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## Our Context

The Internet of Things (IoT) technologies, allied to Cloud Computing and Big Data popularization, poses as a viable way to promote sustainability and quality of life.

The IoT scenario can raise the community awareness regarding technology use benefits to manage natural resources.

Education can directly benefit from the best of both worlds!

- **Technology Transfer:** developing fast and practical Arduino projects can attract the attention of both teachers and children to programming and technology innovations.
- **Environmental awareness:** sustainable water use relies on the population awareness: water irrigation present an important issue as the efficient food production is highly desired.

## Latin America CSCW

Challenges in Brazil:

- **Funding:** limited governmental financial support for research development.
- **Bureaucracy:** technology innovation popularization faces problems with bureaucracy.

Challenging opportunities:

- Use IoT technologies to raise public awareness on sustainability topics.
- Natural resources awareness promotion using the smart cities agenda.
- Use STEM methodology concepts to promote Computer Science among elementary students and teachers.

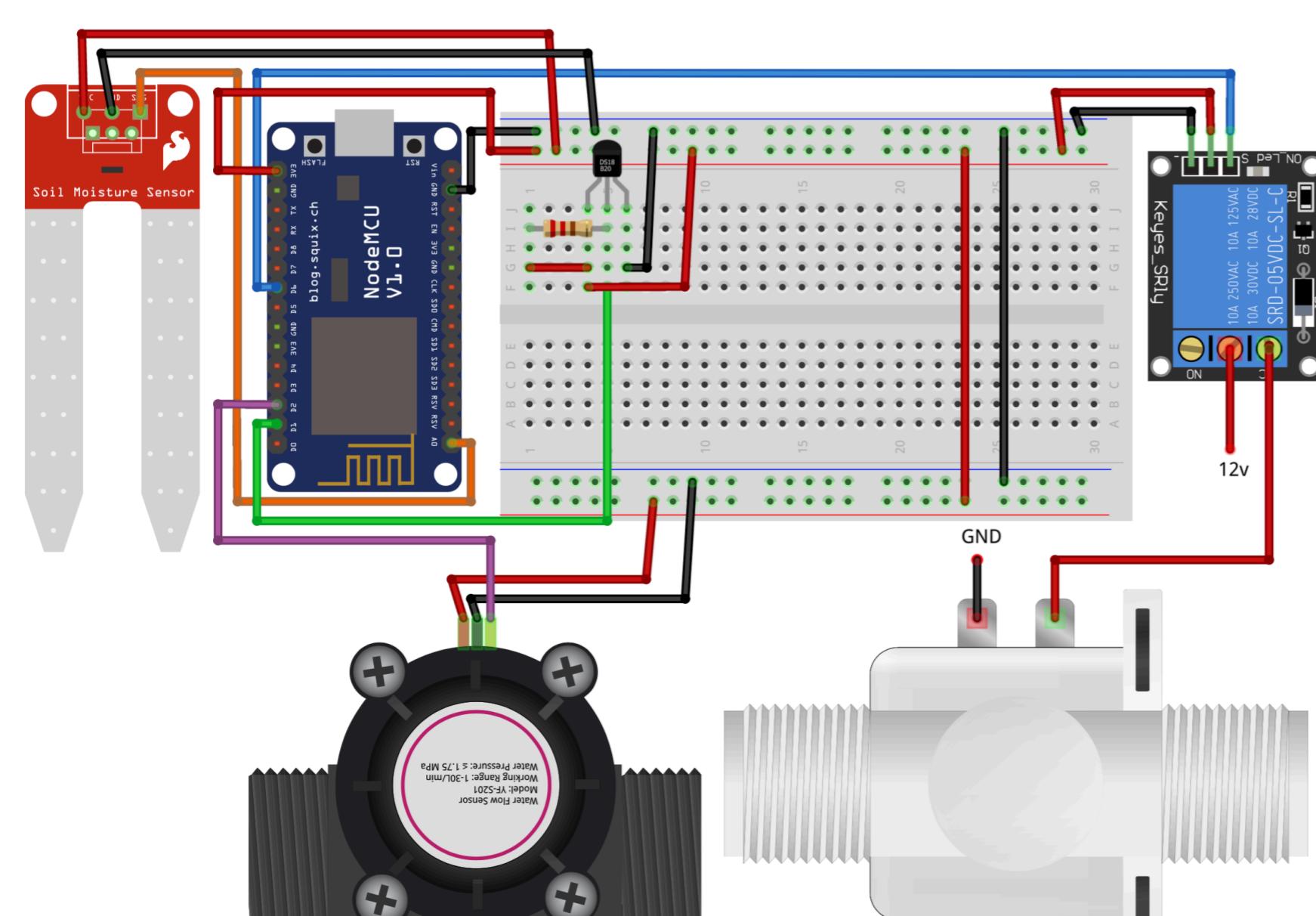


Figure 1. Water irrigation prototype scheme

## Research Prototype

We designed and assembled an automated irrigation system that uses a rainwater cistern to water green and vegetable gardens.

The prototype was developed using an Arduino-based platform, the Node MCU, which also includes an ESP8266 Wi-Fi shield onboard. It uses multiple sensors to control the garden irrigation, such as soil humidity, soil temperature, water consumption and sunlight.

**Cost is an important factor!** The prototype was designed focusing on component cost minimization: total cost under US\$50.

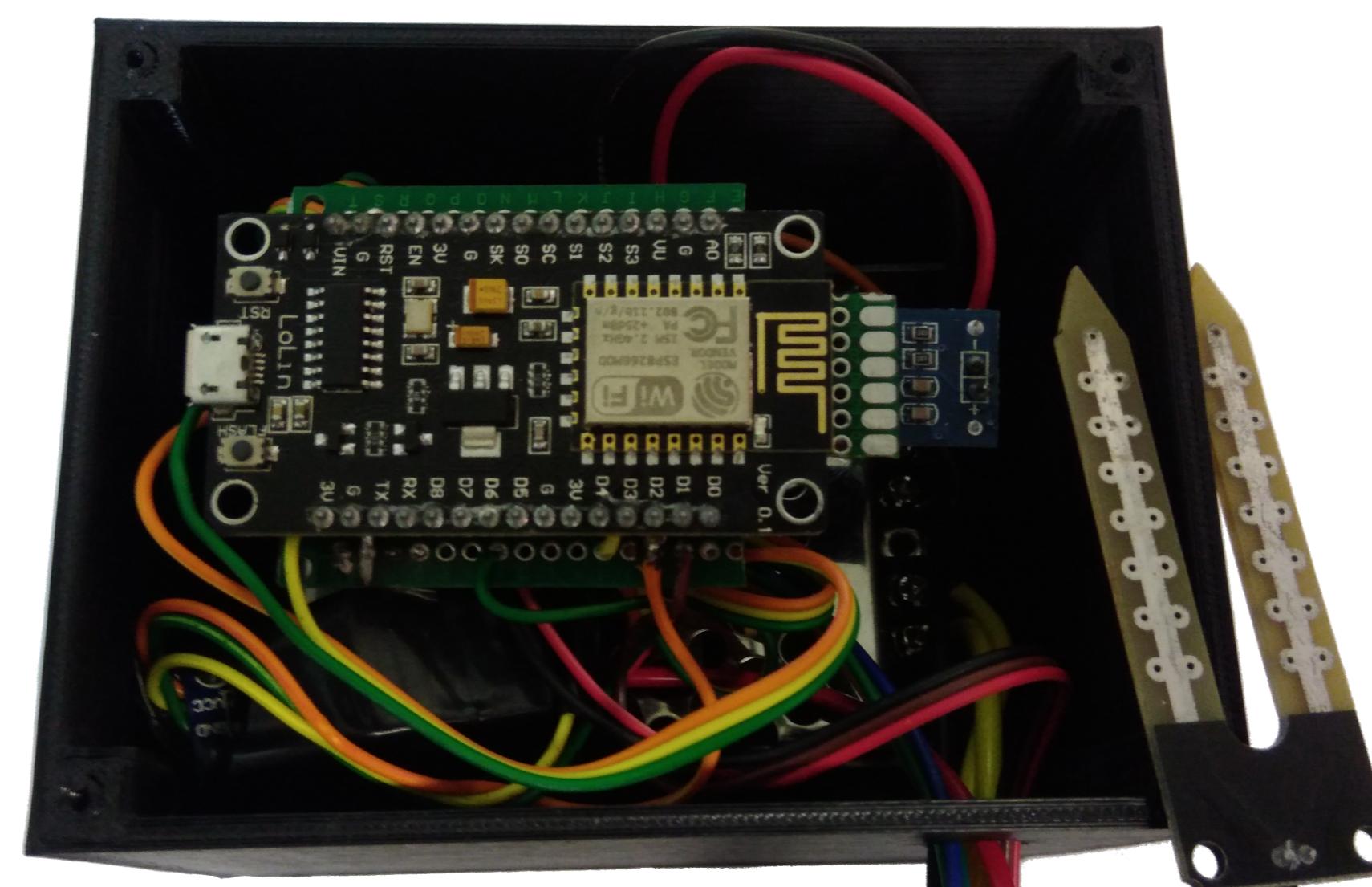


Figure 2. Prototype electronics: Node MCU and humidity sensor

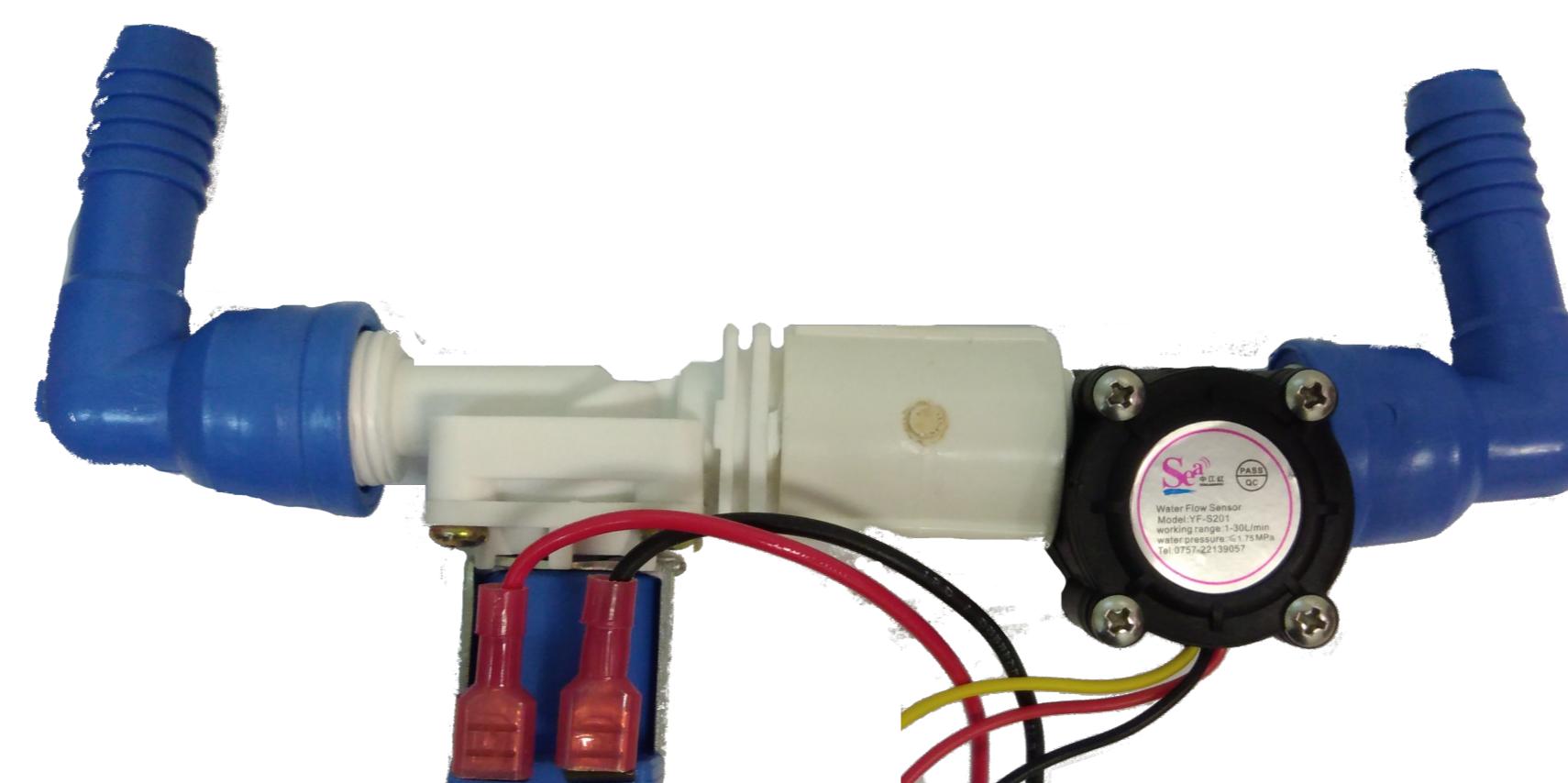


Figure 3. Prototype hydraulics: solenoid valve and water flow sensor

## Technology Transfer

Although Arduino-based systems are not new, they are easy to replicate projects, with hands-on and fast results that attract people outside de Computer Science community.

Technology transfer will take place during the project replication on selected public schools. We will teach introductory courses for teachers and children!

Fast practical results serve as leveraging tool to introduce basic, computer science and IoT concepts in elementary schools, working as a technology dissemination platform.

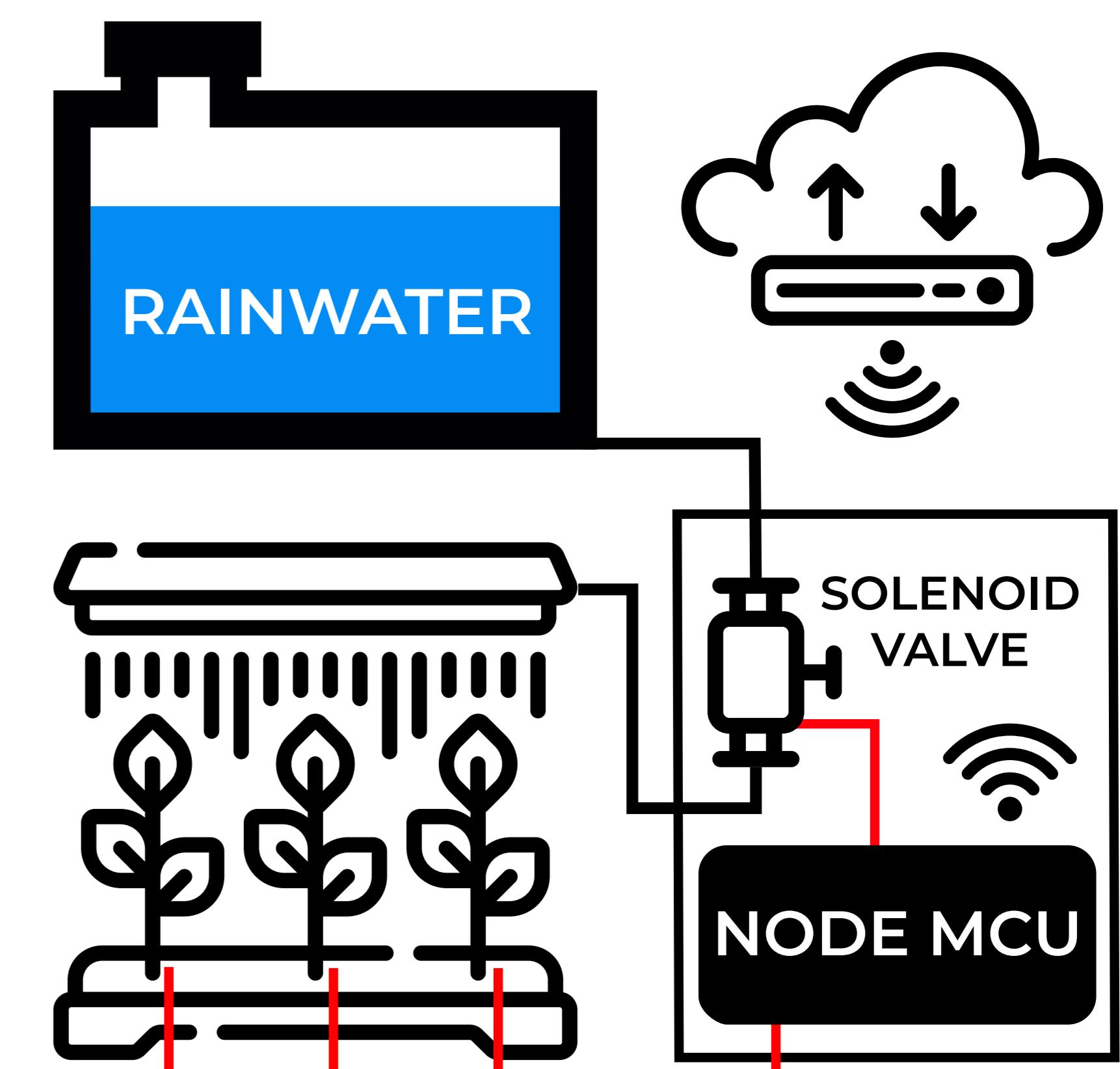


Figure 4. Expected use scenario of our prototype

## Data Collected

Used in elementary education:

- Science classes could use the data to illustrate differences between agricultural cultures; water cycle, use and reuse awareness could also be explored themes.
- Soil data might help in the irrigation process refinement, providing feedback about the water consumption for different green and vegetables.
- ThingSpeak is a user-friendly platform serving as proxy to instruct elementary teachers to use technology to favor experimental classes.

## Research Facts!

**Cost vs. water availability!** Our choices are directly related to limited school budgets. With rainwater in abundance, besides the sustainability factor, the irrigation process automation promotes cost reduction and saves potable water.

**Food matters!** In Brazil, students from low-income families generally rely on the free meals provided by public schools during daytime. To increase the opportunities to receive good balanced meals, this project concentrates on the green and vegetables production on public schools using low-cost technologies and rainwater.

**Water use!** According to the Brazilian's National Water Agency, irrigation responds for 67% of the total water used in Brazil.

**Share the knowledge!** Collaboration comes from sharing artifacts and communicating the results! All of our artifacts are released under open licenses! Visit our project on GitHub!

**Additional information:** <https://github.com/utfpr/HortaOS>

## Contact

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## References

1. CARVALHO, D. F. D. et al. Water use efficiency and economic return of fresh vegetable in organic cultivation. Revista Brasileira de Engenharia Agrícola e Ambiental, v. 20, p. 637-642, Jul. 2016. ISSN: 1415-4366.
2. Agência Nacional de Águas. ATLAS IRRIGAÇÃO: Uso da Água na Agricultura Irrigada, 2016. Available at: <http://atlasirrigacaoана.gov.br>.
3. BARBOSA, W.; POLATO, I. Horta OS Repository, 2018. Available at: <http://github.com/utfpr/HortaOS>
4. MIT Media Lab. Scratch, 2013. Available at: <http://scratch.mit.edu/>
5. LI, D.; QICHEN, H. ArduBlock, 2011. Available at: <http://blog.ardublock.com/>