



NIJ Expert Systems Testbed Project

NIJ

Evaluating Expert Systems for Forensic DNA Laboratories

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Introduction

The National Institute of Justice's (NIJ) Office of Science and Technology has initiated a project to evaluate the commercially available expert systems designed for use by forensic DNA laboratories. Expert systems could easily be one of the most important advances for the forensic DNA databanking community since the development of higher throughput instrumentation and single amplification multiplex chemistry. The NIJ's Expert Systems Testbed (NEST) Project is initially focused on evaluating the ability of commercially available expert systems to analyze single source DNA samples for the eventual upload into the National DNA Index System (NDIS).

Significance

In the field of forensic DNA analysis, superior computer automation for data storage and retrieval of convicted offender and forensic DNA data has proven quite useful. Since the FBI's Combined DNA Index System's (CODIS) inception to August 2005, over 2.6 million DNA samples have been entered into CODIS including convicted offenders and forensic casework profiles that have aided in over 27,000 investigations and resulted in 25,100 hits [1]. As the advancing computer technology has proven its utility, expert systems are now on the horizon to support the analysis and evaluation of convicted and forensic DNA data destined for input into CODIS.

Expert systems will provide forensic analysts with the ability to rapidly review and input large volumes of convicted offender and forensic DNA data into CODIS. In support of the CODIS program, the NIJ Convicted Offender DNA Backlog Reduction Program, as well as the availability of higher throughput DNA analysis systems, has resulted in the processing of over a million convicted offender samples since FY 2000. The NIJ Convicted Offender DNA Backlog Reduction Program has awarded over \$47 million to state agencies for the analysis and upload of offender samples into CODIS which have produced 4,000 blind hits and investigative leads.

The analysis of convicted offender and forensic DNA data requires considerable training and experience. An expert system, one that interprets data as a human expert, could prove to be quite a noteworthy advancement for the forensic DNA community. However, expert systems are not novel to the law enforcement community as they have been developed for hostage-taking incidents, burglary, and murder [2]. In-so-much, it is the right time to adopt expert systems for the forensic DNA community.

NIJ Expert Systems Testbed Project

Expert Systems

Expert systems are computer programs and/or systems that perform at the level of a human expert, and perform consistently. Expert systems provide users with a flag, or an explanation of the reasoning, used to support a decision or conclusion. The expert systems can provide quality scoring, or ranking, of analyzed data. Furthermore, expert systems are designed to be easily modified with the approving authority of a technical administrator for advanced data analysis and interpretation.

With the advances made in higher throughput sample punches of convicted offender cards, robotic pipetting workstations, multicapillary instrumentation, and multiplex single amplification chemistry and the outsourcing of convicted offender samples, the bottleneck today has shifted from sample processing to sample data review for eventual upload into NDIS. Currently, for the submission of convicted offender profiles into NDIS, each sample profile must have two (2) independent technical reviews and be approved by the state's administrator [3]. The incorporation of expert systems into laboratory processes will lead to a reduction in time required for the data review process of convicted offender samples and submission to NDIS.

The NEST Project is focused on the technical review of convicted offender data through an evaluation of three (3) commercially available expert systems. The primary goal of the NEST Project is to conduct a thorough evaluation of the commercially available expert systems and report the results to the forensic community which will enable forensic analysts to be better educated about expert systems and make informed purchasing decisions. The expert systems currently under evaluation during this phase of the project must meet specific criteria.

The evaluation of each expert system will include documenting the entire process of purchasing through operation of each system. Specifically, the NEST Implementation Team will report the purchasing process for each of the individual software packages, the vendor optimization of the analysis parameters, the customer service and training provided by the vendors, the utility of the software, the speed of processing, the speed for analysis, and the many flags, rules, criteria, and features available with each of the software systems.

An expert system for the NEST Project must:

- Meet the criteria defined in the National DNA Index System DNA Data Acceptance Standards, Appendix B [4]
- Be publicly available for purchase
- Be configurable off-the-shelf software
- Be completely housed in the purchasing laboratory's facilities
- Not require of the user computer code knowledge

NIJ Expert Systems Testbed Project

The three (3) systems that have been purchased and that are undergoing independent evaluation by the Project Implementation Team are: 1) GeneMapper® ID Software v3.2 (Applied Biosystems, Foster City, California); 2) TrueAllele® System 2 (Cybergenetics, Pittsburgh, Pennsylvania); and 3) The Forensic Science Service® DNA Expert System Suite FSS-i cubed (Forensic Science Service, Birmingham, United Kingdom). The three expert systems will be evaluated using a standard set of rules (criteria) agreed upon by NEST members on defined systems [5].

Conclusion

The objectives of the NEST Project are to evaluate expert systems as a mechanism for the rapid, accurate technical review of convicted offender single-source samples; to hold workshops and training sessions for the different systems; and to summarize the features and limitations of each software package so that the forensic analyst can make informed decisions on the purchase of such systems. The evaluation of the various software packages is currently underway.

References

[1] CODIS: Combined DNA Index System, data acquired October 9, 2005 at <http://www.fbi.gov/hq/lab/codis/>.

[2] Lynch, KJ and Rodgers, FJ. "Development of Integrated Criminal Justice Expert Systems Applications" August 13, 2002 at <http://ai.eller.arizona.edu/COPLINK/publications/develop/developm.html>.

[3] DNA Advisory Board, "Quality Assurance Standards for Convicted Offender DNA Databasing Laboratories," Forensic Science Communications, 2000:2(3).