Perspectives in Communication, Embedded-Systems and Signal-Processing (PiCES) – An International Journal
ISSN: 2566-932X, Vol. 3, Issue 1, April 2019

Development of a Touch Sensitive Table using Image Processing

Sumanth S Kumar
Department of Information Science and Engineering, R.N.S Institute of Technology, Bengaluru, India, sumanth.1rn15is100@gmail.com

Srivatsa Jade
Department of Information Science and Engineering, R.N.S Institute of Technology, Bengaluru, India, srivatsajade@hotmail.com

Sourav Prakash
Department of Information Science and Engineering, R.N.S Institute of Technology, Bengaluru, India, souravprakash37@gmail.com

Athreya Navda
Department of Information Science and Engineering, R.N.S Institute of Technology, Bengaluru, India, athu.navada@gmail.com

Sudhir Rao Rupanagudi, Varsha G Bhat
WorldServe Education, Bengaluru, India.

Abstract: When it comes to ordering food at restaurant, waiters or cashiers at counters take our order and then pass it on to kitchen. They often require a touchscreen or a notepad to take down the order. In order to fasten the process, we propose to make the existing tables into touchscreen in the most eco-friendly and inexpensive fashion, with an add-on camera. The system is developed based on the concepts of image processing.

Keywords: Image processing; Touchscreen; Food ordering; Camera.

I. INTRODUCTION

We have presented a novel e-restaurant system that uses touch table top technology to enrich customers dining experience which is very convenient to the customer. The system allows customers to order food by touching on the table surface using finger to interact with the digitalized, meal ordering menu which is locally connected to the cashier on the WLAN. The camera based touchable dining table for restaurant developed on the e-restaurants system. It helps to enhance quality of service as well customers dining experience.

The proposed system will help in reducing the number of staffs used in the restaurants. Hence it will help in reducing cost of restaurant management and gives facility to customer. It will also minimize manual service given by waiters and serving staff, thus eliminating the human mistakes. It can also help in reducing child labour problem, which is a huge problem in countries like India. Using this system, it avoids the problem like exchange of order.

The proposed dining consists of a tempered glass on the top of the table, a rear film under the glass, a short focus camera beneath the table. The camera is connected to a personal computer. As a video signal transmitted from the computer, the image on the rear film of the table will recover by the Camera. The user of the table will watch the content which is necessary for an interactive function. Then, the user can give a response to the content by touching certain location of the glass and select menu. The camera under the table will capture the user's finger tips using bright points in the picture. The captured picture will be sent to the personal computer for recognition purpose. This paper investigates the deployment of the touchable dining table in a restaurant environment to enrich customer's dining experience with family. The main aim of our project is to make the whole system of a touchscreen implemented for the purpose of a restaurant ordering system cost effective. This can be done by using equipment that are cheap and sustainable resulting in low maintenance cost for the chain of restaurants that want to be frugal in terms of spending but want to inculcate a feeling of the modern tech in their surroundings.

II. LITERATURE REVIEW

A. Paper Title: VIANO- The Virtual Piano
Author: Ankit Saxena

The use of a piano at different places quite often is a problem faced by many pianists due to the heavy-set nature of the piano. This problem can be tackled by the methods of virtual reality where we project the piano image on a plain surface and the touch inputs from the user are rendered. A mixture of image processing and Computer vision techniques are what make this method achievable. The main stages would include- finding out the region of interest(ROI); assigning a note to the particular ROI. The drawbacks of this process would be -

*Haptic feedback is a necessary part of the keyboard experience which would be missing. *Conflict in region of interest if the projected image is not as expected, this could happen on uneven surfaces. *The piano image should be able to reflect enough light to camera lens for image processing module to correctly mask the image and filter out actual piano from real world image

B. Paper Title: Robust Single Finger Movement Detection Scheme for Real Time Wheelchair Control Physically Challenged People

Authors: Sayeed Shafayet Chowdhury, Rakib Hyder, Celia Shahanaz and Shaikh Anowarul Fattah

The state of movement for people who have limited motor skills have vastly improved, the use of a single finger to make gestures that in-turn help the person move his vehicle is what the technology has been building upto until now. With the help of a wireless connection between the wheel-chair and a mobile device with camera capabilities, the simple gestures of the finger are detected, translated and relayed. The concept can be easily integrated into real wheelchairs using power BJTs to drive the motors which turn the wheels without substantial additional cost.

The main Drawbacks with this implementation would be Wrong Gesture interpretation- this can be seriously dangerous as it may lead to unnecessary movement of the wheelchair *Fast fingers- gestures which are really fast will be hard to perceive for the machine in case of a low resolution and low frame rate camera. *Multiple finger inclusion- The presence of another finger in the image frame at times is inevitable, since the system is designed for just one finger, this would prove to be an impasse.

C. Paper Title: Hand Gesture Recognition System for Image Process Gaming

Authors: Ashwini Shivatare, Poonam wagh, Mayuri Pisal, Varsha Khedkar Prof. Mrs. Vidya Kurtadikar

An intelligent and natural way of human computer interaction: The system can be divided into three parts according to its processing Steps: hand detection, finger identification, and gesture recognition The system is highly modularized, and each of the three steps is capsuled from others. The edge/contour detection of hand as well as gesture recognition is an add-on layer, which can be easily transplanted to other applications. The process of detecting the hand and gesture is done by using a simple web camera and performing the image processing technique in which, by using those gestures we can play games on console similar to an XBOX-Kinect system or a Nintendo Wii.

Drawbacks of the system are as follows. Image processing can be a tedious task in case of low processing power which results in a massive lag in the gaming system that can be really vexing for the end user. Wrong Gestures can be detected that can result in wrong moves being carried out in a videogame. Complex hand movements and gestures might be required in case of a particular set of games which can be hard to master.

III. PROPOSED SYSTEM

The process has been broken down into 4 steps as shown in the below diagram.

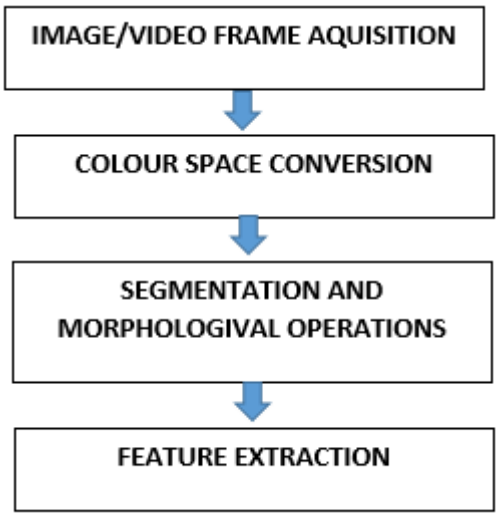

Fig 1. Flowchart showing the 4 stages in the process

Image/Video Acquisition: In the first step we capture images from the camera. These images are in the RGB format. Each color that is red, blue and green take up eight bits per pixel, hence a pixel has a memory of 24 bits.

Color Space Conversion: Choosing the RGB color module will make the task of differentiating the hand from its background hard. Hence we explore the other color modules available to us like HSV and YCbCr. We further discover that isolating each color from a color module can save us time and memory. We evaluate each color in the HSV and YCbCr module for a clear distinction between the user's hand and its background.

Segmentation and Morphological operations: To track the hand easily the image is converted to black and white. The way that segmentation works is by choosing a certain intensity range which coincides with the intensity of the fingertip and if the intensity of the pixel falls within this range, it is converted to white, else it is converted to black. Segmentation is followed by morphological operations, namely erosion and dilation. Using binary erosion, we eliminate any sort of noise which is detected by the camera. During the process of erosion, the outer pixels of the finger or the hand are made black. To convert these pixels back to white we use dilation. We get our final image at the end of dilation.

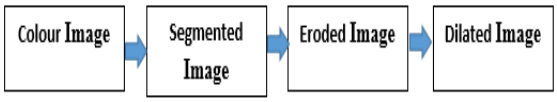

Fig 2. Flowchart showing the steps involved in segmentation and morphological operations

Feature Extraction: Once we acquire the dilated image we match the coordinates of the finger with the coordinates of the menu to extract an output.

IV. RESULTS

The below figure shows images captured during Image Acquisition.

Fig 3. Captured images

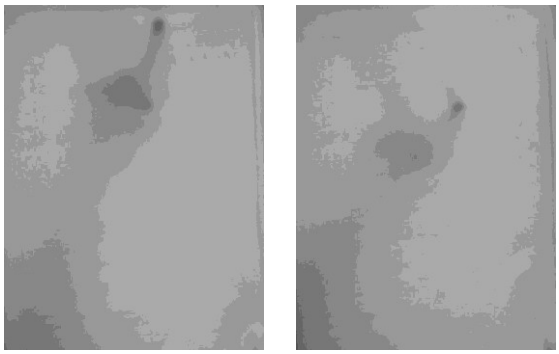

Fig 4. Images of colour Y

Once we acquire the image, it goes through color space conversion. We separate each color present in a color module and check for clear distinction.

Image number	H	S	V	Y	Cb	Cr
1	×	✓	✓	✓	×	×
2	×	✓	✓	✓	×	×
3	×	✓	✓	✓	×	×
4	×	×	×	✓	×	×
5	×	✓	×	✓	×	×
6	×	✓	✓	✓	×	×
7	×	✓	✓	✓	×	×

Table 1. Color Selection

We observe in the above table that the color Y serves our purpose the best. Hence we choose Y.

The image is then segmented, which means that it is converted to black an d white, with the hand or the finger being white. We check the range of the pixels which contain the finger in each image and determine the range for segmentation. We can see this in the table below. This image may contain some noise. The examples of segmented images are shown below

Image No.	Ymin	Ymax
1	98	115
2	97	115
3	98	112
4	93	119
5	95	113
6	90	121
7	96	120

Table 2. Range of Y

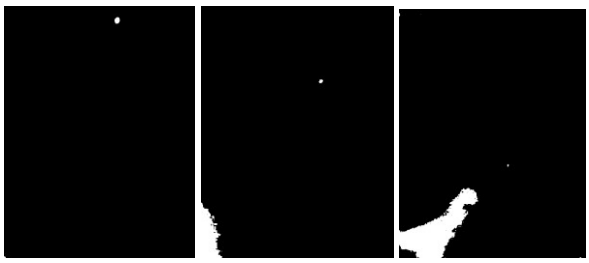

Fig 5. Segmented images

Based on the values tabulated, minimum and maximum values for segmentation are picked for thresholding. We eliminate the noise by the process of erosion. We can observe the eroded images in the picture below

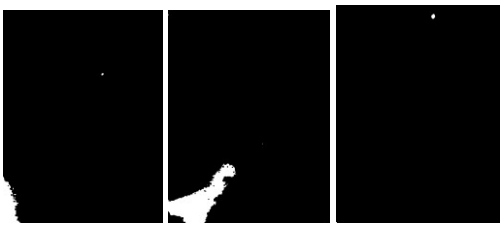

Fig 6. Eroded Images

Due to erosion some part of the finger is lost which can be brought back from the process of dilation.

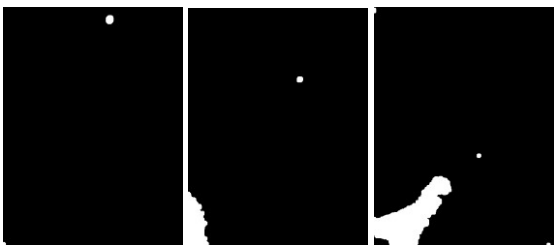

Fig 7. Dilated images

V. CONCLUSION

We solve the issue of multiple fingers being detected by choosing only one of the fingers in our project. This prevents the user from giving multiple inputs at a given time. We do not project the menu; Hence the problem of uneven surfaces never arises. The fear of the wrong

button being pressed is also eliminated as we are specifying a particular intensity range which helps us in isolation the fingertip and its position. Hence at the end of this project we will have an intelligent food ordering system which will save time, money and man power.

REFERENCES

[1] Robust single finger movement detection scheme for real time wheelchair control by physically challenged people by Syeed Shafayet Chowdhury, Rakib Hyder, Celia Shahanaz and Shaikh Anowarul Fattah on 21 - 23 Dec 2017, Dhaka, Bangladesh

[2] VIANO the Virtual Piano by Ankit Saxena meerut institute of technology, Uttar Pradesh, India in 3rd IEEE international conference.

[3] V. Shridhar, "Image based password authentication for illiterates with touch screen", International Journal of Science, Engineering and Technology Research (IJSETR) Volume 1, Issue 3,September 2012. 10.

[4] W. Fikkert, M. Hakvoort, P. Vet, and A. Nijholt, "Experiences with Interactive Multi-touch Tables, "in Intelligent Technologies for Interactive Entertainment, 2009, pp.193-200.

[5] Turn Any Display Into a Touch Screen using Infrared Optical Technique byJI-Ren Liang 1, (Member, Ieee), Kuan-Chin Lin1,Hsiang-Chieh Chen2, (Member, Ieee).

[6] A New Framework for Real-time Hand Gesture Detection and Recognition by J. Geethapriya and A. Srinivasan IACIT press(2012) Singapore

[7] A Novel Hand Posture Recognition System Based on Sparse Representation Using Color and Depth Images by Dan Xu, Yen-Lun Chen, Xinyu Wu, Wei Feng, Huihuan Qian and Yangsheng Xu Intelligent Robotics and systems(IRSO), Novenmber 3-7 2013, Tokyo, Japan

[8] Automated Food Ordering System with Real-Time Customer Feedback by Shweta Shashikant Tanpure, Priyanka R. Shidankar Madhura M. Joshi.

[9] Wireless Two-way Restaurant Ordering System via Touch Screen by B.Vinodhini, K.Abinaya, R.Roja, M.Rajeshwari

[10] Image Features Detection, Description and Matching by M. Hassaballah, Aly Amin Abdelmgeid and Hammam A. Alshazly

[11] An Exploratory Study of Co-located CollaborativeVisual Analytics around a Tabletop Display Petra Isenberg, Danyel Fisher, Meredith Ringel Morris, Kori Inkpen, Mary Czerwinski.

[12] C. Wang and K. Wang, "Hand posture recognition using ad boost with sift for human robot interaction," Recent Progress in Robotics: Viable Robotic Service to Human, pp. 317–329, 2008.

[13] J. Triesch and C. Von Der Malsburg, "A system for person-independent hand posture recognition against complex backgrounds," IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 23, no. 12, pp. 1449–1453, 2001.

[14] H. Zhou and T. Huang, "Tracking articulated hand motion with eigen dynamics analysis," in IEEE International Conference on Computer Vision (ICCV). IEEE, 2003, pp. 1102–1109.

[15] Moreels, P., Perona, P.: Evaluation of features detectors and descriptors based on 3D objects. Int. J. Comput. Vis. 73(3), 263–284 (2007)

[16] Rupanagudi S.R. et al. (2020) A Novel Air Gesture Based Wheelchair Control and Home Automation System. In: Abraham A., Cherukuri A., Melin P., Gandhi N. (eds) Intelligent Systems Design and Applications. ISDA 2018 2018. Advances in Intelligent Systems and Computing, vol 941. Springer, Cham

[17] S. R. Rupanagudi et al., "A novel and secure methodology for keyless ignition and controlling an automobile using air gestures," 2016 International Conference on Advances in Computing, Communications and Informatics (ICACCI), Jaipur, 2016, pp. 1416-1422.

[18] S. R. Rupanagudi et al., "A high speed algorithm for identifying hand gestures for an ATM input system for the blind," 2015 IEEE Bombay Section Symposium (IBSS), Mumbai, 2015, pp. 1-6.

[19] Dhruva N., Rupanagudi S.R., Neelkant Kashyap H.N. (2013) Novel Algorithm for Image Processing Based Hand Gesture Recognition and Its Application in Security. In: Unnikrishnan S., Surve S., Bhoir D. (eds) Advances in Computing, Communication, and Control. ICAC3 2013. Communications in Computer and Information Science, vol 361. Springer, Berlin, Heidelberg

[20] P. C. Ravoor, B. S. Ranjani and S. Rao Rupanagudi, "Optimized fingertip blob recognition for image processing based touch-screens," 2012 International Conference on Recent Advances in Computing and Software Systems, Chennai, 2012, pp. 104-108.

[21] P. C. Ravoor, S. R. Rupanagudi and B. S. Ranjani, "Detection of multiple points of contact on an imaging touch-screen," 2012 International Conference on Communication, Information & Computing Technology (ICCICT), Mumbai, 2012, pp. 1-6.