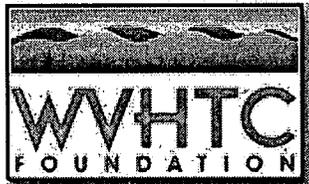


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AmberView – Phase I Report

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July 15, 2005



Returning Children to the
Safety of Their Families

Robert Chico
AmberView Project Manager

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Executive Summary

Over 2,000 children are reported missing or abducted each day in the United States. While the vast majority will be safely returned, about 115 are murdered each year. Seventy four percent of those murdered, are murdered in the first three hours. We can and must do something to stop this. The AmberView program can help. AmberView is a pilot program developed by the West Virginia High Technology Consortium (WVHTC) Foundation to work in collaboration with Amber Alert programs across the country.

The AmberView concept is to take advantage of the latest, cost-effective computer and communications technologies to help in the critical first hours after a child is abducted. Moments after an Amber Alert is declared, AmberView enables the Amber Alert information coupled with a high-resolution 3-D image to be broadcast over the Internet and wireless networks to law enforcement, news organizations and interested individuals in the region where the child could be located. Police officers in patrol cars equipped with standard laptops with an Internet connection (an increasingly common situation) would immediately be notified along with detailed information and an interactive visual image of the child, and additional biometric information. The high resolution image has been designed to aid in the quick visual recognition of the child from various viewpoints (e.g., in a passing car). The image would also be sent to television stations for immediate broadcast. Web-based news services such as CNN.com and FoxNews.com would have the child's enhanced image on their home pages within seconds. And anyone who has signed up to be notified of a child abduction in their region would receive notification with the enhanced image embedded in a high-priority email. Eventually, wireless Personal Digital Assistants (PDA's) and cell phones would be included in the system.

In the Pilot, the high resolution image was garnered using three 3-D cameras. For the Pilot, the cameras were used to enroll a total of 230 children ranging from 10 to 14 years of age at three schools in three different counties in West Virginia. Enrollment was completely voluntary with parents required to sign consent forms. The information was stored on a secure server. (Due to the privacy requirements of the testing phase, all information was destroyed at the end of the Pilot.)

On February 2, 2005 the Pilot AmberView system was publicly demonstrated at the WVHTC Foundation in Fairmont, West Virginia. It was well attended by officials from the National Institute of Justice (NIJ), U.S. Department of Justice, school administrators, law-enforcement officials, State Amber Alert officials, representatives from the private and public sector and news-media communities. This demonstration resulted in numerous news items, including a widely-distributed Associated Press article. It was also featured on ABC's Good Morning America television show.

It was confirmed in the Pilot that the AmberView concept could be successfully implemented. It was also found to be enthusiastically embraced by parents, teachers and school administrators, law enforcement officers, media and others involved.

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This project (AmberView) was supported by Award No 2004-LT-BX-K002 awarded by the National Institute of Justice, Office of Justice Programs, US Department of Justice. The opinions, findings and conclusions or recommendations do not necessarily reflect the views of the Department of Justice.

Acknowledgments

The West Virginia High Technology Consortium (WVHTC) Foundation would like to thank the National Institute of Justice (NIJ), United States Department of Justice and their representatives, for their support and encouragement in Phase I of the AmberView effort.

It is important to express appreciation for those companies who actively participated in this novel initiative:

- A. Bodyshape Scanners, Inc./Wicks & Wilson Corporation
- B. Direct Dimensions/Minolta Corporation
- C. Galaxy Global Corporation
- D. Genex Technologies, Inc.
- E. Octree Corporation
- F. Lawrence K. Schrank

To each of these program participants, we express our appreciation for the efforts and equipment provided.

1.0 Introduction

1.1 Background

One of the few areas where all Americans, regardless of race, religion, gender, age, political affiliation, or position on controversial issues of the day, can agree is that our children should be protected from abduction by strangers. The numbers are frightening. Approximately 800,000 children are reported missing each year, an average of one child every 40 seconds around the clock. It is estimated that in 58% of these cases, there is no indication of foul play, just a report of a child missing or runaway. However, about 115 children will be murdered each year as a result of abduction.

Once a local matter known mostly to the few touched by such tragedies, the full scope of the horror has become widely known in recent years with the advent of new communication methods such as cable news. The abduction of a Polly Klaas in California now becomes a highly-emotional true story experienced in almost real time by millions across the country. Tragic endings leave us angry and fearful and, in some cases, thinking there must be a better way to handle such situations.

Many have realized that the immediate, widespread communication of a child-abduction incident would be a major key to a solution. The killer of Polly Klaas encountered law enforcement within an hour of the abduction but he wasn't arrested. Instead, they helped him pull his car out of a ditch and sent him on his way. They did not know that the nearby crime had even taken place!

A number of efforts to improve the situation have been undertaken. The most extensive, Amber Alerts, started after the 1996 abduction of Amber Hagerman, 9 years old, of Arlington, Texas. The "America's Missing: Broadcast Emergency Response" (or AMBER, for short) system is a voluntary partnership between law-enforcement agencies and local television and radio broadcasters.

When a child has been abducted and believed to be in danger of serious bodily harm or death, the broadcasters agree to interrupt regular programming to broadcast an emergency bulletin. It employs the Emergency Alert System (EAS) that is typically used for alerting the public to weather, civil or national emergencies.

By the middle of 2002 there were 14 statewide systems in operation. They were credited with the safe recovery of 19 children. On April 30, 2003 President Bush signed legislation making Amber Alert a national program. While systems are usually organized at the state level, this national program helps coordinate state plans, train state officials and showcase new technologies. Statewide Amber alert systems are now in place in all 50 states (Hawaii completed the system on February 18, 2005). They have been credited with a total of 192 safe recoveries.

Later efforts have involved adding the use of the Internet into the communications mix, using email and Web pages. For additional information on missing children, including

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Amber Alert, and references to the statistics used in this report, see the sources located in Appendix A.

The timely communication to thousands via radio, television, the Internet, roadside signs, etc. with the news that a child abduction has taken place has clearly been successful and prevented or deterred many tragedies. The value of the information currently communicated is limited, however. A description of the clothes the child was wearing, even if available, may or may not be valuable. The quick broadcast over the radio of the description and license plate number of the vehicle used in an abduction could be what resolves a particular case but such information is usually not immediately available. In a recent case with a tragic ending, it took 19 hours before the child's picture was available for broadcast. And while just the knowledge that an abduction has taken place is extremely valuable by itself, a major question remains. With all our new technology and computers and the Internet, couldn't more be done?

A study provided by the Attorney General of Washington State indicates that the first 3 hours after the abduction are critical for the safe recovery of the abducted child. These statistics show that a staggering 74% of the children murdered are killed in those first three critical hours. This statistic is the forcing function for AmberView, a system designed from the start to aid the Amber Alert coordinators in getting powerful information and an enhanced image out to the masses so that a quick recover can be made.

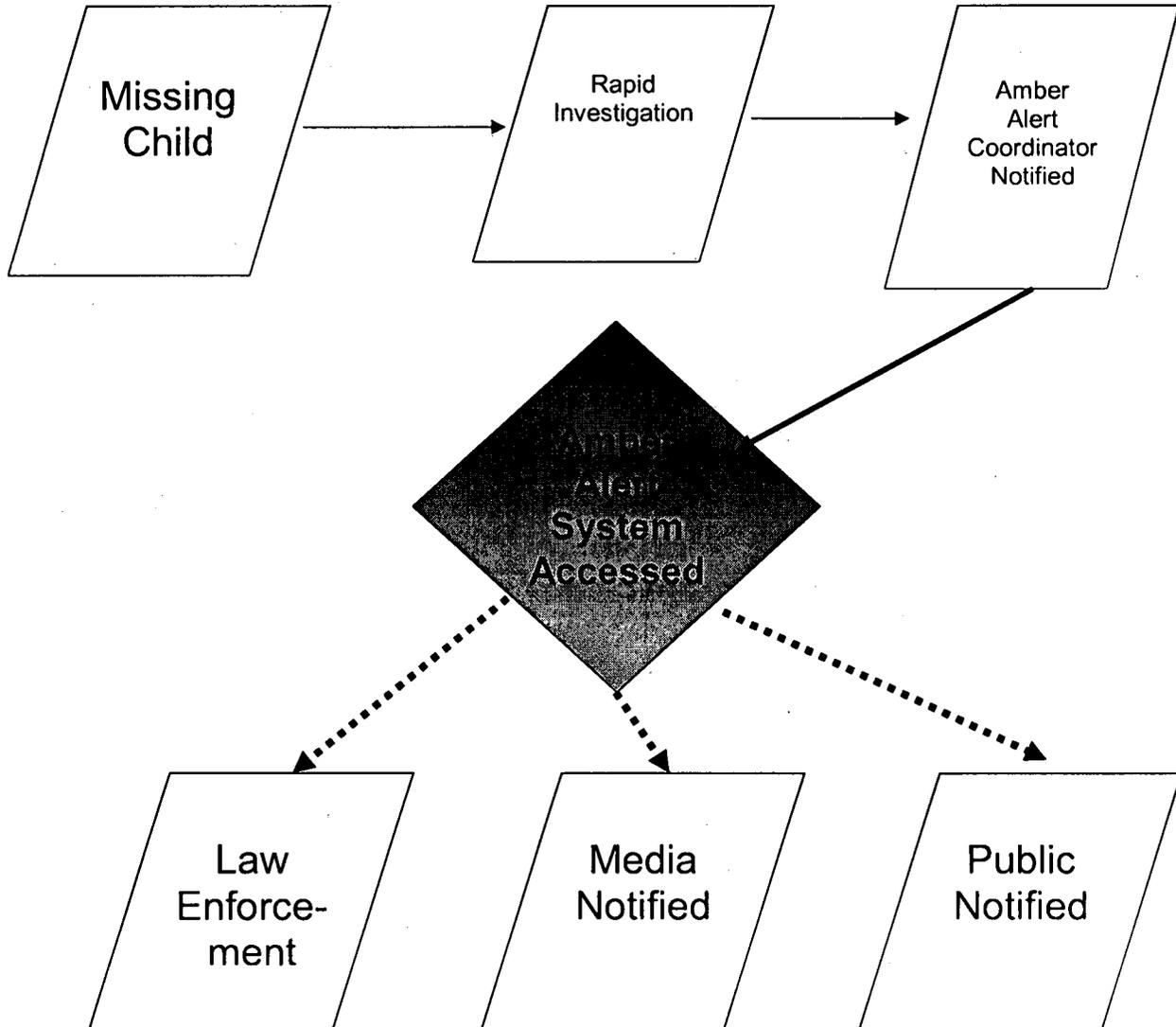
We see AmberView having an impact in three major manners:

1. AmberView is the mechanism where the entire law enforcement community is made aware of the criticality of a rapid investigation and a timely alert.
2. The AmberView system is loaded and ready when the Amber Alert official needs a mechanism for a rapid, mass alert.
3. The existence of the system can very well be a deterrent, the optimum success.

1.2 AmberView Concept

AmberView is the next step. The idea is to preload a computer database with whatever information that may be relevant to an abduction, including enhanced images of the children in the region. The AmberView system comes alive if a child in the region is reported missing and the evidence, as reported by local law enforcement, rises to the level necessary to trigger an Amber Alert (as determined by the official Amber Alert Coordinator). The Amber Alert official then enters the secure AmberView system, matches the missing child information with the image in the database, selects the appropriate "alert" region, and selects "send." The AmberView system immediately transmits the appropriate information, along with whatever is known about the incident, and the enhanced image is instantly transmitted via the Internet and wireless networks to all relevant parties. This includes law enforcement officers on patrol (if, for example, their patrol vehicle is equipped with a laptop and Internet connection, as is becoming

more common). Broadcasters, journalists and the general public would be provided with relevant information and the enhanced image.



1.3 Why Enhanced Images?

The goal is to quickly, within minutes, have thousands of eyes on the lookout and able to recognize the abducted child. But how do we make those eyes "productive" or tuned to recognize the victim based, perhaps, on a brief sighting from a chance viewpoint under unknown conditions?

A clue can be found by studying the human visual system. The ability of people to navigate and operate in a fast-moving, three-dimensional world is remarkable and is unmatched by any computerized system. A popular misconception is that the human vision system is similar to two television cameras (the eyes) connected to a computer (the brain). It is much more complex (and not well understood). We do know that the

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processing begins right in the eye itself where layers in the retina perform sophisticated operations that begin to identify features in the scene (such as edges and movement). By the time the information reaches the brain, a large amount of higher-level information has already been extracted. It may seem that we simply sense what is essentially a video seen by our conscious "self" in some way. Indications are that information derived from the scene actually goes to many structures in the brain with specialized and somewhat mysterious functions. Here it may be combined with previously experienced visual, emotional and other information.

A large part of the human brain, perhaps half, is devoted to vision and visual recognition. And within this, much is dedicated to identifying faces. Infants spend a lot of time studying faces. It is now believed that problems can arise later in life if an infant does not have enough "face time" studying moving faces at a close range.

The general strategy that humans use to recognize faces is partly understood. A large amount of effort is undertaken in analyzing the individual components that constitute a face and how they operate. This includes eyes, nose, mouth and so on. As an indication of the accuracy and sophistication of this capability, often slight abnormalities in a face that would be hard to distinguish by measurements are readily apparent to even a child.

The human visual system developed partly to enhance survival by quickly recognizing friend or foe in the "real world" not in a world of photographs. We seem to build up a mental model of someone's face from viewing it from many directions as we interact with the person or view their movements. We can then use this to almost instantly identify someone from even a brief, distant glimpse.

The task for AmberView, then, is to devise some way to harness this incredibly powerful human recognition capability for finding abducted children. The method selected was to generate a highly-realistic computerized model of children using a 3-D camera and then, in the case of an abduction, to broadcast this to thousands so they can, hopefully, become visually familiar with the child with a few seconds of interaction with the model. The goal is thousands of eyes sensitized to the missing child and helping law enforcement return the abducted child to the safety of his or her family.

The need for positive identification of missing children has been well documented and a robust program of fingerprinting children has been well established. **Unfortunately, identifying missing children through fingerprints has little to do with returning the children safely.** Recent years have proven to be tragic for children being abducted and harmed, resulting in development of "Amber Alert" programs in many communities. The evidence suggests that a detailed description of the missing child, broadcast quickly, is paramount to successfully recovering the child.

1.4 AmberView Pilot Project

The AmberView Project was a coordinated pilot program in West Virginia designed to work in collaboration with the State and National Amber Alert Programs. This planned

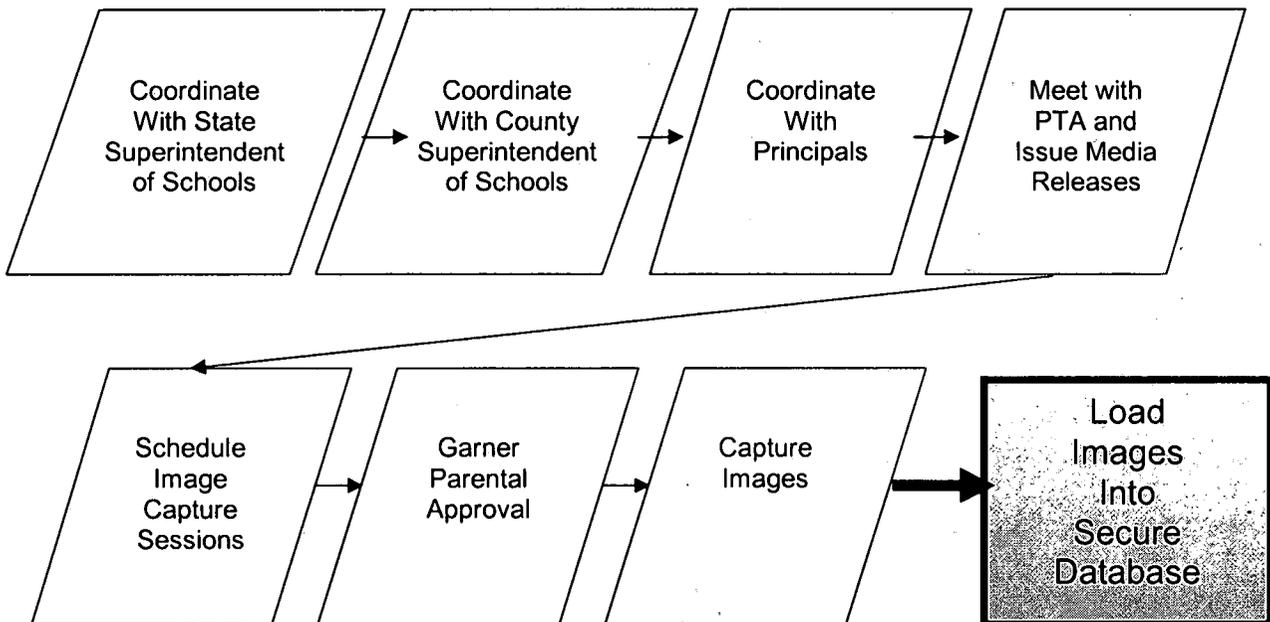
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effort demonstrated the ability to mass broadcast a digital 3-D facial picture of a missing child to law enforcement officials, media organizations, shopping malls, airport monitors, cell phones and other destinations within minutes of the abduction.

The study population included 3-D images from a sample of middle school students as well as surveys, interviews, and questionnaires of participants to collect valuable data and information to measure and evaluate the effectiveness, utility and perceived usefulness of this novel project. No personal information was collected during the imaging or with the surveys, interviews, and questionnaires.

April 2004

The West Virginia High Technology Consortium (WVHTC) Foundation was awarded a contract from the National Institute of Justice (NIJ), U. S. Department of Justice to implement the Pilot project study. This effort resulted in the voluntary acquisition of 230 3-D images of West Virginia school children from multiple regions (counties) aged 10 to 14. On February 2, 2005, the Pilot AmberView System was demonstrated to government officials, business representatives, law enforcement officials, media organizations, academia and the general public at the WVHTC Foundation facility in Fairmont, West Virginia.



During the demonstration, a simulated faxed report of a child abduction was handed live to the Amber Alert Coordinator (AAC) for West Virginia. Using the information contained in the fax he was able to confirm the identity of the child and that she had been enrolled in the AmberView system. Then, after further examination of the details of the situation as reported by the police officer on the scene, he decides to declare an Amber Alert. The AAC then accessed the secure AmberView system and, using the investigation information, found the enhanced image of the missing child in the database along with other relevant information. Then the AAC selected the region

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where the Amber Alert was to be broadcast. The AAC then was asked by the system to confirm both the image and the area. After confirmation, the image and other relevant information was sent to multiple addresses in the region.

Within a few seconds the group gathered for the event heard the blast of a police car's siren confirming that the 3-D model was now being viewed on a laptop in a police vehicle in a nearby parking lot. Within minutes, pre-selected members of the audience arose holding their cell phones to announce that a police agency or a news organization or an individual, all miles away, now had the alert information and were viewing the 3-D model of the missing child.

The event resulted in numerous television and press stories. A CD of the press coverage is attached to this report. This included a widely-distributed Associated Press article and was also featured on ABC's Good Morning America television program.

1.5 Additional Information

Appendix A contains contact and other information on AmberView. There are also addresses, phone numbers and Internet links that can be used to obtain additional information about missing children and the agencies and organization involved.

Appendix B contains a detailed description of Amber Alert and how it operates plus how the AmberView system fits in with it. This compact description brings all of the relevant information together in one place and is a good source for discussion material.

Since evaluating 3-D cameras for use in AmberView was a major part of the Pilot, the details of the use and evaluation are contained in Appendix C. Appendix D contains the safety statements from the camera manufacturers.

A lot of thought and effort went into developing the education materials, forms, surveys, questionnaires, and related items used in the Pilot. The major ones are included in Appendix E. Appendix F contains letters of support from the State of West Virginia and the school districts involved.

2 AmberView

2.1 The Challenge

The development of a practical child-visualization system to help prevent a tragic ending when a child is abducted faces many challenges. They include:

- a) Speed – Visual information must be communicated very quickly after an abduction occurs.
- b) Effectiveness – To provide more than a marginal increase in the probability of the safe return of a missing child, a system must be capable of enabling a large number of people to effectively identify someone they have never met, probably based on a brief, chance sighting.
- c) Coverage – To be effective, information needs to be made available not just to law enforcement and the news media in the area of the abduction but to the public throughout the area to where the child may have been moved in the time available.
- d) Convenience – If a large number of people are to receive AmberView information over a wide area and they are to immediately begin looking for the missing child, the AmberView Alert information must be in a convenient, readily usable form requiring very little or no training, education or experience.
- e) Cost – Since we cannot predict which individual children will be abducted, to be effective a large fraction of children that are in the high-risk age and gender categories must be enrolled for AmberView. This means that the enrollment cost per child must be relatively low. Likewise, the cost to local law-enforcement agencies, both in time and money, cannot be excessive. And, if we hope that a large number of ordinary citizens are to be on the lookout for a missing child in the critical first hours, the cost to individuals must be very low.

2.2 The Plan to Address the Challenge

The concept of AmberView is to develop an effective and efficient visual identification system for missing children by leveraging existing, commercial products and services to solve these challenges. The plan is as follows.

- a) Speed Plan - The solution to the speed issue is to acquire any needed information before hand, in an enrollment process and to safely store it in a secure computer database where it can be accessed if that child is officially declared to be missing.

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From a technical viewpoint, advances in the areas of computer technology such as servers, database software and large disk drives make the storage and fast retrieval of this information for distribution on the Internet achievable at a low cost.

b) Effectiveness Plan - A system to enhance the visual identification of a child depends on the incredibly-powerful ability of the human visual system to identify faces. As noted above, studies over the years shed some light on how this works. People are capable of almost instantly identifying, with a high degree of accuracy and reliability, someone in a photograph, over a wide range of viewpoints, lighting situations, contexts, etc. if they are familiar with the person through visual interaction. This, of course, includes family and friends, but also actors and actresses, athletes, celebrities, and politicians from television or movies who we have "interacted" with as viewers or spectators.

Tests have shown, however, that humans are not good at identifying unknown people from just photographs. It seems likely that we must build up some form of mental model by viewing the movement of someone's face before we can readily identify them under widely varying viewing conditions.

The goal of AmberView is to very quickly provide this "visual familiarity" with a child one has never seen before to a large number of people. The approach taken here is to take a 3-D photograph using procedures similar to conventional photography and then to be able to quickly distribute the 3-D model over a wide area such that the child can be quickly viewed from a wide variety of viewpoints to build up a mental model for later identification. These views can emphasize those that are especially relevant in a missing-child situation such as those of someone in a passing car, at a shopping mall, or convenience store.

To be effective, for example, the model of the child's face sent to rapidly sensitize the viewer to the appearance of the child must be accurate; otherwise the results could be counterproductive.

c) Coverage Plan - The distribution of visual and other information to a large number of organizations and individuals very quickly and at a low cost can now, of course, be readily accomplished using the Internet. With almost all offices and businesses wired for high-bandwidth access and a large percentage of homes having access (60% have high speed), AmberView leverages this resource.

d) Convenience Plan - While acquiring text and photographic information, storing it in a database and then distributing it widely over the Internet has been a reality for some time (e.g., cnn.com), how can this be done in 3-D? As it turns out, this technology has been developed for other uses and is now commercially available. 3-D cameras that use patterns of light projected on to someone's face over, say, a few seconds to acquire a highly-realistic 3-D data set are readily available from several companies. Methods have been developed to

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automatically process such data into 3-D models for inclusion in conventional databases. In addition, such models can be retrieved and viewed in 3-D by an almost unlimited number of people using widely available Internet browsers (such as Microsoft's Internet Explorer) at no cost to the viewer. Again, AmberView leverages technology developed over the years at great expense for other application areas.

e) Cost Plan – As noted above, the cost for securely storing large amounts of 3-D and other data and then distributing selected portions to a large number of users in an emergency has become very inexpensive in recent years. 3-D cameras, however, are not in widespread use and are still relatively expensive (they ranged from \$11,000 to \$26,000 for the three cameras tested for this project). There are no inherently expensive components in these systems, however, and it is expected that camera cost will drop significantly as unit sales increase.

It should be noted that several very low-cost technologies exist for acquiring 3-D face information (two-camera systems, extraction of 3-D shape from one or more photographs, etc.) but that model accuracy may not yet be considered adequate for AmberView use. However, the use and conversion from 2-D to 3-D images is a cost option that needs to be further explored and evaluated in Phase II to ensure broad acceptance and utilization.

Software for the automatic processing and generation of 3-D face models is available for less than the cost of a camera and free 3-D viewers are also available, making the cost of cameras the major equipment expenditure for an AmberView implementation. There are, of course, major non-equipment costs involved in organizing and implementing an AmberView system such as photographing large numbers of children. The organizational, administrative, and maintenance costs also require review, to ensure effective utilization and program longevity and understanding.

2.3 Long-Term Issues

There are many issues to examine when considering the implementation of an AmberView system. While an effort was made in the Pilot phase to address the important issues, many will, no doubt, continue to be subjects for discussion in the future. The major issues that have surfaced are as follows, in a roughly decreasing order of importance, as currently perceived.

2.3.1 Safety

It is the goal of the AmberView effort to enroll large numbers of children where each may be photographed in 3-D multiple times during their childhood. It is vitally important that the 3-D photography process itself pose no danger to a child. This was the most important consideration in the selection of equipment in the Pilot and will continue in later phases.

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As will be described in more detail below, the three scanners used in the Pilot acquire a 3-D representation by projecting a pattern of light on to the subject's face over a short period of time, usually a few seconds. A conventional digital or video camera captures a photo of how the light is distorted by the face. A computer then calculates the actual 3-D information. One camera tested uses a standard video projector as you might find in a house for viewing videos or in an office meeting room to view presentations. The second uses a custom light projector with similar characteristics while the third uses a fast moving sheet of eye-safe laser light.

In all three cases statements were obtained from the manufacturers attesting to the safety of the scanners with human subjects before the scanning of children began (see Appendix D). For the two systems that use conventional white-light projection, the effect is very similar to being photographed with a camera flash, especially one with a "red eye" reduction feature in use where the light flashes several times over a short period. Outside observers will notice, however, the projection is actually of a quickly changing pattern, rather than uniform illumination. The potential risks to a child, if any, is thus very similar to that of conventional flash photography which obviously has a long history of safe use.

The third employed laser illumination. This may have advantages in acquiring a data set with precise information because of, for example, the uniformity of the light. The danger of powerful lasers to humans, especially to eyesight, is well known. This is primarily, however, due to the ability of a laser to generate a concentrated beam that will focus the energy on to one small spot. The damage increases with the length of time that the beam is focused on the same spot. A laser beam that is not focused on a single spot or that is constantly moving will be safer. The laser illumination used in one of the Pilot cameras is spread out into a "fan beam" or sheet of light, rather than a point, and it is constantly moving to sweep over the subject's face. Based on current knowledge it is therefore "eye safe" and poses no known danger to humans.

While the methods used in the Pilot are believed to be completely safe and no injuries or complaints occurred, the issue of safety should always be an area of constant diligence. And while the three cameras used in the Pilot were shown to be safe, scrutiny must, of course, be applied in this area to any new camera or technologies considered for use.

2.3.2 Privacy

After safety, the privacy of the personal information of the enrolled child is perhaps the single greatest issue of concern. While the Pilot enrollment was voluntary, requiring a signed parental consent form, privacy is nonetheless a powerful and controversial issue that will be debated for a long time. However, without the collection of certain biographic data to be used in conjunction with displayed photos, the AmberView Program has limited benefit or value. However, **security of the information is the major concern.**

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There are, in general, several types of information that could, potentially, be stored in the database. These include:

- identification (child's name, address, gender, date of birth, phone number)
- family (parents' names and addresses, sibling and grandparent information, etc.)
- school (grade, etc.)
- 2-D or 3-D photo
- legal (custody situation, restraining orders, etc.)
- parents or legal guardians, names, addresses, social security number
- date of photo

In the AmberView Pilot Project, **NO** personal identifiers or other information linking the student volunteers to the scanned images were acquired (this was due to NIJ Research constraints). During the February 2, 2005 demonstration, "bogus" biographic information concerning the scanned student volunteer was used.

While addressed in the Pilot, the exact items needed in an operational system (and which items would be made available to who) remain to be determined in conjunction with the Amber Alert Coordinator.

The sensitivity of the issue depends, to a large extent, on the collective set of information that could be obtained from a database and potentially put to undesirable use. For example, just the name of a child in a database may be useless in isolation. If combined with a home address, an email address or the name of the child's school, concerns could range from unwanted commercial mail to online communications of an undesirable nature to a targeted abduction.

A simple solution that has been used in previous child identification systems is to place all the information on a plastic card the size of a credit card for the child's parents and then to delete it immediately from the enrollment computer. In other words, there is no database; the information is only possessed by the parents. A typical card would have the child's name and birthday plus a photo of the child's face and one or more fingerprints. This could be enhanced by adding a 3-D or 2-D photo or other information in digital form.

Such a card can be useful outside of the Amber Alert system and could be provided to parents even if a database is maintained. If a child becomes missing in a store, for example, a parent could immediately show the card to store security. In the case of an abducted child, however, the card would need to be produced by the parent and the information somehow taken or communicated to a central location. An unavailable, misplaced or lost card would be useless. This process would take valuable time, effectively reducing or eliminating the fast dissemination of the child's information, one of the major goals of AmberView.

Laws that restrict the acquisition and use of private information vary at the state, county and local levels. The taking of fingerprints by authorities is severely restricted in some

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regions, for example. A person's face is considered to be more or less public information, however, and there are little or no restrictions on simply taking a photo of someone's face in a public place. Inappropriate use is another matter, of course. The taking of a 3-D photograph has generally fallen under the same rules as a photograph but the technology and use is sufficiently new that the legal distinctions between 2-D and 3-D may evolve in unpredictable ways in the future.

For a number of reasons, including security, standardization and control, it was planned that AmberView databases would be set up and controlled by the West Virginia State Amber Alert Coordinator within the WV State Police Department. Information would be released to restricted groups only under tightly prescribed conditions as established and utilized by the State Amber Alert Coordinator. In any event, high standards of security will need to be employed by WVHTC and those who will be entrusted with the AmberView data.

2.3.3 Effectiveness

AmberView is based on the belief that a rapid dissemination of a child's photograph and associated information will aid in the visual identification of an abducted child by law enforcement and the general public, and will result in a reduction in the pain and suffering of such a child and in an increased chance for survival. 74% of the abducted children who are murdered are dead within three hours of the abduction. Since child abduction is, thankfully, rare and large numbers of children would need to be enrolled over a considerable period of time, the quantitative effectiveness of an AmberView system in actual use cannot be truly known for some time.

It may be desirable to conduct tests of improved identification in, for example, staged cases of children being driven past an observer. Examining past cases for opportunities for visual identification that may have existed could be undertaken. While such efforts might be useful, there are simply too many unknowns to make valid predictions. Identifications are often chance occurrences that are difficult to predict analytically or statistically. Theoretical results can be very sensitive to the particular set of assumptions selected beforehand and can easily lead to wildly optimistic or pessimistic predictions.

The method used in the Pilot to obtain some measure of expected effectiveness was to consult those with actual experience in such cases, law enforcement officers. The general belief was overwhelmingly found to be that, yes, such a system would, if properly implemented, be beneficial. It would certainly be welcomed as a new tool by those professionally responsible for handling abduction cases, partly because there are so few tools available to them today.

Biometrics is the use of physical attributes (fingerprints, facial features, patterns of the eye's iris, etc.) to identify or confirm the identity of a person. Biometric systems are being developed for both security and convenience (gain entry to a building or shorter line at an airport, for example). Most systems today require the cooperation of the subject by, for example, placing a particular finger on a sensor or standing still for a

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photograph. Future systems, especially those based on facial features, will eventually be used for surveillance of unaware individuals at airports, border crossings and other areas. The AmberView data collected for an abducted child could eventually be used by such systems to increase the likelihood that a child would be located. The utilization of such biometric technology will be considered and evaluated in future AmberView efforts.

2.3.4 Cost

By taking advantage of existing computer and Internet technologies and products, the cost to store and widely distribute AmberView information is very low. The cost of organizing, managing and conducting the enrollment of large numbers of children would be much more substantial, however. And while some police departments have already equipped vehicles with laptop computers and Internet access, many have not. The cost to assure that all police on patrol could immediately receive AmberView information could be substantial in some communities. Determining the actual cost has been a major part of the Pilot and will continue in Phase II.

Although there has been virtually universal support for the AmberView effort to date, critics could question whether the costs would be better spent elsewhere (perhaps until the first child is returned to his or her parents aided by AmberView). Questions will, however, remain over who should pay. Candidates for consideration include government at the federal, state, county and local levels, national or local corporate sponsors, local volunteers (for labor), parents who have the ability to pay, Boards of Education, and so on. In some states the yearly photography of students in the school system is mandatory. Parents typically subsidize this through the voluntary purchase of optional packages (e.g., wallet photos or mounted prints for the grandparents). Perhaps such an approach could help pay or subsidize the funding of this novel program. In any event, reducing the enrollment cost per child to a minimum is and will continue to be a major part of AmberView. Alternate photographic methods and processes will continue to be explored and evaluated in Phase II.

2.3.5 Organization

It is not immediately obvious how a large scale, perhaps national, implementation of AmberView should be organized. Because of the differences in laws and responsibilities in various jurisdictions across the country, it is expected that AmberView systems would be organized by state or by regions within states, as with the Amber Alert system today. It would seem clear that state police organizations would have a major role. Since overlapping jurisdiction in these matters is more the rule than the exception in the U.S., the organization of AmberView systems is expected to continue to be an active area of interest. The concept of regional "multi-state" Amber Alert Programs should also be explored as a viable alternative.

Another consideration is that interested groups may wish to implement AmberView-like systems outside the Amber Alert community. One could envision, for example, a system that would be implemented within a community where a local alert could be

declared for a situation that didn't rise to the level of seriousness required to issue an official Amber Alert.

While just about any help that can be provided in finding missing children is important, it is also important that groups, while perhaps free to do mostly whatever they like, not work at cross-purposes and waste what would otherwise be valuable support. Amber Alerts in one region or state need to be recognized in all regions or states to ensure maximum effectiveness, efficiency, and multi-state collaboration.

2.3.6 Standards

Since future AmberView systems will, most likely, be somewhat independently organized and customized for the perceived needs of a region, it is important that universal standards be established. This includes standards for picture size, what mandatory and optional information can or should be acquired, how it is represented and stored, and how it is transmitted between systems and to interested parties during an alert. And since the overall success of enrollment efforts may be sensitive to costs, competition in equipment purchases will be important. Standards will thus be needed for the various components to ensure performance, compatibility and effective utilization of resources.

3 The AmberView Pilot Project

3.1 Organization

The West Virginia High Technology Consortium (WVHTC) Foundation is a nonprofit 501 (c)(3) with more than ten years of Federal government contracting experience. Leveraging five years of research and COTS product suitability testing, it has established the Biometrics Center of Excellence (BIO COE). This center orchestrated and coordinated the AmberView pilot program in West Virginia to digitally record and store the 3-D facial image of school age children (with parental approval). The biometric data will be stored on a secure server located at the WVHTC. Unless an "Amber Alert" is posted for a child, all photos and information will be maintained in a secure database accessible only to authorized users.

Upon receiving an authenticated request, the WVHTC will immediately post the 3-D image to the AmberView Missing Kids website and simulcast the image to the appropriate recipients (federal, state and local law enforcement, and to all regional television stations and civic groups). Since the data is stored in a digital file, it can be quickly transmitted electronically to a vast array of recipients. Within minutes of notification, thousands of people in a several hundred-mile area will be on the alert to find the missing child. Using a mouse or other pointing device, the image can be enlarged and viewed from any angle—making positive identification much easier.

This center capitalized on previously developed WVHTC Foundation processes and the biometrics research, testing, and training capabilities of Foundation partners to develop, install, and maintain the system.

3.2 Goals and Objectives

The major goal of the Pilot effort was to validate the AmberView concept and process. Could large numbers of children be enrolled in an efficient and timely manner in 3-D? Would such a system be supported by the major parties that have an interest? This included parents and teachers as well as government administrators, law enforcement, civic organizations, education officials and others at the local, state and national levels. And, of course, it's important to determine the reaction of the students and acceptance and cooperation of the community.

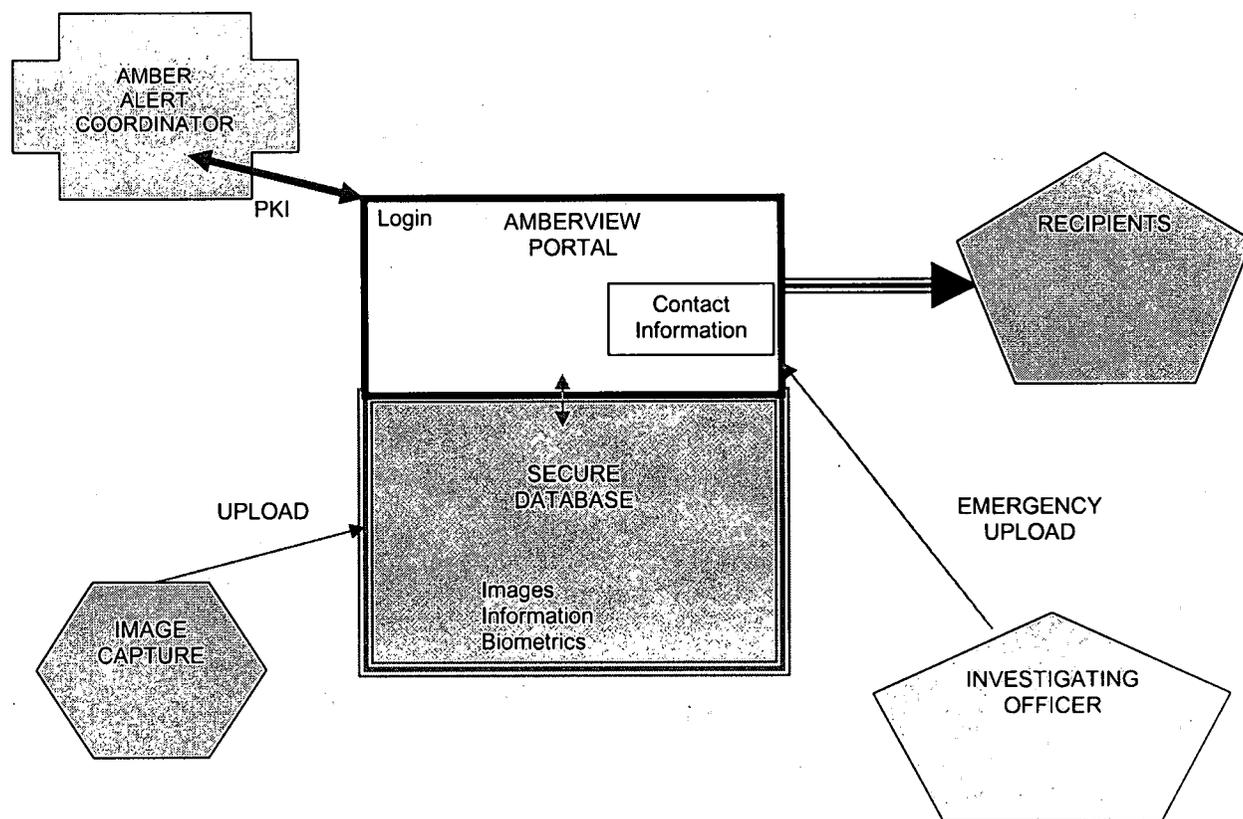
After enrollment, could a large AmberView database be securely maintained and then utilized in a timely fashion to locate key information based on early reports from law enforcement personnel in the minutes after an abduction? If recovered, could the relevant data be widely distributed to law enforcement, the news media and the general public quickly enough to make a difference? And finally, could we expect that a fully deployed AmberView system would actually aid in the return of abducted children?

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The program assembled the hardware and software to enable the immediate dissemination to proper authorities and to the public of the image of the missing child.

Other specific goals were:

- To determine optimum communication and distribution systems for these electronic identification files;
- To design a prototype website as a single portal for collection and dissemination of critical information;
- To determine the optimum techniques to protect the image files from being accessed by criminals and undesirable audiences; and
- To initiate planning for expanding the program within West Virginia and nationally.



3.3 Tasks

Major tasks were planned as follows:

- Evaluate 3-D cameras and select three that would be safe and sufficiently accurate for use in AmberView. Arrange for their use.
- Organize and train a small team of personnel to perform enrollment within schools.

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- Plan and execute an extensive program of information, education and discussion with agencies, organizations, groups, parents and individuals who are interested and whose support and approval will be necessary or important.
- Select an appropriate set of schools and classes for enrollment. Obtain the needed approvals from parents or guardians to implement the scanning process.
- Generate educational materials, fliers, surveys and questionnaires for (1) law enforcement, (2) government administrators, (3) school administrators and teachers and (4) parent groups and individual parents.
- Select the software components needed and arrange for the development of processing, storage, transmission and presentation programs required to implement AmberView.
- Develop an integrated procedure for enrollment operations.
- Conduct enrollment at selected schools, recording important processes for later analysis.
- Conduct follow-up discussions and evaluations by selected participants.
- Develop a secure database system for AmberView information and establish procedures for administration and use.
- Develop pre-alert and alert procedures that integrate with the established Amber Alert process and the Amber Alert Coordinator.
- Determine the methods to be used to disseminate AmberView information.
- Decide on groups or individuals who are candidates for testing the notification part of an alert.
- Educate and establish a relationship with those selected for test notifications and solicit any suggestions or recommendations.
- Establish criteria for testing and evaluation.
- Plan and conduct a public demonstration of the Pilot AmberView system and disseminate the AmberView story via multiple media outlets.
- Generate a final report for the Pilot.

4 The Technology

4.1 Introduction

Several major commercial technologies were brought together and integrated to implement the Pilot AmberView system. They can be divided into four areas, (1) 3-D cameras, (2) face modeling, (3) display and (4) distribution.

4.2 3-D Cameras

There are a number of technologies available to acquire 3-D information from the "real world." Industrial laser scanners are routinely used to generate 3-D data sets of existing "as built" facilities such as power plants and oil refineries. While such systems have powerful capabilities for industrial use such as a long range, they cannot be used with AmberView for several reasons. They are expensive (typically \$90K to \$150K), are slow for scanning something as small as a face, may be too powerful to be completely safe for unprotected eyes, and so on.

Medical scanners such as CT (Computer Tomography) and MR (Magnetic Resonance) systems are routinely used for diagnosis and treatment planning but are unsuitable for AmberView. They generate information on internal organs which is not needed for AmberView; they are large, not easily moved and are very expensive. In addition, they may not be completely safe for routine use, especially for a developing child, a situation clearly not acceptable with AmberView. CT scanners deliver a small dose of radiation, for example.

The 3-D cameras considered for AmberView are short-range systems using what is called "structured light." They have typically been developed to digitize (create a 3-D computer model of) relatively small objects such as mechanical parts for use in Computer-Aided Design (CAD) systems and for scanning faces and other parts of the body for use in medical, animation, game or other applications.

There are various forms of structured-light systems. They are all based roughly on the following principal. Consider a system that sends out a narrow beam of light in a known direction into a scene containing someone's face that is, say, 4 or 5 feet away. A camera then takes a photo of the scene using a conventional (2-D) digital camera at a known, nearby location. Let's say it's a foot from the source of the beam. If the beam illuminates a tiny location in the scene and that location can be seen and automatically located by the camera, the 3-D location of that point in space (relative to the camera) can be estimated using basic trigonometry. This is similar to the process of "triangulation" routinely used to locate, say, a radio transmitter. If two separated receivers with known locations can determine a direction to the transmitter, the intersection of the two direction lines on, say, a map will pinpoint the transmitter's location (to some degree of accuracy determined by a number of factors at play in the actual situation).

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Of course, in trying to obtain a 3-D model of a face, determining a single point on the face is useless; many such points are needed. A number of schemes have been devised to accomplish this. A pattern of light containing many points of light or a more complex pattern, perhaps using various colors, may be projected, for example. This may be done several times over a short period of time, generating more points or more accurately resolving previously found points.

An associated computer analyzes the patterns, or, more accurately, how the patterns are distorted by the face. After a few seconds a large array of 3-D points (usually between 65,000 and 450,000) is available for additional processing.

It should be understood that this is not a perfect process. For example, if someone is standing too close to the camera, some parts of the face may not be visible to the camera and will not show up. Remembering that the 3-D location is a calculated estimate, the accuracy depends on the actual geometry. Some regions in space will be better ("sweet spots") than others. If standing too far away, the number of points acquired on the face may be a small fraction of the total number of possible points, resulting in reduced accuracy. There may also be lighting issues. Direct sunlight, for example, may wash out the projected pattern, resulting in missing points. Or special lighting used, for example, in a gym or auditorium may cause problems.

Along with the images of the patterns, a conventional color photo is also taken. It is later projected on the points within the computer so the actual color value of the face (or hair, or shirt or jewelry or whatever) can be determined. This makes the 3-D model look realistic when viewed later. As with conventional photography, illumination and other problems can degrade the results here also.

Remembering that 3-D points can only be generated where the projected light can illuminate the face and where the camera can see it, the positioning of the face is important. If the subject is not looking straight at the camera, some part of the face may be missing. And any part obscured by hair or clothing will not become part of the 3-D model.

Movement during the scanning process can easily be a problem. If multiple patterns are projected and pictures taken, movement between images will result in errors. This has been found to a problem with very young children.

Because of the sensitivity of the results to lighting, the exact geometry of the situation, etc., there may be calibration procedures that must be performed when the camera is moved to a new location.

The bottom line is that each type of 3-D camera has its own set of characteristics. As with a sophisticated conventional film camera, it takes some experience to "get it right" and to become proficient in its use. After this learning period results can be expected to be consistently good, with occasional exceptions.

4.3 Processing Models and Display

The 3-D cameras generate an array of 3-D points on a face. Various processing operations are needed to "clean up" this data before it is usable in AmberView. First, there may be extraneous points (from, for example, an unruly hair) that must be eliminated. There are often missing points also. This occurs around the eyes where light entering the eye is lost or where reflections off the eyes can cause problems. It is also necessary to fit a seamless surface over the face so it appears realistic and not just as a set of points.

A very important characteristic of these processing operations is that they must be performed automatically. And they must be done quickly, at the time of scanning, so the operator will know if the scan was a success and the subject can be released. A problem will necessitate a "retake" as in regular photography. If even a small amount of manual effort is routinely required to analyze and process the data set, the workflow may be disrupted, decreasing throughput and increasing costs.

Next, the 3-D model must be compressed into a form that maintains the fidelity of the child's face and can be readily stored and transmitted for viewing over the Internet. Finally, a viewer must be available for viewing the 3-D data within a standard web browser. An important characteristic of the viewing software is that it must be able to load automatically. To be effective, the use of AmberView must be convenient for law enforcement, the media and the general public. It cannot require technical skills or a complex installation process, especially during an AmberView alert. A second major characteristic of the viewer is that it must be free. This is necessary for widespread acceptance as well as to ensure its rapid use (without the entry of credit card information during an alert, for example).

The use of conventional 3-D graphics or "polygon" technology as used in video games would seem to be the obvious choice for AmberView. It is in widespread use, is well understood and hardware accelerators are readily available in game boards for PCs.

There are some major limitations, however. Such methods are based on the use of simple polygons, triangles, to represent surfaces. Since a relatively small number of triangles can be used to represent large, flat surfaces, this technique is computationally efficient where the number of triangles can be limited. In video games, for example, skilled artists work with a "triangle budget" and use small triangles only where absolutely necessary to represent curved surfaces in order to visually accomplish an important objective (e.g., the stylized face of a game character).

When dealing with organic shapes with complex surfaces, however, the number of triangles needed to maintain fidelity becomes excessive and burdensome. This has been alleviated somewhat in recent years for display by the use of massive amounts of hardware. Modern game chips, for example, use in excess of 150,000,000 transistors for image generation. While impressive, such chips fail to meet the needs of AmberView. First, they are dedicated to performing only display. Large amounts of 3-D processing are required in AmberView which a display chip cannot accelerate. Second,

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to transmit an AmberView 3-D data set with the full fidelity available from the camera requires the transmission of large files. And third, not all potential viewers of an AmberView alert will have an advanced 3-D game chip available for use in their computer. This will be especially true as AmberView moves to Personal Digital Assistant's (PDA's) and eventually to cell phones.

An alternative 3-D method called "Octree" technology was adopted for AmberView. It was developed for handling large amounts of "real-world" 3-D data rather than for video games. It's employed in 3-D medical systems, biometrics, industrial laser systems and in other areas.

Based on the TrueSolid package from Octree Corporation, the "Kids View Builder" program was developed, partly as a result of the AmberView Pilot effort. It is capable of performing the 3-D processing operations in a timely fashion and of generating a compressed 3-D file suitable for transmission over the Internet. In addition, a free viewer called "Octree View" that can be automatically loaded for viewing 3-D data sets in popular browsers, PowerPoint presentations and in the AmberView facial image that can be "burned" to a mini-CD and made available to parents that contain both facial image and other personal data.

4.4 Distribution

The basic premise behind AmberView is that information that will be important in locating a child in the early hours after abduction will be available for almost instant distribution from a database. While there are a number of important issues concerning the establishment and use of such a databases, the technical implementation is mostly straightforward.

The child enrollment process results in a 3-D data set in the form of an Octree or ".oct" file with a unique name, currently related to the exact camera and the time and date the data was captured. In addition, a record is generated in a database containing all the information determined to be needed within the local jurisdiction such as name, birthday, and so on. An option within the Pilot was to generate a mini-CD with the 3-D scan and related information for later mailing.

When inserted into the CD drive on most computers it self-installs the viewer and presents the 3-D model of the child and other information. Although not implemented in the Pilot, this CD could, in the future, be used to allow parents to securely update selected information about their child (address, school, contact information, etc.). It would also be possible to print a card for parents that contains, say, a picture of the child and instructions with a password for updating child information over the Internet (or, say, via an 800 telephone number).

Immediately after a 3-D snapshot has been accepted by the camera operator, the information could be encrypted. It could be sent immediately to a central database via an Internet connection (wireless or otherwise). This would be preferred for situations where the camera was in a fixed location for a long period of time. As an alternative, a

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CD or DVD could be generated and mailed or taken to the central facility. Or the information could be transmitted when the camera system was returned to its storage location. In any event, the camera system would retain the data until its successful transmission has been positively confirmed.

At the central database it is expected that the database server would not be directly on the Internet. Access to the information would be strictly controlled as would decryption keys. If parents were to be able to update information, provisions would need to be made for update queries to that part of the database.

Octree files contain an internal key which is checked by the viewing program. If it is not on a list of approved "public" keys, it cannot be displayed. It is expected that Octree files, when placed in the database, would have a special non-public key. They would only be viewable with a special version of the viewing program. In this way, if such files were decrypted and obtained outside the AmberView system, they would not be viewable (at least without considerable technical skills).

The information within the database would be available to those specifically authorized, based on conventional security methods. At the time of an incident, in the pre-alert stage, the Amber Alert Coordinator would have access to the data to evaluate the situation. If he or she decided that an Amber Alert should be declared, the special password for such occasions would be used. After double checking, the system would "re-key" the Octree file and related information and send it (along with any new information such as time and location of the abduction, description of car, etc.) to the Amber Alert server where selected subsets would become available to law enforcement, the news media and the general public.

The form of presentation is a standard HTML page which can be viewed directly from the server or within an email. The request to download the Octree viewer is a standard request embedded in the HTML file. It can be downloaded from the AmberView server, if desired.

Standard methods can be used to automatically send email notification of an alert. It is expected that the general public could request notification of alerts, perhaps based on the distance from the abduction.

5 AmberView Phase I Implementation and Results

5.1 Equipment

The three 3-D cameras selected for evaluation were:

- The FaceCam from Genex Technologies (www.genextech.com)
- The Vivid 910 from Minolta (www.konicaminolta.us)
- The TriForm Portrait Scanner from Wicks & Wilson (www.wwl.co.uk)

Arrangements were made to lease each camera for a 60-day period. Additional information on the cameras can be found in Appendix C.

For 3-D processing of the camera information, storage, and dissemination over the Internet and viewing within Internet browsers, the TrueSolid software package from Octree Corporation (www.octree.com) was selected. Octree agreed to develop the software needed and to donate it for the duration of the Pilot.

A Dell server running Windows Server 2003 was acquired. Microsoft SQL Server was installed as the database. For Internet access, Microsoft IIS (Interactive Internet Server) was installed. Internet access was through a high-speed connection. The URL www.amberview.org was registered.

5.2 Permissions

Any effort involving the research and testing of human subjects that is funded with federal money is subject to an Institutional Review Board (IRB). In this case the taking/using of surveys or interviews and the taking and storing of 3-D images of minor children for testing and research are not covered activities. Photographs and the acquisition of personal information are considered "testing" under this law.

In order to conduct Phase I, an exemption was needed. This was requested on August 20, 2004 and rejected by NIJ/Office of General Counsel on October 6, 2004. WVHTC then initiated a request with the West Virginia University Office of Research Compliance on October 21, 2004. The WVHTC was awarded a Notice of Approval for Protocol on November 5, 2004.

5.3 Coordination Effort

It was determined early in the project that a comprehensive education and coordination effort would be needed to establish firm support and understanding for this effort. The following groups were identified:

5.3.1 State Level

- A. Office of the Governor
- B. Secretary of Education and the Arts
- C. State Superintendent of Schools
- D. West Virginia State Amber Alert Coordinator

5.3.2 County/City

- A. Superintendents of Schools in Monongalia, Marion, and Harrison Counties.
- B. City Police Chiefs and officers as well as sheriff's departments and officers in Monongalia, Marion, and Harrison counties.
- C. Principals/teachers involved from the three counties where student volunteers were being scanned.
- D. Parents/PTA organizations in each of the three counties used.
- E. Meeting with student groups in each school where scanning of volunteers was to be initiated.

5.3.3 News Media – TV Stations

- A. WBOY
- B. WDTV
- C. KDKA

5.3.4 Newspapers

- A. Dominion Post
- B. Fairmont Times
- C. The Clarksburg Exponent-Telegram
- D. State Journal

It was not obvious how much education and coordination would really be needed. Since it was a totally new concept and too little could cause unforeseen problems, it was decided that this effort should be a priority and to make it as inclusive as possible.

Meetings with all Law enforcement officials were initiated by the WVHTC Foundation. The AmberView program was outlined and discussed at great length, defining the benefits to law enforcement and their cooperative role in the AmberView initiative. They were supportive and "on board" from the onset.

5.4 Registration

The 3-D cameras arrived during the week of November 1, 2004, and half-day training sessions were conducted on November 7, 2004, with six operators. Training on each scanner continued four hours/day, three days each week for the next three weeks.

The concept of 3-D photography was new to the participants and it quickly became clear that effective camera use was something of an art and that experience would be needed for an operator to become effective.

Meetings with teachers, students, and parents began on October 25, 2004. After the final meeting, a delay of about one week was given before enrollment began in order to give parents and teachers time to read the AmberView material, sign release forms, etc.

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(but not enough time to forget what AmberView was all about!). On December 12, 2004, the three scanners were taken to the Gore Middle School and set up in three locations: the main gym, an unused classroom and an office. The scanning of volunteer students was initiated.

The setup and calibration times were as follows:

Genex:	15 minutes
Minolta:	15 minutes
Wicks & Wilson:	25 Minutes

Part of the extra time for the Wicks & Wilson unit was because it required the use of a backlight assembly. According to Wicks & Wilson it helps to provide a "cleaner" and more accurate result. A version without it was later tested and found to give satisfactory results (although it was not tested under a wide variety of conditions).

Enrollment began at the Gore Middle School (8th graders). The process lasted approximately 2½ hours during which 53 students were scanned. At each school four students were scanned three times, once with each camera to serve as a "controlled base" for later comparison purposes.

Genex:	17
Minolta:	21
Wicks & Wilson:	<u>23</u>
TOTAL	61

The second enrollment process lasted two hours during which a total of 44 students were scanned from Miller Middle School (7th graders).

The number of students enrolled by camera was:

Genex:	15
Minolta:	18
Wicks & Wilson:	<u>19</u>
TOTAL	52

The third enrollment process lasted approximately three hours during which a total of 73 students were scanned from Suncrest Middle School (6th graders).

The number of students by camera was:

Genex:	33
Minolta:	17
Wicks & Wilson:	<u>31</u>
TOTAL	81

In addition, 3-D photos were taken of several teachers and administrators.

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At the end of the enrollment period the equipment was packed up. This required approximately 20 minutes for each scanner.

5.5 Lessons Learned

5.5.1 Lesson Learned #1: The Value of Coordination and Communication

Since community support is vital in any program involving children, it is necessary to directly communicate with key groups within a community. These should include:

School Principals, Teachers, and Parents
Law Enforcement Officials (at all levels)
Newspapers (helps to educate public)
TV Media
Civic Organizations
Public Officials
Amber Alert Coordinator/Officials

Participants in these meetings and discussions should leave with a clear and unambiguous understanding of the following points:

1. The purpose is to save abducted children.
2. The program is free and entirely voluntary.
3. The 3-D photography process is completely safe.
4. Student information and facial images will be in a secure database and will only be disseminated by the State Amber Alert Coordinator if an official Amber Alert is declared.
5. The potential benefits to parents and the community are huge.

5.5.2 Lesson Learned #2: Show the Process

If a picture (of the 3-D camera) is worth a thousand words, a video is even better and a live demo better still.

5.5.3 Lesson Learned #3: Adjust your presentation for the audience.

Be aware of the concerns of different groups. They may be quite different and presentations must be tailored for each. Parents are mostly concerned about the benefit if their child is abducted. They may also ask about safety and, as was sometimes found, ask about when the rest of their children would be enrolled. Teachers are, of course, concerned about child safety but will also wonder about disruption to classes and related matters. Administrators may also be concerned about budgets, paperwork and time requirements.

5.5.4 Lessons Learned #4: Experience is Critical for Enrollment Throughput

3-D photography is new and few have experience in its use. The quality of the result involves several issues such as lighting, child position, movement, etc. It should, therefore, not come as a surprise that student throughput and 3-D image quality

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improved rapidly as the registration teams gained field experience. A key recommendation is that new teams spend several days or perhaps a week repeatedly enrolling themselves or volunteers at various locations and under varying conditions before they can be considered ready to conduct real enrollments. The throughput process also requires additional review/study in an effort to increase the number of students being scanned or photographed each hour. It should be understood that 3-D scanning of students requires more time to review, evaluate and complete than traditional 2-D photography.

6 Recommendations for Future Work

While the Pilot effort confirmed the viability of the AmberView concept and process, and demonstrated its operation, additional work is needed to develop it into an operational capability. Some of the important areas are as follows:

- Streamline the enrollment process so the time required will be less disruptive and costs will be lower.
- Standardize on the child information items necessary for enrollment plus optional items that can be selected at the state or local level.
- Determine if it would be desirable to support the use of existing child 2-D photos to quickly expand the AmberView program before 3-D cameras can be deployed on a large scale.

As noted above, software exists that can automatically or semi-automatically convert a high-quality conventional (2-D) photo into a visually pleasing 3-D dataset. Generating an accurate model, however, is difficult because there is simply not enough information present in a 2-D photo to precisely reconstruct the original shape. This technology was briefly investigated in the Pilot and found to generate 3-D faces models judged to be of some usefulness. Additional effort should be applied to examine current 2-D to 3-D conversion technologies and reevaluate its cost and utilization in AmberView. This effort should certainly be studied and field tested in Phase II.

Appendix A - Additional Information

A.1 Contract Information

**U. S. Department of Justice
National Institute of Justice (NIJ)
Office of Science and Technology
Hyuk Byun
810 7th Street, NW
Washington, DC 20531
(202) 616-1471
hyuk.byun@usdoj.gov**

A.2 Contact Information

**Mr. Robert Chico
West Virginia High Technology Consortium Foundation (WVHTC)
1000 Technology Drive, Suite 1000
Fairmont, WV 26554
(304) 366-2577
richico@wvhtf.org**

A.3 Reference Information

A major source of information on missing children is a study conducted by the Washington State Attorney General's Office. The Executive Summary can be found at www.atq.wa.gov/homicide_report/execsum.html and a summary of the results at www.atq.wa.gov/homicide_report/sum_facts.html.

The office of Juvenile Justice and Delinquency Prevention (a component of the Office of Justice Programs, U. S. Department of Justice) produces the National Incidence Studies of Missing, Abducted, Runaway and Thrownaway Children report (see www.ncjrs.org/html/ojjdp/nismart/ga/).

A.4 Missing Children Organizations and Web Sites

**The National Center for Missing and Exploited Children (NCMEC)
Charles B. Wang International Children's Building
699 Prince Street
Alexandria, Virginia 22314-3175
(703) 274-3900
www.missingkids.org**

The NCMEC was founded in 1984 as a private, nonprofit 501(c)(3) charity by President Reagan and John Walsh, the host of America's Most Wanted television show. (Adam Walsh, the 6-year old son of John Walsh, was abducted from a Florida shopping mall in

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1981 and murdered.) The NCMEC operates under Congressional mandates and is the nation's clearinghouse for information on missing and exploited children. It operates in a partnership with several federal agencies, including the FBI. The NCMEC is unique in that it is the only nonprofit organization that can access the FBI's National Crime Information Center (NCIC) Missing Person, Wanted Person and Unidentified Person Files, the National Law Enforcement Telecommunications System (NLETS) and the Federal Parent Locator Service (FPLS). It operates a 24-hour toll-free hotline (1-800-THE-LOST) in cooperation with the U. S. Department of Justice for reporting missing children and sightings.

The NCMEC employs 260 people in 6 states and reports that it has handled approximately 2,000,000 calls to the hotline, worked with law enforcement on 95,000 missing child cases resulting in the recovery of more than 80,000 children, has trained about 200,000 police officers and other professionals, and distributed over 21,000,000 free publications.

KlaasKids Foundation

P. O. Box 925
Sausalito, CA 94966
(415) 331-6867
www.klaaskids.org

The KlaasKids Foundation is a nonprofit organization that was founded by Marc Klaas (his 12-year old daughter was abducted and murdered in 1993). It has the mission of stopping crimes against children. It promotes prevention programs for at-risk youth, stronger sentencing for violent criminals and governmental accountability through federal and state legislative efforts.

The Polly Klaas Foundation

PO Box 800
Petaluma, CA 94953
(800) 587-4357
www.pollyklaas.org

The Polly Klaas Foundation is a nonprofit organization that helps find missing children and helps them from going missing in the first place. It does this by promoting public policies, educating the public and providing ongoing support and expertise. (Marc Klaas is not associated with the Polly Klaas Foundation.)

Amber Alert Web Portal

www.amberalert.org
www.amberalert911.org

The Amber Alert Web Portal allows anyone to sign up to be notified of Amber Alerts in their region. This is supported by major companies such as Intel and HP.

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Code Amber

805 Tops'l Drive
Mandeville, LA 70448
(504) 473-6075
www.codeamber.org

Code Amber provides the Code Amber Alert Ticker. This is one line of programming that can be inserted into other websites giving them the ability to display Amber Alerts on their websites. They claim that it is used in over 175,000 systems.

Lost Children's Network

P. O. Box 550924
Dallas, TX 75355
(214) 851-8289
www.lostchildren.org

The Lost Children's Network is a nonprofit organization that operates what they claim is the world's only television production facility dedicated to the search for missing children. Telecasts are broadcast daily on the Dish Network satellite television system.

Other

The information page of the Amber Alert Web Portal at www.amberalert911.com/missing_orgs.php contains links to many missing children organizations and resources.

Appendix B - Amber Alert and AmberView

B.1 What is Amber Alert?

The Amber Alert system was initiated in 1996 as a cooperative effort between local broadcasters in the Dallas-Fort Worth area and local police units. The impetus behind the Amber Alert system was the shocking and crushing death of 9 year-old Amber Hagerman, who was abducted while riding her bicycle and brutally violated and murdered close to her home in Arlington, Texas. Concerned citizens shocked at her violent abduction and murder contacted the local broadcast stations and suggested that they issue special alerts when a child was abducted just like they did for severe weather. The Dallas Amber Alert system was officially installed in July 1997.

Amber Alert became a coordinated national effort in October 2002 with the White House Conference on Missing, Exploited, and Runaway Children. On April 30th, 2003 President George W. Bush signed the PROTECT act into law as the most comprehensive set of legislation in United States history for the protection of children.

The bill provided \$25 million in FY 2004 for states to support Amber Alert communication systems and plans. It also removes statutes of limitations on prosecuting sex offenses against children, and authorizes the use of wiretapping and other high tech resources for hunting sexual predators who prey on children. The Act also created the post of a national Amber Alert coordinator to provide resources and guidance for state and local program coordinators and to head the initiative to standardize communication and criteria across different alert systems.

Since its signing statewide, Amber Alert programs have been set up in all 50 states, with Hawaii completing theirs in March, 2005. One of the key goals of the PROTECT legislation and the nation-wide amber alert program is the creation of standard criteria for the issuing of an Amber Alert. This standardization is key because it will both limit the overuse (and thus weakening) of the system while allowing neighboring states and areas to effectively broadcast Alerts in the needed areas.

The **Federal** guidelines for issuing an Amber Alert consist of five criteria. These criteria can be expanded on or modified slightly at this time by individual states / coordinators, but their inclusion is extremely important in order to assure compatibility of the systems across regions as well as to ensure that only valid needed alerts are issued.

1. Law Enforcement verification of an abduction

It is recommended that Amber plans require confirmation by law enforcement of an abduction prior to issuing an alert. This component is essential when determining the level of risk to the child. Clearly, stranger abductions are the most dangerous for children and thus are primary to the mission of an Amber Alert. To allow activations in the absence of significant information that an abduction has occurred could lead to abuse of the system and ultimately weaken its effectiveness. At the

same time, each case must be appraised on its own merits and a judgment call made quickly. Law enforcement must understand that a "best judgment" approach, based on the evidence, is appropriate and necessary.

2. Risk of serious bodily injury or death

It is recommended that plans require a child be at risk for serious bodily harm or death before an alert can be issued. This element is clearly related to law enforcement's recognition that stranger abductions represent the greatest danger to children. The need for timely, accurate information based on strict and clearly understood criteria is critical, again keeping in mind the "best judgment" approach.

3. Sufficient descriptive information

It is recommended that in order for an Amber Alert to be effective in recovering a missing child, the law enforcement agency have enough information to believe that an immediate broadcast to the public will enhance the efforts of law enforcement to locate the child and apprehend the suspect. This element requires as much descriptive information as possible about the abducted child and the abduction, as well as descriptive information about the suspect and the suspect's vehicle. Issuing alerts in the absence of significant information that an abduction has occurred could lead to abuse of the system and ultimately weaken its effectiveness.

4. Age of the child

It is recommended that every state adopt the "17 years of age or younger" standard; or, at a minimum, agree to honor the request of any other state to issue an Amber Alert, even if the case does not meet the responding state's age criterion, as long as it meets the age criterion of the requesting state. Most Amber plans call for activation of the alert for children under a certain age. The problem is that age can vary--some plans specify 10, some 12, some 14, 15, and 16. Differences in age requirements create confusion when an activation requires multiple alerts across states and jurisdictions. Overuse of the Amber Alert system will undermine its effectiveness as a tool for recovering abducted children.

5. NCIC entry

It is recommended that immediate entry of Amber Alert data into the National Crime Information Center (NCIC) system be a plan requirement. Text information describing the circumstances surrounding the abduction of the child should be entered, and the case flagged as a Child Abduction. Many plans do not mandate entry of the data into NCIC, but this omission undermines the entire mission of the Amber Alert initiative. The notation on the entry should be sufficient to explain the circumstances of the disappearance of the child. Entry of the alert data into NCIC

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expands the search for an abducted child from the local, state, or regional level to the national. This is a critical element of any effective Amber Alert plan.

Amber Alert programs have proven widely successful in their primary missions—recovering children in the event of an abduction and educating the public about the needs for child safety and community awareness. According to a release from the Office of Justice Programs, as of March 17th, 2005 the Amber Alert system had aided in the recovery of 192 children, with over 82% of those recoveries coming since October 2002.

Amber Alerts currently go out over radio stations, the emergency broadcast system, television stations, roadside tickers, and in some cases cell phone providers. There is also an un-sponsored Amber Alert ticker hosted by www.codeamber.org that can broadcast alerts over the Internet.

West Virginia Amber Alert System

The Amber Alert plan is a voluntary partnership between the West Virginia State Police, West Virginia Broadcasters, West Virginia Emergency Alert System Committee and the National Weather Service to send out an emergency message to alert the public when a child has been abducted and it's believed that the child's life is in grave danger.

The purpose of the Amber Alert System is to provide a valuable tool for West Virginia law enforcement agencies in the ongoing battle to protect our children while allowing the broadcasters of West Virginia an opportunity to contribute to the communities they serve. Utilization of this plan will provide for maximum public participation to provide rapid response in the event of an abducted child. The media, public and law enforcement must work together to ensure the plan is not abused, which would lead to a lack of confidence in the plan and render the system ineffective.

- Amber Alert may be activated only by law enforcement agencies.
- Amber Alert is intended only for the most serious, time-critical abduction cases
- Amber Alert is not intended for cases involving runaways or parental abduction, except in life-threatening situations.

Criteria for Activating an Amber Alert in West Virginia

The West Virginia Amber Alert System will be activated when law enforcement agencies ensure all these mandatory criteria are met:

- Law enforcement confirms a child 17 years of age or younger has been abducted
- Law enforcement believes the circumstances surrounding the abduction indicate that the child is in danger of serious bodily harm or death
- Law enforcement has enough descriptive information about the child, abductor and suspect's vehicle to believe an immediate broadcast will facilitate the child's location

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- A law enforcement officer **must** enter the abducted child into NCIC and **must** provide supporting documentation as to why the Amber Alert System should be activated

Action

Once a determination is made that the use of the Emergency Alert System (EAS) may aid in locating an abducted child, the West Virginia State Police will provide as much detailed information as reported by the investigating agency. This information will be broadcast over a three-hour period via television and radio. During the first hour, the Amber Alert will broadcast every fifteen minutes. During the second and third hours, the information will be sent every half hour.

In the event that the Amber Alert is cancelled, for whatever reason, the use of the EAS will be immediately discontinued. In the event that significant new critical information is obtained, the determination may be made to issue Amber Alert updates.

B.2 What is AmberView?

Each year approximately 800,000 children are reported missing or abducted; this equates to one child every 40 seconds. Fortunately, the vast majority of these children are not seriously harmed and return to the safety of their home and family. However, some children are missing against their will. The kidnapping and murder of a child remains a parent's greatest fear.

Approximately 115 children are murdered each year in the United States as a result of abduction.

AmberView is a coordinated pilot program developed by the West Virginia High Technology Consortium (WVHTC) Foundation in Fairmont, West Virginia, designed to work in collaboration with state and national Amber Alert Programs to aid in the recovery of missing children. The AmberView Pilot has demonstrated the ability to mass broadcast a digital, facial image of a missing child to law enforcement officials, media organizations, the private sector and other sources within minutes of a reported abduction. The project used 3-D images from a sample of middle school students (grades 6-7-8) as well as surveys, interviews, and questionnaires of participants to collect valuable data and information to measure and evaluate its effectiveness. No personal information was collected during this first Pilot initiative.

The need for positive identification of missing children has been well documented and a robust program of fingerprinting children has been well established. **Unfortunately, identifying missing children through fingerprints has little to do with returning the children safely.** Recent years have proven to be tragic for children being abducted and harmed, resulting in development of "Amber Alert" programs in many communities. The evidence is quite clear that a detailed description of the missing child, broadcast quickly, is paramount to successfully recovering the child. **74%** of abducted children who are murdered, are dead within three hours of the abduction. To an abducted child, time is the greatest enemy.

Written descriptions of the child help the recovery by quickly broadcasting information and a picture to regional authorities and to regional television networks. What is currently missing is the ability to instantaneously mass broadcast a high-resolution picture of the child to law enforcement officials and to the media within minutes of the abduction. However, current technology now allows this to occur using pictures in their most usable form — 2-D/3-D high-resolution facial images that can be manipulated by the viewer to view the face and head at any angle. AmberView makes available a valuable tool to immediately assist law enforcement, utilize the media and galvanize the community to assist in the search for a child immediately following an official Amber Alert.

B.3 How Does AmberView Work?

The WVHTC Foundation provided a variety of information to students, parents, and parent-teacher organizations, regarding the AmberView Project. A high resolution, digital image of a child's face was then recorded. By using a mouse or other pointing device, the image can be enlarged and viewed from different angles, making positive identification easier. All images and biometric information were stored in a secure database on a secure server located at the WVHTC Foundation. This is a voluntary program. Parents and students were encouraged to participate in this effort, however, all such decisions rests solely with parents and student volunteers.

In the event of abduction, that child's high resolution image is immediately posted on the AmberView missing children web site and simulcast via a web-based "broadcast" system to law enforcement, media, and private sector outlets within a broad region surrounding the child's hometown or area of abduction. Since the data is stored in a digital file, it can be quickly transmitted electronically to a vast array of designated recipients. Within minutes of notification, thousands of people are able to see the image of the missing child, and actively participate in the effort to return the abducted child to the safety of their family. Specific biographic information and contact information will accompany the public display and distribution of the abducted child's facial image. Unless an "official" Amber Alert is activated by the State Amber Alert Coordinator, no information, data, or photo is posted or disseminated.

Through state-of-the-art biometric technology and critical partnerships between the technology, law enforcement, media and private sector communities, we can join forces and collectively work together to aid in the recovery of missing children. Communities can now become more actively involved by using their eyes and ears to provide "value-added" support to efforts of law enforcement. In the Pilot of the multi-phase initiative, AmberView validated the process (**Proof of Concept**) to mass broadcast a digital 3-D image of a missing/abducted child to law enforcement, media, and private sector via the world-wide web within minutes of an official Amber Alert.

Appendix C - 3-D Camera Evaluation

The three 3-D cameras evaluated in the Phase I AmberView project are based on illuminating a scene with patterns of light. Photos are taken and 3-D information is computed by analyzing how the patterns are distorted by the shapes in the scene, in this case the faces of children. This technology is generally called "structured light" scanning (although individual manufacturers may have their own terms for their particular technology).

Such cameras have been developed for a variety of uses in medicine, industry, games, cinema, biometrics, research and other areas. A popular commercial use can be found in some shopping malls. A camera is used to acquire a 3-D image of a family or an individual. It is then engraved into the interior of a block of glass using special lasers. They can be used as gifts, souvenirs, advertising give-away items, etc.

While 3-D cameras have been available for a number of years, they are not yet in widespread use. As could be expected, they are relatively expensive and take training and experience to use effectively. Each camera was developed for some specific set of market segments. Since tradeoffs always need to be made in designing a product, each has strengths and weaknesses. For example, some may have higher resolution but have difficulties elsewhere. Some were designed to be portable while others were not. In this section we will attempt to evaluate how various camera characteristics, as found in the Pilot, apply to use in AmberView.

C.1 AmberView Needs

For AmberView to be the most effective, large numbers of children must be enrolled. The efficiency of the enrollment process will be critical. The overall cost for an enrollment will be a major factor in the future success of AmberView. The preferred method of acquiring the information is through yearly enrollment at schools. This would necessitate multiple cameras with multiple teams transporting them, probably on a daily basis. Transportation and setup time will be important. Ease of use will also be important, especially considering the number of teams needed, the training requirements and the possibility that at least some team members will be temporary and possibly volunteers.

C.2 The 3-D Cameras

3-D camera manufacturers typically offer multiple models and there are usually options. For the Pilot, appropriate models (and options) were selected from three manufacturers for testing. The following discussion was condensed from the comments and evaluations of the team members who actually performed the enrollments at several schools. It is certainly possible that a different choice of models or options would have led to different results. It is suggested that anyone needing more information contact the manufacturers at:

Genex Technologies

www.genextech.com

FaceCam: www.genextech.com/pages/603/3D_FaceCam.htm

Minolta

www.konicaminolta.us/ (see Industrial Products, 3D Digitizers)

The Vivid 910: kmpi.konicaminolta.us/vivid/products/vi910-en.asp

Wicks & Wilson

www.wwl.co.uk

In order to provide some basis of comparison, several general areas were evaluated for each camera, including:

Transportability – This is the moving of the camera and any other needed equipment (computer, monitor, tripod, cables, etc.) to a school, assembling the system at some specific location (classroom, gym, assembly hall, office, etc.) and then disassembling and packing for the return to storage.

Ease of Use – This involves any calibration of the system after it is powered up at a new location, the ease of use during enrollment, difficulties encountered during the scanning process, sensitivity to lighting conditions, the number of times rescans are needed and so on.

Overall Quality – This is a more or less subjective evaluation of how realistically the final 3-D model represents the subject. It was found that quite a number of factors contribute to this, including the visual realism of the skin, the quality of hair capture, the presence of holes or missing parts, the ability of the camera to faithfully capture ears and so on.

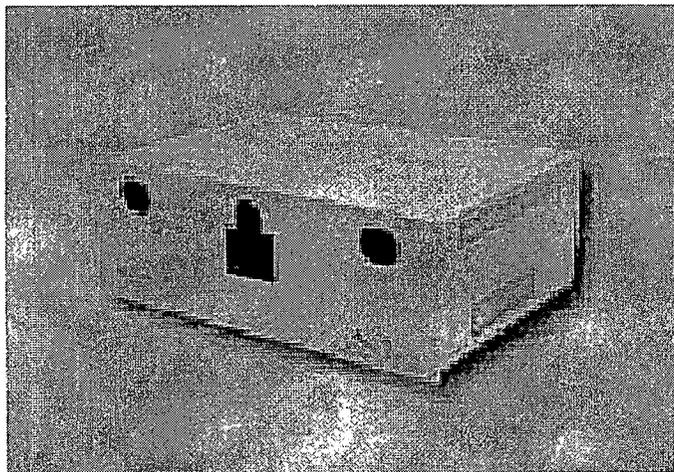


Figure C1 - The Genex Technologies FaceCam

C.2.1 The Genex Technologies FaceCam

This is a box about the size of two stacked VCRs (17.25" wide, 6.75" high and 14" deep) and weighs 21 lbs. Visible on the front are two lenses (it uses two cameras) with a window for the projector between them. The unit is normally mounted on a tripod and can thus be easily moved up and down to accommodate people of varying heights.

After a subject is positioned and ready, the Genex takes about half a second to take the picture (project the patterns and capture the images). It then takes

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about 30 seconds to generate up to about 300K points. As with a photo, not all of the points will actually be on the subject, depending on the size of the subject, distance from the camera, settings and so on.

For the most part the Genex camera is intended to be a self-contained system rather than a peripheral on another system. It thus does not have an API (Application Programming Interface) that would allow it to be controlled from another computer. This means that, for the most part, one must use the software provided by Genex, at least until the 3-D model is ready for export.

Both transportation and setup are facilitated by its use of a specially designed "scuttle drive" computer system. This is specifically built to run with the Genex camera and a full computer system is not needed. It does however require a separate monitor to attach to the scuttle drive, which makes it less portable than a laptop.

The Genex proved to be somewhat difficult to transport. The camera requires a large case to protect it during moving and the whole setup including camera case, monitor, scuttle drive, accessories and tripod requires a dolly or cart to move at one time.

Physical and technical setup of the machine is fairly simple, with only two cords having to be connected and a very simple calibration performed. There are some limitations, however. The Genex must scan in front of an off-white, cream, brown, or other muted color background. This is generally not difficult, but the use of a back cloth may be necessary in some environments. Hanging it to be perfectly flat can be difficult.

The subject's head is placed tilted slightly back with the rear of the head resting against the backdrop. This can be an uncomfortable position for some individuals depending on height and weight. The need to hold the head in this position for several seconds also makes it difficult with younger children (preschool age).

The Genex camera was, in general, able to capture faces with a high rate of clarity without significant holes or distortions. Errors, when present, tended to be mild and limited strictly to the periphery of an image. The most prevalent problems concerned hair and ear capture in a wide range of situations with a variety of subjects. Also, the results tend to appear somewhat less lifelike than the Wicks and Wilson scanner. In the Genex images the face appears more static, even claylike, and thus slightly less realistic.

One anomaly was the unusual increase in significant errors and the overall lowering of scan quality at one school. There were a much greater number of images having uncharacteristic errors and even the majority of good scans exhibited more significant minor errors than at other locations. It was later determined that the room had undesirable lighting conditions.

C.2.2 The Minolta 910

This camera is a little smaller but slightly heavier than the Genex (25 lbs.). It is also mounted on a tripod but in a vertical orientation. There are two openings on the front. The bottom one is a window to the laser and mirror system used to project a moving sheet of eye-safe light on the subject. The upper one contains the lens for a single camera.



Figure C2 – The Minolta Vivid 910

The 910 is very flexible. It comes with three lenses that can be used to change the range, field of view and precision. It can also be operated in "FAST" mode or "FINE" mode. A FAST mode scan takes a half second (0.3 without color) while a FINE scan takes 2.5 seconds. The generation of the 3-D point data is very fast, requiring only a second or two. Approximately 300K points are generated in FINE mode and about 77K in FAST mode.

The Minolta scanner is capable of very high accuracy (for a structured-light scanner). In some cases it is better than 0.25 mm, although it is somewhat less, say 1 mm, when scanning a face.

Minolta provides an extensive API with the 910 and it can easily be used as a component in a larger system.

This unit was designed to be portable and is clearly the easiest to transport of the three. Its primary advantage in this area is that it runs via a hookup to a standard laptop computer and requires no additional peripherals. The camera and tripod in their cases are still large, and even with rollers attached may be unwieldy for a single crew member to carry at one time.

The calibration effort required is more than for the Genex system while not being as involved as the Wicks and Wilson. The Minolta must be calibrated using a white-light balance lens. The need to make judgments on camera lenses as well as the sometimes sophisticated incremental adjustment necessary during calibration require a higher level of training and ability on the part of a crew.

The Minolta was found to be excellent in capturing the body of a subject's face. It was the best of the cameras in terms of clarity and closeness to real life. It has one major flaw, however. It will seldom capture a substantial amount of the subject's hair. This tends to leave just the face "hanging" in space, perhaps with the neck and shoulders. This is a problem because the models lose the context provided by the hair. This was found to be distracting and somewhat annoying.

The problem is apparently because the red laser light is not effectively reflected by the hair, causing a "no return" situation resulting in empty space in the model. This may be understandable in that the other two cameras use white light and were developed for scanning faces. The Minolta was designed primarily for digitizing mechanical parts and small objects.

C.2.3 Wicks & Wilson TriForm Portrait Scanner

The Wicks and Wilson camera or "Wicks camera" is the result of a partnership that began in 1996 between Wicks & Wilson, a company then in the microfilm industry, and a London teaching hospital. The goal was to develop a safe and convenient device to capture faces in 3-D. It uses the "moiré fringe" technique, a form of structured light. It projects a series of fringes (parallel horizontal black and white stripes) on to the subject. Each pattern is captured by a camera and saved for later processing. A conventional "all-white" (no pattern) color image is also captured and later "textured mapped" on to the model to give it a realistic appearance.

The camera part itself is smaller than the other two but it's an integral part of a larger floor-standing unit. There are three items on the front of the unit. The bottom one is the window for the projector while the top one is the lens for the camera. Between them is a small LCD screen where the subject can see the camera's view of himself or herself before the scan is taken.

The camera unit requires about 1.5 seconds to acquire the images. Up to about 444K points are generated with a specified accuracy of about 2 mm. An API is provided to control the camera remotely.

To make a long story short, the TriForm is difficult to transport. This is primarily because it uses a large, lighted back-screen. Neither this nor the scanner itself was designed to be portable. They do not fold up or easily come apart, making them cumbersome. More than one person is required to move the units and they are difficult or impossible to transport in a standard automobile.

Physical setup of the machine requires a large bundle of wires which can be confusing to separate and must all be plugged in properly for the machine to work correctly. Transporting the machine requires wrapping the screen and scanner separately with large blankets using bungee cords, a process which can be difficult and unwieldy as well as time consuming. The machine also necessitates a box or basket in which to carry the multiple cords, outlets, plugs-ins, and adaptors necessary to run it.

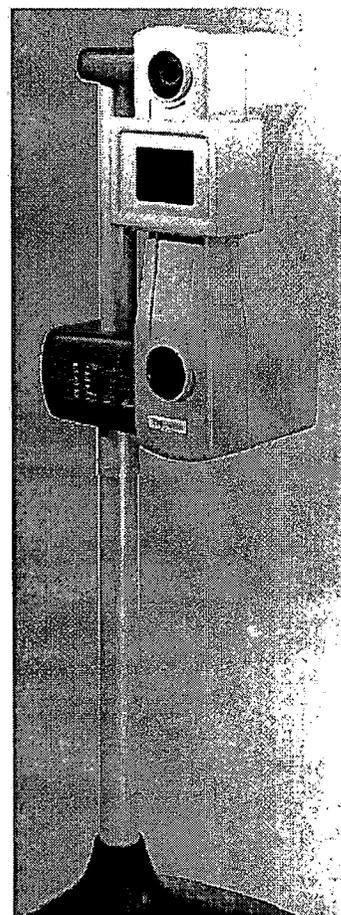


Figure C3 – Wicks & Wilson TriForm Portrait Scanner

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Technical setup of the machine is also complicated. The back screen must be moved forward to the proper calibration length, and then the machine test run via the internal calibration function. Lighting (ambient) during the calibration must be the same as during scanning, or the scan quality will suffer or the machine may have an error.

Then the screen must be moved back to the "Scanning Distance" and the subject placed at approximately the original distance of calibration. Machine failures do not always have to result in recalibration, but persistent image quality problems or failed scans or errors may reveal the need to go back through setup and calibration.

One final issue arises because the camera itself is fixed to the stand and cannot be moved up or down. In order to properly position each subject it may be necessary to move the subject up or down. During school scanning a stool which could be raised or lowered was used.

The difficulty of transportation, setup and calibration later paid off, however. The Wicks camera performed at the highest level in terms of overall image quality, consistency of images, clarity, resolution, identification, lifelikeness, infrequency of errors, and hair and ear capture. In particular, the Wicks scanner singled itself out as by far the most capable in terms of hair capture and the ability to capture the ears. The Wicks scanner also showed a particular ability to compensate for errors. In many cases an error on one of the other scanners would not be fixed in a subsequent scan. Major errors were generally fixed easily and quickly by minor adjustment and rescanning with the Wicks Camera.

A particular quirk (or feature) of the system is its amazing preference towards subjects with long hair. The presence of hair along the sides of the head and down to the shoulders helps the machine create a full and errorless depth of field and results almost universally in perfect scans including full hair and ear capture. It was therefore suggested that subjects with long hair be instructed to put/leave their hair down rather than up for scanning to ensure best scan quality.

The only significant errors occurring with any frequency with the Wicks system are a fade at the very top of the head in some subjects and the possibility of a major data fade in the mid face of a subject due to a lighting abnormality or subject movement. Both can generally be fixed quickly in a second scan with only minimal repositioning of the subject necessary.

C.3 Camera Recommendation for Implementation

It is expected that a single type of camera will be used for all Phase II enrollment. Based on the results of the Pilot, the camera recommended for this use is the Wicks & Wilson TriForm. In spite of the difficulty in transporting and setting up the unit, the consistent excellent quality of the results made it the clear choice. A good part of the transportability difficulty should be addressed with a different model of the TriForm that used a conventional tripod rather than the fixed stand. If the backlight unit was made easier to take apart, the system would be much more acceptable (perhaps even

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transportable in a car!). Wicks & Wilson advises that "the system can be used without the backlight with different software, but perhaps with a little loss of quality".

In spite of advantages such as the strength of the manufacturer, flexibility and high accuracy, the Minolta 910 was found to be unsuitable for AmberView because of its problems in acquiring hair. Likewise, the Genex camera has advantages in several areas. The quality was very good but was not judged to be quite as high as the Wicks and Wilson, a problem for Phase II is its inability to operate the unit as a subsystem in an integrated AmberView enrollment system. It is expected that such a system will be needed to maximize enrollment rates and minimize costs.

It will be important in the longer term to encourage a competitive 3-D camera market or 2-D with associated enhancements for AmberView. To this end a major initiative in Phase II will be to establish standards for this area and look for ways to increase the number of students that can be scanned per hour. Any camera that meets the requirements can be offered for use in an AmberView system. While it is recommended that any organization implementing an AmberView system standardize on a single type of camera, it is expected that regional or state systems, or separate systems within the larger states will make their selections based on their own perceived needs in terms of cost, quality, features, speed, etc. It should be noted that the utilization of 2-D photographs coupled with the use of "state-of-art technologies for photo enhancements will be explored/evaluated in the Phase II effort.

Appendix D – Camera Safety Statements

The following letters are from the manufacturers of the cameras used in Phase I.

D.1 Genex Camera Safety Statement



Genex Technologies, Inc. Leader in 3D Imaging

October 26, 2004

Bob Chico
West Virginia High Tech Consortium Foundation (WVHTF)
1000 Technology Drive
Suite 1311
Fairmont, WV 26553

Re: Safety of Genex FaceCam System

Dear Bob,

The Genex 3D FaceCam uses a structured light process in the capture of data. The internal DLP projector uses visible light at a rating of 1,000 lux and does not use ion radiation. The system captures data from a distance of approximately one meter from the front of the camera to the subject. The system has been on the market for fifteen months without a single complaint about eye damage. Genex has no reason to believe that the 3D FaceCam will cause a harmful effect to children.

Sincerely,

A handwritten signature in black ink, appearing to read "Z. Jason Geng".

Z. Jason Geng
President & CEO
Genex Technologies, Inc.

cc: Melinda Olivario

D.2 Minolta Camera Safety Statement



November 12, 2004

Galaxy Global Corporation
1000 Technology Drive
Suite 1311
Fairmont, WV 26554

Dear Ms. Olivero

Enclosed are copies of the eye safety certificates for our VIVID 3D non-contact laser scanners.
Please advise if you need any additional information.

Sincerely

A handwritten signature in cursive script, appearing to read "Ginny Warsaw".

Ginny Warsaw
Inside Sales Representative
Konica Minolta Photo Imaging USA

The essentials of imaging

KONICA MINOLTA PHOTO IMAGING U.S.A., INC. Instrument Systems Division, 725 Darington Ave., Mahwah, New Jersey 07430
652-473-3605 (US) 201-574-4000 (Outside US) Fax 201-574-4201 www.konicaminolta.us

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MINOLTA

The essentials of imaging

www.minolta.co.jp

CERTIFICATE

DESCRIPTION OF GOODS

NON CONTACT 3D DIGITIZER

MODEL NAME : VIVID900 / VIVID900T / VIVID910

We hereby certify that the above models are classified Class I and comply with the requirements of 21 CFR 1040.10 and 1040.11 (FDA Regulation).

*CLASS I levels of laser radiation are not considered to be hazardous.

Takao Sekai

Takao Sekai

Manager

Quality Assurance Department

Instrument Systems Company

18 December 2002

MINOLTA Co., Ltd. Toyokawa Administrative Center
1-8, Karoyanishi-machi, Toyokawa-shi, Aichi 442-8555, Japan
Tel: +81-533-89-3330 Fax: +81-533-89-3579

D.3 Wicks & Wilson Camera Safety Statement



November 8, 2004

Ms. Melinda K. Otvario
Human Resource Director
Galaxy Global Corporation Inc.
1000 Technology Drive
Suite 1311
Fairmont WV 26554

Subject: TriForm Scanner Safety

Dear Melinda,

TriForm 3D scanning systems use structured patterns of projected white light. No lasers, Infrared rays or other radiation are used in the capture process and they are therefore intrinsically safe.

Please call with any further issues.

Best Regards,

A handwritten signature in black ink, appearing to read "Wayne W. Sandberg", written over a horizontal line.

Wayne W. Sandberg
President/CEO

Appendix E - Information and Consent Forms

E.1 Parental or Guardian Consent and Information Form



PARENTAL OR GUARDIAN CONSENT AND INFORMATION FORM

Amber View Project

Introduction

My child, _____, has been asked to participate in this Amber View Pilot Project. The WVHTC Foundation is conducting this initiative to fulfill a contract with the US Department of Justice. The project will be under the supervision of Robert Chico at the WVHTC Foundation. This pilot project has been fully explained to me.

Purposes of the Study

The purpose is to evaluate the process of using and transmitting 3D images to quickly identify a missing child.

Description of Procedure

This study involves the taking of 3D scanned images of middle school children. I have been asked to fill out a short questionnaire that will help to evaluate this project. I have been told that I may see the questionnaire before signing this consent and I do not have to answer all the questions if I decide to participate. Approximately 200 subjects are expected to participate in this study. All scanned images will be destroyed at the conclusion of this pilot project.

Contact Persons

For more information regarding this project, I can contact Robert Chico at 304/366-2577. For information regarding my child's rights as a research subject, I may contact the Office of Research Compliance at 304/293-7073.

Risks and Discomforts

There are no known or expected risks from participating in this study.

Alternatives

I understand that I do not have to participate in this study.

Submission date: _____ Page 1 of 3 _____

AmberView Phase I Report

Benefits

I understand that this study may help my child or other children who become missing or get abducted. As a result of this project, knowledge will be gained and other may benefit.

Confidentiality

I understand that my child's scanned facial image may be used in this pilot project. My name or that of my child or any information from which we might be identified may not be published. All facial scans will be destroyed at the conclusion of this pilot project.

Contact Person

For more information about this project, I can contact Robert Chico at 304 366 2577. For information regarding my rights as a research subject, I may contact the Office of Research Compliance at 304 293 7073.

Confidentiality

I agree to having my child's scanned facial used in this demonstration pilot project. No personal identifiers linking my child to the scanned image will be collected or published.

Voluntary Participation

Participation in this study is voluntary. I understand that I may withdraw my child from this project at any time. I have been given the opportunity to ask questions about this project, and I have received answers concerning areas I did not understand.

Upon signing this form, I will receive a copy.

I willingly consent to my child's participation in this project.

Signature of Parent or Guardian

Date

Time

E.2 Evaluation/Questions for AmberView Program Parents



**Evaluation/Questions for Amber View Program
Parents**

1. How concerned are you about your child being abducted?
 Not Concerned Concerned Very Concerned

2. Based on what you know, do you think Amber View could help in the recovery of abducted children?
 Yes No Not sure

3. Would you register your child in a national Amber View system?
 Yes No Not sure

4. Do you think registration should be done by schools?
 Yes No Not sure

5. Would you volunteer your time to help with child registration in your area?
 Yes No Not sure

6. Who do you think should be empowered to report your child missing, other than you?
 Grandparents Brothers and sisters Teachers Other _____

7. Who would you trust to hold the information?
 Federal agency State agency Local police Schools Other _____

8. Would you support the acquisition of fingerprints during registration?
 Yes No Not sure

9. Would you like the State Police to have a copy of the 3-D information of your child?
 Yes No Not sure

AmberView Phase I Report

10. How much would you think is a reasonable amount of money for a parent to pay to have 3-D interactive images taken of your children and maintained for a program like AmberView? _____
11. How often would be willing to bring your child in to be re-scanned?
 Once a year Once every two years Other _____
12. Was this a satisfactory experience for you? Yes No
For your child? Yes No
13. In spite of reassurances that the scanning process is safe, are you concerned about having your child scanned? Yes No Not sure
14. Would you recommend other parents to register their children? Yes No
If no, why not? _____
15. If an alert is declared for your child, in addition to law enforcement, who should be notified immediately? (May select more than one).
 School News organizations Cell phones Monitors in malls
 Other _____

E.3 Evaluation/Questions for AmberView Project – Law Enforcement



**Evaluation/Questions for Amber View Project
Law Enforcement**

1. How concerned are you about your child being abducted?
 Not Concerned Concerned Very Concerned

2. Based on what you know, do you think Amber View could help in the recovery of abducted children?
 Yes No Not sure

3. Do you have in place a method of transmitting the 3-D data to the officers in the field? Yes No
Explain: _____

4. In the event of an Amber Alert, where should the 3-D information be made available? Police stations Police cars Internet PDA Cell phone
Explain: _____

5. What additional help would you require to ensure every law enforcement officer in your organization has the ability to receive the Amber View alert information? (Laptops, PDA's, etc.) Explain _____

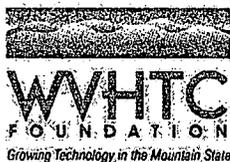
6. Do you think Amber View would help in the recovery of abducted children?
 Yes No Explain _____

AmberView Phase I Report

7. What suggestions would you make to improve the effectiveness of the Amber View system? (Provide suggestions)

Additional Comments/Suggestions:

E.4 Consent and Information Form for Questionnaire/Survey



Consent and Information Form for Questionnaire/Survey

Amber View Project

Introduction

I, _____, have been invited to participate in the Amber View Pilot Project which has been explained to me. This project is being conducted by the WVHTC Foundation to fulfill a contract with the U. S. Department of Justice. The project will be under the supervision of Robert L. Chico at WVHTC.

Purposes of the Study

The purpose of this is to evaluate the process of using and transmitting 3-D images to quickly identify a missing child.

Description of Procedures

This study involves the taking of 3-D scanned images of middle school children. This project will also evaluate the process of quickly transmitting/mass broadcasting 3-D images to identify a missing child.

For questionnaires, "I have been told to fill out a short questionnaire that will help to evaluate this pilot project, which takes approximately ten minutes to complete. I have been told that I may see the questionnaire before signing this consent and that I do not have to answer all the questions if I decide to participate. Approximately 200 subjects are expected to participate in this study.

Risks and Discomforts

There are no known or expected risks from participating in this study.

Alternatives

I understand that I do not have to participate in this study.

Benefits

I understand that this study may help my child or any other child/student/person who gets abducted.

AmberView Phase I Report

Contact Persons

For more information regarding the Amber View Pilot Project, I can contact Robert Chico at 304/366-2577. For information regarding my rights as a research subject, I may contact the Office of Research Compliance at 304/293-7073.

Confidentiality

I agree to having my child's scanned facial image to be used in this demonstration pilot project. I understand that no personal identifiers linking me to my scanned image will be collected. In any publications that result from the Amber View Pilot Project, neither my name nor any information from which I might be identified will be published.

Voluntary Participation

Participation in this study is voluntary. I understand that I am free to withdraw my consent to participate in this study at any time. Refusal to participate or withdrawal will involve no penalty to me. I have been given the opportunity to ask questions about the Amber View Pilot Project, and I have received answers concerning areas I did not understand.

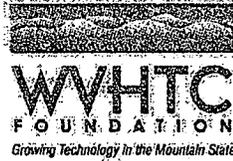
Upon signing this form, I will receive a copy.

I willingly consent to participate in this project.

Signature of Subject or Subject's Legal Representative

Date Time

E.5 Evaluation/Questions for AmberView Program – Public Officials/Administrators



**Evaluation/Questions for Amber View Program
Public Officials/Administrators**

1. How concerned are you about your child being abducted?
 Not Concerned Concerned Very Concerned

2. Based on what you know, do you think Amber View could help in the recovery of abducted children?
 Yes No Not sure

3. Would you register your child in a national Amber View system?
 Yes No Not sure

4. Do you think registration should be done by schools?
 Yes No Not sure

5. Would you like the State Police to have a copy of the 3-D information of your child?
 Yes No Not sure

6. How much would you think is a reasonable amount of money for a parent to pay to have 3-D interactive images taken of your children and maintained for a program like Amber View?

7. What are the most important issues you see in the Amber View program?

8. Do you feel there is a need to develop this system to include college kids as well?
 Yes No Explain _____

AmberView Phase I Report

9. Do you feel that every child in the State should be a part of the Amber View program? (Grades 1-12) Yes No

Explain _____

10. Are you aware of any private organization that might be willing to sponsor children who might not be able to afford any fees in relation to taking part in the Amber View program? Yes No

Explain _____

11. Do you think the State should provide funding assistance to sponsor a statewide Amber Alert Program? Yes No

Explain _____

AmberView Phase I Report

Appendix F - Recommendation Letters

The following letters of support were sent to the West Virginia High Technology Consortium Foundation's AmberView project.

F.1 Letter from the State of West Virginia



BOB WISE
GOVERNOR

STATE OF WEST VIRGINIA
DEPARTMENT OF EDUCATION AND THE ARTS
OFFICE OF THE CABINET SECRETARY
STATE CAPITOL BUILDING 5, ROOM 205
1900 KANAWHA BOULEVARD, EAST
CHARLESTON, WV 25305

KAY GOODWIN
CABINET SECRETARY

12 October 2004

Mr. Robert Chico, Program Manager
WVHTC Foundation
1000 Technology Drive
Suite 1000
Fairmont, WV 26554

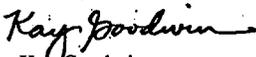
Dear Mr. Chico:

It is our pleasure to write in strong support of the West Virginia High Tech Consortium Foundation's Amber View project. The WVHTC Foundation is an established leader in applying technology to serve a wide range of public policy needs, and the Amber View project is an excellent example of how the WVHTC is responding to the needs of law enforcement officers and parents in their efforts to recover abducted children.

From our perspective, the Amber View project is first and foremost a powerful new law enforcement tool that builds on the strengths of the existing Amber Alert program and increases the likelihood that abducted children will be recovered more quickly. But the Amber View project also represents an innovation of existing biometric technology that holds great potential for other applications, as well. For both reasons, the Amber View project is of great value and utility—not only for West Virginia, but also for the entire nation.

Children may only be 20% of our population, but they are 100% of our future. Harnessing the power of technology to recover abducted children is a key strategy in keeping our children safe and providing them—and all of us—with a brighter future.

Sincerely,


Kay Goodwin
Cabinet Secretary


Jay Cole
Deputy Secretary

F.2 Letter from Harrison County Schools



DR. CARL H. FRIEBEL, JR.
Superintendent

HARRISON COUNTY SCHOOLS

408 E.B. SAUNDERS WAY
POST OFFICE BOX 4370
CLARKSBURG, WEST VIRGINIA 26302-1370
PHONE (304) 624-3325
FAX (304) 624-3367

BOARD OF EDUCATION
SALLY J. CANN, *President*
WILSON W. CURREY, *Vice President*
JAMES E. BENNETT
DOUG GRAY
JAMES L. REASER

November 4, 2004

Mr. Robert Chico, Program Manager
West Virginia High Tech Consortium
1000 Technology Drive - Suite 1000
Fairmont, WV 26554

Dear Mr. Chico:

I am writing to provide my endorsement to you and the WVHTC Foundation for *AmberView*. During our discussion about this project, I have come to believe that *AmberView* is an innovative means by which to reduce child abductions through the use of technology.

I was very pleased to have Harrison County Schools included in your initial Phase I project. I have every confidence that you will find a great acceptance and utility for your project. I further feel that, upon the success of Phase I, *AmberView* will be readily accepted and highly regarded by all agencies which respond to emergency situations. Based on this vision, I feel that *AmberView* has outstanding potential to significantly reduce the possibilities of child abductions in the United States.

I congratulate you on your efforts and look forward to working with you as you continue to develop this vitally important program.

Sincerely,

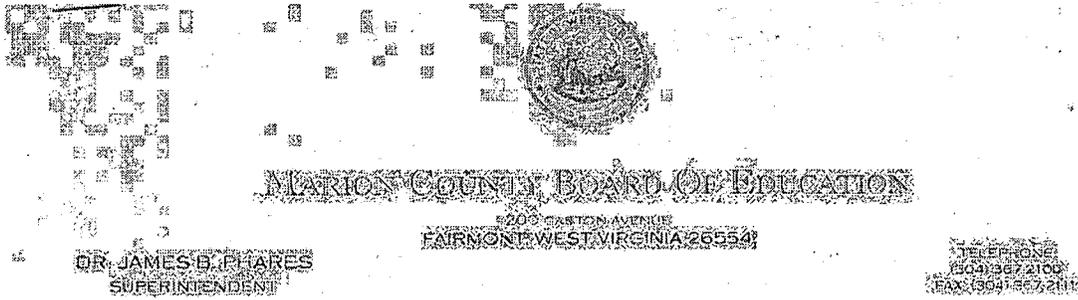
A handwritten signature in cursive script, appearing to read "Carl H. Friebel, Jr.".

Carl H. Friebel, Jr., Ed.D.
Superintendent

CHF/cab

Cc: File Copy

F.3 Letter from Marion County Board of Education



November 9, 2004

Mr. Robert Chico, Program Manager
WVHTC Foundation
1000 Technology Drive
Suite 1000
Fairmont, WV 26554

Dear Mr. Chico:

As Superintendent of Marion County Schools, student safety and security is always the most important aspect of the work we do. Therefore, I would like to wholeheartedly endorse the Amber View Project.

We are pleased to have the opportunity to assist in developing an advanced method for identification of missing children that will serve as a model both statewide and nationally.

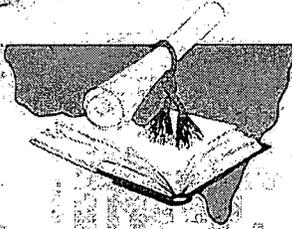
It is a privilege for Marion County Schools to join forces with the West Virginia High Tech Consortium on such a cutting edge project using modern advances in technology to improve the safety of our children.

Sincerely,

James B. Phares
Superintendent

JBP:ssh

F.4 Letter from Monongalia County Schools



MONONGALIA COUNTY SCHOOLS

13 South High Street, Morgantown, WY 26501
Phone 304-291-9210 FAX 304-291-3015

BOARD OF EDUCATION

Dr. Michael J. Vetre, Jr. *President* Nancy A. Walker *Vice President*
Stephen L. Cook *Dr. Barbara E. Parsons* Joseph C. Stiller

SUPERINTENDENT
Dr. Michael J. Vetre, Jr.

November 22, 2004

TO WHOM IT MAY CONCERN:

This letter is being written to fully support and endorse the WVHFC Foundation Amber View Initiative. Innovative projects that will enhance the safety of our children by creating a unique tool to assist law enforcement officials return abducted children to the safety of their families are greatly needed and appreciated by the Monongalia County Board of Education. We look forward to having this opportunity for our schools to actively participate in the initial phase of this biometric project.

It is a privilege to take part in this project and we look forward to working with you and WVHFC foundation in the development of Amber View.

If I can be of further service, please contact my office.

Sincerely,

Michael J. Vetre, Jr., Ed.D.
Superintendent

MJV/bm
cc: Board of Education

PROPERTY OF

National Criminal Justice Reference Service (NCJRS)
Box 6000

Rockville, MD 20849-6000