HoverGames Challenge 2 Help Drones, Help Others During Pandemics

Nitin Dahad, Editor EE Times (00:04):

This is the Smarter World podcast, focusing on technology and issues behind today's connected world. I'm host editor Nitin Dahad, Editor, EE Times and Embedded.com. In this episode, we'll discuss the NXP HoverGames challenge to a challenge based interactive coding competition and its recently announced winners. Today I'm joined by Ian Galloway, Program Manager for Drones and Rovers at NXP, Ramon Roche, Program Manager at Dronecode Foundation, Ian McElhenney and Adam Berlier of Team SCAREcrow, the winners of HoverGames 2. Ian, let's start with you. Can you tell us a little bit about the HoverGames competition and what its mission is?

Ian McElhenny, Team SCAREcrow (00:44):

Yeah, we started HoverGames as part of our mobile robotics team. when we were getting into mobile robotics, we said we needed to really have a platform to work with, to be taken seriously in the space and show off the technology that NXP had to provide. And after building a drone reference design, we said, well, we have this great platform. How can we help the community and thought the best way would be to introduce it to everyone with the help of a competition and getting people more involved in coding in this type of environment.

Nitin Dahad, Editor EE Times (01:13):

When did it actually start?

Ian McElhenny, Team SCAREcrow (01:14):

We actually started the mobile robotics team almost four years ago now. Took about a year to build the platform and then took another year to start our first HoverGames competition.

Nitin Dahad, Editor EE Times (01:14):

Tell us a little bit more about HoverGames 1.

Ian McElhenny, Team SCAREcrow (01:24):

Yeah, so HoverGames is designed in a way, it's a drone competition, but it's not racing, it's not that kind of thing. It's about the coding. It takes place all virtually. And so for HoverGames 1, we wrap that in a nice societal mission. And so HoverGames 1 was called Fight Fires with Flyers, and the idea was to use the drone and the software and the vehicle in any way possible to help a first responder. And we left it fairly open in terms of what the projects were in order to foster creativity with the participants. And what we did, we provided the hardware kit, the software ecosystem, and then a few additional interesting components that they could use like a thermal sensor or those sorts of things, small camera, et cetera. And that was wildly successful, lots of entries there, and then we're following it up. It's an ongoing thing. It's not a single competition.

(02:13):

So the second is called Help Drones, Help Others During Pandemics. We pivoted to make sure we use the platform to allow people to think of creative ways to help others during pandemics. And that's much more than just sort of, you know, delivery and that kind of thing.

Nitin Dahad, Editor EE Times (02:30):

Can you tell us a bit more about the qualifying criteria that participants had to meet?

Ian McElhenny, Team SCAREcrow (02:34):

What we do for qualifying is that they do need to submit a proposal. So on the contest website, they basically submit a proposal and if your proposal is accepted, then you get a steep discount on the hardware tools. And so we do have everyone from senior high school, university, professional engineers, and even just some hobbyists or people that came from other parts of industry. The majority of our participants are engineers and programmers by nature, by trade.

Nitin Dahad, Editor EE Times (03:01):

But if they're at school, then they obviously haven't started that journey yet, have they?

Ian McElhenny, Team SCAREcrow (03:04):

Yeah. You don't want to underestimate students. There's a lot of really gifted people, a lot of people that just dig in and do hard work, and it's perfectly reasonable to be in high school or first year university and jump into this kind of competition. And a lot of it's about the experience and what you learn along the way. Many people starting with HoverGames are learning about these kinds of vehicles and the software ecosystem for the first time. And that's one of the big benefits of running HoverGames as we get more and more people interested in this field and working with the tools such as a PX4 flight stack.

Nitin Dahad, Editor EE Times (03:35):

How long does a competition run for?

Ian McElhenny, Team SCAREcrow (03:37):

We're not strict competition to competition. We have usually allowed one or two months of getting ready to get your proposal in, and then shipping out the hardware. The competitions usually run in the order of six months. I'd like to get people out from time to interact with us and really get a chance to work on their design and learn at the same time.

Nitin Dahad, Editor EE Times (03:57):

What objectives are the contestants given?

Ian McElhenny, Team SCAREcrow (04:00):

We encourage people to say help drones, help others. And we gave a number of different example areas and then encourage people to think of other unique areas. So of course, there's tackling the problem head on, I'm going to deliver a vaccine, I'm going to deliver medicine. But really the idea is to take advantage of the unique characteristics of what a drone could do and some of the new hardware that's presented. So in this particular HoverGames, we introduced some new hardware, which was a vision companion computer or mission computer, which allows them opening up, doing things much more in terms of vision processing, little bit of AI, and then making decisions based on that. So we see all kinds of interesting ways of using that in the winners and all the other competition entries. So everything from detecting where there's large groups of people and generating heat maps so that you can choose not to go in that area, but also looking for code or a sign for help from grandmother lost in the woods, or even still helping first responders because the first responders are part of a pandemic response, really quite interesting.

(05:05):

And we do allow for the number of people that also want to do is a deep dive on a particular software or technology. And we allow that it's very flexible that way.

Nitin Dahad, Editor EE Times (05:13):

Ramon, can you tell us a bit about Dronecode? What is it?

Ramon Roche, Program Manager at Dronecode Foundati (05:15):

Thanks for asking. So the Dronecode Foundation posts open source and open standard projects that are critical to the drone industry. We're a bender neutral foundation for open drone projects. And we're part of the Linux Foundation. We work with developers and users and adopting vendors from around the world. The Dronecode Foundation manages the governance, developer advocacy, runs the main events and manages the community and planning around open drone projects, such as the PX4 Autopilot, Pixhawk, MAVLink and several other projects. The importance of solid governance is critical. They need any open source software and with hundreds of back to contributors and thousands of active community members keeping everyone on track and to community becomes a full-time job for several folks in our team, so we're really the home of the open source Drone community.

Nitin Dahad, Editor EE Times (06:08):

What's the relationship between Dronecode and HoverGames?

Ramon Roche, Program Manager at Dronecode Foundati (06:11):

Well, NXP is a gold member of the Dronecode Foundation and we're excited that NXP runs the HoverGames coding challenge. HoverGames is a great program that gets even more people to participate in the PX4 Autopilot community and exposes them to the broader Dronecode

Foundation community and actually the broader robotics ecosystem as well. A good example of that is a synergy between PX4 and the ROS teams that is happening behind the scenes.

Nitin Dahad, Editor EE Times (06:37):

Our audience might not be familiar with PX4 and ROS. Can you explain what they are?

Ramon Roche, Program Manager at Dronecode Foundati (06:42):

For sure. So the PX4 Autopilot is the most widely used open source autopilot in the drone industry and manages the vehicle dynamics in real time. It's very powerful. Think of it as the brains of the drone. It comes out of the box with all of the latest features that you will expect out of drone in 2021. And best of all, it gets totally tested and has tons of safety features built in. Hundreds of organizations depend on it daily. We like to think of it's a 90% done solution and we don't make a product out of it. We expect companies to actually build their verticals on top of it and put their extra remaining 10% on top of it to build their products.

(07:24):

One of the best features that we have is that we're extensible. And like I was saying, we have great hardware support and will depend on some of the companies and organizations that a dependent PX4 to extend it. Depending on the application that you might want to be trying to run, you might also choose to introduce a Linux companion computer next to the PX4 Autopilot. So you can be running ROS or ROS next to it, which can help you tap into the best frost ecosystem and hook it up directly into PX4 or be a robust API. ROS stands for Robotics Operating System, although in reality it is a collection of tools running on top of Linux. ROS is a powerful part of the Dronecode Foundation and our teams interface very closely.

Nitin Dahad, Editor EE Times (08:07):

It sounds like there were a lot of entries. How many did you look at?

Ian McElhenny, Team SCAREcrow (08:10):

We help guide then rank them before they go to our judges. So there's a lot of work done to go through these and then it's not just one specific aspect, we judge on documentation, the video and photo that's done, code contribution, the inventiveness of the idea. And then in this one, we introduce a collaboration content. So, you basically counted whether you were helping others during the competition as well, which we really wanted to foster that collaborative effort because it's exactly the same way as the developers work in the PX4 community, which is one of the Dronecode projects. You know, you've got developers, they'll all have their own interests in mind, but they're prepared and they're helping each at the same time.

Nitin Dahad, Editor EE Times (08:52):

It seems like this is less about hardware design skills and more about the applications of the code. Would you agree?

Ian McElhenny, Team SCAREcrow (08:58):

It's not a hardware design competition per se. Everyone has different levels of experience. So you get some people that are prepared to put together a little circuit or add some additional boards. It's really one of the biggest advantages of the whole Dronecode ecosystem and PX4 ecosystem. Because everything's open source, commercially supported, people can jump in at any level they're interested in focusing on, you can do low level hardware drivers, you can do some kind of module software module inside of the PX4 code on top of an operating system on a microcontroller, or you can work with off-board control on this Linux companion computer running Python, or C or even open V and ROS. So it's really, you've got so many different levels where you can spend your time at depending on what you're most interested in.

Nitin Dahad, Editor EE Times (09:50):

I understand you were involved in judging the entries. Was there anything that stood out for you?

Ian McElhenny, Team SCAREcrow (09:54):

In both of the HoverGames 1 and HoverGames 2, one of the things that I secretly get excited about is where there solutions that are taking advantage of particularly low cost hardware. It's a $500 solution instead of a $5,000 solution. There's some people that have done fire-fighting heat maps with a $1 thermal sensor, and just leveraging the fact that the drone has the ability to do a grid pattern back and forth. On this one there were other farming type applications, it's kind of similar using a visual camera with just the camera that's provided in the kit to help do some agricultural crop health monitoring. And what I get excited about that is that you're not using a super high, expensive, hyper spectral camera. You're not getting quite as good data, but you're getting enough to actually get a job done.

(10:46):

And those ones do excite me as well as just seeing the unique applications and things that people don't normally think of first of all, like researching bats. Just for the fact that they could control the drone, it was going to save scientists tons and tons of time on the ground, trying to find these bats that they had radio tagged. And you don't think of drones being used for those applications, but it's a nice, simple application, helps the scientists find that bats that they're trying to track, just works out really nice. Now the winners, I think really were outstanding and this whole idea of helping firms with the challenges they experienced during the pandemic is really quite spectacular.

Nitin Dahad, Editor EE Times (11:24):

Have you seen any startups emerge from these competitions?

Ian McElhenny, Team SCAREcrow (11:27):

Startups actually are more participating in it now you've got either new people in a particular area, or they have a drone business already, or they've got new employees. So we know that there's a number of these participants that are also drone startup companies. And then the other thing that from purely an NXP point of view is if we walk into a new startup, we know we've got all these things that can help you. You can actually point to examples that people have done already, how they may have already implemented this hardware. So it's a great proof point for this stuff.

Nitin Dahad, Editor EE Times (11:57):

Ramon, were there any entries that stood out for you?

Ramon Roche, Program Manager at Dronecode Foundati (12:00):

Well honestly, the creativity of the entries. The teams had very limited resources and some of them haven't even been exposed to the PX4 community before, but Dronecode Foundation and the PX4 maintainer team had a great learning experience getting new community members onboarded, especially those coming from parts of the broader robotics community. From the top projects, you can see there was a lot of interactiveness and they were planning on doing a lot and then they ended up refocusing their efforts into actually helping communities and solving problems in a creative way. I cannot understand how creative they were, they actually went out of their way to not actually thinking about technology, but actually thinking about the society and the communities that they were helping. So I was actually blown away by how much they were actually willing to help their communities and not actually just be part of a coding challenge and rather actually trying to help people that were in a pandemic. So that's what actually stood out the most to me, that they were actually trying to help people independently, not trying to just solve a coding challenge.

Nitin Dahad, Editor EE Times (13:04):

What's next for HoverGames then?

Ian McElhenny, Team SCAREcrow (13:06):

We're planning HoverGames 3 now. The theme is not set or we're not letting people know yet what the theme is, but I can tell you our biggest intention is to bring more and more machine learning and artificial intelligence into this space. We saw with this, this particular one, even though it wasn't, the main focus was not on machine learning or artificial intelligence. We saw a lot of people gravitating towards that, and it's quite exciting. So you've got edge IOT, edge processing, and machine learning as all options here coming up in the HoverGames 3. And we expect to have that launched in the summer here.

Nitin Dahad, Editor EE Times (13:44):

How can people find out more about Dronecode?

Ramon Roche, Program Manager at Dronecode Foundati (13:46):

Definitely, so go to our website, has all the information that you need to get started in our community that's dronecode.org for the Dronecode Foundation and PX4.io for the PX4 autopilot and now you would get access to our source code, slack channel forums, documentation, and all of our upcoming events.

Nitin Dahad, Editor EE Times (14:02):

So let's go over to Ian and Adam, the winners of HoverGames 2. And how did you come to hear about the HoverGames challenge?

Adam Berlier, Team SCAREcrow (14:08):

I was just following hackster.io and solid pop-up. And it was geared towards my interest of UAVs and artificial intelligence. And so I sent it to Ian, one of my good friends from college, who I know is doing and interested in a lot of the similar type of work, so we thought we'd put together a proposal.

Ian McElhenny, Team SCAREcrow (14:23):

I would say, in addition to that, me and Adam are always looking for side projects to do with each other. And to that, that was an easy jump to make from finding the project to going ahead and working on that project together.

Adam Berlier, Team SCAREcrow (14:34):

I would say it's a great way to stay in touch as friends, as well as make sure that we're collaborating across the globe to understand what other people are up to and see what sort of innovations can be made.

Nitin Dahad, Editor EE Times (14:42):

What motivated you to get involved with the competition?

Adam Berlier, Team SCAREcrow (14:44):

Yeah, so for me, I think a big part of it was an opportunity to actually have freedom to innovate. So at work, I am trying to make sure that sponsors are happy, so I'm trying to meet their needs and their wants. And then at school it's a similar thing. You've got to do the projects that bring the money and so you can actually put your time into them. But this was an opportunity to have full freedom to make it what we wanted it to be, which I thought was a lot of fun and I really liked that a company such as NXP was pushing the matrix maker community to make more innovations. And I thought that was really cool and wanted to be a part of that.

Ian McElhenny, Team SCAREcrow (15:18):

Yeah. And then from my perspective, without getting too deep in the details of the project, just yet, we have a huge problem in the South and specifically where I'm from Texas with the feral hogs, destroying farmland. And as we saw during the pandemic, there's a lot of shortages at the grocery stores. And so it felt like a natural thing to connect because we have already been thinking about trying to solve this problem with drones. And so this was a nice way to encourage us to take the first step in that direction to prepare for possibly a future, a more in depth project.

Nitin Dahad, Editor EE Times (15:46):

So that's your entry, and what problem you were trying to solve?

Ian McElhenny, Team SCAREcrow (15:54):

At a high level. Like I said, we have a huge issue with feral hogs. They reproduce rapidly and they can destroy farmland. There's actually quite a few industries that are surrounding the problem here in Texas. You've got trappers, you have hunters, you have all that kind of stuff that are really trying to help out the ranchers and farmers because at the end of the day, I want to say a few years ago, at least, I saw a statistic where it was around like 20% of farmers and ranchers land is actually destroyed by these hogs. So that's a huge amount of money that they lose and a huge lot of food production that they lose, and that's the motivation. The solution that we came up with, which is not a full solution, but as a step in the right direction, in our opinion. But that is to essentially set up a system that can monitor a field and create a way to keep animals out of that field to protect those crops.

(16:44):

So our solution to that specifically was to create a base station that would sit and watch a field. It would run a neural net classifier looking for animals. When it finds the animals, it will communicate to a drone and command the drone to take off and fly to that animal. And the idea is that the drone will scare the animal. Now we haven't actually been able to test that in real life to see if the drone will actually scare hogs. But you could imagine that even just being able to notify someone that there are hogs in your area could help with tracing, tracking, and eventually allow you to be able to trap those hogs and relocate them to a different area.

Adam Berlier, Team SCAREcrow (17:24):

Yeah. So, like Ian said, we weren't sure how pigs would actually react to this. What I did is I developed a simulation that assumed some sort of a swarming. So I used the Boids algorithm to mimic like the swarming of the hogs. And then what I did is I put a small repulsion force from the UAV to the actual hog, so that they were scared of it with some small mathematical repulsion, which then allowed in simulation for us to herd and drive these hogs around and in a little world.

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And then what I did is for a human to come up with a controller, we had to sit through and think about all the details of how to actually swarm these pigs. So I had the idea that instead of sitting here and manually trying to tweak this, what if we just let it run overnight while we're sleeping or having dinner and just learn the best controller. And the idea here is that maybe this will show a better controller than humans could come up with for these sort of novel emergent movement behaviors by hogs. And one of the things I think would be really cool is if in the future, we're able to actually collect enough data deploying the system, that we could get a better model of how the pigs actually move, which would then lead to better controllers to be learned, to actually be able to herd these things away from protected areas.

Nitin Dahad, Editor EE Times (18:38):

What would you say were some of the challenges? Because obviously it sounds simple enough, but there's obviously a big challenges here.

Adam Berlier, Team SCAREcrow (18:44):

Yeah, so from my perspective, I'm working on the controller and sort of the reinforcement learning agent to learn how to herd these animals. One of the things that was a difficulty as initially trying to figure out exactly what the control space was going to be, and making sure that it was transferable from simulation to real world. And so initially, I wanted to have sort of a velocity vector to control where this one, a continuous velocity vector, but then what we figured out after a while is it's easier if I just sent a forward backwards left command and it could learn quicker as well as be more transferable to the real world, since our tracking and estimation of current state position of the UAV isn't perfect, so learning in a perfect simulation didn't transfer super well or it doesn't transfer super well. And so we looked at doing the forward backward right left, and that seemed to be a much easier way to learn a controller.

Nitin Dahad, Editor EE Times (19:36):

Coming to like submitting this then for the challenge, did you have to submit a video or did you have to send your project by courier or something to NXP. How does it all work?

Ian McElhenny, Team SCAREcrow (19:46):

Our submission was three pieces. So we have the Hackster post where we outline and overview. We have some photos of our drone and then a bunch of links to other places. And then we have on our GitHub page, so we have two GitHub pages, so on my GitHub page, we have the full project and then Adam's GitHub page is a sub project that lives within my project. But at the upper level project, we have a Wiki page where we described setup, we described running, we describe the architecture and we describe the motivation.

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And then the third component is on my YouTube channel, LogicallyLiterate, where we've posted about five or six different videos describing the system, kind of match them the Wiki format, but

then also showing some videos and things like that. Unfortunately, we didn't have time to do a real test, but Adam has the simulation where he simulated in the animals running away from the drone. And then we have the PX4 sitl that we've connected our airside code to. So we're actually able to show the full pipeline through simulation. We just don't have any videos of it actually running it in real life.

Nitin Dahad, Editor EE Times (20:49):

And what were you hoping to get out of the competition, other than winning of course?

Ian McElhenny, Team SCAREcrow (20:53):

Yeah, so I think it was a nice feedback to us that our project was complex, but also that we delivered and were able to describe the complexity in a way that was understandable to the judges. Additionally, it shows that we're thinking in the right area. And as far as the work we did and the outcome that we received, not the competition itself, but the way that we perceived our own work. It showed us that me and Adam were able to work together, which is nice. This has been our first real big project together. And two, it allows us to see that this idea that we had was brought to life and that we can actually expand on it.

Adam Berlier, Team SCAREcrow (21:29):

Two big things for me are that we were shown that we were on the right path and in our thought process, which I think is really cool to understand, "Hey, this idea is actually doable and people are interested in it". And then the second thing is it gave me much more winning, gave me much more motivation to continue the project. So Ian and I are always talking about ideas and like he said, this is the first real project that we've actually done together. And so winning has given me the motivation to continue doing that, and trying to build on this and work on more innovation and more projects within these kind of novel spaces.

Nitin Dahad, Editor EE Times (22:03):

Okay, so you've done that. What's next for Team SCAREcrow? Are you taking this project any further?

Adam Berlier, Team SCAREcrow (22:07):

There's some work that needs to be done to find a really solid customer base and actually work out a well put together easily developed final product, but I think we're on our way to having a really cool technology that if we can bring it all together, I think that there are more applications outside of just the agricultural industry, but also from animals that could come in and cause harm to like test ranges and things like that.

Nitin Dahad, Editor EE Times (22:29):

Let's reflect a little on what your experience, what would you like to see in future challenges?

Ian McElhenny, Team SCAREcrow (22:34):

One of the hardware challenges we had was having to centralize our base station. So we wrote the software to be able to be modular in the sense that we could have multiple controllers and multiple drones. And that's important because if you're actually trying to cover a farmland or ranch land, we're talking hundreds of acres. And with the current hardware approach that we had, we basically were only able to cover a small, maybe half a football field sized area. But, if we were able to use more powerful transmitters, possibly ones that were mesh networked, where each device can talk to another device via a middle located device, then we could expand our range much greater and actually take advantage of the software that we wrote, which allowed us to have multiple devices controlling multiple drones.

Adam Berlier, Team SCAREcrow (23:22):

Having that opportunity, and that hardware would also give an opportunity to develop algorithms for a decentralized controller, which is something that's a pretty novel space right now, a lot of different researchers are looking into that, but having that sort of foundation will allow us to do a lot more interesting things with our controller, our AI controllers, to actually make these things do the best task allocation across the entire farmland.

Nitin Dahad, Editor EE Times (23:43):

Thanks, for talking to me.

Adam Berlier, Team SCAREcrow (23:44):

For sure. Thanks for having us.

Ian McElhenny, Team SCAREcrow (23:45):

Appreciate it.

Adam Berlier, Team SCAREcrow (23:45):

Thanks everybody for joining me. This has been the Smarter World Podcast with me, Nitin Dahad. Thanks for listening, and see you next time.