Image processing based touch sensing system and computer vision based mouse control using single camera

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Introduction And Motivation

Touch screen devices open a new gateway to interact with the system. In the current world still, the large number of people are using non-touch input based devices, this technology not only converts any screen into to touch-based screen but is also cost effective since it deploys monocular imaging sensors. Here I am proposing a new image processing-based finger touch position detection sensing method using a reflected image reflected on the screen. The most characteristic point of this system is using an only single camera. In many scenarios we want to control our computer from distance like while giving presentations, vision-based mouse control can be very helpful in those cases. We can use just our inbuilt webcam to control the mouse by tracking a custom marker.

Objectives

1. To convert normal screen into the touchscreen using a single camera and image-processing. To control mouse movement by hand gesture using a custom marker and image-processing.

Conclusion

This research proposed a computer vision based approach using a single camera like webcam without any extra hardware like Depth sensors etc. to provide a new dimension of human-computer interaction. It formulated two algorithms for using a normal screen as a touch screen and other to control a mouse cursor using a simple hand gesture. The novelty of the proposed method lies in incorporating the tracking algorithm and the domain information available to us along with image processing pipeline.It was observed that incorporating above mention techniques makes algorithms robust against misses and false positive which results in significant improvement in accuracy.

Challenges and Approach

Using a single view camera, we cannot get the depth information from a single view image. To solve this problem, we use the four corner of the screen as a constraint and detect the coordinate of touch position relative to these four points. To detect the touch with the screen, we use reflected finger image appears on the back of the screen. Detecting the fingertip and the reflected image on the screen effectively enables to detect touch position only using a single camera. The other main challenge was the missing of detection and false positive by image-processing pipeline. On an average, around 30% of frames are missed and no object was detected by image processing pipeline. To overcome it, tracking algorithm(Kalman Filter) is combined with an image-processing pipeline. It makes the overall algorithm robust to misses and false positive. In order to move the cursor on the computer screen, the user simply moves the marker in the viewing area of the web-camera. Computer vision techniques are used to extract motion and gesture information which then converted into corresponding mouse cursor movement. Histogram back projection is used to detect the marker and optical flow based algorithm is used for tracking. The spatial and geometric orientation of feature points in space with respect to one another is unique and is in accordance with the information embedded in custom marker while designing the marker. Exploiting this spatial information while tracking gives additional information and reduces the redundancy of the whole process. This information is used whenever tracking fails to track any of the feature points at any advance point in time then this geometrical relationship is utilized to initialize the position of the lost feature with respect to known feature point.

References

1.Development of Finger Touch Position Detection Methods Using Single Camera Shenjing Chen , Lifeng Zhangb
2. https://docs.opencv.org/3.0-beta/index.html

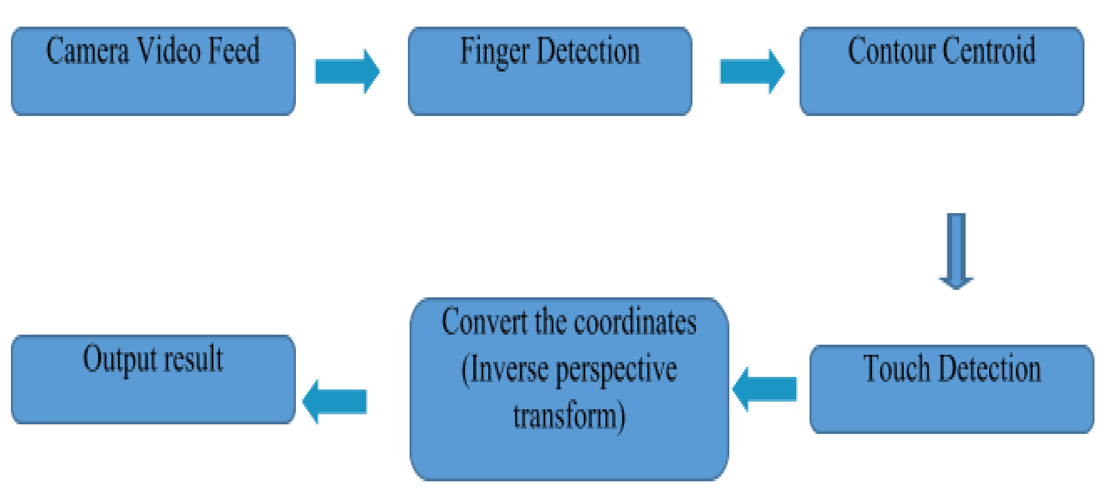

Fig 1. Flow Chart of Proposed Approach

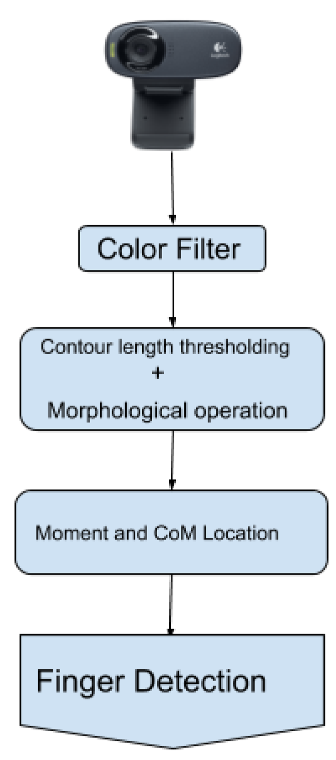

Fig 2. Finger Detection Pipeline

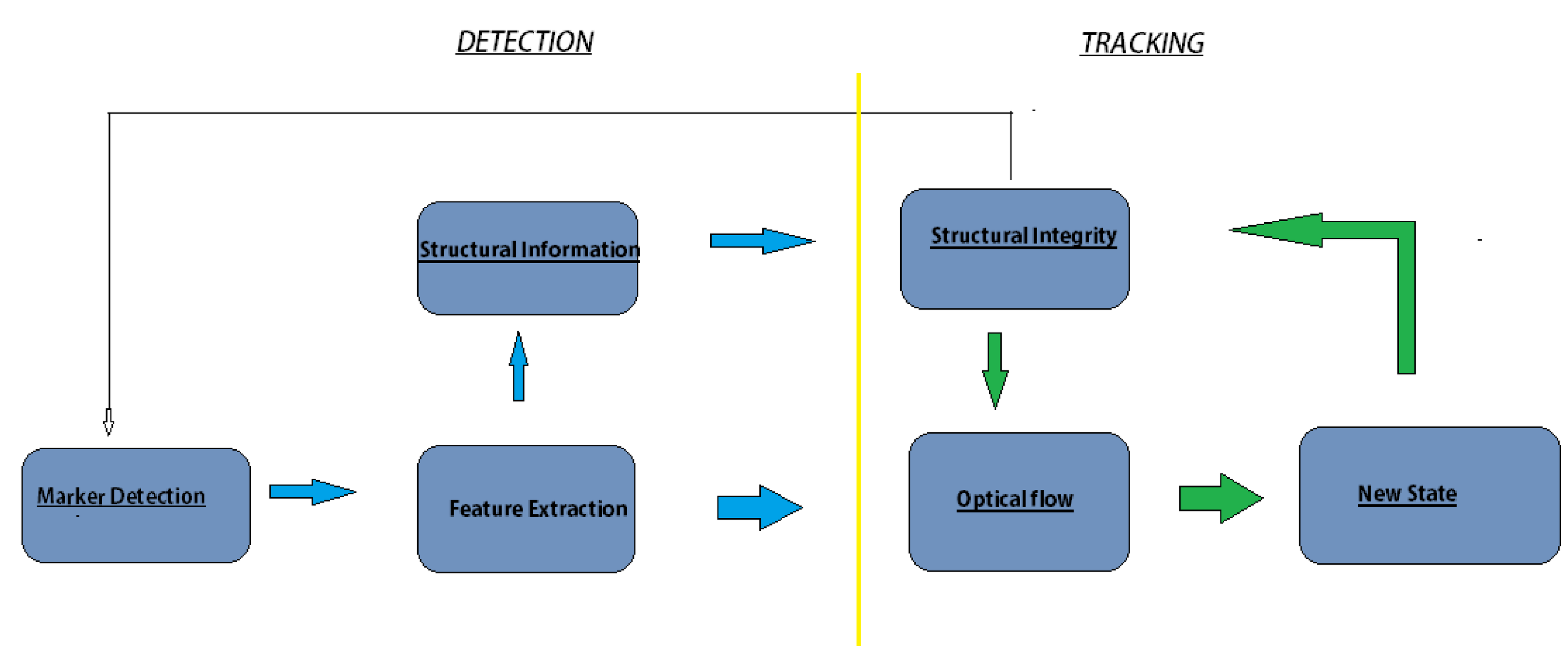

Fig 1(b). Flow Chart of Proposed Approach for vision based mouse control

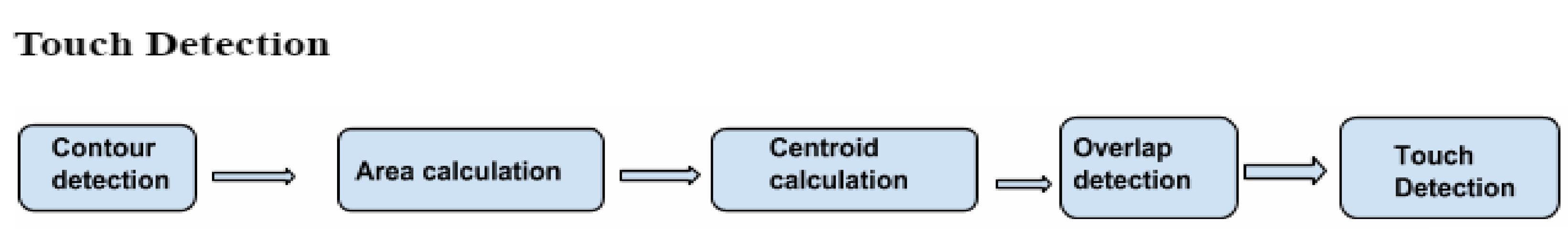

Fig 3. Touch Detection Algorithm

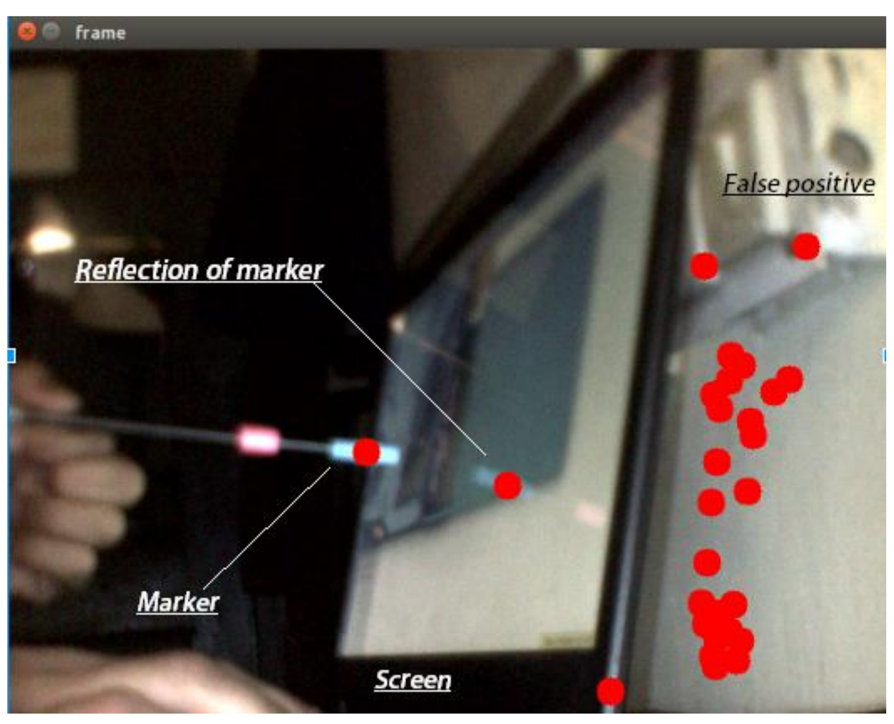

Fig 4. Camera view of normal screen with detection result

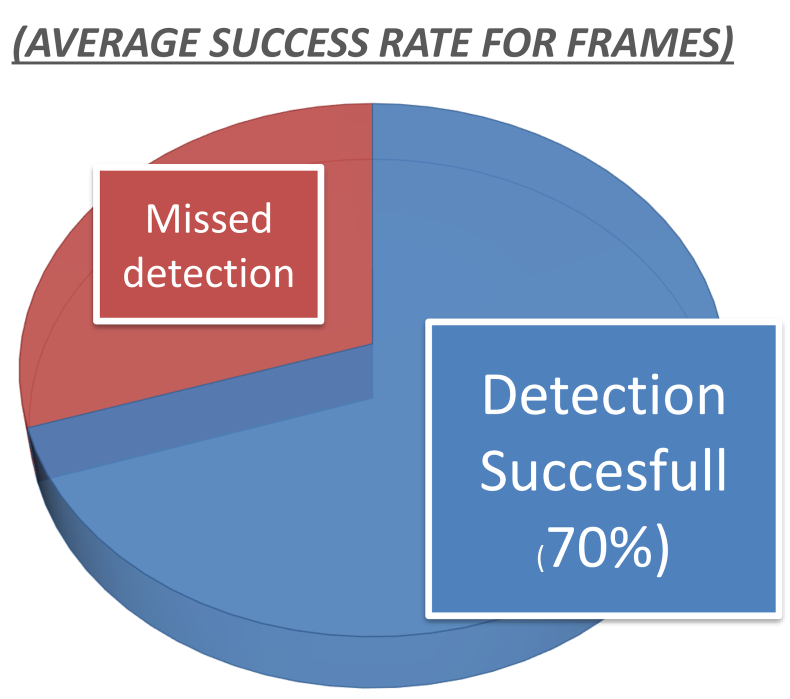

FIG 5. SUCCESS OF IMAGE PROCESSING PIPELINE -WITHOUT TRACKING

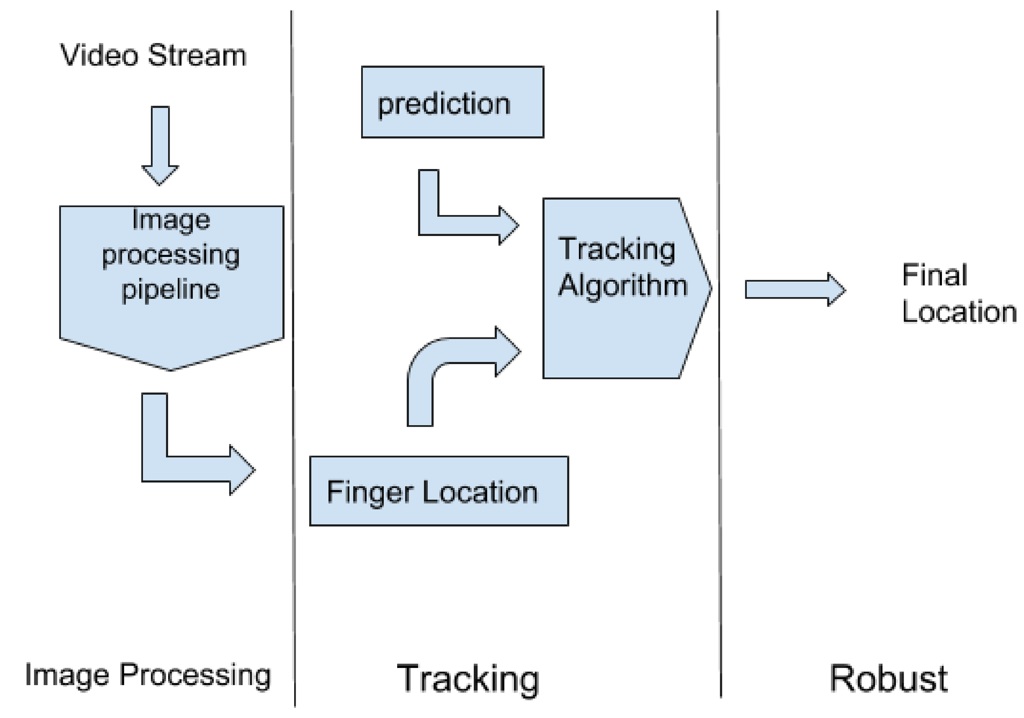

Fig 6. Tracking Algorithm with Image processing pipeline

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