

REAL-TIME FACE DETECTION SYSTEM WITH ADDITIONAL FEATURES

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Specially dedicate to my beloved parent, En. Abdol Rahman b. Bedin and Pn. Aini Bt. Ismail and also to my siblings who give the encouragement and support for me to completely this thesis. Not forgotten to my supervisor Cik Syafeeza Bt. Ahmad Radzi who gave me lot of guidance and advices throughout this project until successful. Thank you very much to all of you.

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ABSTRACT

This project is focusing on develop a real-time face detection system with the additional features using National Instruments Laboratory Virtual Instrument Engineering Workbench (LabVIEW) graphical development environment and National Instrument Vision Automated Inspection (NI Vision AI). The face detection system detects a person's front face which includes eye brows, eyes, nose and mouth. The system is an integration of a face expression, background subtraction, and face searching processes which had to be fixed in the region of interest that is already specified. All of this is work together to detect the frontal of human faces in a captured video frames format. This system interfaced with attractive Graphical User Interface (GUI). This project will use a minimal hardware such as USB camera and standard computer and able to run without any additional requirements. The system is to be automatic, robust and able to operate with minimal necessary interaction from the user.

ABSTRAK

Projek ini adalah menumpu dalam membangunkan sistem pengesanan muka masa nyata dengan ciri-ciri tambahan menggunakan perisian National Instruments Laboratory Virtual Instrument Engineering Workbench (LabVIEW) sebagai grafik antara muka dan National Instrument Vision Automated Inspection (NI Vision AI) sebagai sistem pengesanan. Sistem pengesanan muka ini mengenalpasti dan mengesan paras muka seseorang termasuk kening, mata, hidung dan mulut. Sistem ini adalah satu proses pencatuman oleh paras muka seseorang, ekspresi muka, penolakan latar belakang dan proses pencarian muka dimana pengenalan pastian muka itu hendaklah berada pada kawasan yang telah ditetapkan. Semua proses ini dijalankan untuk pengesanan bahagian muka hadapan seseorang yang dikesan dalam bingkai-bingkai video format. Projek ini menggunakan satu perkakasan yang minimum seperti kamera USB dan mana-mana sistem komputer yang mengikut piawaian atau berkemampuan untuk mengendalikan sistem ini tanpa memerlukan peralatan tambahan. Sistem ini adalah menjadi automatik, tahan lasak dan berkemampuan untuk dikendalikan dengan interaksi yang minimum daripada pengguna.

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LIST OF ABBREVIATION

2-D	:	2 Dimension Image
3-D	:	3 Dimension Image
A		
AI	:	Automated Inspection
AIPD	:	National Instruments internal image file format.
API	:	Application Programming Interface
B		
BD	:	Block Diagram Programming of LabVIEW
BMP	:	Bitmap Image File Format.
BNC Cable	:	Analog Camera Cable
C		
CMY	:	Cyan Magenta Yellow Color Model
CMYK	:	CMY and Black Color Model
D		
DSP	:	Digital Signal Processing
F		
FP	:	Front panel Programming of LabVIEW
G		
GPIB	:	General Purpose Interface Bus

GUI	:	Graphical user interface..
H		
HSI	:	Hue Saturation and Intensity Color Model
I		
IMAQ	:	Driver software for National Instruments image acquisition hardware.
J		
JAI 1/3”	:	DSP Color CCD Camera
JPEG	:	Joint Photographic Experts Group.
L		
LabVIEW	:	Laboratory Virtual Instrumentation Engineering Workbench
LUT	:	Lookup table.
N		
NI Vision Builder AI	:	National Instrument Vision Automated Inspection
O		
OS	:	Operating System
P		
PAL Color Camera	:	Phase Alternation Line.
PCI	:	Peripheral Component Interconnect.
PNG	:	Portable Network Graphic.
PXI	:	PCI eXtensions for Instrumentation.

R

RGB : Red, Green, and Blue Color Model.

ROI : Region of interest.

S

SubVI : When a Vision Inspection (VI) is located within the block diagram of another VI, it is called subVI

T

TIFF : Tagged Image File Format.

U

USB : Universal Serial Bus.

V

VI : Virtual Instrument.

VISA : Virtual Instrument Software Architecture.

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CHAPTER I

INTRODUCTION

1.1 Project Overview

Humans use vision as their primary means for gathering information about, and navigating through, their surroundings. Providing this ability to automated systems would be a large step toward having them operate effectively in our world. There are, however, two major obstacles to automated vision: incomplete human knowledge of how to reliably derive high-level information from a 2-D image; and the computational complexity of image processing and analysis methods. The latter is of primary concern in the research and development of real-time systems.

Only recently has the growth in affordable computing power and research into faster techniques allowed some complex vision tasks to move into industrial and consumer applications. Object detection is one of the best known and most useful machine vision applications, and is also difficult and computationally complex. The specific case that can be consider is face detection, motivated because face analysis is a very active area of vision research. Face analysis can be used in security applications, telecommunications, human-computer interfaces, entertainment, and database retrieval. In order to analyze a face in detail, however, the face must first be located. Many face analysis algorithms are developed with the assumption of controlled environments in which face detection is trivial. Such assumptions become invalid as the applications move into uncontrolled

environments, so accurate face detection is necessary. Since detection is only a first step before recognition and other tasks, it needs to be done quickly.

The face detection system detects a person's front face which includes eye brows, eyes, nose and mouth. The program is an integration of a face expression, background subtraction, and face searching processes which had to be fixed in the region of interest that is already specified. All of this are work together to detect the frontal of human faces in a captured video frames. Even though the geometric configuration of a face is predictable, due to its 3D nature, variations in pose, illumination, texture and shape can have strong effects on the 2D projection of the face in the image plane, making the detection task difficult. Faces are detected by measuring comparing novel patterns to the model distribution and process by which pixels of the given absence image.

Once the part examples have been located within the input image, and perhaps labeled with a confidence in each detection; each component based object detection system will use another classifier to judge whether or not the part detections are truly part of the target object. The face detection system uses a product of probabilities, indexed from histograms, to calculate confidence in some image patch stemming from the face class.

This project will be using a minimal hardware such as a USB camera and standard computer. This project also uses National Instruments LabVIEW graphical development environment and NI Vision AI to develop a rapid and automatic face detection system. LabVIEW (short for Laboratory Virtual Instrumentation Engineering Workbench) is a platform and development environment for a visual programming language from National Instrument. The system would be able to run on any computer system of standard specifications without any additional hardware requirements. The system is to be automatic, robust and able to operate with minimal necessary interaction from the user.

1.2 Project Objective

There are several objectives to be achieved through this project. The objectives are:

- i. To use the National Instruments LabVIEW graphical development environment and National Instrument Vision Automated Inspection (NI Vision AI) to develop a rapid and automatic face detection system.
- ii. To utilize the toolbox and the features function library of NI Vision AI which are used for develop the system to detect faces in a captured video frames with attractive of Graphical User Interface (GUI).
- iii. To develop the face detection system that applies the image processing and image acquisition technique.

1.3 Problem Statement

The problem of face detection falls into the much larger category of object detection. The term of “detection” refer to the task of distinguishing members of one class from members of another. In the most typical detection problem there are only two classes: the class of target face and the class of all other objects, or the background class (non-face).

To build fully automated system that analyzed the information contained image face, robust and efficient face detection algorithms are required that can accurately detect faces in a cluttered image. Such the problem is challenging because faces are no rigid and have a high degree of variability in size, shape, color and textures.

Given an arbitrary image, the goal of face detection is to determine whether or not there are any faces in the image and, if present, return the image location and extent of each face. The challenges associated with face detection can be attributed to the following factors:

- i. Pose: The images of a face vary due to the relative camera-face pose (frontal, 45 degree, profile, upside down), and some facial features such as an eye or the nose may become partially or wholly occluded.
- ii. Presence or absence of structural components: Facial features such as beards, mustaches, and glasses may or may not be present and there is a great deal of variability among these components including shape, color, and size.
- iii. Facial expression: The appearance of faces is directly affected by a person's facial expression. .
- iv. Occlusion: Faces may be partially occluded by other objects. In an image with a group of people, some faces may partially occlude other faces.
- v. Image orientation: Face images directly vary for different rotations about the camera's optical axis.
- vi. Imaging conditions: When the image is formed, factors such as lighting (spectra, source distribution and intensity) and camera characteristics (sensor response, lenses) affect the appearance of a face.

These variations must be handled by any face detection method which hopes to operate in an uncontrolled environment and the uniqueness of the analyzed used to produce fully automated systems. When it combined with computerized monitoring, it is an effective security surveillance and management system.

1.4 Scope of Project

The scope of this project will be divided into two parts which are software and hardware.

1.4.1 Software

Firstly, the focus is basically on the research and the literature review is focused on the face detection. The task taken in this research is mostly on analysis and exploring about the face detection and which is related to the image analysis, face expression and background subtraction.