Tablet-Based Electronic Reporting Form Proof of Concept

by

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DISCLAIMER

This report describes a proof-of-concept system, developed to demonstrate the technical feasibility of implementing a Tablet PC -based electronic accident reporting form. This system is intended for demonstration purposes only.

This is the fourth of four project reports and is not intended as a summary of the all activities conducted during this project. Its scope is limited to the proof-of-concept system and the relationship of that system to prior research.

ACKNOWLEDGEMENTS

Prior research and development on this project was conducted by Cordell Ringel, Gary Harkin and David Kunkel. Their results can be found in separate research papers, as cited in the bibliography.

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2. EXECUTIVE SUMMARY

Based on prior research by Cordell Ringel, Gary Harkin and David Kunkel, an electronic software-based version of a standard accident report form was implemented for the sake of demonstration and proof of concept on a Tablet PC platform. Previous efforts resulted in a working PC-based version that was not optimized for the Tablet environment and another version for a Pocket PC that was abandoned due to the complexity of the form and lack of screen space on the Pocket PC. While the PC-based version could function on a Tablet PC, its lack of support for native tablet features such as handwriting recognition and "ink" –based drawing limited its viability. Thus, this version was produced to capitalize on Tablet PC features and to expand on the work that was already done.

A Tablet PC and a connected, external GPS were used for development purposes. For a production version of the system, these would be replaced with "rugged" equivalents. For the sake of simplicity, data communications capability was not implemented via hardware or software. This would also be desirable in a production system. In a related project, Redding Responder, these aspects have been addressed for a California Department of Transportation (CALTRANS) application. The results of that project are directly applicable to this project.

A standard accident report form was analyzed and form fields were grouped functionally. The functional grouping of form fields provides for a more logical and intuitive user interface in the electronic version. This eliminates clutter by presenting smaller, related sections of the form together for completion and quick access.

The resulting program allows for the entry of all information using pen input. A benefit of using pen input exclusively is that the form can be filled out entirely by using the Tablet PC in tablet mode. A responder could carry and use a rugged Tablet PC at the incident scene, outside a vehicle, and complete the form without a need to "dock" the unit and use a keyboard. Furthermore, the pen is a more natural input device for making sketches. For text fields, handwritten input is accepted and recognized as text. For radio buttons, drop boxes and check boxes, the pen is used like a mouse. For graphical fields such as incident sketches, the pen is used as a drawing tool, rendering smoother drawings than possible by using mouse input.

No formal usability testing was conducted within the scope of this portion of the project. The results are left as "proof of concept," verifying that an implementation on the Tablet PC platform is viable. Further research topics would include usability testing and analysis and further software and hardware development to suit the needs of a specific law-enforcement agency.

3. INTRODUCTION

The Blackfeet Automated Accident Reporting System project was initiated to "*determine the root cause for the historically low reporting of motor vehicle accidents to the MHP database from BIA and Tribal law enforcement personnel on Montana's Indian Reservations*" and to "*Determine what can be done to reduce time, increase efficiency, accuracy, and encourage more responsive accident reporting … (by exploring) … the feasibility, development and implementation of new technologies such as PDA's, enhanced computer software, reporting via the Internet with pull down menus, GPS interface, etc*." [Ringel, 2003].

Cordel Ringel's research focused on the behavioral, social and institutional aspects of this problem, while Gary Harkin's and David Kunkel's research focused on potential technological tools to assist in addressing the problem.

The final efforts in this project, carried out by Douglas Galarus and reported in this document, extend the technical efforts and ideas of Harkin and Kunkel using technology and tools that were not available to them during their development efforts. These final efforts should be viewed as a proof-of-concept or demonstration that the technical facets of this project are viable. It is recognized that technical viability does not guarantee acceptance and use by potential end users. Outreach efforts, feedback, further development, testing and training would be crucial to the implementation of such a system.

The original vision of Harkin and Kunkel was to use a PDA, integrated with a GPS receiver, as the primary input device for in the field accident reporting. The most obvious promise of this vision is that a PDA is ultra-light, portable, and has the potential processing and storage power necessary for this task. Furthermore, end-users might already carry PDAs and use them for other tasks such as contact management. Harkin and Kunkel soon discovered, though, that limited screen size and input capabilities severely restricted their efforts to develop an easy to use interface.

As described by Harkin:

"*During Phase I it became obvious that a handheld unit would be inadequate for data entry of a form as complex as an accident reporting form. There was insufficient space for entering data and the packed form was difficult to read. As tablet computers were on the horizon, we decided, with Steve Albert, to focus on a larger format and the system was converted to run on a standard PC which could be a Tablet PC or laptop PC.*" [Harkin, Kunkel, 2003]

Subsequent efforts by Harkin and Kunkel focused on the development of a prototype that would run on a standard PC including a notebook or Tablet PC. Even though development focused on a PC, consideration was given to creating code that could potentially run on other systems. Due to technical issues with a GPS receiver that had been purchased for use with a PDA that was acquired for initial development, they were unable to integrate GPS functionality into the system. This prototype was completed and demonstrated to a BIA representative who expressed general interest in the project. However, the agency's interest was reported, without explanation, to have "waned." [Kunkle, 2003].

While the prototype developed by Harkin and Kunkel could technically run, as-is, on a Tablet PC, it was not optimized for usability on such a platform. Douglas Galarus focused the efforts described in this paper on developing a prototype for the Tablet PC platform. A Tablet PC was purchased and development tools specifically designed for Tablet PC development were used to

develop a second prototype. The advantage of this approach is that the resulting application would be optimized for use on this platform. For instance, a pen input device could be used to seamlessly input text, select form items from drop boxes and radio buttons, and make sketches on an accident reporting form.

Ease of use is a prime indicator of the likelihood of acceptance of a system by potential end users. In general, even if system use is mandated, users will be reluctant and resistant to using a system if it is cumbersome and more difficult to use than alternatives, and particularly if it does not increase their perceived effectiveness. This general observation is certainly true and even more applicable to the specific problems addressed by this project.

One measurable goal in achieving ease of use for an electronic form system is that use of the system requires no more (ideally less) time for form completion than using a corresponding paper-based system. In conjunction, the system should increase accuracy, particularly through the use of pre-populated information, consistent selections in drop-boxes and input controls, and by using data validation and error checking. Another goal is that an electronic form system would eliminate the need for transcription of information and would facilitate computer analysis.

These goals guided development of the Tablet PC prototype. Prospective follow-up to this project would be testing and evaluation based on these goals.

4. METHODOLOGY AND ANALYSIS

4.1. Goals

The overarching goal of this portion of the project was to build a prototype system based on the Tablet PC architecture. Emphasis was placed on the software development side of the project, with hardware chosen for development and demonstration purposes only. Low-cost, off-the-shelf hardware provided a reasonable development and demonstration platform for the purposes of this project. By no means would the same hardware be recommended for field use. Instead, rugged, environment-ready hardware would be recommended for field use.

Communication capabilities, particularly data connectivity, were not addressed in this portion of the project. One of several scenarios would be possible in regard to communications. First, it could be assumed that data communication capability is not available or not required. In this case, data from the mobile computer (Tablet PC) would be uploaded to a central repository on a regular basis. Downloads and synchronization in the field would not be possible in this scenario.

Second, it could be assumed that communication is "sometimes available." In this case, data could be uploaded when data communication capability is available. Downloads would be possible, but the system could not depend on real-time download capability.

Finally, it could be required that data communication is always available. In this case, data could be uploaded as it is entered. This requirement would be technically challenging, particularly in remote rural areas.

The Redding Responder project, a separate WTI project, is currently evaluating and addressing many of the issues related to data communications in remote rural locations. Results from that study would be directly applicable to the communication and hardware needs of this project.

It was suggested in earlier project research [Kunkel, 2003] that the capability for creating a user-defined accident reporting form (ARF) be incorporated. This capability was not incorporated into this prototype. Building such generic capability is possible, but would require either the use of existing tools, off-the-shelf tools or significant development to create such a tool. This issue has been addressed in the Redding Responder project by including the capability of incorporating user-created Microsoft Word –based forms into a similar interface. An advantage of this approach is that forms can be easily created and exchanged. A disadvantage is that extracting data from the forms for storage and analysis in a database is non-trivial, let-alone automatic.

It was also suggested in earlier research [Kunkel, 2003] that functionality to "generate a file of accident data that could be sent to the state in a mutually agreed upon format" be incorporated. This functionality was considered for exploration with the standard ARF.

The following goals, guided development of the software prototype.

4.1.1. Ease of Use

Ease of use is a prime indicator of system acceptance. If the system is cumbersome and more difficult to use than alternatives, prospective users will be reluctant to make use of it. The primary alternative in this case is a paper-based form.

For the purpose of this project, measurement of ease of use would be considered in terms of software rather than hardware. Since the hardware system was chosen for development and demonstration only, it was not configured for rapid, rugged use in the field. Subsequent research and development efforts could focus on hardware ease of use and field readiness. Note that the Redding Responder project is addressing many of these issues in a similar context. The utilization of pen input capability of the Tablet PC is intended to maximize ease of use.

4.1.2. Increased Accuracy

The system should increase accuracy, particularly by using pre-populated form fields, consistent selections in drop-boxes and input controls, and by incorporating data validation and error checking.

4.1.3. Eliminate the Need for Transcription

The system should eliminate the need for transcription. All information will be stored in electronic form and text information should be stored in text format. It may be the case that sketches will include handwritten, text annotations. The text in such sketches need not be "recognized."

4.1.4. Facilitate Computer Analysis

Eliminating the need for transcription does not facilitate computer analysis. For instance, Microsoft Word forms, as mentioned earlier, do not necessarily lend themselves to automated analysis or preparation for analysis. Custom coding and careful naming of form fields, coupled with naming conventions, etc. are necessary for analysis. Through the development of a custom storage and exchange format (serialization), it will be easy to extract and analyze named pieces of information.

4.1.5. Facilitate Information Exchange

The same functionality that facilitates computer analysis should also facilitate information exchange. It is desirable to store information in a single structure (file) that can be easily stored, exchanged and de-serialized.

4.2. Hardware Platform

The hardware platform for development and demonstration consists of the following:

4.2.1. Toshiba Portege 3505 Convertible Windows Tablet PC

- Dual-action swivel for easy switch between notebook and tablet modes
- 12" diagonal TFT screen
- 1.33GHz Intel Pentium III Processor-M
- 40 GB HDD
- 512 MB RAM
- External DVD-ROM Drive

4.2.2. Magellan GPS 315

- NMEA compatible
- Serial Interface
- Battery Powered

4.2.3. Belkin Serial to USB Converter

- Hardware converting DB-9 serial to USB
- Software providing virtual port

4.3. Software Platform

The hardware platform for development and demonstration consists of the following:

- Microsoft Windows XP Tablet PC Edition
- Microsoft .NET Framework 1.1
- Microsoft Visual Studio .NET (for development)
- GPS component for programmatic communication with a GPS

4.4. Form Analysis

The form was analyzed and form fields were grouped according to content and to facilitate easy access and completion. The paper-based form was constructed to fit on a single page and to optimize the amount of information that could be stored on a single page. The paper-based form facilitated the entry of at most two drivers and two vehicles. It was desirable to easily allow the entry of more (or less) than two items for each of these sections.

No outside clarification or interpretation was sought in analyzing the form. Instead, the form was analyzed as is, yielding observations and issues that might be encountered by someone using the form for the first time, with little or no training.

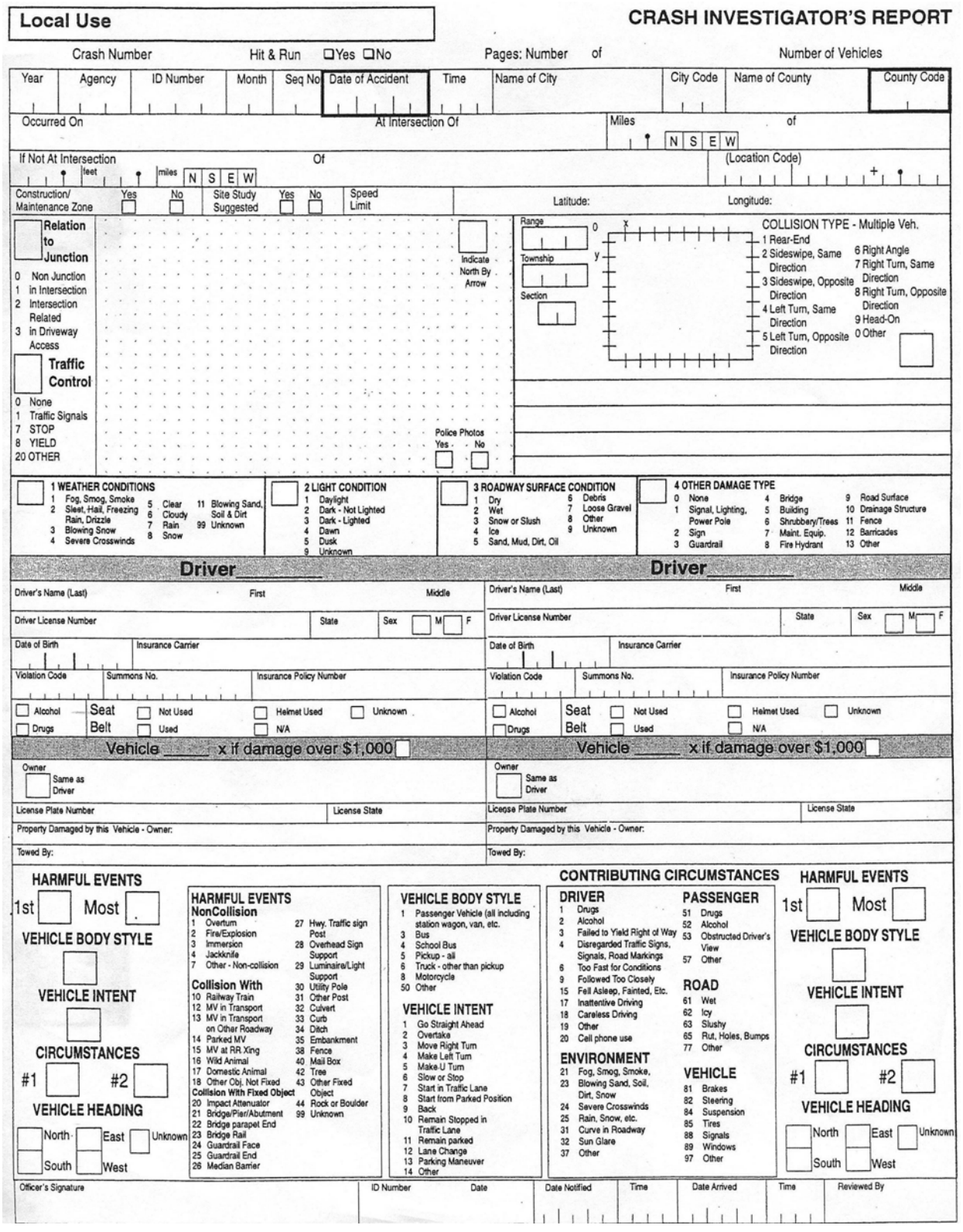

Figure 1: Standard Accident Report Form (ARF)

4.4.1. Observations

Usage of the *Crash Number* field is uncertain. It is likely an identifier to distinguish incidents, but no convention for use is given. This may be a jurisdictional decision. It may be the case also that this field is to be completed by office staff and not at the incident.

The *Hit and Run* field consists of Yes/No checkboxes. It is questionable why these were placed at the top of the form. Either this was done for prominence or to optimize the use of space on the page.

Fields are presented to indicate the total number of pages in the report and the sequence number of the given page. A reason for including multiple pages would be to include information about more than two drivers or vehicles. It may be the case the other information such as *Harmful Events* and *Contributing Circumstances* would require more than two entries. Confusion and/or redundancy could result from the use of multiple pages. It is unclear whether redundant fields such as *Year*, *Agency*, etc. should be completed on each form.

The *Year* field uses a two-digit entry to signify the year. Auto-populating this field could save time.

Agency and *ID Number* fields are agency-specific. It is unclear whether there is a state-wide standard for these fields, or whether they are left to local jurisdictions.

A two-digit, numeric *Month* field follows. Its use is clear. Its placement on the form is questionable. It does not follow the *Year* field immediately, although it does fall on the same line. If this placement was intentional, it may be the case that *Year*, *Agency*, *ID Number*, *Month*, etc., in sequence, are used in combination to form a unique identifier.

Use of the *Seq. No.* field is unclear. It allows for a two-digit number.

The *Date of Accident* field provides space for three two-digit entries. It is assumed, although nowhere stated, that this field use the mm/dd/yy format. Note that this field is highlighted with a bold border. This likely was done to make the field prominent either for entry or processing. Processing, quick retrieval, and sorting are likely reasons for highlighting this field.

Use of the *Time* field is ambiguous. Space for four digits with no indicator of AM/PM implies that time is specified using military, 24-hour specification.

Name of City is straight forward, although space in that field is limited. It is unknown whether this field is required or optional, because incidents may occur outside city limits.

The *City Code* field is presented with no guidelines for use. Three digits are available. In an electronic form, this field could be combined with the *Name of City* field to eliminate the need to look up a code and make an additional entry.

The *Name of County* and *County Code* fields are presented similarly. The *Name of County* Field is short. The *County Code* field allows for two digits. Note that the *County Code* field is highlighted. Processing, quick retrieval, and sorting are the likely reasons for highlighting this field.

The *Occurred On* and *At Intersection Of* fields are combined into a single box. The latter is assumed to be optional since an accident may not occur at an intersection. It is unclear if the nearest intersection would be used, if not exactly at an intersection. If entries are made for both, this field may be too small.

The *Miles* field indicates the distance and direction from an unspecified type of location. Distance is specified with three digits including tenths of a mile. Direction is one of the cardinal directions. Without the use of mapping software, a GPS, or specific knowledge of the location relative to a town (perhaps derived from mile post readings), this will be an estimate, and inherently inaccurate. This field could possibly be omitted if latitude and longitude, which indicate a precise location, are specified. It is unclear if this field is to be completed only if intersection information pertains, or in all cases.

The *If Not At Intersection* field consists for four digit (including tenths) specifications of distance in feet and miles, and cardinal direction from some benchmark location of an unspecified type. This field could be omitted if latitude and longitude are specified. Note though that GPS readings have a potential 10 meter error, so accuracy could not be guaranteed to the precision allowed on this form.

Use of the *Location Code* field is unclear. It includes several sections and separators.

The *Construction / Maintenance Zone* and *Site Study Suggested* checkbox fields are clear.

The *Speed Limit* field is a free-form text field and its use is clear.

The *Latitude* and *Longitude* fields are free-form text fields, with no indication of preferred format or precision. GPS readings can be displayed as degrees with a decimal or as degrees, minutes, and seconds with a decimal. If ultimately this information is intended for electronic storage and analysis, it would be important to provide guidelines for format and precision. Note that there is also a chance of transcription error in recording these values as observed on a GPS.

The *Relation to Junction* and *Traffic Control* fields use numeric codes to indicate selected values. Their use is clear. They are given relative prominence by their size on the form. The reason for this is unknown.

An unlabeled space is provided for an incident diagram. Dots provide a grid on which a freehand sketch can be made. An *Indicate North By Arrow* box is provided within the drawing space to indicate direction in the sketch. Also included are Yes/No check boxes to indicate if *Police Photos* are available, although no room for further information about those photos is provided. The sketch space is relatively small, but no further space is available on the form for expanding this field.

Range, Township and *Section* fields are included with a grid diagram. The purpose of the grid diagram is unknown. *Range*, *Township* and *Section* could be omitted if latitude and longitude are specified.

In the same box as *Range, Township* and *Section* is a box for entry of a code indicating *Collision Type* for multiple vehicle accidents. There are also four lines that are assumed to allow the entry of a description of the accident. No label is present to indicate this purpose though.

Weather Conditions, Light Condition, Roadway Surface Condition and *Other Damage Type* fields allow for numerically-coded entries. The text associated with each possible entry is quite small and difficult to read. Each of these fields is numbered and the purpose of the numbering is questionable.

Two *Driver* sections are shown on the form with accompanying *Vehicle* sections. Space following the *Driver* heading is likely used to indicate a driver number. This would be of particular use if three or more drivers are involved, necessitating the use of multiple form pages.

Similar space is provided following *Vehicle* headings. It is assumed that vehicle numbers will correspond to driver numbers.

Within the *Driver* section, the following fields are listed: *Driver's Name* (*Last*, *First*, *Middle*), *Driver License Number*, *State*, *Sex*, *Date of Birth*, *Insurance Carrier*, *Violation Code*, *Summons No.*, *Insurance Policy Number*, *Alcohol*, *Drugs*, *Seat Belt*. Use of all is intuitive, although there is some ambiguity in choices for the *Seat Belt* field due to inclusion of information regarding Helmut usage.

The *Vehicle* section includes fields for *Owner* (which can be indicated as same as driver by checking a box), *License Plate Number*, *License State*, *Property Damaged by this Vehicle – Owner*, and *Towed By*. Use of all is straight-forward with the possible exception of the *Property Damage* field, in which in may be unclear whether the actual property should be listed.

Near the bottom of the form are a number of boxes for numeric indication of *Harmful Events* (*1st and Most*), *Vehicle Body Style*, *Vehicle Intent*, *Circumstances* (*#1* and *#2*), and *Vehicle Heading*. These are indicated for each of the two vehicle/driver combinations. For *Harmful Events*, use of *1st* and *Most* is not clarified. For *Circumstances*, it is unclear what would be done if three or more circumstances were involved. Even though these fields are associated with each vehicle/driver combination, their association is obscured by the lookup tables for the fields, shown in the middle of the section. The text values in these sections are very small and difficult to read as well.

At the bottom of the form are fields for *Officer's Signature*, *ID Number*, *Date*, *Date Notified*, *Time*, *Date Arrived*, *Time*, and *Reviewed By*. The only question regarding these fields is who is supposed to fill them out and when.

4.4.2. Conclusions

The selected Accident Reporting Form includes a large number of fields for describing an accident. These fields have been arranged to fit on a single page. Use of a single page simplifies duplication and eases retrieval and use of the form at an incident. Restricting the form to a single page, however, has side-effects. Text for certain fields is quite small and difficult to read. Instructions or cues for formatting preferences are omitted in several places where they would be helpful, particularly to ensure data validity and integrity. In general, fields are not logically grouped. Instead, they are grouped to optimize the use of space.

An accident may require the use of multiple forms when additional information about an accident needs to be recorded. In particular, if three or more drivers/vehicles are involved, then additional forms will be required. Under such circumstances, the advantages of the single page form are lost. Furthermore, confusion could arise in determining what information needs to be duplicated on additional pages.

Multiple geographic fields are presented and could be considered redundant if precise location information is available for latitude and longitude. There are pros and cons to removing this redundancy, and the decision to do so would require further investigation. Consistent inclusion of latitude and longitude would definitely be of benefit.

An electronic form could auto-populate much of the information on the form and could make entry of certain information easier and could be used to validate the information. An electronic

form could also make it easier to accommodate fields and sections such as driver/vehicle that occur a variable number of times.

An electronic form could integrate graphical elements such as the incident sketch and police photos, facilitating single file/record storage of all information. The paper-based form would require scanning for electronic storage and exchange of that information.

4.4.3. Logical Groupings

4.4.3.1. Summary

This grouping includes summary information about the incident. Note that the initial *Crash Number*, *Year*, *Agency*, *ID Number*, *Month* and *Seq No* fields could be included in this section as well. They are excluded here either because they are redundant with other fields, they could be automatically associated with the incident report upon storage, or they would no longer be necessary or would be supplanted by other information in an electronic form. The following fields are included:

- Accident Date
- Accident Time
- Number of Vehicles
- Collision Type – Multiple Vehicle
- Other Damage Type
- Speed Limit
- Hit and Run
- Construction / Maintenance
- Site Study Suggested
- Collision Description

4.4.3.2. Conditions

Various external conditions that may have had an impact on the accident are included in this grouping:

- Weather Conditions
- Light Condition
- Roadway Surface Condition

4.4.3.3. Crash Sketch

The crash sketch includes a direction indicator:

- Crash Sketch
- Direction Indicator

4.4.3.4. Police Photos

The availability of police photos is indicated on the original form. However, no information is given beyond that. In an electronic system, photos can be collected and grouped.

- Police Photos

4.4.3.5. Drivers/Vehicles

Driver/vehicle combinations should be paired. There should be the flexibility to record as many or as few as necessary. Note that helmet information has been separated from seat belt information.

Driver

- Driver Name (Last, First, MI)
- Sex
- Driver's License Number
- Driver's License State
- Insurance Carrier
- Insurance Policy Number
- Violation code
- Summons Number
- Alcohol
- Drugs
- Seat Belt
- Helmet

Vehicle

- Owner Name
- License Plate Number
- License State
- Owner of Property Damaged by this Vehicle
- Damage over $1000
- Towed By
- Harmful Events 1st
- Harmful Events Most
- Vehicle Body Style
- Vehicle Intent

- Circumstances #1
- Circumstances #2
- Vehicle Heading

4.4.3.6. Location

Although much of the location information could be derived from latitude and longitude, all location information except *Location Code* is included in this section. Note the inclusion of *Relation to Junction* and *Traffic Control*.

- Latitude
- Longitude
- Occurred On
- At Intersection Of
- Position Relative to City, Town or Other Loc
- City
- County
- Relation to Junction
- Traffic Control

4.4.3.7. Signature

The signature section is intended to hold an electronic version of the investigator's signature. The date field indicates the date of the signature. Other fields such as *ID Number*, *Date Notified*, *Time*, *Date Arrived*, *Time*, and *Review By* are omitted either because they would be filled out by someone other than the responding officer or because of redundancy.

- Signature
- Date

5. IMPLEMENTATION

5.1. Overview

Software was developed using the C# programming language and designed to run on Windows XP Tablet PC Edition with the .NET Framework, version 1.1.

Groupings indicated in section 4.4.3, Logical Groupings, were implemented as sub-forms within a tabbed control. The tabs give a folder-like appearance to the groupings, with quick and logical access to each. This allows plenty of space for form fields.

Where possible, auto-population of information is implemented. Latitude and longitude are populated from the GPS upon request from the user. Date and time are populated automatically from the system clock.

Every field accepts pen input. For checkboxes, radio buttons and drop boxes, the pen acts like a mouse. For text fields, selection invokes a writing pad / on-screen keyboard, so input can be entered entirely with the pen. For the drawing fields, the pen can be used to draw sketches. The sketches tend to be smoother than if "drawn" using a mouse.

5.2. Screen Shots and Descriptions

The *Summary* tab implements the summary grouping. The *Accident Date* and *Accident Time* controls are auto-populated with the current date and time. These values can be easily changed via a calendar control, up and down arrows, or text entry.

Number of Vehicles and *Speed Limit* are implemented as numeric up-down controls, allowing for quick selection of values.

Collision Type- Multiple Vehicle and *Other Damage Type* are implemented as drop boxes, allowing the user to select the value by name.

Hit and Run, Construction / Maintenance Zone, and *Site Study Suggested* are implemented as checkboxes.

Collision Description can be completed using the writing pad, onscreen keyboard or an attached keyboard.

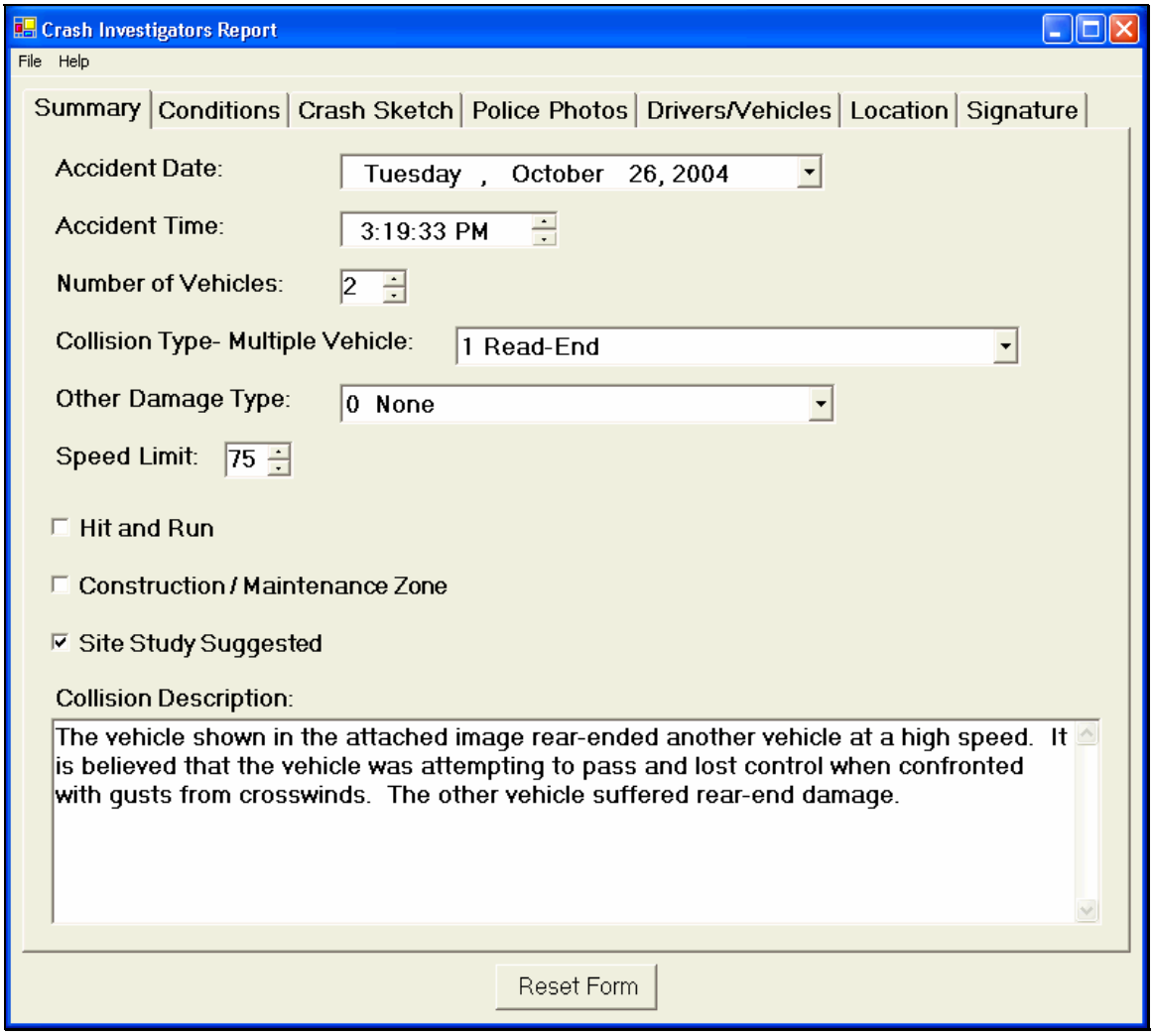

Figure 2: Summary Tab

The *Conditions* tab organizes *Weather Conditions*, *Light Condition*, and *Roadway Surface Condition* in drop boxes for quick selection.

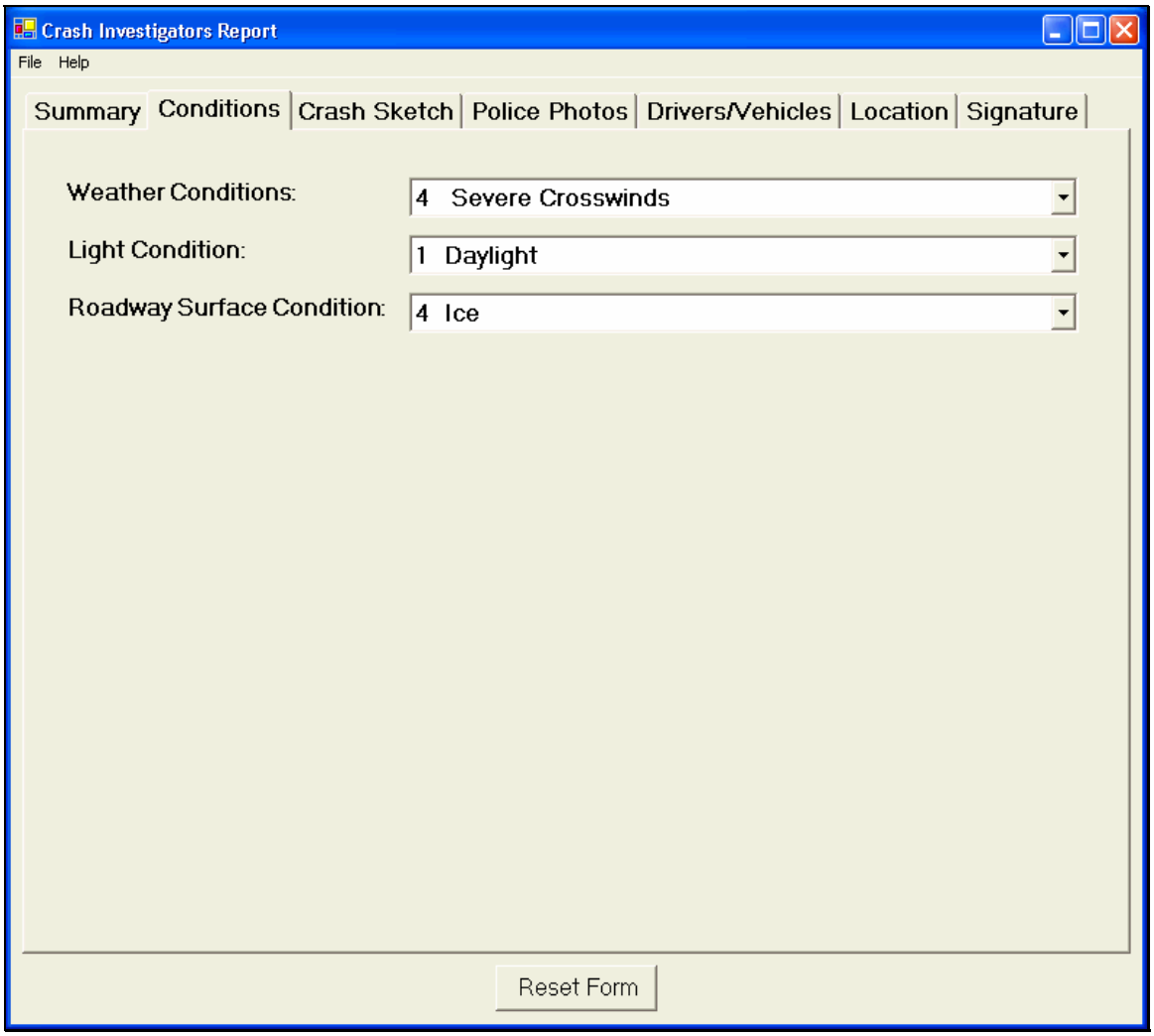

Figure 3: Conditions Tab

The *Crash Sketch* tab facilitates a crash sketch by providing a sketch area and direction indicator that can be drawn on directly using the Tablet PC pen. In the example below, the sketch area is shown without a grid to produce a cleaner image. Grid functionality could easily be incorporated into the program. Note that the direction indicator is separated, freeing more space for the sketch. Ease of use was emphasized here by facilitating simple, one color sketching. The Clear button allows the sketch to be erased.

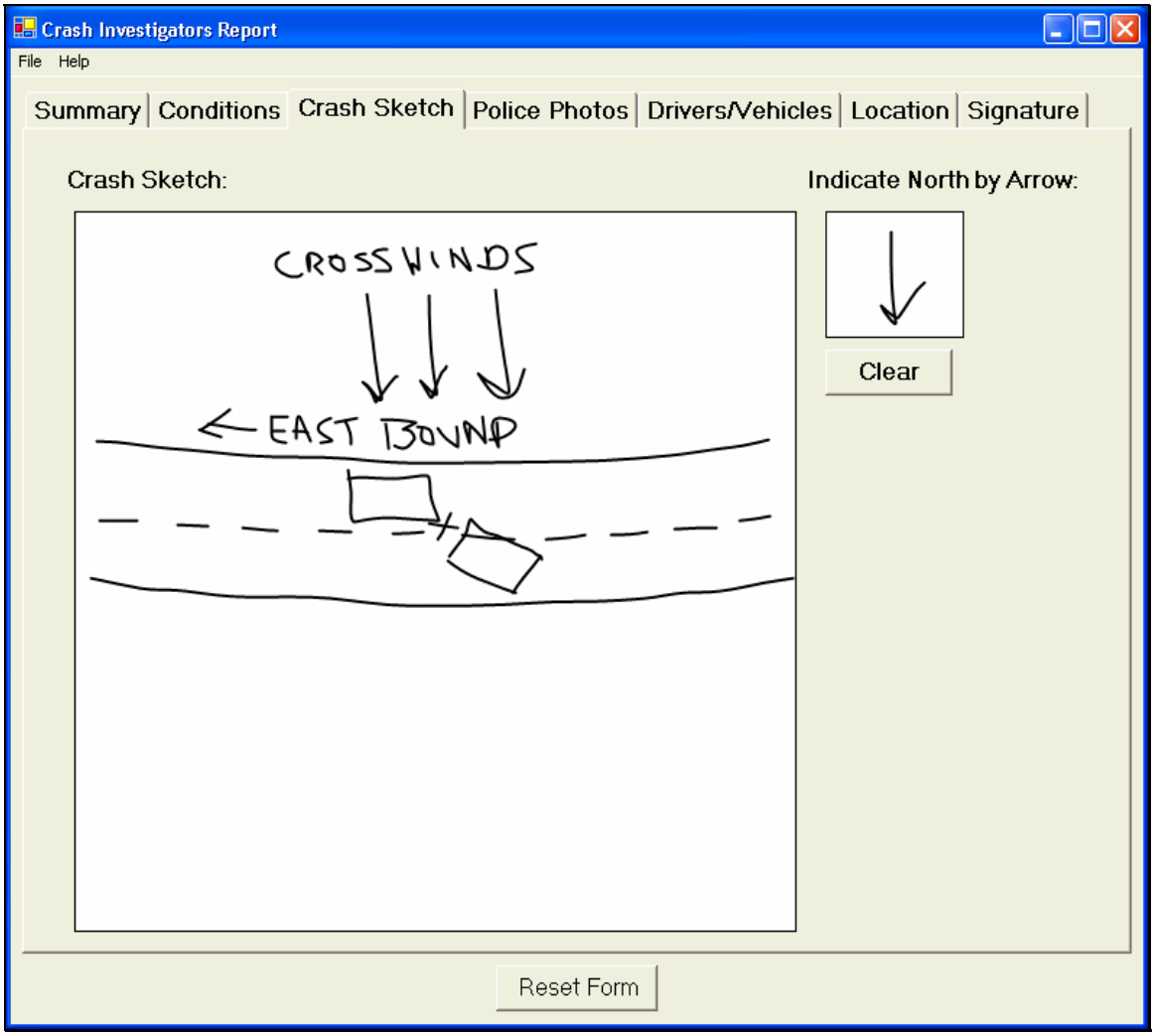

Figure 4: Crash Sketch Tab

The *Police Photos* tab organizes photos collected at the incident scene. Photos can be selected from the hard drive or directly from an attached digital camera, and will be automatically scaled to best fit within this section.

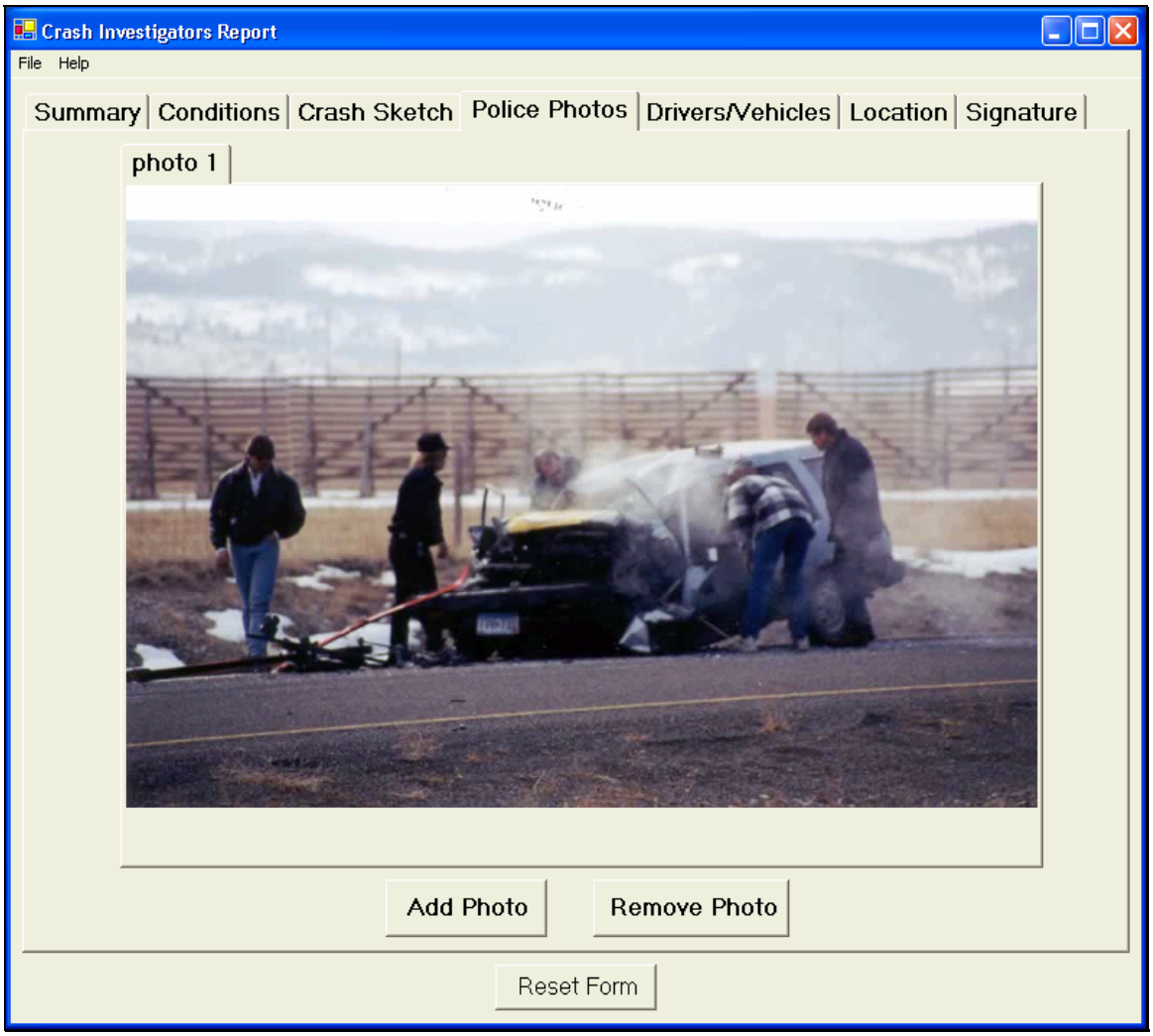

Figure 5: Police Photos Tab

The *Drivers/Vehicles* tab organizes the driver/vehicle pairs involved in the accident. A key feature of this section is that it allows any number of drivers and vehicles, overcoming one of the primary limitations of the paper-based form. Driver/vehicle combinations are added using the *Add Driver* button. Each combination is identified and selected by tab headings showing the names of the drivers.

All text fields accept pen input. Radio buttons, check boxes and drop lists are used for remaining fields, allowing for easy and rapid entry.

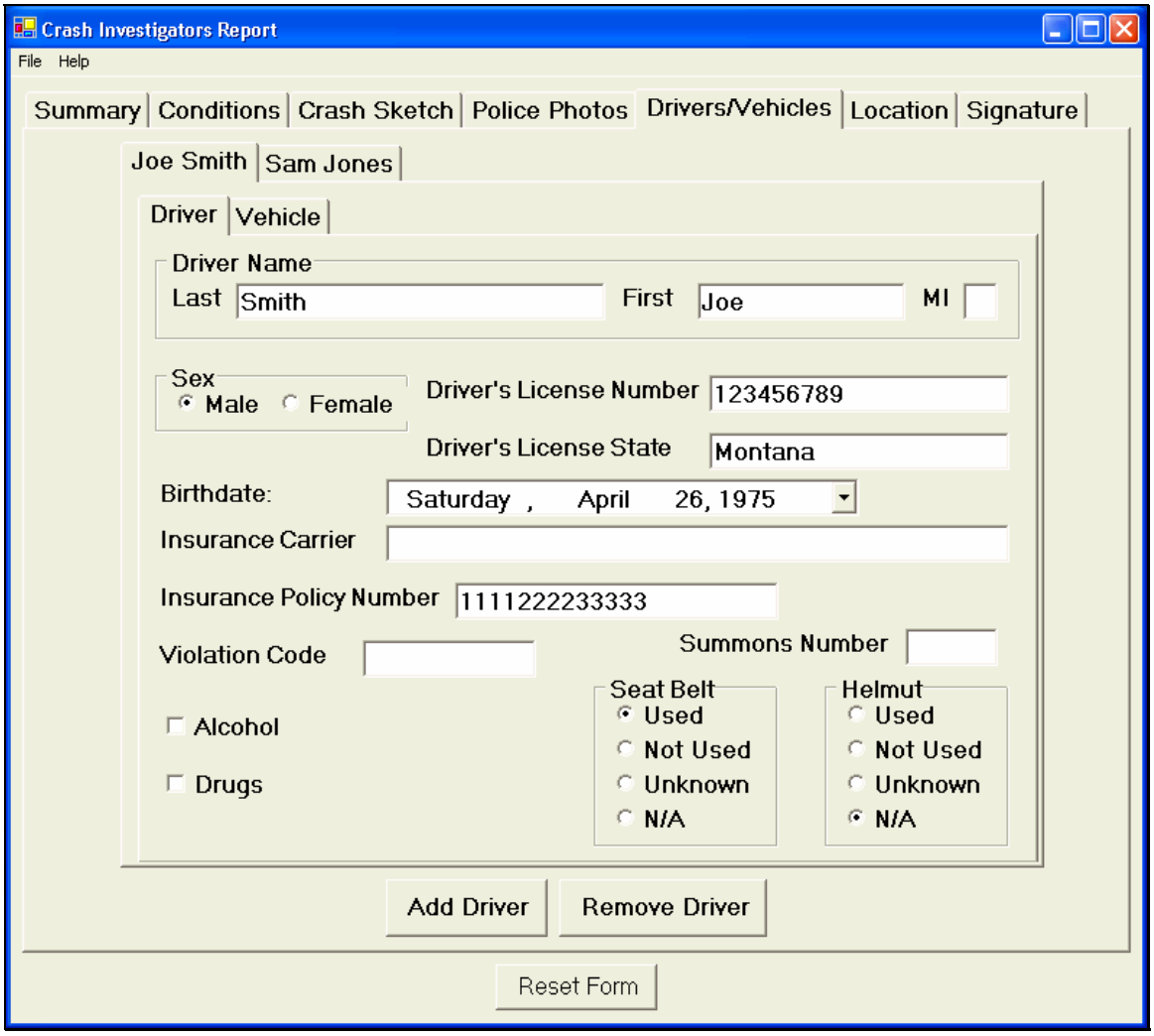

Figure 6: Drivers/Vehicles Tab – First Driver

The *Vehicle* sub-tab facilitates entry of vehicle information in a similar manner. Note that checking the *Same as Driver* checkbox will automatically copy the driver's name from the *Driver* tab to the *Owner Name* tab, not only making data entry faster, but also potentially increasing accuracy by eliminating possible transcription error.

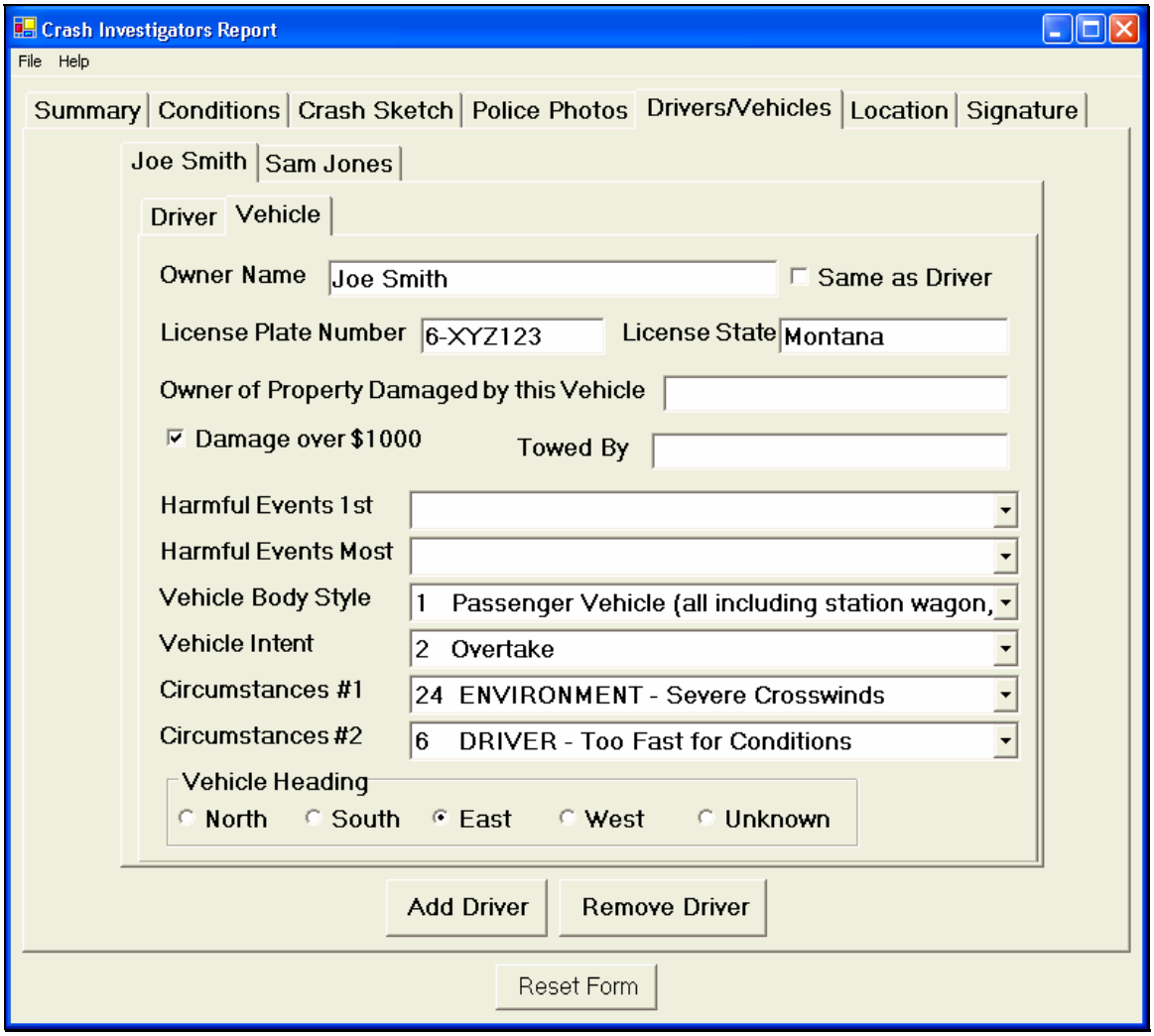

Figure 7: Drivers/Vehicles Tab – First Vehicle

The figures below show information for a second driver/vehicle combination:

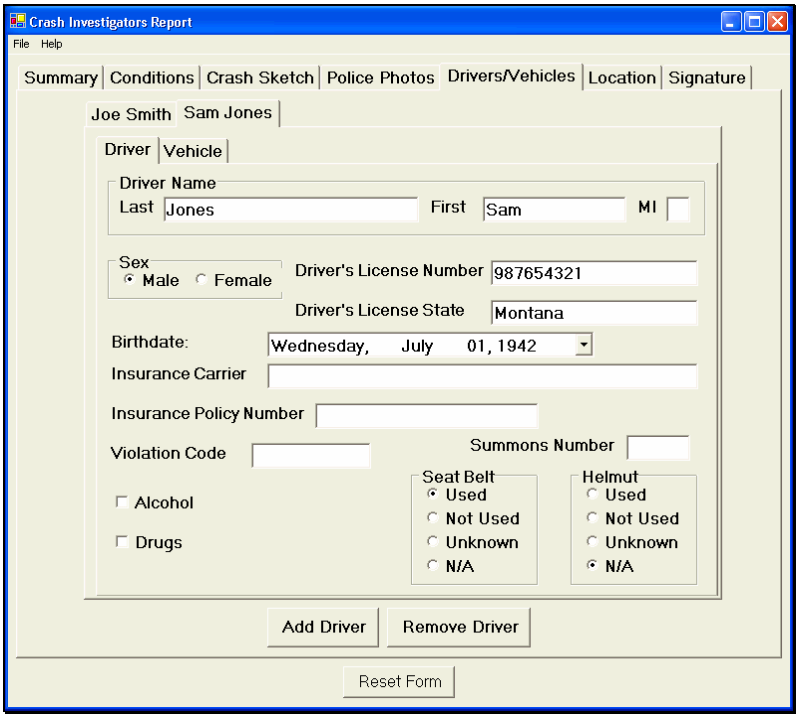

Figure 8: Drivers/Vehicles Tab – Second Driver

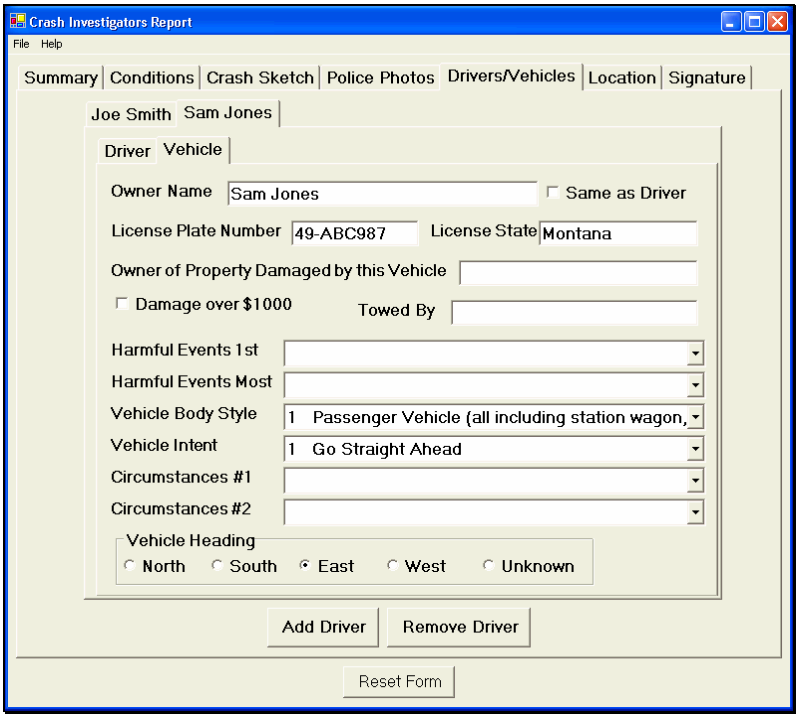

Figure 9: Drivers/Vehicles Tab – Second Vehicle

The *Location* tab consolidates location information and includes the ability to directly acquire *Latitude* and *Longitude* from an attached GPS.

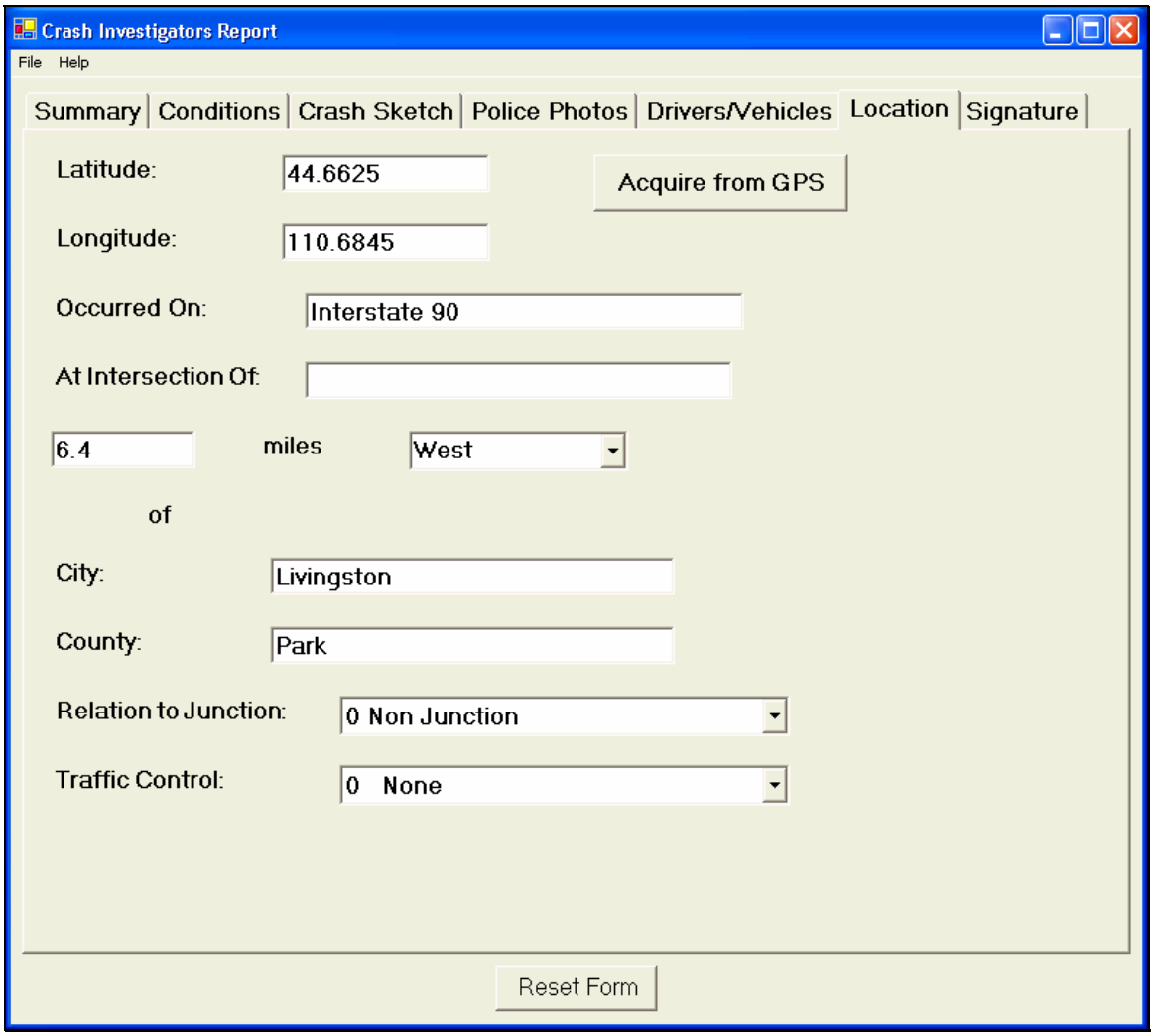

Figure 10: Location Tab

The signature tab allows for the electronic capture and recording of the officer's signature. The *Date* field allows the date to be selected from a pop-up calendar.

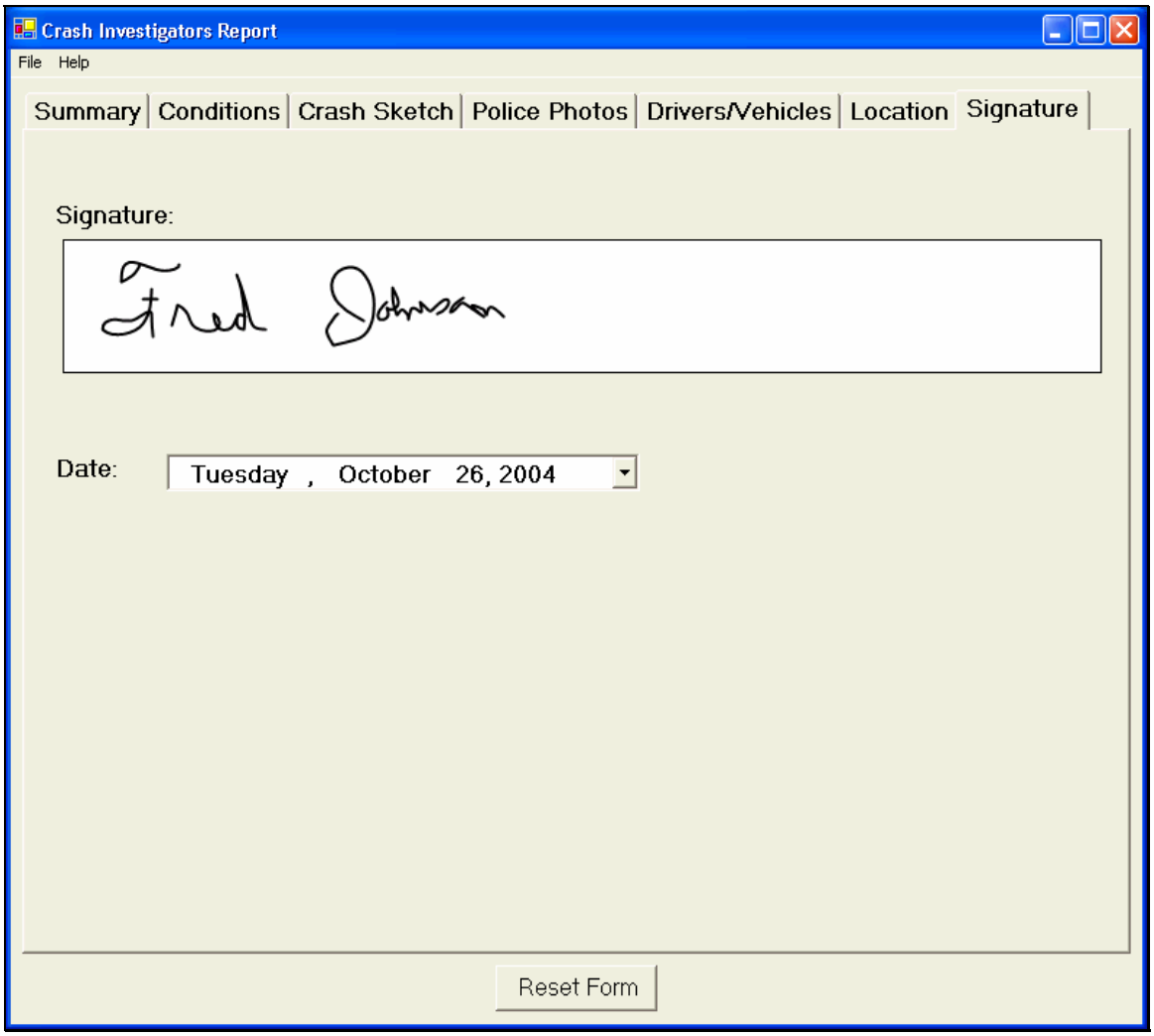

Figure 11: Signature Tab

6. CONCLUSIONS

The developed application demonstrates the possibility of replacing the paper-based accident report form with an electronic version. The application includes the primary information from the paper-based form, plus additional information such as photos from the scene. Further conclusions can be made about the software based on the goals presented in section 4.1, Goals, as summarized in the following list:

6.1. Ease of Use

In general, the software appears to be easy to use. The logical grouping of form fields makes it easy to find and organize information. Furthermore, controls such as radio buttons, drop boxes, and checkboxes facility the rapid and easy entry of information.

6.2. Increased Accuracy

The use of pre-populated form fields for dates, locations, etc. should increase the accuracy of incident reports. Some error checking and field validation functionality was included. More extensive error checking and validation would increase accuracy further.

6.3. Eliminate the Need for Transcription

The use of an electronic form like the one developed should generally eliminate the need for transcription. The form can be stored and exchanged entirely in electronic form. It might be necessary to transcribe or at least copy and paste information from the form into other systems if no programmatic link has been built to automate the sharing of information. The development of such programmatic links would be technically feasible in most circumstances.

6.4. Facilitate Computer Analysis

To facilitate computer analysis, a further step would need to be taken. Data would need to be imported into a relational database or other structure that allows for the organization and comparison of structured data. Although not implemented, this is certainly technically feasible with the implemented data storage mechanism for the form.

6.5. Facilitate Information Exchange

Incident information, including sketches and photos, is stored in a single file, facilitating easy information exchange. Note that at this point it would be necessary to use the application to view the contents of the incident record. It would be possible to develop converter or export applications in order to make incident record information readable by other programs.

7. RECOMMENDATIONS

This portion of the project is concluded as a proof of concept, showing that it is possible to implement the form electronically on a Tablet PC. A next step would be to conduct usability tests to verify that the electronic version of the form is viable. Feedback regarding usability and correctness of information could then be incorporated into the software. Further software enhancements would include the ability to import form information into a relational database, for the sake of retrieval and analysis. A rugged hardware system would need to be integrated to accompany the software in a field. It would also be desirable to incorporate data communications capabilities in both the hardware and software. Note that many of these steps have been implemented for a slightly different application in the Redding Responder project.

8. REFERENCES

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