

Mobile Crime Scene Applications: An Evaluation of Their Use and Future Direction

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Abstract

Following the release of the National Academy of Sciences' report: *Strengthening Forensic Science in the United States: A Path Forward*, the forensic community has been striving to make improvements and develop plans to follow the recommendations that it outlines [1]. In the field of crime scene investigation, a new technology is emerging in order to bring standardization and speed to the discipline; mobile crime scene applications for tablets and smartphones. A qualitative evaluation of a mobile crime scene app's performance, considering defined criteria while documenting mock crime scenes was made. Experts were questioned regarding their current approaches to scene documentation and reporting, as well as their preferences and technological proficiencies. After recording mock crime scenes, the app was qualitatively assessed with respects to each established criteria. In its current state, the app will not supplant any existing field instruments, with the exception of paper and stencils. While incorporating photos in one's field notes is convenient, the iPad's camera cannot be substituted for the traditional digital single lens reflex cameras commonly used in crime scene investigation. If the department has to purchase the equipment and the app, then it may be cost prohibitive. However, if the app reduces the amount of time the crime scene investigator spends documenting a scene or entering data back at the office, than reduced labor costs may in time offset equipment costs. It was recognized that while the app provided streamlining of case notes, many alterations and/or additions could be made to create the ideal crime scene documentation tool. Future studies with this application hope to analyze the use of this app in more real world settings and in the hands of working crime scene investigators. Also, there are many security concerns that fall into the realm of digital forensics and should be explored further. There are other applications on

the market which also claim to improve note-taking and documentation, and future studies hope to compare and contrast these apps with the one evaluated here.

Introduction

With many forensic science disciplines coming under scrutiny in recent years, it has become the objective of the forensic community to improve and standardize as many of the current practices as possible [1]. Since crime scene investigation is a subjective field due to the large amount of investigator discretion, it stands to face strong criticism in the courtroom. It is also becoming one of the slower steps in the analysis process; while DNA and chemistry technologies are getting faster and faster, the human role in analysis is more difficult to expedite. There is also disparity in evidence collection and reporting methods between agencies. Emerging technologies should therefore focus on reducing the time spent documenting a scene and streamlining and standardizing the documentation and collection process. To be effective, a technology should also be straightforward to learn and implement, as well as cost efficient. These are the categories that will be considered when evaluating the crime scene app. The question this research will seek to answer is: Will crime scene apps improve the field of crime scene investigation?

Features of MobileCSI™

The app that was examined in this study was MobileCSI™ by Siamese Systems Incorporated. This app is designed for use on various smartphones and tablets [2]. In this case, an Apple iPad 2 was used. When the app is opened, after entering a user name and password, the home screen is the Case Library, where the user can access any previous case or open a new one (Fig. 1). When a new case is opened, a box pops up with spaces to fill in case number, location, reporting official, time/date of arrival, time/date of departure, weather conditions, and comments

(Fig. 2). The app automatically fills in the reporting official and time/date of arrival. It also auto-fills the address and weather conditions if the device has internet access. Once a new case is opened, the user is presented with a blank screen. From here, the investigator can take notes, draw a sketch, take pictures, or open an evidence log form. All of these options are represented as icons along the side of the screen (Fig 3).

To take notes, the user inserts a text box anywhere on the screen and can begin typing. There are many fonts, colors, and sizes from which to choose (Figs. 4 and 5). These text boxes can be moved around the screen after they are made. The sketching functions are comprised of the basic drawing options one would see in software such as Microsoft Paint; squares, circles, straight lines, arrows, a pencil, and an eraser (Fig. 6). There are also a variety of colors and pen-point widths available. Users can also insert scene-mapping pictures into their sketches. These include many crime-related images such as guns, drugs, blood, and fingerprints, as well as common scene images like trees and cars (Fig. 7). Once placed onto the sketch, pictures can be rotated, resized, and moved around.

Opening a new evidence log form attaches the evidence form to the front of the page it was opened from. This form has fields for photo placard number, location, evidence type, whether it was collected and by whom, seizure tag number, and comments (Fig. 8). The evidence type field contains a drop-down menu with many options as well as the preferred collection method (Fig. 9). Also, it was suggested by the company to include evidence pictures into the case notes after each evidence log form (Fig. 10).

Once the user is ready to export their case notes, they have the option to email individual pages or to email the whole case as a PDF. Also exported with the PDF are a chain of custody

form and a property receipt containing the information from the evidence log forms.

Experimental

A set of categories was established – standardization, ease of learning and use, speed, and cost – and used to evaluate MobileCSI's™ performance while processing scenes. Several mock crime scenes were processed using the app for documentation, to attain both a general assessment of the app's performance as well as to gain familiarity with all of the app's functions. These scenes were processed by a different person than the one who set them up. They were all one-room scenes with varying amounts of evidence.

Standardization was defined as any features of the app that would remove disparity across all of the various crime scene investigation agencies – any feature that would provide uniformity across the board. Ease of learning and use was evaluated by the author's experience in learning and using the app, as well as a local investigator's (L.I.) brief exploration of the app. Speed was measured by noting the time on the iPad at the start of note-taking and at the end of sketching/note-taking while processing mock crime scenes. Cost was evaluated by taking the price of the app, tablet, and data plan into consideration along with a known investigator hourly wage and any equipment that may be replaced by the app.

Four more mock crime scenes were then processed and timed; once with the app, and once without. Times were compared to determine if there was a significant difference in the amount of time required to document a scene using the app vs. using pen and paper. These four scenes were set up and processed by the same person; they were very straightforward with two or three pieces of evidence each. When processing these scenes, no general photography was taken, nor a full scene search/walk through. Since only the documentation process was to be compared, steps that would be the exact same in either method were skipped. The steps that were included

were note-taking, sketching (which included taking measurements), and evidence photography (when using the app).

Scene 1 was a single room, with several pieces of furniture, one decedent, and a hammer lying next to the body as a potential murder weapon. Notes and measurements were taken, all furniture measurements were recorded in a furniture log, the body was measured into the scene using a baseline for reference, and a sketch was drawn. When processing the scene with the app, evidence photography was included in the notes and the evidence logs were filled out. Scene 2 was a single room with only a few pieces of furniture, one decedent, a handgun, and two bullet casings. This scene was processed in the same way as the first. Scene 3 was an outdoor scene with all the evidence confined to a gazebo. There was a blood pool and drip trail, and a screwdriver as a possible murder weapon. Notes and measurements were taken, and two sketches were made – one of the overall property and one of the gazebo and evidence. This scene was also processed in the same way as Scene 1. Scene 4 was a single room with several pieces of furniture, a broken window, and possible latent prints in two different places. Notes and measurements were taken, a sketch was made, and traditional crime scene photography was taken.

Finally, pictures were taken in different conditions commonly encountered in real crime scenes, including low lighting, situations when a macro lens would be used, and depth of field considerations. The iPad's camera was compared to a digital Nikon D40 single-lens-reflex (SLR) camera. The settings used for each photo taken with the digital camera were chosen manually, while the iPad's camera auto-adjusts its settings based on the amount of light in a room. The settings from each camera were compared in addition to the overall quality of the photos.

Results

Standardization

The app's PDF formatting and inclusion of chain of custody and property receipt forms streamlines the look of case notes and the chain of custody process, which will save some time and therefore, money. The suggested evidence collection procedures will standardize how evidence is collected by all agencies using MobileCSI™. Because the note-taking is free-form typing, the app does not do anything to standardize the way case notes are taken. It will, however, make notes more legible, especially for those with handwriting that is difficult to read.

Ease of Learning and Use

The app itself is not entirely intuitive, but when an agency purchases the app, a representative from the company can give a tutorial via webcast. The pictures in the menu are mostly self-explanatory, and could be understood quickly by some trial and error. Anyone who owns and is familiar with using a tablet or smartphone should have little trouble becoming acquainted with the app.

Speed

MobileCSI™ was not found to reduce time spent at a crime scene. Documentation of a crime scene took, on average, 1.63 times longer when using the app vs. using pen and paper (Table 1). This does not, however, take into account the possibility of saving time further down the line. It should be noted that prior to conducting this study, the researcher had only classroom experience processing crime scenes with technology and with traditional methods.

Table 1. Comparison of time taken to document crime scenes with and without using MobileCSI™

	MobileCSI™	Pen and paper
Scene 1	56 min	39 min
Scene 2	54 min	34 min
Scene 3	36 min	23 min
Scene 4	131 min	68 min

Cost

The total cost of implementing a tablet-based application would vary greatly based on the brand of tablet, the amount of data storage, and the data plan purchased. Here, the cost was determined assuming that an iPad would be the platform used. The cost of a 16GB iPad 2 with Wi-Fi and 3G capabilities is \$529. The Wi-Fi and data plan would be necessary for the app to auto-fill the weather and location, and to export case notes. The application costs \$100, so it would cost an agency \$629 per investigator [3]. Salary for a local department’s investigators is \$22.25 per hour. Crime scenes often put investigators into overtime which is time and a half- \$33.37. If an investigator is at a scene for 12 hours, and the last 4 hours are considered overtime, the department will pay him over \$311. If using the app causes his investigation to take 1.63 times longer, the department will now owe him over \$563 for processing the same scene. Total cost would depend on the number of investigators in the department; larger departments with more employees would have to spend much more than smaller departments. Because the iPad’s camera settings cannot be changed as specifically as a digital camera’s, and it does not have a flash function, it could not replace the digital SLR cameras that are most commonly used in crime scene photography (Table 2). Comparisons of the iPad camera vs. a digital SLR camera can be seen in Figures 11-18. Since the iPad’s camera cannot replace current cameras, adding

MobileCSI™ to a department’s repertoire would not offset the cost of traditional cameras and camera accessories. The iPad could possibly replace laptops used by some departments in the field, depending on the format desired or software used.

Table 2. Comparison of iPad and digital camera settings in different conditions.

	Digital SLR Camera			iPad Camera		
	F-Stop	Exposure Time	ISO	F-Stop	Exposure Time	ISO
Depth of Field	16	1/30 sec	400	2.4	1/15 sec	64
Low Light	11	1/40 sec	400	2.4	1/15 sec	800
Macro Lens (iPad zoomed)	5.6	0.62 sec	400	2.4	1/15 sec	800

Discussion

While the app streamlines the look of case notes by exporting them in the same PDF format each time, this does not have any effect on how each individual agency submits data. Agencies will still have their own system that notes need to be entered into, and different requirements for report-writing, so the app is only standardizing one small piece of crime scene investigation. Something else that must be considered is that sometimes there are explanations for discrepancies in evidence collection. Sometimes the investigator may have the time and space to let bloody clothing dry before collection, and other times she may not. Some departments may have access to Faraday bags for cell phone collection, while others may use foil (Table 3). Having to stray from the suggested method of collection would also bring up questions in court (Fig. 9).

Table 3. Difference in evidence collection methods between the app and two local law enforcement agencies.

Evidence	Collection Protocol from App	Collection Protocol from Local Agency A	Collection Protocol from Local Agency B
Dried blood spot	Collect sample with clean razor blade and place in paper envelope	Swab with sterile swab moistened with distilled water, place in swab box and seal	Swab with moistened sterile gauze pad or swab, air-dry and package in paper packaging
Wet blood spot	Collect with a clean Q-tip	Swab with sterile swab, place in swab box and seal	Swab with moistened sterile gauze pad or swab, air-dry and package in paper packaging
Bone	Collect in paper envelope	Boxed and sealed	-----
Spent cartridge	Place in paper envelope	Placed in casing box and sealed	Wrapped separately in packaging material and placed in sealed container, ie. film canister
Spent cartridge with latent prints	Collect with the aid of a pencil and immobilize	Placed in casing box and sealed	Placed in sealed container, ie. film canister
Clothing	Collect in paper envelope	1 item per paper bag after drying	Wrapped separately, after drying, in clean brown paper
Cell phone	Wrap in 3 layers of foil/foil bag	Plastic bag	Wrap in 3 layers of foil; iPhone 4 and above placed in a case before wrapping
Fire debris remains	Collect in paper envelope first and then place in plastic bag	Individual arson cans	Clean metal paint can
Knife	Collect in paper bag	Knife box	Puncture-resistant container
Powders	Collect in plastic bag	Plastic specimen cups with screw top lids	Place in vial or plastic bag

The app does not help with the note-taking process unless you prefer to type your notes rather than hand-write them. Since the investigator is still typing onto a blank page, this is really no different than writing on blank paper. However, this could be beneficial for those whose handwriting is difficult to read (Figs.22-27). If an investigator was out of town or retired and someone else needed to access their notes, it would be much easier for them to understand.

Even though the app makes scene documentation take longer, this does not mean it will not speed up the crime scene investigation process as a whole. Whether or not it will cut back on the total time spent working on a case will depend on each agency's specific protocols. If a protocol requires investigators to upload their notes electronically, and they take their notes by

hand, this will take up time they could be using for something more productive. In this case, using the app could be faster.

Compared to some of the instruments found in a crime lab, \$629 is not an excessive amount to spend on a piece of equipment. This amount does add up when it is considered that each investigator would need their own tablet. The app is programmed so that the reporting official and evidence collection fields are auto-filled with the name of the person who registered the software and cannot be edited. This could be corrected for in each person's field notes, but could present a problem with chain of custody records and in court. Even if two investigators worked as partners investigating scenes together, each one would need his own tablet to ensure that the official records were correct. If an investigator collects a piece of evidence, it needs to be entered into their app. They could not speed up the process by allowing one investigator to collect evidence while the other logged it and took notes. Depending on the number of crime scene investigators employed by a department, implementing this app could be very pricey.

Even though the quality of the pictures taken with the iPad is perfectly adequate for many conditions, there are many special circumstances presented in crime scene investigation that the iPad's camera could not handle. Some of these include low lighting, situations that would require a macro lens, and some depth of field considerations. Probably the biggest detriment of the iPad's camera is that it does not have a flash function, and while there are external flashes available, they are camera brand or model specific [4]. Focusing on particular areas while preparing to take the photograph (by tapping the screen where you want the camera to focus) will adjust the iPad camera's exposure time and ISO speed, but the F-stop is locked at 2.4 (Table 2, Figs. 19-21). Since the shutter speed and exposure time cannot be manually changed, it would be

impossible to use the painting with light method and likely impossible to capture some common techniques for blood or fingerprint development [5].

To improve upon the application and further advance the field of crime scene investigation, particularly with regards to the aforementioned criteria, many changes could be made in addition to tweaking some of the drawbacks stated previously. This subject was discussed with local investigators (L.I.s) and several ideas came to light. First, the notes pages should include customizable worksheets. Investigators often write up their own worksheets that they can take into the field so that they know they are not forgetting anything in their notes. L.I. created such a worksheet, but has since abandoned it because paper worksheets are too rigid; they don't account for the wide range of scenes investigators may encounter. To have a template that does cover all possibilities would mean a very long document that would often be unnecessary. Because each case isn't going to have every scenario, the overly long form would be both irritating and a waste of paper. Integrating a worksheet of this kind into the software would not only reduce paper waste but standardize the format and increase the quality of case notes.

Second, sketching functions could be more customizable. Scene mapping images should be able to be inverted. Even though it is only meant to be a rough sketch, it is still inconvenient when the drop-in images face the wrong direction. When placing something like a hammer or a car, orientation within the scene is important (Fig. 25). Extra time must be taken to make sure the notes accurately describe the correct orientation.

Third, when using text boxes to place measurements on a sketch, the boxes cannot be rotated, they can only be placed horizontally. This makes it more difficult to discern exactly which

line each measurement is describing (Fig. 25). Being able to rotate each text box to fit to exactly what it was labeling would make the sketch more legible and accurate.

Finally, the L.I.s suggested integrating audio recordings into the app, or having talk to text capabilities – which would be even more convenient. Again, this could come down to investigator’s preference, but would most likely be faster than writing or typing.

Conclusion

With its current capabilities, MobileCSI™ would most likely not be a viable option for many departments. At this time, the app most greatly benefits individuals who prefer to type rather than hand-write notes and sketches. If a department had already assigned iPads to their officers in lieu of laptops, downloading the app could be a more viable option.

Future studies should evaluate the app in more real life circumstances and in the hands of working professionals in the field. The authors plan to survey professionals and forensic science students to establish each group’s technology proficiencies and preferences. This will help to predict how successfully crime scene apps may be accepted by investigators. It would also be useful to compare MobileCSI™ to the other crime scene apps on the market, in order to see if there is an app that meets all of the criteria mentioned in this paper. Research could be done to see if using a talk to text application would be faster than typing. Also more work with the app in different locations could determine the accuracy of the GPS function. Finally, there are many security concerns that should be investigated including data backup to the cloud and exporting case notes via email. The L.I.s’ agency does not currently have a policy regarding the sending of case material via email, but others may.

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APPENDIX



Fig. 1. Screenshot of Case Library.

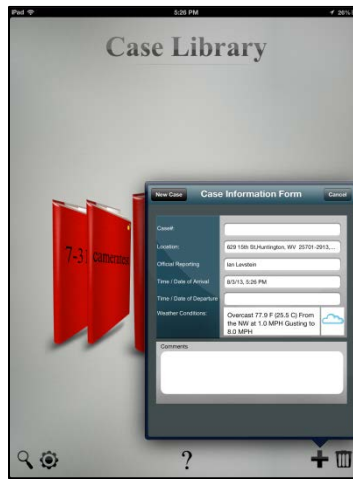


Fig. 2. Screenshot of new case form.

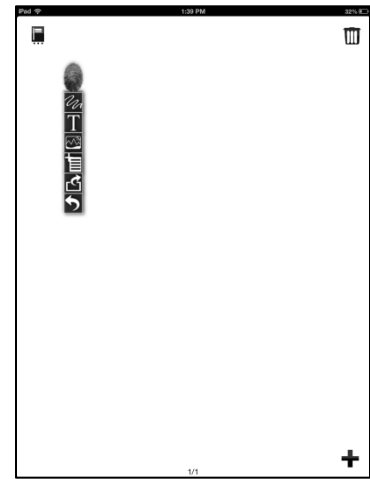


Fig. 3. Screenshot of new case screen with options.



Fig. 4. Screenshot of text options.

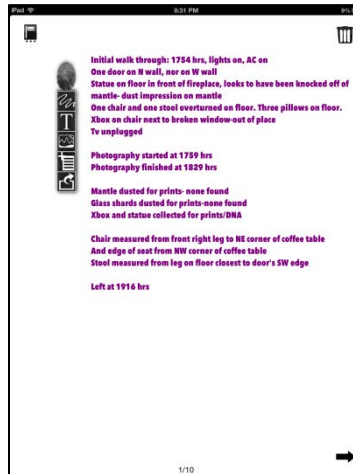


Fig. 5. Screenshot of notes page.

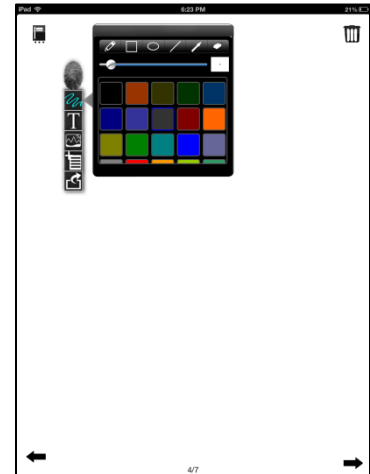


Fig. 6. Screenshot of drawing options.

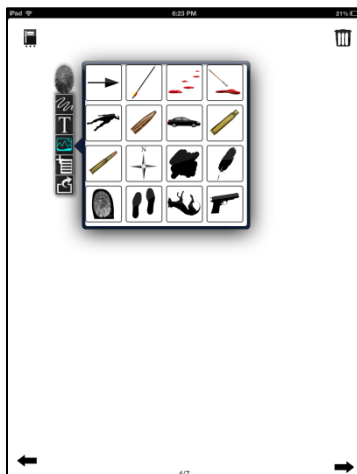


Fig. 7. Screenshot of scene mapping images.

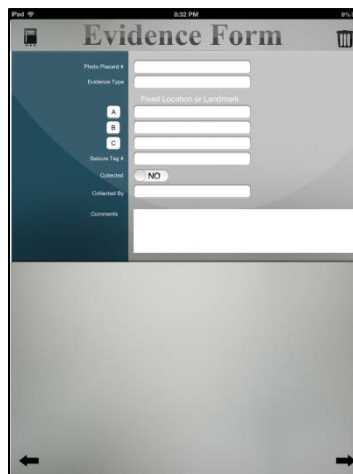


Fig. 8. Screenshot of Evidence Form.



Fig. 9. Screenshot of evidence options and collection method.



Fig. 10. Example of photos taken with the iPad camera.

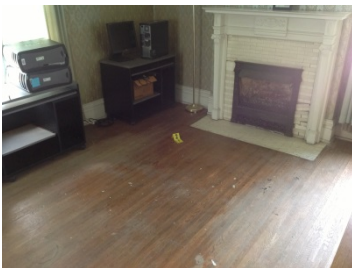


Fig. 13. Overall photo taken with the iPad camera in natural lighting indoors.



Fig. 11. Mid-range photo taken with a digital-SLR camera in natural lighting indoors.



Fig. 12. Mid-range photo taken with the iPad camera in natural lighting indoors.



Fig. 14. Overall photo taken with a digital-SLR camera in natural lighting indoors.



Fig. 15. Photo taken using the painting with light technique with the iPad camera.



Fig. 16. Photo taken using the painting with light technique with a digital-SLR camera.



Fig. 17. Zoomed photo taken with the iPad camera.



Fig. 18. Macro photo taken with a digital-SLR camera with macro lens.



Fig. 19. Photo taken with the iPad camera focused on the bathroom.



Fig. 20. Photo taken with the iPad camera focused on the bullet casing (evidence 3).



Fig. 21. Photo taken with the iPad camera focused on the floor between the bathroom and casing.

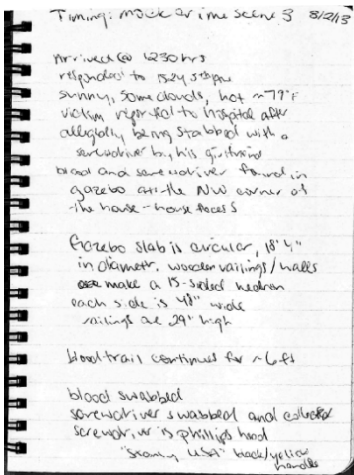


Fig. 22. Notes taken by hand (mock scene 3).

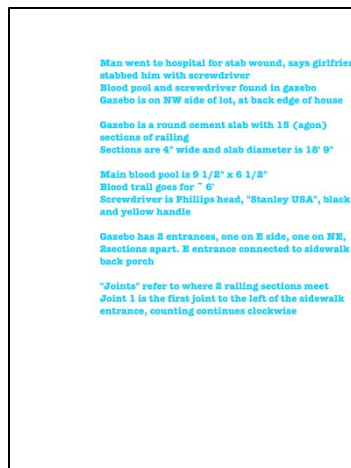


Fig. 23. Notes taken using the app (mock scene 3).

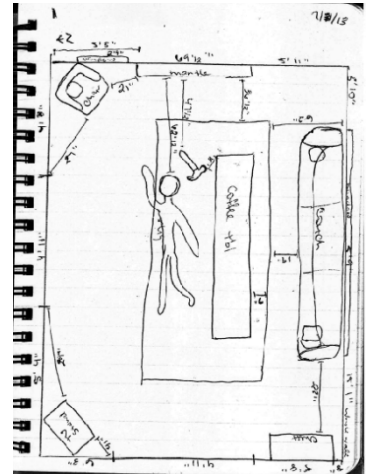


Fig. 24. Sketch made by hand (mock scene 1).

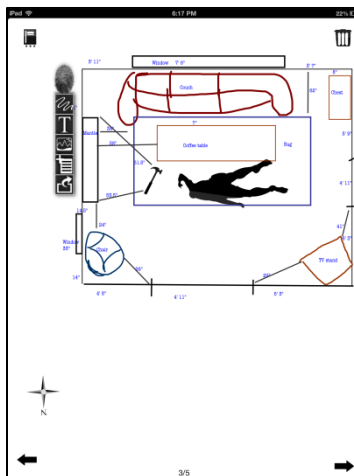


Fig. 25. Sketch made with the app (mock scene 1).

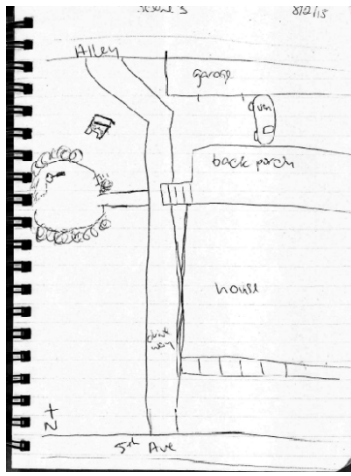


Fig. 26. Outdoor sketch made by hand (mock scene 3).

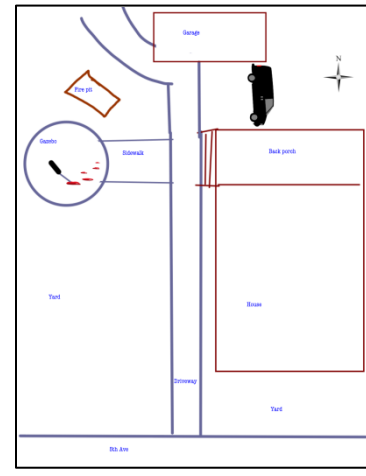


Fig. 27. Sketch made using the app (mock scene 3).

