Flexible Burst Image Capture System for Mobile Devices

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Abstract

In this paper a newfangled selective image capturing approach is described where all events of the current scenario are intended to be captured. Mobile phone usage has seen an exponential increase in the last few years and hence mobile phone photography has progressed rapidly. Phone camera is your best camera, because it is always with you. Our photographic brains are switched on all the time, looking for possibilities to capture the expected and unexpected moments. There are numerous scenarios where a user might want to capture images without missing any event, which is tedious if manual clicking is adopted. To capture continuous shots burst mode is devised, but it has fixed rate of image capture and results in many similar and unnecessary images even if there is no significant change in the scenario. Towards such needs, it is quite necessary to develop an intelligent system that captures image only when a new information is added to the scenario, hence saving memory, enhancing battery life and thereby improving the overall device performance without restricting the user needs. A software based solution has been developed in this research that performs selective capture without human interaction by continuously varying rate of image capture by dissecting the scenario, identifying constituents and their characteristics, applying movement restrictions and identifying disruption parameters. In this way, it is ensured that all the useful information, which user wants from a scenario, is successfully captured. The proposed mechanism is called as Flexible Burst Image Capture System for Mobile Devices. It has three inter-dependent modules (1) Context Detection & Object Classification module (2) Object Tracking & Scene Change Detection module (3) Scene Change Estimation module. Content Detection and Object Classification module is responsible for identification of different objects/backgrounds entering and exiting the scene. Once the object/background is successfully identified, it classifies them further according to their type. Object Tracking and Scene Change Detection module monitors the identified objects/background by the first module. Scene Change Estimation module, takes continuous input from the first two modules to devise the new image capture rate so that only images representing some new and important information are captured, without any duplication. In this way this mechanism helps user to capture all important moments without compromising on storage space.

Keywords - *Image capture, Storage space, Context Detection, Object Classification, Object Tracking, Scene Change Detection, and Scene Change Estimation.*

I. INTRODUCTION

With each passing year, the population of mobile users is increasing manifolds. Cameras and new features associated with cameras are one of the unique selling propositions of mobile device manufacturing companies. Advancement in both hardware and software technologies has led to various new modes and increase in capturing capabilities of mobile phones. Still there are many areas of improvements in the field of image capturing via mobile devices. One such area is effectively and efficiently image capturing of various stages of an ongoing scene with one or more objects.

Most of the current available solutions in the market offer continuous capturing of the scene at a specific rate of capturing of images. Drawbacks of this approach are many. Firstly, it leads to capturing of repetitive and distorted images which in-turn overburdens the mobile device storage space and battery life. Secondly, user does not have an option or intelligence to perfectly time the capture of each change in the ongoing scene. Thus, there is a need to come up with a solution that overcomes the above mentioned short comings.

Flexible Burst Image Capture System for Mobile Devices aims to capture all important events which user does not want to miss, taking into consideration the effective utilization of storage space. This paper explains three closely integrated modules (1) Context Detection & Object Classification module (2) Object Tracking & Scene Change Detection module (3) Scene Change Estimation module. The system along with each and every component has been described in detail, along with complete logical and technical insight of the methodology for each of the above modules. Results achieved have been explained at the end, which helps evaluating the proposed approach.

II. PROBLEM

Capturing the perfect image of objects in motion/action remains one of the major problem user faces today. As an example, capturing the image of a racing car on the tracks is not an easy task for any mobile user to perform. There are many such real life example where user faces problem to capture the perfect image of the moment. In doing so user may click numerous picture just to capture one or few flawless image or images. As a result capturing of both inefficacious and duplicate images of the scenario will occur. In addition, storage space and battery resource will be consumed in capturing and processing of such images. This intend will adversely affect the overall performance of the device. Therefore, it brings us to our problem statement

"To find a burst image capturing technique which only captures images with a significant change, thereby

reducing the amount of similar images captured intelligently without any human intervention.

III.CONCEPT

The proposed invention is based on device intelligence in predicting and evaluating any introduction of useful information that could or has occurred in the scene on focus and accordingly varying the burst rate of image capturing.

Our mechanism on basis of the scene elements detected will perform image capturing with different combinations (in case of multiple subjects) of no. of image captured and timing of each capture. Again, with change in scene elements our mechanism will dynamically make decision to alter the no. of captures and timing of captures. Hence, new approach to improve the photography experience by introducing thinking and predicting camera is proposed. No information is missed and useful/non-useful image ratio is improved.

The algorithm starts by identifying the no. of objects in the first frame. Then followed by the type and characteristics of the each object identified, the data collected is distributed into two types of variables, independent and derived variables. The algorithm devised to calculate the new capture rate for the above theoretical concepts has been explained in detail with the explanation for Decision Making Component of Scene Change Estimation Module in this paper.

IV. METHODOLOGY – CONTENT DETECTION AND OBJECT CLASSIFICATION MODULE

This part majorly covers the actual implementation of the Flexible Burst Image Capture System. The entire Flexible Burst Image Capture System is divided into three sub-modules; Content Detection and Object Classification module, Object Tracking and Scene Change Detection module and Scene Change Estimation module.

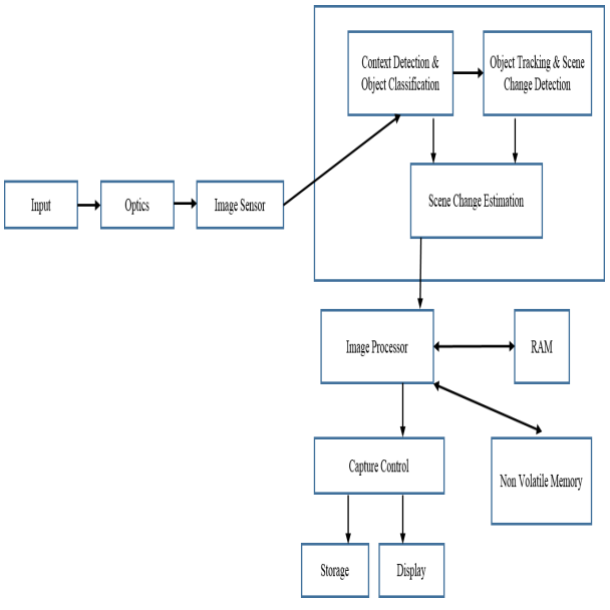

Fig. 1. Flexible Burst Image Capture System

The first module that is Content Detection and Object Classification module is responsible for identification of different objects/backgrounds entering and exiting the scene. Once the object/background is successfully identified, the next step is to classify them as the type of object/background.

A. Implementation Approach

There were many different real life scenarios taken into consideration to implement this particular module. As the module requires identifying various types of objects and backgrounds, all different types of objects and backgrounds were thought of and incorporated with this module. This helped to effectively categorize the objects and backgrounds, which in turn helped to increase the efficiency of the algorithm used in the system. Few of the real life scenarios considered were; Wildlife photography, this is one area which requires a continuous series of photographs to depict an entire scenario. Above that, there are different species along with different surroundings where these species exist. Sporting events was another field chosen, as it also involves fast moving objects in a scenario. The athletes and their skills involved are very dynamic in every sport. So proper identification and categorization of the objects and backgrounds becomes very important. Similarly, one more important category that is of Astronomical events was also taken into account while implementing the above module.

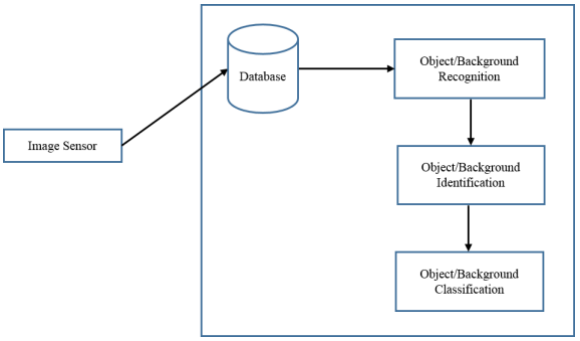

Fig. 2. Architectural diagram of Content Detection and Object Classification Module

The architectural diagram of the module is depicted in Fig. 2.

Image sensor that stores each frame captured by the device provides the initial input to the module. All the frames supplied are stored in the local database/storage of the module.

B. Module Components

This module comprises mainly of three components. The description of each component is gives as below.

1. Object/Background Recognition Component

The first task of the module is to recognize if there has been introduction of any new object or background in the frame being captured by image sensor of the device. The Object/Background Recognition Component performs this task. It clearly marks and

keep the count of the newly added objects and backgrounds in the frame.

2. Object/Background Identification Component

The above component supplies the frame with total count marked region of each object and background making it easier for the next component to identify each object and background in the frame. Therefore, the task of correctly identification of each object and background lies with the Object/Background Identification Component. Various techniques of image processing are applied for precise identification of each objects. Once identified the results are associated with the frame and then supplied to the next component.

3. Object/Background Classification Component

The final task remains to classify the identified objects and backgrounds in the previous component. Object/Background Classification Component performs this task of effectively classifying the identified objects and backgrounds. This component associates different parameters with each object and background, for example, the speed at which the object can move or make any motion. Once the component tags all different parameters with the each identified object, the whole task of Content Detection and Object Classification module is completed.

V. METHODOLOGY- OBJECT TRACKING AND SCENE CHANGE DETECTION MODULE

The second module is Object Tracking and Scene Change Detection module which takes care of constantly monitoring the identified the objects/background by the first module.

A. Implementation Approach

The major task of this particular module is to independently monitor every object and background identified by the Content Detection and Object Classification module. Its task is to maintain the data of the current state of the object and background identified. Different objects and backgrounds have different properties associated with them. The categorization of each object and background in the previous module helps to identify the parameters associated with each object and background and accordingly those parameters are monitored in this particular module. For example in a wildlife scenario if any animal species is identified, then different attributes of that particular animal species are monitored, like if the particular animal species could fly or could swim. Similarly, the background identified in the Content Detection and Object Classification module are also monitored for any change. This change plays very important role in determining the rate at which the images are captured.

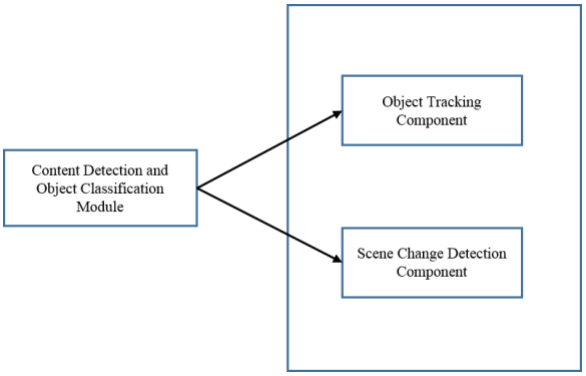

Fig. 3. Architectural diagram of Object Tracking and Scene Change Detection Module

The architectural diagram of Object Tracking and Scene Change Detection Module is depicted in the Figure 3.

This module comprises of two main components, namely Object Tracking Component and Scene Change Detection Component. Object Tracking Component is responsible for tracking each and every object identified. Scene Change Detection Component is responsible for detecting the change in the background and surroundings of the scenario being captured.

B. Module Components

This module comprises mainly of two components. The description of each component is gives as below.

1. Object Tracking Component

The task of this particular component is to track all the properties or parameters associated with the objects as identified in the Content Detection and Object Classification module. It maintains the data of change and rate of change of each property/parameter of the object. In addition, it maintains the status of each object that whether the object is live or not, in other words the object is still the part of the current scenario or frame. This data collected plays a critical role in estimation of the rate of frame captured decided by the Scene Change Estimation module.

2. Scene Change Detection Component

The Scene Change Detection Component primary task is to monitor the backgrounds identified in the current frame.

It includes monitoring the change in background surrounding, any change or movement in the background elements, any introduction of sound in the background. It is important to monitor these changes in background as these changes in turn may lead to change in the behavior of the objects identified in the whole scenario. It helps to find the co-relations between the changes in the background of the scenario and the objects present in the scenario. The state of every element of the background are maintained and it acts as the input to the next module that is the Scene Change Estimation module where the actual decision making algorithm uses this data.

VI. METHODOLOGY – SCENE CHANGE ESTIMATION MODULE

The third module is the Scene Change Estimation module, which takes care of processing the new rate of image capture based on the information provided along with each frame by the previous two modules.

A. Implementation Approach

The third module is the Scene Change Estimation module, which in turns takes continuous input processed from the first two modules to devise the new image capture rate so that only images representing some new and important information are captured, without any duplication. The mechanism helps the user to capture the moments for which user might not be prepared beforehand. The module closely evaluates every information associated with frame with respect to each object and background identified. On finding some new useful information introduced to the frame, a new rate of image capture is devised to successfully store the newly added information to the frame. For example in a wildlife scenario, the initial frame had captured a wildlife species in a sitting position, but in the next frame received the same wildlife species is now running, so the module will see a significant change in the parameters of the wildlife species (object) and will change the rate of capture to store each and every new information that might occur in future frames due to the change in the parameter of the object. Similarly, in case of sporting events, the athlete (object) is in constant state of change. Therefore, the module needs to constantly re-evaluate the rate of image capture to successfully store every new information being added in the frame.

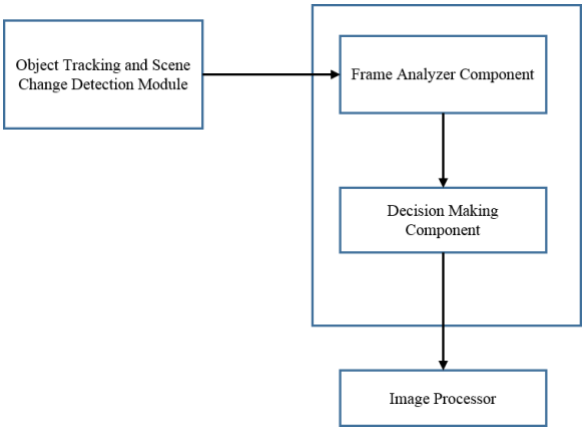

Fig. 4. Architectural diagram of Scene Change Estimation Module

The architectural diagram of Scene Change Estimation Module is depicted in the Figure 4.

This module comprises of two main components, namely Frame Analyzer Component and Decision Making Component. Frame Analyzer Component is responsible for analyzing the new frame. If any new significant change is detected by the component, it supplies the parameters of the object and background in the frame to the Decision Making Component. Decision Making Detection Component is responsible for calculating the new rate of image capture based on the parameters of each of the object and backgrounds in the frame. This new rate makes sure that the user misses no useful information.

B. Module Components

This module comprises mainly of two components. The description of each component is gives as below.

1. Frame Analyzer Component

Frame Analyzer Component is responsible for analyzing the arrival and departure of new objects or backgrounds and evaluating the change in parameters of existing object and backgrounds. If there is significant change that may provide any new useful information to the user, then the Frame Analyzer Component retrieves the parameters associated with object and background and sends it to the Decision Making Component.

1. Decision Making Component

Frame Analyzer Component is responsible for calculating the new rate of image capture so as to all the new useful information that is being introduced or maybe introduced in near future is captured completely. It is in this component where the actual algorithm of the system runs and devises the new rate of image capture for the system. The algorithm is defined as follows.

Let ‘R’ be the initial rate at which the algorithm will be capturing the images. Input to the algorithm will be two types of parameter; Independent parameters (‘K’) and Derived parameters (‘L’). Once all the parameters are identified, the algorithm will be assigning the weightage (‘wK’ and ‘wL’) to each one of them. Governed by the above-mentioned parameters with their respective weights, a correction factor ‘μ’ will be generated. This newly generated correction factor ‘μ’ will used to define the new rate ‘R´’.

$$R' = \mu * R$$

Where $\mu = \sum wiKi + \sum wjLj$ i= 1 to n, j = 1 to m

Now the device will capture the images on basis of the newly devised capture rate R´.

VII. RESULTS

On testing the proposed solution with several scenarios, it was found that proposed image capture mechanism increases the relevant images captured by 72% and reducing the similar/irrelevant images to an extent of 79%. Which depicts efficient memory utilization as well as providing content that is more relevant to the user.

Market surveys shows that more than 50% of the Indian users are using phone with storage less than 8GB and which often gets filled quite easily when the user captures images in a burst. This method only captures the image if there is a significant change in the scenario, and hence reduces the unnecessary storage usage.

The scenes that were earlier being missed, due to a constant burst speed and highly dynamic scenario, are now being captured. At the same time, in static scenarios, where lot of similar images were getting captured, only different images are now getting captured.

The tests conducted shows that this method provide good results increasing the number of relevant images by more than 70%.

Table 1. Test results

	Normal Burst Mode	Flexible Burst Image Capture System
Total Memory on Device	16GB	16GB
No of Images captured	225	188
Similar Images	86	17

Fig 5. Unique images captured by Flexible Burst Image Capture System

VIII. CONCLUSION

This proposed method provides a significant improvement to mobile device users who are photographing enthusiast. User is able to capture the required information without any manual effort and preserving critical resources of storage space and battery. The same mechanism can be easily replicated to all image capturing devices. This new mechanism can prove to revolutionize the entire experience of photography in various fields like in wildlife photography, sporting events and astronomical events. It will be useful in all the scenarios where it is important to capture all important events in a series of events.

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