State of Research, Development and Evaluation at NIJ

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Who is the National Institute of Justice?
NIJ Biometrics Research Program and Advances

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Establishment of the Office

  - Title II of the Homeland Security act as it relates to NIJ’s Office of Science & Technology
  - Research, development and evaluation arm of the Department of Justice
NIJ’S MISSION

Advance scientific research, development and evaluation of technologies to improve efficiency and effectiveness of the criminal justice community and public safety.
We develop innovative solutions to the next generation of technology through:

• Capturing the technology needs of the criminal justice community.
• Strategic planning of a research agenda.
• Supporting research, development and evaluation via the competitive award process.
• Demonstrating and testing of emerging technologies.
• Dissemination of research and evaluation results
Solicitation Process

- Seeded with TWG identified needs
- Competitive; peer reviewed
- Peer panels with practitioners and technologists
  - TWG representatives as well as representatives from Federal R&D agencies

The U.S. Department of Justice, Office of Justice Programs, National Institute of Justice is seeking applications for funding to enhance the ability of law enforcement personnel to deal with the threat of Improvised Explosive Devices (IEDs) and Vehicle Borne Improvised Explosive Devices (VBEDs).

This program supports the Department's mission by sponsoring research to provide objective, independent, evidence-based knowledge and tools to meet the challenges of crime and justice, particularly at the state and local levels.

Solicitation:
Enhanced Tools for Improvised Explosive Device (IED) and Vehicle Borne IED Defeat

Eligibility
(See “Eligibility,” page 3)

Deadline
All applications are due by April 30, 2017, 11:59 p.m., eastern time.

Contact Information
For assistance with the requirements of this solicitation, contact Chris Miles, Senior Program Manager, Research and Development Technology Division, 282-016-1110, Chrismiles.jjaa@usdoj.gov.

This application must be submitted through Grants.gov. For technical assistance with submitting the application, call the Grants.gov Customer Support Helpline at 1-800-518-4720.

Grants.gov Funding Opportunity No. 2007-JU-1434
SL#908087
Past Research
Selective Feature Based Quality Measure Plug-in for Iris Recognition System

- Method to estimate the accuracy of the iris image preprocessing in the form of a plug-in
- Evaluates and produces quality metrics/score for segmentation
- Assessment of feature information
- Assigns quality score for feature extraction based on feature characteristics
- Developed a score fusion method to calculate the confidence level of possible match
Algorithmic Fusion of Face and Iris

- Single image capture for face-iris recognition
- Iris technology to process images within the conditions and resolutions of face acquisition
- Face acquisition near infrared illumination (usual for iris)
- Improved iris feature extraction for off axis acquisition and uneven illumination
- Designed algorithm for mode selection: iris-iris and face-iris
Application of Level 3 Matching to Latent Finger and Palm Prints

- Fuse various Level 3 feature matchers with Level 2 minutiae matcher for latent fingerprints. (Level 3 features include ridge shape, sweat pores, incipient ridges, scars, permanent creases, and other distinguishable marks)

- NIST-EFS data set

- Automated level 3 feature extraction for gallery. Manual level 3 feature extraction of latent probes

- Candidates from level 2 matcher will invoke level 3 matching.

<table>
<thead>
<tr>
<th>Matcher</th>
<th>BE7 (level-2)</th>
<th>BE7+BYT (texture)</th>
<th>BE7+BYT +HCP</th>
</tr>
</thead>
<tbody>
<tr>
<td>L5 (minutiae only)</td>
<td>49.80%</td>
<td>N/A</td>
<td>56.08% (≈ BE7)</td>
</tr>
<tr>
<td>L1 (image only)</td>
<td>57.68%</td>
<td>62.24%</td>
<td>N/A</td>
</tr>
<tr>
<td>L2 (image+minutiae)</td>
<td>70.98%</td>
<td>74.12%</td>
<td>74.51%</td>
</tr>
<tr>
<td>L3 (image+extended feature set)</td>
<td>81.18%</td>
<td>86.27%</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Table 1.1: Rank 1 Performance with data subset of 240 mates on 4180 exemplars ordered in by increasing effectiveness of feature set used.

* HCP = Hausdorff Distance matcher
Site Adaptive Face Recognition at a Distance

- Designed to recognize low quality facial images from video surveillance
- System to locate 26 pose specific landmarks on the human face
- Site adaptive training method has been developed for the major components of the PittPatt face recognition training algorithm
- Improved precision of face alignment by extending Boosted Ranking Model (BRM)
- Semi-supervised face alignment which can propagate the manual labeling from a few images to a large image ensemble
- Eleven white papers published
Current Research
3D Hand-Held Surveillance and Real Time Remote Multi-Modal Facial Recognition Device

- Develop a hand-held wireless 3D binocular/camera capable of face acquisition up to 1000 meters capable of real time face recognition.

- Wireless transmits 3D video clip to server via encrypted wireless upload. Server performs quality assessment.

- Field testing with LA Sheriff Dept. & subsequent delivery of two devices to NIJ.

- L1 matcher

- Super resolution and speckle processing

Status: OPEN
Mobile Fingerprint Capture

- Optical based fast four fingerprint scanner
  Acquisition time approx 1 sec per finger
- Rotational contactless 180 degree scan area or “rolls”
- Liveness test with IR scan of blood vessels
- Mobile unit with wireless encrypted WiFi and Bluetooth upload
- Will include adaptive lighting system. Camera provides real time feedback of lighting conditions of 6 areas of each finger

Status: OPEN
Automatic Fingerprint Matching Using Extended Feature Set

- Improve match performance with automated extraction and matching of extended features singular points, pores, dots, ridge flow (orientation field) and minutiae shape
- Ten prints and latent prints
- Combine minutiae and extended features using various fusion schemes
- Study the statistical properties of extended features and demonstrate the performance gain by combining minutiae and extended features using various fusion schemes
Create the Research Transition Center Enterprise within the Center for Identification Research (CITeR) at West Virginia University (WVU)

- Host cooperative operation-based research with direct involvement of academic, industry, and government to assess readiness of biometric technologies that specifically address government needs.
Face Annotation at the Macro-scale and the Micro-scale: Tools, Techniques, and Applications in Forensic Identification

- Formulate the characterization and representation of macro and micro facial features
- Previous categorizations overlap and are ambiguous
- Form and propose a standard for localized facial features
- Develop and evaluate methods for automatic and/or semi automatic extraction of such facial features in high resolution digital imagery
- Definitions of marks are now based on three different morphologies (i.e., Point, linear and Irregular) and two color characteristics, (i.e., light or bright)
- Currently designing automatic mark extraction and classification with medium resolution images to eventually be used on high resolution images

Status: OPEN
DNA Solicitations

- DNA backlog reduction - Make funding available to states and local LE for DNA analysis of cold cases (CODIS)
- Using DNA to find the missing (CODIS)
- Convicted Offender and/or Arrestee DNA Backlog Reduction Program
- Post conviction DNA Testing Assistance
- Forensic DNA Unit Efficiency Improvement
- Forensic DNA Research and Development - robust, more informative, less costly, or less labor-intensive identification
- Solving cold cases with DNA
DNA Backlog

**Figure 1:** DNA Casework: Supply, Demand, Backlogs

2005

- Total to be Processed
- Completed
- Year-end Backlog

2007

- Total to be Processed
- Completed
- Year-end Backlog

2008

- Total to be Processed
- Completed
- Year-end Backlog

Legend:
- Backlog from previous year
- New cases
The Fingerprint Source Book

- Invaluable resource for the forensic community

- Topics such as: History, Anatomy of friction ridges, Processing, Equipment, Quality Assurance, Research and Challenges

- Chapters will appear online at the NIJ website as they are completed

- A hardcover print version will be available when all chapters have been completed
CHAPTER 1

History

Other ancient artifacts have been found that have ridge patterns on them that were clearly used rather than left as accidental impressions. It is important to note, however, that ridge designs similar to human friction ridge skin also occur in animal species other than humans. In some plants, and even in natural stone formations such as sand blown by wind or water. Therefore, it cannot be conclusively determined that all friction ridge-like structures in ancient artifacts were produced as a representation of human friction ridge skin. However, we call these ridge designs include artistic representations in tombs of Chewink, an island just off the west coast of France (Figures 1-3) and in the tombs at Navagraha in the coast of India (Figures 4-6).

Additionally, there are references to the nobility using friction ridge skin as signatures.

In 1673, the poet John Dryden published his play "The Pilgrim's Progress," in which the character of Mr. Reliance is depicted as using the power of the friction ridge skin in order to escape from his enemies. The method was shown to be successful in the case of the character, and it was adopted by many others as a means of identification.

The above text is an example of the nobility's use of finger-prints in India to demonstrate authenticity when verifying a document. The use of finger-prints on important documents was adopted from the Chineses, where it was used generally, but in India it was mainly used for royalty (both and Kaur, 2005, p. 134-135). The use of friction ridge skin as a signature in China, Japan, India, and possibly other nations prior to European discovery is thus well-documented.

1.2 221 B.C. to 1637 A.D.

The Chinese were the first culture known to have used friction ridge impressions as a means of identification. The earliest example comes from a Chinese document entitled "The Volume of Crime Gene Inception: "Bopaiy"", from the Qin Dynasty (221 B.C. to 206 B.C.). The document contains a description of how fingerprints were used as a means of evidence against the crime of theft (Xiong Jin and Chun-Ga, 1998, p. 263).

FIGURES 1-3

The stones of Navagraha, India (dated 2000 to 3000 B.C.) (Reprinted from Burt, Commissary).

FIGURES 4-6

The stones of Navagraha, India (dated 2000 to 3000 B.C.) (Reprinted from Commissary).

1.4 17th and 18th Centuries

In the late 17th century, European scientists began publishing their observations of human skin. Friction ridge skin was first described in Italy by Dr. Nehemiah Grew (Figure 9) in his 1683 paper "Micrographia," Transactions of the Royal Society of London. Dr. Grew's observation marked the beginning of the Western tradition of friction ridge skin observations and characteristics (Kaur, 2005, p. 33; Lambrou, 1991, p. 234). In 1683, Giovanni Battista, a Roman anatomist, published an Anatomy of the Human Body, which included skin and the periosteal ridges of the thumb and fingers. This work laid the foundation for the study of friction ridge skin and its characteristics (Kaur, 2005, p. 28).

1.5 19th Century

Interestingly, the English veterinarian and anthropologist Thomas Bewick (1753-1828) published many books with wood engravings of birds and other animals. Three woodcuts in 1809, 1812, and 1826 included a fingerprint, and the latter two had the legend "Thomas Bewick, his mark" (Hassell, 1919, p. 234). The woodcuts (Figure 10) were very detailed, but it is unknown whether Bewick understood the value of friction ridge skin for individual identification (Kaur, 2005, p. 24). Lambrou (1991, p. 234). In his 1823 treatise "A Comparison of the Physiological Characters of the Organ of Vision and the Cerebrospinal System," Dr. Johannes E. Putins (1767-1860), professor of the University of Basel in Germany, described fingerprint patterns from his colleagues and gave them a name (Figure 11) (Lambrou, 1991, p. 234; Garton, 1962, pp. 164-166). Although Dr. Putins went further than naming the patterns, his contribution is significant because he is the first person to use the term "fingerprint."
NIJ Partners

FBI Biometric Center of Excellence

NLECTC National Law Enforcement and Corrections Technology Center

BIMA Biometrics Identity Management Agency

Homeland Security Science and Technology
NIJ’s Customers

- Federal, state & local criminal justice practitioners
  - 19,000 Law Enforcement Agencies
    - 750,000 Law Enforcement Officers
  - 4,451 Corrections Agencies (some overlap with law enforcement agencies)
    - 430,000 Corrections Officers
  - 351 Crime Laboratories
  - Courts, Probation & Parole, etc.
  - Public Safety Community at-large
- Department of Justice
  - Law enforcement components
    - OJP program offices, other Federal agencies
- Policymakers at all levels of government
- Researchers
- American public
Where to go........

www.ojp.usdoj.gov/ni

www.Justnet.org

www.ncjrs.gov
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Back Up Slides
Past Solicitations
(Areas of Interest)

FY10 - Hand-held biometric acquisition and identification at a distance

FY09 - Mobile fingerprint capture

FY08

FY07
- Identification from video and audio surveillance
- Fast capture of latent and rolled-equivalent fingerprints and palm prints
- Expedited automation of legacy biometric information that is not yet shared electronically
- Acquisition of biometrics in field environments
- Access control

FY06
- Through-the-wall surveillance (TWS) for locating and/or tracking individuals within buildings
- Fast capture of rolled-equivalent fingerprints
- Identification from audio video
- Acquisition of biometrics in field environments
- Access control (weapons, communication devices)