Machine Vision System Solution

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Abstract. The problem faced by the Linamar Corporation's vision automation system is one of which deals primarily with its performance accuracy ratings falling below an acceptable threshold set forth by the client. The solution that has been presented within this report addresses the clients problem through a multi-faceted approach which incorporates specific lighting and optic schemes, hardware placement and preparation and software as well as firmware tuning. The various aspects of the final solution were tested independently against the common base case (a mirror of the current failing setup) as well as all together as a final complementary solution to show its overall effectiveness in addressing the performance accuracy ratings desired by the Linamar Corporation.

1 Introduction

The vision system problem consists of two areas of focus pertaining to the current system performance. The vision system project is essentially comprised of two main areas of focus which are; the processing elements (software), and the visual elements (hardware). The visual elements can be further broken down into three parts; camera optics, lighting, and the presentation and preparation of the part or subject matter being analyzed. The issue faced with the current system pertains to its consistent in-ability to achieve the required performance accruacy ratings set forth by the Linamar corporation. The systems shortcomings can be attributed to several factors; poor OCR training, overly narrow peripheral view constraints (several characters are cut off during recognition depending on the part being processed), as well as poor lighting and inadequate optical implementations.

2 Background

The materials reviewed throughout the analysis of this project include literature on recognition software being utilized along with its pertinent algorithms, material regarding the optics of the lens, lighting, and material regarding the vision system process in an industrial setting. From these materials a basic understanding of the issues effecting the project itself can be obtained. See the references section attached to the end of this document for the specific books reviewed.

With the division of the system as mentioned above into smaller sections, the solution becomes attainable. The improvement of the system with the purpose of raising both the recognition rate, and the consistency of these rates can be achieved by improving each area of the problem independently to attain a total solution.

3 Methodology and Design

The processing elements of the recognition system are largely under the scope of the camera manufacturer which leaves little room for improvement or modification of the recognition rates via its processing algorithms. However, an improvement available to the vision system camera is a potential operating system upgrade. There are two main available options for upgrading; upgrade to DVT FrameWork 2.8, or upgrade to DVT intellect 1.5.0. While using the current version (DVT FrameWork 2.5) as a reference, testing of the other available packages revealed that DVT FrameWork 2.8 produced the best recognition rates detailed within the conclusion of this report. Therefore, DVT Framework 2.8 was selected as part of the solution for our design.

Another aspect of the solution which we have addressed is that of optical and lighting schemes; the current optical setup of the camera appears to fall short by not meeting the necessary peripheral view constraints (ie. It cuts off several characters from the serial number during the requisition phase) this can be attributed to the initially chosen lens having inappropriate characteristics for the systems needs. In addition to the poor lens choice there is also an approximate variation of the part in relation to the static position of he camera of about 3 mm which can add to the peripheral view constraints. Optical calculations deriving the area being viewed by the camera revealed that a smaller focal length lens was better suited for the application. Several lenses where purchased, and after testing the new lenses it was found that an 8mm lens instead of the current 16mm lens gave a large enough area of the image to capture the entire serial number, and at the same time retain the fidelity of the picture. In order to address the wide variety of lighting conditions present in the industrial setup of this system, appropriate literature was consulted in relation to both testing and optimizing. The results achieved indicated that the recognition of the image was best under a moderate illumination, generally in the form of non direct lighting due to the fact that direct lighting tended to create reflections, glare, and white washing. Additionally the literature and testing indicated that the use of similar color lighting to the paint on the part helped to improve recognition rates by providing a better contrast between the paint (background) and the

dark etched serial numbers (foreground). This improvement was hampered by the inconsistency of the paint on the part itself.

Of the parts available for testing it was observed that slight variations in the thickness of the paint on the part contributed significantly to the loss in recognition. Specifically it was observed that small variations in uniformity of the paint became apparent when viewed through the vision camera. This variation was remedied by increasing the application of the paint itself as well as replacing the current bulb with one with a similar color of paint to that of the parts background. It was also noted, through testing, that an increase in the current volume of paint applied by a factor of two as well as the consistancy that the pain was applied (more uniformed) was sufficient to remedy the inconsistencies.

Overall the proposed solution for the currently implemented system improves the recognition rates and the consistancy of the rates significantly. The vision system solution is therefore composed of these sub-solutions; upgrade the firmware and software, appropriate lens, sufficient lighting and color, and the increase in consistency of the paint. These four sub-solutions work simultaneously to provide a complete and robust solution for the client.

4 Conclusion

Independently, the facets of the solution presented within this report achieved minor to moderate system performance enhancements. There was a noted average improvement of approximately 20.3 percent recognition in comparison to the base case when implementing the new 8mm lens selected for this project, and an improvement of 3.3 percent when applying the new optical lighting scheme, a minor performance decrease of 3.8 percent when the new part preparation procedure was introduced to the base system (it must be noted that this is solely intended to show results when complemented with the new lighting scheme for the final solution. Individually these improvements do not necessarily achieve the desired accuracy ratings by the client, but when implemented together serve to compliment one another to provide a total and well rounded solution achieving the desired confidence levels set forth by the client at confidence rating of approximately 84.0 percent.

5 Acknowledgements

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