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Capturing Candid Moments using Daily Device without Dedicated Human Resource

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Abstract

In most organizations, candid moments on held events should be captured as images for administrative purposes. For instance, if an event is sponsored by third parties, it is necessary to send some images capturing moments on that event to them. However, human resources are required to capture such images, resulting additional operational cost. This paper proposes a method to capture candid moments without human intervention. Unique to this method, daily device (i.e., mobile phone) is used to replace human resource with the help of a phone holder and a dedicated mobile application. Prior capturing images, given mobile application should be installed to the mobile phone and such phone should be attached to the phone holder that is aimed at event area. Candid images can be then automatically collected by running installed mobile application. According to our evaluation, such method can replace human resource for capturing candid moments using daily device. Further, it is more efficient than video recording (i.e., an alternative to capture candid moments) in terms of used battery power and memory.

Keywords: *multimedia tool, mobile application, surveillance system, automation*

Abstrak

Pada kebanyakan organisasi, momen-momen dari sebuah acara perlu disimpan sebagai gambar untuk tujuan administratif. Sebagai contoh, jika sebuah acara disponsori oleh pihak ketiga, adalah perlu untuk mengirim beberapa gambar berisi momen-momen dalam acara tersebut pada pihak terkait. Namun, sumber daya manusia diperlukan dalam mengambil gambar-gambar tersebut, menyebabkan tambahan biaya operasional. Riset ini mengembangkan sebuah metode untuk mengambil momen-momen dari sebuah acara tanpa melibatkan intervensi manusia. Salah satu keunikan dari metode ini adalah penggunaan perangkat sehari-hari (perangkat selular bergerak) sebagai pengganti sumber daya manusia. Sebelum mengambil gambar, sebuah aplikasi perlu dipasangkan pada perangkat selular terkait dan perangkat selular tersebut perlu dipasangkan pada pemegang perangkat yang mengarah pada lokasi acara tersebut. Gambar-gambar dari momen acara tersebut kemudian dapat diambil secara otomatis dengan cara menjalankan aplikasi yang terpasang pada perangkat selular tersebut. Berdasarkan hasil evaluasi, metode ini dapat menggantikan sumber daya manusia dalam mengambil gambar dengan perangkat sehari-hari. Selain itu, metode ini lebih efisien ketimbang perekaman video (alternatif pengambilan momen) dalam hal penggunaan baterai dan memori.

Kata kunci: *perangkat multimedia, perangkat selular, sistem pengawasan, otomatisasi*

1. INTRODUCTION

Mobile device is increasingly popular [1]; in 2010, mobile phone (i.e., a subset of mobile device) were sold more than 1.6 billion units [2]. Further, two recent research shows that 92% of all households in the U.S. has at least one mobile device [3] and the number of people who have more than one device each is increasing [4]. One of the reasons behind such rapid popularity is the existence of wireless technologies, which enables mobile device to be reachable anywhere [5].

Mobile device have become a pervasive companion on more than one billion people [6]. Hence, a lot of research start to utilize mobile device as a part of their implementation tool. Education and Health are two research domains which rely heavily on such thing.

In Education, mobile device is used to support distance education [7]. Student can learn a particular course material without the need to meet the lecturer in person; they are only required to use their mobile device (particularly tablet) to access the material. This kind of learning is called mobile learning [8] and targets either PK-12 education [9] or higher education [10].

In Health, mobile device is commonly used to inform users whether their behaviors are healthy or not. For example, a work in [11] develops a mobile application to maintain healthy behaviors of prediabetes users. Two other examples are a work in

[12] that develops a mobile application to prevent adolescent obesity and a work in [13] that develops an application for stress monitoring.

It is important to note that mobile device is also used in research from other domains. First, a work in [14] aims to build a personalized assistant for handling privacy management on mobile phone. Second, a work in [15] aims to handle malware application on Android. Third, a work in [16] shows that mobile phone can be used to enhance user experience at museum.

One of the uses of mobile device is to capture candid moments of a particular event as images for documentation. At organization level, those images are usually used for, at least, three administrative purposes. First, if an event is sponsored by third parties, it is necessary to send those images to them as a proof that such event has been successfully held. Second, those images can be published on social media (or even printed media) as a part of promotion. Third, those images can be stored privately for either accountability report or unexpected cases. Despite such importance, capturing those images requires dedicated human resources and such resource usually leads to extra cost.

To not utilizing dedicated human resource, a dedicated multimedia device (such as timer-featured SLR camera) attached to a tripod can be used. Nevertheless, such device is uncommon (when compared to mobile devices). In addition, tripod cannot be placed in most places since it takes a considerable amount of space.

Visual surveillance system aims to observe a particular area using electronic sensors [17]. It is typically implemented by placing several Closed Circuit Televisions (CCTVs) wherein their captured visual data will be gathered on a server for further observation [18]. To date, most surveillance systems are featured with intelligent capabilities such as object recognition, object tracking, scene interpretation, and visual event retrieval [19]. IBM Smart Surveillance System [20] and ADVISOR [21] are two practical examples which have such features.

Having visual surveillance system installed on event area, candid moments can be captured easily without human resource. Nevertheless, we would argue such mechanism is still impractical due to three rationales. First, not all areas are featured with such system (especially in developing countries). Second, the quality of captured moments from surveillance system is considerably low (since some systems are installed with limited budget in mind). Third, in public places, data from installed surveillance system is inaccessible.

This paper proposes a method to capture candid images automatically with a mobile application, a mobile phone, and an adjustable phone holder. Prior capturing images, given mobile application (which can capture images automatically in a specific period of time for a particular duration) should be installed to the mobile phone and such phone should be attached to the phone holder that is aimed at event area (see Figure 1). Candid images can be then automatically collected by running installed mobile application. Our proposed method is not only cost-efficient but also practical to use since used devices can be found easily in daily life.

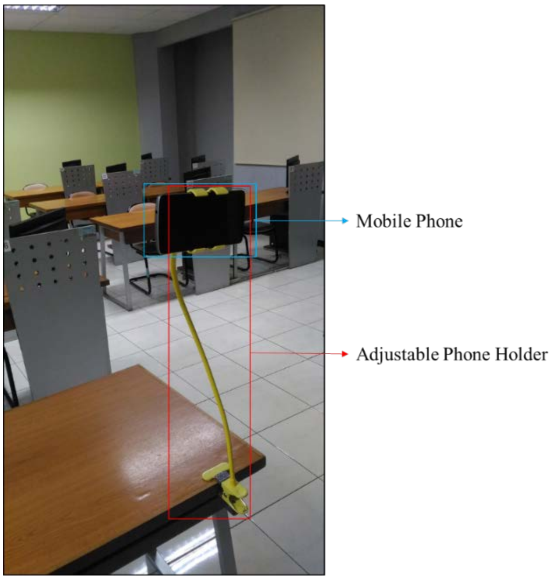

Figure 1. How mobile phone is attached to adjustable phone holder in our proposed method (front view)

It is important to note that proposed method can also be used for three other tasks. First, it can be used to record biology experiment [22] (such as observing the growth of a particular plant or the behavior of an animal) without dedicated multimedia device. Second, if installed aiming the whole class (as in Figure 1), it can be used to collect supporting evidences for in-class plagiarism (either in text [23] or programming works [24]) without the need of conventional surveillance system. Third, if installed aiming the whole class during lecture session, it can be used to check student behavior while learning. Such factor is not only applicable to re-evaluate teaching method but also applicable for predicting student performance [25] (by assuming student concentration as a considered factor).

2. Method

This paper proposes a practical method to capture candid images without human resource. Unique to this method, it utilizes mobile device which can be found easily in daily life. Featured with an application named Photo booth and an adjustable phone holder, such device can replace human resource for capturing candid moments.

Photo booth, as a mobile application, is specifically designed to automate capturing images on mobile phone. User can determine how long the application will run to capture candid images (i.e., running duration) and how long-time interval between each image capture (i.e., image-capturing interval). Both parameters should be set prior running the application and can be inputted in hour-minute-second format. Figure 2 shows User Interface (UI) of Photo boot for accepting those parameters.

Upon parameter setting, user will be redirected to main UI (see Figure 3). It contains camera preview, setting button (the leftmost button), start button (the center one), and gallery button (the rightmost button). Camera preview is used to check whether mobile phone's camera aims the right direction to event area. Setting button will redirect user to UI for changing defined parameters (see Figure 2). Start button will activate image capturing mechanism with defined parameters. Gallery button will redirect user to their gallery where they can see captured images.

Figure 2. User Interface of Photo booth for accepting running duration and image-capturing interval

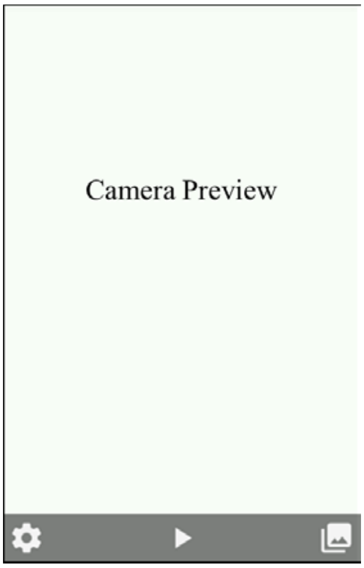

Figure 3. Main UI of Photo booth

While capturing images, camera preview will be disabled to save battery power. Further, start button will be replaced with stop button (that will stop capturing images directly if pressed). It is important to note that captured images will be stored on dedicated directory automatically created by Photo booth; where each image is named based on date and time when the image is captured.

To date, Photo booth is only developed as an Android application. Hence, it is natural that our proposed method can only work with Android mobile phone. Despite such limitation, we would argue that our method is still practical to be used; Android mobile phone is commonly used in community due to its affordable price and promising features.

Adjustable phone holder used in our proposed method is preferred to have long adjustable neck for easy direction to target area. In addition, its holder should not cover mobile phone's camera so that captured images will look natural. An example of suitable phone holders in our method is shown in Figure 4. Mobile phone with installed Photo booth will be attached to such phone holder where its camera should aim for target area (see Figure 1 for front view of such installment and Figure 5 for back view of such installment).

Figure 4. An example of suitable phone holder

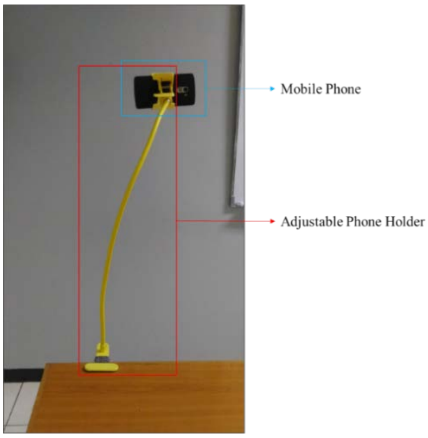

Figure 5. How mobile phone is attached to adjustable phone holder in our proposed method (back view)

3. RESULTS AND DISCUSSION

Four metrics are selected to evaluate proposed method: user perspective, functionality, battery power usage, and memory usage. The first metric is directly related to proposed method. It aims to measure the effectiveness of proposed method based on questionnaire-survey. In contrast, the other three are more focused on Photo booth (i.e., a mobile application that is a part of our method). Functionality aims to measure whether Photo booth is features are implemented correctly; battery power usage aims to measure the power efficiency of Photo booth; and memory usage aims to measure the efficiency of Photo booth in terms of resulted moments' size.

User perspectives are evaluated by performing a questionnaire survey. It involves 20 respondents gathered from our institution. Those respondents are undergraduate students who have participated at several organizational events. Each respondent was asked to rate 9 statements in 5-points Likert scale (1 refers to *strongly disagree*, 2 refers to *disagree*, 3 refers to *neutral*, 4 refers to *agree*, and 5 refers to *strongly agree*). To provide objective feedback, they are asked to use proposed method prior answering the survey.

The detail of survey statements can be seen in Table 1. The first five statements (S1-S5) are related to proposed method's benefits. S1-S3 are about method's benefits in general while S4 & S5 are about the benefits of Photo booth (i.e., mobile application developed for our proposed method). The last four statements (S6-S9) are also related to proposed method's benefits. However, these statements put more stress on comparing proposed method with other existing methods. S6 & S7 compare proposed method with surveillance system while S8 & S9 compare proposed method with video recording using mobile phone and its holder (assuming candid moments from recorded video can be cropped out as images).

Table 1. Survey Statements

ID	Statement
S1	Proposed method can be used to capture candid moments of an event
S2	Proposed method can capture candid moments using daily device
S3	Proposed method can capture candid moments without dedicated human resource since the moments will be taken automatically
S4	Photo booth is functionality is comprehensive to capture candid moments of an event
S5	Photo booth is User Interface (UI) is intuitive for users
S6	When compared to surveillance system, proposed method can capture moments with higher quality; mobile phone's camera typically has higher specification than surveillance system's
S7	When compared to surveillance system, proposed method is cheaper since no cost required for buying dedicated devices and installing them
S8	When compared to video recording using mobile phone and its holder, proposed method consumes less power since mobile phone is not required to take moments in every occasion.
S9	When compared to video recording using mobile phone and its holder, captured moments of proposed method consumes less memory considering images taken at some occasions commonly have smaller size than video which records all occasions

Figure 6 shows that all statements are rated positively. They are rated higher or equal to 3 (*neutral*) with most rates on either 4 (*agree*) or 5 (*strongly agree*). Hence, it can be stated that the benefits of our proposed method are also felt positively by respondents.

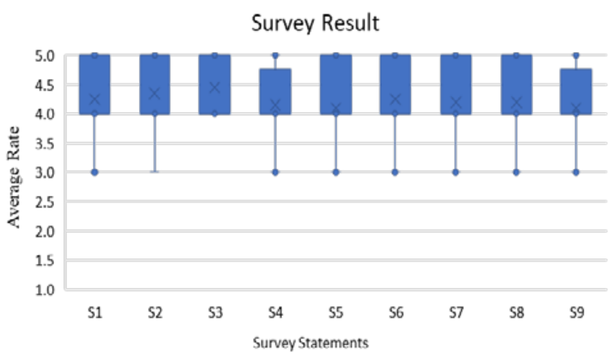

Figure 6. Questionnaire survey result. Horizontal axis represents survey statements while vertical axis represents their average rates.

Among survey statements, S3 gains the highest average rate (4.45 of 5) with no rates are lower than 4 (*agree*). In other words, the absence of dedicated human resource is the most prominent benefit for respondents. Such finding is natural considering dedicated human resource is costly to hire. Following S3, S2 is assigned with the 2nd highest average rate (4.35 of 5). Further observation shows that the use of daily device is an important aspect to lead practical use; dedicated multimedia device is often hard to find in daily life.

In contrast, S5 gains the lowest average rate (4.1 of 5) even though their rates still tend to agree (higher than 4). Further observation shows that buttons on Photo booth is main UI (see Figure 3) are not intuitive enough due to the inexistence of button text. S9 also gains the lowest rate (which is as low as S5's) since some respondents argued that images taken will take more memory than recorded video if defined image-capturing interval is extremely short.

It is important to note that S4 and S9 gain the lowest number of *strongly agree* (see Figure 6 where both statements are assigned with narrower and lower box-plots). They only get 5 rates of *strongly agree* each. Such phenomenon occurs on S4 since Photo booth is cannot work as a background application. Some respondents argued that they are still required to open other applications while taking candid moments in unexpected cases. On S9, such phenomenon occurs since total image size could be higher than video size if the number of captured images is high.

Two additional findings can be stated from S6-S9 result shown in Table 1 (which are agreed by most respondents). First, our proposed method captures moments with higher quality (S6) and is more affordable in terms of cost (S7) than surveillance system. Second, our proposed method consumes less power and memory (for storing captured moments) when compared to video recording using mobile phone and its holder (i.e., an alternative method to capture candid moments without the presence of Photo booth).

Photo booth, which is a part of our proposed method, is evaluated from three perspectives: functionality, battery power usage, and memory usage. In terms of functionality, it is evaluated based on black-box testing. Such testing involves 12 Photo booths is aspects which detail can be seen on Table 2. A1, A2, and A4 are about initial UI; A3 is about tutorial UI; A5 is about *About Us* UI; A6-A8 are about setting UI; and A9-A12 are about main UI.

Battery power usage of Photo booth is evaluated using three mechanisms. The first mechanism measures whether image-capturing interval affects battery power usage. The second mechanism measures whether proposed method consumes less battery power than video recording (i.e., an alternative method to capture candid moments without Photo booth). The third mechanism measures how much battery power exclusively used to run Photo booth (without considering battery power to maintain the mobile device running).

Table 2. Photo booth's Evaluated Aspects

ID	Evaluated Aspects
A1	Start button at initial UI
A2	Tutorial button at initial UI
A3	Back button at tutorial UI
A4	*About Us* button at initial UI
A5	Back button at *About Us* UI
A6	Running duration input at Figure 2
A7	Image-capturing interval input at Figure 2
A8	Save button at Figure 2
A9	Setting button at Figure 3
A10	Start button at Figure 3
A11	Stop button at Figure 3 (that only occurs when Photo booth is running to capture moments)
A12	Gallery button at Figure 3

The first mechanism involves five scenarios derived from proposed method where the only difference among them is image-capturing interval; their intervals are assigned with 15, 10, 5, 2, and 1 minute(s) respectively. Each scenario was performed on two mobile phones (which are Andromax I65D2G and Lenovo VIBE K4 Note) by subtracting remaining battery power (in percentage) prior and upon running Photo booth for 30 minutes. To avoid misleading results, two conditions were set uniformly for all runs. First, mobile phone's camera was aimed at an empty room where no moving objects are involved. This condition assures no extra power is spent in automated camera focus. Second, both phones were set to airplane mode. This condition assures no extra power is spent in searching signal or receiving internet-based notifications.

Figure 7 shows that battery usage for all scenarios on two mobile phones are considerably constant (about 6% per run) regardless of defined image-capturing interval. Hence, it can be stated that image-capturing interval does not affect battery usage significantly.

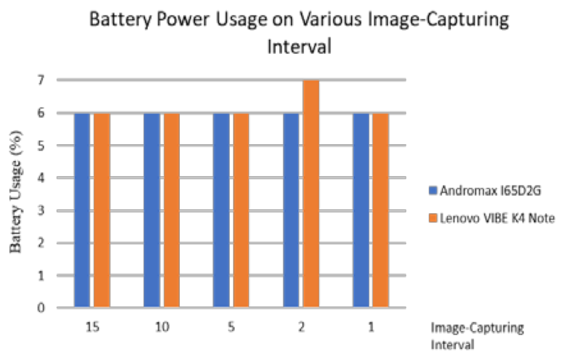

Figure 7. Battery power usage on various image-capturing interval. Horizontal axis represents evaluated image-capturing interval while vertical axis represents battery usage in percentage.

The second mechanism involves 2 scenarios; one of them is our proposed method with 1 minute as image-capturing interval and the other one is video recording. Both scenarios were set under similar setting as the first mechanism.

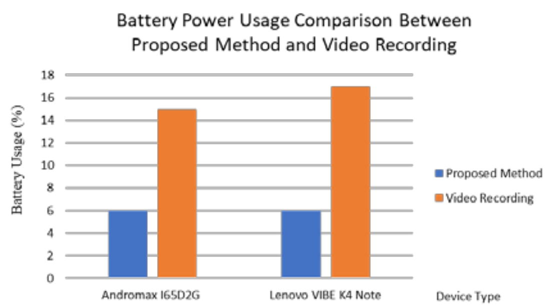

Figure 8. Battery power usage comparison between proposed method and video recording. Device types are shown at horizontal axis and their respective battery usage is shown at vertical axis.

As seen in Figure 8, proposed method consumes less battery power than video recording. On Andromax I65D2G, it only takes about 40% of total power used for video recording; whereas, on Lenovo VIBE K4 Note, it only takes about 35.294%.

The third mechanism involves five scenarios described on the first mechanism and an idle scenario. Idle scenario aims to measure how much battery power used only to maintain the mobile device running. To measure battery power exclusively used for Photo booth, battery usage from former scenarios are then subtracted with battery usage from idle scenario. For comparison purpose, idle scenario also performed under airplane mode.

According to our observation, idle scenario takes 4% battery on Andromax I65D2G and 3% battery on Lenovo VIBE K4 Note. Hence, considering the first five scenarios take about 6% on both devices, it can be stated that Photo booth is power-efficient; it only exclusively takes about 2% battery power.

Evaluation regarding memory usage is split to two parts. The first part measures memory size growth in accordance with image-capturing interval; whereas the second part measures how large is the difference between proposed method and video recording (i.e., an alternative method to capture candid moments without Photo booth) in terms of memory usage for storing captured moments.

Image size growth is measured by involving five derived scenarios from proposed method. These scenarios are only different in terms of image-capturing interval; their intervals are assigned with 15, 10, 5, 2, and 1 minute(s) respectively. Each scenario will be run under two mobile phones (i.e., Andromax I65D2G and Lenovo VIBE K4 Note) wherein, for each run, mobile phone's camera was aimed at an empty room with no moving objects (to assure no extra power is spent in automated camera focus).

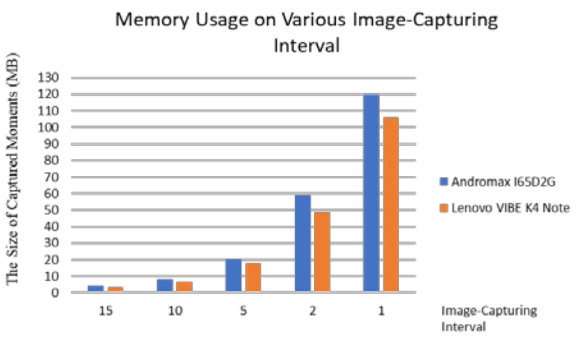

Figure 9. Memory usage on various image-capturing interval. Image-capturing intervals are shown at horizontal axis while their respective size of captured moments is shown at vertical axis.

Two findings can be deducted from comparing aforementioned scenarios (see Figure 9). First, image-capturing interval is inversely proportional to memory size; higher interval leads to smaller memory size due to limited number of images taken. Second, memory size depends on the quality of captured moments. As seen on Figure 9, Lenovo VIBE K4 Note generates smaller size than Andromax I65D2G due to their different camera specification.

The difference between proposed method and video recording in terms of memory usage for storing captured moments is measured by comparing the size of captured images from proposed method (utilizing 1 minute as image-capturing interval) with the size of recorded video from video recording. Both proposed method and video recording were set under similar setting as the first evaluation part.

Figure 10 depicts that proposed method is far more efficient than video recording. Captured images from proposed method only consumes 120 & 106 megabytes of data for Andromax I65D2G & Lenovo VIBE K4 Note respectively whereas recorded video from video recording consumes 4.085 & 3.624 gigabytes. Proportionally speaking, proposed method could save up to 99% allocated memory of recorded video.

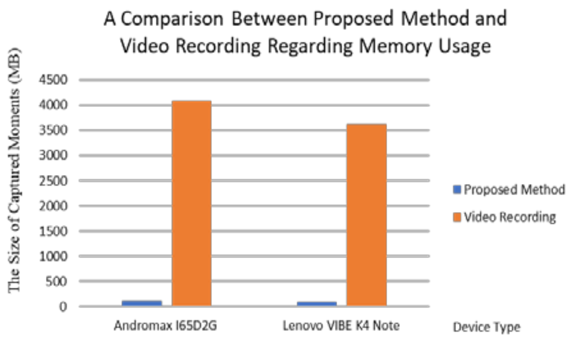

Figure 10. A comparison between proposed method and video recording regarding memory usage. Horizontal axis represents device types while vertical axis represents memory usage.

4. CONCLUSION

This paper proposes a method to capture candid moments of a particular event without allocating dedicated human resource. Unique to this method, it utilizes daily device (i.e., mobile phone) with an application (named Photo booth) and phone holder in mind. According to evaluation, five findings can be deducted. First, the benefits of proposed method are positively agreed by respondents. Second, Photo booth's functionality works as it should be. Third, Photo booth consumes less battery power and memory size than conventional video recording. Third, image-capturing interval does not significantly affect battery usage. Fourth, image-capturing interval is inversely proportional to memory size. Fifth, Photo booth is power-efficient since it only exclusively takes about 2% battery power.

For future work, we plan to provide more intuitive UI for Photo booth (responding S5 survey result) and enable Photo booth works in background (responding S4 survey result). Further, we also plan to conduct a more comprehensive evaluation involving larger number of respondents. Such evaluation is expected to provide broader feedback toward proposed method.

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