Release No. 52
Mexico City, November 19th, 2025

IPN Students Create TlalocBox, a Device for Cisterns that Monitors Water Quality in Real Time

- **Unlike commercial analysis services, which require several days to process samples, this prototype provides immediate readings of water's physicochemical parameters.**
- **To visualize the results, students from UPIITA developed a web and Android app that also stores the monitoring history.**

Monitoring cistern water quality in real time is the goal of TlalocBox, a prototype developed by Eduardo Rodrigo Cruz Figueroa and Andrés Jalpilla López, students from the Unidad Profesional Interdisciplinaria en Ingeniería y Tecnologías Avanzadas (UPIITA) of the Instituto Politécnico Nacional (IPN).

According to the students, the presence of contaminants in commonly used water poses a significant challenge to human health and the environment. The existence of heavy metals, industrial chemicals, or agricultural waste can have devastating effects on ecosystems and public health.

To address this issue, the newly graduated Telematics Engineers, under the supervision of Dr. Miguel Félix Mata Rivera, designed a hermetic box containing a system capable of monitoring physicochemical water parameters such as temperature, acidity or alkalinity (pH), and turbidity. The system integrates three sensors connected to an Arduino microcontroller—an open-source hardware and software platform for creating interactive electronic projects—powered by a portable rechargeable battery.

"The box is specially designed to prevent water from seeping in and damaging the electronic components while detecting the presence of contaminants," explained Cruz Figueroa.

This project aligns with the water management policy promoted by President Claudia Sheinbaum Pardo, which aims to clean up various water bodies and recover them as a national resource and human right, under the guidance of Secretary of Public Education Mario Delgado Carrillo.

Unlike commercial water analysis services—which can be time-consuming, as they require sample collection and several days for laboratory study—TlalocBox provides near-instant results thanks to the Internet of Things (IoT) system integrated into the device.

The prototype features a module that connects to SigFox, a global low-power network that enables the cost-efficient connection of devices and sensors capable of transmitting small data packets over long distances.

"We programmed the Arduino board so that once it collects data from the sensors, it sends the information through the SigFox network to a platform called ThingSpeak, where end users can easily interpret it via mobile or desktop applications," explained Jalpilla López.

To download and manage this information, the students developed a web and Android application that updates every 15 minutes with the latest sensor readings.

The app features a traffic-light interface: green indicates acceptable water quality, yellow represents moderate levels, and red signals high contamination. It also stores a data history, allowing users to search by date or node—such as the two TlalocBox units currently installed in UPIITA's cisterns.

The students are now preparing their prototype to collaborate with UPIITA's Chemistry Laboratory, which has built a highly promising water filter and will use TlalocBox for rapid and reliable measurements.

TlalocBox aims to become a valuable tool for research on new filters and water treatment methods, helping researchers perform comparative analyses between filtration systems and contribute to the development of innovative solutions for water treatment and monitoring.

For more information, visit www.ipn.mx

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