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Title: **Bartus Iris Biometrics**

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Abstract

This is the final report of a one-year, Laboratory-Directed Research and Development (LDRD) project at the Los Alamos National Laboratory (LANL). We won a 1994 R&D 100 Award for inventing the Bartas Iris Verification System. The system has been delivered to a sponsor and is no longer available to us. This technology can verify the identity of a person for purposes of access control, national security, law enforcement, forensics, counter-terrorism, and medical, financial, or scholastic records. The technique is non-invasive, psychologically acceptable, works in real-time, and obtains more biometric data than any other biometric except DNA analysis. This project sought to develop a new, second-generation prototype instrument.

1. Background and Research Objectives

We received a 1994 R&D 100 Award for the invention of the Bartas Iris Verification System. The instrument is named for Seigneur du Bartas, the French poet who first called the eyes "the windows of the soul." The concept actually dates to 1885 when Alphonse Bertillon first proposed using iris colors and patterns to identify people [1,2]. The idea has reappeared several times during the 1960's, 1970's, and 1980's [3,4], but has not previously been demonstrated or implemented.

The Bartas Iris Verification System verifies the identify of people based on video images of the externally visible iris, the colored part of the eye. It does this by analyzing the extremely complex iris patterns and markings that are unique to each person [3-13]. (Even identical twins have different iris patterns.) Iris patterns become permanent after adolescence and do not change with time or stress. They change very little with injury or disease. The pattern for a person's left eye differs from that for his/her right.

Iris patterns are the result of a complex meshwork of melanocyte and fibroblast cells [3,8,10]. The density and pigmentation of this meshwork vary across the iris, forming a complex pattern that becomes permanent at puberty [3,6,8,12]. Iris color depends on the density of cells and on the concentration of pigment. Brown eyes have a high density of cells

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and a large amount of pigmentation. Blue, gray, hazel, and green eyes have lower densities and less pigmentation. The meshwork pattern on an iris can be interrupted by permanent markings such as freckles or nevi [7-13]. Freckles are flat spots on the iris caused by localized accumulations of pigment in melanocyte cells. Nevi are discrete, elevated dark masses of cells.

Potential applications for the Bartas Iris Verification System include protecting controlled-access sites such as government, military, corporate, financial, medical, day care, and laboratory facilities. Protection of legal, financial, military, scholastic, or medical records is another area of use. Iris biometrics may also prove to be valuable tools for law enforcement, border and customs control, counter-terrorism efforts, and forensic identity confirmations after catastrophic accidents. Iris patterns might also be used to check the identity of certain species of animals; this is important, for example, for special show or breeding animals, or for rare species released back into the wild by environmentalists.

Iris biometrics have a number of important advantages over other biometric techniques, including commercial retinal scanning systems. These include:

- Much higher information content than any other biometric, except DNA analysis. Identification is thus possible, not just verification. (Identification involves determining the identity of a person, based solely on his/her iris and a search of the entire database of iris patterns. Verification, in contrast, involves comparing the person's iris patterns with only one pattern on record to make a yes-no decision about whether the person is who he/she claims to be; for verification, a person must present a security badge, personal identification number, or password, in addition to his/her iris.)
- Video iris verification occurs in real-time, unlike DNA analysis.
- The system is remote and highly non-invasive.
- Psychological acceptance is much higher than other biometric techniques, such as retinal scanning. (The iris system uses a familiar video camera; there is no scary high-tech looking equipment; the person is in charge of the verification procedure and is not touched; the eye is kept at least seven inches from a podium containing the equipment; safety and perceived safety are very high.)
- Privacy and legality issues with iris patterns may be simpler and more advantageous than for other biometric techniques.
- Work to date suggests we can deal successfully with most or all counter-measures such as contact lenses and drug-induced pupil dilation.
- Verification/identification of moving people is at least theoretically possible.
- It should be possible to digitize high-quality photographic film images of people's faces to provide video iris patterns.

- It may be possible to detect when an individual is intoxicated by alcohol or a dozen other drugs based on abnormalities in the pupil and in eye responses. The "rapid eye test" [14,15], when performed manually by trained medical personnel, detects intoxication with a reported 95% accuracy rate [14-21]. It may be possible to automate this test by modifying the Bartas Iris Verification System. Users of biometrics for the purpose of access control may want to prevent intoxicated persons, even if authorized for entry, from gaining access to their facilities. Pilots, truck drivers, and train engineers could potentially be screened for intoxication prior to assuming their duties in a rapid, non-invasive manner.
- Other possible applications: Eye abnormalities are often present in people with mental disorders [22-24] or who are lying or severely stressed [25,26].

The goal of the project was to produce a second-generation, improved unit for performing iris biometrics. We delivered our only prototype instrument to the United States Secret Service in October. Since then, we are not able to demonstrate the instrument or improve its performance. This new prototype unit was designed to perform iris recognition faster and cheaper and provide a platform for demonstrating LANL capabilities in iris biometrics.

2. Importance to LANL's Science and Technology Base and National R&D Needs

This project supports Los Alamos core competencies in bioscience and biotechnology as well as complex experimentation and measurement. A second-generation prototype unit will maintain LANL's visibility in this area and increase the Laboratory's ability to respond to initiatives.

3. Scientific Approach and Results to Date

Our original iris biometric prototype unit was delivered to the government sponsor, leaving us with no functioning units to demonstrate our capabilities. As a result of this LDRD project, we were able to construct and test a second generation unit. This instrument is smaller (by 30%), cheaper (by 30%), and faster (by 20%) than the original unit.

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