Axicon Response to Proposal for the development of a 2D Judge

Introduction

This document is in response to the request for proposal from GS1 US to development a device to measure and analyze high precision, NIST traceable, matrix symbology test targets. The proposal is being submitted by Axicon Auto ID Ltd as the project manager of a group of UK organisations which will bring the expertise and resource required to complete the work of delivering the product as outlined in the request for proposal document. Part of the task of managing the project will be to refine the statement of work into a detailed specification of each aspect of the project and to coordinate the testing and delivery of the completed sections. Further details of the contributing organisations are given below.

Section 1: Technical Proposal

1. Imager
In order to meet the requirements of resolution and achieve sufficient field of view for the larger test symbols, it is felt that an imaging array of at least 3000 pixels in each axis will be required. There are a few devices available that would meet this requirement and the final choice will depend on a compromise of image sensor price and field of view that will be required. Different optical arrangements will need to be made possible in order to accommodate the need to image and measure symbols with the minimum X dimension as well as larger symbols such as those on current conformance test cards for linear symbologies.

The preferred resolution of 5000 pixels/inch will give the following limitation in image width or height for the smallest axis (where the number of pixels differs in X and Y directions, if such a sensor device type is employed).

> 3000 pixels on smallest sensor axis will give 0.6 inch maximum imaging length
> 4000 pixels on smallest sensor axis will give 0.8 inch maximum imaging length

The fixed pattern damage symbol in section 3.5.1.4 of the request for proposal, which is a 32 x 32 module symbol would exceed 0.6 inch width if it was produced with a 0.5 mm (roughly 0.02 inch) X dimension, so this would suggest that 4000 pixels on the shortest axis of the sensor would be needed as a minimum and this would certainly limit the available choice of image sensor device.

Several sources of illumination will be provided, to meet the needs of ISO/IEC 15415 and AIM DPM-1-2006, and it will be possible to switch each of these on or off with controls available in the user interface software. Which illumination source is used for the analysis will be reported and stored along with the results.

2. Mechanical positioning and rotation of samples
An X-Y motor driven table will take the sample to be measured from a loading position to the imaging point. It will then be possible to rotate the table for the purpose of imaging the sample at different angles. Mechanisms to hold the samples in place will be developed to suit the calibrated conformance test targets that are manufactured. It is assumed that the 2D Judge will be located in an environment with appropriately controlled environmental conditions so that the test targets can be certified with the measurements made at those controlled temperatures and humidities. The 2D Judge will not control its own environmental conditions.

3. Image analysis software
Axicon will define individual programming tasks to be undertaken and the actual coding will then be performed by resources from organisations associated with the consortium, some of which will probably include university research departments. Testing tools will be developed in order to check individual modules of decoding and analysis software and Axicon will coordinate and have ultimate testing responsibility for the code that is being written.

The prioritization of software development will follow the phased approach outlined in the request for proposal but planning from the start will ensure that matrix and multi-row 2D symbologies in addition to Data Matrix are catered for as well as linear symbologies.

4. Image capture and control software
This software and any firmware required will be written in conjunction with the hardware development of the imaging and positioning systems.

5. User interface and reporting software
The user interface will bring together the control of the positioning, image capture and data analysis modules and will enable reporting and storage of the results of the analysis that has been performed.

The 2D Judge will be a useful backup to the existing linear Judge, however, the optical resolution of the 2D Judge will not be equivalent to the existing linear device. In order to replace the existing linear device completely, it may be necessary to consider ways in which the current outline for the 2D Judge be modified to achieve better measurement resolution.

Section 2: Organization Qualifications

There has not been time to fully confirm the roles and contributions of all of the participants listed below and other organisations and individuals are likely to be brought in where their expertise can be used for the success of the project, so this list is just the starting point for getting the project off the ground.

Organisations involved

1. Axicon Auto ID Ltd
   The lead company in the consortium would be Axicon who would oversee and project manage the work.

2. European Centre of Excellence for AIDC in the UK
   A not for profit organisation funded jointly by European, UK and local funding. The Centre will provide support in raising funding for this project and at the same time would be an excellent home for a second 2D Judge to reside should funding for two devices be achieved.

3. University of Central England - Technology Innovation Centre
   Web link - Automatic Identification And Data Capture @ tic
   The Technology and Innovation Centre have considerable expertise in Automatic Identification and will provide some of the programming resource required to generate the software modules for this project.

4. AIM UK

Key personnel:-

Martin Morrison – Technical Director at Axicon Auto ID Ltd
Professor Anthony Furness – Chief Technology Officer at European Centre for AIDC
Professor Keith Osman - Research Manager & Pervasive Computing Leader at TIC

Specific expertise

Axicon have been designing bar code verification equipment for over 20 years and have used CCD devices in their verifier designs for 15 years. In addition, Axicon designed a highly accurate photoplotting system for the generation of bar code film masters. This photoplotting system included an X-Y positioning system for locating the unexposed film with stepping motors in increments of 2 microns (0.00008 inch).

Professor Tony Furness has a background in Electronic Engineering, Engineering design, Total Quality, Quality Assurance of Measurement, Automatic Identification and Data Capture and the development of item-attendant ICT he is well qualified to participate in the development of the 2D Judge, particularly with respect to metrology and quality assurance of measurements, systems design, 2D symbologies and signal processing.

Professor Keith Osman has experience in 2D bar code technology and signal processing and is currently running a research project looking at direct part marked Data Matrix symbols.

Section 3: Price Proposal

It is Axicon's intention that some, probably 50%, of the funding for this project will be obtained from UK or European development grants. Axicon are proposing that two identical pieces of hardware be built, one to reside in the USA and one in the UK. The costings below, however, are for a single device.

1. Imager system
   Two options presented here depending on ultimate resolution employed. This price includes the imaging CCD device,lens arrangements, illumination and the associated electronics to control and capture signals from the device.
   a. 9Mega Pixel solution -
   b. 16Mega Pixel solution -

2. Measuring platform, base and positioning systems
   Mechanical devices as specified in the statement of work -

3. Calibration targets
   NIST traceable reflectance and dimensional calibration targets -

4. Image Analysis software
   The intention is for all of the image analysis software modules to be written by sub-contract resource at UK universities.
   Phase 1 -
   Phase 2 -
   Phase 3 -
   Phase 4 -

5. Image capture, control and positioning software
   This work is expected to be completed during phase 1 of the project -

6. User Interface and reporting software
   This work will be significantly complete during phase 1, but there will be some additional time spent in this area during the following three phases -

7. Stand alone computer with necessary additional interfaces to system
   Desktop computer with necessary interfaces and operating system -

Assuming that the option B imaging system is the one that is chosen, the total costs for the project will be;

Hardware design costs -
Software design costs -