AIR SAVE

Leading the Way Towards Clean and Sustainable Production

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Whether through extreme droughts, or heavy rainfalls, we are constantly reminded how the world is going through some devastating environmental changes as a result of the global warming phenomena. Governments all over the world are implementing directives and setting goals, such as the United Nations Sustainable Development Goals[1], to mitigate these impacts. On a national level, these include the Climate Action Act, the Malta Low Carbon Development Strategy [2]and the National Energy and Climate Plan [3], which stipulate the reduction of CO_2 emissions by 2030 (19% below 2005 levels).

Despite these efforts, there are many areas which still have to be addressed, including the industrial sector. For example, industrial systems heavily exploit Compressed Air Systems (CAS) since they are reliable and safe to operate [4]. Such systems operate at a low energy efficiency, as only 5-10% [5] of the electrical power is converted into usable output. Indeed, this makes pneumatic systems one of the major electrical consumers, with research claiming that this amounts to around 10% [6] of the total electrical energy consumed in industry. Additionally, the Malta Low Carbon Development Strategy classifies CAS as one of "the main energy consuming industrial processes in Malta". Another disadvantage plaguing CAS is that they are highly susceptible to leaks which are the most rudimental form of faults and inefficiencies. Typically, these amount to around 30% of the total available compressed air [7]. Moreover, the consequent hissing noise from these faults can also result in health hazards, since it does not only annoy operators, but can increase stress, anxiety and blood pressure, amongst others [9].

From a local perspective, research conducted at the University of Malta [8], [10], [11] shows that around 16,000 MWh are wasted annually due to pneumatic leakages and faults in Malta. This does not only result in a more expensive electricity bill of around EUR 2 million annually, but an additional 6,000 tonnes of greenhouse gases are also emitted. Around 32,000 photovoltaic panels would be required to offset these emissions, occupying the area of ten football pitches.

A number of conventional methods exist to minimise these losses. . Other than the traditional walk-through paying attention to apparent hissing leaks, one can use hand-held equipment such as ultrasonic leak detectors. These work by having the user go around the factory in order to isolate the noise emitted by the leak. Preventive maintenance actions, such as periodically changing piston seals, also ensure the upkeep of the equipment. Despite these activities, the chance of fault occurrences can never be completely eliminated. The mentioned techniques require human intervention, meaning that a considerable amount of downtime and manpower is required to perform these actions. To this effect, these maintenance actions are often given a blind eye in order not to disrupt production.

With this in mind, and with the ever-rising costs of energy production, there is an ever-increasing need for developing an automatic pneumatic monitoring system. The aim of such a system would be to make the overall fault-finding process a painless and cost effective task. This is where the project **'Development and Analysis of an IndustRy 4.0 System to Autonomously ImproVE the Sustainability of Pneumatics' (AIR SAVE)** comes into play. Its main goal is to develop a CA monitoring and control system which addresses the aforementioned shortcomings.

This system will focus on the demand side, i.e. targeting the compressed air delivery system and end uses, such as compressed air cylinders and end effectors, rather than the compressed air generation stage, as currently found in other monitoring products. This has huge potential since it is claimed that 50-70% of all possible CA improvements lie on the demand side. Adopters of this system will also have their mind at ease since this system will utilise pre-existing sensor equipment, making it easily retrofittable to pre-existing systems.

Industrial Internet of Things (IIoT) has embedded itself into various systems since it allows remote access to real-time system data. The proposed system is of no exception and will also integrate a number of Artificial Intelligence (AI) capabilities. The latter will allow the system to comprise intelligent monitoring capabilities, meaning that it will continuously learn how the system operates and perform the required actions automatically.

By encouraging the adoption of AIR SAVE, companies will invest in the reduction of downtime associated with fault repairs. Such efforts contribute towards a push for a cleaner and more sustainable industrial sector, whilst improving the economic and social pillars. *AIR SAVE* is a three-year research project funded by the 'R&I Fusion - Technology Development Programme' of the Malta Council for Science and Technology. It is led by Dr Ing. Paul Refalo, from the Faculty of Engineering of the University of Malta, in collaboration with Dr Ing. Emmanuel Francalanza, from the same faculty, and Dr Peter Xuereb from the Faculty of Information and Communication Technology. Research Support Officers Mr Massimo Borg and Ms Jasmine Mallia have embarked on their PhD studies related to this area. Mr Jurgen Aquilina, a Master by Research student, is also contributing towards the AI and ICT aspects of this system.

The University of Malta partnered with Mr Angelo Mifsud and Mrs Ylenia Grech Mifsud from AIM Enterprises. This project builds on years of preliminary research and collaboration between both institutions. Together with insight from the project's Industrial Advisory Board (comprising members from Toly Products, STMicroelectronics and Methode), it is the goal of both partners to see a concept moving forward from the labs to real industrial environments.

References

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