

Hand Detection for Computer Graphical User Interface

Control

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This thesis is submitted as partial fulfilment of the requirements for the award of the Bachelor of Electrical Engineering (Hons.) (Electronics)

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SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the degree of the Bachelor Degree of Electrical Engineering (Hons.) (Electronics).

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STUDENT'S DECLARATION

I hereby declare that the work in this thesis is my own except for quotations and summaries which have been duly acknowledged. The thesis has not been accepted for any degree and is not concurrently submitted for award of other degree.

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LIST OF ABBREVIATIONS

BLOG	Binary Large Object
GUI	Graphical User Interface
HSI	Hue, Saturation, Intensity Color Format
HMI	Human-Machine Interaction
L.a.b	Lightness, a and b Color Opponent
RGB	Red, Green, Blue colour format
SVM	Support Vector Machine
VCM	Vision Mouse Control
YCbCr	Luma, Blue Different, Red Different colour format
BW	Black and White

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ABSTRACT

Computer has become a vital part in humans' lives as it has become difficult to work without a computer. Hence, this project presents a mechanism of hand detection for computer graphical user interface control. The mechanism works on real time hand gestures. Through this project, computers' GUI can be controlled using machine vision to help computer and laptop users to operate computer with ease without high costing. This project is driven by the increasing demand of computer and laptop users for an easier, low costing and portable GUI (Graphical User Interface) control. This design is to simplify HMI (Human Machine Interaction) by controlling the computers' GUI with empty hands and only using the pre-installed web camera in the laptop as vision sensor. The methodology starts with image processing where batches of hand images were processed to detect the fingertips and the most minimum fingertip followed by video processing where real-time video were processed using the code from image processing. The image processing starts with image segmentation and background separation, centroid detection, fingertip detection and followed by movement detection. Video processing involves webcam start up and java robot programming to move the mouse cursor. When the programming is run, mouse cursor moves according to the hand movement in front of the camera. The outcome of this project is that the user could move mouse cursor by moving their hand in front of the webcam.

ABSTRAK

Komputer telah menjadi sebahagian penting dalam kehidupan manusia kerana ia telah menjadi sukar untuk bekerja tanpa komputer. Oleh itu, projek ini membentangkan satu mekanisme pengesanan tangan untuk kawalan grafik komputer oleh pengguna. Mekanisme ini berfungsi dengan isyarat tangan pada masa nyata. Melalui projek ini, GUI komputer boleh dikawal menggunakan penglihatan mesin untuk membantu pengguna computer meja dan komputer riba untuk mengendalikan komputer dengan mudah tanpa kos yang tinggi. Projek ini adalah didorong oleh permintaan yang semakin meningkat dari pengguna komputer meja dan komputer riba agar lebih mudah, harga yang rendah dan GUI mudah alih (Graphical User Interface). Reka bentuk ini adalah untuk memudahkan perhubungan antara Manusia dan mesin dengan mengawal GUI komputer menggunakan tangan kosong dan hanya kamera web yang telah dipasang dalam komputer riba sebagai sensor penglihatan. Kaedah ini bermula dengan pemprosesan imej di mana kelompok imej tangan telah diproses untuk mengesan hujung jari-jari tangan dan hujung jari di kedudukan y yang paling minimum, diikuti oleh pemprosesan video di mana video masa nyata telah diproses menggunakan kod dari pemprosesan imej. Pemprosesan imej bermula dengan segmentasi imej dan pemisahan latar belakang, pengesanan titik tengah, pengesanan hujung jari dan diikuti dengan pengesanan gerakan. Pemprosesan video melibatkan memulakan kamera web dan pengaturcaraan java robot untuk menggerakkan kursor tetikus. Apabila program ini dijalankan, kursor tetikus bergerak mengikut pergerakan tangan di hadapan kamera. Hasil projek ini adalah bahawa pengguna boleh menggerakkan kursor tetikus dengan menggerakkan tangan mereka di hadapan kamera web.

CHAPTER 1

INTRODUCTION

1.1 Background

Computer has become the essence of our everyday lives. We are dependent to a computer whether in our personal lives or working life. Most of our activities in our studies and in our jobs are computer dependent. Therefore, the research and studies to ease the usage of computer is growing rapidly parallel to the demands of computer users.

Computer users also tend to skew towards using a light, compact and portable computer such as laptops, smart phones and tablets as it is more convenient for travels and easier work anywhere. Laptop is the closest device to a computer's function and it is a better choice for works.

Next, computer users seek to ease the usage of technological devices and improve the simplicity of **HMI** (Human Machine Interaction) In the modern days, computer **GUI** (Graphical User Interface) is mainly controlled by external and internal devices such a touchpad, mouse or touchscreen. All these methods requires user to touch the devices to control **GUI**. Due to the advancement of technology, the demand of virtualisation technique for **HMI** has increased. For example, the development of Kinect technology that uses image processing for various virtual reality products such as x-box gaming console, 3D models scanning and robotic movement control via body movement and gestures. However, virtual techniques require extra device or equipment that requires additional cost for installation.

Hence, a method is proposed to promote virtualisation technique to control computers' **GUI** without having to pay for extra cost. The method only uses internally installed device on the laptop which is the laptops' web camera. The method involves movement of hand gestures which are captured by the laptops' built in web camera and translated with high level programming language to control the laptop's cursor. The hand gesture detection could also

boost **HMI** by using laptop's web camera instead of common input device such as mouse and touchpad. Furthermore, the web camera can be used as backup cursor's controller if the build in touchpad couldn't be used instead of having to connect external device like a mouse to the laptop.

MATLAB software is chosen as high level programming language as it has user-friendly interface for image processing and computer visions functions such as image processing toolbox and computer vision system toolbox. MATLAB is also easier to program compared to JAVA, C programming and Ruby freeware software as the other software require complex programming to translate the image capture into machine language. The translation will take up unnecessarily long processing time that could be avoided with the use of MATLAB software.

This new technology is suitable for the modern era where laptop users tend to travel and they would want a technology which is convenient without having to carry external devices around and is not costly to install. The user would also be able to control laptops' **GUI** without having to touch a device.

1.2 Problem Statement

Secondary **GUI** devices need to be prepared if the build in touchpad could not be used and it would be easier to use the build in web camera instead of plugging in external devices to control laptop's GUI.

A method to ease **HMI** should be developed so that human can naturally interact with machine such as laptop with body parts movements and gestures. A hand gesture cursor controller that could detect different hand sizes developed for various users.

A system has to be developed for users to control laptops' GUI without having to touch a device with their hands for the ease of usage.

A system that can detect fingertips movement to move mouse cursor which is the basic function of a mouse and touchpad without having to connect the laptop to external devices needs to be developed.

1.3 Project Objective

The primary objective of this project is to design a system which control computers' cursor by movement of fingers. The objectives are:

- 1.3.1 To develop a system that could control GUI with computer vision system.
- 1.3.2 To develop a system that could focus only on the fingertips of the hand.
- 1.3.3 To develop a system that could detect movements of fingertips and centre of the palm.
- 1.3.4 To develop a system that could differentiate the background from the hand image.

1.4 Scope of Project

- 1.4.1 The system developed detects only users' right hand.
- 1.4.2 The system developed uses laptop's build in web cam with 1.3M pixel resolution.
- 1.4.3 The system is developed by using MATLAB software and coding.
- 1.4.4 The system runs in white background with no external objects

REFERENCES

This PROJECT is prepared based on the following references;

- [1] Shany Jophin, Sheethal M.S, Priya Philip, T M Bhruguram.2012. Gesture Based Interface Using Motion and Image Comparison. Dept of Computer .Science Adi Shankara Institute of Engineering And Technology, Kalady. International Journal of Advanced Information Technology (IJAIT) Vol. 2, No.3, June 2012
- [2] Hojoon Park. 2010. "A Method for Controlling Mouse Movement using a Real-Time Camera". Department of Computer Science. Brown Unversity, Providence,RI,USA.
- [3] Ankush Chaudhary, Ashish Kumar Sharma, Jyoti Dalal, Leena Choukiker. March 2015. "Mouse control using Hand Gestures". Volume 2, Issue 3.
- [4] V B Katariya, Y N Makwana, P A Goswami. 2012. *A Review on Implementation of Automatic Movement Controlled Using Gesture Recognition*. IJRTE. Vol 1(5). 2277-3878
- [5] Madhurjya Kumar Nayak, Anjan Kumar Talukdar, Kandarpa Kumar Sarma. 2013. *Hand Segmentation and Tracking of Continuous Hand Posture Using Morphological Processing*. IJESS. Vol 3(1).83-86
- [6] K. Madhuril, L. Praveen Kumar. 2013. Cursor Movements Controlled By Real Time Hand Gestures. Department of Electronics and Communication Engineering CVSR College of Engineering, Hyderabad, India. International Journal of Science and Research (IJSR), Volume 2 Issue 2, February 2013
- [7] Dejan Chandra Gope. November 2012. "Hand Tracking and Hand Gesture Recognition for Human Computer Interaction". Vol. 4, No. 6, Department of Computer Science and Engineering Dhaka University of Engineering and Technology (DUET) Gazipur-1700, Dhaka, Bangladesh.
- [8] Akhil Gupta, Akash Rathi, Dr Y Radhika. 2012. "*Hands-Free PC Control*" *Controlling of Mouse Cursor Using Eye Movement*. ISSN. Vol 2(4). 2250-3153.