

INSPIRING PRACTICES | FEATURED PROJECT 2023 |  COLOMBIA

#FAIRSOCIETY

## STEM project develops cap that alerts about obstacles

Student invention leverages technology knowledge to improve mobility for visually impaired people.

### TEACHER

Lina Maria Delgado

### COMUNITY/CITY

Bucaramanga, Santander

### STEM AREAS

Technology

### STUDENTS

Sebastián Gómez  
Sofia Herrera  
Emanuel Castellanos

### SCHOOL

Institución Educativa Técnico  
Dámaso Zapata

### OTHER AREAS OF KNOWLEDGE INVOLVED

Sociology

### PROJECT NAME

Eye Buzzer

One difficulty that people with visual impairments find in everyday life is that many environments are not designed to be inclusive. There are not always signs, such as tactile floors, to help with orientation, or spaces for moving around free of obstacles. As a result, there is a high risk of being hit, especially in the head and upper body. With this problem in mind, Colombian students created the “Eye Buzzer”; a device that warns when there are barriers ahead. The creation was one of the highlighted projects of Solve for Tomorrow 2023 in the country.

The prototype is basically a cap with sensors in five directions, alerting the user about sudden obstacles with the use of vibrators. It is also possible to have sound alerts, activating a speaker with a switch. In addition, the distance at which the sensors identify obstacles can be regulated, from 2 cm to 1 m.

The three students on the team were studying at the Technical Dámaso Zapata Educational Institution in the municipality of Bucaramanga and were 16 years old when they applied for Solve for Tomorrow and worked on this project from 9th to 11th grade, the last year of compulsory schooling. The [mediator teacher](#), Lina Delgado, teaches Political Science and Economics, which combines citizenship, environmental problems and reality lessons. In addition, Delgado also teaches innovation and development, where students at the school learn the [basics of scientific research](#) from preschool.

Throughout the course, student groups, that they call companies, are formed to innovate together. “The students decide which projects they will do. Sometimes they even continue developing them into university.” “Eye Buzzer” is one of the 7 prototypes the “Deblind Caps” team made.

## **Discussions inside and outside the classroom lead to the prototype**

The classroom methodology includes games to learn about the [United Nations Sustainable Development Goals \(SDG\)](#). “We observe the global scenario, in a transversal way that has to do with their lives, interests and pains,” she emphasizes. The teacher believes that project-based learning broadens the future perspective of young people and shows the importance of continuing to study. “It is wonderful to learn with the students. The projects are also an excellent opportunity to recognize their realities and help them have more self-esteem: they can realize that they are capable of changing the world,” she says.

One issue that caught the team’s attention was accessibility for people with visual disabilities, after a cousin of a student mentioned that she was going to teach Braille. “She invited them to talk with teachers who give these classes and inclusion professionals from the Department of Education of Bucaramanga,” she recalls. They then delved deeper into the problem, looking for data at global, national, and regional levels.

Thus, they saw that there was a problem of upper body injuries suffered by this population. They brought this up in the “Community of Inquiry”, a space in the classroom where someone presents an idea and everyone asks questions. And at the same time, they continued researching in articles and scientific journals that tried to solve the same problem.

They then decided to create a mechanism that would detect and warn when a barrier was nearby. The idea was that it would be something that could be placed on the head, which is an area more vulnerable to impacts. The first stage was to test an automated system that would allow this.

With further research, they arrived at a low-cost and functional formula. The programming was done with Arduino, an open-source electronic prototyping board. In addition, they needed Raspberry sensors, which are multi-platform single-board minicomputers and have a lower cost (depending on the model, the sensors can cost less than 40 US dollars). “The design and programming are done by the students. It’s very different from buying imported technology that you have to pay a patent for,” she compares. They tested everything in class and the theories were validated in practice. The device worked: the sensors that indicated obstacles and the vibration and sound alerts were well connected.



## Eureka moment!

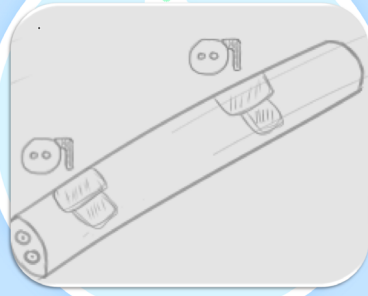
Getting the prototype to work was just one part of the process. The team considered the user experience equally important. In total, they made four designs. The first was simpler, just to test the sensors. “Afterwards, we started thinking about angles and movements. In the second, we had a beret that the group considered ugly. We replaced it with a cap and put the sensors on top. But we had to think about how to protect the device from rain or accidental bumps,” recalls the teacher. In the Solve for Tomorrow mentoring sessions, a 360° camera was presented, attached with a magnet, and that was “Eureka.” “That day we didn’t sleep, we met and worked to see how to integrate this camera into the cap. Finally, we came up with a design that was more effective and discreet,” she concludes.



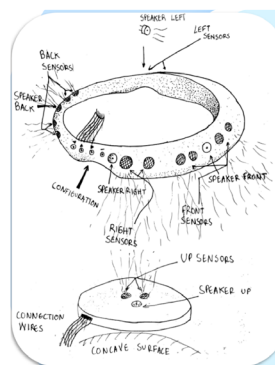
**“With these projects, we are teaching them to learn from mistakes. We say that you should always have a plan B,”**

says Delgado.

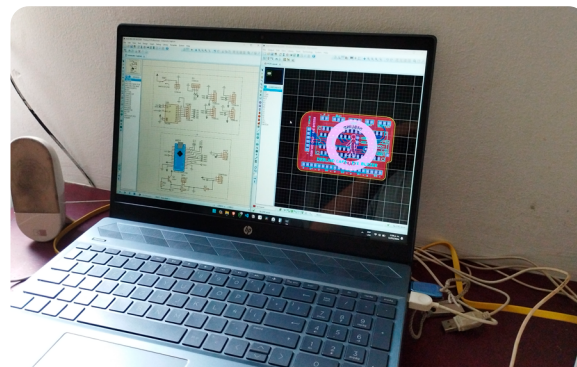
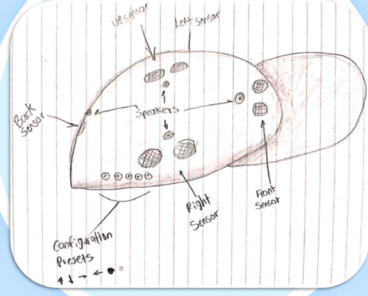
### PRIMER DISEÑO



### SEGUNDO DISEÑO



### TERCER DISEÑO



## A new vision of inclusion is born

To validate the prototype, the Universidad Pontificia Bolivariana was an ally. They participated in an event at the institution where they presented the project and a student with a visual disability offered to test the prototype. “He fell in love with the project and made some suggestions for improvement for the future, such as integrating a cane and installing a georeferencing system,” she describes. Later, they had the opportunity to test it in other institutions and fairs with more people with visual disabilities.

The teacher felt that the experience taught the students to communicate effectively, whether in the production of the video or the final presentation. “They do everything themselves, with the tools they have and in their own language,” she says proudly.

The project mentors helped the educator with materials that she continues to use in class, such as Design Thinking, a methodology for developing answers or solutions to complex questions or problems. “They gave us work tools that I share with my classmates. It’s very practical and good knowledge,” she says. Now, the young people are at university, studying Electronics and Biomedicine, but they are still interested in working on the project when they have free time.



### Explaining!

During the testing, the team discovered that there were visually impaired children in their school. “This showed us that we ourselves sometimes weren’t seeing this population. It completely changed our perspective. We are all more aware and this year’s projects already have a more inclusive perspective,” says teacher Lina Delgado. The impact was so big that it inspired them to create “Rediscovering,” a tour of the school to observe the institution closely. “And this way I can also develop [critical thinking](#) and [empathy](#) in young people,” she says.




## Focus on practice!

Take a look at the teacher's guide on how to create an obstacle alert cap.




### Empathy

 In the Innovation and Development class, the students were instigated to reflect on the social problems that affect their communities. Through research and conversations, three students became aware of the social inclusion of people with visual disabilities and deepened their research into the difficulties that this population faces.




### Definition

 At the invitation of a cousin of a student, the team spoke with Braille teachers and inclusion professionals from the Education Department of their city, Bucaramanga. Thus, they saw that there was a problem that this population suffers hit to the upper body. They brought it to the "Community of Inquiry" for reflection, a space in the classroom where someone presents an idea and everyone asks questions. And at the same time, they continued researching in articles and scientific journals that try to solve the same problem.



### Ideation

 Then, they decided to create a mechanism that would recognize and warn when a barrier was nearby. The idea was that it would be something that could be put on the head, which is a more vulnerable area to impacts. The first stage was to test an automated system that would allow this.



## Prototype

Through research, they came up with a low-cost and functional formula. They programmed it with Arduino and used Raspberry sensors. The device worked: the sensors that indicated obstacles and the vibration and sound alerts were well connected.



## Testing

Through validation, they improved the prototype. They spent time on the user experience and the result was a functional and discreet prototype. The sensors are attached to a cap by a magnet. At other institutions and fairs, they had the opportunity to test them with visually impaired people.