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Motion Detection and Analysis with Four Different Detectors

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Abstract— **A change in measurement of speed or vector of an object or objects in the field of view is called motion. Detection of motion can be achieved by electronic devices or mechanical devices that interact or quantify the changes in the given environment. In this paper, a monitoring system is being enhanced utilizes motion detection technology with modified internationally recognized algorithms, implemented in C sharp and Matlab programming language. The result of this study is expected to be beneficial and able to assist users on effective motion detection and analysis. Four different motion detectors are being compared. The assessment includes three trials in three different speeds of motion and Morph filter has given a better and smooth detection. In conclusion, an effective motion assessment and monitoring system has been developed for the improvement of the motion detection ability.**

Keywords- Motion; motion detection; morph; motion detectors

I. INTRODUCTION

Motion can be detected by: sound (acoustic sensors), opacity (optical and infrared sensors and video image processors), geomagnetism (magnetic sensors, magnetometers), reflection of transmitted energy (infrared laser radar, ultrasonic sensors, and microwave radar sensors), electromagnetic induction (inductive-loop detectors) and vibration (triboelectric, seismic, and inertia-switch sensors) [1].

There are many approaches for motion detection in a continuous video stream. All of them are based on comparing of the current video frame with one from the previous frames or with something that called as background. In this paper, there are four approaches are used and comparison is made to find out a best detector for an effective motion detection.

The system supports the AVI files, JPEG from internet cameras, MJPEG (motion JPEG) stream, local capture device and webcam.

This paper is divided into six sections. The first section mainly introduces the whole study. It provides the general overview of the motion and analysis system. The second section includes the objectives of this study, which describes the aims that needed to be achieved. The third section discusses the background studies, literature review and the study implementation. A specification list of the computer environment and thorough discussion on the developmental tool or assessment and analysis on various motions will be explained in section 4. Finally, the last section contains the conclusions, future developments and possible enhancement and improvement on this study.

II. PROBLEM FORMULATION

The hypothesized function of this monitoring system is to provide the users with information about the detection of an object's movement in order to deliver useful information about the motion with connection to the theory of motion through movement. The subjective experience of motion is simple hypothesized as the feedback from tiny movement and differences between two frames. In this study, the practice item of motion was focused on comparison among four detectors.

The objectives of the fundamental studies are as follows:

- To implement the algorithm for motion detection analysis in a newly developed monitoring system.
- To compare and analysis among four detectors used (Current and Previous, Pixellate, Blob Counter and Morph).

Counterbalancing should be instituted to control for order effects and efforts made to ensure that all subjects complete objectives. New task need to be developed drawing on the best features of existing tasks.

A wide variety of human-machine interactions learning techniques have been used in human monitoring approaches for motion analysis. This employs a large number of visual and physiological features, a fact which usually impedes the training process [2].

In this paper, an effective monitoring system for motion assessment is presented. Several aspects for example the speed of the subject are considered while the assessment is being done. This monitoring system does not only serves motion movement as assessment, but also important in managing the subject data effectively and providing scientific information about object's movement.

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III. LITERATURE REVIEW

A. Current Frame vs. Previous Frame

One of the common approaches for a motion detector is to compare the current frame of a streaming video with the previous frame. It is very useful in video compression especially in estimation of changes, writing only the changes and not the whole frame.

Firstly, Difference and Threshold filters are used to distinguish the difference regions between an original gray scaled frame and the previous video gray scaled frame. An image with white pixel on the difference regions is obtained on the specified threshold value. A motion event can be signaled if the value is greater than a predefined alarm level [3].

Then, erosion filter is used to remove random noisy pixels since mostly of cameras produce a noisy image. The Erosion filter is a morphological filter that changes the shape of objects in an image by eroding (reducing) the boundaries of bright objects and enlarging the boundaries of dark ones. It is often used to reduce or eliminate small bright objects [4].

This filter assigns minimum value of surrounding pixels to each pixel of the result image. Surrounding pixels, which should be processed, are specified by structuring element: 1 to process the neighbour or -1 to skip it. It is very useful for binary image processing, where it removes pixels, which are not surrounded by specified amount of neighbours. It gives ability to remove noisy pixels or shrink objects [5].

At this stage, an actual motion is obtained since mostly only the interest regions are being detected. From the below picture, the disadvantages of the approach had been discovered. If the object is moving smoothly, small changes from frame to frame was received. Hence, it is a problem and difficulty to get the whole moving object. Things become worse when the object is moving so slowly and the algorithms will not give any result at all.

B. Current Frame vs. First Frame

Another approach is to compare the current frame with the first frame in the video sequence. Comparison between these two frames were resulting the whole moving object independently of its motion speed.

At the beginning, the first frame of video sequence is set as background frame. The upcoming frames are always comparing with this background frame. The most important approach here is to "move" the background frame slightly in the direction of the current frame on the specified amount for example used one level per frame. Then, the colours of pixels in the background frame are changed by one level per frame [6].

The most efficient algorithms in detection motion are building the scene or background frame as a reference to make comparison with the current frame. Some approaches listed below are rather simple if compared with the most which are too complex.

C. Pixellate Filter

Pixel art scaling algorithms are image scaling algorithms specifically designed to upsample (enlarge) low-resolution pixel and line art that contains thin lines, solid areas of colour rather than gradient fills or shading and has not been anti-aliased [7].

It is a simple pixellation algorithm that takes the median of the saturation over each square and the mean of the luminescence. The main idea of this filter is to replace pixels in some rectangular area with their average value and produces a nicely graduated luminescence by taking the mean of the hue is prone to error since adjacent hue indices can be radically different colours [8].

Hence, the pixellated versions of the current and background frames are produced. The next step is to move the background frame towards the current frames and the rest is only the main processing step [9].

D. Blob Counter

The idea of blob detection is to turn an image of pixels into a collection of "super pixels". Blob detection works by grouping sets of pixels that fall within a particular range of colours. The rest of the image can then be discarded and the resulting superpixels can either be highlighted on the image or sent for further processing. This creates very specific areas of interest, which can be processed further, as each region has a set of coordinates.

This approach has a great possibility for performance optimization. It provides the number of objects, position and dimension on a binary image. Blob counter is a very useful feature and can be applied in many different applications. It can count objects on a binary image and extract them. The idea comes from "Connected components labeling," a filter that colors each separate object with a different color [10].

Blob extraction is also very useful because once the super pixels have been identified, a simple calculation can be performed to see if the blob meets per determined conditions, such as height, width or shape [11].

IV. METHODOLOGIES

In this section, the procedures and the methods used for the monitoring system will be described. C Sharp and Matlab software are used in all the programming section. Generally, the flow of the motion monitoring system is as in Figure 1.

First, a short motion of hand waving with a ring on the last finger as reference is recorded real-time with a laptop webcam. The data is then fed into system for analysis using four different detectors. Result of motion detection is generated parallel with the data input. All the detected motions are highlighted with red colour.

Motion alarm is added into the motion detection system by calculate the amount of white pixels on the difference image between current frame and background frame.

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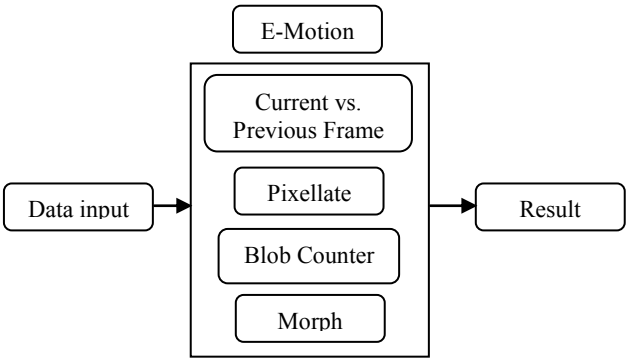

Figure 1. Block diagram for motion assessment and training monitoring system.

A. *Proposed Approach*

Morphing is a special effect in 2D images that changes (or morphs) one image into another through a seamless transition. Most often it is used to depict one person turning into another through technological means or as part of a fantasy or surreal sequence. Traditionally such a depiction would be achieved through cross-fading techniques on film. Since the early 1990s, this has been replaced by computer software to create more realistic transitions [12].

The idea of the filter is to preserve specified percentage of the source filter and to add missing percentage from overlay image. So, if the filter was applied to source image with percent value equal to 60%, then the result image will contain 60% of source image and 40% of overlay image. Applying the filter with percent values around 90% makes background image changing continuously to current frame.

This new filter has two benefits that it is much simpler to understand and produce better performance due to the efficiency of implementation of filter.

V. RESULT

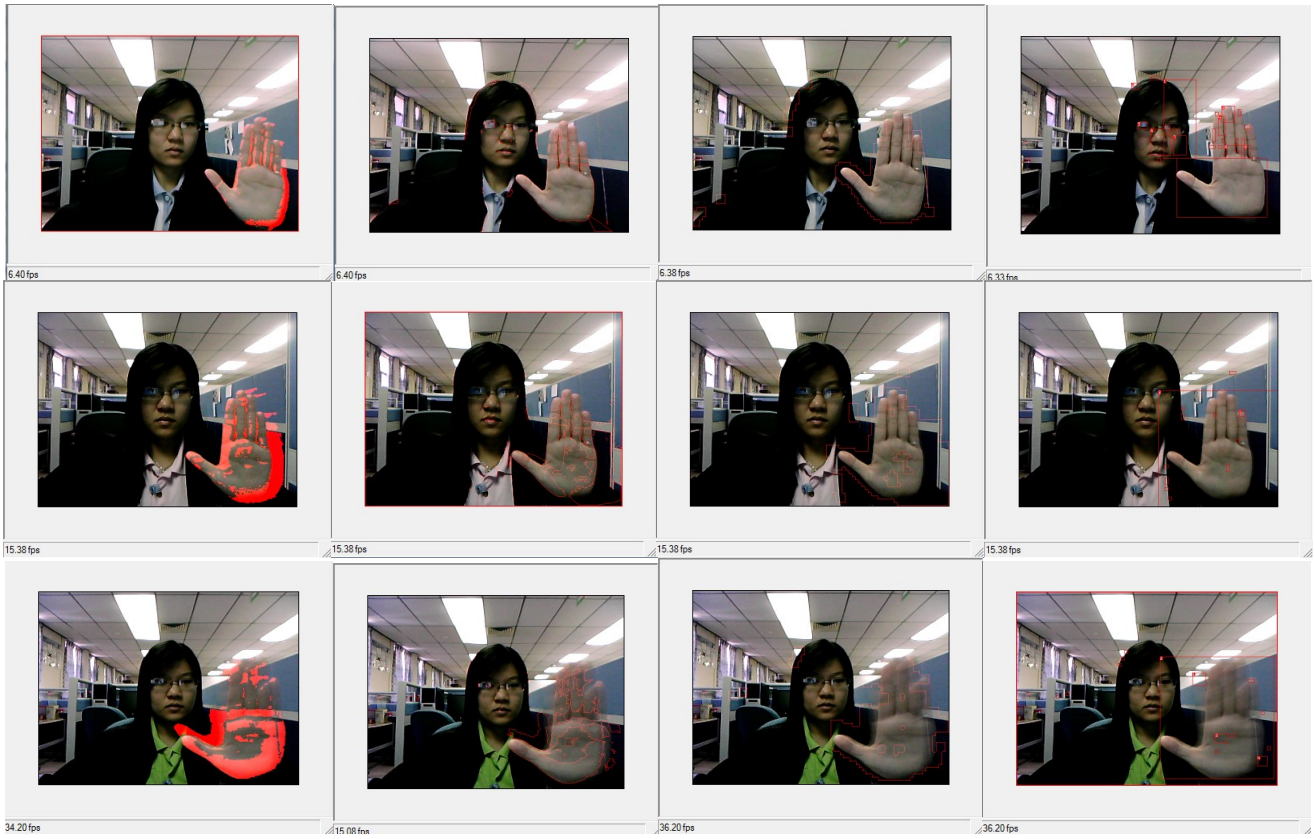

Figure 2. Result image (from left) using Current vs. Previous Frame, Pixellate Filter, Blob Counter and Morph Filter with increasing motion speed.

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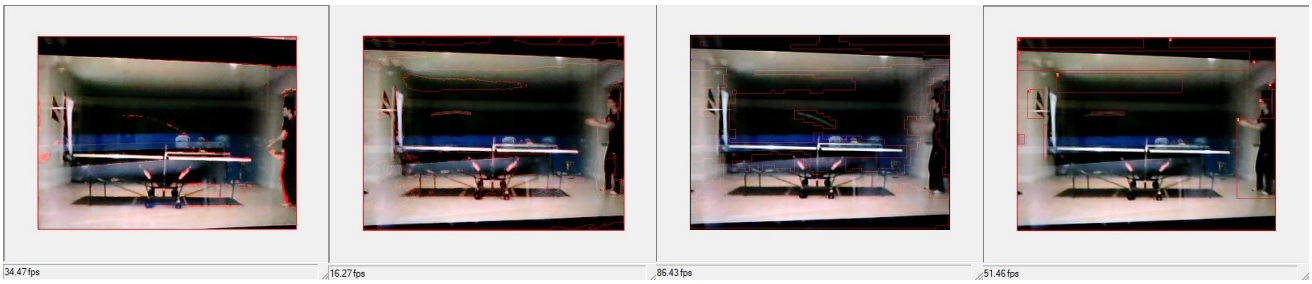

Figure 3. Result image (from left) using Current vs. Previous Frame, Pixellate Filter, Blob Counter and Morph Filter for a small table tennis ball detection.

VI. DISCUSSION

The advantage of this monitoring system over other is the ability of this monitoring system to provide an effective and easy method for user. It is important to consider the assessment in all the aspects including speed and background.

The most appropriate monitoring available is this system able to monitor a progress in a long time. Result is presented in Figure 2. Four different detectors are used in the system starts from left is comparing current frame with previous, pixellate filter, blob counter and morph. All these detectors are working smoothly with high efficiency during slow motion about 6.40 frames per second (fps).

On the other hand, when the system is applied on very fast motion around 36 fps, morph filter is able to detect the object's motion clearly with a tiny lagging rather than the previous three detectors but there is an interesting finding that pixellate detector is unable to detect a very fast movement. It will automatically decrease the motion to become slow motion for an analysis due to its characteristic of enlarge low resolution image and it takes longer time to process the mean for detection. Some sections of the trial motion like subject's palm center and subject's ring on the last finger were successfully detected by the last detector.

Another motion video was analyzed using this four detectors and the result showed that morph filter able to detect the fast movement of table tennis ball effectively for a long period. The detector can detect, recognize and coping out a zone of interest of every moving object in a frame.

The result indicates that morph filter is better in motion detection for the monitoring system. The detection is running smoothly and available in fast motion detection.

This monitoring system also could be revised to make them more user-friendly, with a focus on issues such as layout, illustrations, message, information, and cultural appropriateness. It provides full functionality for the entire assessment cycle: authoring, scheduling, administering and rating. A non-technical rationale for using the procedure, including the type of information and what we can do with this information will be provided. It is a premier and affordable personal computer-based assessment system for academia, government and business users.

The monitoring system is designed around four essential qualities: validity, reliability, impact and practicality. Validity is normally taken to be extent to which an assessment can be shown to produce scores which are an accurate reflection of a human's motion true level. Reliability concerns the extent to which assessment results are stable, consistent and accurate, and therefore the extent to which they can be depended on for making decisions about the motion. Impact concerns the effects, beneficial or otherwise, which an examination has on the motion. Practically can be defined as the extent to which an assessment is practicable in terms of the resources needed to produce and administer it.

There is a lot to do with this motion detection monitoring system depending on the imagination. One but not the only one straight forward application for this system is video surveillance. It also can be applied on the incredible thing likes gesture recognition, behavioral analysis and gait analysis.

VII. CONCLUSION

In conclusion, an effective monitoring system for motion detection and assessment tool has been developed. The level of motion is used as the input for the monitoring system to generate assessment to the motion detection to the particular person specifically. Results and findings show that the monitoring system is effective and consistent in producing relevant results to the detected motion. This monitoring system can be developed in the algorithm for speech recognition system in order to obtain more accurate and reliable voice input.

In future, this system will be upgraded to mobilize resources to provide the necessary infrastructure, supplies and materials needed to ensure every assessment is achieving the motion analysis potential. This is important to increase the reliability and effectiveness of this monitoring system.

A more detailed concept of motion detection will be more useful in later processing stages. As in image flow algorithm, all the information is need to be incorporated on the direction of motion. Optimization in realization is very important for a optimize solution from the beginning.

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REFERENCES

[1] Randal, C. N. (1991). "Qualitative Detection of Motion by a Moving Observer", Proc. IEEE Conference on Computer Vision and Pattern Recognition, Maui Hawaii, 173-178.

[2] Loui et al. (1990). "High-Speed Architectures for Morphological Image Processing", Nonlinear Image Processing, pp. 145-156.

[3] Sternberg, S. R. (1983). IEEE Computer, Biomedical Image Processing, CytoSystems Corporation.

[4] Heijmans, H. J. and Ronse, C. (1990). The algebraic basis of mathematical morphological-I: Dilations and erosions, *J. Comput Vision, Graphic, Image Process,* Vol. 50.

[5] Ramprasad, P. and Randal, C. N. (1994). "Recognition of Activities", Proc. International Conference on Pattern Recognition, Jerusulem, Israel, A815-820.

[6] Tetsuya, M., Makoto, N., Tomohiro, Y. and Shinji, T. (2010). "Comparison of Color Space in Extraction of a Hand Region for Computer Human Interface Using Color Image Processing", Technical report of IEICE. PRMU 98(528).

[7] Thomas, K. (1999). "Fast Blit Strategies: A Mac Programmer's Guide". *MacTech*.

[8] "Eagle (idea)". *Everything2*. 2007-01-18.
http://thread.gmane.org/gmane.linux.redhat.fedora.legal/661

[9] Stepin, M. (2007). "hq3x Magnification Filter".
Retrieved 2007-07-03.

[10] AForge.NET. (2009, 03 27). *BlobCounter.cs*.
Retrieved 03 01, 2010, from code.google.com:
http://code.google.com/p/aforge/source/browse/branches/1.7/Sources/Imaging/BlobCounter.cs

[11] Amit, Y. (2002). *2D Object Detection and Recognition: Models, Algorithms, and Networks.* Chicago: Cambridge, Mass. MIT Press, 2002.

[12] Kalman, R. E. (1960). *A new approach to linear filtering and prediction problems*, Transactions of the ASME -- Journal of Basic Engineering, Series D, pp. 35-45.

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