

Smart Botanic IoT Hackathon Report

The Yerevan Botanical Garden is a national treasure, home to a vast collection of plants from around the world. It is a place of beauty, tranquility, and learning, and it plays a vital role in preserving Armenia's rich biodiversity.

However, like many botanical gardens around the world, the Yerevan Botanical Garden is facing a number of challenges. These challenges include climate change, water scarcity, and the spread of invasive species.

The IoT, or Internet of Things, has the potential to revolutionize the way we manage and conserve our natural resources. By connecting sensors, devices, and data, we can create intelligent systems that can monitor and optimize our use of water, energy, and other resources.

This hackathon was an opportunity to harness the power of the IoT to develop solutions to the challenges facing the Yerevan Botanical Garden. Participants of the hackathon had access to data, sensors, and experts from the botanical garden, and had the opportunity to work with other talented individuals to develop prototypes and applications.

The groundwork for the hackathon began in mid-October, involving several key initiatives. A dedicated domain was registered for the event, leading to the development of the hackathon's official website, <https://iot-hackathon.am>. The website served as a comprehensive resource, containing detailed information about the hackathon, including conditions, participant requirements, the hackathon agenda, and responses to frequently asked questions.

An extensive advertising campaign unfolded across various social networks, such as Facebook, LinkedIn, and Instagram. The outreach efforts extended to the DigiTec2023 technology exhibition, where printed booklets were distributed. In addition, numerous meetings were organized at prominent educational institutions, including Yerevan State University, Polytechnic University of Armenia, and Agrarian University of Armenia. Leveraging personal connections, representatives from both the Internet Society and SmartCity Society facilitated outreach.

As a testament to the success of these initiatives, a total of 14 teams from Armenia and two teams from Nigeria and Senegal registered to participate in the hackathon.

In Relation to the Production of Design and Printed Materials:

Concerning the creation of design and printed materials, we initiated the printing of:

1. The roll up banner

- 2. Notebook and pencil
- 3. Badges



Additionally, certificates in a large format were printed for the winners of the hackathon.



T-shirts featuring the hackathon logo and participation certificates were prepared for all hackathon participants and volunteers.

An agenda of the hackathon is attached.

The hackathon unfolded through three stages. In the first phase on November 7, participants and guests gathered at the Yerevan Botanical Garden. The objective was to familiarize them with the garden, ongoing projects, and existing challenges. The opening ceremony featured notable figures, including Deputy Minister of High Technologies of the Republic of Armenia David Harutyunyan, IOT SIG Chairman Vahan Hovsepyan, and Chairman of the Internet Society Armenia chapter Igor Mkrtumyan.



Arsen Gasparyan, the Director of the Yerevan Botanical Garden, along with Karen Yerznkanyan, the President of the Smart City Community Development Innovation Center, presented the participants with the challenges facing the botanical garden that could be addressed through IoT technologies.



For international participants, a Zoom connection with simultaneous English translation was arranged. Additionally, an on-site tour of the botanical garden was organized to provide insight into the existing challenges.

During the initial meeting, the hackathon organizers engaged in detailed discussions with each participating team, addressing additional project details and providing clarification on the necessary tools and electronic components required for prototyping.



Second stage: The 24-hour hackathon unfolded from November 18 to 19 at the ISTC Yerevan State University Technology Center.



A total of 48 participants, forming fourteen teams from Armenia, and a team of four participants from Senegal were present (the Nigerian team did not participate in this stage). Throughout the hackathon, three presentations covered the following topics:

1. "Smart Solutions in Botanical Gardens Worldwide and the Challenges of the Yerevan Botanical Garden" by Karen Yerznkanyan.



The presentation delved into a comprehensive exploration of innovative and intelligent solutions implemented in botanical gardens globally. It highlighted cutting-edge technologies, IoT applications, and intelligent systems that have been successfully integrated into botanical environments worldwide. The discussion aimed to provide participants with a broader understanding of the

global landscape of smart solutions in botanical gardens and set the stage for their innovative projects at the hackathon.

2. "Artificial Intelligence in Internet of Things Solutions" by Mher Yerznkanyan



The presentation focused on the integration of artificial intelligence (AI) within the context of Internet of Things (IoT) solutions. The speaker explored the synergies between AI and IoT, discussing how AI algorithms enhance the capabilities of IoT devices, leading to more intelligent

and adaptive systems. The presentation covered real-world applications, benefits, and challenges associated with combining AI and IoT technologies. Participants gained insights into the transformative potential of AI-infused IoT solutions during this session.

3. "The Contribution of Cloud Computing to the Development of the Internet of Things" by Yervand Galoyan.



The presentation delved into the pivotal role that cloud computing plays in advancing the Internet of Things (IoT). The speaker, Yervand Galoyan, have presented how cloud computing infrastructure provides a scalable and efficient platform for IoT applications. Topics have

included data storage, processing, security, and the overall synergy between cloud computing and IoT ecosystems. Participants gained an understanding of how leveraging cloud resources enhances the capabilities and flexibility of IoT solutions.

The mentoring team actively engaged with each participating team, conducting three comprehensive discussions to provide guidance and support in refining their projects



A panel discussion on the development and implementation of smart solutions in Armenia, exploring both current status and future prospects, was moderated by Narek Margaryan, a PhD student at Yerevan State University. The panel

featured SmartCity President Karen Yerznkanyan, Babken Harutyunyan (Associate Professor at Yerevan State University), and Kristina Hakobyan (Board Member of the Internet Society Armenia Chapter).



Additionally, mentors closely monitored the participants' work, approaching teams on the spot to offer real-time advice and assistance. This ongoing interaction aimed to enhance the quality and development of the projects throughout the hackathon.



During the hackathon, participants were well taken care of with a provision of four meals a day. For those needing rest at night, comfortable pouffes and warm blankets were made available, ensuring a conducive environment for both work and relaxation.

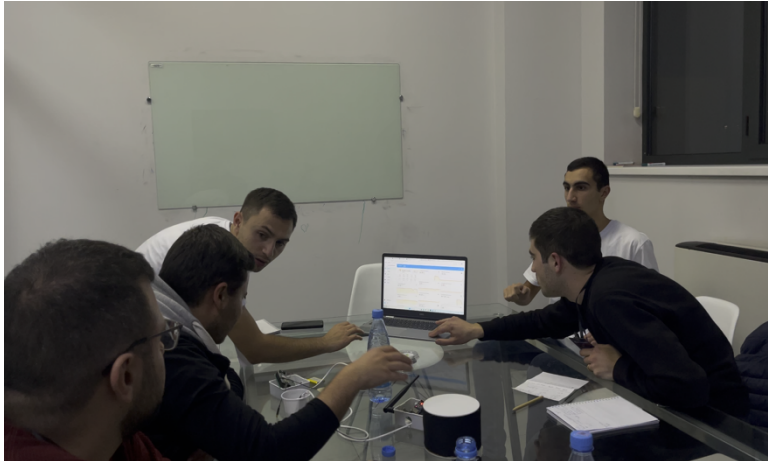


Hackathon participants were equipped with a range of tools, including multimeters and soldering accessories. Additionally, they were provided with electronic components essential for the development of their prototypes. The goal was to ensure that teams had access to the necessary resources to bring their

innovative ideas to life during the hackathon.

On November 21, the final stage of the hackathon witnessed the participation of 12 teams (from 14 teams 2 teams unable to complete their solutions). These teams presented their innovative projects to the jury and guests.

SmartStars



The Smart Stars team showcased their project, focusing on the heating and irrigation system for the Botanical Garden's greenhouse. The system is controlled by Arduino and ESP32 microcomputers, offering automated soil moisture control. Users can manage the greenhouse environment locally or remotely via the Internet from any location worldwide. Additionally, the team proposed playing classical music to enhance plant growth.

IT 2023



The IT 2023 team introduced a greenhouse management system model for the Botanical Garden, designed to maintain optimal conditions for soil and air humidity, temperature, and lighting. The model is based on the Arduino microcomputer and includes automatic ventilation through the greenhouse windows.

Smart Tree



The Smart Tree team developed a system for monitoring air components in greenhouses and open spaces. The model utilizes a Particle Boron microcomputer, allowing for remote control through mobile communication. The system includes alerts for exceeding permissible air quality limits,

and the monitoring results are displayed in the Home Assistant environment on a unified panel.

Smart Garden



The Smart Garden team introduced a smart lighting model for the Botanical Garden. The system is designed to differentiate between human movement and plant swaying caused by the wind, activating the lighting only when human movement is detected. The

implementation of this system aims to enhance the comfort and safety of park visitors while also contributing to substantial financial savings.

Fourward Engineers



The Fourward Engineers team has developed a model for automating the irrigation system of the Ecocenter in the Botanical Garden. As the Ecocenter is divided into distinct sectors, each representing the flora of various climatic regions in Armenia, the team aims to create a model ensuring specific climate conditions in each sector. The

proposed system is intended to be constructed using the ESP32 microcomputer.

Garden Whisper



The Garden Whisper team has designed an Armenian language "Anahit" voice assistant. The team has implemented an automatic guide using artificial intelligence and also proposed the development of a mobile application to assist visitors in navigating the botanical garden through voice instructions. The voice assistant can additionally control various smart equipment, including an idea to integrate it with a smart waterfall in the botanical garden.

BlazeBusters



The BlazeBusters team has created an artificial intelligence-based model for the early detection of fires in the Botanical Garden. By processing camera images, the system can recognize fires and trigger an alert at the initial stage, sending a message about the

detected fire. The recommendation is to install special towers in the botanical garden with cameras that scan the entire area for effective fire detection.

RCS



The RCS team has developed a remote monitoring and automatic control system designed for the automated monitoring and control of extensive areas. Utilizing Lora technology as the communication method, the team can establish communication between equipment over several kilometers. The

central node is constructed using a Raspberry PI microcomputer and is managed through the Home Assistant software interface. The team suggests

employing the system for the revitalization of specific zones within the Botanical Garden.

AGreen



The AGreen team has developed a software environment for cataloging the plants in the botanical garden. A garden staff member can approach a plant, capture a photo, choose its type using the mobile application, and register it on the botanical garden's map with a simple button

press. The system incorporates capabilities for identifying plant diseases and preventing theft. Furthermore, the team suggests augmenting the plant registration system with a task management subsystem to streamline and enhance plant care organization.

AeroGreen

The AeroGreen team has designed a smart IoT environmental monitoring system enabling remote measurement of temperature, air and soil humidity, and lighting intensity. This system can capture real-time environmental data and store historical information with graphical representations. Additionally, it incorporates a warning system to alert users in case of emergency situation.

The jury reached a unanimous decision to select the winners after a thorough evaluation of all the presented projects during the hackathon.





The top prize was awarded to the RCS team for their remote monitoring and control system, utilizing Lora technology for seamless communication between equipment over several kilometers. The central node, managed through a Raspberry PI microcomputer and Home Assistant, is proposed for irrigating specific zones within the Botanic Garden.



The AGreen team secured the second prize for developing a plant inventory software with features for disease detection and theft prevention in the botanical garden. They propose adding a task management subsystem for efficient plant care organization.



The Smart Tree team secured third place with their air monitoring system for greenhouses and open spaces, using a Particle Boron microcontroller for control via mobile communication. The system issues alert for exceeding air quality standards, and monitoring results are displayed in the Home Assistant environment through a unified panel.

The GreenGuardian project by the Greensavers team from Senegal offers an end-to-end solution that leverages IoT technology and advanced data analytics for efficient crop care. The project is designed to cater to both

greenhouse and outdoor environments, showcasing innovative and effective approaches to agricultural technology.



To facilitate the organization of the hackathon, 12 volunteers were enlisted to assist with participant coordination and manage processes such as food and recreation. In recognition of their contributions, the volunteers received certificates from both the Internet Society Armenia Chapter and the SmartCity Community Development Innovation Center.

Following the hackathon, a series of comprehensive events and meetings were initiated to delve into the details of each team's projects. The objective is to finalize project specifics and actively pursue funding opportunities for the botanical garden initiatives.

Currently, we have reviewed the hackathon results with the botanical garden staff and identified the three most compelling directions:

1. Implementation of an irrigation and climate control system in different sections of the botanical garden, including the greenhouse, environmental center, and distinct open areas where automated irrigation can be established.
2. Development of a botanical garden inventory system, featuring an online map showcasing plants with photos, characteristics, and historical care data. Integration of the system with task management is proposed to significantly enhance the efficiency of garden management.
3. Implementation of a fire detection system utilizing computer vision and artificial intelligence technology. The proposed system involves the installation of cameras on towers, interconnected via wireless communication, to detect smoke or fire. In case of an alert, messages will be sent to security personnel.

As for the assessment of necessary resources, our team is conducting a thorough analysis of the financial requirements for the selected projects. This involves estimating the costs associated with implementing the proposed technological solutions in the Yerevan Botanical Garden. The goal is to identify and secure the funding needed to accelerate the projects, ensuring their successful and timely execution. The team is actively exploring various avenues for financial support, including potential sponsors, grants, and partnerships. The detailed financial assessment will guide the planning and execution phases, contributing to the effective implementation of the innovative solutions in the botanical garden.



Smart Botanic

AGENDA

Introductory Meeting, Botanical Garden, 07.11.2023		
12:00	Visiting the Botanical Garden	
12:15 - 13:00	Opening speech	Davit Sahakyan, Deputy Minister of HighTech Industry
		Vahan Hovsepyan, Chair, IoT SIG
		Arsen Gasparyan, Director of Botany Institute
		Igor Mkrtumyan, President at ISOC AM Chapter
		Karen Yerznkanyan, President SmartCity NGO
13:00 - 14:00	Presentation on "Projects and Problems of the Botanical Garden"	Arsen Gasparyan, Director of Botany Institute
14:00 - 15:00	Tour-presentation in the Botanical Garden	Arsen Gasparyan, Director of Botany Institute
15:00 - 15:15	Coffee break	
15:15 - 17:00	Individual meetings with teams	Advisory team
Smart Botanic Hackathon, ISTC Center, 18.11.2023		
12:00 - 12:20	Hackathon opening	Karen Yerznkanyan, President SmartCity NGO
12:20 - 12:30	Presentation of condition and schedule	Narek Margaryan SmartCity NGO
12:30 - 13:30	Teamwork	
13:30 - 14:30	Lunch	

14:30 - 15:10	Presentation, IoT laboratory, Technology solutions in World botanical garden	Karen Yerznkanyan, President SmartCity NGO
15:10 - 17:10	Teamwork and advisory team consultation	Advisory team
17:10 - 18:00	Presentation, Artificial Intelligence in IoT solutions	Mher Yerznkanyan, SmartCity NGO
18:00 - 19:00	Dinner	
19:00 - 20:00	Panel discussion	
20:00 - 21:00	Teamwork	
21:00 - 22:00	Presentation, How cloud computing is driving growth of IoT	Yervand Galoyan, OkayCode Ltd
22:00 - 04:00	Teamwork	
04:00 - 08:00	Teamwork and advisory team consultation	Advisory team
08:00 - 09:00	Breakfast	
09:00 - 11:30	Teamwork and advisory team consultation	Advisory team
11:30 - 12:00	Summary of the round	Karen Yerznkanyan, President SmartCity NGO
Project presentation and award ceremony, ISTC Center,, 21.11.2023		
11:00 - 11:10	Opening of the final round of hackathon	Karen Yerznkanyan, President SmartCity NGO
11:10 - 13:00	Presentation of works by RA participants	
13:00 - 13:20	Coffee break	
13:20 - 15:00	Presentation of works by foreign participants	
15:00 - 15:30	Summary of results by the jury and announcement of winners	
15:30 - 15:50	Summary of hackathon results	Davit Sahakyan, Deputy Minister of HighTech Industry, Igor Mkrtumyan, President at ISOC AM Chapter Karen Yerznkanyan, President SmartCity NGO Arsen Gasparyan, Director of Botany Institute