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# A Survey on Gaze Estimation Techniques in Smartphone

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**Abstract -***Now days, we seem that technology is very advance and especially mobility create its own tremendous image in field mobile technology and digital image processing. Massive development in mobile technology make human life very easy to do useful stuff like paying online bill, sending mail, online transaction, browsing etc. The handicapped people with several disability can't enjoyed the benefit provided by mobile hence to facilitate those people some advance gazing technique is required . In this research paper we presented several techniques to detect eye motion to get exact gaze point. Image Processing play a very crucial role to detect the eye pupils when input dataset is in the form of images. The motivation is to design and to develop mobile application for detecting eye pupils and to make correct gaze estimation with minimum of error rate. To get correct gaze, this paper present various existing techniques of Image processing and their active role in getting exact gazing point.*

***Key Words***: Gaze Estimation/Tracking, Dataset, Mobile device, Image Processing, Eye Detection, Pupils Detection.

## 1. INTRODUCTION

GAZE estimation is the technique or process of detecting at what and where the eyes are pointing. Many of the application have created in field of human computer interaction including good graphical interface, advance eye tracking system etc. Now a day smart phone has become important tool in everyone lives. More than 60% of people our globe use smart phone and count is incremented continuously. Today person with disabilities can't enjoy the benefit provided by Smartphone like playing video games, chatting, and browsing etc. physical handicapped every time keep one person with them to do their activity like if they wants do secure online transactions over internet banking, so for security purpose some eye control tools are needed.

Commercial mobile eye tracking systems are available but they are very costly, complex and required additional hardware, scanner to detect the exact gazing point. Unconstraint gaze estimation technique is most effective technique to get exact gaze point. This methodology is shown in figure 1:

The demands and applications for eye tracking systems already exist. For example, there are business holder who use eye trackers to identify what customer's gaze is pointed to this leads to a better understanding of a customer's interest. Many of this application are developed using video based sensors that uses an infrared light to illuminate the retina which helps to reduce interference from the surrounding environment.

The goal of this system to get correct gaze point with minimum of error rate and allow handicap people to operate mobile easily by eyes .The proposed system consist of collecting some steps as: Collecting people different position eye image dataset ,preprocessing, feature extraction, regression. This paper is organized as follows: Section 2 comprises Previous Work; section 3 comprises Methodology and Conclusion is in section 4.

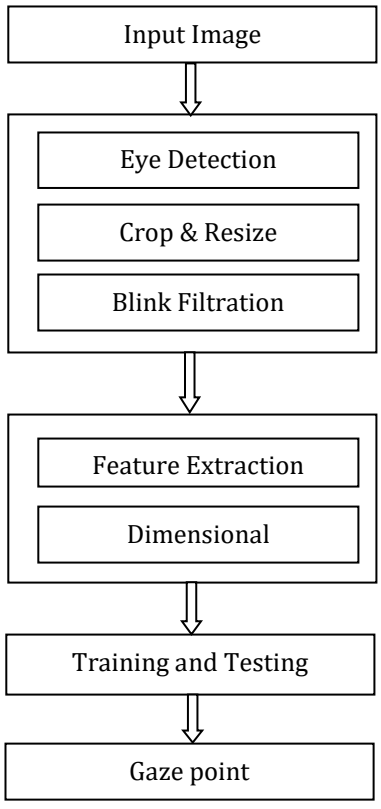


**Figure 1:** Basic steps of Gaze Estimation

## 2. RESEARCH WORK

Qiong Huang et.al [1] proposed an unconstraint gaze estimation technique on mobile tablet. First they have collect large unconstrained gaze dataset, labeled Rice TabletGaze dataset. The dataset are 51 subjects, each having 4 different postures and 35 gaze locations. Subjects vary in race, gender and in their need for **ordinance** of glasses, all of might impact gaze estimation accuracy. They proposed TabletGaze algorithm for automatic gaze estimation using multi-level HoG feature and Random Forests regressor. The TabletGaze algorithm achieves a mean error of 3.17 cm.

Yusuke Sugano et.al [2] developed Appearance-Based Gaze Estimation with Online Calibration from Mouse Operations. They proposed an unconstrained gaze estimation technique using an online learning algorithm. They focus on a desktop scenario, where a user operates a personal computer, and use the mouse-clicked positions to infer, where on the screen the user is looking at. This method regularly captures the user's head pose and eye images with a monocular camera. In order to handle head pose variant, the pattern are adaptively clustered according to the estimated head pose. Then, local reconstruction-based gaze estimation models are regularly updated in each cluster. This method achieved an estimation accuracy of 2.9◦.

Xucong Zhang et.al [3] studied appearance based gaze estimation in the wild. They present the MPIIGaze dataset that contains 213,659 images collected from 15 participants and CNN-base gaze estimation approach .In addition to CNN approach, they papoose the baseline methods using the same facial landmark detection, head pose estimation, and input features like Random Forest(RF), k-Nearest Neighbors (kNN), Adaptive Linear Regression (ALR), Shape-Based Approach (EyeTab).

Shogo Matsuno et.al [4] focuses on relative on small smart phone device. To achieved better accuracy the line-of-sight input interfaces have been investigated. This research has achieved line-of-sight accuracy of ~70%.

Davide Valeriani et.al [5] presented a wearable device for controlling a smart phone with eye winks. The system records muscular potentials by means of two electrodes placed either above or laterally to each eye to detect winks and filter out the blinks. Left and right winks are then Converted into commands and streamed to the smartphone via Bluetooth. The commands that received are mapped into specific actions through an app that is installed on the mobile smartphone.

Xiaolong Zhou1 et.al [6] solves the 3D eye gaze estimation problem using a simple-setup ,high definitions , low-cost and non-intrusive sensor (Kinect sensor).They have presents an effective and accurate method based on 3D eye model to evaluate the point of gaze of a subject with the tolerance of free head movement. A convolution based means of gradients iris center localization method was proposed, which improved the accuracy and speed of the conventional means of gradients method. A geometric constraints-based method uses to estimation the eyeball center. The constraints consider that all the iris center points are distributed on a sphere generated from the Eyeball center and the sizes of two eyeballs of a subject are identical. Then, calculate Kappa angle using the constraint that the visual axes of both eyes intersect at a same point with the screen plane when a subject gazes a point on the screen. This proposed method with an average estimation accuracy of 3.78◦.

Aun Kei Ariana Honget.al [7] proposed a lightweight, low-cost, side-mounted mobile eye tracking system that uses side-view. A hybrid algorithm using both feature-based models and appearance based models is designed to accommodate this novel system. A resulting in a correct gaze estimation rate of 95.7%.

Deepak Akkil et. al [8] presents tools and technique for measuring the gaze tracking quality .They have introduced generic system to evaluated the gaze data quality. They use tool called TraQuMe (Tracking quality measurement) is independent data quality measurement software. With TraQuMe they reported that the median offset was just below 0.81 degree and a median precision of 0.25 degree.

## 3. SUMMARY

In Mobile Technology, Image processing has shown marble improvement in terms of availability of apps and Gaze estimations.

Table:1 gives the summary of image processing and various techniques and performance parameters used.

**Table -1:** Summary of Image Processing

| Sr.No. | Author | Year | Techniques | Datasets | Performance |
|---|---|---|---|---|---|
| 1. | Qiong Huang et.al [1] | 2016 | CART Tree, Contrast normalized pixel intensities,LoG,LBP, HoG and mHoG feature,SVM | 51 subjects, each with 4 different postures and 35 gaze locations | 3.17 CM : Error Rate |
| 2. | Yusuke Sugano et.al [2] | 2015 | Model-Based Methods, Appearance-Based Methods, Adaptive clustering framework,LWPR | - | 2.9◦ : Accuracy |
| 3. | Xucong Zhang et.al [3] | 2015 | CNN-base gaze estimation approach, Random Forest (RF), k-Nearest Neighbors (kNN), Adaptive Linear Regression (ALR), Shape-Based Approach (EyeTab). | 213,659 images | - |
| 4. | Shogo Matsuno, et.al [4] | 2016 | line-of-sight input methods, A quasi eye control input interface | - | ~70% : Accuracy |
| 5. | Davide Valeriani et.al [5] | 2015 | EOG | - | -- |
| 6. | Xiaolong Zhou1 et.al [6] | 2016 | A convolution based means of gradients, A geometric constraints-based method, Kappa angle | - | 3.78◦ : Accuracy |
| 7. | Aun Kei Ariana Hong et.al [7] | 2012 | A hybrid algorithm, Gaussian regression | 4339 frames, 7 subject | 95.7% : Estimation Rate |
| 8. | Deepak Akkil et.al[8] | 2014 | TraQuMe, Standard Deviation Precision | - | 0.81◦ : Median offset<br>0.25◦ : Median precision |

## 4. CONCLUSIONS

This Paper shows an analysis of different Image processing Techniques and methods which be used in detection and prediction of gazing point. Overall review of different algorithms and different classification techniques of image processing is presented. In our study we found that Qiong Huang provide best gaze estimation and GazeTablet algorithm to reduce error rate and also consider different conditions like facial visibility, posture, and glasses reflection, which provide a deeper understanding of the challenges present in the mobile environment.

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