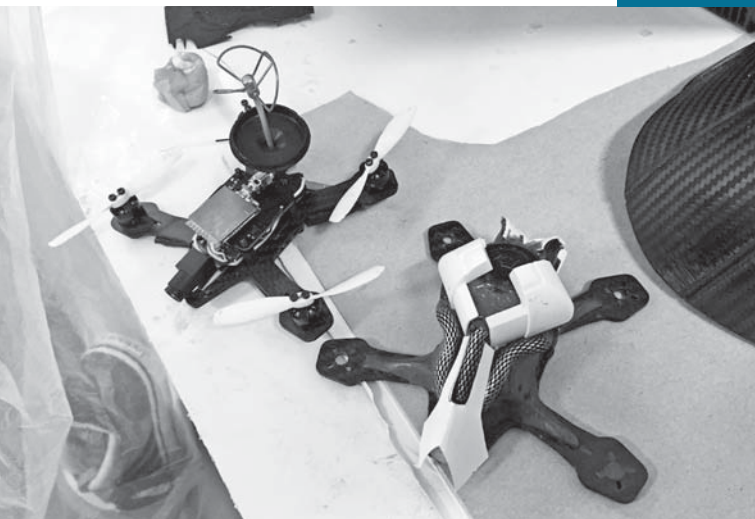
**Right:** A drone docking station was molded into the carbon-fiber shoulder in the early stages.

Other than the frame and motors, most of the other parts were fairly standard: DYS 20A ESC with BLHeli, Naze32 flight controller, micro MinimOSD, a 600mW VTX, and a tiny FPV camera. It was a slightly tricky build as there was so little space to work with, but it came together easily enough. Most of the custom work went into the canopy at a later date.

Quite late in the process, Sophie and I went through a few different options to create a canopy for the drone to make it match the aesthetic of the arm itself. This proved to be quite difficult as there was only about 1–2mm room between the frame and the propellers to work with. We tried a few different options from vacuum-formed shells and moulded silicone skins.

**RD:** James, you're a gamer, so you probably have an inherent advantage when it comes to piloting skills. Were you a drone pilot already, or was this one your first experience with a drone?

**JY:** I flew nano drones—badly—before, but they were too weak. Even the 122 [mm] drone for the arm is kind of... weighed down by its custom art shell. I've since moved to 250 [class] and much prefer it! That is currently in for repairs by yours truly when I have the time.



**BL:** I've lost count at this point. I've been getting on for 40 FPV racers and acro[batic] quads using frames from Fossils Stuff, Thug Frames, Shen Drones, Flyduino and XHover as well as the ubiquitous ZMR250. I've built 5–6 larger aerial photography rigs (450–1000 size), a couple of survey/inspection prototypes, and a few micro size builds. I have also performed repairs and upgrades on quite a few other machines, from S1000s to Hubsan X4s. Currently, I'm working on a custom build for a 360-degree camera rig to improve on my current setup.

**RD:** Tell us about the drone itself. What components did you use? What did you fabricate yourself? What construction parameters did you have that were different than your usual builds?

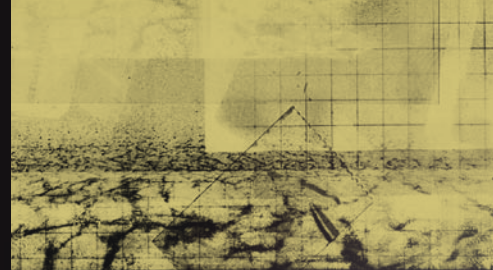
**BL:** The drone was initially built using a custom 150mm CF frame, 1306 motors, and full-size FPV [first-person-view] gear, as the frame I wanted to use had not yet been released and I needed to get something ready. But I felt this was too big to fit comfortably on the arm, and after a long wait, I managed to get hold of the newly released Rotor X Atom kit, which included a tiny 122mm CF frame and 1105 brushless motors. This was the most powerful micro setup available, and I was really happy to base the build around it.

**RD:** James obviously has a unique challenge with respect to the controller. Ben, how did you approach that?

**BL:** The drone itself was straightforward enough to begin with, but the controller was a blank slate—usually it is the other way around. I arranged to meet up with James early on to run over several ideas I had for a one-handed drone controller. I had done a lot of research into “single stick” RC controllers that were popular back in the day as I thought they might provide a tried and tested solution to the problem, but it soon became apparent that James had other ideas. He was very clear that he would prefer the controller to be as close to a games-console-style one as possible, as he had already adapted well to playing his Xbox using a standard controller, with one hand on the right stick and using his mouth to move the left stick.

After a few goes on an FPV simulator in the office, I took James to the local flying field to have a go flying one of my FPV quads. He was able to fly one using my Taranis+ controller, but having to hold it with one hand for a period of time got very tiring for him and I realised it would be crucial to make the controller as light as possible for his comfort.

I then created a prototype controller built inside the shell of a games-console remote, using the same joysticks and buttons interfaced with a



## DRONE SPECIFICATIONS

- Model:** Hvassvidri (means “windstorm” in Icelandic)
- Manufacturer:** Custom-built by Ben Lyford of Mobulair
- Based on:** Rotor Atom V2 kit
- Type:** Quadcopter FPV drone
- Size:** 122mm
- Weight:** 175g (with custom body shell)
- Motors:** 1104 Gatling brushless
- Battery:** 3S 460mAh LiPo
- Speed controls:** DYS 20A with BLHeli
- Flight controller:** Naze32
- Props:** RX3020
- Radio:** ImmersionRC 5.8GHz 600mW Tx internals custom-built into an Xbox game controller

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James learned to control the left stick of his Xbox controller with his teeth, so that's the setup Ben built for him to fly the drone. (Photo by Omkaar Kotedia)





FrSky DIY transmitter module and some custom hardware and software. I later refined this design in version 2 and added an LCD screen to display flight telemetry data and an additional flight-mode switch. The controller and a pair of Skyzone FPV goggles were prepared and sent off to be painted to match the rest of the arm components.

I also suggested implementing some additional flight modes on the flight controller, such as "Headless" mode, in case James had difficulty controlling both throttle and yaw at the same time with his mouth, but it turned out to be unnecessary.

**RD: James, this project has also exposed you to a lot of media attention. How has that been? Strange? Intimidating? Fun? Annoying?**

**JY:** The media attention was rapid and intense, and it was weird having to be in top form for a number of interviews (or at least try to be), but overall, I think it went quite well. I try not to worry about stuff in life, so I just went with the flow and was curious about where it took me. Some speaking opportunities and interesting

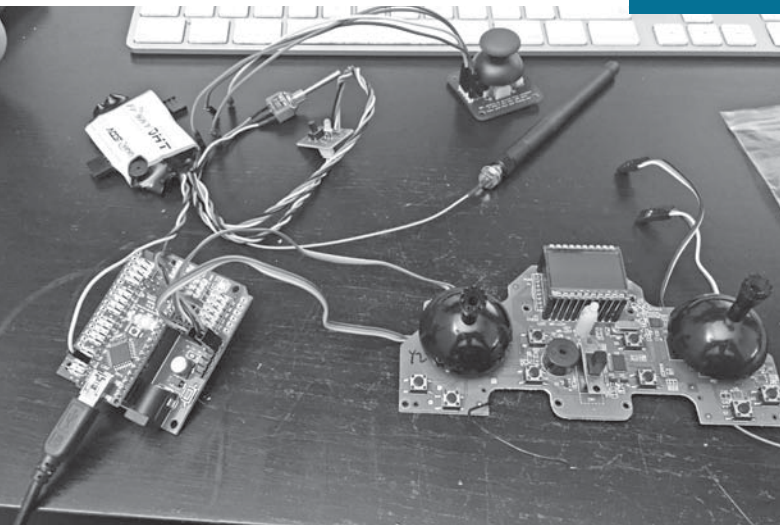
fine control. For this, I'm basically fundraising for a titanium bone implant, which would allow my skeleton to be extended from bone to metal, out of the skin, to connect artificial limbs. It allows you to carry the weight of the batteries and motors almost without feeling it. This is because the weights are loaded through your skeleton in a natural way rather than being mounted on the skin with straps.

I'm just incredibly pumped about chasing this dream, as it also provides the capability to use a neural interface that connects to your nerves and send data at the same implant site, rather than having electrodes on the skin which [can] fall off. The same technology is actually really great for legs as well—and because I know how positive an impact it has on people's lives from speaking to people who have had it, I've begun fundraising at [gofundme.com/titaniumjames](http://gofundme.com/titaniumjames). [People can go there to] find about the benefits for the lower limbs as well.

It's quite a novel procedure with only [a few] hundreds of people having had it in legs, and pretty much single digits having had it to integrate arms. For

**Left:** The controller uses FrSky guts, but they have been retrofitted into a custom Xbox controller housing that James is most comfortable with.

**Right:** The finished controller and a pair of Skyzone FPV goggles were sent out to be painted to match the arm-and-drone theme.



pathways have opened themselves to me, so, for that, I'm pretty grateful for the arm and how it has allowed people to notice how excited I am about forward-thinking technologies. I have some collaborations and solo projects in the works that are fairly long-term, but I look forward to sharing with people!

It's very weird. Just from a short documentary about the arm [Editor's note: Look up *Metal Gear Man* on YouTube], the people stop me in the supermarket or when I'm outside the train station and talk to me like they know me! It's kind of disconcerting because I feel like an arsehole for not knowing who they are in return. Fortunately, it's been very positive, and I appreciate the kind comments—you guys are great.

**RD: You have started a fundraising campaign to help finance the next stage of the project—is that correct? Can you tell us what that next step is, why it's important, and how people can contribute if they want to help?**

**JY:** With my amputation height on my arm, there is basically not enough arm left to realistically be able to integrate well with bionic arms. With socket-based technology, like the one we used for the phantom limb project, I don't really get to move the arm around except for opening and closing the bionic hand. What I'd really like is greater physical control—by which I mean being able to lift my arm around and position objects with

that reason, I'm quite looking forward to contributing to medical progress in the area of integrating tech with the body. Somebody's got to try and be more cyborg!

### FINAL THOUGHTS

It would be easy to get caught up in the tragic beginning of this story—James's accident—and let it overshadow the achievements that have followed from it. James certainly has not; his positive energy makes him a fantastic advocate for prosthetic technology. Konami deserves kudos; from a PR perspective, getting involved in a project like this was risky, to say the least. It could easily have come off as exploitative, but by teaming up with The Alternative Limb Project and letting Sophie, Ben, and the team keep the focus squarely on pushing the technology forward for the benefit of James and others in circumstances similar to his, they did something far more important than promote a video game. James himself has embraced the opportunity, not only stepping seamlessly into the role of spokesperson but also enthusiastically volunteering for experimental technologies that might benefit many more people in the future. It's completely fitting that this project also incorporates drone technology as a key component because, in many ways, it is emblematic of a theme we routinely champion in the pages of *RotorDrone*: innovative application of progressive technologies that yield tangible real-world benefits. ✨