Automated Crime Profiling

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By
DAVID J. ICOVE, Ph.D., P.E.
Senior Systems Analyst
Behavioral Science Investigative Support Unit
National Center for the Analysis of Violent Crime
FBI Academy
Quantico, VA

In the fall of 1983, Special Agents from the FBI's Behavioral Science Unit constructed a criminal personality profile describing an individual who could have been responsible for a series of fires at religious homes and houses of worship that summer in a posh New England community. The profile was prepared at the request of the community's police department, which later discovered that the FBI's profile not only accurately described the suspect in detail but also pinpointed his residence, based upon a series of intricate computer calculations using artificial intelligence technology. The suspect later confessed to the crimes.

This pioneering use of artificial intelligence technology in crime analysis and criminal personality profiling provided the groundwork for the present automation efforts at the FBI's National Center for the Analysis of Violent Crime (NCAVC).[1] In an active project at the NCAVC, experts in criminal personality profiling are taking advantage of the existing technology of artificial intelligence, or AI as it is known to its users, to capture the elusive decisionmaking rules associated with the profiling of serial violent criminals.

This article is an overview of the ongoing research and development efforts by the NCAVC to automate the criminal personality profiling process. Future articles are planned to advise law enforcement researchers and investigators as to the success of this exciting and thought-provoking technology.

Violent Crime Model

The relationship of AI to the profiling process is best described using the "Violent Crime Systems Analysis Model." (See fig. 1.) This model was developed during the conceptualization and development of the NCAVC computer systems and traces the philosophical activities involved with the detection, prediction, and prevention of violent crime.

The model is divided into *reactive* and *proactive* investigative strategies. Reactive strategies include crime scene investigative support during immediate response to incidents, while proactive strategies explore effective anti-crime programs to both deter and apprehend offenders.

Briefly, the model emphasizes the reporting of violent crimes (step 1) to the NCAVC for crime pattern analysis and classification. This information may come from written media accounts (step 2), crime scene processing (step 3), VICAP crime reports (step 4), or violent crime research findings (step 5). Crime pattern analysis (step 6) can determine if any case trends are detected in the profiled incident that have existed in the past, predict the probability of the occurrence of future incidents, and check for the possible identification of prior known/unknown criminal offenders based upon their past methods of operation.

Crime pattern recognition analysis can also classify incidents into naturally occurring groups, such as the type of

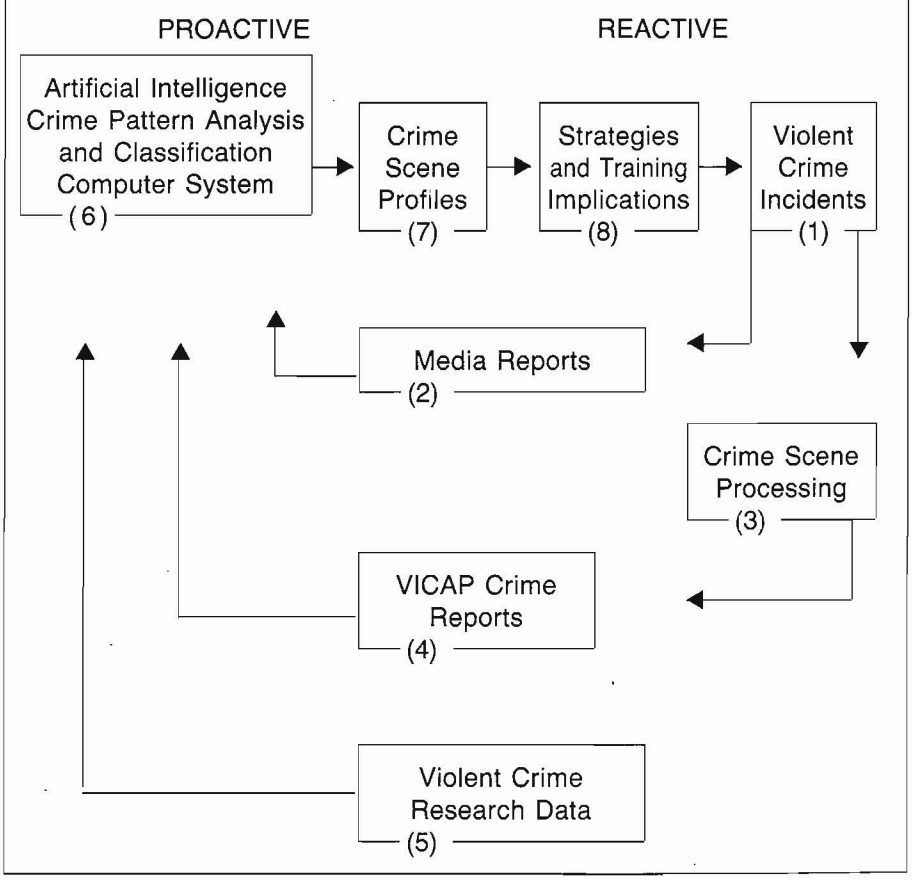
Dr. Icove

crime, motive, or temporal conditions. Furthermore, pattern analysis can reveal multidimensional trends and profiles in the crime data which in the past have gone undetected.

Based upon prior profiling experiences in combating violent crimes (step 7), effective prevention strategies are documented for future operational and training use (step 8). Using historical information, actual probabilities of success can be assigned to the suggestions of specific, proven prevention strategies.

The use of effective crime prevention strategies will minimize the risk of future violent crime incidents. Many strategies include operational, personnel, and physical security programs. However, once an incident occurs, the effective case management of the investigation must be carried out. The violent crime investigator at the scene summarizes the incident and submits a VICAP report. The feedback loop is then completed with an inquiry into the model of the encoded case data.

Figure 1 The Violent Crime System Analysis Model



"Computer technology is also necessary to support ongoing behavioral science research efforts."

Several computer systems presently serve the needs of the NCAVC in support of the VICAP, profiling and consultation, and research programs. The computers are located at both Quantico, VA, and Washington, DC.

VICAP

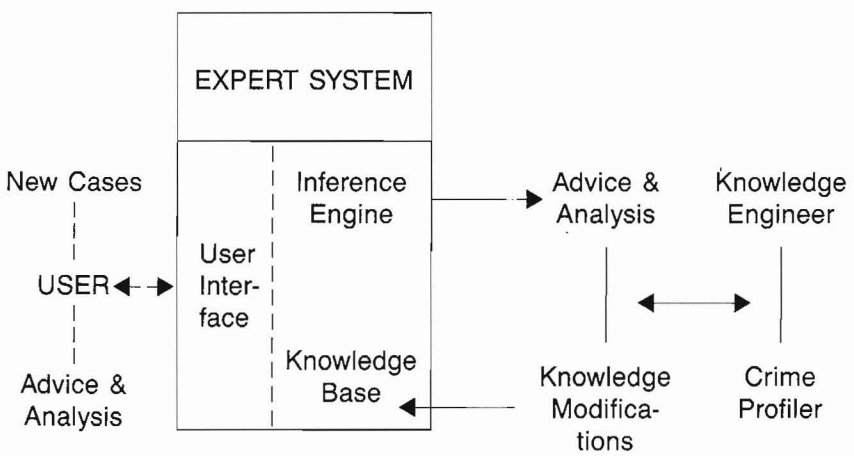
The Violent Criminal Apprehension Program (VICAP) computer system is located at FBI Headquarters in Washington, DC, and stores information on unsolved homicide-related violent crimes reported to the NCAVC. VICAP crime reports are entered on-line from the NCAVC at Quantico, using a secure telecommunications network.

When a new case is entered, the VICAP computer system simultaneously compares and contrasts over 100 selected modus operandi (MO) categories of that case with all other cases stored in the data base. After overnight processing, a printed computer report is returned to the VICAP crime analyst handling the case. This report lists, in rank order, the top 10 "matches" in the violent crime databank; that is, the 10 cases that were most similar to the new case. This crime pattern analysis technique, called template pattern matching, was specifically designed for VICAP and programmed by the FBI's Technical Services Division. The VICAP computer system also produces selected management information system reports which monitor case activity geographically, with hope that it will eventually trace the travels of serial violent criminals across the United States.

Profiling

The profiling and consultation program uses a collection of crime pattern recognition computer programs on mini- and micro-computers at the NCAVC's offices to detect and predict the behavior of violent criminals. The Arson Information Management System (AIMS) is a crime pattern analysis computer program used at the NCAVC which has enabled staff members to predict accurately the times, dates, and locations of future incidents, as well as the most probable residence of suspects.[2]

Figure 2 A schematic diagram of the NCAVC's Artificial Intelligence Knowledge-Based Expert System



Computer technology is also necessary to support ongoing behavioral science research efforts. NCAVC staff members are encouraged to perform and publish research studies on all aspects of violent crime and rely upon computers at Quantico for their support. Some research projects include the use of portable computers carried into the field.

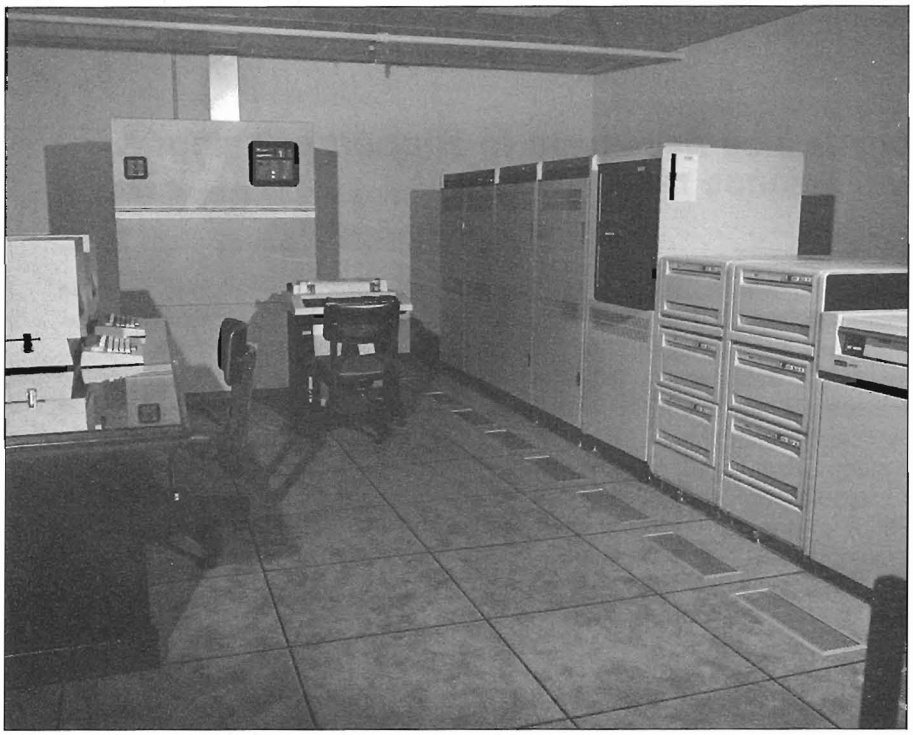
Artificial Intelligence Project

Using the insight and experience gained with VICAP and AIMS computer technology, the NCAVC staff is now developing a comprehensive AI knowledge-based expert system which will assist users of the NCAVC computer system in tracking and predicting violent crimes. Knowledge-based expert systems have proven effective in applying knowledge to solve problems that ordinarily require human intelligence.[3] Figure 2 illustrates this system and the relationships of the various individuals in its design and use. It is anticipated the project will be completed in 2 years.

Following the diagram in figure 2, the *knowledge engineer* transforms prior experiences of the *crime profiler* and the results of *violent crime research* into a *knowledge base.* Using artificial-intelligence computer software, the knowledge base is transformed into *decision rules* defining an *inference engine.* The NCAVC investigators input new cases and receive consultation via a *user interface.*

The expert-based computer system under development will allow the NCAVC to:

1) Eliminate useless investigative paths which historically have proven fruitless in profiling and identifying the offender;
2) Preserve and recall knowledge of similar cases, criminal personality profiles, and research studies;



The NCAVC Computer Center

3) Display the hierarchy of complex criminal network problems from the general to specific level;
4) Develop and use decision rules which accelerate computation time, as well as allow the investigator to understand the problem better;
5) Receive advice and consultation from the expert system on new and existing cases based upon prior knowledge captured by the system;
6) Preserve information in an active form as a knowledge base, rather than a mere passive listing of facts and figures;
7) Train novices to think as an experienced crime profiler would; and
8) Create and preserve in an active environment a system that is not subject to human failings, will respond to constant streams of data, and can generalize large bodies of knowledge.

AI applications show great potential for solving complicated crime profiling and assessment problems. Research is currently being conducted in two such uses which will be integrated into the NCAVC's AI computer project.

Social network analysis is a behavioral science-oriented approach that describes the interaction patterns between people.[4] This analysis can be used to identify possible courses of action an individual or group might take, as well as to surmise as to the hierarchical structure of an organization or group. Examples of the application of social network analyses include structures of organized crime syndicates, motorcycle gangs, and terrorist groups. NCAVC staff members are developing AI procedures to manipulate data and compute the probable hierarchies and interactions of complex organizations.

The behavioral analysis of threatening oral and written communications in extortions, bombings, and terrorist incidents is another viable application of artificial intelligence technology to real-world law enforcement problems.[5] The NCAVC is actively researching and experimenting with computer-assisted linguistic analysis techniques to evaluate the content of these communications in an effort to determine the authorship profile and assess the viability of the threat.

Summary

Presented in this article have been the systems approach to the management of violent crime data and the development of an artificial intelligence crime profiling computer system for the National Center for the Analysis of Violent Crime. The major benefit of this effort is an effective management information system which will track the activities of the program, assess the impact of law enforcement efforts against violent crime, and introduce automated computer-assisted profiling technology.

FBI

Footnotes

[1] D. J. Icove. et al., *Incendiary Fire Analysis and Investigation,* Open Fire Service Learning Program (Lexington, MA: Ginn Publishing Co., 1984); D. J. Icove, V. B. Wherry, and J. D. Schroeder, *Combating Arson-For-Profit: Advanced Techniques for Investigators* (Columbus, OH: Battelle Press, 1980).

[2] J. L. Bryan and D. J. Icove, "Recent Advances in Computer-Assisted Arson Investigation," *Fire Journal,* National Fire Protection Association, vol. 71, No. 1, January 1977; D. J. Icove and H. L. Crisman, "Application of Pattern Recognition to Arson Investigation," *Fire Technology,* National Fire Protection Association, February 1975; "Arson: the Prevention Chain," National Clearinghouse for Criminal Justice Systems, U.S. Department of Justice, May 1980.

[3] B. G. Buchanan and E. H. Shortliffe, *Rule-Based Expert Systems* (Reading, MA: Addison-Wesley Publishing Co., Inc., 1984).

[4] R. H. Davis, "Social Network Analysis: An Aid in Conspiracy Investigations," *FBI Law Enforcement Bulletin,* vol. 50, No. 12, December 1981.

[5] M. S. Miron and J. E. Douglas, "Threat Analysis: The Psycholinguistic Approach," *FBI Law Enforcement Bulletin,* vol. 48, No. 9., September 1979; U. Perret, "Computer Assisted Forensic Linguistic System 'TEXTOR,' " IEEE International Conference: Security through Science and Technology, September 1980.