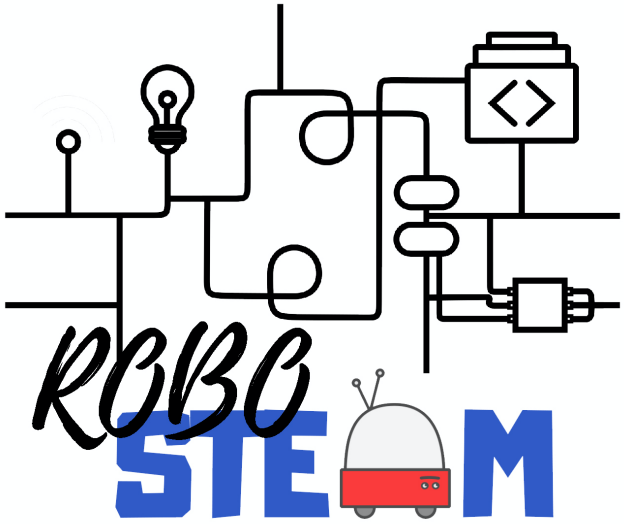
Environment Maintenance – O3.A4



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Version History

Version	Date	Comments
0.1	15/12/2020	Compilation of software updates
0.2	31/12/2020	Compilation of resources updates
1.0	31/03/2021	Compilation of COVID updates
2.0	31/02/2021	Compilation of hardware in the loop resources

Table of Contents

1. Description of the O3.A4 output

This document describes part of the work of the Output 3 – RoboSTEAM Environment [1], specifically the maintenance of such environment. The output aims to define an educational environment which will offer to schools and teachers a complete set of tools, activities, guides and support to manage the implementation of STEAM challenges within RoboSTEAM project [2-9]. An important part of this output is maintenance and continue with the compilation of resources defined in O3.A2 during the first year [10]. This activity is described as follow in the proposal:

> "*The environment will be maintained and improved during the project lifecycle, with special attention to the needs and requirements of the community members. New functions/manuals/tutorials will be added or improved if considered necessary.*"

The environment maintenance can be divided in technological maintenance and in resource update. In addition, this output has been extended to include resources that can be applied in the COVID-19 pandemic situation [11-17]. Some resources can have been uploaded as normal resources but if they can fit in COVID-19 category they should be updated to be classified in this way. Given such situation the current document includes three sections describing each of the cases. It is necessary to mention that this activity comprises two reports one in month 21 (after the two pilots) and the other in month 24. However, as the pilots were delayed, all the results are compiled in a single one.

2. Technical maintenance

The environment includes several components each of them are software solutions that interact between them to facilitate different functionalities to the project stakeholders. The Figure 1 shows the environment scheme as described in O3.A1 [18].

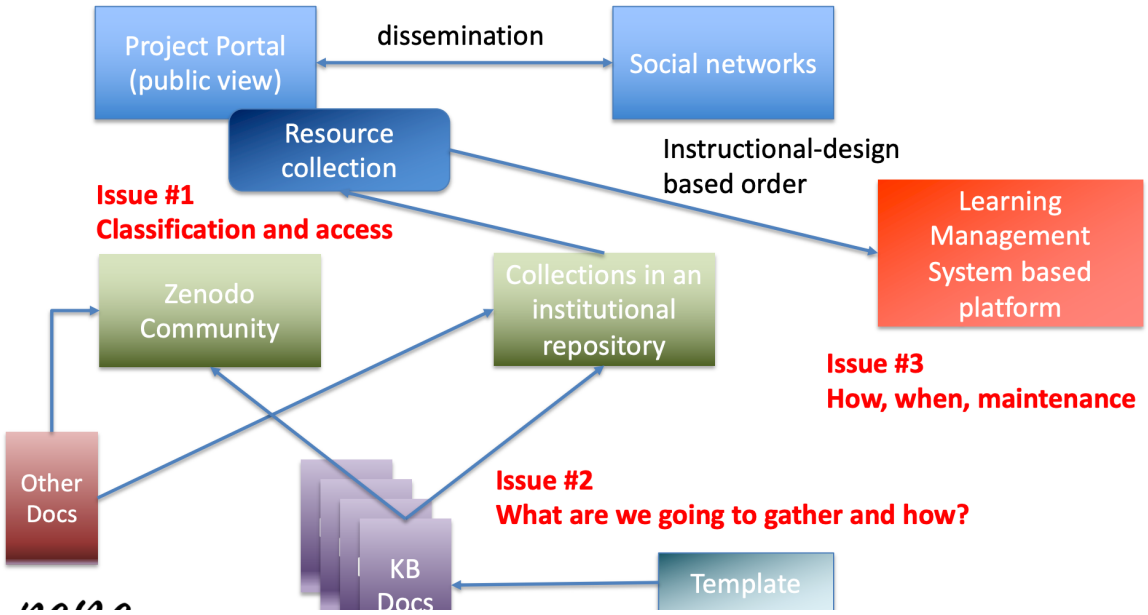

Figure 1 .- RoboSTEAM Environment Architecture

From it the two software systems that require updates have been the project portal and the learning management system, the others are based on cloud solutions, so it is not needed any technological update.

Regarding the Project Portal WordPress was used as platform and the initial version installed was the 5.0.3 release in February 2019, it was updated to the version 5.3 in December 2019 and to version 5.5 in September 2020. The last time it has been updated was to the 5.7 release in April 2021. In addition, the plugins included in the portal have also been updated, specifically Askimet-AntiSpam, Contact Form, GDPR Cookie Consent, Google Analytics, iThemes Security, JQuery Validation for Contact Form, Orbit Fox, Share Buttons, WP Facebook Auto Publish, WP SMTP, WP to Twitter and WP Forms Lite.

The Learning Management System installed in February 2019 was Moodle and the release 3.6.2. It was updated in January of 2020 to the 3.7.4 and in 2021 to the 3.10.1 in March.

3. Bank of Resources

Based on previous projects experiences [19-24], RoboSTEAM project uses the following template to describe the resources.

Template for a resource description

Draft. Version 1.
June 1th, 2019

Title: The resource title.

Description: A short, but significant resource description.

Link: Link to the resource if it is available.

License: What kind of licensing system the resource has, if available.

Languages: In which languages the resource is available.

Target groups: Which are the main target groups of this resource.

Known uses: Examples of the use of the resource, it they exist (including videos, text-based descriptions, links, etc.).

Pedagogical level: Resource pedagogical level.

Classification: The classification of the resource taking into account if it is (Tools to develop STEAM Challenges, Questionnaires about integrating and assessing STEAM, Frameworks, Report Tools, Learning Analytics Tools, Other).

Quality: Perceived quality of the resource [scale 1-5].

Open comments:

3.1. Tools to develop STEAM Challenges

1. Webots.
2. Robotbenchmark.
3. Turtlebot3.

4. Blocklyduino.
5. Hardware-in-the-loop.
6. STEMpedia.
7. STEM Education Curriculum.

3.1.1. Webots

Title: Webots.

Description: Webots is an open source and multi-platform desktop application used to simulate robots. It provides a complete development environment to model, program and simulate robots. It has been designed for a professional use, and it is widely used in industry, education and research.

Link: https://www.cyberbotics.com/.

License: Copyrighted by Cyberbotics,Ltd., license under the Apache Licence, Version 2.0. (The base program is free). More information: https://www.apache.org/licenses/LICENSE-2.0.

Languages: English.

Target groups: In the challenge-based learning context the target groups could be students, teachers, parents and experts.

Known uses: We can develop an environment / model, use one of the available manufactures robots or customize one, program it and simulate.

Pedagogical level: Any level (from 14 to 16).

Classification: Tools to develop STEAM Challenges.

Quality: 4.

Open comments: Feature rich and very comprehensive cross-platform robotics simulator. Contains a rich selection of different robot models and objects to create simulated environments. Includes also a variety of high-quality samples. Has a quite steep learning curve but tutorials help to get started with the environment. The environment is available for Windows, macOS, and some Linux distributions. It is also possible to compile the package from the source code. As a downside, the advanced 3D simulation engine requires a powerful PC or laptop with 3D accelerated GPU. The system might not run with lower-end computers often found at schools. In the challenge-based context we can simulate realistically the challenge. https://bit.ly/3hD1tMn.

3.1.2. Robotbenchmark

Title: Robotbenchmark.

Description: Online simulator for robotics challenges.

Link: https://robotbenchmark.net/.

License: Free to use, web version of Webots desktop simulator (Apache license).

Languages: English.

Target groups: Robot programmers from novices to experienced ones. Challenges are scaffolded so that they build on top of each other.

Known uses: https://robotbenchmark.net/about.php
https://youtu.be/S0k0cJb_Mus

Pedagogical level: From secondary school up to higher education.

Classification: Tools to develop STEAM challenges.

Quality: 4.

Open comments: Very robust and accessible robot online simulator. Challenges build nicely on top of each other, starting from basic tasks (difficulty level 1), where the user learns how to use the environment and how to move a robot in the simulator. Most difficult, five-start tasks provide challenge for advanced robot courses in higher education. The challenges are complemented with instructions and learning material that help to achieve tasks. System is, however, closed and users can't add new tasks. It remains to see how actively the developers and maintainers update the environment. Requires a modern web browser and a decent internet connection to work smoothly. Also, 3D enabled GPU helps to increase user experience.

3.1.3. Turtlebot3

Title: Turtlebot3.

Description: TurtleBot3 is a ROS-based mobile robot for use in education and research. It was designed. The goal of TurtleBot3 is to offer a platform under the

useful prices without reducing its functionality. The TurtleBot3 offers different expandability options that can be customized depending on how you reconstruct the mechanical parts, and which can of computational unit can we apply.

Link: https://emanual.robotis.com/docs/en/platform/turtlebot3/overview/.

License:

Languages:

Target groups: In the challenge-based learning context the target groups could be students, parents and teachers.

Known uses: ROS environments (http://wiki.ros.org/turtlebot3).

Pedagogical level: Any level (from 16 onwards).

Classification: Tools to develop STEAM Challenges.

Quality: 4

Open comments: it is a good robot offering several real sensors under 1,500€.

3.1.4. Blocklyduino

Title: Blocklyduino.

Description: blocklyduino is a Web-based visual programming editor for Arduino.

Link: https://blocklyduino.github.io/BlocklyDuino/blockly/apps/blocklyduino/.

License: free version.

Languages: English.

Target groups: In the challenge-based learning context the target groups could be school pupils, university students, teachers.

Known uses: Tutorial How to program an Arduino with Blocklyduino: https://maker.pro/arduino/tutorial/how-to-program-an-arduino-with-blocklyduino.
Maker.pro. DIY Electronic Projects and Tutorials. Collaboration Tools to Design and Share Electronics Projects with the Maker Community: https://maker.pro/.

Pedagogical level: Any level ("This article belongs to the STEAM learners, young and old, who want to make cool Arduino projects but are unsure where to start, as they have no prior knowledge of C programming. There is a fun and easy way to grow that knowledge: by using BlocklyDuino to program an Arduino").

Classification: Tools to develop STEAM Challenges.

Quality: 4.

Open comments: common tool to use for programming Arduino.

3.1.5. Hardware-in-the-loop

Title: Hardware-in-the-loop.

Description: The developed hardware-in-the-loop (HIL) tool provides a feature to test the hardware responsible for controlling all actions of the real robot, but controlling the virtual robot instead through Serial (USB) communication. In other words, the simulator will provide the sensor data (encoders, light, etc.) to the embedded controller in the hardware, which will process the data and control the actions of the virtual robot.

The HIL tool provides the possibility for students to implement their scripts in the microcontroller that will control the real robot and perform tests on the simulated robot, reducing errors in design, algorithms, controls and logic. The HIL deals with the real limitations of the microcontroller used to control the robot. The memory requirements and the processing limitations of a microcontroller are stressed and return the real problems minimizing the gap between the simulation and the reality.

License: Free.

Languages: English.

Target groups: Applied to students developing robot control algorithms.

Known uses: Micromouse and Robot@Factory Lite competitions.

Pedagogical level: All levels.

Classification: Tools to develop STEAM Challenges

Quality: 4.

Open comments: One of the most common tools to use for communication with peers and experts in challenges.

3.1.6. STEMpedia

Title: STEMpedia.

Description: An online "learning to code" course provider for kids. STEM counselling for Programming, AI and Robotics with STEM experts.

Link: https://thestempedia.com/.

License: What kind of licensing system the resource has, if available. No licence, STEM classroom bundle for educators available at: https://thestempedia.com/shop/educators/stem-classroom-bundle/.

Languages: English.

Target groups: school kids from elementary level on.

Known uses: Examples of the use of the resource, it they exist (including videos, text-based descriptions, links, etc.).

Introduction to AI, programming for different levels https://thestempedia.com/courses/.

Project hub: https://thestempedia.com/project/.

Also, commercial aspect: shop for STEM kits DIY STEM Kits https://thestempedia.com/product.

Pedagogical level: Beginners.

Classification: Tools to develop STEAM Challenges.

Quality: 3.

Open comments:

3.1.7. STEM Education Curriculum

Title: STEM Education Curriculum.

Description: A modular STEM education curriculum curated by STEM curriculum experts at STEMpedia and other educational institutes for introducing students to STEM disciplines with an interdisciplinary hands-on approach.

With experiential learning as its prime focus, the curriculum consists of about 90 lessons and hands-on STEM activities that will help students develop important life skills such as creativity, critical thinking, problem-solving, teamwork, and attention to detail.

The curriculum is accompanied by detailed lesson plans, activity sheets, and teaching slides for assisting educators in making the most out of the lessons.

Link: Link to the resource if it is available https://thestempedia.com/curriculum/.

License: STEM classroom bundle for educators available at: https://thestempedia.com/shop/educators/stem-classroom-bundle/.

Languages: English.

Target groups: School kids from elementary level on.

Known uses: Introduction to AI, programming for different levels https://thestempedia.com/curriculum/. Curriculum can be accessed at: https://v6f7u6f8.rocketcdn.me/wp-content/uploads/2019/09/STEMpedia-STEM-Education-Curriculum-Educators.pdf

Pedagogical level: Beginners

Classification: Tools to develop STEAM Challenges.

Quality: 3.

Open comments:

4. Bank of COVID-19 Resources

This set of resources has been very useful during COVID-19 pandemic to continue with RoboSTEAM activities.

4.1. Tools to develop STEAM Challenges

1. SUFFER.
2. Microsoft Teams

4.1.1. SUFFER

Title: SUFFER.

Description: SUFFER is a cloud e-learning tool. SUFFER stands for SimUlation Framework for Education in Robotics. It lays out the possibility of deploying labs with different characteristics based on Container as a Service, Platform as a Service and Software as a Service. SUFFER main objective is to adopt an approach oriented towards services on cloud to provide the robotics resources needed by the teacher and by the student for delivering and receiving a class.

Link: https://robotica.unileon.es/index.php?title=Tools#SUFFER.

License: Proprietary Software. Ad-hoc subscriptions.

Languages: English.

Target groups: In the challenge-based learning context the target groups could be students, parents and teachers.

Known uses: https://easychair.org/publications/preprint/b4GF

Pedagogical level: Any level (from 12 onwards).

Classification: Tools to develop STEAM Challenges.

Quality: 4.

Open comments: it is a cloud solution; thus, it is not useful in places without Internet.

4.1.2. Microsoft Teams

Title: Microsoft Teams.

Description: Microsoft Teams is a powerful team-work application that evolves the Skype application to a real networking tool. It might be applied to challenge-based learning environments and might be integrated with different LMS.

Link: https://www.microsoft.com/es-es/education/products/teams

License: Commercial. Microsoft 365.

Languages: Multilingual.

Target groups: In the challenge-based learning context the target groups could be students, teachers, parents and experts.

Known uses:
https://onedrive.live.com/view.aspx?resid=91F4E618548FC604!2263&ithint=file%2cdocx&authkey=!AMAtJ_tqrNP2lyg
https://onedrive.live.com/view.aspx?resid=91F4E618548FC604!2265&ithint=file%2cdocx&authkey=!ADrTMCACJVjL1YA
https://educationblog.microsoft.com/

Pedagogical level: Any level (from 12 to 16).

Classification: Tools to develop STEAM Challenges.

Quality: 5.

Open comments: One of the most powerful tools for teamwork.

4.2. Communication tools

1. Slack.

2. Discord.
3. Telegram.
4. Whatsapp.
5. Zoom.

4.2.1. Slack

Title: Slack.

Description: Communication platform for teams.

Link: https://www.slack.com/.

License: Free plan available, all features in paid subscriptions.

Languages: English, Germany, Spanish, French, Portuguese, Chinese.

Target groups: Any team of collaborators.

Known uses: https://slack.com/intl/en-fi/features.

Pedagogical level: Fits well in any age group and school levels working in group projects.

Classification: Communication tool.

Quality: 4.

Open comments: Slack is a feature-rich communication platform which provides sufficient tools to start with in its free version. However, some features (such as many-to-many video calls) are available only in the paid plans. Also, the free version has a limit of 10 000 messages, and after the limit is reached, the older messages are not available. This may set some constrains on the use of the tool in large organizations and/or in long-term projects. Slack API provides good possibilities to extend functionality and develop custom-made, project specific tools to increase productivity or to analyse groupwork or learning outcomes.

4.2.2. Discord

Title: Discord.

Description: Communication platform for teams.

Link: https://www.discord.com/.

License: Free to use.

Languages: Support for about 30 different languages.

Target groups: Any team of collaborators.

Known uses: https://www.discord.com.

Pedagogical level: Fits well in any age group and school levels working in group projects, younger students might need some help to get started.

Classification: Communication tool.

Quality: 4.

Open comments: Discord is a feature-rich communication platform which provides a communication platform without message or user limits. Getting started to use Discord is not difficult, but it might take a bit to get the group organized. Different channels can be created for example for working groups in a classroom. Discord API provides possibilities to extend the functionality of the platform. Clients are available for different desktop environments and mobile platforms, works also in browser.

4.2.3. Telegram

Title: Telegram.

Description: Telegram is a messaging app with a focus on speed and security, it's super-fast, simple and free. You can use Telegram on all your devices at the same time — your messages sync seamlessly across any number of your phones, tablets or computers.

Link: https://telegram.org

License: Free software based on an open development platform.

Languages: Mainly English.

Target groups: In the challenge-based learning context the target groups could be students, teachers, parents and experts.

Known uses: https://telegram.org/faq

Pedagogical level: Any level (from 12 to 16).

Classification: Tools to develop STEAM Challenges.

Quality: 5.

Open comments: One of the most common tools to use for communication with peers and experts in challenges.

4.2.4. WhatsApp

Title: WhatsApp.

Description: WhatsApp is a well-known tool that can be applied in Challenge based learning environments to facilitate the communication of the team members when they are not working in person. It includes the possibility to chat, make voice or video calls and share files.

Link: https://www.whatsapp.com/

License: 2019 © WhatsApp Inc.
More information: https://www.whatsapp.com/legal/#key-updates

Languages: Almost all.

Target groups: In the challenge-based learning context the target groups could be students and teachers.

Known uses:

Pedagogical level: Any level (from 14 to 16).

Classification: Tool to develop STEAM Challenges.

Quality: 4.

Open comments: One of the most common tools to use for communication with peers while developing challenges.

4.2.5. Zoom

Title: Zoom.

Description: A state-of-the-art video conferencing tool.

Link: https://zoom.us

License: Commercial product (free personal plans, limitations apply).

Languages: English.

Target groups: Teachers, students (12+ years).

Known uses: https://support.zoom.us/hc/en-us

Pedagogical level: Any level (from 12 to 16).

Classification: Tool to develop STEAM Challenges.

Quality: 5.

Open comments: Probably the best online conferencing tool currently available. Works in various platforms (browser, mobile phones). Works nice with lower bandwidth connections, good sharing features. Ideal for communication between the groups working with challenges.

4.3. Authoring tools

1. Kaltura.

4.3.1. Kaltura

Title: Kaltura.

Description: Video cloud platform.

Link: https://corp.kaltura.com/.

License: Corporative use.

Languages: Multilingual.

Target groups: Teachers.

Known uses: Many university campuses.

Pedagogical level: All.

Classification: Authoring tool.

Quality: 5.

Open comments: Open-source platform that enables video management, creation, interaction and collaboration. Kaltura's platform allows to integrate, in any web page, advanced and interactive rich-media functionalities such as search, ingest, import, editing, annotation, remixing and splitting of photographic, video and audio material.

5. Acknowledgements

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