A study of the tablet measuring application to determined the distances of observed trails at crime scene

การศึกษาโปรแกรมการวัดจากแท็บเล็ตเพื่อระบุระยะของร่องรอยที่พบในสถานที่เกิดเหตุ

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ABSTRACT

In documenting the distance in a crime scene relating to a traffic accident, an officer routinely uses a measuring tape to measure the distance such as a skid mark and record the data into a notebook. The results of evidence are then sent to an officer for investigation and calculation. In this study, an alternative method that can shorten the measuring time is proposed. An iPad application to measure the distance varied from short to long distances under the pre-determined values was studied, Measure Tape HD between iOS and android operating, iHandy on iOS operating were chosen for studied. The results were collected and compared with the actual distances measured by a measuring tape. The measurements by the tablet application were found to be statistically reliable within a distance range of 1.0 to 5.0 m. Results of this work suggest that the iPad application can be applied for measuring distance in the crime scene.

บทคัดย่อ

ในการตรวจวัดระยะทางในสถานที่เกิดเหตุเกี่ยวข้องกับอุบัติเหตุทางถนน เจ้าหน้าที่ใช้ตลับเมตรเพื่อวัดระยะทางในสถานที่เกิดเหตุ เช่น การลื่นไถล และทำการเก็บข้อมูลของหลักฐานในคอมพิวเตอร์พกพา เพื่อนำไปคำนวณ หรือประกอบการสืบสวน ในการศึกษานี้ ได้ใช้อุปกรณ์และโปรแกรมของไอแพด ในการทำการทดลองวัดระยะ เริ่มจากการวัดระยะสั้น ไปถึงระยะยาวภายใต้ค่าที่กำหนด โดยเลือกสองโปรแกรมในการศึกษาได้แก่ โปรแกรมเมเชอร์ เทป เอชดี ในระบบปฏิบัติการไอโอเอสและแอนดรอยด์ และ โปรแกรมไอแฮนดี้ ในระบบปฏิบัติการแอนดรอยด์ ทำการเก็บข้อมูล และเปรียบเทียบกับระยะทางที่ถูกตั้งไว้ตามจริงโดยตลับเมตร ผลการทดลองได้แสดงถึงค่าทางสถิติซึ่งทำการวัดด้วยโปรแกรมของอุปกรณ์ไอแพด มีความน่าเชื่อถือในระยะ 1.0 ถึง 5.0 เมตร จึงสรุปได้ว่า ผลการศึกษานี้แสดงให้เห็นว่าสามารถนำโปรแกรมของอุปกรณ์ไอแพดมาประยุกต์ใช้ในการตรวจวัดระยะทางในสถานที่เกิดเหตุได้

Keywords: Traffic accident, Measuring Tape, Application

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Introduction

Initially, electronic devices were only used for text messages and entertainments. But nowadays electronic devices can be used for many different objectives. The iPad is a tablet device of the Apple Company. It uses iOS system to work and has a size as big as a book. Therefore, it is so comfortable and offers various applications, including Wi-Fi, an accelerometer, optional 3G and GPS (Gómez-Miralles L et al., 2012; Mashman W et al., 2011). Currently, there are very few works reporting on the use of iPad in medical and other applications. The user is able to work collaboratively through the application in iPad such as applications for plastic surgery trainee (Freshwater MF et al., 2011). However for effective use of tablets, different applications should be downloaded. Thus, there will be advantages if these applications can be used for measurement in the forensic cases. Applications of tablets in quantitative analysis are a new research in forensic science. For example, it can be applies for measuring the distance of tracks, a range of the trajectories, or it can be a tool for other checking (Bicen H et al., 2013). A smart device has not been applied for a forensic case in Thailand. The conventional tools such as tape measures are still used in the investigation unit. The record data are collected for security in report-paper or books. The security can be improved with a smart device. For example, iPad settings allow the owner to prevent unauthorized using of iPad and data. A user can set a PIN (Personal Identification Number Code) code on the device in order to protect outsider user. It calls Passcode such as a four-digit, numeric code and alphabet (Hartnett E et al., 2011; Hoog A et al., 2011; Daniel LE et al., 2012).

Objective of the study

The aim of this study was to compare the distances measured by a measuring tape **(**a standard technique**)**, ordinarily used to measure the distance in a crime scene, and a smart device with a measure application reliantly**.**

Materials and methods

The study was performed mock cases by measuring the distance by the common tools, measuring tape. The distance was also measuring using the application in a smart device and the data was kept in the document file. The distance measurement applications are available in both free of charge and purchase. The application download was the legitimate for using in this study. The statistics of the measurements from various scenarios based on actual measured distances were performed.

Instruments

For the measurement including the measuring tape (the standard technique) and the smart devices were used. The 50-m measuring tape, the smart devices (iPad Model) with iOS operating system and the smart devices (Samsung galaxy S5 Model) with Android operating system, were used in this study.

Measurements

The details of cases require the skid mark or wheel-track on the street and various distances are in a scene, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5 and 5.0 m. These numbers were covered from low to far length. To produce a

mock distance, the black tapes were set on the street in various distances along the fiberglass measuring tape (Figure 1). Each test was measured ten times with two smart devices by ten volunteers had different ages and gender. Each volunteer measured ten times per one distance from 0.5 - 5.0 m. All data were kept in the document file. The volunteers were trained to measure the distances of mock cases by two smart devices including iPad and Samsung galaxy S5. First, open the application and choose mode of measuring. Second, hold the smart device and use the line on screen for point to the distance, the screen show numerical distances and record the results (Figure 2,3). The results were compared between the actual distance with the measuring tape, the standard technique for investigating and the measured distance by the Measure Tape HD application of the smart devices.

Figure 1 The black tapes set on the street in various distances along the fiberglass measuring tape.

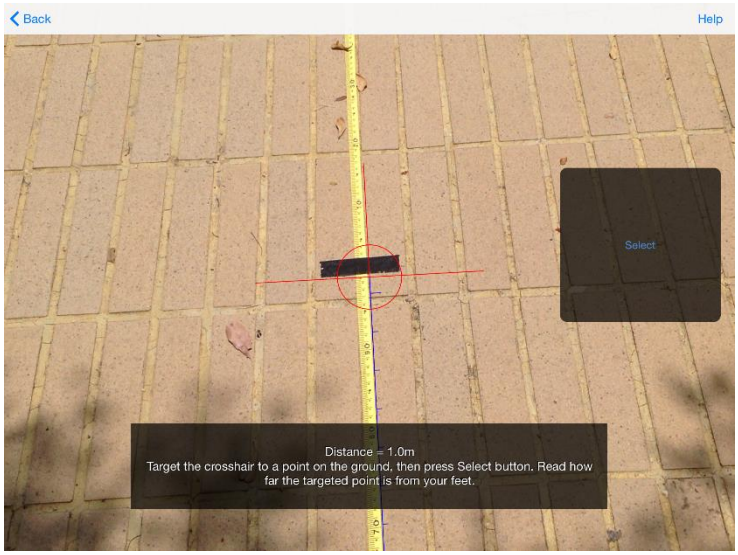

Figure 2 The line for pointing and numerical distances show on screen (Measure Tape HD application).

Figure 3 The line for pointing and numerical distances show on screen (iHandy application).

Statistical analysis

Data processing and statistical analysis were done by Prism, version 5.0 (GraphPad Software Inc., San Diego, CA, USA). The analysis of variance (t-test) with Paired-Sample T test was used.

Results

Distance determination by the iPad applications

The distances of 0.5-5.0 m were measured by two applications of iPad, the Measure Tape HD and the iHandy Ruler, and compared. The results showed that at the distances of 1.0, 1.5, 2.0, 2.5, 3.0, 4.5 and 5.0 m the Measure Tape HD application could determine the distances accurately ($P<0.05$). But at the distances of 0.5 m this application determined the distance longer than the actual value, while at the distances of 3.5 and 4.0 m, the application determined the distances shorter than the actual values (Table 1). For the iHandy Ruler application, only at the distances of 1.0, 2.0, 3.0 and 4.0 m could be determined accurately by this application ($P<0.05$). The remaining distances were determined with incorrect distances, either longer or shorter distances than the actual values (Table 2).

Table 1 Distances determination by the Measure Tape HD application of iPad.

Control (m)	Mean ± S.D.	P-value
0.5	0.550 ± 0.053	0.0150*
1.0	1.010 ± 0.057	0.5911
1.5	1.500 ± 0.047	1.0000
2.0	1.970 ± 0.067	0.1934
2.5	2.450 ± 0.085	0.0957
3.0	2.940 ± 0.084	0.0510
3.5	3.410 ± 0.074	0.0039*
4.0	3.880 ± 0.123	0.0130*
4.5	4.420 ± 0.132	0.0868
5.0	4.930 ± 0.134	0.1323

Table 2 Distances determination by the iHandy Ruler application of iPad.

Control (m)	Mean ± S.D.	P-value
0.5	0.540 ± 0.052	0.0368*
1.0	1.060 ± 0.084	0.0510
1.5	1.580 ± 0.092	0.0224*
2.0	2.060 ± 0.084	0.0510
2.5	2.570 ± 0.082	0.0248*
3.0	3.050 ± 0.071	0.0522
3.5	3.560 ± 0.070	0.0239*
4.0	4.000 ± 0.047	1.0000
4.5	4.560 ± 0.052	0.0051*
5.0	5.110 ± 0.099	0.0067*

Distance determination by the Samsung Galaxy S5 application

For the Measure Tape HD application of Samsung galaxy S5, the results showed that only the distance of 1.5 m was measured with the accurate value ($P<0.05$), while the other distances were determined with the inaccurate values (Table 3).

Taking all results together, this work suggested that among three measuring conditions, the Measure Tape HD application of iPad provided the most accurate measurement, followed by the iHandy Ruler application of iPad. However, the Measure Tape HD application of Samsung Galaxy S5 yielded the unaccepted measuring values. They are proved by R-Square. Each R-Square of application was approached to one, it would be accepted but in fact, there were only two usable applications of iPad (Figure 4). Thus, in addition to the application type, the smart phone band is importance for the accurate determination of the distance.

Table 3 Distances determination by the Measure Tape HD application of Samsung galaxy S5.

Control (m)	Mean ± S.D.	P-value
0.5	0.550 ± 0.053	0.0150*
1.0	0.960 ± 0.052	0.0368*
1.5	1.440 ± 0.108	0.1114
2.0	1.820 ± 0.123	0.0012*
2.5	2.250 ± 0.127	0.0002*
3.0	2.750 ± 0.127	0.0002*
3.5	3.240 ± 0.126	0.0001*
4.0	3.760 ± 0.126	0.0002*
4.5	4.180 ± 0.166	< 0.0001*
5.0	4.690 ± 0.166	< 0.0001*

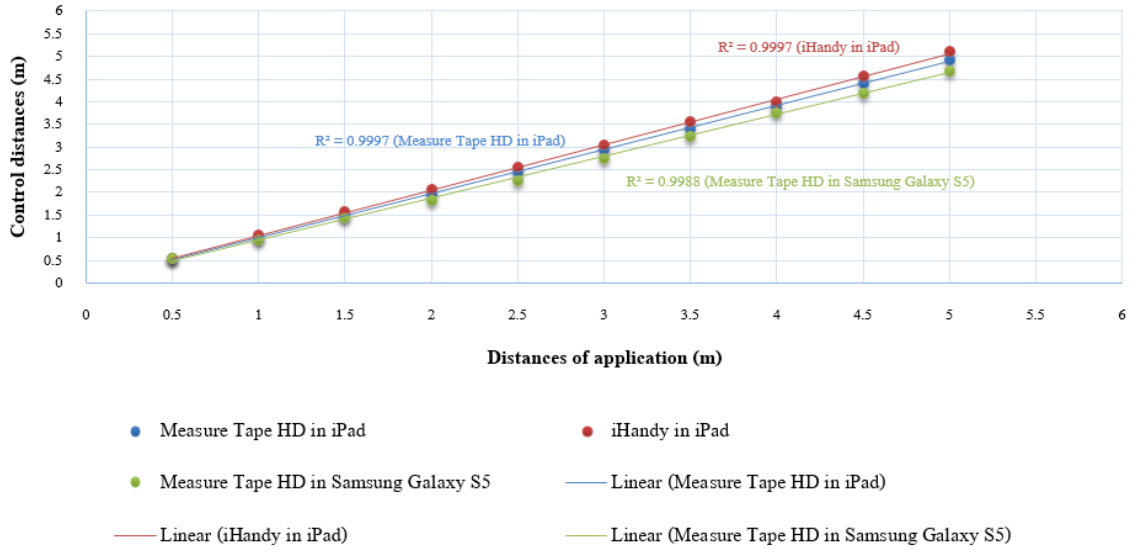

Figure 4 R-Square of distances determination by the application.

Discussion

The study used the Measure Tape HD application of iPad to measure the distance and set control by the tape measure. Most distances were accurately determined by this application of iPad, except at 0.5, 3.5 and 4.0 m. The iPad application could not detect a distance of 0.5 m as the measured distance was greater than the actual value. On the other hand, at 3.5 and 4.0 m the measured distances were lower than the actual values. These inaccurate determination could be explained by statistical results. This function's application was easy to use and had stable numerical showing.

For the use of the iHandy Ruler application of iPad to determine the distance, only four distances were determined accurately; 1.0, 2.0, 3.0 and 4.0 m. The remaining values were either longer or shorter than the actual values, which were likely caused by the numerical distance of screen showed the unstable result and the function of application was hard for measuring.

For the use of Measure Tape HD application of Samsung Galaxy S5, only one distance at 1.5 m was accurately measured. The rest of distance determination was inaccurate, which suggested that the android system phone could not measure the distances correctly because the mobile's screen was small and the holding in each person was affect to measurements.

The objectives of this study were to compare the various distances between the actual distances set by measuring tape and using the measuring application on devices such as iPad and Samsung series.

This measurement shows that the experimental results with device application, which is slightly discrepancy in excess of 1 meter. While, there were many deviation in a distance of less than 1 meter. Depending on the characteristics of holding device. The results from Measure Tape HD application in iPad were better than iHandy Ruler application in iPad and Measure Tape HD application in Samsung Galaxy S5. For the distances in excess of 1 meter gave the better than the other application and device.

In term of interfere factor found in this study, the holding in each person was affect to measurements, the height and the light did not affect the experiments and can use iPad device to help in the investigation.

This study of distance measurements by smart device has not yet been conducted in other smart device and other distances. The study could potentially be adjusted in the future by modifying the distance measurement to find better applications on smart devices to help in the investigation, to eliminate interfere factors or the limitations in this study and benefit the forensic method of investigation in Thailand.

Conclusion

The results of this study indicate the stability and validity of application in measuring the distances of traffic accident and evidences. In forensic case, many devices were used for investigation. Reducing the devices could optimize the performance of officials that were important for working, which this method could be suggested to the forensic officials.

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