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Computerized Printing Supporter for Quality Colour Printing
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Declaration

The author hereby declare that the project work entitled *“The computerizes printing supporter for quality colour printing”*, submitted to the Plymouth University is a record of an original work done by the author, under the guidance of our Supervisor Mr. Saravanapavan Nasiketha.. The results embodied in this report have not been submitted to any other University or Institution for the award of any degree. Information derived from the published or unpublished work of others has been acknowledged in the text and a list of references is given.

Abstract

Approximately 80% of the printing machines used in Sri Lanka are one colour. During one route the machine print only a single colour. To print a four-color image, the paper needs to be printed four times. That is four routes, until the process complete, we are unknown about final product, whereas we cannot guarantee if the final outcome will be accurate as the actual sample.

The colour mixing totally depends on the machine operator on how the CMYK combinations need to be used in the machine to obtain a perfect outcome. Practically not all operators are experts, and there is high possibility of going wrong.

And also, beginners who processed the basic knowledge of printing machine to obtain perfect outcome of a given sample by comparing colour depth and value between the sample and the outcome obtained. Apart from the colour guidance, the application also decides the colour depth and the water level of the output to further optimize the outcome.

In present printing industry not available any system for checking the printed sample with the original image. Because of that printing wastage is very high. And not enough expert employers who are capable with printing quality printing out come as the original image.

In this research team develop a system to compare printed sample with the original image sample. It will help machine operator to compare the two printed samples and do any necessary changes to the machine and reprint a quality printed image. And system user friendly for less computer literacy people also.

Acknowledgement

The work described in this thesis was carried out as the final year research project. The completed final project is the result of combining all the hard work of the author and the encouragement, support and guidance given by many others. Therefore, it is the duty of the author to express gratitude to all who gave the support to complete this major task.

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1 Introduction

1.1 Research problem to be addressed

In Sri Lanka there are 6500 registered printing organizations. In printing industry mainly use two verities of printing machines to printing job. They use one single colour machine and four colour machines for printing process. But most of the printing organizations use single colour machines for their work.

Most of the printing organizations use single colour machines to print four colour image. In the printing process it is very difficult to print four colour image in a single colour machine. According to the single colour machine process it will print only a one colour for a one printing process. Problem arises, to print a four colour image, the image must be printed four times to get final outcome. Until paper complete all four-printing process inside the machine. Machine operator cannot guarantee about the final outcome. And also, machine operator cannot check the accuracy of the printed sample with the original image. There is no option to check the quality of the final outcome.

In the printing process colours highly effects on the printing output. Inside a printing machine color mixing done by manually. Colour mixing depends on the machine operator, to get a quality outcome machine operator mush have experience in colour mixing. Most of the machine operators have less experience which cause lack in quality of the product which will also result in a greater cost and high wastage.

In the printing machine there are kind of value that control the ink on the printing surface. Controlling valves done by machine operator. Machine operator cannot predict the amount of colour level to be used in the printing area. Any change in the colour levels in image will reduce the quality of the outcome and will be change the printed outcome. Because of that, the wastage will be high. This ink controlling process very poor and inefficient.

In a printing paper there are some registration marks to register the colours in the paper. It will check weather all the four colours are exactly printed on each other. If any differences between these registration marks, it means image did not printed correctly or not all the colours positioned on the printing surface correctly. In the present printing industry, there are not any available options to analyze the registered marks until the printing job is done.

In the printed image, colour is filled into small dots. If any damage in a dot, it will damage the quality. In the present printing industry, there are any methods to analyze the dots.

These are the problems highly arise in the present printing industry.

1.2 Background context

The computerized supporter for a quality colour printing outcome is a system that will overcome problems in the printing process. This project is a motivational research project considering the fact that it is a printing supporter. It has multiple research components which go beyond the scopes of simple logical structuring and usability, involving also the development of an image processing to handle the functionality of channel separation, four colour registrations and identify the quality of the printed dot which is the smallest component of a printed document.

As mentioned before when it comes to four colour printing with single colour printing machine, biggest problem operator face is now how to balance inks to get fine printing outcome same as the sample. Because operator with less experience enable to predict the extracted cyan, magenta, yellow and black images for given printed sample. Basically, most of the operators follow a method to get the cyan image in to their head is use photoshop to extract channels and see if ink balance is accurate. But the problem in this scenario is computer display will show image using RGB colour schema and printed outcome will use CMYK. If operator use this method and probably end up with getting the wrong printed outcome.

A small change in a colour will directly affect to the final outcome and it cannot be correct again when printed using single colour machine. Because int the process operator will print the whole bilk in one colour, then change to another colour and print again the whole bulk. It is decided to design a system that capable of driving channels from supplied sample and compare it with the printed outcome. So, the system will get the colour density value of both documents and suggest operator what he should do. When it comes with controlling valve, no ink will com e to that area. If operator opens the valve that area will be filled with ongoing colour. Likewise, operator can control all the vertical lines according to need of ink for the printing.

In the system will get the sample and extract the channel operator wants to print. Then system will divide image to controllable vertical lines and calculate the values of colour density predict values for valves.

In four colour printing industry uses some marks to ensure four colour channels printed on each other correctly. Only then operator get sharp printed final outcome. System will locate registration marks and analyze those marks are accurate. If not, system will provide alerts to operator to make changes to the machine. With this function we can prevent wastage that happens when operator makes changes without guiding. Because current process is depending on operator only. So, he has to print around 50 pages to get sharp image with two colour. But when it comes to four colour wastage will high. Then he has to print around 300 papers get prints registered accurately.

In four colour print's smallest unit is dot. It's like a pixel in a monitor. Sharper the dot will get, sharper document gets. So, the system must consider about the dot. There are about 3 main factors that cause to print the clear dot.

- Ink level
- Water level
- Pressure of the cylinders

When ink level is high space between dots are filled. So, the system can identify problem and alert operator to reduce the overall ink flow.

When scanning the image offset printing uses probably more large documents rather than just A4 or Legal. So, it is decided to build a device with a camera and four lights. Using this device can scan printed outcome and supplied sample.

Probably this system will use people who have miner computer literacy. Se it is decided to have to design all the GUIs more user friendly and use simple design patterns.

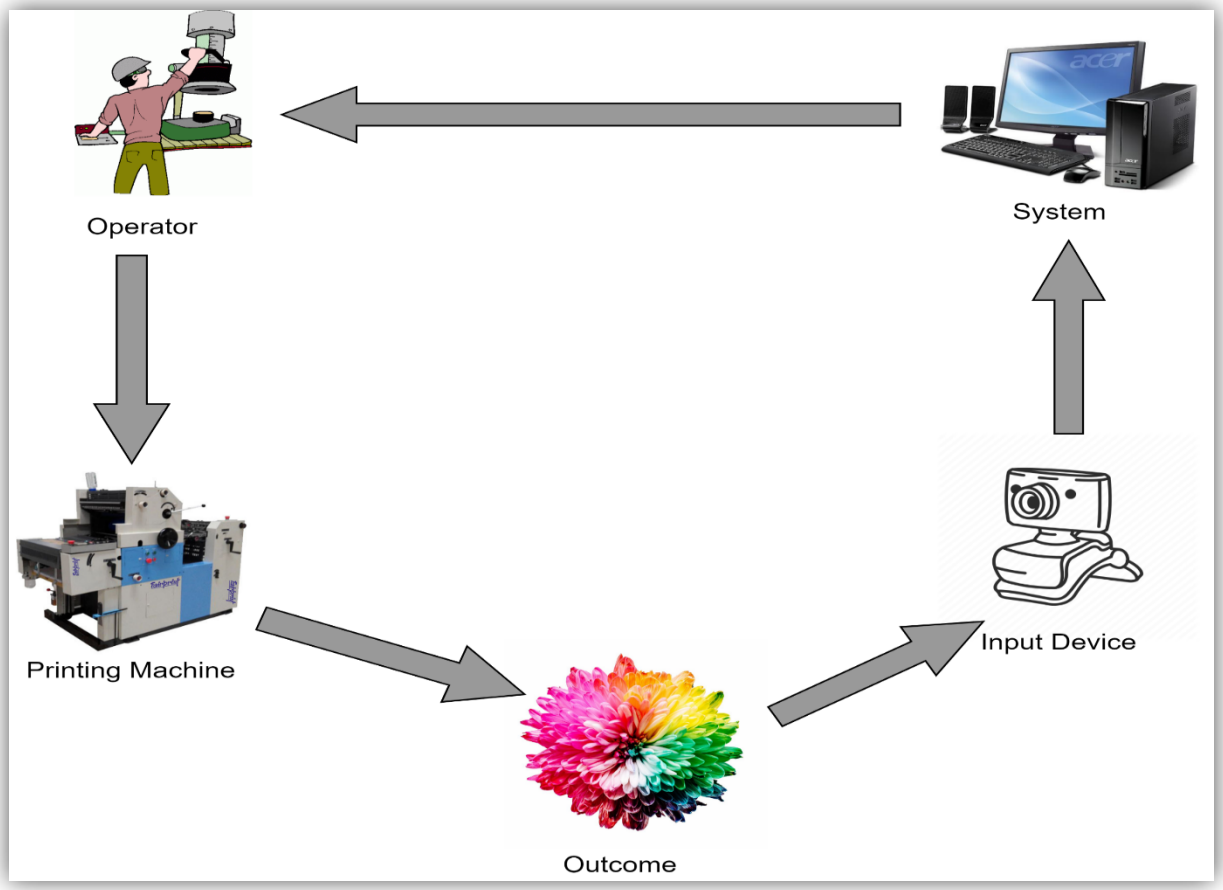


Figure 1- High level diagram

The implemented system consists hardware part and the software part. When capture the sample image using the digital camera, it is inserted into the system user. Then user check for the image analyzed details, image comparing details and solutions. Then machine operator does the machine changes by analyzing the system details. After changing the configurations of the system, operator reprint the image. All process act as the showing in the image.

1.3 Research gap

By the following research papers and journals reviewed, the idea could be extracted on how the approach could be made to continue this research. The papers and journals mainly speak on supporting areas of the research topic, these literatures' supports the arguments and questions which lie on this topic. The gap is that there are no research's done at the moment on exactly the topic or the idea on obtaining a quality output of printing by measuring the sample colour values of CMYK, providing the user on what values needs to be used to get the perfect output.

Basically, colour printing consist of four colour as Cyan, Magenta, Yellow and Black. In the present some printing organizations have four colour machines which are capable of printing four colours continuously by one flow. But in that machines also not developed any method to compare sample image with the original image. After researching Google, couldn't find out any researches related to comparing printed details. In this research obtaining a quality output of printing by measuring he sample colour values of CMYK.

In the research focus on analyzing registration marks. After researching Google, was able to find some related searches to the analyzing registration marks. In that research, it is focused on black registration marks. That process black registration marks position in the portion on the image that is intended to be print in black, and preferably adjacent to a black ink image. The identifiers area is examining to determine where the process black registration mark is properly positioned (Craig D, 1995). When it comes to four colour printing industry uses some four colour marks to ensure four colour channels printed on each other correctly. In this system will not locate registration marks and analyze those marks are accurate. It only focusing on single colour printing process.

1.4 Research question

Main component of this research is comparing sample with the original image. In this system compare colour values of an original image with printed sample to check the colour values.

There are several problems with existing systems. When implementing this new system also arise some questions to be solved. First arise when image get into the system. How to scan documents larger than A4 sheet using scanning. And how to do this process using digital camera.

In this research main component is dividing image into CMYK channels. To check colour values in the original image have to divide the image into these four channels. To do this use image processing and must use new software to find that out how to divide the colours. After dividing image get the percentage of the in values.

Identifying micro information in a document using a camera.

1. How to scan document larger the A4 sheet using camera?
   How to do this process using digital camera?

2. How to decrease the quality of the non-printed graphic comparing to printed outcome?

3. How to divide image into CMYK channels?

4. How to identify micro information in a document?
   Can do this process using camera?

5. How to measure colour brightness and image density in an image?

6. How to divide image into controllable vertical lines?

7. How to implement the system user friendly, who has less knowledge about computer literacy?

8. How to compare the sample image details with the printed image?

9. How to analyze the micro details?

10. How to implement the system availability resources?

2 Overall research description

2.1 Addressing the literature

A study by Yamaguchi, Masahiro on Beyond Red-Green-Blue (RGB): Spectrum-Based Colour Imaging Technology states "…spectrum-based colour reproduction system, called Natural Vision (NV), which aims to break through the limitation of red-green-blue (RGB) three-primary schemas. After a basic discussion on the motivation for colour imaging technology beyond RGB, the method for systematizing the multispectral and multiprimary colour imaging technologies, including image capture, processing, storage, printing, and display, is presented. The experimental multispectral systems for both still image and video are introduced, and the following features of spectrum-based scheme are revealed,

a. Highly accurate colour reproduction is possible even under different illumination environment
b. An expanded color gamut can be reproduced by multi primary colour displays
c. The influence of observer mesmerism can be reduced by he spectral colour reproduction
d. The quantitative spectral attributes of an object, useful for its analysis or recognition can be captured and preserved.

(Yamaguchi, et al., 2008)

In n extensive study on "Colour gamut mapping and the printing of digital colour images", William B. Cowan of National Research Council of Canada, Ottawa, Ont., Canada, stated that "results are derived from a project to take digital images designed on a variety of different colour monitors and accurately reproduce them in a journal using digital offset printing. Most of the images printed were reproduced without access to the image as viewed in its original form; the colour specification was derived entirely from calorimetric specification. The techniques described here are not specific to offset printing and can be applied equally well to other digital colour devices. The reproduction system described is calibrated using CIE tristimulus value. An image is represented as a set of three-dimensional points, and the colour output device as a three-dimensional solid surrounding the set of all reproducible colours for that device, called its gamut. The shapes of the monitor and the printer gamut's are very different, so it is necessary to transform the image points to fit into the destination gamut, a process we call gamut mapping. (Maureen C, 2008)

Luo and Z. (2003) in "Automatic colour printing inspection by image processing" School of Engineering and Computer Science, University of Exeter "Inspection of colour printing products constitutes a very important quality control (QC) task in the printing industry." Many defects on such products may be inspected by current commercially available vision systems. However, for the inspection of complex colour prints, the capabilities and performance of available systems are limited. The current practice in the printing industry is to inspect complex

colour products manually. This process is labor-intensive, and the results are not reliable as they vary with the time, mood and personal skills of the inspectors. In this paper, the authors propose an algorithm to automate the colour prints inspection process, which incorporates colour histogram-based techniques for colour image processing and a neural network for image classification. Preliminary results have shown that this algorithm is able to inspect the defects of complex colour prints under varying illumination conditions. (Z.Zhang, 2003)

Report form Wang Hongmei Zhang Ke Li Yanjun “Research Progress on Image Matching”, Image matching is an important research content in computer vision and image processing. In this paper, the difficulties and key technique of image matching are analyzed, the algorithms are classified into four groups, an overview of some representative algorithm which include the classical algorithms and its improved method, the new idea and method proposed in recent years are presented, the issue needed to be investigate further is discussed. (Yanjun, 2004)

In “A Fast Fuzzy C-Means Clustering for Colour Image Segmentation” Hoel Le Capitaine and Carl Frelicot states that Colour image segmentation is a fundamental task in many computer vision problems. A common approach is to use fuzzy iterative clustering algorithms that provide a partition of the pixels into a given number of clusters. However, most of these algorithms present several drawbacks. They are time consuming, and sensitive to initialization and noise. In this research paper the author is proposed a new fuzzy c-means algorithm aiming at correcting such drawbacks. It relies on a new cluster centers initialization and color quantization allowing faster and more accurate convergence such that it is suitable to segment very large colour images. Thanks to colour quantization and a new spatial regularization, the proposed algorithm is also more robust. Experiments on real images show the efficiency in terms of both accuracy and computation time of the proposed algorithm as compared to recent methods of the literature. (LIN Kai-yan, 2004)

In the study “Syverud Kristin: Analysis of Lint Particles from Full-scale Printing Trials” states that improved method for acquiring tape pulls from printing press blankets, preparing samples from the tape pulls for light microscopy analyses and quantification was performed on non-image areas, on image areas in the black printing unit and non-image areas in the yellow printing unit where the paper had previously been printed in black. Lint collected from the non-image areas were characterized by having a large fraction of filler particles. (WENFENG, 2004)

In the study “Designing progress of paper Ink-jet Printing Quality Analysis Technology” Chen Gang Tao Jinsong, of South China University of Technology, states that the progress of latest research and development of ink0jet printing quality analysis technology at home and abroad was discussed in this paper. Image analysis with computer, modulation transfer

function measurement and wavelength dispersive X-ray spectroscopy analysis were particularly stressed. At present, image analysis with computer is the best one and it is getting perfect along with the related technology development. (SYVERUD, 2007)

In the study “Research on the Checking of Printing Quality by Image Processing” TANG WANYOU WANG WENFENG. The traditional printing checking method always uses printing control strips, but the results are not very well in repeatability and stability. In this paper, the checking methods for printing quality basing on image are taken as research objects. On the base of the traditional checking methods of printing quality, combining the method and theory of digital image processing with printing theory in the new domain of image quality checking, it constitute the checking of printing quality system basing on image processing, and expound the theory design and the model of the system. This is an application of machine vision. It uses the high-resolution industrial CCD (Charge Coupled Device) colorful camera. It can display the real-time photographs on the monitor, and input th video signal to the image gathering card, and then the image data transmits through the computer PCI bus to the memory. At the same time, the system carries on processing and data analysis. This method is proved by experiments. The experiment is mainly about the data conversion of image and ink limit show of printing. (JINSONG, 2002)

2.2 Methodology

2.2.1 Flow of the project

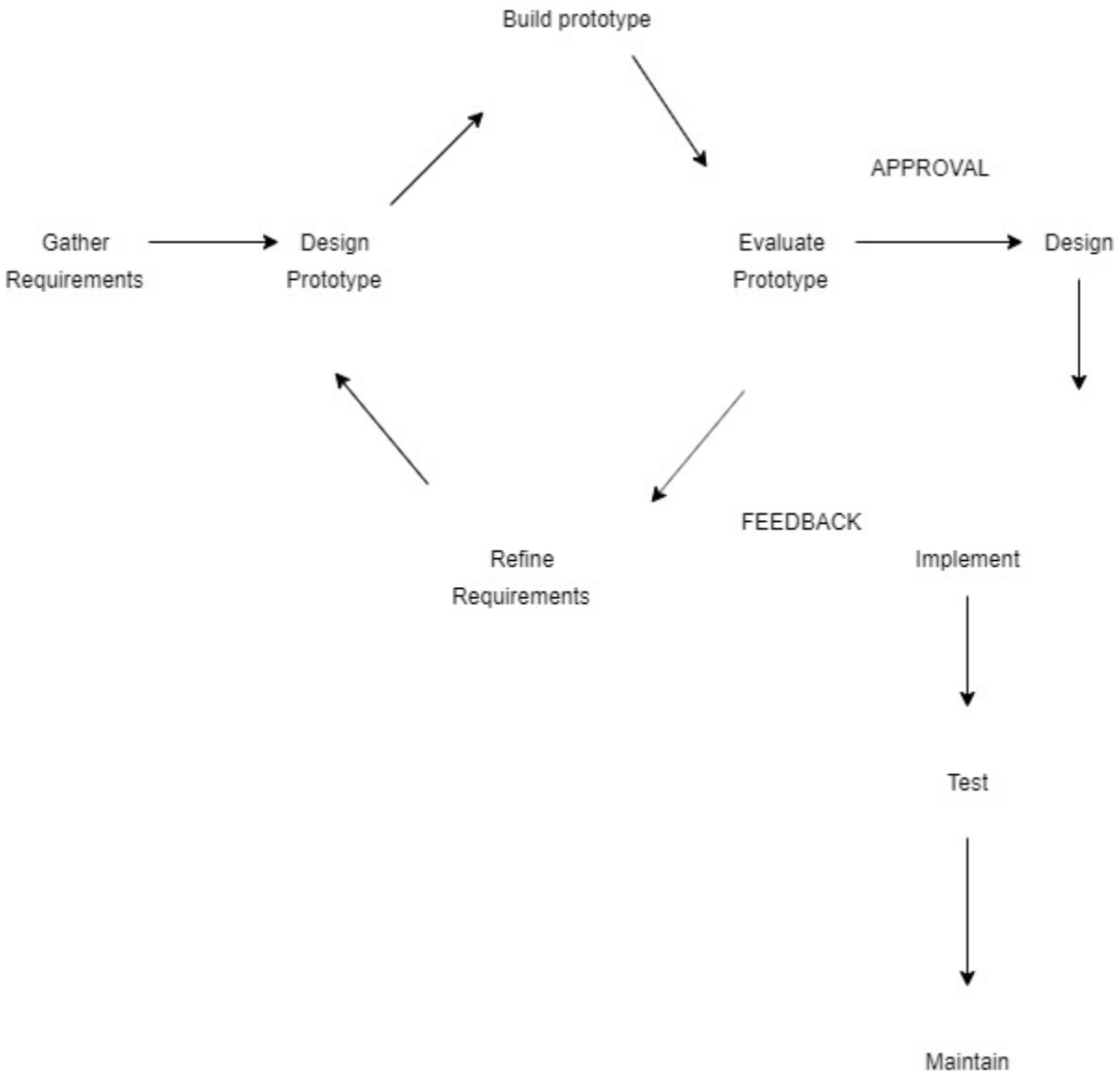
Through a sample research, this project has able to come an understanding, that there was no proper standard to compare printing sample with the actual outcome. Also, it is a complex task to print as it is when it comes to more than two colour print, since most of the printers in the island have one colour offset printing machines. This is when problem arises to the machine operator.

After visiting few printing organizations in the Sri Lanka, it can be known that most of the quality depends on the experience of the machine operator. But unfortunately, it’s very hard to find experienced operator.

Then it can be identified the problem of the current process and then decided to build a system that helps the machine operator to get printouts just as the sample, even with a basic printing knowledge.

The system used several methodologies in the developing process. SDLC (Software Development Life Cycle) models used for this product are the Prototype model and the Classical Waterfall model. Before the development of the actual system, a working Prototype of this system was built. A prototype is a toy implementation of the actual system. There are several reasons for developing a prototype. Basically, it helped to critically examine the technical issues like the response time of the hardware controllers and the efficiency of the

sorting algorithms, etc. in such circumstances, prototype may be the best or the only way to resolve such technical issues.



The system mainly with several windows form application to communicate with the user. The system developed for the printing industry to increase their productivity. System developed with Microsoft visual Studio in C# platform and Microsoft SQL Server. After research finding used Aurigma Graphic Mill software for our research implementations. Mainly system capable with colour channel separation in an image into CMYK and comparing colour value details in the image.

System function to analyze micro details in printed image. System analyze the registration marks of a printed image and make dissections according to the analyzed result.

And the dot analyzer shape f the printed dot and give the result. Printing dot is the most thing in the printing image. Printing quality is depending on the print dot.

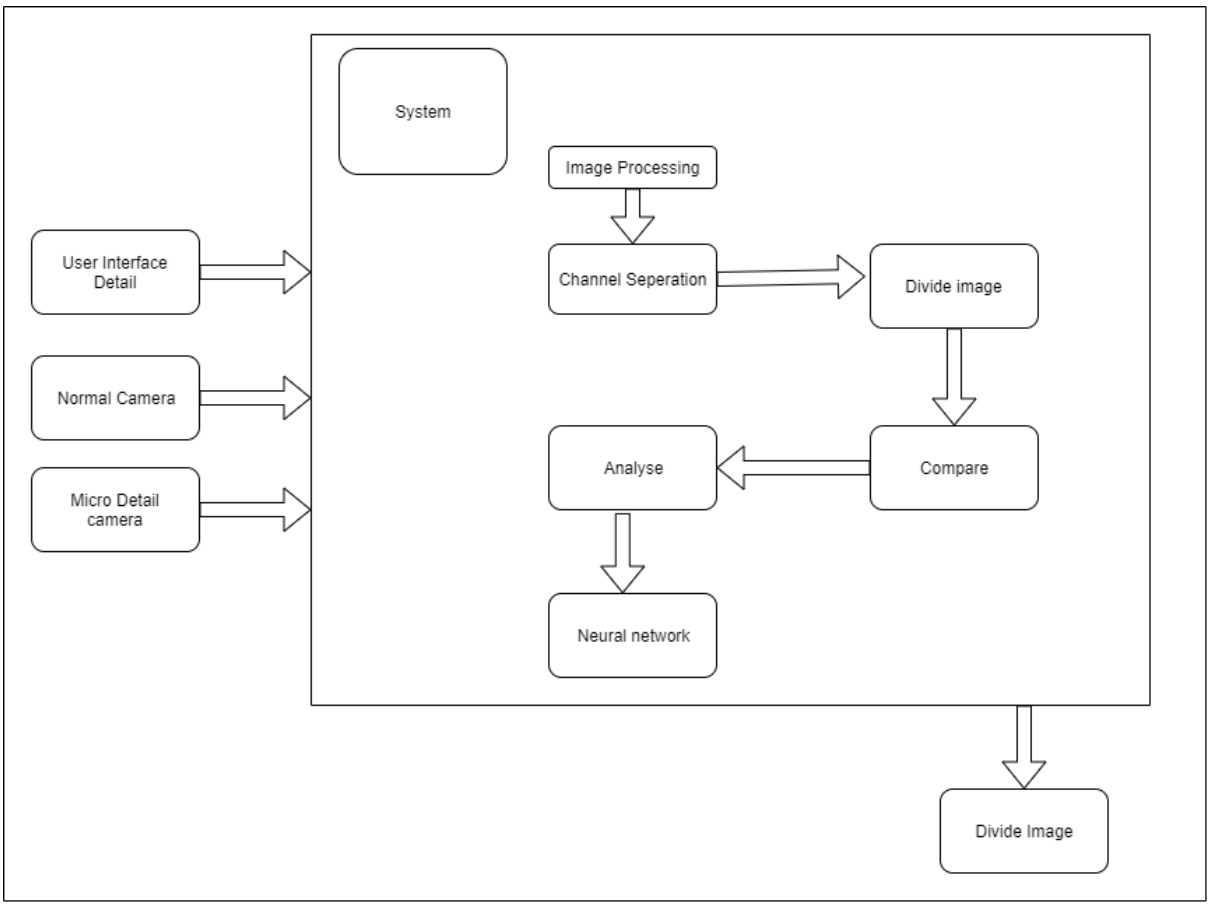


Figure 2 - Example of a system interface

2.2.2 Requirement analysis

After the field research, we found that there is no successful method to decide whether the printing outcome will exactly match the sample. When referring to past research papers discovered some information about printing process how the printing machines are working in the printing process. After several interviews with employees who works in the printing industry, was be able to identify some critical points in the reach.

Basically, colour printing consists of colour as Cyan, Magenta, Yellow and Black. Present printing machines manufacture have produced machine which are capable of printing four colours continuously by one flow. So, the operator can compare the final outcome with the sample. If there any adjustments to be made, the operator can do the necessary adjustments and reprint. In this scenario the operator can print one paper at a time and compare it with the

sample. The paper clearly represents the final outcome because that machine operator is capable of printing four colours simultaneously.

When working with the colour printing machine, if the work is have to print flour colour image, operator has to print Cyan first, after print all the paper with Cyan colour, operator has to reload machine with Cyan printed paper and print magenta on it. Until operator finish printing all the colours, he has to continue this process again and again. Drawbacks of this process is operator has to wait until print the final colour for comparing printing outcome with the sample. If there any difference sample and final printing outcome there is no way to correct it. So, in this process operator has a big burden on his head to get quality outcome.

2.2.2.1 Database design

Database should be design very precisely because holds the values that to do calculations in the system. Other than that, when implement the system will manage more than one machine, as you can see database act as core in the system.

After analyzing the requirements, it is decided to add a component to gather data about jobs and keep track how many times operator compare printed outcome and sample. So, it is added more tables to database and then can be ensure about reliability. Database contain four data table to store data. In user data table store and manage user details who operates the system. This table use to log into the system. The machine table storing about printing machines. The user authorized with handling machine details. User can insert, remove or update machine details. Printing jobs insert into the printing table containing jobID, machineID, colours, samples. etc. when insert a new job detail system automatically assign a jobID for the now job. In the comparison table when selecting jobID retrieve data to compare sample with selecting colours. The database retrieve data to JobContol panel interface.

2.2.2.2 Algorithm design

It has to design main algorithm.

- The system has to divide whole image into controllable vertical lines, according to provided machine data.
- System should calculate average colour density, brines and contrast by colour.
- System should compare those values with sample provided.
- System should identify registered marks and compare results to ensure printed outcome registered successfully.

2.2.2.3 Hardware Design

It has to build a hardware component to support this system. In the hardware device main component is camera and light bulbs. The device is responsible to to capture a quality image and insert image copy into the system. The light bulbs capable with controlling lights.

It has to design some device to insert sample into the computer also. Obviously, it can use a scanner for do this. But when it comes to larger than legal it cannot use a normal scanner for those.

2.2.3 Implementation

Digital image processing is the use of computer algorithms to perform image processing on digital images. As a subcategory or field of digital signal processing, digital image processing has many advantages over analog image processing. It allows a much wider range of algorithms to be applied to the input data and can avoid problems such as the build-up of noise and signal distortion during processing. Since images are defined over two dimensions (perhaps more) digital image processing may be modeled in the form of multidimensional systems.

Digital camera generally includes dedicated image processing chips to convert the raw data from the image sensor into a colour-corrected image in a standard image file format. Images form digital cameras often receive further processing to improve their quality, a distinct advantage that digital cameras have over film cameras. The digital image processing typically is executed by special software that can manipulate the images in many ways.

Many digital cameras also enable viewing of histogram of images, as an aid for the photographer to understand the rendered brightness range of each shot more readily.

It is used digital image as the input for our proposed system, analyze it and give suggestions to operator of a single offset printing machine.

As mentioned before when it comes to four colour printing with single colour printing machines, biggest problem operator face is now to balance ink to get fie printing outcome same as the sample. Because nonexperience operator can’t predict the extracted Cyan, magenta, yellow and Black images for given printed sample. Basically, most of the operators follow a method to get the Cyan image into their head is use photoshop to extract channels and see if ink balance is accurate. But the problem in this scenario is computer display will show image using RGB colour scheme and printed outcome will use CMYK. If operator use this method and probably end up with getting the wrong printed outcome.

2.2.3.1 Get image into the system

It is built a device that capable of getting image to the computer. It is not feasible to use a scanner for scanning. Because offset printing uses probably more large documents rather than just A4 or Legal. Using this device will scan printed outcome and supplied sample. Expect some quality decrease when scan it using build device. When building the device, it could be able to identify light is most point of getting quality image. But look forward to tuning it to get most accurate result as much as possible. Then can ignore the quality decrease of both sample and printed outcome because both contain the same issue.

But after the implementation, the project had a problem with identifying a colour as same colour in computer. As an example, system couldn't identify 100% Cyan as 100% Cyan inside the computer. So, it had to adjust the light source and grab few samples so that can be able to get the accurate colour. After realizing only light source adjustment is not enough, had to create a box for cover image area and get the image correctly, so then could control light balancing more accurate way.

In this research main research part is comparing sample image with printed outcome. After the research it was be able to successfully accomplish the target with many researches and findings. Following describe the mythology that it followed.

2.2.3.2 Derive four channels and get initiating values

As the document mentioned earlier colour image consist of four colours. The printing image follows several steps showing in the following image.

Figure 3 - Example of a four colour image with derived channels (Deprintedbox, n.d.)

A small change in a colour will directly affect to the final outcome and it can't be correct again when printed using single colour printing machine. Because in the process operator will print the whole bulk in one colour, then change to anther colour and print again the whole bulk. What it decided is design a system that capable of driving channels from supplied sample and compare it with the printed outcome. So, the system will get the colour density value of both documents and suggest operator what he should do. When it comes to offset printing print quality depends on two factors, water and ink. When it comes to ink offset machine has a mechanism that helps to control ink by operator. It comes with controlling valve. Single knob

presents a vertical around “1” line in a printing area. If operator closes the valve, it will not spare the ink in the area. If operator opens the valve, particular area will be filled with ongoing colour. Likewise, operator can control all the vertical lines according to need of ink for the printing.

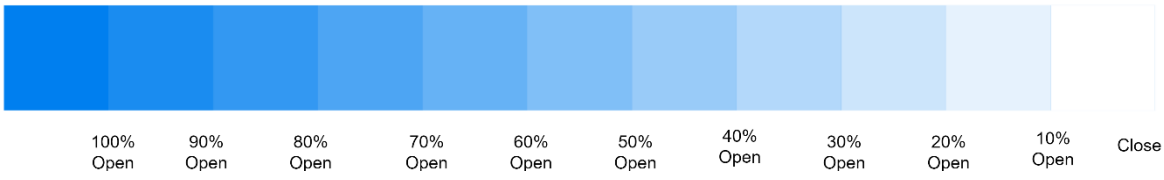


Figure 4 - Example of a gradient controlled by ink valves

For print above gradient in the figure this is how to manage those valves in the machine. If operator opens valve more than enough percentage, area will be filled with the colour. When printing more complex design operators can’t decide which values those values should have. So, they end up with false colour percentages and fail printing outcome.

This system helps operator on this process. System will first get the sample and extract the channel operator wants to print. Then system will divide image to controllable vertical lines and calculate the values of colour density predict values for valves. This process will use Aforge image lab as supportive component.

Figure 5 - Example of more complex magenta channel

To get colour channels separately it is used another library provided by Aurigma Company. It is Aurigma Graphic mill. It’s supporting four colour channel separation more

reliable way. Before it gets graphic mill as the third party add on it tried to separate channels with Aforge image processing lab. There got the error and can't separate CMYK colours with Aforge because it supports only RGB colours. Then it has tried to accomplish the task with colour diagram and aforge. Because theoretically RGB colour model is known as emitting colour model and CMYK model is subtract colour model. But these two-colour models has relationship with each other, as an example if we extract Red colour channel and Green channel from a image and overlap those two should get the Cyan image of the respective image. Theoretically this is correct but when it id done and couldn't get the accurate colour.

To do this process it used Aurigma Graphic Mill library in the C# platform. Aurigma Graphics Mill 10 for .NET is an image processing component developed for .NET platform. This component is very accurate when create applications that work with images. Whenever create an application which applies preprint preparation to images, a script which generates web graphics, or whatever else imaging application, Graphics Mill for .NET help in it. Graphic mill is the best solution for printing and pre-print operations. Graphic mill supports to separate in to CMYK channels as follows. (Google, n.d.)

CMYK is a native color space for printing. Load CMYK images from TIFF, JPEG, PSD, etc. Process them without converting to RGB or any other color spaces.

When user select the color type by selecting drop down list it will Convert RGB images into CMYK using ICC profiles (and therefore get precise color conversion).

After converting image into CMYK it will split CMYK image into separate channels and perform other operations with CMYK images.

CMYK images may contain alpha channel. This allows to blend two CMYK images without extra conversions to RGB. Graphics Mill for .NET also handles 16 bits per channel CMYK files.

2.2.3.3 Compare with printed outcome with the sample

After completing channel separation system feasible to compare the printed image with the sample image. As soon as machine ready operator will print a copy and scan both sample and printed copy and enter it into the system. Then system will re do the process again for both sample and printed out come compare the values. System divide the image into controllable vertical lines. Those vertical lines calculate the colour values for each vertical line. This implemented using image processing technology. First insert the sample image and check for the colour values in each CMYK colour. Then insert printed sample it will display the different of the printed image values.

This mainly implemented with the help of Aurigma Graphic Mill libraries. Aurigma Graphic mill consist with lot of technic to develop implementation task. Graphic mill divides the

image in to CMYK and manage the colour profiling. To be sure that the hardcopy image will have the same colours as the image file, need to apply colour management. Graphics Mill for .NET allows to do it as easily as possible. First load and save embedded ICC profiles in files.

Conversion between color spaces (RGB, CMYK and Grayscale) based on ICC profiles, Conversion of bitmaps and individual colors, Display of image on screen using a device profile. Possibility to use two profiles together (to see on the current device what the image will look like on the target device).

Here is a brief color management features that used in implementing comparing function.

- Can change this profile or convert pixels to fit another profile,
- Can specify output color profiles for all color spaces supported by Graphics Mill for .NET: RGB, CMYK, and grayscale
- During conversion can specify necessary rendering intent - relative colorimetric, absolute colorimetric, perceptual, and saturation
- When using relative colorimetric, it can use the so-called "black point compensation" mode which increases the contrast of the output image
- Can preview the result of printing on the screen by specifying two profiles for conversion, for the printer and for the monitor. This helps user to see and proof the image without long and often costly printing.

(Google, n.d.)

In the following shows the steps when colour profiling in the image.

- Choose Little CMS color management engine
- Load RGB image without embedded ICM profile from file
- Assign input sRGB profile.
- Assign output CMYK profile for conversion.
- Convert to CMYK.

To accomplish this task, it is using Histogram class on graphic mill and get the slandered deviation of the differentiated image.

2.2.3.4 Analyze registered marks

When it comes to four colour printing industry uses some marks to ensure four colour channels printed on each other correctly. Only then operator get sharp printed final outcome. (Craig D, 1995)

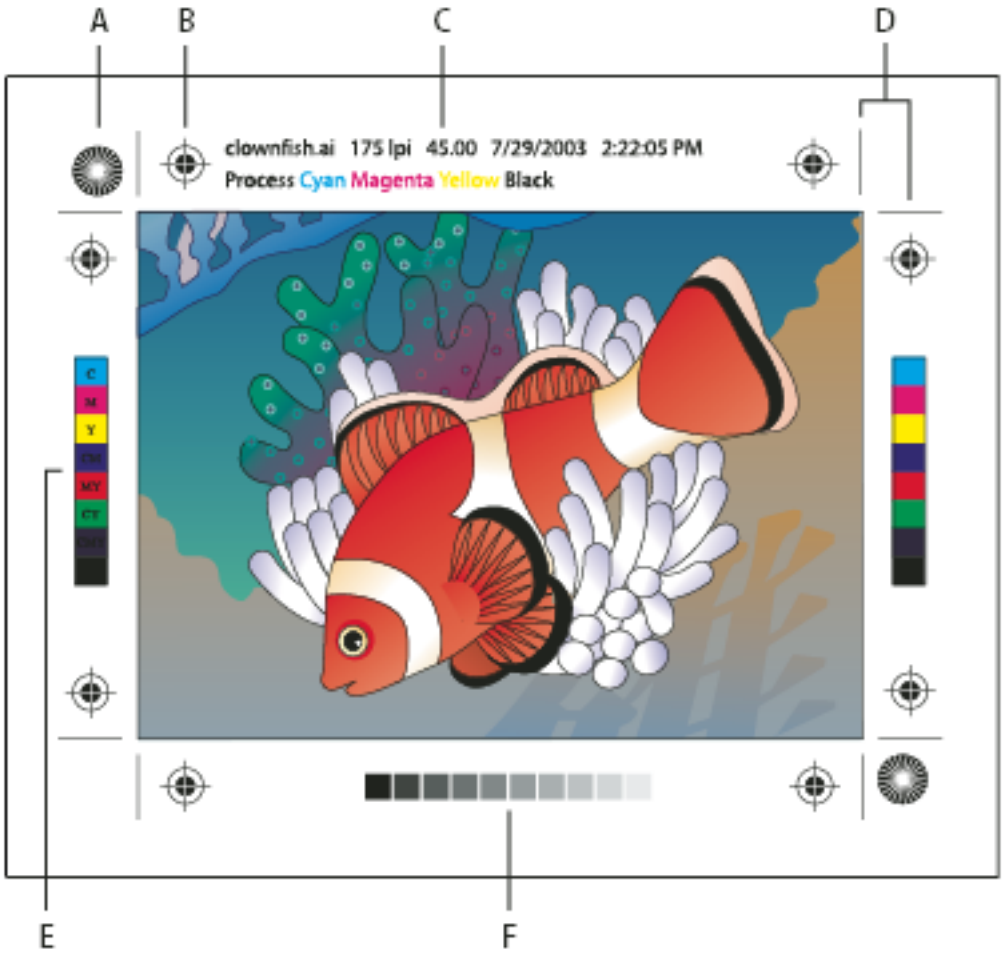


Figure 6 - Example of a printed document with registration marks (adobe, 2020)

Those B and D are commonly use in printing industry in Sri Lanka. Those lines and shapes have 100% of cyan, magenta, yellow and black. When magenta mark exactly prints on the cyan mark only operator get sharpest outcome. When it prints like in figure follow it'll not lead to quality print. To be a quality printing outcome registration marks must be shape. To be a shape outcome fist print the Cyan mark, then Magenta mark must print on the Cyan mark without any changing alignment, next print yellow mark on the Magenta mark finally black mark print on the yellow mark, In there should not be have any different between this printed marks. But in practically it's different, there are lot of different between these marks because printing machines do not cable with functioning this process.

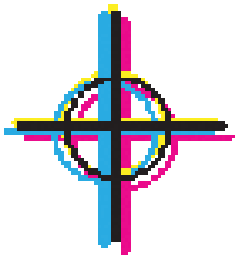


Figure 7 - Example of a unregistered mark

In this research when implementing this function, it is identified lot of calculations and algorithms. Use algorithms for getting the height to the first line and to get length to the first line.

When upload the registration mark image into the windows form application, first it checks for the position.

Used algorithm describe how to get height to the first line of the registration mark. It will calculate number of pixels form the straining point to first line.

The implementation of the GetHeightToTheFirstLine algorithm to calculate the number of pixels to the first line of the registration mark. Then the system detect the first line and it will calculate the number of pixels to the bottom of the height.

To calculate the width to the first registration mark it implemented a GetLenghtToTheFirstLine algorithm. Same as the calculating height, this algorithm also calculates the number of pixels. User have to upload some image regarding the registration marks to calculate these pixels. User have to upload eight registration mark images in the printed image.

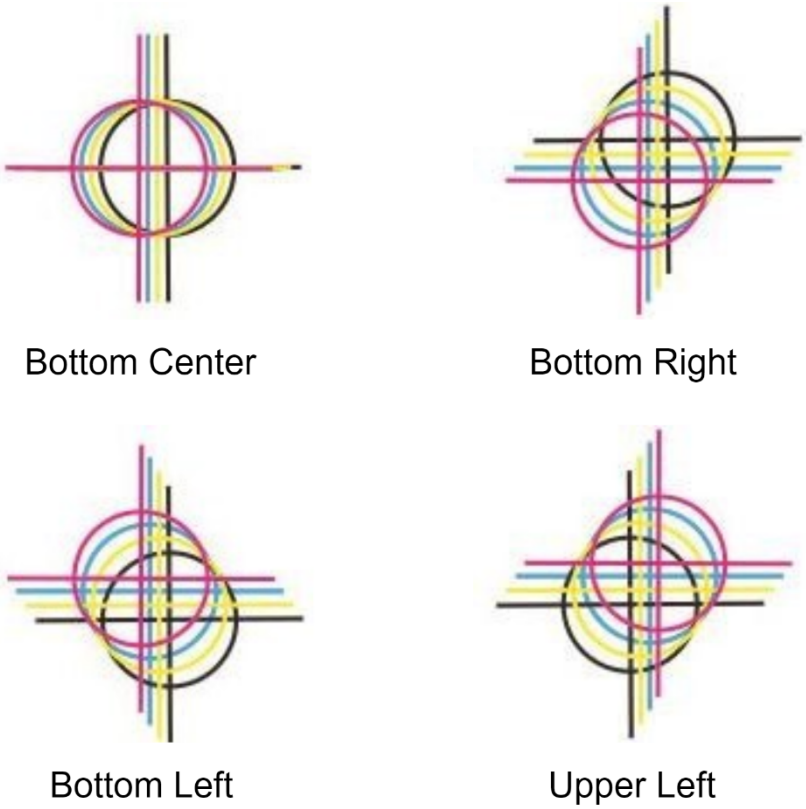


Figure 8 - Example for the registration mark

So, the system will locate registration marks and analyze those marks are accurate. When select the current colour of the registration mark system will out put the changes if there any. System calculate the position value for X and Y edges, if the edges values have big different, then it is a printing machine fault. To correct it configure the machine. If the X, Y edges value have not very big different, can change the machine pins and correct the fault. Machine give dissections which pin to be change according to the analyzing result.

By implementing this function, it can prevent wastage that happens when operator makes changes without guiding. Because current process is depending on operator only, so he has to print around 50 pages to get sharp image with two colour. But when it comes to four colour wastage will high. Then he has to print around 300 papers get prints registered accurately.

2.2.3.5 Analyze the dot

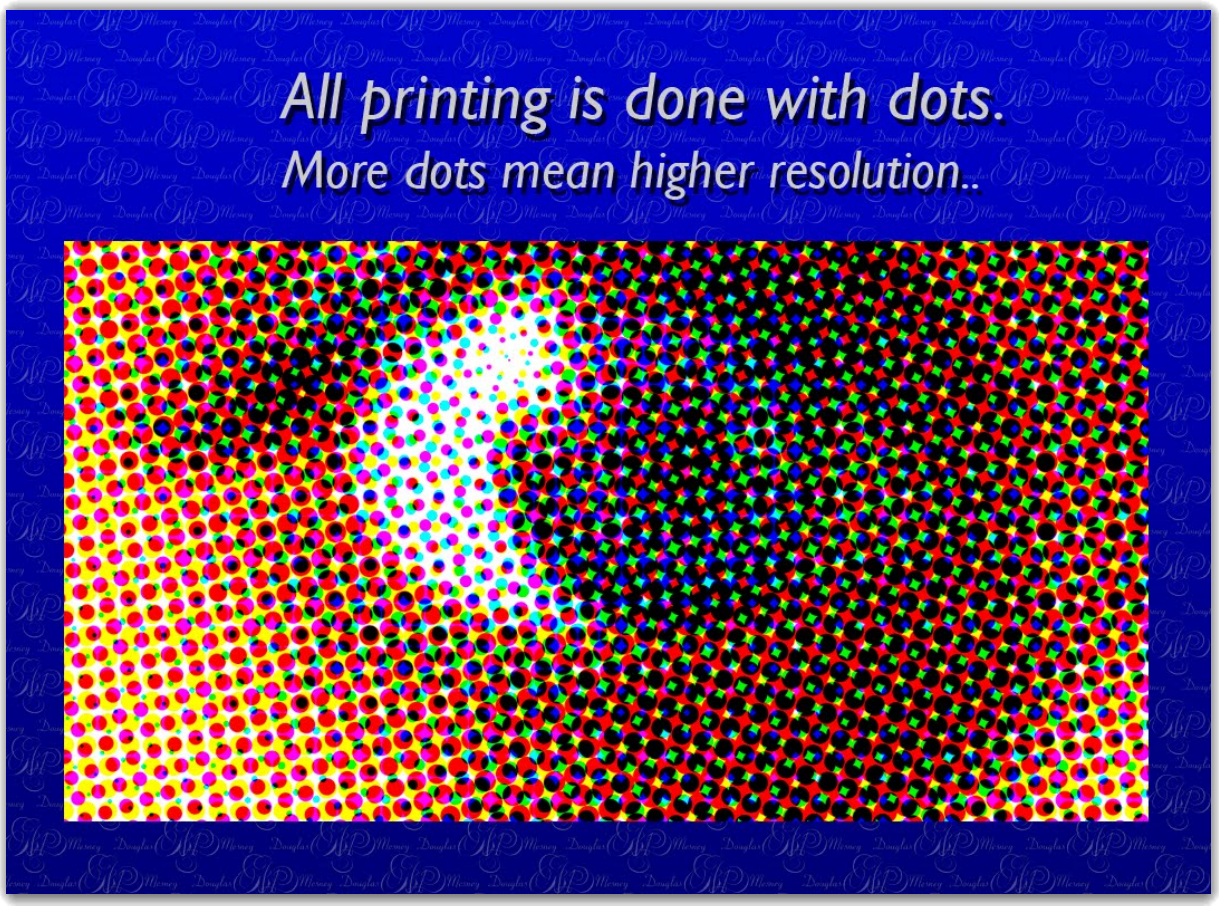


Figure 9 -Example of image Printed with dots (Deprintedbox, n.d.)

Four colour print's smallest unit is the dot. It's like a pixel in a monitor. Sharper the dot will get, sharper document gets. So. it has to consider about the dot. For print clear dot it will cause 3 main factors.

- Ink level
- Water level
- Pressure of the cylinders.

When ink level is high space between dots are filled, system can identify problem and alert operator to reduce the overall ink flow. When water level is high dots will not print sharply. All the dots should be in same colour. Only the spaces between them are varying. So, if there is uncolored dots system can alert operator. When pressures between cylinders are high dots become more like oval shape. But dots should be in circle shape. So, system can identify shape difference and alert operator to reduce the pressure.

When printing four color process, each color is put on the paper separately, and then layered. Zoom in on a printed image and you will notice half-toning or little dots of color layered over one another. As shown here to the left, this layering of dots is what creates the perception of a solid. To prevent offsetting & more pattern effects each ink must be printed at a specific angle and the dots perfectly aligned.

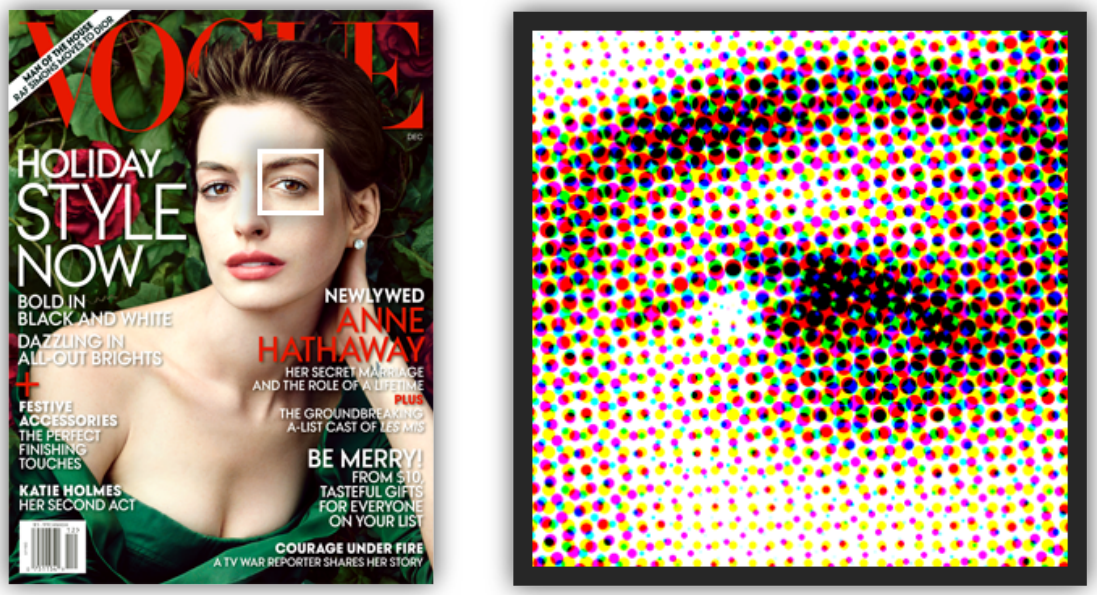


Figure 10 - Example of a analysed dot (Pinterest, 2019)

To do above task it will use a digital camera with a high glass used in printing industry. And it will use artificial intelligence, image processing and neural network also for implement this part. When print the first sample image, have to capture the dot using height digital camera and get it in to the system for analyzing.

System will analyses the dot; it checks for the shape of the dot. Dot must be shape round for a quality print. System check the edges of the circle for analyzing. If the analyzed dot is not in standard shape system will alert the user to do changes to the system. This function mainly implemented with the image processing technology.

2.2.3.6 Implementation Techniques

- Asp.net / C#, Framework 5.0, Microsoft Visual Studio for system implementation.
- Microsoft SQL Server 2017 for Database designing.
- MS Office 2016 for Documentation.
- Hardware Requirements
    - High Voltage light bulbs
    - Digital camera

- Software Requirements
    - Microsoft Visual Studio 2019
    - Microsoft SQL Server 2017
    - Aurigma Graphic Mill

2.2.4 Testing

Software testing is any activity aimed at evaluating an attribute or capability of a program or system and determining that it meets its required results. The system and modules will be rigorously tested in three stages in order to eliminate various kinds of errors.

2.2.5 System design

2.2.5.1 Entity relationship diagram

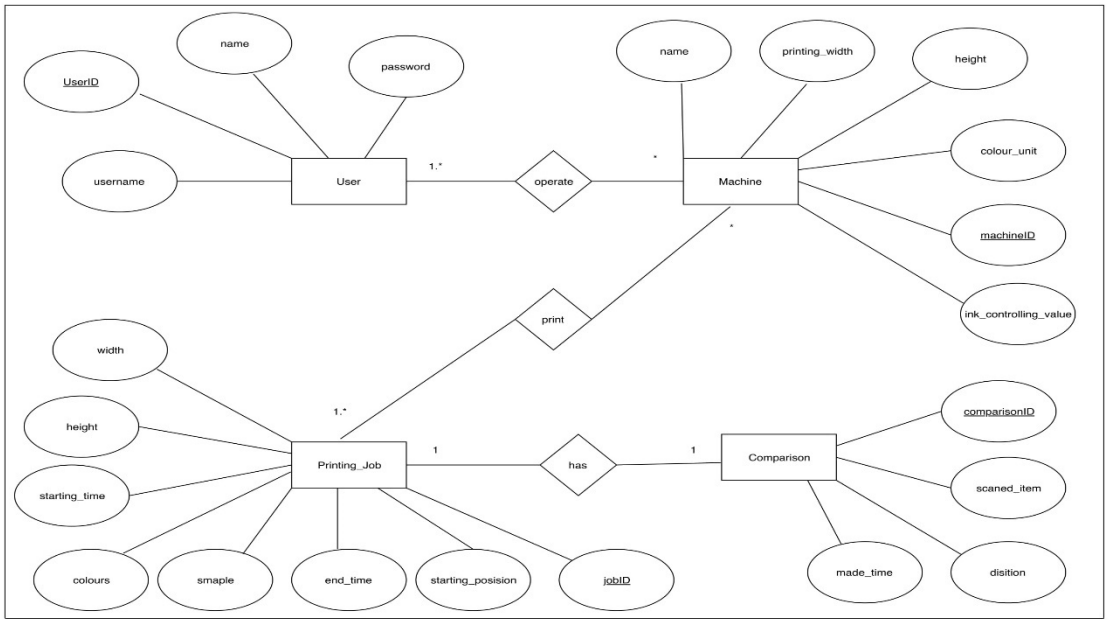


Figure 11 – ER diagram

2.2.5.2 Use case diagram

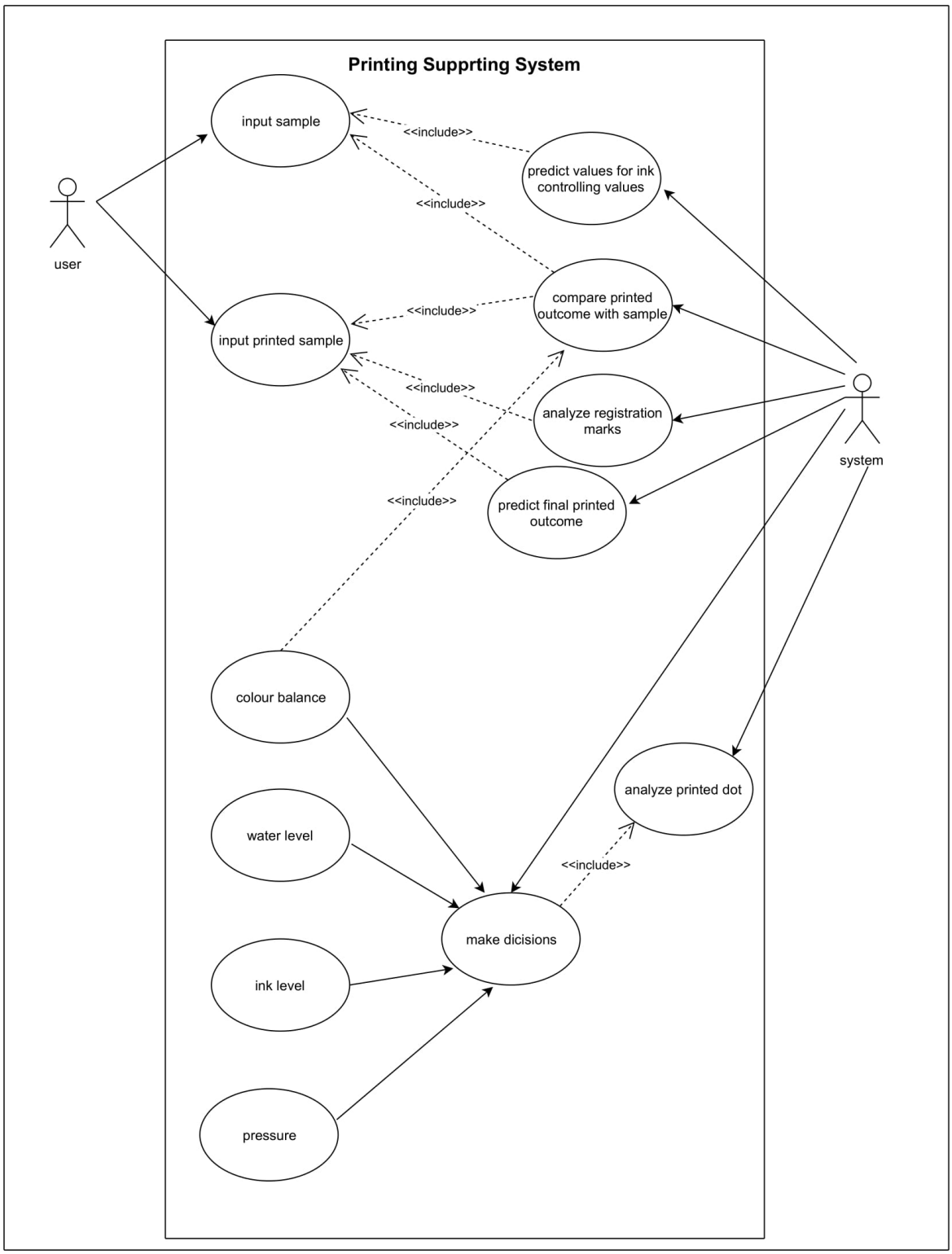


Figure 12 - Use case diagram

2.2.5.3 Class diagram

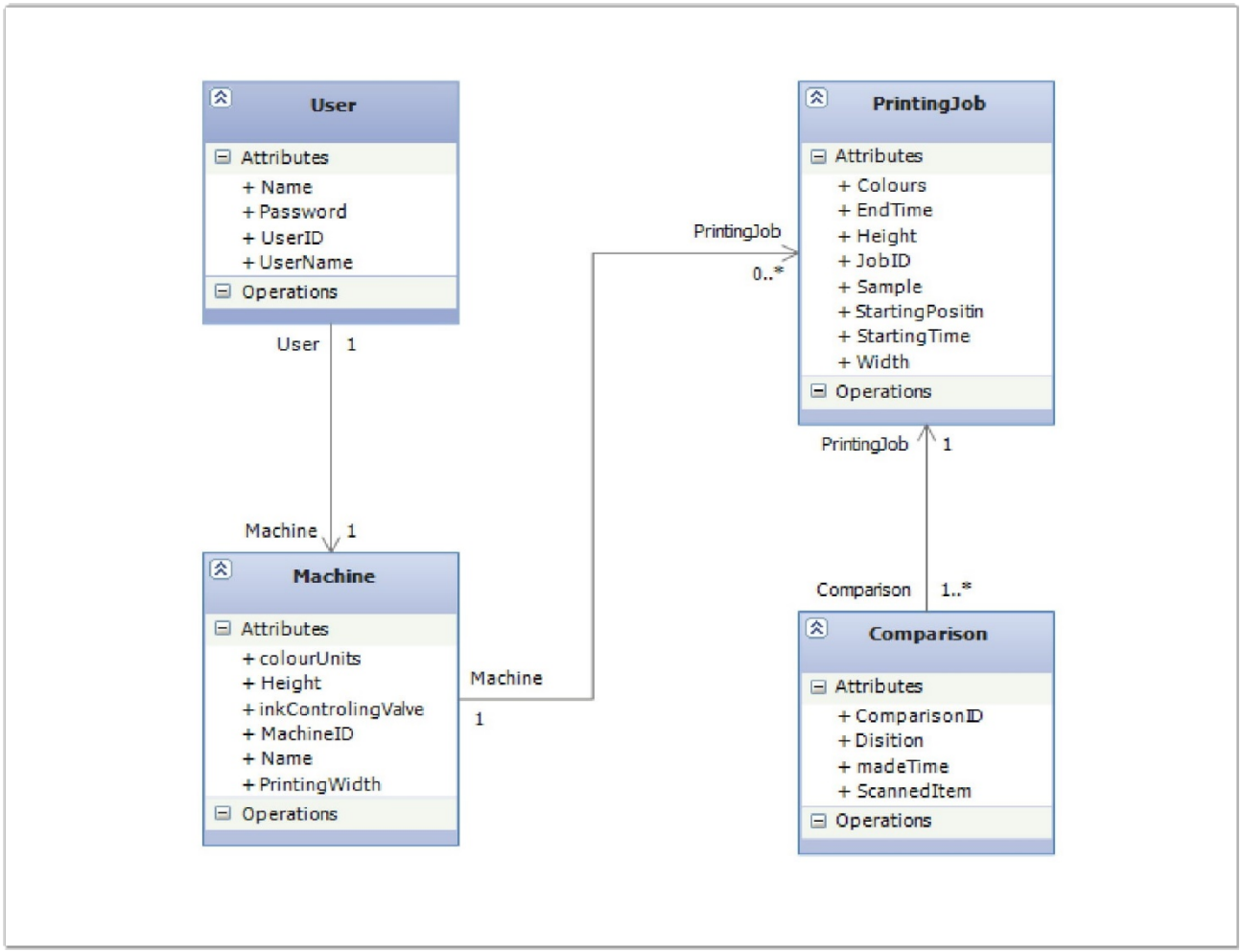


Figure 13 - Class diagram

2.2.5.4 Sequence diagram

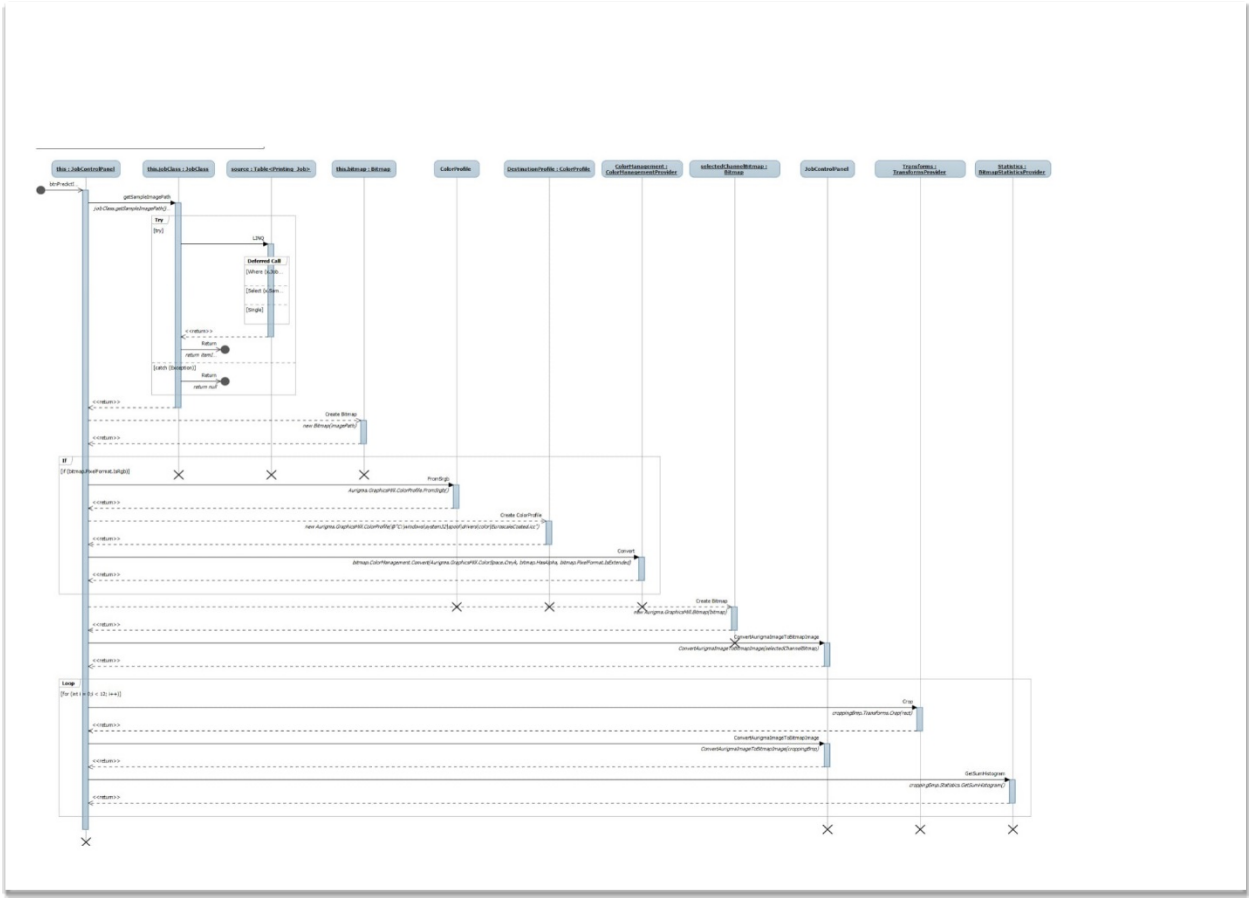


Figure 14 - Sequence diagram

2.3 Research findings

The following report contains a comprehensive research overview for the Project in line with the final year curriculum of the Degree of BSc (Hons) Software Engineering. The key objective of this project is to devise and develop digital supporter for quality colour printing outcome .In the printing Industry there's no any system to compare sample printed image with the original image .The system solution will be in is comparing sample image printed details with the original image printing details.

Many key constraints had the project stumped during the research process. It is not always that you get what you are looking for once a search is done regarding a certain topic. Many irrelevant topics have to be examined and filtered before the real research reading could be done. But all this relevant content had to be read over and over again for it to be made clear and to be used in the design stage of the development. In printing industry wastage is high because of not available any mechanism to check printing details before bulk of papers complete its printing job.

In present four colour process printing is a system where a colour image is separated into 4 different colour values (called a colour separation) by the use of filters and screens. This used to be done with photographic film on a graphic arts camera. The result is a colour separation of 4 images that when transferred to printing plates and sequentially printed on a printing press with the coloured inks cyan (blue), magenta (red), yellow and black (the k in CMYK), reproduces the original colour image. Most of the entire spectrum or gamut of colours are reproduced with just the four-process ink colours. But colour separation with the Photoshop not very accurate and easy. Need qualified people in this process. Research aim is to build a proper system for accomplish this goal.

In present there are rapidly developing technics in the industry, and it focus on image processing as the main technology to accomplish this target. In here channel separation, calculate the densities, divide image to vertical lines to predict ink valve values, are the main components of the system. This job complete using image processing.

Main challenge of the research was to find and develop image processing technologies and tools supporter to dividing image into vertical lines and channel separation. It had to go through many research papers and thesis reports to find out suitable solutions to perform these operations using the above-mentioned methods.

In first it decides to develop image tasks which are using Aforge Image processing lab but finally identified Aforge Image processing lab failed to complete the research part.

After doing research through Google finally found Graphics Mill from Aurigma which could basically buy as a toolkit and could implement easily. Graphics Mill's image manipulation library allows the ability to efficiently modify and manipulate images in many ways. Graphics Mill work with each channel just as if it was an independent grayscale image. This gives the ability to create masks, "cut holes" in images, etc. Graphics Mill is a robust image processing SDK which enables .NET developers manipulate images of any sizes from their applications. This component is feasible to do in given time frame with Graphics Mill image processing software which easy to integrate with C#. (Google, n.d.)

Analyzing micro details in the print image is implementing for identifying symbols which are called registration marks and dots in this research. This also acts as a main role in this project. It has gone through similar type of projects those identify symbols using neural network. So, then decided it is feasible to do this module.

AI is essential to this research topic when it comes to decision making. it is going to implement this system to analyze given printed outcome and make decisions according to it. This module will analyze the smallest component in printing which industry professionals call dot and make suggestions according to quality of the dot. This module is also feasible to do in the knowledge and give time frame.

3 Results and discussion

3.1 Evidence

The approach for testing the system was Unit Testing Strategy .The primary goal of unit testing is to take the smallest piece of testable software in the application, isolate it from the remainder of the code, and determine whether it behaves exactly as you expect. Each unit is tested separately before integrating them into modules to test the interfaces between modules. Unit testing has proven its value in that a large percentage of defects are identified during its use. Debugging is made easier through using testing since the errors are identified before the integration of the software.

3.1.1 Test cases

Test case : **Get the image according to the selected JobId**

Pre-condition : Upload the job detail

Test NO	*Sequence No*	*Test description*	*Input values*	*Expected value*
1	1.1	Check whether the load image according to the JobID	4	Display the image in the image box

Actual result – Pass

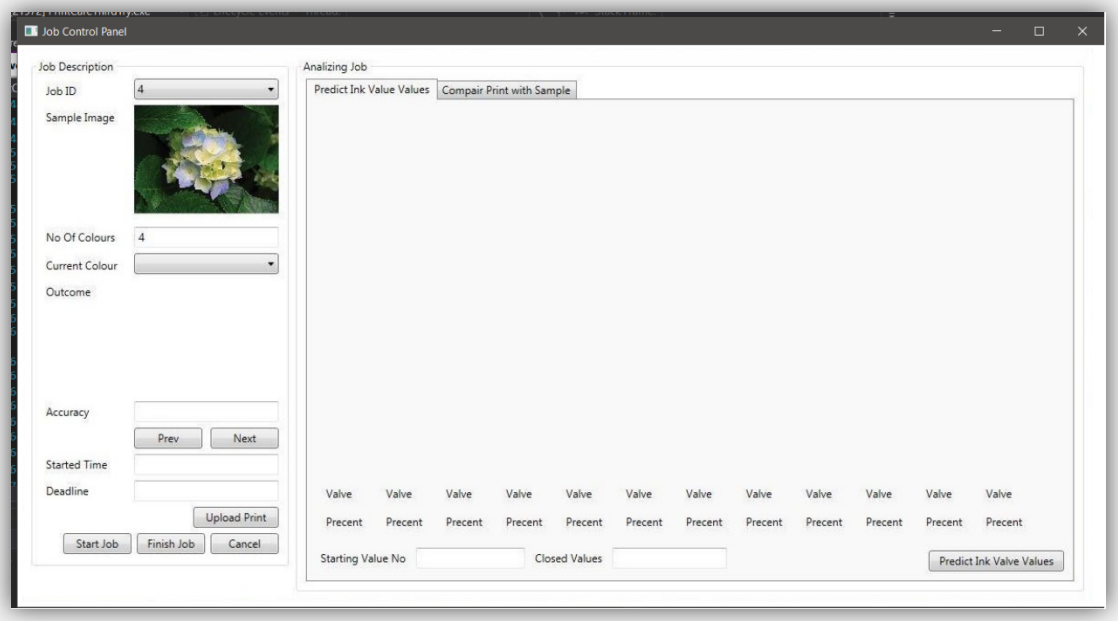


Table 1 - Test case 1 Upload the image

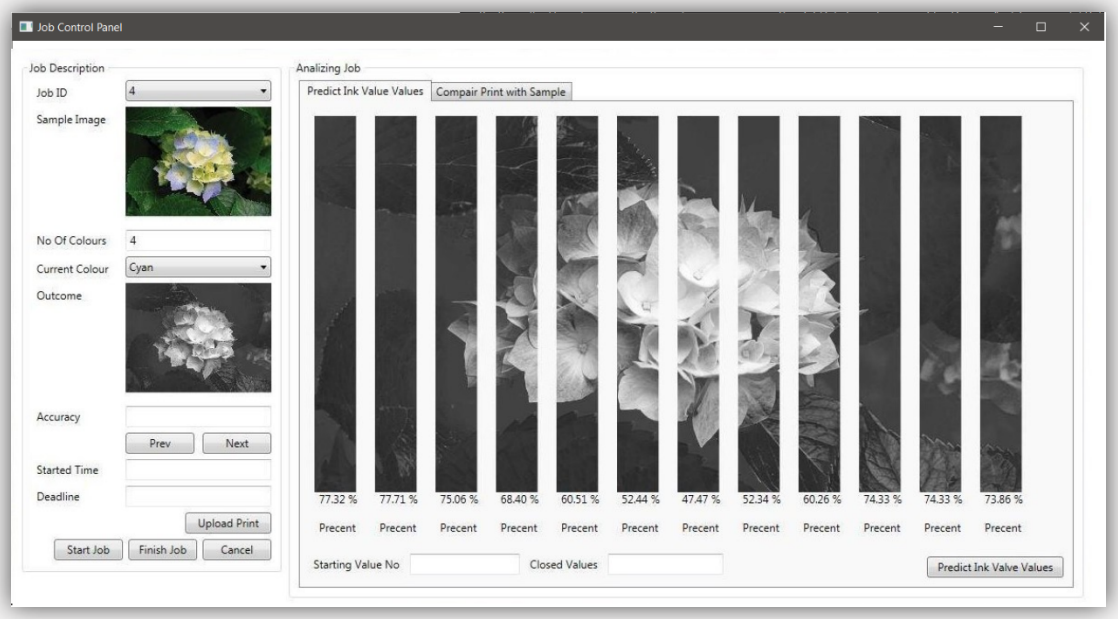
Test case : **Extract the image into CMYK colour channels** Pre-condition : Successfully upload the image				
Test NO	*Sequence No*	*Test description*	*Input values*	*Expected value*
2	2.1	Check whether the selected image is divided into selected colour	Cyan	Image extract into the Cyan colour
Actual result – Pass  				

Table 2 - Test Case 2 Extract the image into CMYK channels

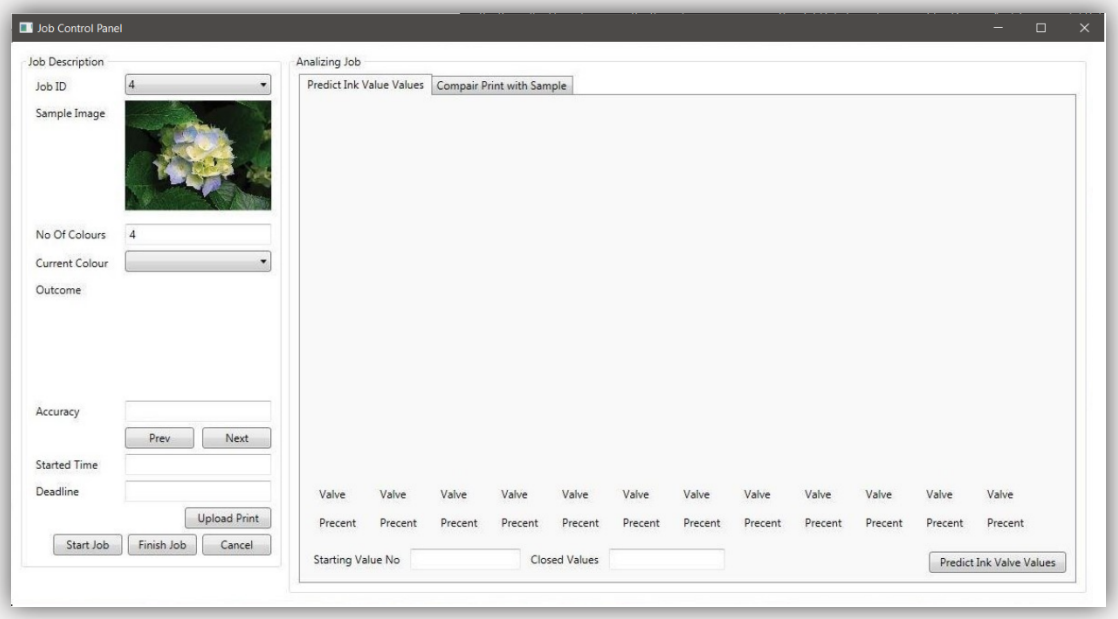
Test case : **Retrieve image related to jobID** Pre-condition : Successfully uploaded the image to the system				
Test NO	*Sequence No*	*Test description*	*Input values*	*Expected value*
3	3.1	Check whether the uploaded image belong to JobID	JobID - 2	Image box get the image related to JobID
Actual result – Pass  			

Table 3 - Test case 3 Retrieve image related to job ID

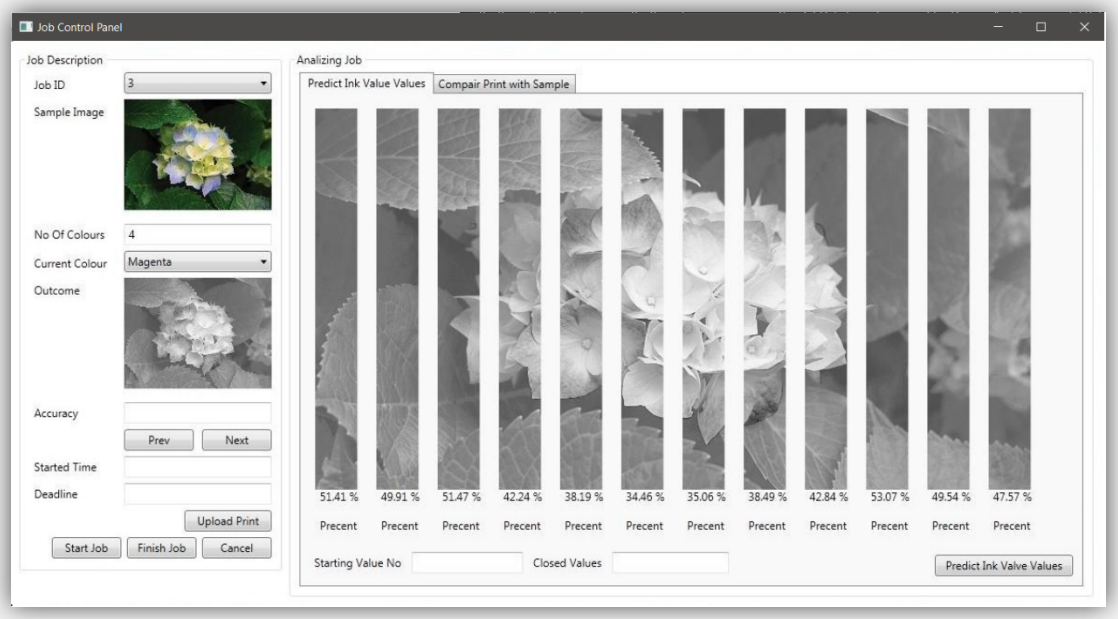
Test case : **Image divide into controllable lines.** Pre-condition : Image should be filtered into selected CMYK colour.				
Test NO	*Sequence No*	*Test description*	*Input values*	*Expected value*
4	4.1	Check where the image divided in to controllable vertical lines	Filtered image	Filtered image divide into controllable vertical lines.
Actual result – Pass 				

Table 4 - test case 4 - Image divided into controllable lines

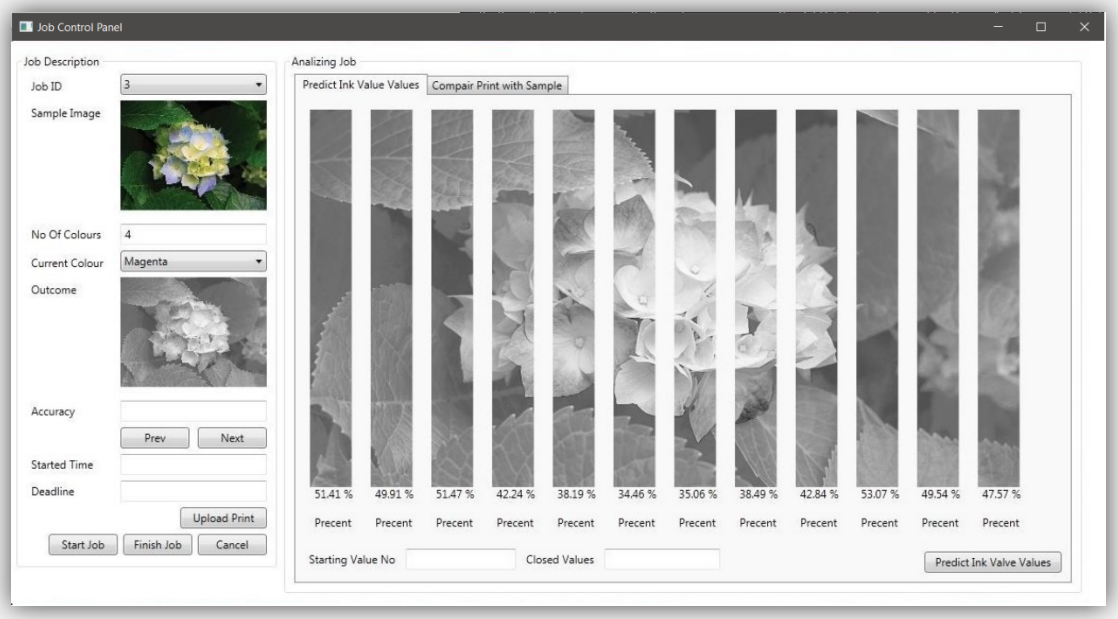
Test case : **Analyzing Job** Pre-condition : Enter a new job to the system				
Test NO	*Sequence No*	*Test description*	*Input values*	*Expected value*
5	5.1	Check where the predict ink valve value button is functioning.	Divided image in to the image box	Display color values in the bottom of the vertical line,
Actual result – Pass 				

Table 5 - Test case 5 Analysing job

Test case : **Compare printed sample.** Pre-condition : System get the printed sample image.				
Test NO	*Sequence No*	*Test description*	*Input values*	*Expected value*
6	6.1	Check where the comparing method functioning.	Get divided printed sample image.	Calculate the percentage colour values in vertical lines.
Actual result – Pass  				

Table 6 - Test case 6: Compare printed sample

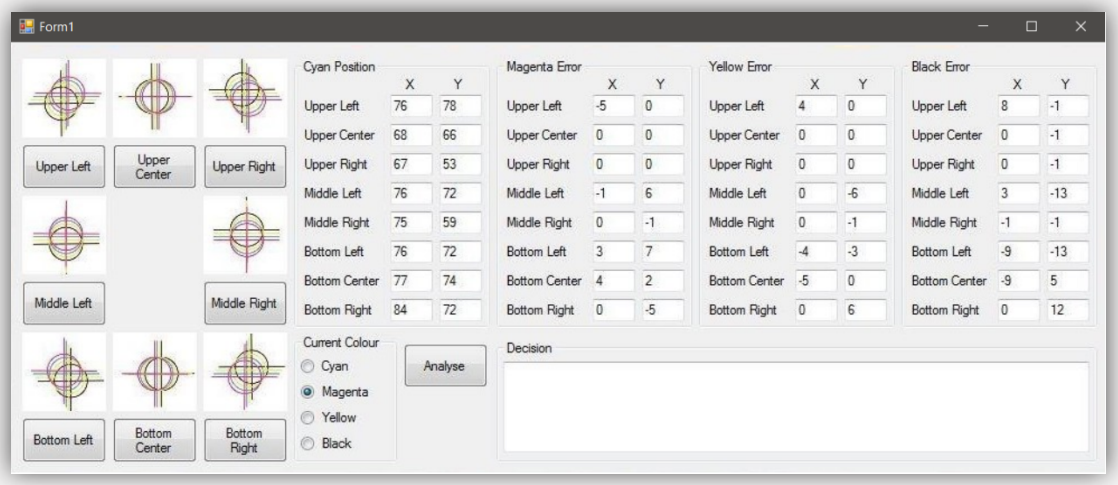
Test case : **Analyzing registration mark** Pre-condition : Insert registration mark images to the system				
Test NO	*Sequence No*	*Test description*	*Input values*	*Expected value*
7	7.1	Calculating different between the registration mark	Upper left image Upper centre image Upper right image Middle left image Middle right image Bottom left image Bottom middle image Bottom right image	Display values between the registration mark
Actual result – Pass 				

Table 7 - Test case 7 Analyzing registration mark

Test case : **Decision making according to the registration mark analysing result**

Pre-condition : Analyse the registration mark

Test NO	*Sequence No*	*Test description*	*Input values*	*Expected value*
8	8.1	Dissection make after analysing the registration mark	Analysed result	Display dissections according to the analysed results

Actual result – Pass

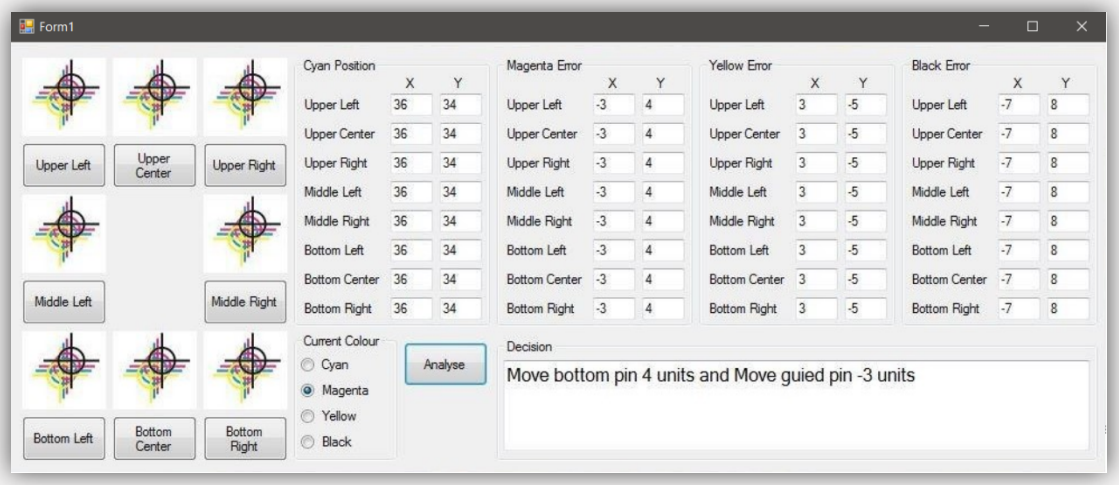


Table 8 - Test case 8 Dissection making

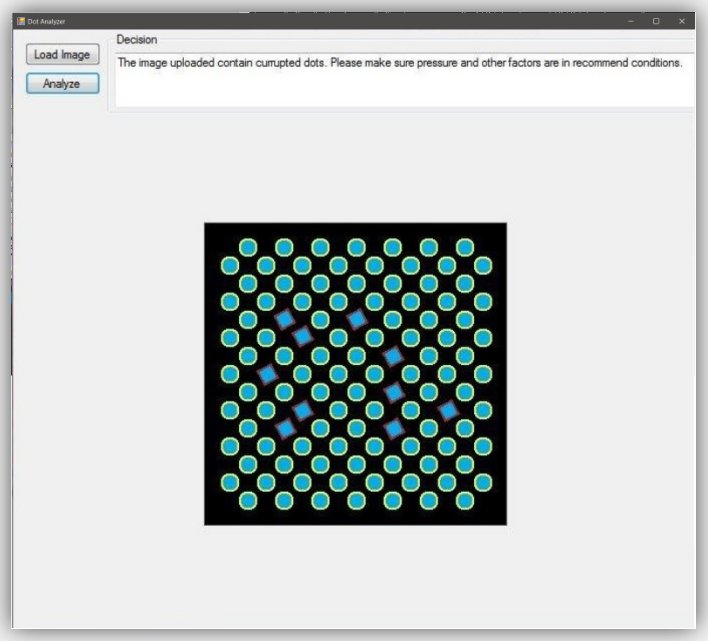
Test case : **Analyse dot in the print area** Pre-condition : Insert dot mark to the system				
Test NO	*Sequence No*	*Test description*	*Input values*	*Expected value*
9	9.1	Analyzing the dot in the printing area to check shape	Dot image	Display analyzed result
Actual result – Pass 				

Table 9 - Test case 9 Analyzed dot

3.1.2 Result of testing

Test case No & description	*% of success (a/b) *100*	*Evaluation of test results & modifications to the design*
upload the image	5/5 = 100%	Images were uploaded successfully
Retrieve image related to JobID	5/5 = 100%	Successfully retrieve the image.
Select the CMYK colour	5/5 = 100%	Selecting CMYK colour successful.
Image divide into controllable lines	5/5 = 100%	Successfully divide the image.
Analyzing job	5/5 = 100%	Colour prediction method successful.
Compare printed sample	5/5 = 100%	Colour prediction method successful.
Separate CMYK colours	5/5 = 100%	Successfully image loaded on the picture box after filtering.
Analyzing registration mark	5/5 = 100%	Successfully analyzed the image.
Analyzing dot in the print area	3/5 = 60%	Identify shapes.

Table 10 - Result of testing

3.2 Discussion

Research is based on printing industry to provide good service in printing process. This system mainly implanted based on the image processing. Main purpose of developing this system is support for quality printed out come without wasting cost. Main function of this system is comparing printed sample image with the original image. And analysing registration marks use in printing industry, analysing micro details and developing a hardware part.

3.2.1 Reliability

The system should not fail any time and it should respond accurately to the user requests all the time. The System provides the exact information that the user expects with minimum time and effort. All the information contained in the system should be accurate and up to date. In system the user can operate by just uploading the sample image and the

information is processed. This system is a high quality, accurate and reliable system for the printing industry.

3.2.2 Availability

The system should be up and running all the time. The database should always be online without any unavailability and response errors. Especially the images loaded in the database should be available almost all the time.

3.2.3 Security

The system is controlled with a username and a password just for the user to login to the system and authenticate. This is a primary level of security which is implemented to make sure the logged user is authorized to access the contents of the system.

3.2.4 Maintainability

The system is developed to suit the future maintenance and addition of other functionalities. The system will be update further with the necessary updates.

4 End-project report

4.1 Project summery

The goal of this research study is to develop a original and sample comparing system in printing industry where operators develop final accurate and quality outcome with is avoiding print wastages, rework, etc.

4.1.1 Objectives reviews

1. Analyzing current systems – the research focus identifying weaknesses in the industry and focus functional and nonfunctional requirements before building up this research application.
2. Analyzing user requirements – a study by Yamagishi Yashiro on beyond RGB; spectrum based colour imaging technologies. (Yamaguchi, et al., 2008) and study on colour gamut and the printing of digital colour images by William B of the national research council of Canada motivated this research in identifying functionality requirements of the industry. (Maureen C, 2008)
3. Analyzing potential development technologies – when conducting initial research in this project which technologies to use to develop solutions. Factors such as cost, security, scalability, and documentation also considered.
4. Design the architecture – when planning the application, it was decided SQL to use as the database for the system.

4.2 Changes to the project

As the project develops due to gaining further knowledge on the subject some minor deviations to the initial plan was done and additional functionalities introduced. There were no lags or falling short of scheduled time as a result. These deviations for the results of change of the scope of the client during development stages.

5 Project postmortem

5.1 Evaluation of objectives

The personal interest of the developer in application of software development processors to apply on to a in industrial concerns was the triggering point of this research initiation. Therefore, conventional applications deviated to apply on development on and industry.

5.2 Development process evaluation

The approach applied to develop the research is agile since its flexibility of approach and user testing on the job and updating of the knowledge let to the creation of more accurate schedule and plan.

5.3 Performance evaluation of the developer

This regarding personal commitment and adhering set guidelines was the success of completion of the project in time.

5.4 Future development

Any user involves in this industry with their hands on the experience there in the potential in upgrading this project with the advancement of the in industry.

6 Conclusion

This document so far has presented a brief overview of a digital supporter for quality printing outcome. With the current market trends, economic and the social concerns have a very slim margin for error, which will cost the total industry. In the current context, the printing industries are using single colour machines which results in wastage of paper, ink and time. As this is the core of the business and when considering this in the long run, the industry tends to lose its profitability. Therefore, it had come up with this research project which will provide the users an upper hand to analyse the printing process much deeper and reduce the amount of wastage at a considerable amount. It has also integrated a number of features for boosting retrieval performance.

As the initiation step of our process, it has modeled a tool for the scanning process of the sample image with proper lightings to obtain high quality resolution image as the input to the system. Since this is the primary part of this process, it needs to obtain a high-quality image, this continues throughout the system. Users are to get a scan of the sample image to by using the ‘Image scanning tool’ and then upload it to the system for further process.

In overall application, the response time should not exceed more than 50 seconds. Each time users requires portioning of the image and obtain colour separation; it should be processed within 10 seconds. The input image will be portioned and then the colour separation will be done, each process may process different query and be with different response time. Depending on what actions that user may take in the colour separation and shape options the time taken for the whole process may vary. If the database is not connected it will take minimum of 2 seconds to establish the connection when uploading an image or when colour separations.

When the user interacts with the system for the first time, they have to insert the images to the Database and the time taken to insert images will depend on the number of images inserted by the particular user.

The implementation of this system raises several research challenges, such as,

- How to separate channels.
- Software for image processing.
- Build a hardware devise for scan image.

From the start of the project, the main concern was to fulfil the scoped work within the given time period. Because the system uses many Colour separation systems, there is always room for improvements in every method that have used. There are many options and techniques that can be added to give more options to the user to perform image comparison using different methods in colour, slice and ink density. Because it was framed into a time period. This system implemented the basic and most imminent features for every image

portioning method. Colour separation, registered mark analysis, ink/water depth and few other features. The author hope to add more functionality to the system with time and the challenges that are faced to improve the accuracy and flexibility of the results shown in favour of the user preferences.

6.1 Future research

Apart from the main functionality of the system, the author hope to design more user-friendly GUI interfaces for who has less literacy in operating computers.

The author is looking for more efficiency and easy way to gat image into the system. It is identified that quality of the image depends on the quality of the camera and more than the brightness of the surface.

However, integrating a complete system is impossible at the moment with the lack of technological resources implementation in Sri Lanka.

The author hope to build a hardware device more advance. Upgrade capturing image quality, and control environment lights in proper way.

6.2 Project limitations

The following are identified as the limitations and drawbacks of the developed system:

- The software will operate on PCs running Windows 10, 2GB ram and 500GB Hard disk.
- C# shall be implementation language of the system.
- This is not fully automated system. There must have a user to monitor some task.
- The printing machine operator must have computer literacy to work with this system.
- This system will help machine operator to do his job. According to the system operator have to control color balancing, water level, presser and ink controller valves by manually.
- When capture image there must be a quality camera and must be consider about brightness in the background.
- Image must be capture in a controllable environment for quality image.

6.3 Problems to be addressed in the future

- The system could be work with any image file format.
- More accurate methods for channel separating, comparing and also for image processing can be used for better performance.
- A method to save the trained neural network without training it all over again.
- A different artificial neural network system for accurately identifying the characters.
- When getting image to the system, problems arise in capturing image.
- More advance hardware device for capture. Light controlling must be in the controllable environment.

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8 Appendices

8.1 User Guide

This project is about comparing sample and printed image in the printing industry. User interfaces are designed with WPF in Microsoft visual studio for attractive and to increase user friendly. System containing several interfaces for main functions.

The following screen shots show the interface for enter the new job details. System operator upload the sample image by clicking the open. The user enter job detail mention in the interface. When save the detail system automatically assign a JobID for each new job.

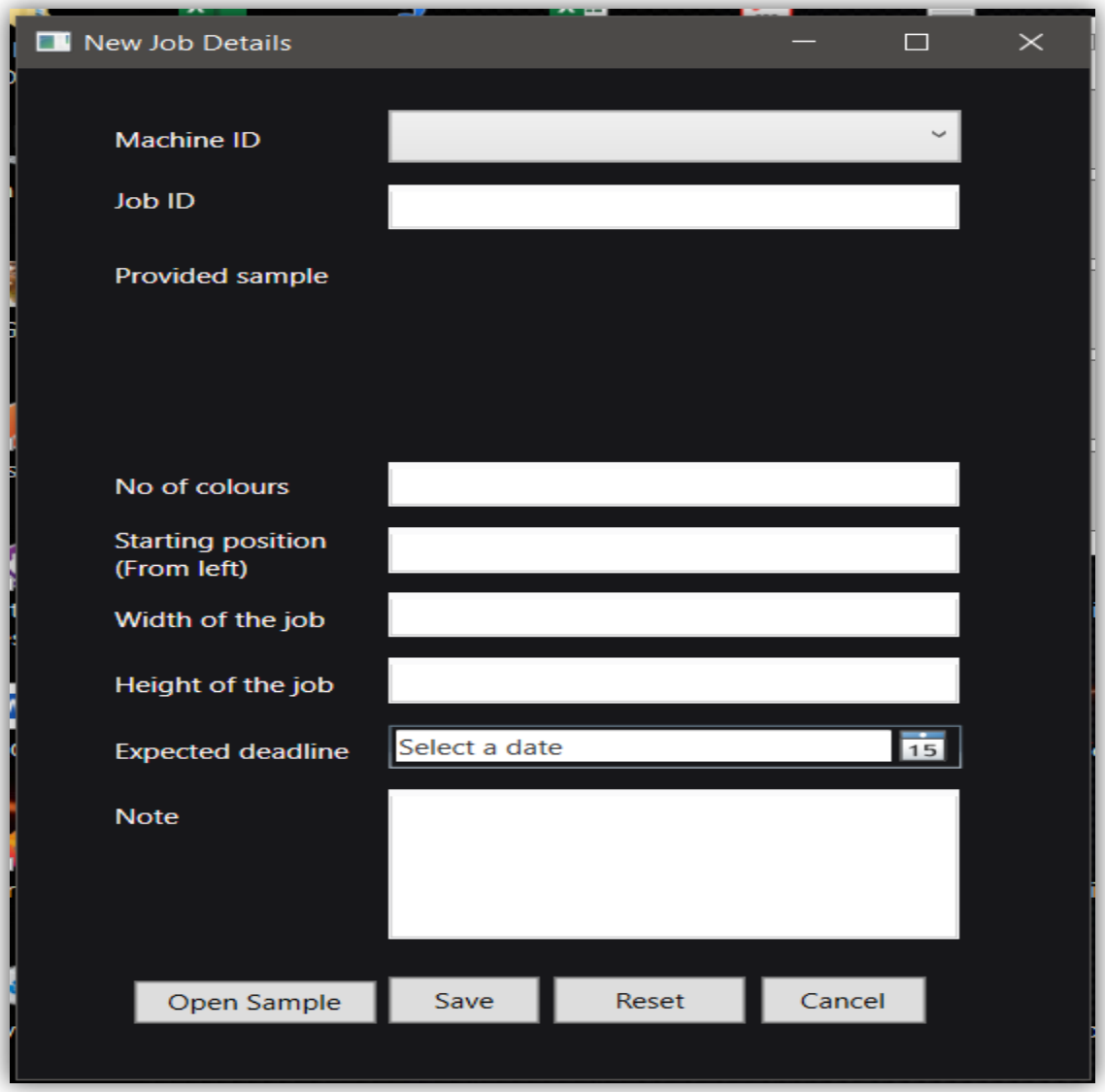


Figure 15 - Example image for inserting new job detail

This is the main interface in this sytem. Basically, when selecting the JobID it will be loaded related image for the job. When selecting the current colour, image will be filtered according to the selected colour. After that image divide into controllable vertical lines. When clicking predict ink valve value button, display the parentage of colour value for each vertical line.

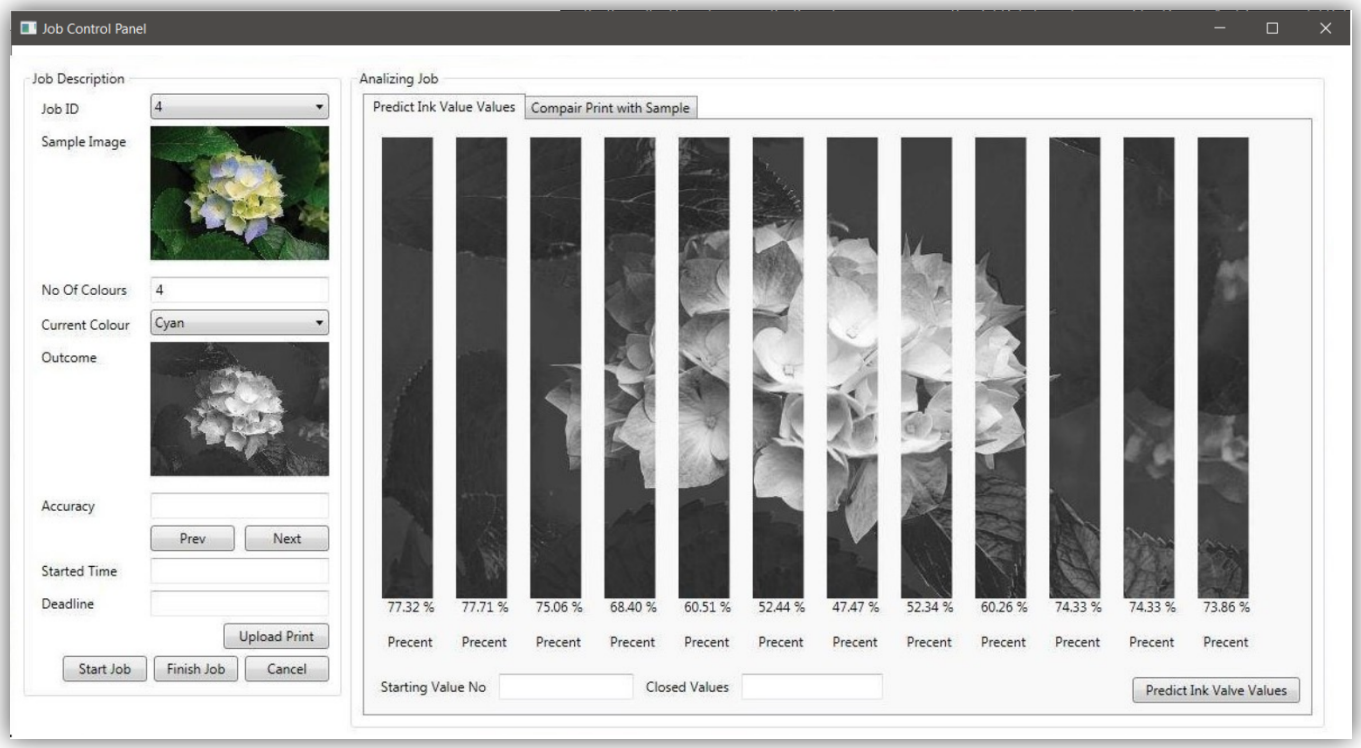


Figure 16 - Example interface for Job Control panel

In this interface compare the printed sample image with the original image. In their get the printed sample image and it will calculate the parentage colour values for each vertical line, then can compare the changes in the sample image.

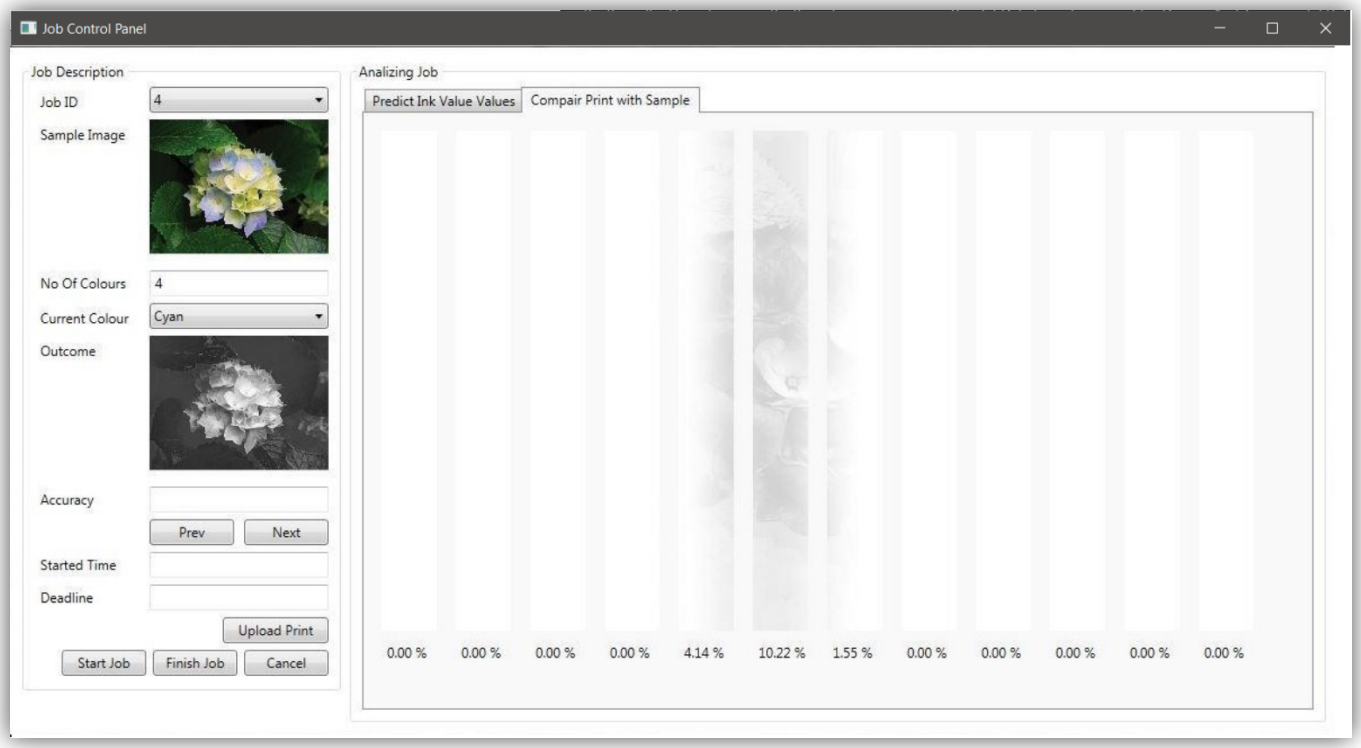


Figure 17 - Example interface for Job Control Panel part II

This interface give facility for user to upload an image. When uploaded an image it will filter the image into CMYK colour. By clicking colour menu can view the extract image in to one colour.

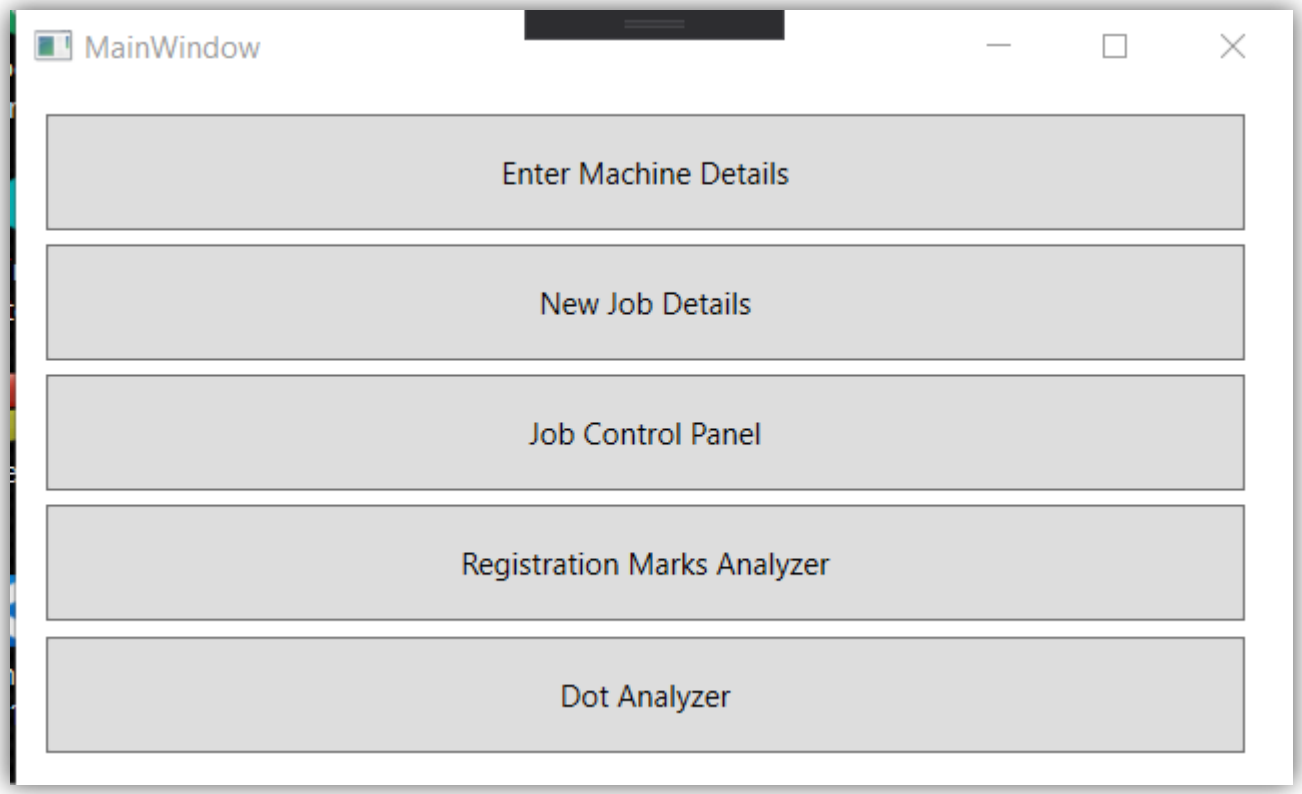


Figure 18 - Main window

Display the machine details.

When enter data to the machine table in the database user can retrieve the machine table data through the following interface. Interface view Machine ID, Manufacture, model,No of colour units and etc.. If the user has to do any update, click on the edit but and do the changes.

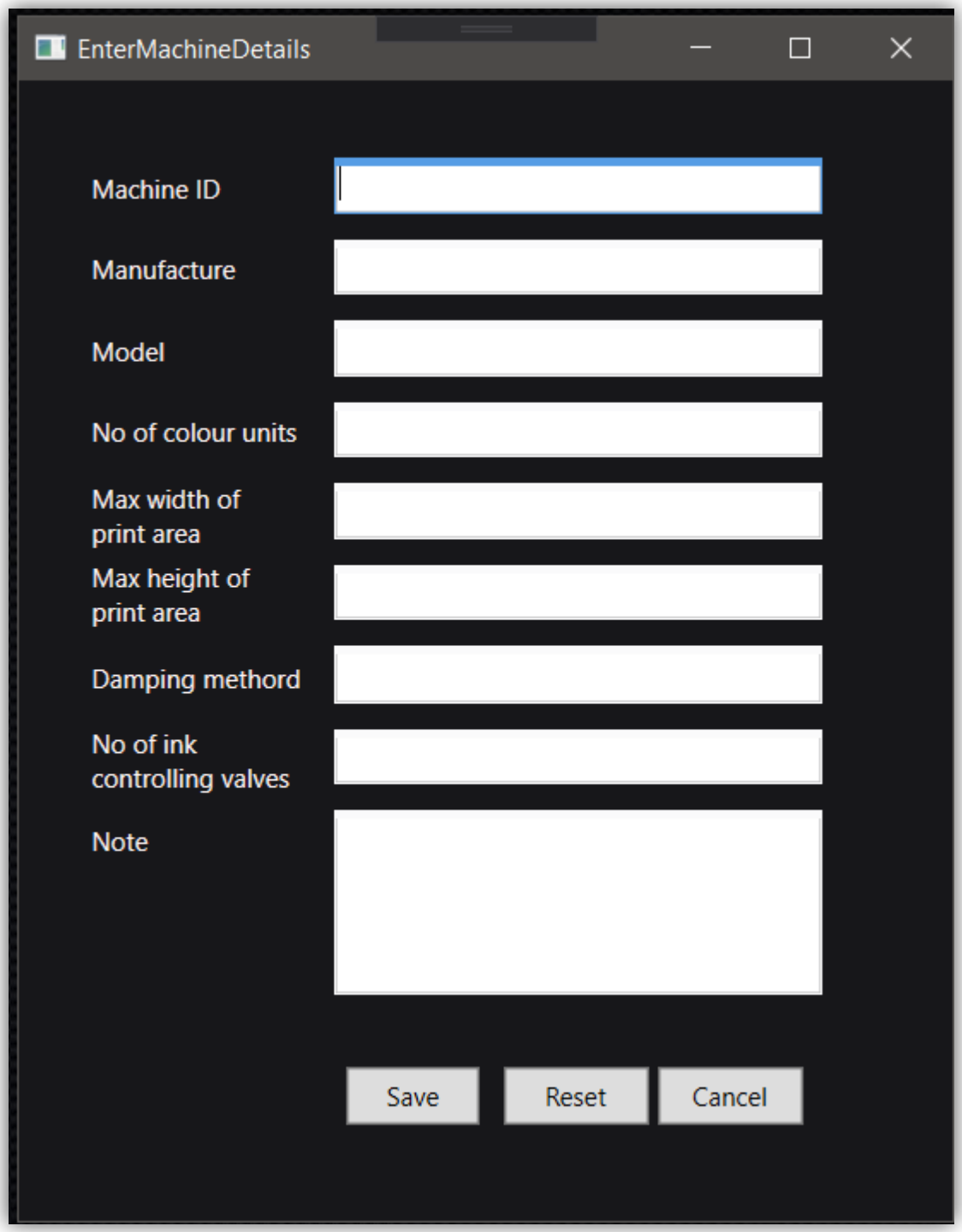


Figure 19 - Enter machine details

Following interface facilitate user to analyse registration mark. User upload images as following in the interface. Then system will calculate values for X and Y edges. System display the values for each CMYK colour.

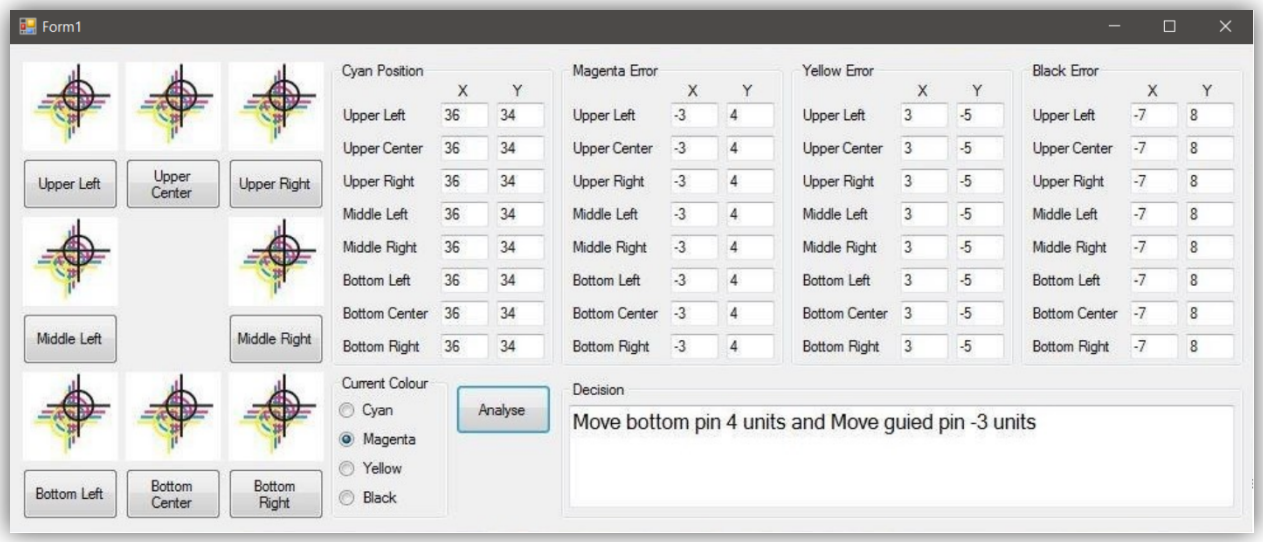


Figure 20 - Example of the Analyzing registration mark interface

Following interface show the results for analysed images. But the values different between the X, Y edges are large. This fault cannot be correct changing the pins. This is a machine fault. In this case change the configurations of the machine.

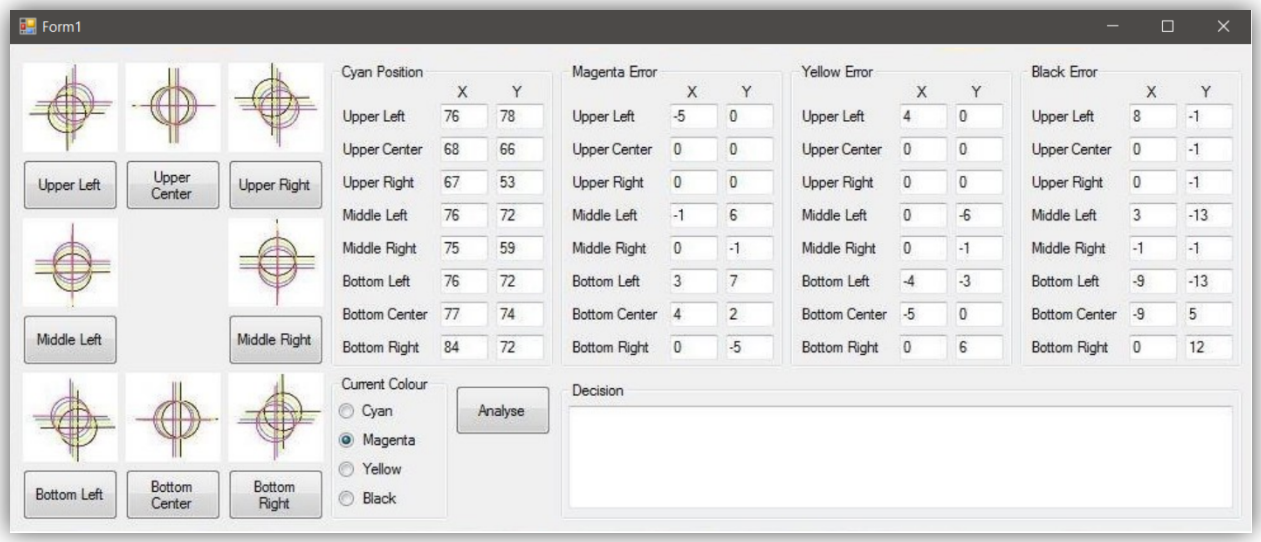


Figure 21 - Interface of an analyzing registration mark

Following interface for the dot analysing. When user insert dot image by clicking upload image, image will be upload successfully. After uploading the image when click on the analyse button system will analyse the image and display the decision in the text box.

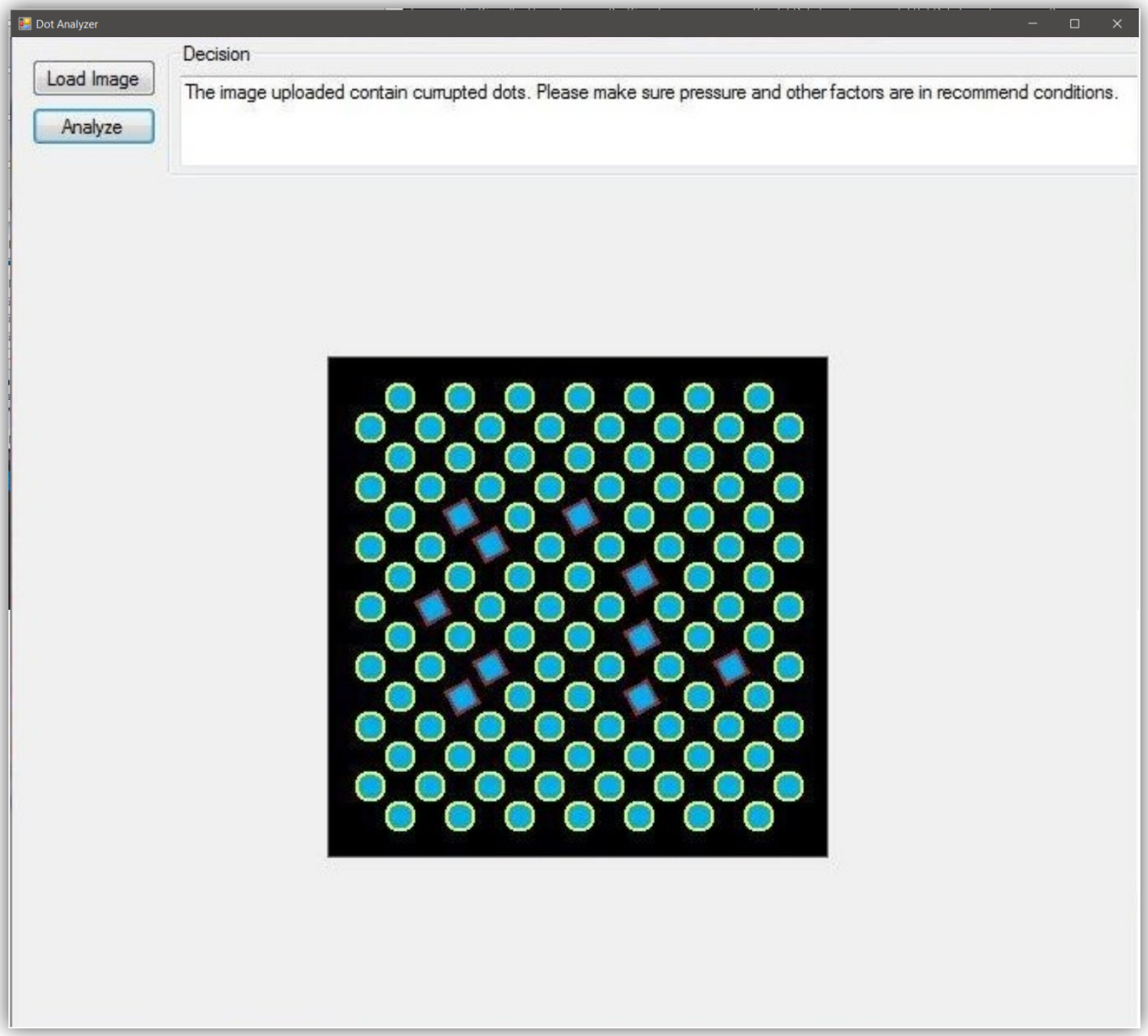


Figure 22 - Interface of analyzing dot

8.2 PID

Introduction

Offset printing (Offset lithography) is the reproduction of an image or texts in colour where inked images transferred (offset) from a plate to a compressible rubber blanket and then to printing surface or media. During printing process operator's expertise and ability place very important role in getting perfect finished good.

Since there are no options to compare and check the accuracy and the quality of the final outcome (proof) until all press runs complete , the operator cannot guarantee its outcome whether it is accurate as the sample. Operator's experience in colour blending, ink and water balancing place a major role in the final quality and the time taken to setup the levels and getting the printing registration averting damages of the dots. Those are the major requirements which needs to be monitored and controlled in achieving perfect outcome to customers satisfaction.

Business Case

1. Evaluation of the project

In sri Lanka approximately 75% of printing machines are single colour offset machines due to high initial cost of investment for four colour offset machines. Most of registered printing organizations are unable to afford them.

One colour printer means printing one colour. Black or a spot colour like Blue or Red or another. When you wanted to do process colour and have a press with good registration it is required to run the paper through in four passes. There can't see the results until all four passes complete. industry rely on comparison on colour bars and operator's experience.

In two colour machines in one pass can run Black and spot colour in one pass can run process colours in two passes. Again, it takes experience, more waste and time and more production errors.

Four colour means to do process colour in one pass with a unit of Cyan, Magenta, Yellow and Black (CYMK). Adding a perfecter in between units means both sides in less colours or run straight to do process colours.

This research is a motivational research project considering the fact that this is a printing supporter. This involves development of an image processing to handle functionality of

channel separation, four color registrations and identifying the quality of the printed dot which is the smallest component of the printed document. This also makes decisions of water level, ink level and the pressure of the cylinder which are called plate cylinder, blanket cylinder and impression cylinder.

2. Problems the industry encounters

- High cost of investments
- Finding certified expert operators
- Controlling production errors
- Quality control issues QC specialist

3. Objectives with regard to identified problem

- The industrialist who possess single colour machine can use the one colour offset machines at optimum and correct level
- With this project employees with less experience able to get high quality products.
- Development of image processing techniques to handle channel separation, colour registration and colour matching, resolution issues, reviewing preplace and proofing files issues.
- Controlling quality control issues with regard to ink density, over printing grey balance, etc. associates with ink hue, rubber blanket and impression cylinder.

Project Objectives

1. Ease of work for Machine operators.
2. Lower Job initiating time.
3. Compatibility of the original with the outcome.
4. Controlling Rejection of orders and monitory lost.
5. Low investment cost.
6. Service of semi-skilled operators.
7. Profitability of the business.

Initial Scope

1. Machine operators can release from the burden of balancing inks, water and cylinder pressure.
2. Machines can easily configure for a job rather than following present methods therefore initializing time will be lower.
3. System will help the operator to get printing outcome same as the original.

4. Sometimes clients reject orders due to variances of the outcome not matching the sample. Consequently, printers have to repeat the job. Owner's reputation suffers in addition to monitory lost. With this system clients do not encounter these types of problems.
5. Printing with one colour machines will be easier and enjoyable.
6. Less experienced employees can work on more complex printing outcomes.
7. Printing operation will be more profitable.

Method of Approach

I decided to use following tools and technologies for the system (some more may be added during the way),

- Implementation techniques
    - Asp.net / C#, Framework 4.5, Microsoft Visual Studio for Server-side application designing.
    - Microsoft SQL Server 2010 / MySql for Database designing.
    - Microsoft Office package for Documentation.
    - Aforge Image Processing Lab / Aurigma Graphics mills for Image processing
    - Photoshop for interface design
- Hardware
    - 14 MP Digital Camera
    - Set of Camera lights

1. Getting the image into the system

I have decided to build a device with a camera and four lights. Using this devise, I will scan printed out come and customer sample.

2. Derive four Channels and Getting initiating values

System will first get the sample and extract the channel operator requires to print. Then system will divide image to controllable vertical lines and calculate the values of colour density, predict values for valves. This process will use Aforge image lab as supportive component.

3. Comparing print with the sample

As soon as machine is ready operator will print a copy and scan both sample and printed copy and enter it to the system. Then system will re do the process again for both sample and printed out come comparing the values. If there is a difference between those values, system will alert user.

4. Analyze registered marks

When it comes to one colour printing industry uses some marks to ensure four colour channels printed on each other correctly. Only then operator get sharp printed final outcome. The system will locate registration marks and analyze those marks for accuracy. If not system will provides alerts to operator to make required changes to the machine. To do this part I will use image processing and neural network.

5. Analyze the dot

Four colour print's smallest unit is the dot. It's like a pixel in a monitor. Sharper the dot will get, sharper image gets. So, we have to consider about the dot. For print a clear dot, following factors should be monitored.

- Ink level
- Water level
- Pressure of the cylinders.

When ink level is high, space between dots are filled. Then system can identify problem and alert operator to adjust the overall ink flow.

When water level is high dots will not print sharply. All the dots should be in same colour. Only the spaces between them are varying. Therefore, if there is uncolour dots system can alert operator.

When pressures between cylinders are high dots become more like oval shape. But dots should be in circle shape. Therefore, system can identify shape differences and alert operator to adjust the pressure.

To do above task we will use a digital camera with a high glass used in the printing industry. And we will use artificial intelligence, image processing and neural network also for implementing this part.

Project Plan

#	Stage	Deadline	Deliverable
1	Initiation	05/11/2019	PID
2	Survey and Requirements	20/11/2019	Surveying & analysis customer requirement
3	Design GUI Sketch	01/12/2019	Design GUI

4	Channel Separation	15/12/2019	Install Aforge Library and implement algorithm for channel separation
5	Artificial Intelligence	10/01/2020	Design and implement algorithm for divide whole image into controllable vertical lines
6	Identifying Registered marks	10/02/2020	Design and implement algorithm for calculate average color density, brightness and contrast by color.
7	System Testing & User Acceptance	25/03/2020	Testing for unit, integration and system. Testing for usability of the system.
8	Documentation	06/04/2020	Final documentation of the project.

Control Plan

At the end of each stage following project control techniques will be followed,

- Preparing a brief report of objectives at the end of each stage.
- Updating of the progress to the supervisor at the end of each stage.
- Checking the deviations from the project plan and set deadlines.
- Checking forecasted risks or any changes made to the risk list.

Communication Plan

Reviewing the progress of completion of works with the supervisor to get his comments and feedback. More discussions are to be made for the completion of end stage report with the view to create the next plan and to review any technical issues of the deliverables identified during each stage. Following the submission of interim reports feedback meetings will be held with the supervisor.

Initial Risk List

Risk	Management Strategy
Time Management	An exceptional plan will be developed, and approved by the supervisor, in the event of more than 1 week's slippage.

Scope – this project has two major research components which can be disastrous if not completed within allocated time period.	Construction of research components simultaneously reduces overall time taken for the completion of project in addition to avoiding the risk or project crashing.
Technical Difficulty	Third party libraries are needed to be compatible with all target platforms and complete functionality must be preserved for all the platforms, this creates a need for complex development procedure. The system will be deployed using standard technologies, and system backups will be taken daily

Initial Quality Plan

Quality Check	Strategy
requirements	Requirements gathered up to the discussion with the client will be checked against the actual implementation at the end of each stage to ensure that the customer requirements are fulfilled at the end of the projects.
Design validations	The design will be validated with the use of HCI principles for the ease of use at the designing stage.
Integrated Testing	Integrated testing will be done at the end of each development cycle in order to identify bugs early.
System Testing and UAT	System testing and UAT will be done at the end to analyze the productivity and usability of the system.

8.3 Interim I

Introduction

Approximately 80% of the printing machines used in srilanka are one colour. During one route the machine print only a single colour. To print a four-colour image, the paper needs to be printed four times. That is four routes, until the process complete. We are unknown about final

product, whereas we cannot guarantee if the final outcome will be accurate as the actual sample.

The colour mixing totally depends on the machine operator on how the CMYK combinations need to be used in the machine to obtain a perfect outcome. Practically not all operators are experts, and there is high possibility of going wrong.

And also, beginners who processed the basic knowledge of printing machine to obtain perfect outcome of a given sample by comparing colour depth and value between the sample and the outcome obtained. Apart from the colour guidance, the application also decides the colour depth and the water level of the output to further optimize the outcome.

A digital supporter for a quality printing outcome is a system that will overcome problems in printing process. The Digital Printing Supporter is a motivational project considering the fact that it is a Printing supporter. It has multiple research components which go beyond the scopes of simple logical structuring and usability, involving also the development of an Image Processing to handle the functionality of Channel separation, four colour registrations and identify the quality of the printed dot which is the smallest component of a printed document.

Scope

This software system will be a digital supporter for the printers. This system will be designed to maximize the operator's productivity by providing tools to assist to compare sample with the original printing document, which would otherwise have to be performed manually. By maximizing the operator’s work efficiency and production the system will meet the editor’s needs while remaining easy to understand and use.

More specifically, this system is designed to predict values of the valves to be adjust and analyse the water level, ink level and the pressure of the cylinders. The System will facilitate to operator to get the quality print outcome same as the sample.

Motivation

When I visited a printing company, I have be able to come an understanding that there was no proper standard to compare printing sample with the actual printed outcome. Also, it's a complex task to print as it is when it comes to more than two color print, since most of the printers in the island have one color offset printing machines. This is when the problem arises to the machine operator.

I identified the problems of the current process and then we decided to build a system that helps the machine operator to get perfect print outputs just as the sample, even with a basic printing knowledge.

Basically, color printing consists of four color as Cyan, Magenta, Yellow & black. In present some printing organizations have four color machine which are capable of printing four colors continuously by one flow. So, the operator can compare the final outcome with the sample and operator able to do necessary adjustments and reprint. In this scenario the operator can print one paper at a time & compare it with the sample. The paper clearly represents the final outcome because that machine operator is capable of printing four colors simultaneously. But this kind of machines cost height. But these machines will not compare the sample image with the printed image. This system helps to machine operator to make decision to change machine settings to print accurate print sample.

I will compare the sample and printed outcome and make decisions according to brightness and colour density of channels.

Project objectives

- Machine operators can release from the burden of balancing inks, water and pressure
- Machines can easily configure for a job than following current method so initializing time will low
- System will help to operator to get printing outcome same as original.
- Sometimes clients will reject order because printing out come not same as sample. Then printers reprint again those jobs. So, it is a very bad and owners lost money. With this system they'll not face those types of problems.
- Printing with one colour machines will easy and enjoyable.
- Non experienced employees also can work on more complex printing out comes.
- Printing will be more profitable.

Project methodology

Flow of the project

After visiting few printing organizations i came to know that most of the quality depends on the experience of the machine operator. It was very hard to find experienced operator.

I identified the problems of the current process and then I decided to build a system that helps the machine operator to get perfect print outputs just as the sample, even with a basic printing knowledge.

Requirement analysis

When referring to past research papers discovered some information about printing process how the printing machines are working in the printing process. I visited printing organizations for several times to gather requirements about printing. I arranged several interviews and servers with employees who works in printing industry. I identified some critical points in the reach.

Basically, colour printing consists of four color as Cyan, Magenta, Yellow & black. Present printing machine manufactures have produced machine which are capable of printing four colors continuously by one flow. So, the operator can compare the final outcome with the sample. If there any adjustments to be mad, the operator can do the necessary adjustment and reprint. In this scenario the operator can print one paper at a time & compare it with the sample.

The paper clearly represents the final outcome because that machine operator is capable of printing four colors simultaneously.

When working with one colour printing machines, if we are to print four colour images, operators has to print cyan first, after print all the paper with cyan colour, operator has to reload machine with cyan printed paper & print magenta on it. Until operator finish printing all the colours, operator has to continue this process again & again. Drawbacks of this process is operator has to wait until print the final colour for comparing printing outcome with the sample. If there any different sample and final printing outcome there is no way to correct it. So, in this process operator has a big burden on his head to get quality outcome.

Database designing

Data base should be design very precisely because database holds the values that use to do calculations in the system. Other than that, when implement the system this system will manage more than one machine, as you can see database act as core in system.

After analyzing the requirements, I decided to add a component to gather data about jobs and keep track how many times operator compare printed outcome and sample. So I add more tables to database so that I can ensure reliability. Database contain four data table to store data. In User data table store and mange user details who operates the system. This table use to log into the system. The Machine table storing data about printing machines. The user authorized with handing machine details. User can insert, remove or update machine details. Printing jobs insert into the printing job table containing jobID, machineID, colours,sample, etc .When insert a new job detail system automatically assign a jobID for the new job. In the comparison table when selecting jobID retrieve data to compare sample with selecting colors.

The database retrieve data to JobConrol panel interface.

Algorithm designing

I have to design main algorithm.

- The system has to divide whole image into controllable vertical lines, according to provide machine data.
- System should calculate average color density, brightness, and contrast by color.
- System should compare those values with sample provided.
- System should identify registered marks and compare results to ensure printed outcome registered successfully.

Hardware designing

In the hardware device main component is camera and light bulb. The device responsible to capture a quality image and insert image copy into the system. The light bulbs capable with controlling lights.

I have to design some device to insert printed sample into the computer. Obviously, I can use a scanner for do this. But when it comes to larger than legal, I can't use a normal scanner for those.

So, I propose a devise with a normal digital camera and set of lights.

Implementation

Digital image processing is the use of computer algorithms to perform image processing on digital images. As a subcategory or field of digital signal processing, digital image processing has many advantages over analog image processing. It allows a much wider range of algorithms to be applied to the input data and can avoid problems such as the build-up of noise and signal distortion during processing. Since images are defined over two dimensions (perhaps more) digital image processing may be modeled in the form of multidimensional systems.

Digital cameras generally include dedicated digital image processing chips to convert the raw data from the image sensor into a colour-corrected image in a standard image file format. Images from digital cameras often receive further processing to improve their quality, a distinct advantage that digital cameras have over film cameras. The digital image processing typically is executed by special software programs that can manipulate the images in many ways.

Many digital cameras also enable viewing of histograms of images, as an aid for the photographer to understand the rendered brightness range of each shot more readily.

I plan to use digital image as the input for our proposed system, analyze it and give suggestions to operator of a single colour offset printing machine.

As I mentioned before when it comes to four colour printing with single colour printing machine, biggest problem operator face is how to balance inks to get fine printing outcome same as the sample. Because non experienced operator can't predict the extracted cyan, magenta, yellow and black images for given printed sample. Basically, most of the operators follow a method to get the cyan image in to their head is use photo shop to extract channels and see if ink balance is accurate. But the problem in this scenario is computer display will show image using RGB colour scheme and printed out-come will use CMYK. If operator use this method and probably end up with getting the wrong printed out come. So, let's see how we can prevent these.

Get image into the system

We will use a device that capable of getting image to computer. We can't use a scanner for this matter. Because offset printing uses probably more large documents rather than just A4 or Legal. So we've decided to build a device with a camera and four lights. Using this devise we will scan printed out come and supplied sample. We expect some quality decrease when we scan it using our device. But we look forward to tune it to get most accurate result as much as possible. Then we can ignore the quality decrease of both sample and printed outcome because both contain the same issue.

But after we implement we had a problem with identifying a colour as same colour in computer. As an example system couldn't identify 100% cyan as 100% cyan inside the computer. So we had to adjust the light source and grab few samples so that we can get the accurate colour. After we realize only light source adjustment is not enough, we created a box for 14

cover image area and get the image correctly, so we could control light balancing more accurate way.

Our way of addressing the problem is team will compare the sample and printed outcome and make decisions according to brightness and colour density of channels. How team will do this task as follows.

Derive 4 Channels and Get initiating values

As document mentioned earlier colour image consist of four colours.

Figure 23 - 4-clour image with derived channels

A small change in a colour will directly affect to the final outcome and it can't be correct again when printed using single colour printing machine. Because in the process operator will print the whole bulk in one colour, then change to anther colour and print again the whole bulk. What I decided is design a system that capable of driving channels from supplied sample and compare it with the printed out come. So the system will get the colour density value of both documents and suggest operator what he should do. When it comes to offset printing print quality depends on two factors, water and ink. When it comes to ink offset machine has a mechanism that helps to control ink by operator. It comes with controlling valve. Single knob present a vertical around 1" line in a printing area. If operator closes the valve, no ink will come to that area. If operator opens the valve that area will filled with ongoing colour. Likewise operator can control all the vertical lines according to need of ink for the printing.

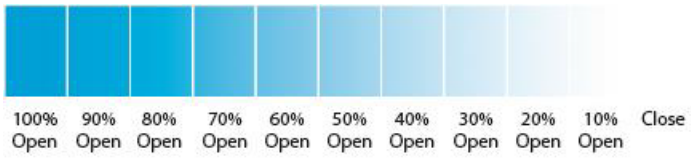


Figure 24 - Gradient Controlled by ink valves

For print above gradient in the figure this is how to manage those valves in the machine. If operator opens valve more than enough percentage, area will filled with the colour. When printing more complex design operators can't decide which values those values should have. So they end up with false colour percentages and fail printing outcome.

This system helps operator on this process. System will first get the sample and extract the channel operator wants to print. Then system will divide image to controllable vertical lines and

calculate the values of colour density predict values for valves. This process will use Aforge image lab as supportive component.

Figure 25 - More complex cyan channel

To get colour channels separately I had to get another library provided by Aurigma Company. It is Graphic mill. It's supporting four colour channel separation more reliable way. Before I get graphic mill as our third party add on we tried to separate channels with Aforge image processing lab. There I got the error, I can't separate CMYK colours with Aforge because it supports only RGB colours. Then I tried to accomplish the task with colour diagram and aforge. Because theoretically RGB colour model is known as emitting colour model and CMYK model is subtract colour model. But these two colour models has relationship with each other, as an example if we extract Red colour channel and Green channel from a image and overlap those two we should get the Cyan image of the respective image. Theoretically this is correct but when we did we couldn't get the accurate colour.

So I had to look for another source for do our task. Then I found Graphic mill. It's easy and accurate for our project.[1],[5],[3],[4].

Compare with print with the Sample

As soon as machine ready operator will print a copy and scan both sample and printed copy and enter it to the system. Then system will re do the process again for both sample and printed out come compare the values. If there is a difference between those values alert user.

To accomplish this task I am using Histogram class on graphic mill and get the slandered deviation of the differentiated image.

Analyze registered marks

When it comes to four colour printing industry uses some marks to ensure four colour channels printed on each other correctly. Only then operator get sharp printed final outcome.[2]

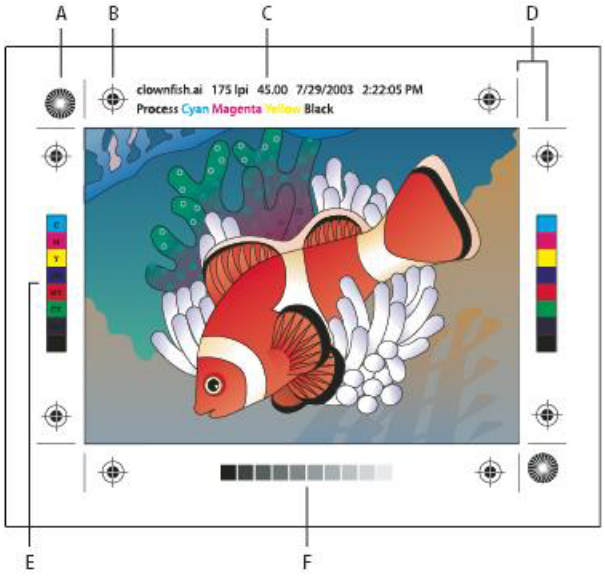


Figure 26 - Printed document with registration marks

Those B and D are commonly use in printing industry in Sri Lanka. Those lines and shapes have 100% of cyan, magenta, yellow and black. When magenta mark exactly print on the cyan mark only operator get sharpest outcome. When it prints like in figure follow it'll not lead to quality print.

Figure 27 - Un registered mark

So system will locate registration marks and analyze those marks are accurate. If not system will provides alerts to operator to make changes to the machine. With this function we can prevent wastage that happens when operator makes changes without guiding. Because current process is depend on operator only so he has to print around 50 pages to get sharp image with two colour. But when it comes to four colour wastage will high. Then he has to print around 300 papers get prints registered accurately.

To do this part I will use image processing and neural network.

Analyze the dot

Four colour print's smallest unit is the dot. It's like a pixel in a monitor. Sharper the dot will get, sharper document get. So I have to consider about the dot. For print clear dot it will cause 3 main factors.

- Ink level
- Water level
- Pressure of the cylinders.

When ink level is high space between dots are filled. So system can identify problem and alert operator to reduce the overall ink flow.

When water level is high dots will not print sharply. All the dots should be in same colour. Only the spaces between them are varying. So if there is uncolored dots system can alert operator.

When pressures between cylinders are high dots become more like oval shape. But dots should be in circle shape. So system can identify shape difference and alert operator to reduce the pressure.

To do above task I will use a digital camera with a high glass used in printing industry. And I will use artificial intelligence, image processing and neural network also for implement this part.

Discussion

This project is based on printing industry to provide good service in printing process. This system mainly implanted based on the image processing. Main purpose of developing this system is support for quality printed out come without wasting cost. Main function of this system is comparing printed sample image with the original image. And analysing registration marks use in printing industry, analysing micro details and developing a hardware part.

Reliability

The project should not fail any time and it should respond accurately to the user requests all the time. The System provides the exact information that the user expects with minimum time and effort. All the information contained in the system should be accurate and up to date. In the project the user can operate by just uploading the sample image and the information is processed. This project is a high quality, accurate and reliable system for the printing industry.

Availability

The project should be up and running all the time. The database should always be online without any unavailability and response errors. Especially the images loaded in the database should be available almost all the time.

Security

The system is controlled with a username and a password just for the user to login to the system and authenticate. This is a primary level of security which is implemented to make sure the logged user is authorized to access the contents of the system.

Maintainability

The system is developed to suit the future maintenance and addition of other functionalities. The system will be update further with the necessary updates.

Conclusion

In the current context; the printing industries are using single color machines which results in wastage of paper, ink and time. As this is the core of the business and when considering this in the long run, the industry tends to lose its profitability. Therefore I have come up with my project which will provide the users an upper hand to analyze the printing process much deeper and reduce the amount of wastage at a considerable amount. I have also integrated a number of features for boosting retrieval performance.

As the initiation step of our process, I have modelled a tool for the scanning process of the sample image with proper lightings to obtain high quality resolution image as the input to the system. Since this is the primary part of this process, I need to obtain a high quality image; this continues throughout the system. Users are to get a scan of the sample image to by using the ‘Image scanning tool’ and then upload it to the system for further process.

An important assumption done while developing the system is that user manual will not be provided with the initial product. So the application is designed in a manner in which it demands its user to have satisfactory computer literacy to operate a basic Windows application.

When I was performing various phases I came across some limitations. Among them the application is developed and run on PCs running Windows XP or later operating system was an issue. Application is developed in C sharp language in Microsoft Visual Studio 2019 IDE.

Since the application demands high accuracy, it is important that the application is provided with images of high quality and condition.

The implementation of the system raises several challenges, such as:

- How to separate channels.
- Software for image processing.
- Build a hardware devise for scan image.

8.4 Interim II

Introduction

Approximately 80% of the printing machines used in srilanka are one colour. During one route the machine print only a single colour. To print a four-colour image, the paper needs to be printed four times. That is four routes, until the process complete. We are unknown about final product, whereas we cannot guarantee if the final outcome will be accurate as the actual sample.

The colour mixing totally depends on the machine operator on how the CMYK combinations need to be used in the machine to obtain a perfect outcome. Practically not all operators are experts, and there is high possibility of going wrong.

And also, beginners who processed the basic knowledge of printing machine to obtain perfect outcome of a given sample by comparing colour depth and value between the sample and the outcome obtained. Apart from the colour guidance, the application also decides the colour depth and the water level of the output to further optimize the outcome.

A digital supporter for a quality printing outcome is a system that will overcome problems in printing process. The Digital Printing Supporter is a motivational project considering the fact that it is a Printing supporter. It has multiple research components which go beyond the scopes of simple logical structuring and usability, involving also the development of an Image Processing to handle the functionality of Channel separation, four colour registrations and identify the quality of the printed dot which is the smallest component of a printed document.

Scope

This software system will be a digital supporter for the printers. This system will be designed to maximize the operator's productivity by providing tools to assist to compare sample with the original printing document, which would otherwise have to be performed manually. By maximizing the operator’s work efficiency and production the system will meet the editor’s needs while remaining easy to understand and use.

More specifically, this system is designed to predict values of the valves to be adjust and analyse the water level, ink level and the pressure of the cylinders. The System will facilitate to operator to get the quality print outcome same as the sample.

Project methodology

Flow of the project

After visiting few printing organizations i came to know that most of the quality depends on the experience of the machine operator. It was very hard to find experienced operator.

I identified the problems of the current process and then I decided to build a system that helps the machine operator to get perfect print outputs just as the sample, even with a basic printing knowledge.

Algorithm designing

I have to design main algorithm.

- The system has to divide whole image into controllable vertical lines, according to provide machine data.
- System should calculate average color density, brightness, and contrast by color.
- System should compare those values with sample provided.
- System should identify registered marks and compare results to ensure printed outcome registered successfully.

Hardware designing

In the hardware device main component is camera and light bulb. The device responsible to capture a quality image and insert image copy into the system. The light bulbs capable with controlling lights.

I have to design some device to insert printed sample into the computer. Obviously, I can use a scanner for do this. But when it comes to larger than legal, I can't use a normal scanner for those.

So, I propose a devise with a normal digital camera and set of lights.

Implementation

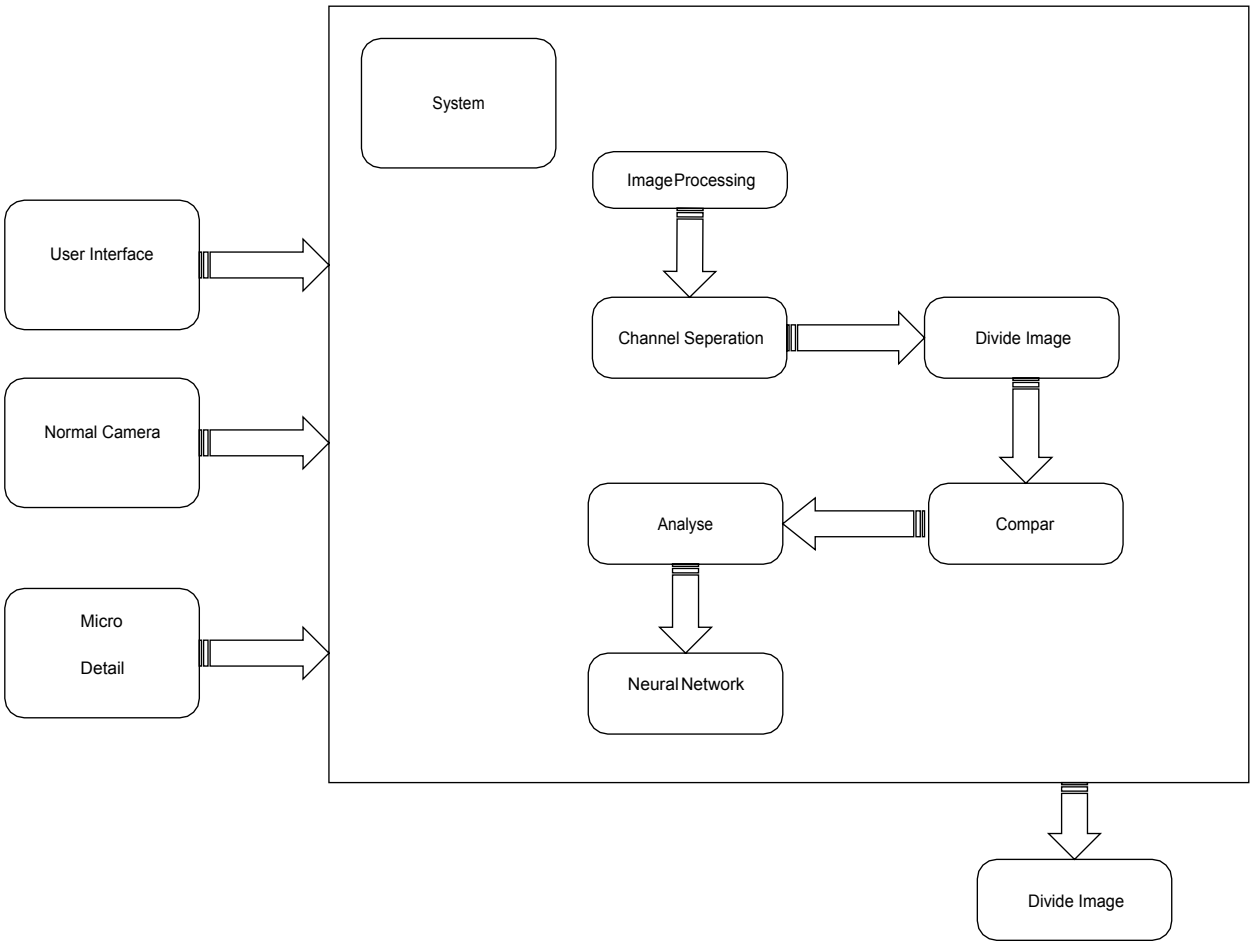
Digital image processing is the use of computer algorithms to perform image processing on digital images. As a subcategory or field of digital signal processing, digital image processing has many advantages over analog image processing. It allows a much wider range of algorithms to be applied to the input data and can avoid problems such as the build-up of noise and signal distortion during processing. Since images are defined over two dimensions (perhaps more) digital image processing may be modeled in the form of multidimensional systems.

Digital cameras generally include dedicated digital image processing chips to convert the raw data from the image sensor into a colour-corrected image in a standard image file format. Images from digital cameras often receive further processing to improve their quality, a distinct advantage that digital cameras have over film cameras. The digital image processing typically is executed by special software programs that can manipulate the images in many ways.

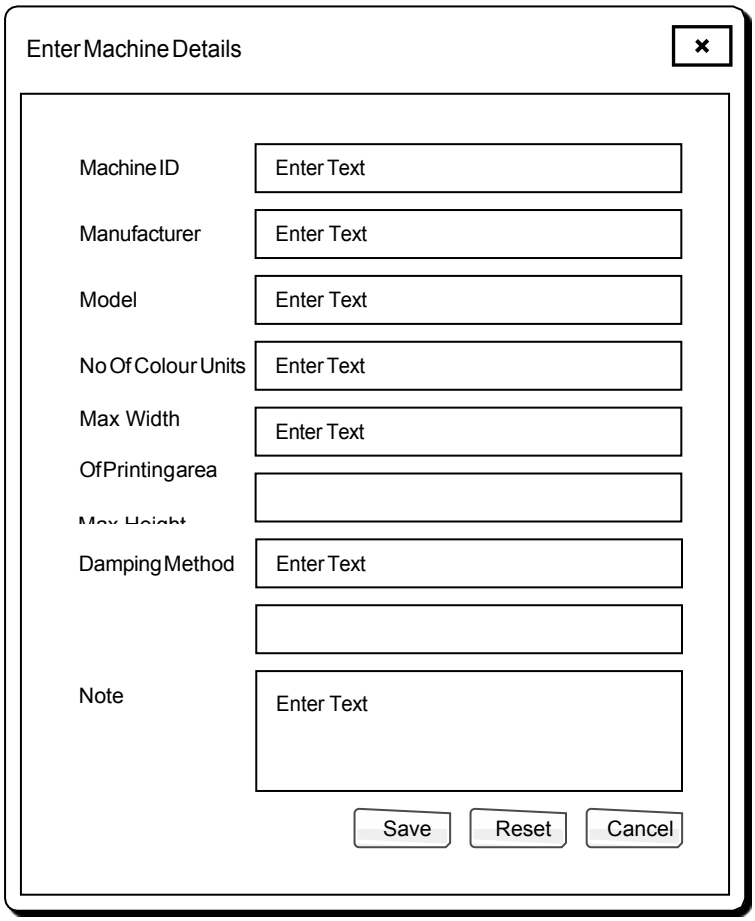
Many digital cameras also enable viewing of histograms of images, as an aid for the photographer to understand the rendered brightness range of each shot more readily.

I plan to use digital image as the input for our proposed system, analyze it and give suggestions to operator of a single colour offset printing machine.

System interface



User interfaces



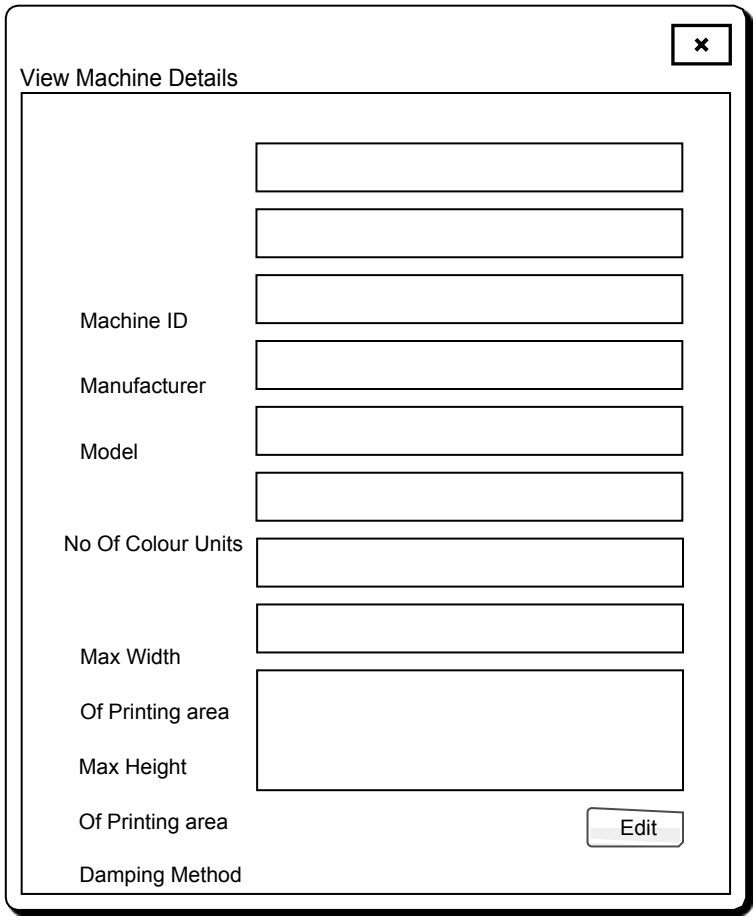
Enter Machine details

Name of Item- Enter Machine details

Description-This interface will enable to users, to enter the details of the machine.

Input- Details of the machine

Output-insert details to the data base.



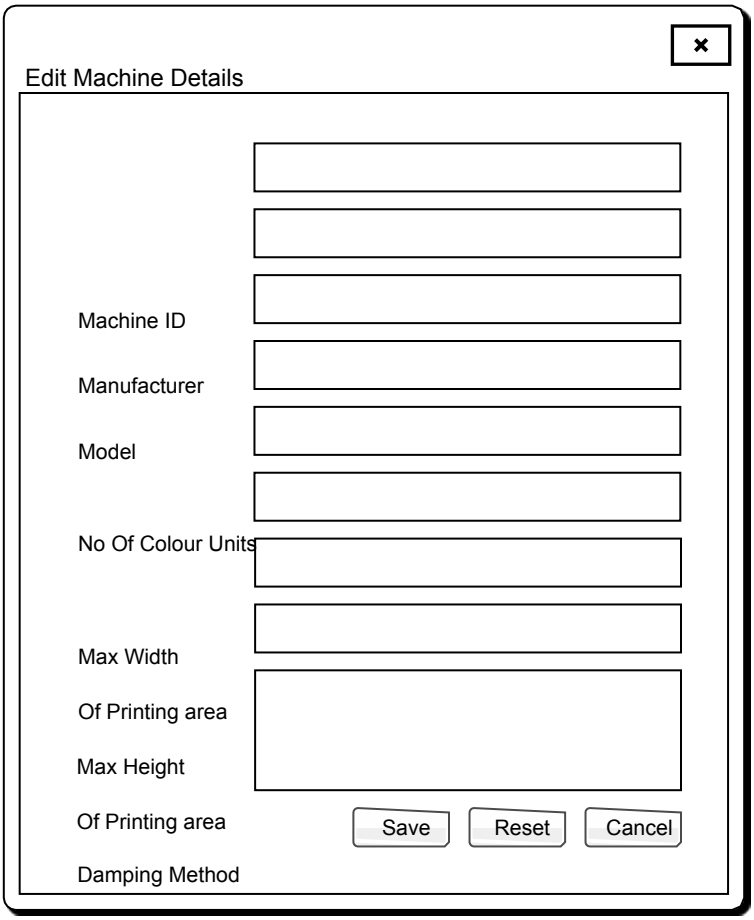
View machine details

Name of Item – View machine details

Description – This interface will enable users to view machine details

Input – Machine ID

Output – details of the machine.



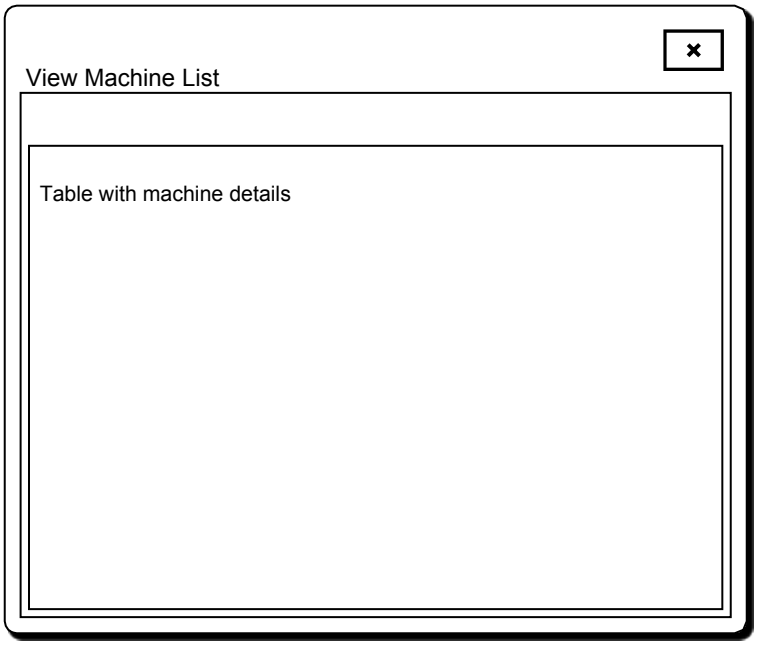
View machine details

Name of Item – View machine details

Description – This interface will enable users to edit machine details

Input – Details of the machine.

Output – update the details of the machine.



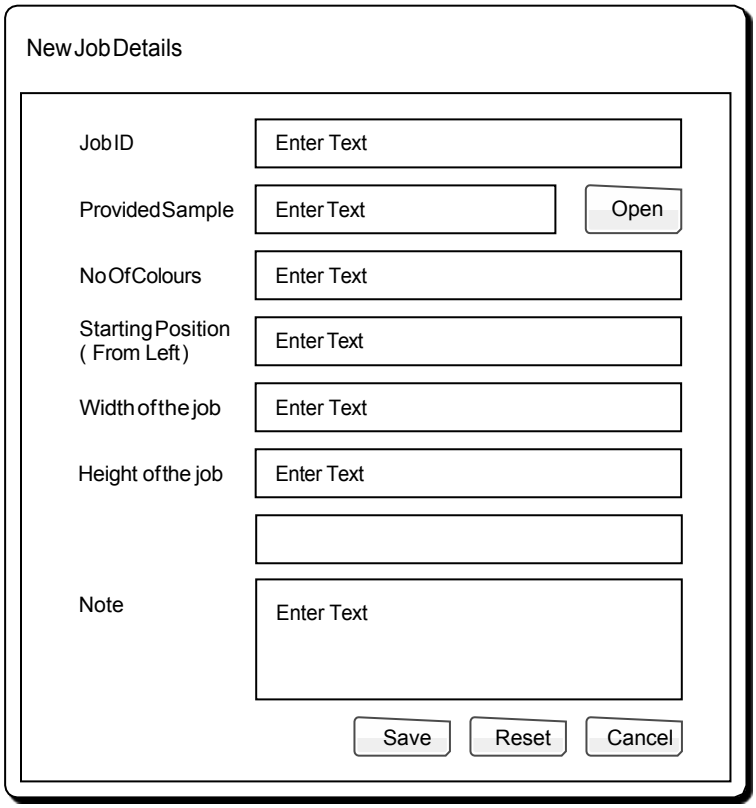
View machine list

Name of Item – View machine list

Description – This interface will enable users to view machine list

Input – N/A

Output – List of machines



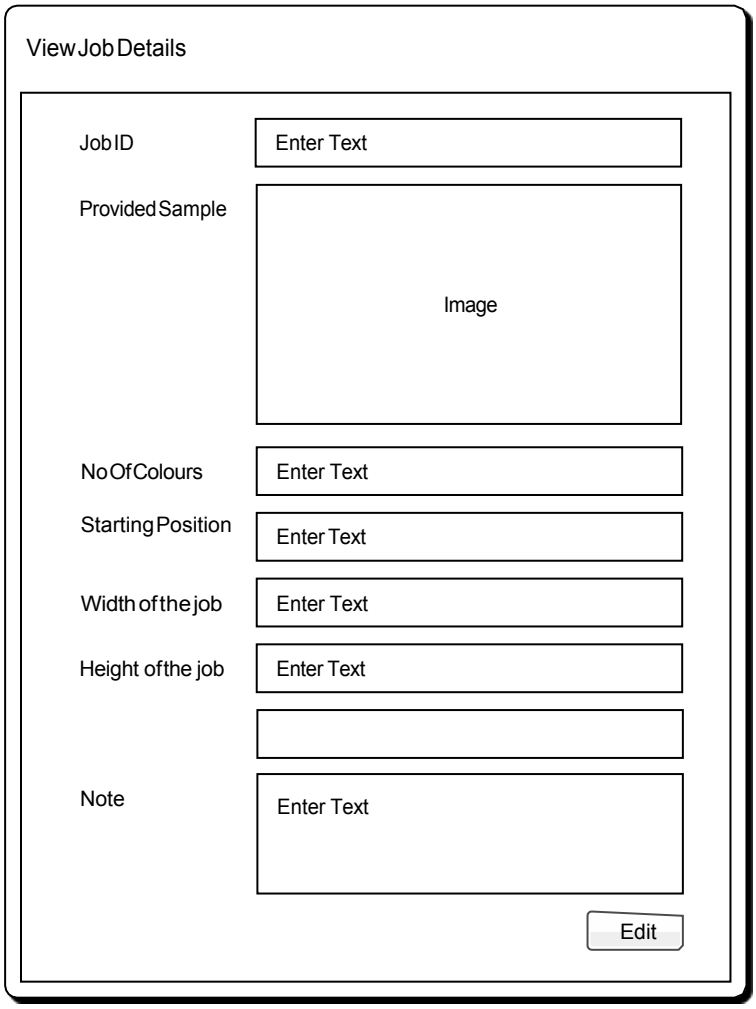
New job details

Name of Item – New job details

Description – This interface will enable users to add a new printing job

Input – Details of the job.

Output – insert job details to the data base.



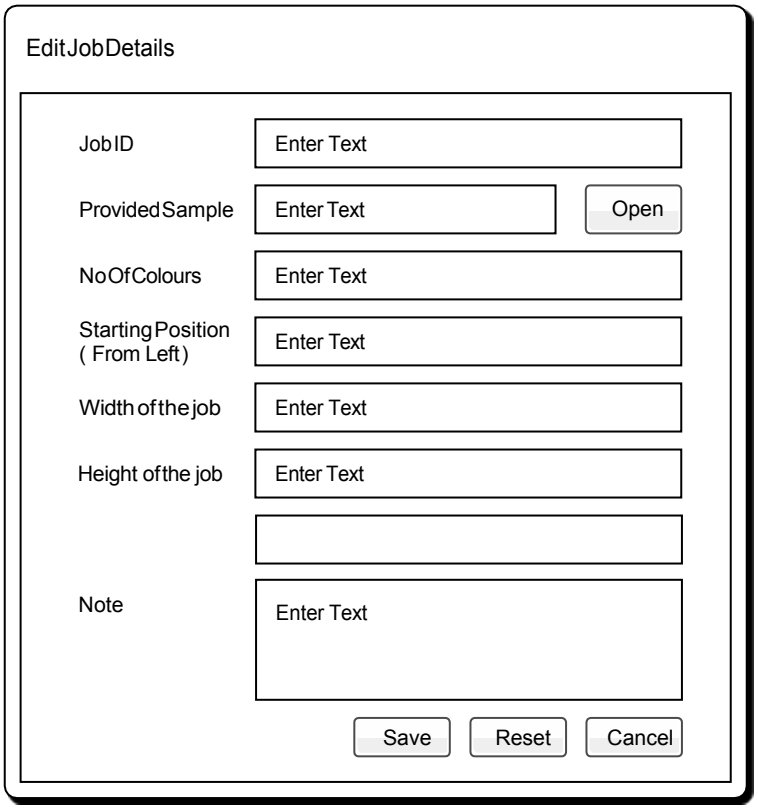
View job details

Name of Item – View job details

Description – This interface will enable users to View job details

Input – job ID

Output – Details of the job.



Edit job details

Name of Item – Edit job details

Description – This interface will enable users to edit the details of the job.

Input – Details of the job.

Output – update the details of the job.

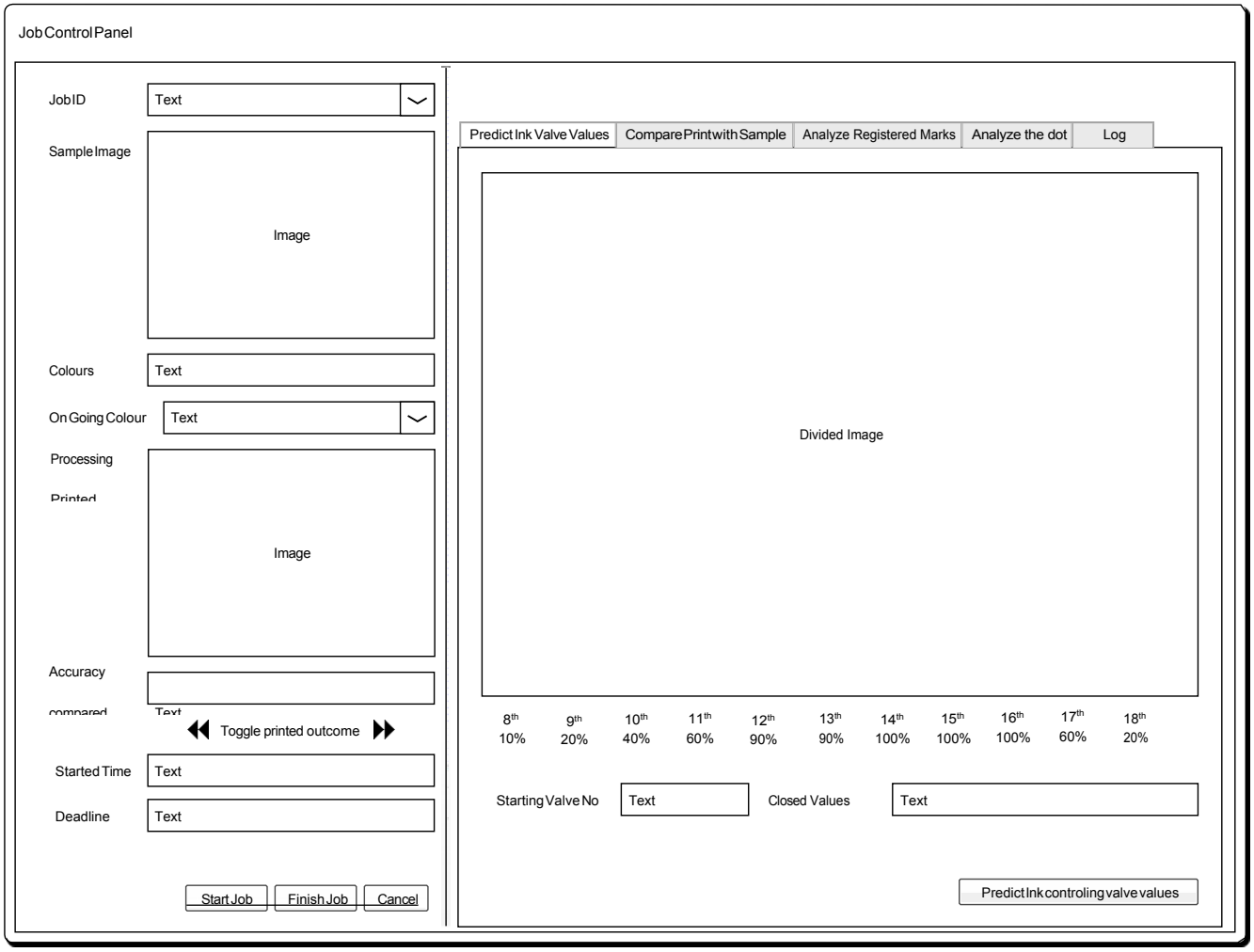
View job list.

Name of Item – View job list.

Description – This interface will enable users to view the details of the job.

Input – N/A

Output – List of jobs.



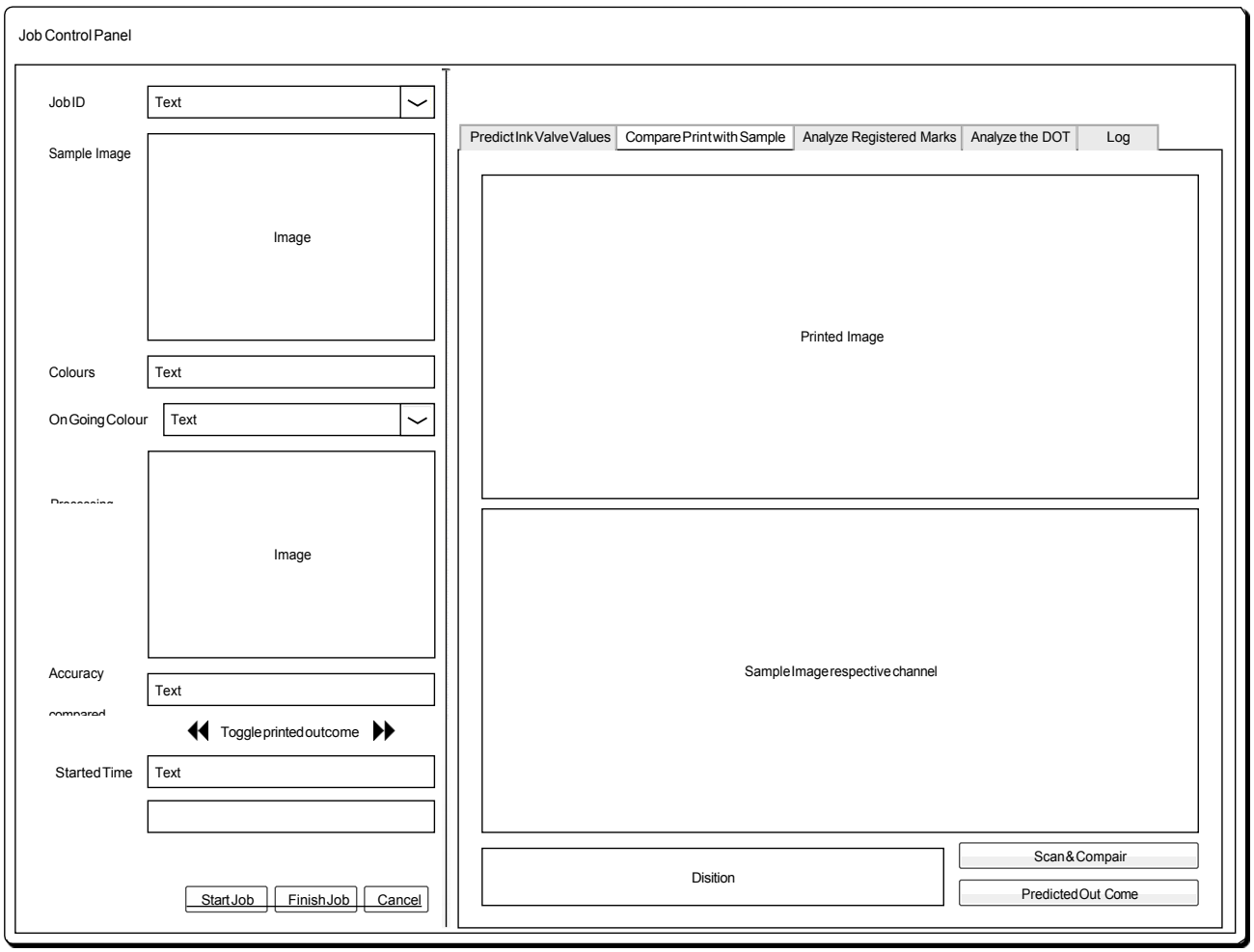
Job control panel/Predict ink valve values.

Name of Item – Job control panel/Predict ink valve values.

Description – This interface will enable predict values of the ink valves.

Input – Job ID

Output – Values for the ink valves, which valves should be closed.



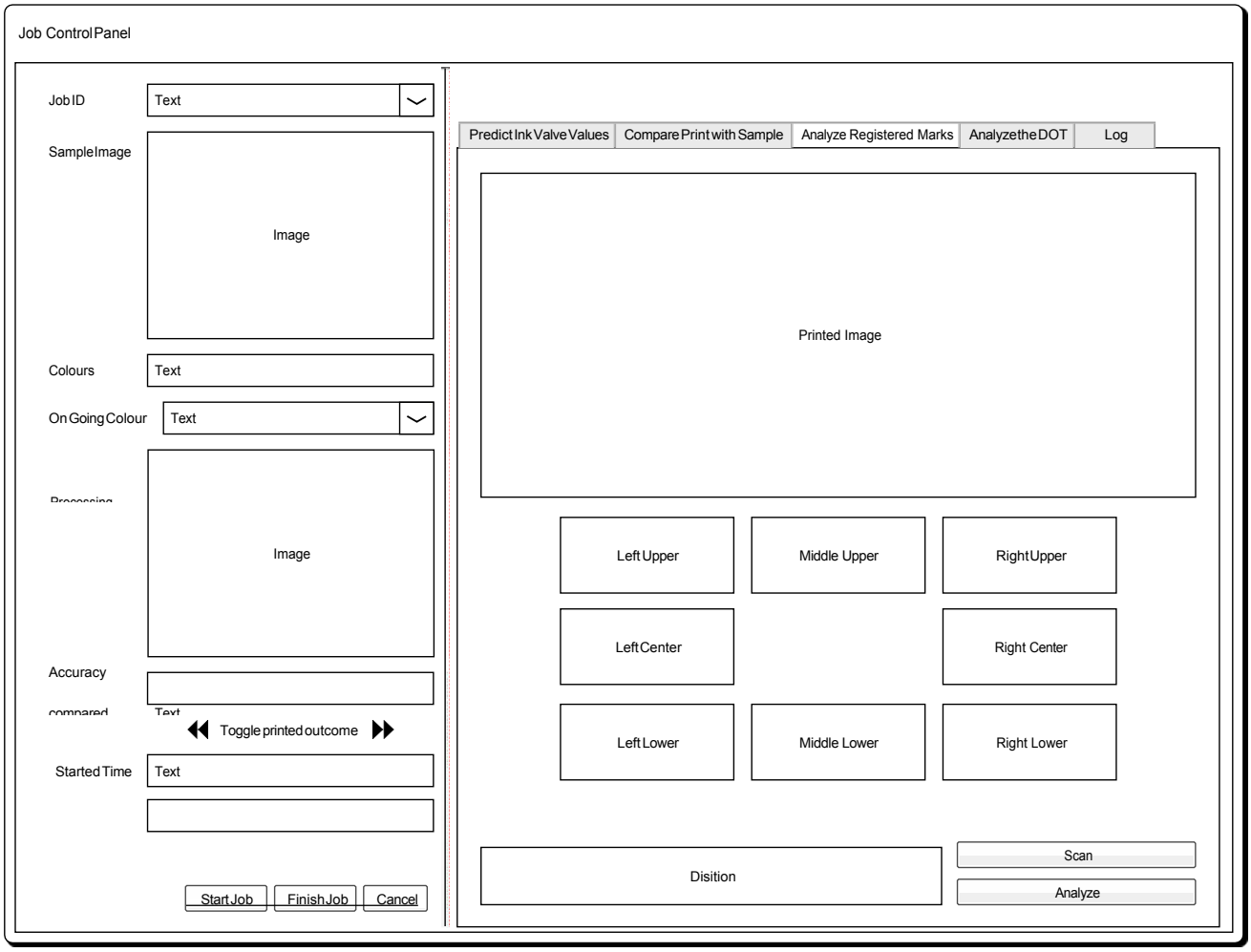
Job control panel / Compare print with sample.

Name of Item – Job control panel / Compare print with sample.

Description – This interface will compare the sample image with printed outcome.

Input – Printed outcome, currently on going colour.

Output – Decision for control the ink.



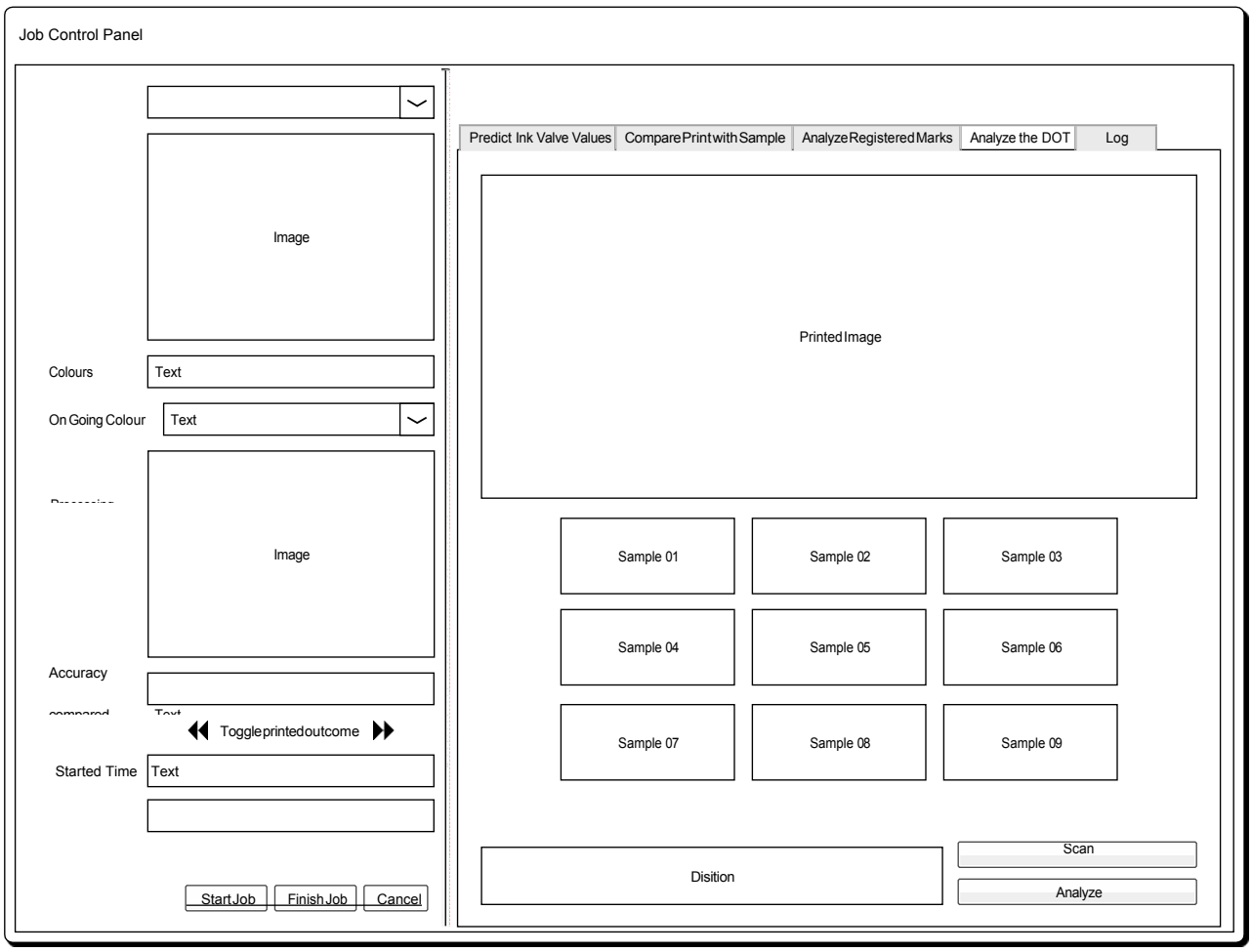
Job control panel / Analyze register marks.

Name of Item – Job control panel / Analyze register marks.

Description – This interface will analyze the register marks and predict values for adjust the pin.

Input – N/A

Output – Values for adjust the pin.



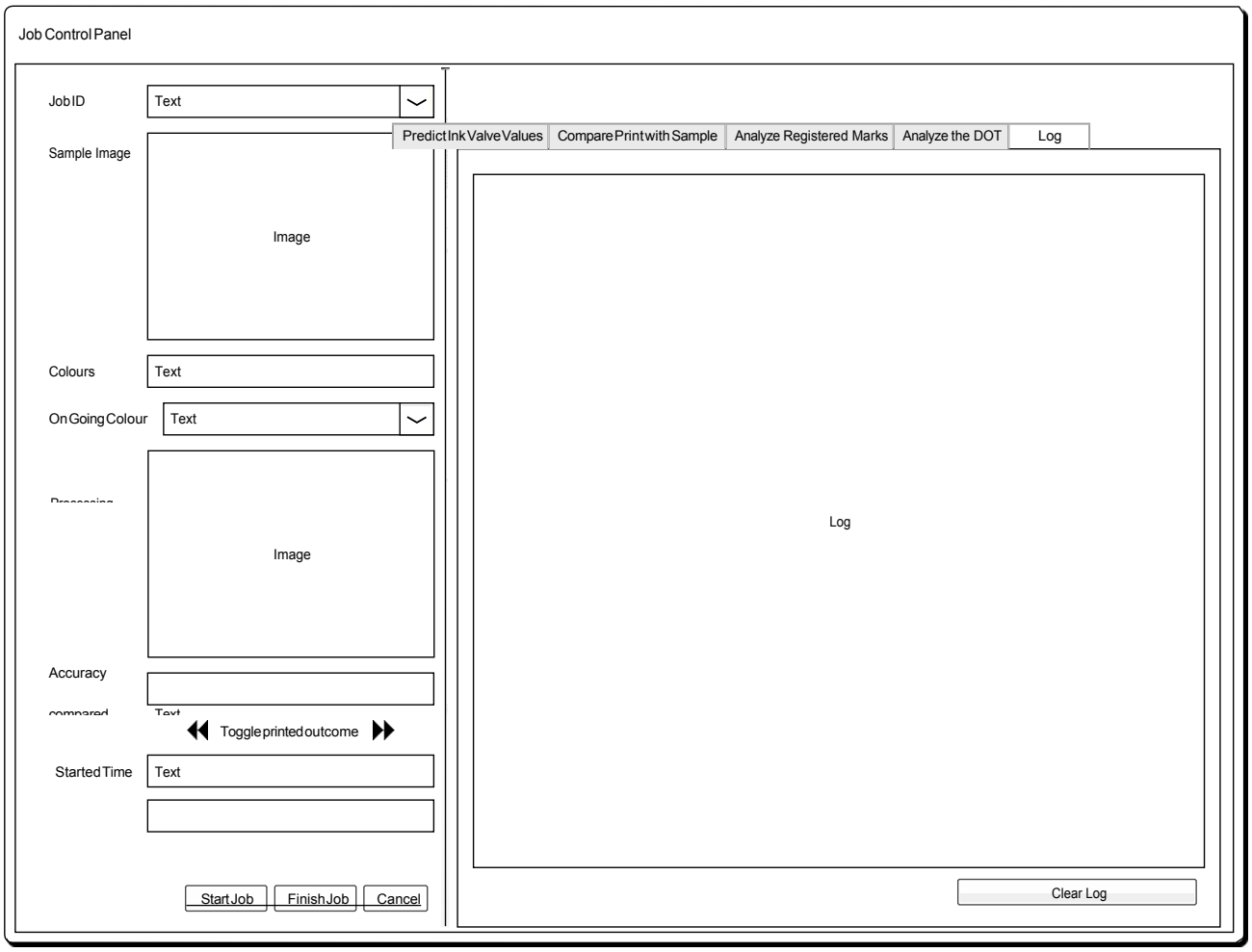
Job control panel / Analyze the DOT

Name of Item – Job control panel / Analyze the DOT

Description – This interface will analyze the DOT and provide the values to be change for the machine.

Input – N/A

Output – Values for control water level, pressure of the plates.



control panel / Log

Name of Item – Job control panel / Log

Description – This interface will notice the all the job related log. (Number of scanned images etc.)

Input – N/A

Output – Job related log

8.5 Supervisory meeting minutes

NSBM IN PARTNERSHIP WITH PLYMOUTH UNIVERSITY

Final Year Project – Supervisory meeting minutes

Meeting No: 01

Date : 2019/11/01

Project Title : computerized printing Supporter for Quality printing color ~~image~~

Name of the Student : Y. D. R. Prabha

Students ID : 10638231

Name of the Supervisor : Mr. Naji Saravanabavan

Items discussed:

Problem Description.

Items to be completed before the next supervisory meeting:

System Development.

Supervisor (Signature & Date)

Instructions to the supervisor: **Do not sign** if the above boxes are blank.

NSBM NATIONAL SCHOOL OF BUSINESS MANAGEMENT IN PARTNERSHIP WITH PLYMOUTH UNIVERSITY

Final Year Project – Supervisory meeting minutes

Meeting No: 02

Date : 28 - 01 - 2020

Project Title : Computerized printing supporter for Quality color printing

Name of the Student : Rashmi Prabha

Students ID : 10638221

Name of the Supervisor : Mr. Saravanapavan Nasiketha

Items discussed:

The Development & Project idea.

Items to be completed before the next supervisory meeting:

Process.

Supervisor (Signature & Date)

Instructions to the supervisor: **Do not sign** if the above boxes are blank.

NSBM NATIONAL SCHOOL OF BUSINESS MANAGEMENT IN PARTNERSHIP WITH PLYMOUTH UNIVERSITY

Final Year Project – Supervisory meeting minutes

Meeting No: 03

Date : 2020/05/03

Project Title : Computerized printing supporter for quality colour printing

Name of the Student : Y.D. Rashmi Prabha

Students ID : 10638231

Name of the Supervisor : Mr. Saravanapavan Nasiketha

Items discussed:

Final project Submission.

Items to be completed before the next supervisory meeting:

https://us04web.zoom.us/j/4029293113

Supervisor (Signature & Date)

Instructions to the supervisor: **Do not sign** if the above boxes are blank.

8.6 Algorithms code implementation

```
private int GetHeightToTheFirstLine(Bitmap processingBitmap)
        {
            bool isYBreak = false;
            int ImageYPosition = 0;
            for (int i = 0; i < processingBitmap.Width; i++)
            {
                for (int j = 0; j < processingBitmap.Height; j++)
                {
                    Color c = processingBitmap.GetPixel(i, j);
                    if (c.R >= 240 && c.G >= 240 && c.B >= 240 && !isYBreak)
```

```
                    {
                        ImageYPosition++;
                    }
                    else
                    {
                        isYBreak = true;
                    }
                }
                if (ImageYPosition == processingBitmap.Height)
                {
                    ImageYPosition = 0;
                }
                if (isYBreak)
                {
                    break;
                }
            }
            return ImageYPosition;
        }
        private int GetLenghtToTheFirstLine(Bitmap processingBitmap)
        {
            bool isXBreak = false;
            int ImageXPosition = 0;
            for (int i = 0; i < processingBitmap.Height; i++)
            {
                for (int j = 0; j < processingBitmap.Width; j++)
                {
                    Color c = processingBitmap.GetPixel(j, i);
                    if (c.R >= 240 && c.G >= 240 && c.B >= 240 && !isXBreak)
                    {
                        ImageXPosition++;
                    }
                    else
                    {
                        isXBreak = true;
                    }
                }
                if (ImageXPosition == processingBitmap.Width)
                {
                    ImageXPosition = 0;
                }
                if (isXBreak)
                {
                    break;
                }
            }
            return ImageXPosition;
            63
         Implementation class JobClass
        { //Class ID : CLZ02
            PrintCareDataContext db = DatabaseImplimentor.getDataContext();
            public int insertJobDetails(Printing_Job Job)
            { //Method ID : MTH01
              //Methode Description : This method will Save job details & return job Id.
                try
                {
                    db.Printing_Jobs.InsertOnSubmit(Job);
                    db.SubmitChanges();
                    var jobIds = (from x in db.Printing_Jobs orderby x.JobID descending select x.Jo
bID).Take(1);
                    int jobId = 0;
                    foreach (var x in jobIds)
```

```
                    {
                        jobId = Convert.ToInt32(x);
                    }
                    return jobId;
                }
                catch (Exception ex)
                {
                    MessageBox.Show("Error occuered while processing. CLZ02MTH01 Error Code : " + e
x.Message, "Error", MessageBoxButton.OK, MessageBoxImage.Error);
                    return 0;
                }
            }
            public BitmapImage getSampleImage(int jobId)
            { //Method ID : MTH02
              //Methode Description : This method will return sample image for given jobId.
                try
                {
                    var itemImage = (from x in db.Printing_Jobs where x.JobID == jobId select x.Sam
ple).Single();
                    BitmapImage bmp = new BitmapImage(new Uri(itemImage));
                    return bmp;
                }
                catch (Exception ex)
                {
                    MessageBox.Show("Error occuered while processing. CLZ02MTH02 Error Code : " + e
x.Message, "Error", MessageBoxButton.OK, MessageBoxImage.Error);
                    return null;
                }
            }
   64
   public DataTable getJobIDs()
            {
                //Methode ID : MTH03
                //Methode Description : This methode will return job ids from the database
                try
                {
                    var jobIds = from x in db.Printing_Jobs select x.JobID;
                    DataTable dt = new DataTable();
                    dt.Columns.Add("Name", typeof(int));
                    dt.Columns.Add("Value", typeof(int));
                    foreach (var x in jobIds)
                    {
                        dt.Rows.Add(x, x);
                    }
                    return dt;
                }
                catch (Exception ex)
                {
                    MessageBox.Show("Error occuered while processing. CLZ02MTH03 Error Code : " + e
x.Message, "Error", MessageBoxButton.OK, MessageBoxImage.Error);
                    return null;
                }
            }
            public Printing_Job getPrintingJobDetails(int jobID)
            { //Methode ID : MTH04
              //Methode Description : This methode will return Printing job details for given jobID
                try
                {
                    var printingJob = (from x in db.Printing_Jobs where x.JobID == jobID select x).
Single();
                    return printingJob;
                }
```

```
                catch (Exception ex)
                {
                    MessageBox.Show("Error occuered while processing. CLZ02MTH04 Error Code : " + e
x.Message, "Error", MessageBoxButton.OK, MessageBoxImage.Error);
                    return null;
                }
            }
            public string getSampleImagePath(int jobID)
            { //Method ID : MTH05
              //Methode Description : This method will return sample image memory stream for given
jobId.
                try
                {
                    65
                 var itemImage = (from x in db.Printing_Jobs where x.JobID == jobID select x.Sample
).Single();
                    return itemImage;
                }
                catch (Exception ex)
                {
                    MessageBox.Show("Error occuered while processing. CLZ02MTH05 Error Code : " + e
x.Message, "Error", MessageBoxButton.OK, MessageBoxImage.Error);
                    return null;
                }
            }
        }
        Machine Class class MachineClass
        { //Class ID : CLZ01
            PrintCareDataContext db = DatabaseImplimentor.getDataContext();
            public int inserMachineDetails(Machine machine)
            { //Methode ID : MTH01
              //Methode Description : This methode will save machine details and return saved machi
ne id
                try
                {
                    db.Machines.InsertOnSubmit(machine);
                    db.SubmitChanges();
                    var machineIDs = (from x in db.Machines orderby x.MachineID descending select x
.MachineID).Take(1);
                    int machineID = 0;
                    foreach (var x in machineIDs)
                    {
                        machineID = Convert.ToInt32(x);
                    }
                    return machineID;
                }
                catch (Exception ex)
                {
                    MessageBox.Show("Error occuered while processing. CLZ01MTH01 Error Code : " + e
x.Message, "Error", MessageBoxButton.OK, MessageBoxImage.Error);
                    return 0;
                }
            }
            public DataTable getMachineIDs()
            { //Methode ID : MTH02
              //Methode Description : This methode will return mechine ids from the database
                try
                {
                    66
                 var machineIds = from x in db.Machines select x.MachineID;
                    DataTable dt = new DataTable();
                    dt.Columns.Add("Name", typeof(int));
```

```
                    dt.Columns.Add("Value", typeof(int));
                    foreach (var x in machineIds)
                    {
                        dt.Rows.Add(x, x);
                    }
                    return dt;
                }
                catch (Exception ex)
                {
                    MessageBox.Show("Error occuered while processing. CLZ01MTH02 Error Code : " + e
x.Message, "Error", MessageBoxButton.OK, MessageBoxImage.Error);
                    return null;
                }
            }
        }
        Job Control Panel public partial class JobControlPanel : Window
        {
            JobClass jobClass = new JobClass();
            public JobControlPanel()
            {
                InitializeComponent();
            }
            private void frmJobControlPanel_Loaded(object sender, RoutedEventArgs e)
            {
                FillJobIDs();
                fillCmbColours();
            }
            private void FillJobIDs()
            {
                DataTable dt = jobClass.getJobIDs();
                cmbJobID.DisplayMemberPath = "Name";
                cmbJobID.SelectedValuePath = "Value";
                cmbJobID.ItemsSource = dt.DefaultView;
            }
            private void cmbJobID_SelectionChanged(object sender, SelectionChangedEventArgs e)
            {
                int jobID = Convert.ToInt32(cmbJobID.SelectedValue);
                BitmapImage sampleImage = jobClass.getSampleImage(jobID);
                imgSampleImage.Source = sampleImage;
                Printing_Job job = jobClass.getPrintingJobDetails(jobID);
                txtNoOfColours.Text = job.colours.ToString();
                67
             fillCmbColours();
            }
            private void fillCmbColours()
            {
                DataTable dt = new DataTable();
                dt.Columns.Add("Name", typeof(string));
                dt.Columns.Add("Value", typeof(string));
                dt.Rows.Add("Cyan", "Cyan");
                dt.Rows.Add("Magenta", "Magenta");
                dt.Rows.Add("Yellow", "Yellow");
                dt.Rows.Add("Black", "Black");
                cmbCurrentColour.DisplayMemberPath = "Name";
                cmbCurrentColour.SelectedValuePath = "Value";
                cmbCurrentColour.ItemsSource = dt.DefaultView;
            }
            private void cmbCurrentColour_SelectionChanged(object sender, SelectionChangedEventArgs
 e)
            {
                generateInitiateValveValues();
            }
```

```
            private void btnPredictInkValveValues_Click(object sender, RoutedEventArgs e)
            {
                generateInitiateValveValues();
            }
            private void generateInitiateValveValues()
            {
                int jobID = Convert.ToInt32(cmbJobID.SelectedValue);
                string imagePath = jobClass.getSampleImagePath(jobID);
                Aurigma.GraphicsMill.Bitmap bitmap = new Bitmap(imagePath);
                if (bitmap.PixelFormat.IsRgb)
                {
                    bitmap.ColorProfile = Aurigma.GraphicsMill.ColorProfile.FromSrgb();
                    bitmap.ColorManagement.ColorManagementEngine = Aurigma.GraphicsMill.Transforms.
ColorManagementEngine.LittleCms;
                    bitmap.ColorManagement.DestinationProfile = new Aurigma.GraphicsMill.ColorProfi
le(@ "C:\windows\system32\spool\drivers\color\EuroscaleCoated.icc");
                    bitmap.ColorManagement.Convert(Aurigma.GraphicsMill.ColorSpace.Cmyk, bitmap.Has
Alpha, bitmap.PixelFormat.IsExtended);
                }
                string selectedChannel = cmbCurrentColour.SelectedValue.ToString();
                Aurigma.GraphicsMill.Bitmap selectedChannelBitmap = new Aurigma.GraphicsMill.Bitmap
(bitmap);
                if (selectedChannel == "Cyan")
                {
                    selectedChannelBitmap = bitmap.Channels[Aurigma.GraphicsMill.Channel.Cyan];
                }
                else if (selectedChannel == "Magenta")
                {
                    selectedChannelBitmap = bitmap.Channels[Aurigma.GraphicsMill.Channel.Magenta];
                }
                else if (selectedChannel == "Yellow")
                {
                    selectedChannelBitmap = bitmap.Channels[Aurigma.GraphicsMill.Channel.Yellow];
                }
                68
    else if (selectedChannel == "Black")
                {
                    selectedChannelBitmap = bitmap.Channels[Aurigma.GraphicsMill.Channel.Black];
                }
                BitmapImage bmpimg = ConvertAurigmaImageToBitmapImage(selectedChannelBitmap);
                imgSelectedChannel.Source = bmpimg;
                int WidthOfTheImage = selectedChannelBitmap.Width;
                int partWidth = WidthOfTheImage / 12;
                int partHeight = selectedChannelBitmap.Height;
                System.Windows.Controls.Image[] imgArr = new System.Windows.Controls.Image[12];
                imgArr[0] = image3;
                imgArr[1] = image4;
                imgArr[2] = image5;
                imgArr[3] = image6;
                imgArr[4] = image7;
                imgArr[5] = image8;
                imgArr[6] = image9;
                imgArr[7] = image10;
                imgArr[8] = image11;
                imgArr[9] = image12;
                imgArr[10] = image13;
                imgArr[11] = image14;
                Label[] lblValveArr = new Label[12];
                lblValveArr[0] = lblValve01;
                lblValveArr[1] = lblValve02;
                lblValveArr[2] = lblValve03;
                lblValveArr[3] = lblValve04;
```

```
                lblValveArr[4] = lblValve05;
                lblValveArr[5] = lblValve06;
                lblValveArr[6] = lblValve07;
                lblValveArr[7] = lblValve08;
                lblValveArr[8] = lblValve09;
                lblValveArr[9] = lblValve10;
                lblValveArr[10] = lblValve11;
                lblValveArr[11] = lblValve12;
                Aurigma.GraphicsMill.Histogram histogram;
                int startingPoint = 0;
                for (int i = 0; i < 12; i++)
                {
                    System.Drawing.Rectangle rect = new System.Drawing.Rectangle(startingPoint, 0,
partWidth, partHeight);
                    Aurigma.GraphicsMill.Bitmap croppingBmp = new Aurigma.GraphicsMill.Bitmap(selec
tedChannelBitmap);
                    croppingBmp.Transforms.Crop(rect);
                    BitmapImage croppedBitmap = ConvertAurigmaImageToBitmapImage(croppingBmp);
                    imgArr[i].Source = croppedBitmap;
                    startingPoint += partWidth;
                    histogram = croppingBmp.Statistics.GetSumHistogram();
                    double histoValue = Convert.ToDouble(histogram.Mean);
                    double calcValue = (255 - histoValue) / (255);
                    double precentageValue = calcValue * 100;
                    69
                 lblValveArr[i].Content = precentageValue.ToString("0.00") + " %";
                }
            }
            private static BitmapImage ConvertAurigmaImageToBitmapImage(Aurigma.GraphicsMill.Bitmap
 selectedChannelBitmap)
            {
                System.Drawing.Bitmap bmp = (System.Drawing.Bitmap)selectedChannelBitmap;
                BitmapImage bmpimg = new BitmapImage();
                using (MemoryStream memstr = new MemoryStream())
                {
                    bmp.Save(memstr, System.Drawing.Imaging.ImageFormat.Jpeg);
                    memstr.Position = 0;
                    bmpimg.BeginInit();
                    bmpimg.StreamSource = memstr;
                    bmpimg.CacheOption = BitmapCacheOption.OnLoad;
                    bmpimg.EndInit();
                }
                return bmpimg;
            }
            private void btnUploadPrint_Click(object sender, RoutedEventArgs e)
            {
                int jobID = Convert.ToInt32(cmbJobID.SelectedValue);
                string SampleFilePath = jobClass.getSampleImagePath(jobID);
                Microsoft.Win32.OpenFileDialog open = new Microsoft.Win32.OpenFileDialog();
                if (open.ShowDialog() == true)
                {
                    Aurigma.GraphicsMill.Bitmap SampleBitmap = new Bitmap(SampleFilePath);
                    Aurigma.GraphicsMill.Bitmap PrintedOutCome = new Bitmap(open.FileName);
                    if (SampleBitmap.PixelFormat.IsRgb)
                    {
                        SampleBitmap.ColorProfile = Aurigma.GraphicsMill.ColorProfile.FromSrgb();
                        SampleBitmap.ColorManagement.ColorManagementEngine = Aurigma.GraphicsMill.T
ransforms.ColorManagementEngine.LittleCms;
                        SampleBitmap.ColorManagement.DestinationProfile = new Aurigma.GraphicsMill.
ColorProfile(@ "C:\windows\system32\spool\drivers\color\EuroscaleCoated.icc");
                        SampleBitmap.ColorManagement.Convert(Aurigma.GraphicsMill.ColorSpace.Cmyk,
SampleBitmap.HasAlpha, SampleBitmap.PixelFormat.IsExtended);
```

```
                    }
                    if (PrintedOutCome.PixelFormat.IsRgb)
                    {
                        PrintedOutCome.ColorProfile = Aurigma.GraphicsMill.ColorProfile.FromSrgb();
                        PrintedOutCome.ColorManagement.ColorManagementEngine = Aurigma.GraphicsMill
.Transforms.ColorManagementEngine.LittleCms;
                        PrintedOutCome.ColorManagement.DestinationProfile = new Aurigma.GraphicsMil
l.ColorProfile(@ "C:\windows\system32\spool\drivers\color\EuroscaleCoated.icc");
                        PrintedOutCome.ColorManagement.Convert(Aurigma.GraphicsMill.ColorSpace.Cmyk
, PrintedOutCome.HasAlpha, PrintedOutCome.PixelFormat.IsExtended);
                    }
                    string selectedChannel = cmbCurrentColour.SelectedValue.ToString();
                    Aurigma.GraphicsMill.Bitmap selectedColourSampleBitmap = new Bitmap(SampleBitma
p);
                    Aurigma.GraphicsMill.Bitmap selectedColourPrintedOutCome = new Bitmap(PrintedOu
tCome);
                    if (selectedChannel == "Cyan")
                    {
                        selectedColourSampleBitmap = SampleBitmap.Channels[Aurigma.GraphicsMill.Cha
nnel.Cyan];
                        selectedColourPrintedOutCome = PrintedOutCome.Channels[Aurigma.GraphicsMill
.Channel.Cyan];
                    }
                    70
     else if (selectedChannel == "Magenta")
                    {
                        selectedColourSampleBitmap = SampleBitmap.Channels[Aurigma.GraphicsMill.Cha
nnel.Magenta];
                        selectedColourPrintedOutCome = PrintedOutCome.Channels[Aurigma.GraphicsMill
.Channel.Magenta];
                    }
                    else if (selectedChannel == "Yellow")
                    {
                        selectedColourSampleBitmap = SampleBitmap.Channels[Aurigma.GraphicsMill.Cha
nnel.Yellow];
                        selectedColourPrintedOutCome = PrintedOutCome.Channels[Aurigma.GraphicsMill
.Channel.Yellow];
                    }
                    else if (selectedChannel == "Black")
                    {
                        selectedColourSampleBitmap = SampleBitmap.Channels[Aurigma.GraphicsMill.Cha
nnel.Black];
                        selectedColourPrintedOutCome = PrintedOutCome.Channels[Aurigma.GraphicsMill
.Channel.Black];
                    }
                    System.Drawing.Bitmap bmpSelectedColourFromSample = new System.Drawing.Bitmap((
System.Drawing.Bitmap)selectedColourSampleBitmap);
                    System.Drawing.Bitmap bmpSelectedColourFromPrintedOutCome = new System.Drawing.
Bitmap((System.Drawing.Bitmap)selectedColourPrintedOutCome);
                    System.Drawing.Bitmap bmpResultAfterDifferentiate = new Difference(bmpSelectedC
olourFromSample).Apply(bmpSelectedColourFromPrintedOutCome);
                    bmpResultAfterDifferentiate.Save("bmpResultAfterDifferentiate.jpg", System.Draw
ing.Imaging.ImageFormat.Jpeg);
                    System.Drawing.Bitmap bmpInvertedResult = new Invert().Apply(new System.Drawing
.Bitmap("bmpResultAfterDifferentiate.jpg"));
                    bmpInvertedResult.Save("bmpInvertedResult.jpg", System.Drawing.Imaging.ImageFor
mat.Jpeg);
                    Bitmap bmpForCropping = new Bitmap(bmpInvertedResult);
                    int partWidth = bmpForCropping.Width / 12;
                    int partHeight = bmpForCropping.Height;
                    System.Windows.Controls.Image[] imgArr = new System.Windows.Controls.Image[12];
                    imgArr[0] = image15;
```

```
                imgArr[1] = image16;
                imgArr[2] = image17;
                imgArr[3] = image18;
                imgArr[4] = image19;
                imgArr[5] = image20;
                imgArr[6] = image21;
                imgArr[7] = image22;
                imgArr[8] = image23;
                imgArr[9] = image24;
                imgArr[10] = image25;
                imgArr[11] = image26;
                Label[] lblArr = new Label[12];
                lblArr[0] = lblValve101;
                lblArr[1] = lblValve102;
                lblArr[2] = lblValve103;
                lblArr[3] = lblValve104;
                lblArr[4] = lblValve105;
                lblArr[5] = lblValve106;
                lblArr[6] = lblValve107;
                lblArr[7] = lblValve108;
                lblArr[8] = lblValve109;
                lblArr[9] = lblValve110;
                lblArr[10] = lblValve111;
                71
            lblArr[11] = lblValve112;
                int startingPoint = 0;
                Aurigma.GraphicsMill.Histogram histogram;
                for (int i = 0; i < 12; i++)
                {
                    System.Drawing.Rectangle rect = new System.Drawing.Rectangle(startingPoint,
0, partWidth, partHeight);
                    Bitmap croppedPart = new Bitmap(bmpForCropping);
                    croppedPart.Transforms.Crop(rect);
                    BitmapImage croppedBitmap = ConvertAurigmaImageToBitmapImage(croppedPart);
                    imgArr[i].Source = croppedBitmap;
                    startingPoint += partWidth;
                    histogram = croppedPart.Statistics.GetSumHistogram();
                    double histoValue = Convert.ToDouble(histogram.Mean);
                    double calcValue = (255 - histoValue) / (255);
                    double precentageValue = calcValue * 100;
                    lblArr[i].Content = precentageValue.ToString("0.00") + " %";
                }
            }
        }
    }

}
```

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