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2020 AWARD FOR SIGNIFICANT CONTRIBUTION TO UTILITY PIPELINE TECHNOLOGY

Entry Form

Entry Deadline: Friday, 17th April 2020

1. **Brief title of entry:** Artificial Intelligent Inspection for Electrofusion of PE Pipelines
2. **Company name:** ControlPoint Ltd.....

3. **Precis of your entry for inclusion in the Awards Lunch booklet (50 words):** Development of a truly unique artificial intelligence system to examine photographs to look for the three key causes of Electrofusion failure. Over the past few years ControlPoint have developed a pre-weld automated method to check for clamping, scraping and cleanliness in under 15 seconds, to guarantee right first time.

4. **Summary of entry:**

ControlPoint have spent the last few years tirelessly developing an in-house solution that can harness artificial intelligence and machine learning to teach an inspection robot (computer) to inspect photos collected during the Electrofusion welding process.

This development has utilised what we believe is the world's largest data base of site data (ControlPoint Joint Manager Platform) of real-world joint preparation to inspect for the main areas of concern in relation to quality. Through a technique of supervised learning we can detect for 1) Presence of a clamp 2) Evidence of scraping and 3) Cleanliness, these are proven to be the greatest cause of joints leaking or failing.

We have examined thousands of photographs from our database and taught the robot to recognise 1000's of different application of a clamp. If you consider how many different variations of fittings and clamps there are, and then multiply that by the number of permutations that they can be used in, hopefully this gives you an understanding of the size and the scale of the task we set ourselves. Add to this the complexity of contamination, hopefully you will agree that we set ourselves a challenging but worthwhile task? We ultimately see AI as a missing piece in the approach to quality assurance, providing quality control and therefore an overarching quality system aligned to the industry standards.

The 'why' is simple, we wanted to develop a quality assurance approach that can confirm if the fundamentals of joint preparation have been met **before** the welder can weld the joint. We recognise that this approach will (as our Bluebox app has already demonstrated), change mindsets on site and become a tool for permanent behavioral change. Too many welders are used to pressing yes on a fusion box, confirming and answering specific questions about the weld preparation but really just trying to increase speed of installation. This AI approach will check their answers in real time, and if they have not used a clamp or the joint is wet, it will allow them to rectify the issue and then re-submit the data. It may also be possible to prevent the welder to continue to work, until this is resolved or their supervisor has approved.

Therefore the 'what' in this development is that this gives everyone peace of mind that a joint will be installed right first time. The value this brings is real in a monetary sense, in that for every non-conformant joint traditionally identified using Bluebox app or supervision, two more joints are needed to replace it. If you think of the time and effort and associated cost of the fittings this could be a significant saving. By harnessing the power of AI as a 'friend' of the welder, it ensures that they don't miss anything critical when they are under pressure from other environmental or work based factors.

We have never believed that anyone wants to make a bad joint, but that on some occasions things are missed or they don't have the right equipment to hand. We want to see this development as a positive for quality assurance around jointing, but we also want to use the app to capture data from the welding box, the fittings weld time (adjusted for temperature) traceability (batch number) and to provide enhanced data through our unique Smartforms, where clients can start to tag data for future use in the journey for big data.



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So often when talking about new tech it is natural to ask 'when' it will be ready. ControlPoints AI product is ready now and is already being piloted by contractors for Yorkshire Water and Severn Trent and soon GTC and Northern Gas. We are not piloting the system, as it was built using real world images, we are testing its performance speed, accuracy and interaction with end user (e.g. the welders) so this is not something that we need to wait years for to see a benefit. We are seeing the accuracy of the system improve, with this type of approach, you're looking for not only how many times the AI inspection is correct, but how many times it is incorrect, when in fact the welder had no issues. On all three aspects accuracy is above 90% which is an amazing result given the variations we can often see. All AI inspections are then checked by a human inspector and the AI development Engineer to monitor variations to continue the teaching of the robot.

We see the use of AI in the field of quality assurance as game changing and therefore worthy of the Utility Technology Award, as we seek to support contractors, and asset owners in the construction of leak free networks that will stand the test of time for centuries to come.

4. **Signed:** **Wez Little**

5. **Date:** **27th April 2020**.....

6. **Company contact name:** **Wez Little**

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Email: **wlittle@controlpoint.co.uk**.....



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Detailed Description of Entry

ControlPoint has been the market leader for nearly a decade in driving improvements in the field of polyethylene jointing. These improvements have been focused on the development of EUSR training courses, coaching, development of mobile applications and a cloud-based database for real time intervention.

During this time technology has advanced significantly allowing us to harness the use of a miniature computer that people carry around in their pockets every day. We chose to take an integrated approach and our technology is embedded within the Electrofusion Boxes. We utilise Bluetooth tech to allow the mobile application and box to talk to each other and share information. Traditionally we then ask the welder to interact with the Electrofusion Boxes and the mobile app (Bluebox).

The operator can use the app to scan the fitting barcode and automatically capture the required weld time, and fitting material traceability. This is the first stage in the use of AI allowing us to determine the type of fitting that is being used. We then ask the welder to take three photographs of the electrofusion joint preparation, once these are taken the electrofusion box will receive a signal to allow it to weld. Once the weld is completed, we then upload the data to our cloud server for inspection by a trained inspector.

There is nothing wrong with this approach however we can only provide a result (conformant / non-conformance to standards) after the weld is completed. Therefore, two years ago we decided we wanted to find a solution that could work in real time and be pre-weld. We knew to achieve this we would need to use a combination of machine learning and artificial intelligence and teach a computer to inspect photographs we received, before sending the signal for permission to weld to the Electrofusion box. We want to target a time of less than 20 seconds, as we know that people would perceive this as an efficiency impact, which is why we currently complete the in-depth inspection post weld.

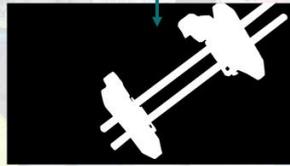
So this is our journey, we recruited some specialised software developers to start building and training our very own AI Robot. You might ask, what made us best placed to do this? Well, we have the world's largest database of labeled site data of joint preparation. More importantly we had real world photos to learn from, not photos that have been taken in laboratory conditions. We can't go into detail in this submission about the development of the algorithms as this is our Intellectual Property. It is not our intention for the AI to replace our detailed inspection approach, rather it will be complimentary.

We then determined based on testing data from across many industries and determined that AI would need to be capable of detecting three key things 1) Presence of a clamp 2) Scraping 3) Cleanliness. The sheer variety of clamping techniques and contamination means we have analysed thousands and thousands of photographs to look for the presence of these three things. It has been an immense effort to be able to say we have been able to not only develop an AI tool that correctly identify the three most common mistakes, but more importantly this is already market ready and has been used by Yorkshire Water and Severn Trent. We are seeing the accuracy of the system improve, with this type of approach your looking for not only how many times the AI inspection is correct, but how many times its incorrect when in fact the welder had no issues. On all three aspects accuracy is above 90% which is an amazing result given the variations we can often see. All AI inspections are then checked by a human inspector and the AI development Engineer to monitor variations to continue the teaching of the robot.

What we can now offer our partners (customers) is a method for identifying non-conformant joints before they are welded. As the system develops we will be able to put in layers of control for the asset owner and installer, however for now, we are using the AI to interact with the welder. If the system detects something it does not recognise, it will firstly ask the welder to retake photos to address the issues. It can also ask the welder if they are happy with the preparation (they may not be able to use a clamp due to other restrictions). It is well proven that this type of approach will engage the human brain and make them think, it also requires them to confirm that they are taking a decision that could ultimately make the joint non-conformant. This therefore makes this a significant onsite behavioral tool, with the benefit of being contact free and remote, meaning that no one needs to go to site, the data is captured in real time, and we can truly start to say that this approach to AI+QA will lead to leak free and right first time installations. For an SME to have developed this inhouse around two years this is a significant achievement, especially as this was all self-funded by ControlPoint, and naturally we are excited to see the impact it has across the utility sector.

AI Development Challenges

- ✓ 000's of variables
- ✓ Component recognition / Smart Components
- ✓ Uniquely positioned to develop AI - Database
- ✓ Data Tagging opportunities – Excavation



Clamping – Examples



Power of AI – Pre-inspection of Scraping



Power of AI – Pre-inspection of Contamination

