ZERO DEFECTS Manufacturing Platform ZDMP

ZDMP Blog

Open Source AI and analytics to support Zero Defects

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Some questions for you

- How can you discover open source resources that you can use in your development projects?
- Do you know what algorithms or machine learning models can help you achieve zero defects in manufacturing?
- Do you know how Continuous Integration / Continuous Development pipelines can help you get the best out of those available resources?

Open Source to Achieve Zero Defects

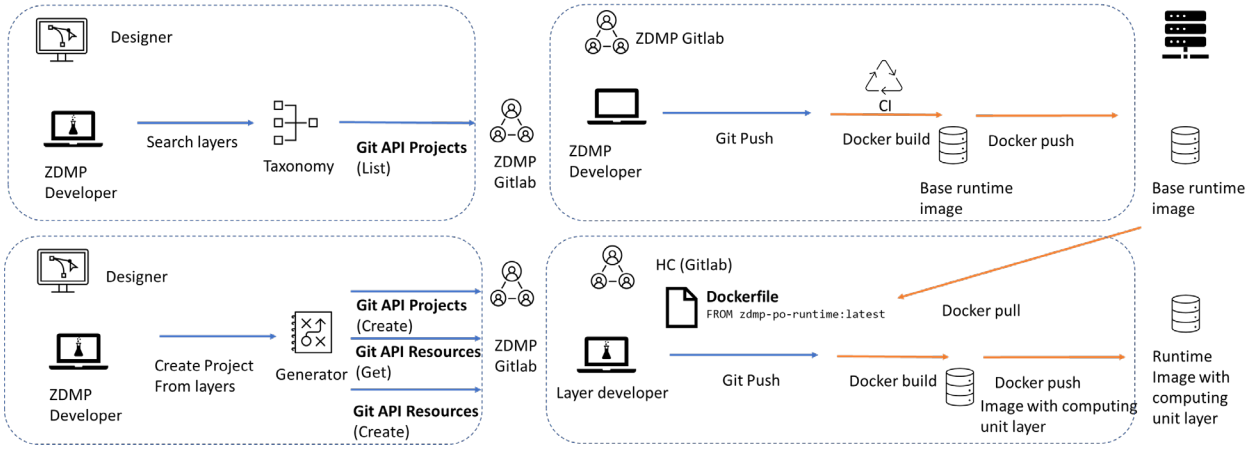
Open source software for Artificial Intelligence (AI), Machine Learning (ML), and Data Analytics solutions are backed by a vast community of software developers, data scientists, and specialists. Platforms such as Kaggle [1] aim to support this ever-growing community with a public data platform to exchange datasets, a cloud-based workbench for AI and ML, as well as education and training materials. One of the objectives of ZDMP is to create and support a vibrant community of AI and ML developers specialized in zero defects manufacturing. For this reason, there are specific design time components to foster the development and exchange of open source solutions for zero defects manufacturing.

Development of AI and Analytics components in ZDMP

Cooperation is one of the key aspects of digital manufacturing platforms such as ZDMP. In a trusted environment, manufacturers are willing to share their concrete problems and their data so that developers can test and validate their models and algorithms. Software developers and data scientists respond to the challenge with innovative solutions often based on open source. Just as in other areas of science and technology, data science is firmly rooted in the premise “we stand on the shoulders of giants” and in many cases re-using existing libraries and models proved to effectively solve specific problems. To support these interactions, ZDMP implements design time components that allow the sharing of datasets, algorithms, and machine models for zero defects manufacturing. These resources are classified according to: The specific problem in the product quality or process quality domain they address (eg detection of a process parameter going out of range); the objectives they aim to achieve (eg equipment performance); the algorithms or models they use (eg supervised learning);and the data fields involved (eg production speed).

Based on these taxonomies, developers can search for development resources (either datasets or development libraries) that are linked to the problem they are trying to solve. Developers only need to select the resources they would like to use and the design tool allows to either download a copy of the source code or to create a new development project from these sources in the ZDMP Git based collaborative development environment. This second option has several advantages for developers: Thanks to the tight integration of the development environment in the platform, generated projects provide valuable Continuous Integration / Continuous Development (CI/CD) pipelines which facilitate the deployment of the solution into the platform; and collaboration with final users. To close the loop, developers can also add new open source resources so that they are available to the rest of peers in the development community.

The figure below illustrates how the ZDMP Prediction and Optimisation Designer implements these features together with the Gitlab instance of the Human collaboration hub, based on the Docker container architecture of ZDMP. Development resources are organised in Docker layers. Docker layers install development libraries in the base runtime image so that they can be used in runtime. Through the designer, developers can browse available layers and add them to their development projects in the Human Collaboration hub git repository. They can modify or extend these libraries and publish the results in the marketplace. Additionally, developers can share their code as open layers for other ZDMP developers to be integrated in other layers or reused in other projects.



A new project based on open source

A fictitious example: ZDApps is a brand-new development company conceived to leverage from ZDMP. Good news! Sales have just landed a hot project on zero defects. The project needs a really strong AI and analytics component but there is no need to panic. Developers at ZDApps certainly have the skills, plus a further ace up their sleeve,,,tThey use the ZDMP design and collaborative tools to search for available modules linked to their project. Luckily, they find an open source algorithm that does most of the heavy lifting and that can easily be adapted to their particular use case. The project has been a great success and the customer is already asking for additional features that would require additional models. ZDApps wishes to be an active member of the community and in consequence, they open up the new models so that they are available to the development community.

What will ZDMP achieve

Through the design tools and the collaboration environment, ZDMP will facilitate the use of open source AI and analytic software solutions.

Starting from the use cases, the objective is to develop an extensive catalogue of open datasets, algorithms, and models for zero defects applications, linked to the specific problems they model and solve. A knowledge graph will capture the relationships between problems and solutions to support search queries in the design interface. In general terms, the knowledge graph should cover a significant part of the zero defects problem domain. The open calls will be another important source of contributions to enhance the knowledge graph and extend the catalogue of available open source resources.

ZDMP Links

• **Architecture Component(s)**	Prediction and Optimisation Designer
• **Work Package**	WP7 - Process Quality Assurance
• **Tasks**	T7.1 - Preparation Stage: start-up optimisation T7.2 - Production Stage: Equipment Performance Optimisation T7.3 - Production Stage: Material and Energy Efficiency

References/Acknowledgements

[1] Kaggle. Available online: https://www.kaggle.com/. Last accessed: 29/06/2020