zImageAnnotator

Improving traceability during the manufacture and repair of air quality devices using zImageAnnotator

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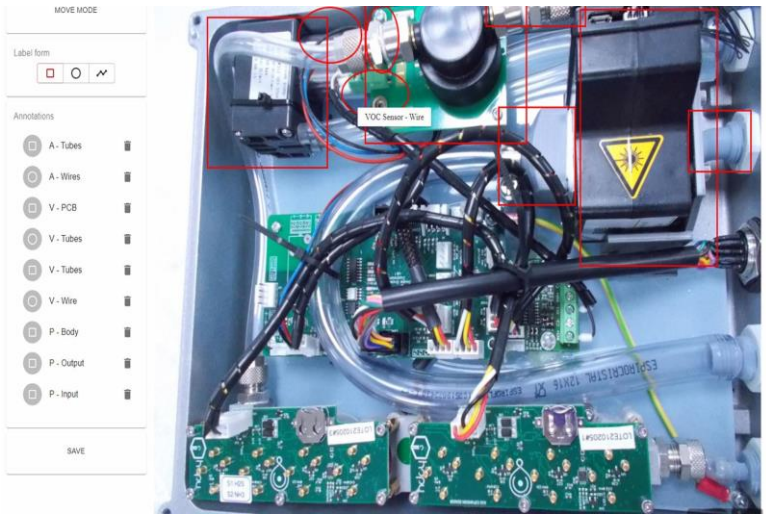
Project Details and Motivation

HOPU is a Spanish-based company specialising in manufacturing and deployment of air quality monitoring devices. The manufacturer of this type of device has many features that limit the standardisation of manufacturing, scalability, and cost reduction. One of these features is the possibility of product customisation: The HOPU catalogue has several sensors (NO2, O3, CO2, SO2, H2S, VOC, etc.) and different communication technologies (GPRS, NB-IoT, LoRa, etc.), which customers can combine to configure a product. This wide range means that each individual order is quite different and in batches of small units (10-50 units), making it difficult to automate production processes.

As part of quality control, and to check the assembly of a device with a certain sensor combination, all devices are photographed after the quality control is finished. This extensive photographic record is of great help to the technicians when faced with assembling a device with an unusual sensor combination. However, the current system does not allow for efficiently managing all these images, so within the ZDMP Lottery subproject (Lot-size one manufacturing defects mitigation via agile quality control and digital-driven dynamic and adaptive metrology), HOPU is solving these challenges with the use of the zImageAnnotator component for the labelling of sensors and other elements of interest that appear in the photographs.



Once the images are labelled, the result is a JSON annotated file containing information about the labelled elements in the image. These files can be processed using specific tools to search for certain elements in the picture. The use case aims to benefit from using the component available within the ZDMP project and to validate its usefulness in a real environment.

In addition, during the quality control process, this component is used during device maintenance and repair services. These devices will be photographed in those devices where they are necessary to replace or repair physical elements because they are damaged. Subsequently, the images will be labelled using zImageAnnotator.

The information collected through these annotations in the images is important for continuous improvement system since it allows a posteriori analysis of the problems that occurred to be performed and thus allows actions to reduce the number of incidents such as the use of parts that suffer less weathering by introducing alternatives with greater mechanical strength to prevent breakage of plastic parts.

Since the beginning of HOPUs company's activity, the quality control process for air quality devices has evolved according to the results obtained. Currently, this process results from the incorporation and optimisation of different new steps. One of the steps proven to be most effective is the 24-hour performance test. This is one of the last steps of quality control; the

device is connected and left in operation for 24 hours. After this period, a technician evaluates the device's behaviour in search of anomalies or possible issues. If any incident is found, the technician conducts the appropriate tasks for its resolution and repeats the test. This step allows identifying problems before installing the devices, reducing the failure rate.

Another process incorporated after some bad results with some parts is the quality control process of raw materials. Specifically, with certain elements used to manufacture air quality devices, there have been incidents that have affected a significant percentage of the batch of these components. This was the case in 2021 in batches of buttons and air pumps. After their use in the manufacture of devices, it was found that these parts did not meet the company's quality standards and that many of them failed early. Following these incidents, the quality control process for raw materials was incorporated. All batches of those elements that have had any incident are reviewed when the supplier delivers them. This process allows us to identify possible defects before they enter production in the batches. With Lottery and ZDMP, it will incorporate the use of zRemoteQC for better traceability of raw material batches used in manufacturing.

With the Lottery project implementation, HOPU intends to digitise and automate part of the quality control and monitoring process in deploying air quality devices. With digitisation and automation, a reduction in production times is obtained, which translates into a reduction in costs, and defects obtained during manufacturing, obtaining devices of higher quality and durability by having greater control and traceability of overall production processes. To achieve the above objectives, Lottery proposes the use of components and zApps such as zAutomaticMaterialOrdering (automation of the purchasing process), zRemoteQC and zMaterialID (traceability of raw material batches), zImageAnnotator (quality control and repairs) and Monitoring and Alerting and Digital Twin (quality control).

ZDMP Fit

One of the weaknesses in the Production and Quality Control departments is automating the digital registration of all details related to devices that have not passed the Quality Control requirements (losses) and, finally, losses statistics. For that, zImageAnnotator plays a key role as a software tool that can help to generate digital registers of each loss that is generated during the Quality Control process. For each device, a JSON file is created. highlighting the most important defects or issues found during the quality control process. Moreover, a list of labels that cluster all possible defects or issues found during the Quality Control process is defined and aligned with the different batches, thanks to the integration with the ZRemoteQC. Finally, it is crucial to monitor and validate the initial hours of the device performance to identify issues with the alarm and monitoring components (and the digital twin one).

Therefore, the fit with ZDMP is excellent since the improvements obtained through digitisation contribute directly to the reduction of manufacturing times, the improvement of device quality and, consequently, the achievement of a zero-defect manufacturing process, which is fully aligned with the objectives of the ZDMP project.

Results to Date

At the date of publication of this document, the ZDMP components (ie Apps and platform) have been successfully deployed on the HOPU data centre. The components have been tested and validated, verifying that they effectively fulfil the purpose established in the initial Lottery project proposal. After the validation, some technicians have already started to use the component for the labelling of the images made in the quality control to generate the database and tags for annotation and classification of defects. The next steps focus on integrating these digitalisation tools into the ISO9001, ISO14001 and ISO17025 processes implemented at HOPU to align all these processes with the normative and adopted processes, guaranteeing the long-term impact of the results.

Participant Details

- **Organisation(s) involved:** HOPU:
  - **Web**: https://www.hopu.eu/
  - **Contact**: info@hou.com
  - **Profile**: HOPU is an innovation leader in the Internet of Things (IoT) solutions and Smart Cities. HOPU brings urban innovation such as AI, IoT and Data through key techs-Quality. It engages citizens and decision-makers to guarantee that data is understandable by everybody. HOPU supports urban development and digital transformation through data-powered tools with dashboards and IoT devices to monitor air quality for gases and particulates. Creating IoT sensors and data-driven Smart Environments. HOPU's main market is environmental monitoring solutions, covering digital services with dashboard and decision support tools

based on AI algorithms compatible with reference platforms such as FIWARE / NGSI, CEF Context Broker, Sentilo, oneM2M / OMA LwM2M and LoRa Cayenne.

Environment

The ZDMP – Zero Defects Manufacturing Platform – is a project funded by the H2020 Framework Programme of the European Commission under Grant Agreement 825631 and conducted from January 2019 until December 2022. It engages 31 partners (Users, Technology Providers, Consultants and Research Institutes) with a mission to “Provide the platform, components, services, and marketplace to achieve the right product, at the right time, with the right conditions using the right resources.". Further information can be found at www.zdmp.eu. ZDMP channels 3.2M€ of SME orientated funding to subprojects, such as this one, to facilitate SMEs with their innovations and increase the value of the ZDMP ecosystem.

Links

● **Primary Partner:**	https://www.hopu.eu/
● **zImageAnnotator documentation**	https://www.zdmp.eu/iprdocumentsforzapps/project/zimageannotator
● **ZDMP Website**	www.zdmp.eu