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SEARCH PATTERNS IN HUMAN VISUAL INSPECTION

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Visual inspection in high value manufacturing is a task currently undertaken by highly trained human operators. Human operators show variability in detection rates and strategies. Work has been carried out (within the centre?) to automate certain aspects of visual inspection using robots. This paper presents the results of a small study investigating human visual search patterns and their effect on defect detection rates. This paper will focus on the human aspect of visual search which can provide an insight into the most effective ways of detecting defects.

Introduction

There are various definitions of visual inspection, but from a human perspective is the process of using the eye (aided or unaided) to make judgements about the condition of an item. From a scientific perspective, it is a change in the light's properties after contact with the item. Whether this change is identified by the human eye, or a vision enhancing accessory, or an automatic system does not change the key objective of visual inspection (Drury and Watson, 2002). When considering automating a process currently undertaken by a human operator, gaining a thorough understanding of current processes is vital in order to design effective automation. Work has already been carried out to effectively measure surface defects using a 6 axis industrial robot to provide a robust, repeatable, mathematical solution for automatic defect detection and characterization (Tailor et al., 2013) and this study will provide human insight into this mecahanised process.

When a human visually inspects a part or a system, they may also use tactile feedback to identify the nature of any fault or abnormality, and could potentially use auditory cues to alert them to a defect. So although coined visual inspection, these other qualities should not be discounted. For this task, detailed as oppose to general visual inspection is considered. Currently in high value manufacturing, detailed visual inspection is a task carried out by human operators. Depending on

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the criticality of the task, different training lengths and methods are required. While standard operating instructions are often provided for the inspection of parts, the task is currently very subjective and finite techniques vary between operators, as do detection rates. Spitz and Drury (1978) developed a two component model of visual inspection which is the most widely recognised. The two components they describe are search and decide. They state that these elements are totally independent of one another, and literature supports the theory that the search aspect and strategies used cannot be carried over to a different task, whereas learned decision making strategies can (Drury and Wang, 1986). However, one would argue that it is dependent on the type of defect being inspected: surface defects are surface defects, no matter what object they are on. If it was a detailed inspection of a circuit board, this may be different. This study focuses on the search aspect of Drury's model and aims to identify if patterns emerge through practice, or if optimal strategies exist, which can then feed into automation work.

Method

10(??) participants with no previous industrial inspection experience were asked to identify 12 different indentation defects (3 different sizes of indent following the Rockwell specification set out in ISO 6508-1 (Baxevani and Giannakopoulos, 2009)) on metal test pieces of 4 different surface finishes (Tailor et al., 2013) while wearing eye tracking glasses. There were also 4 test pieces of differing material finishes with no defects. The test pieces were randomly assigned, but given in the same order to each participant. They were told that there would be one defect per test piece, and were told that it would be an indent defect. Eye tracking data was gathered for each participant, and a short interview was carried out with each participant after the test and the glasses were removed.

Results

Eye tracking data:

Any patterns? Did the smaller ones take longer? How long did it take to notice the test pieces without defects? Were there any prevalent patterns that aided faster detection?

Qualitative data:

1) Did you find that task easy or difficult? Why?
2) Did it get easier as the trial progressed? Why?
3) Did you have a strategy? What was it?
4) If the trial was more complex do you think you may have approached it differently? How?

Conclusions

This study demonstrates that …. (search patterns, , surface finishes, size of defect **affect** detection rates, improvement with practice)

By considering human behaviours and approaches to visual inspection tasks, automation can be optimised, and is more likely to be accepted and trusted by human operators. This is important when considering collaborative environments and should be incorporated into any work package considering automating a human led task.

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References

Baxevani, E. and Giannakopoulos, A. (2009), "The modified Rockwell test: a new probe for mechanical properties of metals", *Experimental Mechanics,* vol. 49, no. 3, pp. 371-382.

Drury, C. G. and Wang, M. (1986), "Are Research Results in Inspection Task Specific?", *Proceedings of the Human Factors and Ergonomics Society Annual Meeting,* Vol. 30, SAGE Publications, pp. 476.

Drury, C. G. and Watson, J. (2002), "Good practices in visual inspection", *Human factors in aviation maintenance-phase nine, progress report, FAA/Human Factors in Aviation Maintenance.@ URL: http://hfskyway.faa.gov*, .

Spitz, G. and Drury, C. G. (1978), "Inspection of sheet materials--test of model predictions", *Human factors,* vol. 20, no. 5, pp. 521-528.

Tailor, M., Phairatt, P., Petzing, J., Jackson, M. and Parkin, R. (2013), "REAL-TIME SURFACE DEFECT DETECTION AND TRACEABLE MEASUREMENT OF DEFECT IN 3D", *11th International Symposium on Measurement and Quality Control 2013,* .

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