# FACE IMAGE QUALITY INSPECTION SYSTEM ACCORDING TO ISO STANDARD

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**UNIVERSITI TEKNOLOGI MALAYSIA**

# FACE IMAGE QUALITY INSPECTION SYSTEM ACCORDING TO ISO STANDARD

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requirements for the award of the degree of
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Specially dedicated to my beloved parents, brother and sister for their continuous love, encouragement, guidance, motivation, support and inspiration throughout my journey of education....

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# ABSTRACT

Poor quality of face images is one of the reasons leading towards face recognition performance degradation. Therefore, this gives the motivation to have an International Standard (ISO/IEC 19794-5 Document) to provide guidelines for the usage of proper facial photographs for applications such as the E-Passport so that the face recognition process can be carried out more effectively. Nevertheless, despite the emergence of the ISO/IEC 19794-5 Standard, traditional passport photographs quality acceptance presently used is based on human visual perceptions and is very subjective. This is because there is no standardized checking system utilized which is able to give the same result on the quality acceptance of a photo regardless where or when it is being evaluated. As a result, there is a need for a system that is able to perform automatic checking on a passport size image to be developed. This project develops a system to perform automatic checking on a passport size image to ensure that it satisfies the image quality requirements according to the ISO/IEC 19794-5 Standard. The criteria considered in this project are image resolution, image aspect ratio, image brightness, image background colour, image eye distance, image head height and head width as well as image head rotation. The system developed managed to achieve at least 90% accuracy on all the attributes evaluated.

# ABSTRAK

Gambar pasport dengan kualiti yang kurang memuaskan adalah salah satu sebab utama yang akan menjejaskan proses pengenalpastian identiti individu berdasarkan proses pengenalan muka. Dengan ini telah tercetusnya motivasi untuk pembentukan satu Standard Antarabangsa (Dokumen ISO/IEC 19794-5) bagi menyediakan garis panduan untuk penggunaan gambar-gambar yang sesuai dan berpadanan dalam dokumen pengenalan diri seperti E-Pasport supaya proses pengenalan muka dapat dijalankan dengan lebih lancar dan berkesan. Namun begitu, walaupun Dokumen ISO/IEC 19794-5 telah sedia ada untuk rujukan, tetapi penilaian kualiti gambar pasport yang digunakan pada masa kini masih berdasarkan persepsi visual manusia. Oleh itu, penerimaan atau penolakan kualiti gambar pasport masih merupakan sesuatu proses yang sangat subjektif. Ini kerana tidak adanya satu sistem penilaian yang selaras dan seragam yang dapat digunakan untuk memberi keputusan yang seragam kepada penerimaan kualiti gambar pasport tidak kira bila atau di mana gambar tersebut dinilai. Dengan ini, wujudnya keperluan untuk membangunkan satu sistem yang mampu menilai kualiti gambar bersaiz pasport secara automatik. Projek ini bertujuan untuk melahirkan satu sistem untuk melaksanakan penyemakan automatik kualiti gambar bersaiz pasport untuk memastikan bahawa ia memenuhi kualiti seperti mana yang telah ditetapkan dalam Standard ISO/IEC 19794-5. Kriteria yang dipertimbangkan dalam projek ini adalah resolusi imej, nisbah aspek imej, kecerahan imej, warna latar belakang imej, jarak mata imej, ketinggian dan lebar kepala imej serta sudut putaran kepala imej. Sistem yang dibina berjaya mencapai ketepatan sekurang-kurangnya 90% ke atas semua kriteria yang dinilai.

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| | | |
|---|---|---|
| ACC | - | Adaptive Cross-Correletion Algorithm |
| E-Passport | - | Electronic Passport |
| GUI | - | Graphic User Interface |
| HSV | - | Colour space based on the Hue, Saturation and Value elements |
| ISO | - | International Organization for Standardization |
| RGB | - | An additive colour model in which the Red, Green and Blue light is added together in various ways to reproduce a broad array of colours |
| YCbCr | - | A family of colour spaces used as a part of colour image pipeline in video and digital photography systems. Y is the luma component while Cb and Cr are the blue-difference and red-difference chroma components |

# CHAPTER 1

# INTRODUCTION

## 1.1 Project Background

Nowadays, many countries including Malaysia have started to implement the usage of biometric passport as the identification document for travelers. This approach is to limit the usage of falsified documents by irresponsible individuals. Over the years, fingerprints have been employed as the key differentiator to distinguish between different individuals. Nevertheless, to further enhance the security measures, facial image has also been added as one of the mandatory biometric identifier to be used in the biometric passport. Unfortunately, face image of bad quality is one of the reasons leading towards face recognition performance degradation. Poor illumination, tilting of the facial pose and bad focus are among the fundamental reasons that create degraded quality photograph which eventually may lead to disqualification of the facial image to be used in identification documents. Therefore, this creates the motivation to have an International Standard (ISO/IEC 19794-5 Document) to provide guidelines for the usage of proper facial photograph for applications such as the E-Passport so that the face recognition process can be carry out more effectively in order to achieve a tighter security control.

The ISO/IEC 19794-5 Standard proposes the defined thresholds and allowable ranges for the biometric parameters of a face image. It also specifies the recommended size for the photograph to be used in the E-Passport. The standard also includes instructions for proper lighting, facial pose and focus distance when the

photograph is taken. Generally, the ISO/IEC 19794-5 Standard categorized the face image qualities into three main aspects. The aspects are scene requirements, photographic requirements and digital requirements which are summarized in Table 1.1 below. In addition, Figure 1.1 shows the generic face image recommended in the ISO/IEC 19794-5 Standard.

Table 1.1: General face image requirements in the ISO/IEC 19794-5 Standard [1]

| **Clause** | **Attribute** | **Constraint** |
|---|---|---|
| Scene | Posture | Control on deviation from frontal |
| | Illumination | Uniformly illuminated with no shadow |
| | Background | Plain light coloured |
| | Eyes | Open and clearly visible |
| | Mouth | Close and clearly visible |
| Photographic | Head Position | Placed in the center |
| | Distance to Camera | Moderate head size |
| | Colour | Neutral colour |
| | Exposure | Appropriate brightness |
| Digital | Focus | Not out of focus |
| | Resolution | Width constraint of the head |

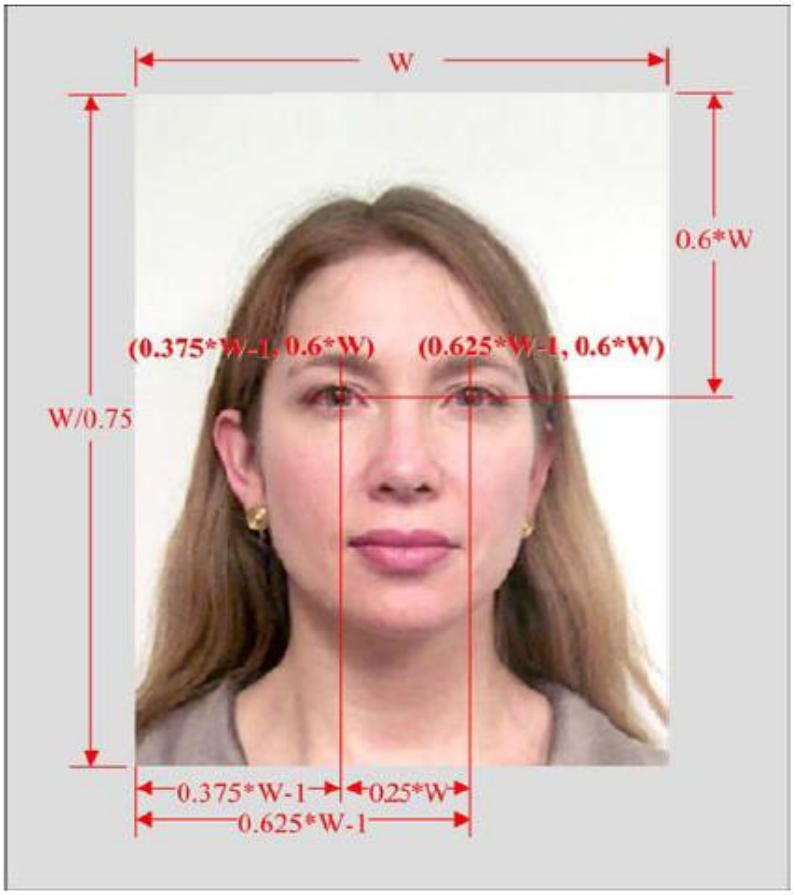


Figure 1.1: Generic face image recommended in the ISO/IEC 19794-5 Standard [1]

## 1.2 Problem Statement

Traditional passport photographs quality acceptance presently used are based on human visual perceptions. Therefore, the pass or fail criteria is very subjective as it really depends on the leniency of the evaluator to judge the quality of the image provided. An image maybe considered acceptable by evaluator A but it may not be the same verdict when it is being examined by evaluator B. Hence, the gap that exists today is that there is no standardized checking system utilized which is able to give the same result on the quality acceptance of a photo regardless where or when it is being evaluated.

As a result, there is a need for a system that is able to perform automatic checking on a passport size image to be developed. This system will be utilized to

ensure that the passport photograph used in the identification document satisfies the image quality requirements according to the ISO/IEC 19794-5 Standard. Furthermore, this system can then be employed across all the immigration offices or at the centers where the passport photos are captured so that a standardized checking process can be realized.

## 1.3 Objective

The purpose of this project is to develop a software system that is able to evaluate the quality of a digital passport size photograph to ensure that the image complies with the ISO/IEC 19794-5 Standard. In addition, a recommendation will be provided at the end of the test to confirm if the image presented is suitable for use in identification documents such as the E- Passport. The developed system is called the Face Image Quality Inspection System and this naming convention will be used in the subsequent sections of this project report.

## 1.4 Scope of Work

The Face Image Quality Inspection System involves a series of research work on digital image processing to develop a system that is capable to automatically validate the face images provided to check if it satisfies the ISO/IEC 19794-5 Standard. The system is developed based on the following assumptions:

- The Face Image Quality Inspection System is a purely software based system developed with the Matlab software.
- The input to the system is a passport size photograph.
- The input image provided is guaranteed to contain a human face.
- The input image is assumed to be containing only one face and is captured under controlled environment.

- Images wearing head gear and sunglasses are not covered in the context of this project.

There are actually a lot of criterions listed in the ISO/IEC 19794-5 Standard to specify the requirements of a recommended facial image. However, only a subset of the criterions as listed in Table 1.2 will be covered and evaluated by the Face Image Quality Inspection System.

Table 1.2: Criteria from the ISO / IEC 19794-5 Standard that will be evaluated by the Face Image Quality Inspection System

| **Criteria** | | **ISO / IEC 19794-5 Recommendation (Full Frontal Image)** |
|---|---|---|
| Image General Attributes | Image Width | Minimum 420 pixels |
| | Image Height | Minimum 525 pixels |
| | Image Aspect Ratio (Width : Height) | Between 1:1.25 to 1:1.34 |
| | Image Brightness | Appropriate brightness level |
| | Image Background Colour | Plain and light coloured background (grey, light blue or white) |
| Image Biometric Attributes | Image Eye Position | Inter eye distance between 20% to 30% of the Image Width |
| | Image Head Width | Occupy 50% to 70% of the Image Width |
| | Image Head Height | Occupy 70% to 80% of the Image Height |
| | Image Head Rotation | Less than +/- 5 degrees |

The results of the image quality evaluation from the Face Image Quality Inspection System will be displayed onto a GUI developed using Matlab. Recommendation on whether the image is appropriate to be used in identification documents will be provided based on these results. If image resolution is the only condition that is failing on the input image while the other criterions fulfill the

required specifications, the Face Image Quality Inspection System is capable to help resize the image to the minimum recommended size and certify the image for use in the identification document. Otherwise, if any one of the other image attributes fail, then the image will not be approved for use in identification document.

## 1.5 Project Report Outline

The organization of this project report is as follows. Chapter 1 provides some insights on the project background and problem statement that exists today which leads to the motivation of developing the Face Image Quality Inspection System as the research work for this project report. In addition, the project objectives and scope of work is also discussed in Chapter 1. Meanwhile, literature reviews covering the previous work on image quality evaluation, face detection as well as eye detection are discussed in Chapter 2. The methodological approach to realize the Face Image Quality Inspection System is depicted in Chapter 3. Implementation results with the Matlab software applying all the algorithms discussed in the methodology section are presented in Chapter 4. Finally, Chapter 5 covers the conclusion along with the recommendations for future research work and possible improvements to further enhance the Face Image Quality Inspection System.

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