



Project. RELAR (REmote Learning and examination
based on AR)

Grant Agreement n. 2020-1-NL01-KA226-ET-083043

Output 02 Task 5

SCENARIO 2

MARINE ENGINEERING



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1. Lesson Plan

Title of Scenario: Basic Cooling Systems Operation and Troubleshooting	
Partner Leading Scenario	Universidad de La Laguna
Partner Supporting Scenario	STC group
Scenario	• Marine Engineering • Shipyard technician • Fleet Assistant
Subject/Course	Cooling and refrigeration systems.3rd year
EQF Level	4
Date	During the 1st semester, 1 lesson/week
Time/duration	10 classroom hours and 15 self-study hours
Aim(s)	The unit prepares the student to perform basic operation and troubleshooting procedures in a cooling plant, including: normal start and stop, defrosting, long term stopping process, and the investigation and fixing procedures for the most malfunctioning problems.



Key Learning Objectives:

After completing this unit, the student will be able to:

- (1) understanding how a cooling system works,
- (2) operating a cooling plant for regular starting, stopping and defrosting,
- (3) preparing a cooling system for a long-term stop,
- (4) investigating common alarms in a cooling system, and
- (5) fixing common malfunctions of a cooling system.

Resources Needed:

- Cooling plant
- LMS system
- Electronic unit documents
- HMT-1 head mounted tablet

Knowledge, Skills and Competencies:

- Knowledge: Architecture, working principles and control strategies of a cooling system. Basic operation and troubleshooting procedures of a cooling system.
- Transferable skills: Analytical thinking, problem solving, and troubleshooting linked to industrial systems, assisted reality operation of systems.

Teaching and Learning Content:

- Description of a cooling system.
- Operation of a cooling system at operation level.
- Maintenance of a cooling system at operation level.



Steps in developing lesson including methodology as well as time allocated per activity

<i>Task/Activity description</i>	<i>Type [Guided; Unguided; Assessment]</i>	<i>Time allocated</i>
I. Prior knowledge activation about cooling physics. Students' presentation of cooling physics based on previous knowledge and written contents given by the instructor. Self evaluation test and feedback from the instructor.	Guided	1 hour
II. Hardware architecture of a cooling system. Physical description of a real cooling&5 plant by the instructor. Self evaluation test and feedback from the instructor.	Guided	1 hour
III. Control architecture of a cooling system. Physical description of the control board and its components. Self evaluation test and feedback from the instructor.	Assessment	1 hour
IV. Description of a cooling system at operation level. Students should discuss the function of each human-machine interface component and matching them in the control schematics. Self evaluation test and feedback from the instructor.	Assessment	1 hour
V. Starting, stopping, and defrosting procedures. Students will be given a written procedure. They should follow it in a real cooling plant with a HTM-1 headset. Instructor will assist the student remotely during the operation. Briefing and debriefing processes can be included as part of the learning process.	Assessment	1 hour
VI. Long-term stopping procedure. Students will be given a written procedure. They should follow it in a real cooling plant with HTM-1 headset. Instructor will assist the student remotely during the operation. Briefing and debriefing processes can be included as part of the learning process.	Assessment	2 hours
VII. Alarms and safety controls of a cooling system. Students will be given a safety diagram of the cooling plant. During teaching hours, and with the assistance of the instructor, students will elaborate the catalogue of alarms of a real cooling plant.	Assessment	1 hour



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VIII. Fixing common faults and alarms. Students will be exposed to alarms during their operation procedure with HTM-1 headset. Students should use written instructions to fix the problem. Instructor will assist the student remotely during the operation. Briefing and debriefing processes can be included as part of the learning process.	Assessment	2 hours
Use of Headmounted tablet: Exercises V, VI and VIII. Remote assistance, workflow creation and workflow testing		

Table 1. Lesson Plan

2. Digital Active Learning Process

The pedagogical framework for Demo Scenario design is based on active learning and remote learning. The instructor's role during the process is to guide and facilitate the learners through their actions and to give feedback when it is needed. Considering it necessary for proper active learning, the activation of previous knowledge is fundamental, where wrong concepts and misconceptions are corrected and helps to relate previous experiences to a new situation. Creating new knowledge and competencies, and consolidating them are the next steps, always considering the learner's motivation for the optimal autonomous learning process.

The Digital Active Learning process incorporates two different actions for remote instruction called Expert Coaching and Digital Workflow.

During *Expert Coaching*, learners receive instant feedback through selected technology while they are taking their own actions and decisions.

Digital Workflow contemplates asynchronous formative assessment to consolidate learning.

HMT-1 features allow the instructor to follow the user's view using a video call, capable to maintain a synchronous connection for immediate feedback or recording the action for asynchronous review, helping in Expert Coaching and Digital Workflow respectively.



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From the learner's point of view, the device can be used as a tool for viewing documentation related to their actions or as a guide to follow previously generated workflows.

3. Scenario description

The scenario splits into two separate spaces: the working area and the remote expert desk. The **working area** is where the chosen training system is located, with the HMT-1 user performing the selected task for the session, while the **remote expert desk** is where the HMT-1 user can be monitored or assisted. In Table 1. one can find the different elements needed in both spaces.

Working Area	Remote Expert Desk
• Chosen training system • HMT-1* ○ App RELAR Scanner ○ Zoom for HMT-1 • RELAR Scanner QR code • <i>In-situ</i> camera (optional)	• Computer* ○ RELAR Scanner's Google Sheet ○ Documentation for training ○ Zoom for PC ○ Working area pictures ○ Tablet with Zoom (optional) ○ Realwear Explorer (optional)

*Internet connection is required in both devices, preferably to the same network

Table 2. Elements needed in each space.

The HMT-1 user can work independently on their task without needing a Remote Expert to assess or monitor.

3.1 Scenario workflow

In the following diagram can be found the workflow followed by the HMT-1 users in scenario 3



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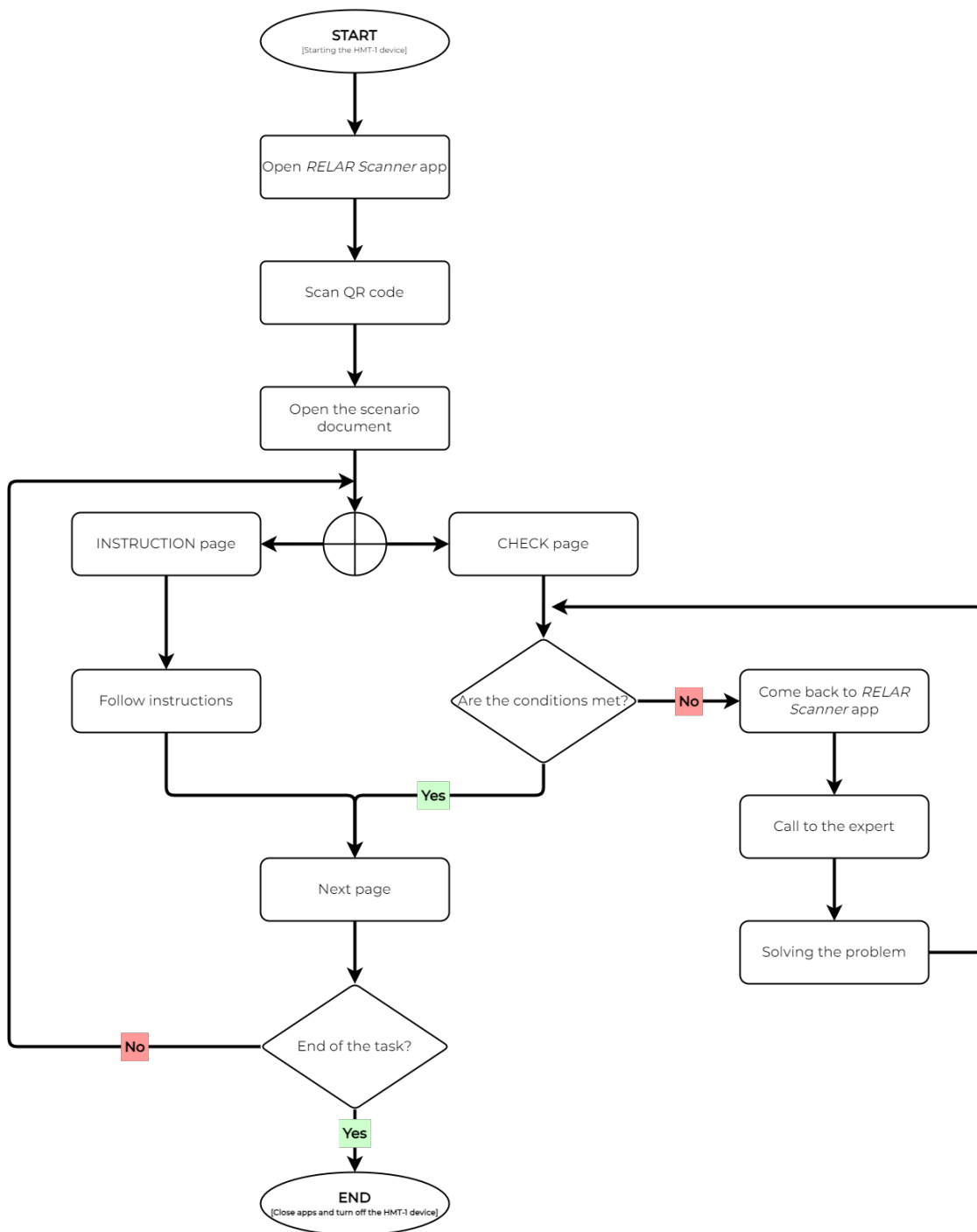


Diagram 1. Scenario 2 workflow



3.2 Wearing the HMT-1 device

Instructions for first time user were generated using a genial.ly presentation. It is linked to RealWear HMT-1 Setup Guide videos, such as Dominant eye, Adjusting Device and Voice Commands, steps to start “My training” in the HMT-1 device and connection to Wi-Fi. Figure 2-1 shows one of the presentation slides with links to the different videos. The presentation can be found in the following link: [ASSISTED REALITY WITH HMT-1](#) (Waszink, F. 2022)

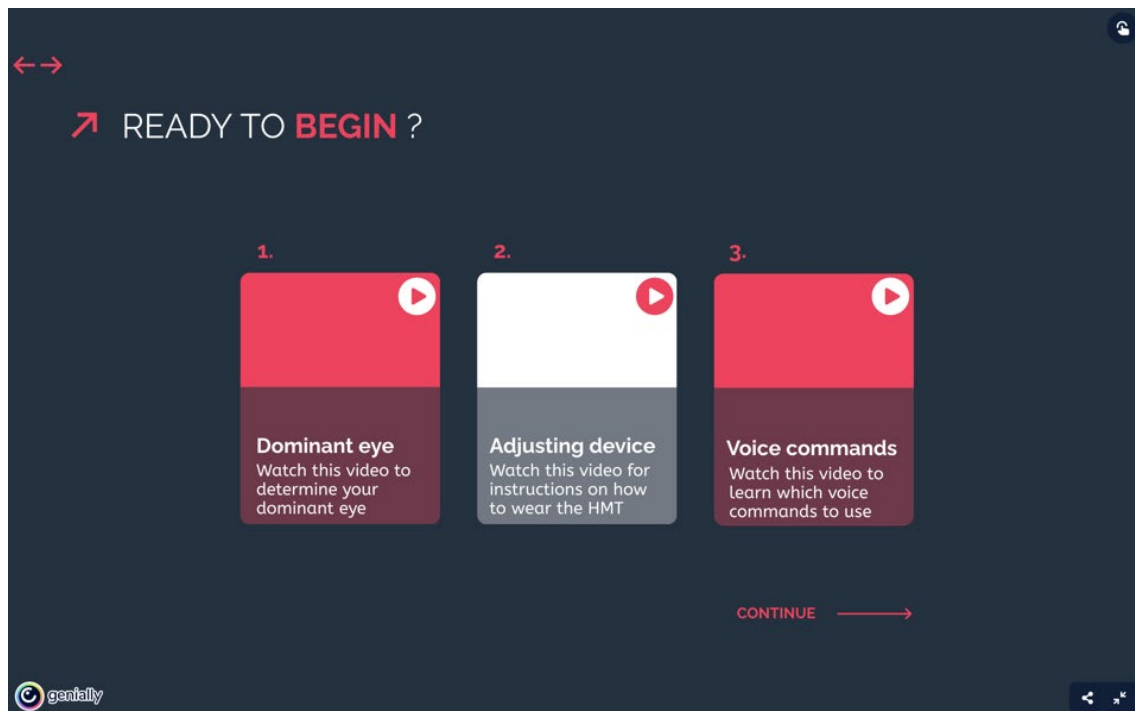


Figure 1 Genial.ly presentation for HMT-1 user first-time training

4. Scenario testing

In this section, a series of photos and screenshots are presented to explain the testing of the Marine Engineering scenario. The scenario is divided into 2 different areas, the first, where the HMT-1 user is in the Working area, and the second, where the instructor can follow the user’s steps through the RealWear Explorer and a scene-orientated camera. The HMT-1 user was connected by phone and in constant communication with the instructor just to follow short commands and to check that everything works during the experience. Scenario testing was recorded and uploaded to YouTube. It can be found in the following link: [Emisión en directo de LDF-Tecnomar](#) (made with a 360 camera, click and drag in the screen to change the view).

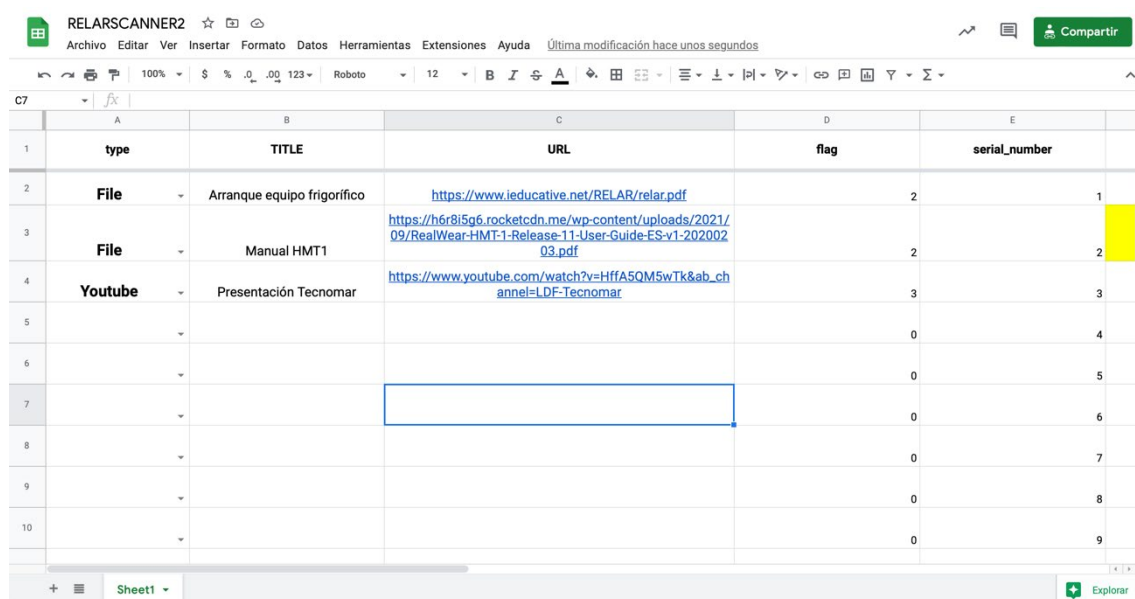
4.1 Digital Workflow

After preparing a workflow and making everything accessible via RELAR Scanner, with the QR code printed and placed somewhere visible in the working area. The learner can access the working area, open the RELAR Scanner apk, scan the QR code, and start working on the



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workflow. More instructions for the use of RELAR Scanner apk can be found in [RELAR ScannerApp - Manual & Videos](#) (Kogias, T. 2021)



	A	B	C	D	E
	type	TITLE	URL	flag	serial_number
2	File	Arranque equipo frigorífico	https://www.ieducative.net/RELAR/relar.pdf	2	1
3	File	Manual HMT1	https://h6r8i5g6.rocketcdn.me/wp-content/uploads/2021/09/RealWear-HMT1-1-Release-11-User-Guide-ES-v1-20200203.pdf	2	2
4	Youtube	Presentación Tecnomar	https://www.youtube.com/watch?v=HffA5QM5wTk&ab_channel=LDF-Tecnomar	3	3
5				0	4
6				0	5
7				0	6
8				0	7
9				0	8
10				0	9

Figure 2. RELAR Scanner Google Sheet



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Figure 3. Learner in the working area using the HMT-1 device.

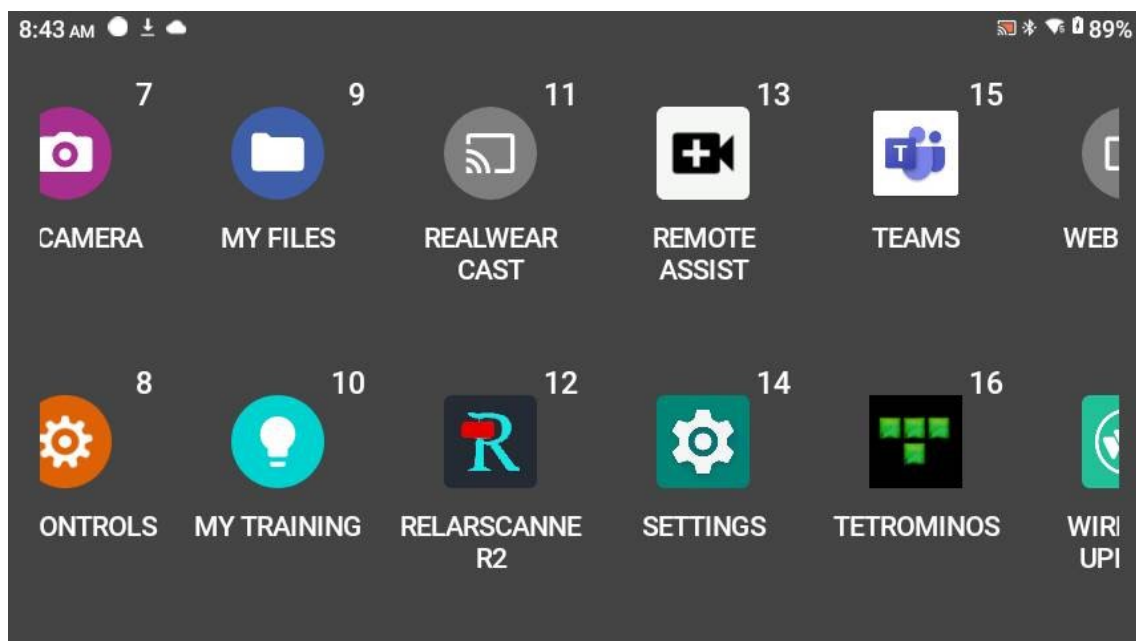


Figure 4. RELAR Scanner apk in the HMT-1 device.

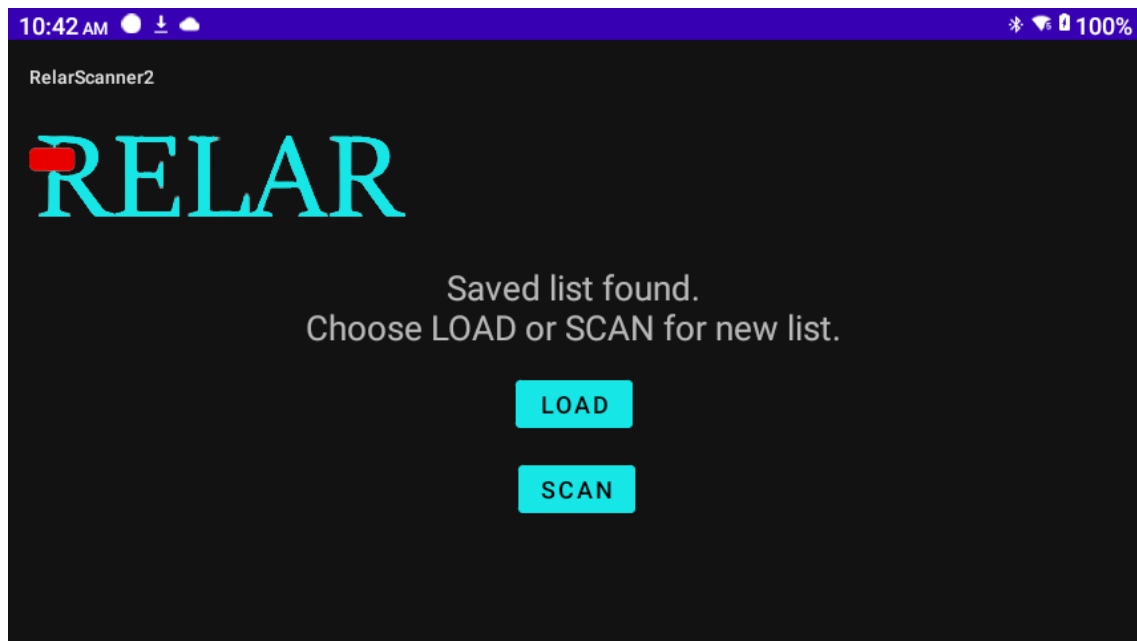


Figure 5. RELAR Scanner main menu.



Figure 6. Learner scanning the QR code in the Working area



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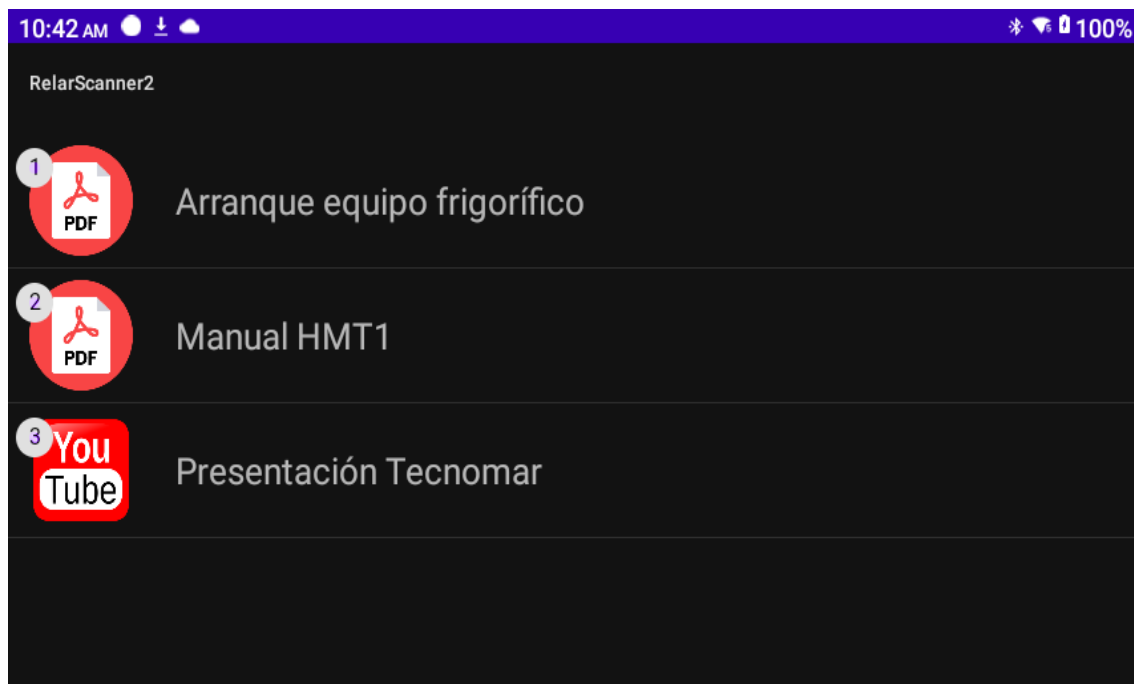


Figure 7. Available links from the RELAR Scanner apk



Figure 8. Step 1 in the workflow



el de aceite
mpresor
debe estar por
encima de la
mitad en el visor
del compresor



: MORE OPTIONS

RELAR

Figure 9. Step 3 in the workflow.



Figure 10. Learner performing step 3 in the workflow.



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The steps the learner had to follow during the *Digital Workflow* are enumerated below:

1. Operate the main switchboard to feed the electrical system
2. Check that the electrical supply is ON, at the control board
3. The compressor oil level must be above its half
4. Set the 'run switch' in position RUN (MARCHA)
5. Check the following items:
 - A. the compressor is running and the corresponding green led is ON
 - B. the oil level can be seen through the glass level
 - C. the condenser fans are ON, as indicated by a led at the control board
6. Be sure the oil level is above the minimum after starting
7. Low and high pressures should stabilize around 2 and 15 bar
8. Check the temperature value of the thermostatic controller goes down:
 - vegetables store temperature should reach +5°C
 - meat and fish store should reach -18°C



4.2 Remote coaching

For this mode, a videocall via Zoom is performed from the instructor side. It can be used to see POV of the learner or to share screen and navigate through previously prepared presentation.

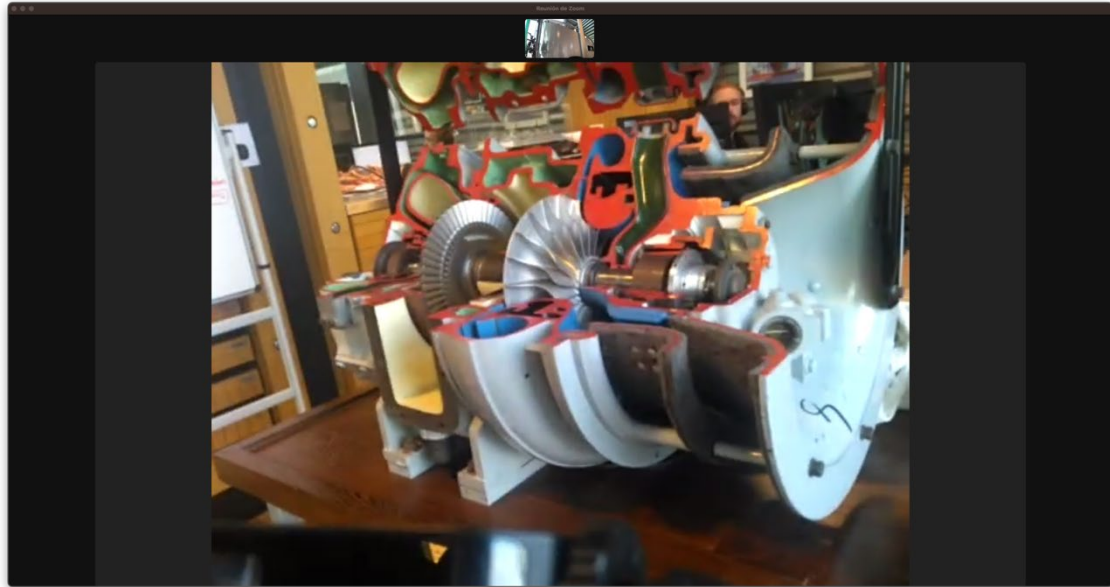


Figure 11. Instructor Zoom screenshot. Mainly learner's POV.



Figure 12. Learner Zoom screenshot. Mainly PC camera view with small screen with view of the learner's POV.



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5. Technical issues during scenario testing.

5.1 Landscape mode for Documentation viewer in HMT-1

First issue is related to the use of landscape mode in PDF for the HMT-1 document viewer. As it is possible to see in the figure below, a small screen appears in the upper left side of the document. This screen is normally used to navigate while using a zoom in a vertical document. This screen appears in every zoom level, and it isn't possible to get rid of it, blocking part of the screen view for the HMT-1 user.

This inconvenient could be solved by avoiding this area during workflow construction or by using zoom level 2 on each page of the document. Until finding a new solution, avoiding



Zoom navigation screen pointed with an arrow

putting info in that area could be a more useful method. A template with a highlighted area could be helpful for future workflows.

5.2 Zoom free account limitations

The Zoom app shows some advantages compared to the Teams app. These features are the Zoom free plan and the ability to continue viewing the caller in PIP (Picture in Picture) while navigating the device. There are also some disadvantages, such as:

- 40-minute limit for call.
- If the calling Host is the HMT-1 user or an Android or iOS user, it isn't possible to give permission to others to share screen.



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- A scheduled meeting made by a free account user cannot be accessed with the RELAR Scanner apk.

This can limit the possibilities in communication. 40 minutes call could be enough for many tasks, and it is possible to have another meeting right after the first one ends.



Figure 2-13. Learner Zoom screenshot when the instructor is sharing screen. Mainly shared screen with small screen with PC camera view.

In the case of sharing screen, the host must be the one that is going to share the screen or is in a computer to enable this feature.



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