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INSPIRATIONAL CASES | WINNER 2023 | ARGENTINA

#MEIOAMBIENTE

# Students spread devices around Buenos Aires to monitor air quality

Group develop computer, electronic and communication skills while creating their own sensors, at a much lower cost than conventional ones

**TEACHER**
Pablo Hernández

**STUDENTS**
David Daniel Chajade
Facundo Arechaga
Noah Micaela Laurito
Tomas Marrocchi

**COMMUNITY/CITY**
Autonomous City of Buenos Aires

**SCHOOL**
Escuela Técnica N 36 Alte Guillermo Brown

**PROJECT NAME**
CitySensor: sensors and web platform to inform on air quality

**STEM AREAS**
Science and Technology

**OTHER AREAS OF KNOWLEDGE**
Environment

According to the World Health Organization (WHO), air pollution is the main environmental risk to public health in the Americas. Exposure to important levels of this type of pollution increases the risk of respiratory infections, heart disease, stroke, and lung cancer. Therefore, it is important to know what the air quality is like where we pass. This was the thought when the team of four students led by teacher Pablo Hernandez created the CitySensor platform. The project is from Technical School No. 36, in the Autonomous City of Buenos Aires (Argentina), and was the winner of the 10th edition of Solve for Tomorrow (Argentina, Uruguay and Paraguay).

The students are between 17 and 19 years old and they are in the last year of the Informatics/ Computer technical school (also the last year of compulsory schooling). Technical Education in the Autonomous City of Buenos Aires has a First Cycle of the Professional Technical Modality with a duration of two years, common to all specialties, and a Second Cycle of specialties with a duration of four years.

The educator has decades of experience with technology and develops other projects in the school of innovation and environment.

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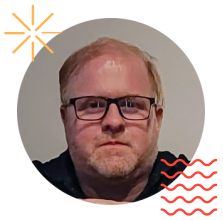
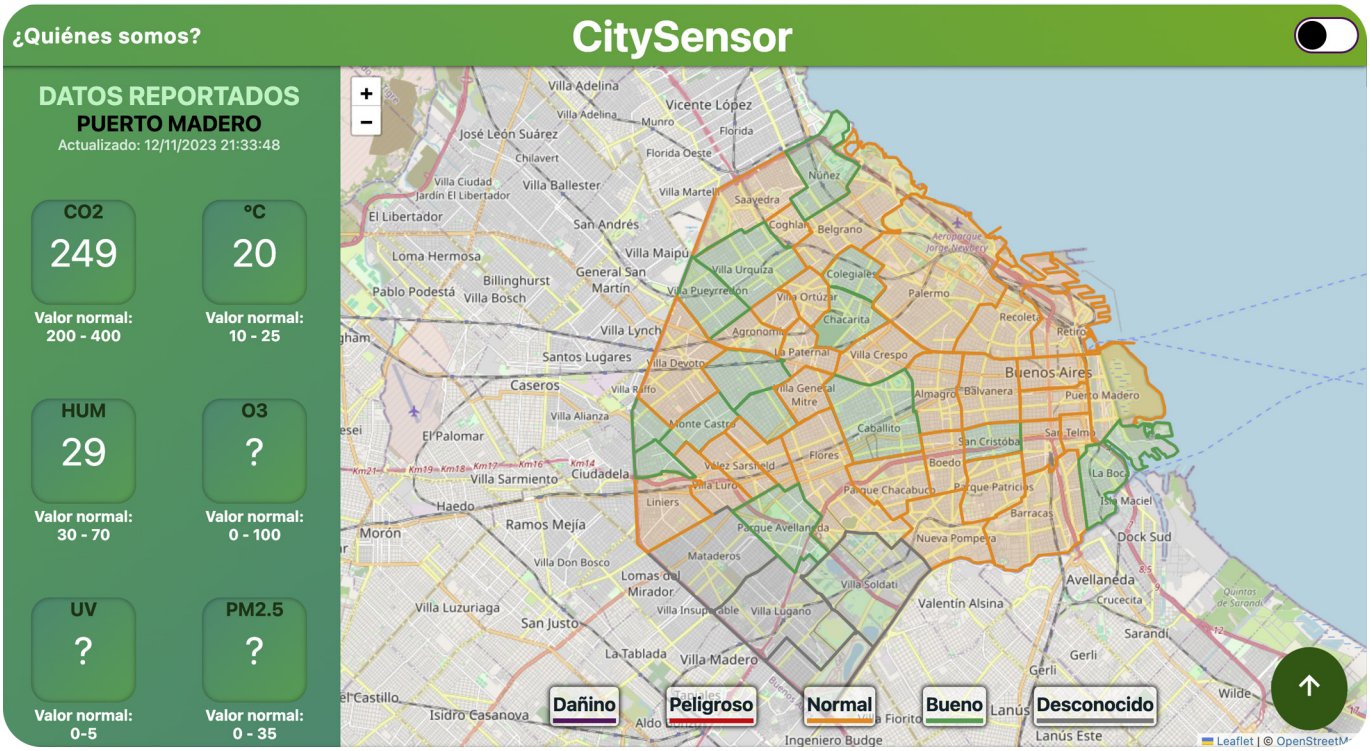


**"I have a personal conviction that technology is going to be responsible for repairing the planet",** declares Hernandez.

The teacher brought the concern to the classroom and together they began to think about the format of the platform and to plan how they could monitor the data from the city. The team's choice, to work with air, was due to alarming statistics. For example, 15,000 Argentines die annually because of diseases caused by poor air quality, according to estimates by the World Health Organization (WHO).




## Platform available to everyone

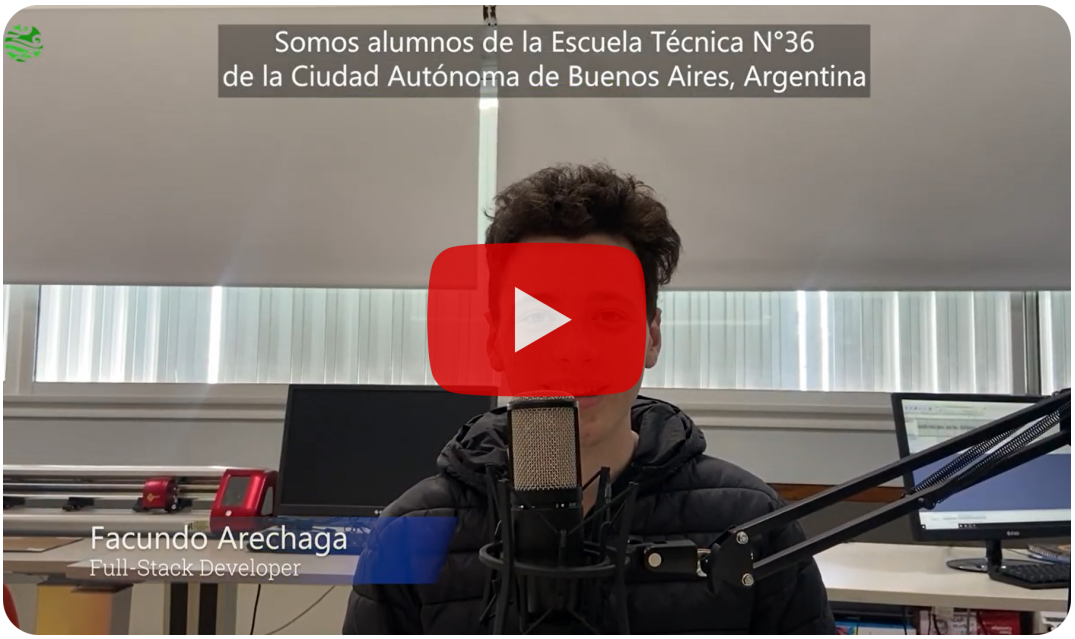
They planned the creation of a website with a real-time map of Buenos Aires, divided by neighborhoods. Each of the students was in charge of a specific task and the teacher acted as a mediator. David was in the production; Noah did the 3D design; Tomás was the Arduino and Hardware developer and Facundo was the Full-Stack Developer, the person who develops software (both for the part that runs on the server side, as well as in the user interface). "I seek to have more of a tutor role since they are students graduating and have advanced knowledge. They are the ones who have to take ownership and work on the project," Hernandez believes.

The result was an intuitive and easy-to-navigate free website prototype. No technical knowledge is needed to understand the map — the idea is that anyone can do it. With one click on each neighborhood, it is possible to observe different parameters. The colors indicate how critical the air quality is in a specific area. In addition, the platform explains to the user what effects this contamination produces, what the risks and levels of contamination are, and how to act in each case.

### Owned stations a thousand times cheaper

The project's ambition was not limited to systematizing online data. That's just the result. CitySensor has been working since the creation of some stations, which the city has installed, then connected to the network, and finally made available on the website.

The proposal to create stations of their own is not unprecedented, but in general, doing this is expensive. CitySensor has managed to discover much more viable alternatives. According to Hernandez, the team collaborated with researchers from the University of Buenos Aires, who have been working on a similar project for about 10 years to measure air quality. They have three functional sensors, but they have not managed to overcome the cost of producing the stations. With a lot of research from the entire team, CitySensor managed to develop devices a thousand times cheaper than the usual ones. "Our weather stations cost between 20 to 30 dollars. The others cost between 20 to 30 thousand dollars," he reports.



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With the help of university researchers and other electronics professors at school, they were able to produce a successful combination: the stations can be made on a 3D printer, using weather-resistant plastic. “In addition to that, its components are much cheaper than similar to other stations that were attempted to be manufactured commercially,” he details.

After the cost issue was resolved, other challenges arose. Since it was not possible to install the stations in public places, the team had to install them higher up, on rooftops, for example, where ideally, they would be at the average height at which people breathe.

The group still had to figure out how to connect all the sensors to the database available on the platform. “We were working and having many problems; some sensors reported poorly, others reported at the wrong time, and other times the graphics did not look good,” he says.

**Eureka Moment!**

After a sequence of mistakes and successes, changes of electronic components, and a lot of perseverance, the result finally arrived: “I remember a student shouting ‘Yes, it worked!’, I looked at them with my ‘what happened’ face and when I saw that everything was working in real time, we hugged each other. It was a moment of immense joy, very emotional, really”, Hernandez recalls.

## Selling the idea is key to growth

Throughout the challenge, the team grew in multiple ways. Beyond technical skills (web development, sensor utilization, and 3D design), they learned management and presentation techniques that allowed them to dream more clearly about the future. “Of course, we can give an effective communication talk to the students, but never at the level they achieved due to Solve for Tomorrow mentoring” emphasizes Hernandez.

The teacher highlights that the students learned project management, teamwork, and communication of ideas, thanks to the virtual workshops and mentoring. “They seem to be in their element; I mean, they made an exceptionally good presentation to the jury,” he says, proudly.

## Expansion is the next goal

Now, the project plans to seek funding to take CitySensor on a large scale and be able to install the stations in the most suitable places for data collection. Maybe cover other cities and regions and start measuring water quality as well as air. “We have a fully functional developed platform so that we can almost instantly add new sensors to measure water quality, perhaps in strategic places in the city,” he hopes.

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### Learn more

If you want to know more about the technical details of each type of sensor used in the project, you can take a look at the CitySensor prototype on this link.

## Focus on practice!

See teacher guidelines on how to encourage and guide students in creating an air quality information platform, using their sensors:

### 1 Empathy

Teacher Pablo Hernandez has made his mission to use his knowledge of technology to restore the environment within the school. Thinking in the context of the Autonomous City of Buenos Aires, he realized that 15 thousand Argentines annually die due to diseases caused by poor air quality. With a specific role for each student, they began to think about a platform to offer more qualified information to people.

### 2 Definition

The students and the teacher came up with the central idea that a way to help population with their technical knowledge would be to create a system with real-time detection and data freely available online. By reviewing existing research and surveillance in this field, the group was able to identify the biggest potential obstacles, such as the cost of creating the sensors, choosing where to install them, and the task of connecting them all into the same system in real-time.

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## 3 Ideation

The CitySensor project is beginning to take shape. The established dynamic was to dedicate  to research and to look for references to arrive at an initial design of the site. Each student had a role and the group met periodically to put together each step of the project. Now the group has to create stations that are affordable, efficient, and viable for both installation and maintenance and capable of connecting to a single device that will collect data in real-time. In addition, it is necessary to decide where the weather stations will be installed. To do it in a public space would require authorization from the Government, something that the educator is studying for the future; but in this first phase, the team has chosen to install it in places such as the terraces of houses or the school itself, to simplify.

## 4 Prototype

In the CitySensor prototype, the sensors are connected to an ESP32 electronic board, a piece that integrates all the components into a single electronic circuit. The team chose and purchased five types of sensors (each to control a different parameter) and developed some 3D-printed stations with them. When the devices were ready and assessed, they were moved to various parts of the city. Once the levels of substances in the air were measured, they took the station to another location to repeat the process. With the first measurements, the group was able to predict the temperature on other dates and to collect the data that is now available on the platform. Because is a prototype, the platform presents the information with more limitations in terms of periods and locations.

If you want to know more about the technical details, you can take a look at this link.

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## Testing

Despite obstacles, CitySensor shows that it is possible and feasible to have a platform with real-time data and good navigability. The final product uses a device connected to a Wi-Fi network that records the different data using Arduino code.

Subsequently, this information is sent to a database, and the web page (developed with HTML5, CSS3, and JavaScript) manages to display the data on the map in real-time. The teacher believes that, in addition to the citizens of Buenos Aires, the government can take advantage of CitySensor data and statistics to support local public policy.