Intro 00:00:01 Inventors and their inventions. Welcome to Radio Cade—a podcast from the Cade Museum for Creativity and Invention in Gainesville, Florida. The museum is named after James Robert Cade, who invented Gatorade in 1965. My name is Richard Miles. We'll introduce you to inventors and the things that motivate them, we'll learn about their personal stories, how their inventions work and how their ideas get from the laboratory to the marketplace.

Richard Miles 00:00:38 Flying cars. We've seen them in movies and TV shows. It's a long-time symbol of the future. How much longer do we have to wait? Turns out not very long. I'm Richard Miles, your host of Radio Cade, and my guest today is Santh Sathya, the inventor, founder, and CEO of LuftCar, a road and air vehicle that can take off land vertically. Welcome to Radio Cade Santh.

Santh Sathya 00:00:58 Thank you very much. Nice to be here. And you could hear my dogs barking, so that's part—parts of our life here. Thank you.

Richard Miles 00:01:04 In this day and age of Zoom meetings and calls, I think that doesn't bother or phase anybody. So, Santh I was gonna start out by making a cultural reference to "Chitty Chitty Bang Bang", but then I realized I'm of the age that nobody really gets my cultural references anymore. So, first thing, have you actually seen the 1968 movie with Dick Van Dyke?

Santh Sathya 00:01:21 Uh, yes, absolutely. That's one of my favorite movies along with "Those Magnificent Men in Their Flying Machines", that's another movie. And, uh, my all-time favorite is "The Absent-Minded Professor", which is probably what planted the seed of flying cars in my mind. Referring to flying the Model T and I call my invention the Model T of flying cars, incidentally.

Richard Miles 00:01:39 Excellent. So, there we go. We're on the same sheet in terms of movie references and book references, at least. So, let's start by defining what you mean by a flying car. In the popular imagination, there's all sorts of images or ideas of what it is. So, you have a great video online that we will put in the show notes, link that video so people can check it out, but this being a podcast, you'll have to describe it for our listeners. So, you call it a Model T with wings, but it's in fact more of a system. So, help us visualize what that system is made up of.

Santh Sathya 00:02:06 Yeah, absolutely. So, the term flying car has been used quite a bit in the industry now, but in my parlance, flying car would be a complete unit that could fly as well as drive on the road. So, it'll be a multimodal dual use kind of application. Uh, it is not just a hovercraft that will take you from point A to point B, flying in the air. It'll also take you from point A to point B, flying in the air and then point B to point C on the road, achieving the last mile, door to door delivery. This is pretty much what we always tried and thought about flying cars. We would take a road car and make it fly. And that's what we do here at LuftCar.

Richard Miles 00:02:43 So, for are those who haven't had a chance to look at a picture of the system yet, it almost looks like a giant drone with four or five propellers, and then going into it, attaches an actual road vehicle that can go in and out of the propeller assembly. So, that once it lands like at a hover pad or at an airport, the road portion just detaches and drives away, basically like a normal vehicle and then can come back right and reattach to the propeller assembly and flyway. Is that a more or less accurate description?

Santh Sathya 00:03:13 Uh, you're absolutely right. We have two modules, a road module, and the air module. The air module fits your description of a drone. So, it's pretty much a drone carrier that will

carry the road module from point A to point B. And both of them will be AI equipped. So, they will be able to independently fly, that's our long-term plan. Then the road module will be able to independently drive off the air module. The air module will be able to independently fly without the road module. They'll have their own power train propulsion systems. And the docking mechanism between the road module and the air module is our invention. That's our patent. And that's where our uniqueness comes in. And I'll answer further questions going forward.

Richard Miles 00:03:51 And I think that's kind of the exciting thing about it, cause I imagine the ability to basically drive away once you've landed and do whatever you need to, whether it's being used for a delivery or a medical emergency or just regular travel or transportation, you don't want that to take an hour or two hours. It looks like from the video, at least that it's pretty quick process that the entire assembly lands, the road component can detach pretty quickly. And then likewise, can come back and reattach very quickly and be off the ground.

Santh Sathya 00:04:20 Yes, absolutely. So, the air speed is going to be 200 miles per hour—max. So, you can possibly go from Orlando to Miami in 45 minutes to an hour timeframe. And once you land there, you don't have to rent a car, or you don't have to take public transport. You can use your road vehicle to travel inside of the city. And the point of that is that we don't want to put too many air taxis within the urban environment with these vehicles flying between buildings on city roads. We really want to keep the air modules away from the city, keep the noise out of the public experience and have only the road vehicles drive as usual cars. So, we are trying not to create too much changes to existing infrastructure within the urban environment, but also, we will mimic the current air highways, the current aerial transportation we have got between the cities. So, the goal is to connect city to city, city to small rural places, and provide more coverage, provide an alternative to the current cars, trucks, and small aircrafts.

Richard Miles 00:05:16 And that's an important point, right? Because this is not something that you're gonna get in this and fly 1500 to 2000 miles. This is more, as you said, Orlando to Miami, cities four or five hours apart. And it just speeds that whole process up instead of a long drive, it's essentially a drive to the airport. You get in, you dock into the airport to the other end, and then you're at your destination, like you said in shorter time.

Santh Sathya 00:05:37 Exactly. So only 28% of the people in the United States have direct aerial coverage, uh, have direct access to air transport. A lot of people have to travel hundreds of miles to go to a large commercial airport to take an overseas trip or take a long-distance flight. So, what we are doing is promoting an alternative for those people to fly from their little hometowns, from the rural areas, from small cities, to these bigger commercial airports and both those slides. So, what we want to eventually do is have biometrics and TSA check in for our LuftCar vehicles, so that people can do all the right entry process into the vehicle. And they don't have to wait in lines at the bigger airports, they can land at the turf and then boat the airplanes. So that's another commercial model for the aircraft companies to consider.

Richard Miles 00:06:17 Let's talk a bit about the road vehicle itself, cause that's obviously the thing that can be configured for lots of different uses. If it were just say being used essentially as an air taxi, how many people could fit in the road vehicle?

Santh Sathya 00:06:29 So, I'd rather call it, as a regional transportation vehicle, okay. An air taxi, it typically would be limited within the city because we're talking about CGC. We'll first be designing a vehicle for five seats, plus some cargo space. And then we'll eventually scale it up to seven seats, but that is for the transport vehicle. But for the cargo, the road module can be customized to anything that we want. If FedEx or Amazon wanted to be configured in a certain way, or if a food storage company, food distribution company wants a storage a certain way, we will configure it differently. So, the cargo part of it can be customized as needed.

Richard Miles 00:07:00 So as perfect segue, let's talk about some of the applications of this, assuming that, um, you prove the systems are up and working, you get all the regulatory approval, who is actually gonna use this, who's gonna buy it? And then, let's talk a little bit about the infrastructure that is possible because I've been mentioning airports, but also basically you could build special custom pads, right? To accommodate these vehicles so that a city wouldn't have to depend on having a fully-fledged airport in order to accommodate these. But let's talk about what are some of the markets that you're going after as you develop the roof car.

Santh Sathya 00:07:34 So we will talk about three industry segments that we are targeting. One is the cargo and emergency medical services. So, we got tremendous support from Florida EMS to develop these vehicles. We got AdventHealth that gave us an LOI to develop these vehicles. So, in the medical space, it would be an emergency response vehicle. It would also be non-emergency response vehicles providing transportation for passengers or patients who do not have access to an ambulance. I would not need the ambulance, but still need the a, a quick access to hospitals. We will be operating as mobile hospitals in certain industries, in certain countries, where there is not much access to medical facilities in the rural areas. Then cargo. Cargo is a big application for both commercial and industrial purposes. These vehicles can land in vantage points and subdivisions and deliver, say Amazon goods to people door to door.

Santh Sathya 00:08:23 They could also be industry delivery vehicles where they can land an industry complex and go straight into the workstation and deliver goods right there. They could be great inspection vehicles, where you can fly on, say a solar farm or a wind farm, land in a place, have boots on the ground inspection, and also do an inspection. I mean these energy farms sprawled through thousands of acres and vehicles like these can help the industries do the surveillance for this grass expanses. So, cargo, last module to develop, is, is really important. And for offshore applications, we have one oil and gas company was signed up to work with us for supporting their offshore operations, which is just gonna save them tremendous cost. Cause right now they're paying a lot of money for contracting helicopters for taking their people into those offshore sites. So, the second biggest market is defense. A U.S. Navy sees tremendous use cases for this vehicle going from ship to ship, ship to shore, going into contested zones, rescuing people. Take the Ukraine situation, for example, uh, these vehicles can land in safe places and the road vehicles can drive to rescue people from conflict areas and bring them back to safety and then take them outside the country. So, uh, without much of a direct intervention in the air space. And then lastly, personal transportation, like I said earlier, these vehicles can be used by individuals to go from point A to point B. At the same time, they could also be owned by or operated by airline companies, creating hub and spoke mechanism, expanding their market coverage.

Richard Miles 00:09:48 Those are fascinating. I imagine you have some tough choices that you have to make, which segment to focus on, because all those are fairly large segments. Obviously, defense

uses are large, personal transportation, cargo, and so on. Give us an idea of cost. So, if you've got one LuftCar, what sort of price point are we talking about? And how does that compare to say a helicopter, which would maybe be the next best thing, right? In terms of the utility of what you're talking about.

Santh Sathya 00:10:14 So we have limited more utility than a helicopter in terms of taking people into the final destination. But obviously we have limitations in the payload because our dependence on batteries and hydrogen fuel cells. With the hydrogen fuel that we already use, the operating causes vehicles will be substantially lower compared to helicopters. So, if you look at the capital itself, we will be one-fifth the price of a helicopter. Our initial base price would be around $350,000 to $400,000, a full vehicle, including the air module and the road module. That would be one-fourth, one-fifth, the price of a helicopter. If you look at the operating cost, we are targeting close to a $1, $1.50 per car seat mile, per the vehicle, which is very similar to what you would pay Uber for long distance travel. And a lot of it depends on the hydrogen cost coming down to a $2 or $1 per kilogram for hydrogen, and which is pretty much what the DOE is trying to do. And we have a very clear roadmap as an industry to bring down the cost of hydrogen. And when I say hydrogen, I'm specifically talking about green hydrogen. So, we'll be net zero, we will be decarbonizing aviation, and also providing low-cost commute for passengers.

Richard Miles 00:11:20 So that's pretty significant. One fifth of the capital outlay to buy the LuftCar. And then the operating costs are kind of a slam dunk. And obviously if these are self-flying or AI flying, then you don't have to worry about a pilot as well, which costs to say a helicopter or private plane makes it astronomical, right?

Santh Sathya 00:11:35 Yes, absolutely. And autonomy is also gonna to be a game changer. Fortunately, for us, there are a couple of competitors who are doing autonomous electric air vehicles right now, and they're testing them. They're probably going through certification process, but we will have a late, more advantage in that when we already to commercialize our autonomous certification, probably will take shorter time. But the goal is to have this vehicle have level four, level five autonomy to a level where my 17-year-old son can drive it safely and, and land it in case of an emergency. So, there would be an emergency override option as necessary, but autonomy is the way to go.

Richard Miles 00:12:10 Santh, tell us a little bit about where you are in terms of product or market development, as you noted. You're not the only people doing this. In fact, you know, I've been reading for a long time that the next best thing is this sort of mid-range transportation using smaller airports and smaller aircraft and so on. So, the idea's been around here a while, but the technology is obviously advancing very quickly. Where are you in terms of your path to market, for instance, do you have a workable prototype? I assume you've got some sort of patent protection. Do you have initial investors or capital to get you to your next benchmark?

Santh Sathya 00:12:42 Uh, yes. We have raised some initial investment, but we are continuing to raise more investment to get to that first minimum viable product, which I would call a concept prototype, which would likely be ready by March 2023, a year from now, which will be ready for a passing on for certification. And we are raising, connecting with investors right now. We are in conversations, and it has been looking good so far. As of the technology stage, we have couple of IPS filed around the docking system and the hydrogen fuel cell propulsion. We are at TRL2, TL3 stage in terms of technology development, which is approaching concepts. We have partnered with a couple of Florida universities that are working on the digital twin. And we are also partnered with some companies in Ohio who are, uh, going to give us some critical components. What we have accomplished

so far is establishing a strong supply chain, very formidable supply chain, and people come looking for us to partner with us because of the hydrogen value proposition that we provide. And it has been exciting partnering with many of these great name brands. It's gonna be an exciting journey with all these folks working with us.

Richard Miles 00:13:45 Yeah. I can imagine one more sort of detailed question on the development. What does a regulatory landscape look like for you? I'm a little bit familiar with say like drug development and the FDA and how hard that process is. What is the equivalent in the transportation sector? Who do you have to prove or what government agency basically says, okay, yep, this is good to go, it's safe, it works and et cetera.

Santh Sathya 00:14:04 So the primary regulatory authority for us in the United States is FAA, Federal Aviation Authority. FAA knows about our concept. We have been in conversations with them. FFAs appointed a program manager to work with us. We have to prove both airworthiness and a road worthiness because we are dual use vehicle. And that's one of the reasons why FAA is interested in us, because we will be one of the first vehicles to demonstrate this kind of a road, air dual vehicle. And we are working through that part. As far as airworthiness, we will be like anybody else, meeting all the requirements and ultimately working with FAA to develop requirements around the hydrogen handling and hydrogen safety, particularly when it comes to refueling. And that's something that we are developing. So those would be some of the new things that we are doing, and that's the exciting part. Somebody has to do it and we'll be one of the first to do it. And we will be, uh, pioneers in bringing hydrogen into electric aviation. FAA has been great in working with, they are very cognizant of new innovations coming in and they are doing their very best to support new ideas. Uh, so this is a great time to be in this industry.

Richard Miles 00:15:04 That's good to hear. Usually inventors have tales of woe, talking about dealing with regulatory agencies and how slow it is and, and so on, but it sounds like you're on the right track. So Santh, one thing we'd like to talk about in addition to inventions, is we like to talk about the inventors themselves. So, describe for us a little bit, first of all, the process of getting this idea, there are at least two ways to model the classic eureka moment where you're taking a shower, you're walking your dog, and all of a sudden, this idea just pops in your head. Or sometimes you iterate your way into the concept by tweaks here or there to existing ideas that you've read about or heard about elsewhere. How did you come up with the concept for LuftCar?

Santh Sathya 00:15:41 Flying car is a need that we all felt, right? Every time you're stuck behind in the traffic and congestion, you wish you're able to fly on top of all those cars and get ahead of all of them, right? So, there is a need that we all felt. About me, coming from the engineering industry, particularly from the auto industry. I am very familiar with how cars are being made. I did 300 hydrogen fuel cell cars for a four-motor company. So, I'm very familiar with the technology as well, then having worked at Boeing, and also having enough experience with the batteries. But just a year ago, I realized that now as an industry, we have the capability to distribute power across different sections of anybody and make it fly. Then that's when I realized that if I put a docking mechanism, then I can really achieve what I always wanted to have a flying car, take my car and attach it with a flying drone, like you said earlier with distributor power.

Santh Sathya 00:16:28 And I originally started my idea with battery in mind. I was not thinking about hydrogen, but during my first conversations with my advisor, shared at Lawrence Berkeley labs, I just

quickly came to the conclusion that batteries alone will not give you enough power to achieve that 300 to 500 miles range, which is why we buy cars. We buy cars not to drive around within the city. We buy cars so that we can go from city to city, take our families with us, enjoy vacation, go camping, and pretty much support our lifestyles. So, I really don't wanna compromise on that and to achieve the 300, 500 miles, hydrogen gives you the option. And fortunately, I have the experience working in hydrogen cars. So, within a matter of one month of starting my company, I quickly diverted to hydrogen power fuel cell electric flying car.

Santh Sathya 00:17:15 So it's, it's a no brainer. It's, it's a logical series of conclusions that happened in conversations with myself while walking my two German shepherds. And that's how I ended up to where I am. And within one year we were able to generate a lot of interest across the world. Right now, we have partnerships in MEA in the Middle East, we have interest from one province in Germany at documented interest, and we have signed MOU with two airports in Germany. And we are working on agreements with airports in the United States to demonstrate hydrogen landing pads, the landing pads, which will have hydrogen refueling capability. And we have signed partnerships with some really big companies. It's all looking good so far. I've accomplished quite a bit in one year and largely thanks to a dedicated set of individuals that are there in my company.

Richard Miles 00:17:57 That's a great story. And it, it occurred to me as you're explaining it. One problem you probably don't have is some inventors have to spend a long time or substantial amount of time explaining to people sort of the value proposition of what their idea is. But I think with flying cars, trying to solve that problem of the 300-to-500-mile distance. Do you take a car? It's too short to fly. People get that, they understand the advantages that you would have of being able to cover those shorter distances a lot faster than existing alternatives, including getting in your car and driving for six, seven hours. What a boom that would be across the board, whether you're delivering a package or taking somebody to the hospital, or like you said, just going to visit another city for tourism. It makes sense.

Santh Sathya 00:18:35 Yeah, absolutely. That's what makes my day, is when I show the video to somebody and they say, hey, I can think of a hundred different use cases for this vehicle. And they tell me things that I've not thought about, right? That's of my market strategy evolves by a others telling me how they can use this vehicle. I originally started this concept to support defense and to support regional transportation. I was not even thinking about cargo, I was not thinking about medical, but all of this came about by simple conversations with the right people.

Richard Miles 00:19:03 I think the other huge advantage you have now, at least in, in your current design that I saw on YouTube, is that a lot in lot people are familiar with drones and how they work and how reliable they're getting and how widespread they're getting, and they're relatively cheap. So, the fact that it looks like a big drone, I think helps connect people with the idea. Cause if you think about it, 10, 15 years ago, you would have looked at it and go, well, that looks kind of like a fancy helicopter and I'm not sure that would work, but the fact that we've all now seen drones doing pretty impressive things you think, okay, just a lot bigger, more powerful, and you can carry a car. It's not a leap of imagination, like it would've been 20 years ago to think about something like that.

Santh Sathya 00:19:40 You are spot on. The technology that I got is nothing new. Yeah. If you make it into pieces, we have done that before. If you look at my overall vehicle, that looks like a drone, many people that look like the V-22 Osprey that we use in the Navy. The tilt motors is something that we have

used in the V-22 Osprey. If you look at the hydrogen fuel cell, that's something we have done in the cars in the past, right? And then if you look at the docking mechanism, that's very similar to a locomotive docking. It's a more expanded sophisticated version with sensor guidance and stuff, but at the end of it, it's still a mechanical linkage. So, none of this is rocket science and all it requires is some really smart systems engineering. And I believe my team has got some really good systems engineers.

Richard Miles 00:20:17 Yeah. I agree exactly. There's nothing in there that is not understandable to the average person in terms of how it works or having seen it work in other applications. So, you're really just putting it all together for a new application, which is how a lot of inventions work. Okay. Enough about flying cars. Let's talk about you for a while Santh. You're a Tamil American born in Chennai. I dunno if I'm pronouncing it correctly, which some people know is a Madras, on Indian subcontinent. So, tell us what you were like as a kid. Did you wanna be a pilot or an engineer, or were you just running around with your friends doing stupid stuff, like I did? You probably were doing a lot more complicated, elevated things than I did.

Santh Sathya 00:20:52 Well in my family, we never had an engineer before me. I was the first engineer in my family, and I did not know what it would take to be an engineer. There was nobody to really guide me around. But what I knew was I like to build stuff. I made lots of kites, bad kites that never flew <laugher>. I made spinning tops, which kinda worked. I always built things and always loved to see things fit with each other and do something with it. But by default, because we didn't have much of an option out there, I ended up doing engineering, but I went to very great school. Just my engineering college was established by the British 300 years ago, and until this date, stays as one of the better engineering schools in the region. And then, like many people with aspirations, for higher education and technology, I came to the United States in 1993, and did my masters at Ohio University.

Santh Sathya 00:21:39 The funny story, and I have to tell this, is that those days when we did not have computers, I thought I was going to Ohio State University, the pro forma, or the publication in the Delhi American Embassy had a print error. It said the Ohio State University, Athens, Ohio. So, I applied and before I boarded my plane, I thought I was going to Ohio State University. When I ended up here, there is a completely different university, but it's okay, it's too late to change, but no regrets. I had some great faculty, but I'm from there on I went and worked for Ford Motor company, which is where I really did some real engineering and learned all about product manage, product development and systems engineering. Gave me tremendous conference in developing complex products and working with teams. And from there on, it's been a great journey. I worked for top corporations, fortunately, and with all of that, what I do in LuftCar is from those experience from those great companies.

Richard Miles 00:22:30 But no one else in your family, your parents, weren't engineers, were they scientists or researchers since its sort of the general area, or are you just sort of an outlier in your family?

Santh Sathya 00:22:38 I'm an outlier, but after me, there have been some engineers in our family, architects, but before me, none of the elders in our family had any technical background whatsoever.

Richard Miles 00:22:46 That's a great story. Um, before we leave your childhood out entirely, you did mention that in one of your inspirations, you saw the movie, "The Man With the Golden Gun" when you were seven years old. Tell us about that and how it inspired you.

Santh Sathya 00:22:56 Yeah. That's a movie that I've seen repeatedly, and it's always fascinating that particular flying car part. And I always thought it was a flying car, but now when I look at the video, I realize it's actually a plane and they tricked us into believing it's a flying car. Oh <laughter>. But the fact that you can bolt something on to a car and make it fly, caught my imagination, but the flying car would not have been possible without the energy storage solutions we have now, with batteries and with the ability to put motors anywhere we want. That's why the flying car, those days now really picked up and, uh, made an imagination till now.

Richard Miles 00:23:30 Santh, you were a finalist in the Cade Prize last year. How long have you been working on that LuftCar project?

Santh Sathya 00:23:35 Well, I would say less than a year, I registered my company in, uh, March, 2021, but we seriously started putting together a team of filing the patent and building relationships across technology partners, only in the last six to seven months. And we've come much further in the time.

Richard Miles 00:23:50 Wow. That surprised me. I thought you'd been working on this a lot longer. So, my next question, I don't know if it'll make much sense at all, but I was gonna ask you so far, what has been the hardest part of the project? Any big surprises in terms of assumptions you made that turned out not to be true, or are there roadblocks that you just weren't anticipating? What has been the hardest part in your view?

Santh Sathya 00:24:07 Well, it has been great so far with support from different corners, but one of the hardest parts would be either people know too much about it or too little about it. If they know too much about it, they would immediately say, I know FAA would not approve, FAA bought in the past, but talking to FAA, they really wanted start working in this direction. They are very welcoming, but of course it's left for us to prove the concept, it's left for us to take all the efforts to certify. But there are also lots of people who have not heard about flying cars yet. They still think this is a moonshot. They still think this is futuristic. What we are doing is not futuristic. We should have been here 10 years ago. We had 10 years ago, I developed hydrogen fuel cell cars for the country. They worked great, but we couldn't commercialize them because we did not have hydrogen available in the market. Same thing with electric aviation. We could have been here much earlier. So, we are solving today's problems, and these are not futuristic by any means. It's just that we need to work together as industry, as regulators, and also the government, and making this happen and develop social acceptance.

Richard Miles 00:25:07 That's a very important point because if you think of other enabling technologies like GPS, for instance, GPS came along. Essentially, we started wide use in the military by the late eighties, early nineties, but it was another 25 years almost before we had things like Uber or any of the things are essentially the core business ideas of use of GPS. But it took that while for people to put the pieces together, right? And figure out how would you actually use this? And obviously the technological advances are necessary, but the core technology was there 30 years ago, but it's only recently where we depend on GPS for everything pretty much now.

Santh Sathya 00:25:40 Absolutely. And sometimes these vehicles should navigate in GPS enrollments and non-GPS enrollments, control spaces, and control. But now I'm very hardened to see a variety of industries kind of solving those problems piece by piece. So, we have companies doing air traffic management in different environments and they're experimenting a lot. So, these are very interesting

times. And by doing our pilot, we will also be helping others through their pilots, in the different industry segments. And we are all coming together. So, this is a great effort, but there's a lot of energy that's going into it.

Richard Miles 00:26:11 Santh, thank you very much for talking to me. It's been a fascinating conversation. I can't wait to get my first LuftCar subscription. Probably won't be able to get a LuftCar car itself, but I'm sure there'll be some model where it'll be like Uber, right? Where you just sign up and you can use it, but you're on the right path and, and wish you all the best.

Santh Sathya 00:26:25 Thank you very much. Thanks for the interview.

Outro 00:26:28 Radio Cade is produced by the Cade Museum for Creativity and Invention located in Gainesville, Florida. Richard Miles was this podcast's host and Ellie Thom coordinates inventor interviews, podcasts are recorded at Heartwood Soundstage and edited and mixed by Bob McPeek. The Radio Cade theme song was produced and performed by Traci Collins and features violinist Jacob Lawson.