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A SEVENTH SENSE FOR THE SMARTPHONE: A RADIATION DOSIMETER MODULE

Russian Breakthrough Technologies

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Moderator:

Sergei Nedoroslev, Chairman of the Board of Directors, Kaskol JSC

Panelist:

Vladimir Elin, Chairman of the Board of Directors, Intersoft Eurasia; Project Manager, DORA

A SEVENTH SENSE FOR THE SMARTPHONE: A RADIATION DOSIMETER MODULE

S. Nedoroslev:

Good afternoon, everybody.

We do not have so many people with us today, but they all have computers. Our audience is professional and 'in the know', you could say.

I would like to present one project. The man behind it is Vladimir Elin. We are about to see and hear some amazing things. It will be interesting. The environment can be safe or dangerous, and Vladimir determines the radiation level in it.

I think things will start with a short presentation for you, and then we will answer questions if you have any. Maybe Vladimir will even have questions for the audience.

V. Elin:

Thank you, Sergei. I really do work in an interesting field: dosimetry. We develop gadgets for smartphones, mobile phones, and other electronic devices that run on operating systems. Today we would like to present the DO-RA project, which is short for Dosimeter/Radiometer, and show how it all works in real life. But first, let us watch a brief film.

So, colleagues, the film you just saw does a good job of showing what it is that we are doing, what we have done to date, and how this can be used in everyday life. Our civilization is built on technology. Electricity is produced, among other places, at nuclear power plants. The world has vast stockpiles of nuclear weapons. We are all under threat, even as we hope that the threat will not come to pass.

So, I came up with my idea: equipping mobile phones and smartphones with a dosimeter/radiometer, with runs in sleep mode and does not disturb us. But when we enter an area that is radioactively contaminated, or where there has been an accident, this electronic helper will tell us about the danger.

We are moving away from the 'Dosimeter/Radiometer' name. Now we are calling our project 'Seventh Sense', which, besides avoiding panic, aptly describes our device. We all know that people have five senses, and they say that intuition is the sixth one. The seventh sense is a device which will react to different dangers, including to radiation.

A year ago, I was asked to write a short article on the events of Fukushima. On 29 March, I wrote a quick, one-page article about the idea. I returned to the topic a week later. The idea really did seem interesting, so I decided to look through the patents: what if there was no such patent? Indeed, that is how it turned out. I was able to find the claim rather quickly. To complete the patent paperwork quickly, my application was for a ‘useful model’, instead of an invention. The way things work here, that kind of filing takes six months. Six months later I had my patent.

I bought several dosimeters/radiometers from different manufacturers on the market beforehand. I took them apart and found that the devices are nothing more than run-of-the-mill electronics and a regular old Geiger counter, invented back in 1907. Later I began to work on inventing and designing, and ended up with a fantastic device named DO-RA. I am not a programmer, so I needed a team. My university specialization was in electronics: my science Ph.D. thesis was on an issue at the junction of electronics and medicine. After three to four months I found a team in the very heart of Russia, in Sarov. It is a nuclear centre, where in their time they forged the ‘Kuzka’s mother’ which Khrushchev brandished in front of the United States during the Cold War.

My sketches and tech specification were used as the basis for several programs for different platforms. All went well. The DO-RA programs were written for eight key platforms and also registered with the Russian Federal Service for Intellectual Property. It all proved harder with the radiation-catching device. There are not so many sensors that can identify radioactive radiation. There are the classic Geiger–Müller counters, and there are devices that hook onto air vents and arrays. I thought about protecting my device from being copied abroad. I had another idea, to develop a graphene-based radiation sensor. There were several more inventions after that, and the project came to fruition within six months.

Now I will show you how the device works. It is easy to use and you can download programs for it online. When the sensor is present, the device works as a fully functional identifier of ionizing radiation, with dosimetry and radiometry functions. This is our device. We declared it the smallest dosimeter/radiometer in the world: half of the space inside is empty, so we can fit in more circuits.

S. Nedoroslev:

Maybe you could put another battery in there, to not draw off the iPhone's power?

V. Elin:

The device is unique technically as well. It consumes just 1% of the energy used by a regular smartphone. We made it for the iPhone, since I use one, but it could be adapted for the Android too. So, we push it in the headphone jack until it clicks and we launch the DO-RA app, which, I repeat, can be downloaded for free online. Here, it has turned on.

To verify that it works, let us perform an experiment. In the studio there is a small source of radioactive radiation. Call it a war artefact. It is an old German officer's compass. Officers would carry it on their belts, thus subjecting themselves to slight radiation. Now we will try to find it under these cups which I took from the bar. We are not cheating, none of them are marked! We use the compass as a source of ionizing radiation: until the 1970s, navigation devices used radium-based paints to indicate numbers. The compass is rather radioactive and glows in the dark. Could the assistant please hide it?

The natural background level of radiation, incidentally – this is the 'green zone' on the smartphone here – is 0.3 millisieverts per hour. This measures the impact of ionizing radiation on the human body. There are other units, of course: rads, Becquerels, and so on, but we use this measurement system because it is the one used in official Russian radiation safety regulations. So, we are looking for a source of radiation under a cup.

It is probably this one or that one. The cups have been placed too close to each other...

S. Nedoroslev:
We can move them apart.

V. Elin:
For experimental purposes.

S. Nedoroslev:
How long would one need to wear this compass on their belt for something to happen?

V. Elin:
One second, someone is calling. By the way, it works even during calls – you just have to turn on the speakerphone function.

S. Nedoroslev:
But the compass dates back to the war, over 50 years.

V. Elin:
The device has slight inertia, it is picking it up from this cup... Change it again, please.

S. Nedoroslev:
At the hotel where I am staying, the 'Exit' sign shines very brightly at night, even without an external source. Maybe we should have taken it?

V. Elin:

So let us measure it. The first cup clearly does not have a radiation source under it. We shall get the exact results in a minute. But we want to determine where the radiation source is as fast as possible. It is probably under the middle cup. As I guessed: or should I say, measured.

We studied this compass: the radiation background in it is comparable to a conventional aircraft flying at an altitude of 11.5 kilometres. From time to time I take this dosimeter with me and measure the background when I am flying. At an altitude of 11 kilometres, the background is about 15 to 20 times higher than the ordinary background on the earth's surface.

S. Nedoroslev:

How much can one fly before harming their body?

V. Elin:

For flight attendants, say, the number would be around 650 hours of flying time. You can calculate how many trans-Atlantic flights one could safely get away with. Right now they are taking another look at the impact of ionizing radiation on the body, they want to raise the allowable dose a tiny bit. In Russia, the allowable dose is 0.3 millisieverts per hour. In Japan, it is 0.6. That is all for me, I think. If you have any questions, I will be happy to answer them.

S. Nedoroslev:

I have a small question: say that someone smokes one cigarette, per day, for a year. How many millisieverts is the burden on the lungs? It is common knowledge that cigarettes have radioactive tar.

V. Elin:

We did not research those areas. Most likely, the lungs accumulate nicotine.

S. Nedoroslev:

But tar too. If you put this up to a smoker's chest, will it go 'beep'?

V. Elin:

We would need more precise devices for that, this is more for everyday purposes.

S. Nedoroslev:

I see. Are there questions, on the method or on anything else?

From the audience:

What is the margin of error on these? Could you please tell us?

V. Elin:

With low background levels, the current margin is plus or minus 30%. At higher levels, it is plus or minus 15%. Now we are making a new sensor which will be plus or minus 3–5%.

From the audience:

What is the cost of the device?

V. Elin:

We hope that after going to mass production, the retail cost will be RUB 1,500.

From the audience:

It would seem that your device measures the amount of gamma radiation. Have you considered creating a device that would measure alpha and beta radiation?

V. Elin:

Thank you for asking. Our device with a Geiger counter can measure hard gamma radiation and hard beta radiation when the end window is open. With the silicon sensor that we have under development, it will measure the gamma and beta radiation, and a separate sensor will measure alpha radiation. So we will have all radiation types covered.

From the audience:

This is not some everyday consumer device. It could replace the sensors used by workers at nuclear facilities, where everyone carries a phone. And would it not be better, if the phone were also a dosimeter?

V. Elin:

It is almost a law of dosimetry: in 90% of cases you need to measure gamma radiation, in 9% of cases you want to measure beta and gamma radiation, and neutron radiation in 1% of cases. So the market is very narrow, but we may start making tools for measuring that too.

S. Nedoroslev:

If the device were improved a little more, would it be possible to catch neutrinos? As it stands, people are tunnelling through rock at great cost. So even if this were to cost RUB 2,000...

V. Elin:

I think the next version will be different. The device is currently designed as a model for the iPhone. The next model will be transplatform: it will be compatible with all sorts of platforms, such as Android, Windows, and more. Then the DO-RA-Ultra device will go transplatform: gadgets, platforms, logical device detection – all of this will be on the system level. Then we will switch to microchips and try to put our chips in mobile phones, smartphones, and other gadgets. The potential market is rather large.

S. Nedoroslev:

The design is attractive, it is not typically Russian. Did you design it yourself, or did you contract Italians to do it?

V. Elin:

That is a whole story in itself. Our designers did the first version and a few after that. But we could not arrange production in Russia, unfortunately. In one place, they made us a design that was out of all proportion: they had mixed up millimetres and inches. However, in China, they made it in two weeks: cheaply, attractively, and with good quality. So for the first stage, maybe we will make the body in China and the electronics in Russia. When we develop the microchip, it will be possible to produce it where we are selling: in Southeast Asia, Europe, and America.

S. Nedoroslev:

I am not sure I understand, you sent the information to America? They probably made it in inches.

V. Elin:

No, alas. I sent it to a Moscow address.

S. Nedoroslev:

In my day they used centimetres for measurement.

V. Elin:

Right, and they made us an incorrect model on a 3D printer for USD 400. In China, that model would have cost USD 115.

S. Nedoroslev:

But if you look at it by weight, it was more expensive in China. Are there any other questions?

From the audience:

When do you plan to go to market?

V. Elin:

We hope we can make a test batch of 100 units by the end of this year, of the so-called DO-RA-Classic, which will have a Geiger counter. But production will really kick in when we have a silicon sensor. It is cheaper to make, firstly, it is of high quality, has a broader measurement spectrum, and has more advanced technology. I think that mass production will be up and running in early 2013.

S. Nedoroslev:

You already have one buyer.

V. Elin:

We will make you any sensor you like.

S. Nedoroslev:

Would anyone else here like a device with a sensor like that for USD 100?

V. Elin:

Sergei Kirienko was sitting in this room yesterday. I came up to him and showed him the device. It turns out he remembers me from April 2011. He told me, “Vladimir, send me an invitation, and I will order some as presents for people at the ministry.” So I answer, “No problem, we will make you a titanium body and sign it.”

The sensors will not be made of plastic, most likely, because the semiconductor version of the dosimeter has problems with GSM reception. There are different circuits for amplifying the sensor signal; it should be shielded. There are issues with the multiplier and data transmission circuits, with the controller. But if we can put this all on a circuit board, we can solve this all at a go.

S. Nedoroslev:

Maybe you could have an iPhone-independent model for the less technologically inclined? It would have two lights, green and red, and be the same size as the current model.

V. Elin:

We have a few versions, almost like Steve Jobs: 4, 4C, 5, and so on. We have the DO-RA-Classic, DO-RA-Uni, and DO-RA-Ultra. We will also make very simple devices, with the same circuitry and same sensor, that do not require an interface. They will cost USD 5 to 10, I think, and will give a signal when they detect danger.

S. Nedoroslev:

Since you brought up Steve Jobs, we should release a DO-RA-Classic with a Geiger counter and wait for everyone to snap them up like hotcakes. And then a silicon sensor with an error margin of 5%. They too would get snapped up.

V. Elin:

There are two problems. Russian industry produces Geiger counters in very small quantities. And unfortunately, their Chinese counterparts do not work very well.

S. Nedoroslev:

I understand there is just a tube inside?

V. Elin:

As a joke, we named the first DO-RA device a ‘tube’ model. It was not far off the mark, although it has a gas-discharge counter. It is a tube that has gas pumped inside of it and a metallic surface. It has a special layer that is three microns thick. When it is struck by gamma particles, it gives off Compton electrons. The electronics create a charge and the event takes place. I am afraid that not many will understand that. The point is that the sensor is quite reliable.

We want to make the next version semiconducting, out of graphene. We hope that it will work out. But overall, our focus is on silicon: the circuitry is cheap, if you can make a device without an interface and not link it with expensive gadgets. It will be an alarm device that you can keep on a keychain. For a year, it will tell you about any danger.

S. Nedoroslev:

Great. And what if we bought all these sensors and made a site for regularly monitoring the radiological environment on the earth, all online? Telephones are Internet-enabled, these days.

V. Elin:

Our next idea, by the way, is to 'crowdsource' analysis of the radiological environment worldwide.

What is that noise?

S. Nedoroslev:

Your sensor. It picked up the compass.

V. Elin:

One more thing. I had almost forgotten a silicon sensor that I wanted to show you. I have it in my pocket.

S. Nedoroslev:

Our time is running out, but we left the most interesting part for last. The silicon sensor.

V. Elin:

This is an iPod. We could not put the sensor inside so we put it inside a toy. Here we have a 0.25-centimetre silicon sensor, and it too is analysing the radiation environment – with even more quality, precision, and ability.

S. Nedoroslev:

I am not a smoker but my lungs are red. Maybe I breathed in something from your compass.

V. Elin:

We made a program that uses cloud technologies to post measurements online, with the results appearing on a Google map. You can show someone's movements through a dangerous zone – through a city, say – updated every four seconds.

S. Nedoroslev:

So, crowdsourcing is already here. All the sensor-carriers are shown on the map. On Vasilievsky Island where we are, everything is green and calm.

From the audience:

Does it show which direction we need to run away to?

V. Elin:

Our colleague made a special program for optimizing exit strategies for escaping a contaminated area. It is based on a very complicated mathematical model with all sorts of probability tricks involved. We will include this program in the smartphone version, maybe under the name of 'Stalker'. Now, the Japanese are not well versed in our classics, so they did not get the 'Stalker' reference.

S. Nedoroslev:

'Heat Lightning' could be a good name too.

From the audience:

Is movement plotted in two or in three dimensions?

V. Elin:

In two, basically.

S. Nedoroslev:

You can jump if it makes you feel better.

V. Elin:

The image can be large, if you are on the second storey and something happened on the third story. If it has a blueprint of the building, the program will give clear instructions on how to exit, you can get out even with your eyes closed. The program will suggest the least risky way out of the affected area.

S. Nedoroslev:

In closing, I will ask this question: do I understand that you are the first in the world to marry a mobile device with a mobile sensor, and that nobody else is producing this today?

V. Elin:

I wish it were so. But at about the same time and with the same speed of initial work, Scotch, an American company, made a device in the form of a big mouse and cable with one smartphone. Then DoCoMo made a device built into the case for one model. We are ahead of them in the speed of our work and in what we can detect. We have very good, novel developments in the realm of new sensors. We were able to not just make the sensor itself, but patent the measurement method. That is a serious invention.

S. Nedoroslev:

Thank you, Vladimir.

Let us all thank Vladimir for his remarkable presentation. I hope that you have success, and that we get sensors. Many good sensors.