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A NEW PERSONAL APPEARANCE METHODOLOGY STUDY

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Project Director
James J. Paley

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INTRODUCTION

The State of New York has developed a statewide information sharing system for all the agencies of criminal justice and law enforcement in the State. The New York State Identification and Intelligence System (NYSIIS) was created (1965) to implement and maintain this system. As one of its projected new on-going capabilities NYSIIS has been evaluating the feasibility and probable efficacy of creating and supporting, at the state level, a computer processed data base, structured upon individual personal appearance attributes or descriptors. A viable capability of this type could extend immeasurable assistance to local law enforcement agencies in the rapid and (hopefully) more reliable identification of unknown suspects, particularly where they might not be known to that jurisdiction.

As a result of studies conducted by staff members of NYSIIS in 1965, it appeared that the automatic processing of personal appearance data was feasible and desirable. A two phase research program was formulated with the objective of acquiring the necessary data to support any development of a personal appearance module. To assist NYSIIS in achieving the objectives of the research programs, specialized technical expertise was supplied, under contract, by the Cornell Aeronautical Laboratories, Buffalo, New York. Their studies and results are reported in detail under separate covers entitled "Computer Aiding in the Human Identification of Criminal Suspects" (CAL Report No. XM-2624-B-1), 1968 and "Psychological Studies of Human Identification and Recognition Processes" (CAL Report No. XM-2624-B-2).

This report discusses the methodology, results and conclusions of the research to date, with recommendations for ongoing activities.

SUMMARY

Objectives of Phase One

The purpose of the work reported in this document was to conceptualize and evaluate an Automatic Processing of Personal Appearance Data System (APPADS) as a potential module of the New York State Identification and Intelligence System (NYSIIS). The specific objective of the first phase of the program was to conduct an objective study of present personal appearance data systems of some major law enforcement agencies. This information would be used to aid in the delineation of the various files to be included as components of the APPADS module, and to define the parameters and strategies for file structure, storage, and retrieval.

Results of Phase One. The basic need for an APPADS stems from the increase in crime rates that surpasses the population growth rate. An APPADS could facilitate the investigation of criminal cases, identifying criminals, suspects, lost persons, and cadavers, and in court.

The technology currently in use for personal appearance identification includes mug shot photography. Most law enforcement agencies use black and white photography, while some use color slides. Two facial compositors are in use. One is the Identi-Kit and the other is the MIMIC. Both provide advantages but their efficacy is contingent on the training and skill of the operator. Artist's sketches are used when a witness cannot identify a suspect from the mug file and when a facial computer is not available. This method is also slow. Computer systems for identification are in use. In these systems descriptors of suspects are filed in computer storage digitally, using codes for personal appearance descriptors. There is no evidence that the development of the descriptors used for these systems was based on thorough and systematic research.

The technology available for use includes computers, communication (e.g. analog data transmission, digital data transmission and teletype equipment), storage technology, and display technology (e.g. black and white and color video, facsimile equipment and video tape).

The system design for the APPADS module takes into consideration the file content in terms of the descriptors of personal appearance. System components include a central terminal, with primary terminals at the major population centers of the State, secondary terminals at heavily populated centers not covered by a primary terminal, and (optionally) mobile or portable terminals for small local areas. Components would be linked hierarchically to succeedingly larger terminals as well as having direct access (in most cases) to the central terminal. The central terminal would also have input-output and buffer storage equipment. A weighting scheme may be used for the retrieval of personal appearance information, based on the availability and agreement of that information with specified criteria. Thus descriptors having high information content (e.g. scars, tatoos, etc.) would have greater weight. Entries of information and file updating procedures are included in the system design.

Objectives of Phase Two

The objectives of the second phase of this program were to review studies and methods aimed at achieving an understanding of how people recognize or identify others on the basis of personal appearance. Also included in the objectives of this report is to describe a series of experiments which were designed to explore further variables that may influence the identification process. Based on the review of previous research and findings of the present experiments, conclusions are provided along with recommendations for additional research needed in personal appearance identification.

Results of Phase Two. Basic psychological research studies reviewed in this program revealed that:

Psychological studies of memory for words and pictures reveals that memory for pictures is superior to that for words, and memory for faces is better than that for other pictures. The longer the series of pictures to be recognized the poorer is the memory. Inversion of pictures influences memory adversely. Studies conducted revealed:

1. That the longer the exposure to a suspect, the better the ability of witnesses to identify him, especially when the witness knows in advance that he must later make an identification and when the file of suspects is not too long (i.e. about 50 or less).

2. Another finding was that front views, profile views or portrait views of mug shots do not differ significantly in improving witness identification.

3. When all conditions favor accurate identification by witnesses, the use of color versus black and white mug shots does not appreciably differ. Also, whites are generally easier to identify than blacks. In addition, men do not differ significantly from women in their ability to identify suspects accurately.

4. The features people use most frequently in making identifications are the nose, eyes, face shape, hair, chin, mouth, complexion and color of skin, eyebrows, and ears. Good identifiers, as opposed to poor, more frequently use facial markings (i.e. unusual features) in identifying suspects. Poor identifiers, as opposed to good identifiers, more frequently use general or intuitive methods in identifying suspects.

5. Dimensions of facial features of white men and women and of black men and women were identified. These dimensions revealed that a manageable subset of categories could be used to encompass each of the major facial features (e.g. hair, eyebrows, eyes, nose, mouth, chin,

ears, and head shape). Some of these features varied parametrically, (e.g. degree of eyebrow slant, or amount of thickness of lips).

6. Listeners can identify a talker better than those who visually examine a sound spectrogram. The age and sex of a talker can be identified with reasonable accuracy. Important in identifying the talker are the appeal of his voice, its roughness, masculinity, and the anxiety of the talker.

When using dynamic imagery (e.g. including speech and movement) methods instead of or in addition to mug shot procedures for booking, a sample of the suspect's speech may be obtained effectively by having the suspect count from one to ten, and having him recite the months of the year. These items are non-biasing, and easy to perform for most suspects, and they are brief.

7. Distraction (e.g. that may arise from violence) to which a witness has been accustomed will not detract from his performance in identifying a suspect. Distraction coupled with emotional stress will undoubtedly alter this conclusion.

8. The use of color still photography or black and white dynamic imagery result in better performance of witnesses identifying suspects as compared to the use of black and white still photography.

BACKGROUND

A. NATURE OF THE PROBLEM

Early in 1965, as one of its initial research programs, NYSIIS initiated a study of the Personal Appearance aspects of the identification process. To obtain an accurate assessment of this area of the law enforcement methodology, the study was conducted on a statewide level.

The objectives were set forth as follows:

1. Identify the system that has been adopted, presumably consistent with the needs of agencies associated with the various political and geographic sub-divisions within the state.

2. Establish a dialogue with the professionals responsible for ongoing law enforcement.

3. Accurately assess the role of Personal Appearance methodology in the "real world" of the administration of criminal justice.

4. Attempt to measure the effectiveness of the current systems employed.

5. Obtain sufficient data to make management decisions as to the implications of the proposed NYSIIS Personal Appearance capability.

6. Delineate areas of need which might impact the development of the NYSIIS Personal Appearance capability.

The following is a listing of the agencies contacted during this phase of the study:

Statewide Responsibility	New York State Police
County-wide Responsibility:	
Area adjacent to a large city (Rochester)	Monroe County Sheriff's Department
Area adjacent to a medium size city (Binghamton) and to another state (Pennsylvania)	Broome County Sheriff's Department
Resort Area	Sullivan County Sheriff's Department
Major City and Metropolitan Area	New York City Police Department
Major Metropolitan Area	Nassau County Police Department
Large City	Rochester Police Bureau
Medium-sized City	Schenectady Police Department
Small City	Elmira Police Department

The methodology employed was essentially as follows:

1. Interviews were extensively conducted to obtain qualitative data. Detectives, police identification specialists, police artists and other knowledgeable professionals were asked to contribute.

2. Formal and informal records, where available, were examined and abstracted.

3. Statistical procedures were employed to summarize any quantitative data that was made available.

At the conclusion of the foregoing study, two follow-on programs were conducted. The first program was structured around a limited record analysis of availability and variance in the reporting of physical descriptions in connection with arrest records. Again this study was conducted in collaboration with several local law enforcement agencies.

The second study was an analysis of the effectiveness of Personal Appearance data as it is available today, in attempting to search a centralized data file. This study was conducted within the New York State Bureau of Identification.

As a result of these three studies NYSIIS has concluded, in part, that:

1. A need exists for personal appearance data to assist in the investigative process.

2. The effectiveness of most of the present personal appearance methodologies appears to be generally low.

3. Automating any of the existing personal appearance data systems will probably not result in a commensurate improvement in effectiveness.

4. The foundation for any new personal appearance data system must be established by scientific research beginning with the witness.

Areas of Need

From the foregoing research programs several major areas of deficiency in present personal appearance data systems were identified. A few are broadly enumerated as follows:

Limited Base File for Photographic Identification

In this method of identification, it was recognized that potentially this is one of the most effective means for singling out a possible suspect and swiftly apprehending him. Since the responsibility of law enforcement usually rests with a local police department it is obvious that the main source of information for this file ("rogues-gallery") will be the by-product of their arrest and booking activities. The implication here is clear. If a crime is perpetrated by an individual in-transit or new to the area any rapid subsequent recognition is almost precluded, since his photograph would not normally be on file.

It would appear that combining local files on a statewide basis would be a considerable improvement, since it would effectively extend the "sphere of cognizance" of a local police department.

Inadequate Descriptors

Limited file analysis by NYSIIS has shown that there is a problem, in that, many descriptors used to catalogue individuals for record purposes quite often are not meaningful for identification purposes. This is one of the most serious and prevalent gaps in most personal appearance data systems today.

Lack of Standardized Descriptors

In addition to the foregoing, there does not appear to be too much agreement among law enforcement people as to what constitutes adequate description. As a result of this divergence of opinion, it is now almost impossible to develop a centralized personal appearance data base that would be responsive to the realistic needs of potential users.

Lack of Universal Method for Classifying Facial Elements

It is very important that in the identification process the witness be afforded an opportunity to discern facial details. It would help immeasurably if he could, for instance, recognize instead of a "large nose," a "large flat nose." He would be better prepared to do this if he could be shown several classical types of this feature. The problem here is that generally speaking this type of information is unavailable.

Lack of Uniform Photographic Quality

It becomes evident that because of the two dimensional photographic effect of the "mugshot," this type of recognition is necessarily tedious. When this is coupled to the fact that there is very little standardization of picture quality level, the process is considerably more complicated than it first appears.

Lack of Additional Stimuli

Since under the more prevalent photographic recognition techniques, there usually is no capability for introducing voice or motion, complete reliance has to be placed on the witness' ability of visual perception. Yet psychologists here apparently clearly demonstrated that voice and motion can enhance the recall process.

Lack of Training in Witness Interviewing

This is a particularly critical area in the identification process. In dealing with witness, the first interviewer is most frequently the patrolman. It is at this point where emotional stress appears most significantly. Other problems of physical injury, language difficulties, etc., will also be encountered. Yet, the information required at this point is most vital to initiate the apprehension process.

Immediate and Longer Range Research Goals

In order to provide a firm foundation upon which to structure a new personal appearance system some of the following goals must be achieved as a prerequisite, others in the on-going.

1. Develop a standardized family of descriptors that will facilitate the rapid and reliable identification of perpetrators of criminal acts.

2. Develop stereotype sets and sub-sets of facial elements which will enable the classification of individual features of a person's photograph. Photographs so classified could be stored and retrieved using computer processing.

3. Develop a standardized, scientific witness interviewing technique which will elicit witness response in terms of common denominator descriptors.

4. Develop a scientific witness evaluation technique which will permit some assessment as to the probable reliability of the witness' recall capabilities.

5. Develop a standardized, scientifically designed suspect interrogation technique. The object of this development will be to make possible more effective information elicidation within the framework of the recent Supreme Court decision in the case of Miranda.

Affected Organizations

The organizations most directly affected by this program will be most state and local law enforcement agencies. If the objectives of the program can be accomplished, a new personal appearance system will be made available to all agencies which might be a first step in a broader standardized system.

The new methodology should be such that all interested agencies could expeditiously employ automated techniques since all the hardware required, will be essentially "off the shelf" items.

SECTION II

PHASE ONE - SYSTEMS DESIGN

PHASE ONE

To meet Phase One objectives, data were gathered from visits, interviews and reference sources both within and outside of the State of New York. The results of this work yielded information regarding the needs and uses to which an APPADS could be employed. Among these possible uses were, identifying criminal suspects, lost persons, and cadavers. Information regarding current practices and technology was also obtained. This information included current methods of the use of mug shots, facial compositors, artist's sketches, and video recording systems, as well as various types of computer and hardware technology.

The design of the APPAD system, which was developed as part of this program, included the system's file content and its hardware and software components. The latter two included terminal configurations, data transmission methods, system operation, hardware, file management, and information retrieval philosophies and techniques. Also included were suggestions for the number and locations of the various system components. The specific purposes of the first phase of this study were:

1. To conduct an objective limited study of present personal appearance data systems of a few selected major law enforcement agencies inside and outside of New York State in order to:

    a. ascertain a broader understanding of the details, value, and potential of personal appearance data.

    b. determine gross requirements and constraints that a new system must embody.

    c. enlist the aid of people working in the field for suggestions, criticisms, etc.

2. Delineate the various files that should be included as components of the personal appearance module.

3. Define the parameters and strategies for file structure, storage, and retrieval of the various files.

4. Define any quantitative supporting studies which must be made in order to obtain previously determined parameters of data upon which to structure component files.

5. Develop a proposed system which will be responsive to the actual and ongoing needs of law enforcement agencies.

Specific details of the survey and of the system design are found in the report "Computer Aiding in the Human Identification of Criminal Suspects," prepared by Dr. Melvin H. Rudov, Dr. Albert Zavala, and Mr. Eugene S. Okonski of the Cornell Aeronautical Laboratory, Buffalo, New York (CAL Report No. XM-2624-B-1), 1968.

I. THE NEEDS AND USES OF AN APPADS

It is the purpose of this section to review the needs that now exist for an APPADS and the uses to which it could be applied. The needs are discussed in terms of the population and crime rates in the State of New York.

A. SOME CRIME TRENDS IN NEW YORK STATE

In order to evolve the design criteria for an APPADS statistics describing population, crime rates and arrest rates were collected. Observation of recent trends in crime and arrests revealed a significant rise in the number of crimes not being paralleled by the number of arrests over the same time period. While the crime rate increased about 98 percent from 1950 to 1960, the proportion of crimes cleared by arrest appeared to be slightly decreasing. There is no reason to question the prediction that this increase in crime will continue at an equal if not a greater rate.

In addition to the crime statistics, the analysis identified the most densely populated areas showing that densely populated cities are associated with higher crime rates. More importantly, the rate of crime is increasing faster than the population growth rate. Based on this information, a plan was formulated for the distribution of APPADS facilities to best serve the State's population and enforcement needs.

B. THE USES OF AN APPADS

Increases in technology usually result in many additional uses beyond those for which that technology was originally created. This may also be expected of the APPADS. It is, therefore, important to design sufficient flexibility into the system so that only slight modification is necessary as these additional uses become apparent. At the same time, it is necessary to examine closely existing needs in order to assure that these

are not compromised by design decisions made to accommodate peripheral uses. It is the purpose of this section to report those specific needs and uses which can be identified for an APPADS.

1. Investigating Crime

The types of crime in which personal appearance (PA) identification can be relevant include assault, robbery, homicide, auto larceny, fraud, and extortion.

Although such crimes may be witnessed by only one individual as in many gas station hold-ups, frequently there are multiple witnesses as in some bank robberies. The most important information in such crimes is usually that of personal appearance, and multiple witnesses sometimes create more confusion than assistance with their varying descriptions. Currently, investigating officers make judgments as to which witnesses are the more reliable. Alternatively, investigating officers may try to form composites based on multiple witness information. The establishment of more effective techniques for determining witness reliability is definitely needed. The APPADS can be a very effective tool for such purposes.

2. Identifying Criminals

The previous section dealt with APPADS usage in investigating crimes. That is, given that a crime was committed, who did it? This section deals with APPADS usage in identifying criminals. That is, given that a suspect has been apprehended, who is he? If the suspect is not co-operative in identifying himself, an APPADS search may be more rapid and/or convenient method than the use of fingerprints in identifying him.

3. Identifying Lost Persons

Nassau County reported that with their population of approximately 1.6 million people, their missing persons caseload is approximately 3,000 cases per year.

There are two general needs required of an APPADS in dealing with missing persons cases. The first is to collect and disseminate information concerning reported missing persons so that aid might be given in trying to find them. The second is to help in the identification of people under detention so that they might be properly handled. In this latter case are included children who do not want to return home, mental patients who escape from confinement, people with no identification who are hospitalized from accidents, and amnesiacs.

4. Identifying Cadavers

The problem of cadaver identification may occur when there has been an accident, or when there has been a natural disaster. Therefore, it frequently occurs that bodies do not have other means of identification on them.

5. Training

One of the potential long range applications for a fully implemented APPAD system might be for identification training. In those major installations where an on-line audio-video capability would be provided, it would be possible to provide training sequences to law enforcement personnel, which would introduce the standard descriptor concept, together with graphic displays of the various categories of descriptors. Also the training sequences could be directed toward making the professional, particularly new personnel, better observers, etc.

6. Criminal Prosecution

In the City of New York, the District Attorney's Office handles the investigation of some selected crimes in addition to its role as prosecutor. For the most part, this office limits its investigations to extortion, rackets, organized crime, corruption, bribery, and conspiracies. There are two ways in

which the APPADS might help. The first way is by providing a standardized, systematic procedure for obtaining recognition of criminals by witnesses. Court cases, particularly those involving crimes in which PA is important, frequently rely heavily on witness identifications. Therefore, the procedures under which those identifications were made come under close scrutiny. By using approved, standardized procedures, objections to their admissibility can be obviated. By standardizing the procedures, less court time need be taken in describing how the identification was accomplished. To the extent that a remote APPADS Central-based investigator participates in the investigation, the impartiality of the procedure can become greater.

II. TECHNOLOGY AND PRACTICES

The purpose of this section is to describe that technology which is in use or available for use in an APPADS. The discussion of technology that is currently in use is based on the survey conducted during this project.

A. TECHNOLOGY CURRENTLY IN USE

The devices described in this section are in use in some of the police departments surveyed, but are not necessarily applied universally or uniformly.

1. Mug Shots

The use of mug shots is one of the most commonly employed techniques for obtaining personal appearance information in police work.

In most departments, the mug shot is a black and white picture of the suspect's head and shoulders. A front view and profile are most frequently taken as part of the mug shooting procedure. In some departments full length (stand-up) pictures are taken for certain types of crimes. These stand-up pictures are sometimes made of a group of people who were accomplices.

In a few departments, color photos are taken for certain types of crime. Of the departments visited, only one, Nassau County, used stand-up color slides for all bookings.

Detectives bring witnesses to the mug shot file room to show them the mug shots for identifying suspects. In this procedure, the detective searches the files manually, based on his knowledge of the circumstances of the complaint and on the organization of the files. Witnesses typically spend from one to three hours scanning the mug shots placed before them by the detective.

In the absence of any other technology, the use of mug shots is an important and useful tool for criminal investigations. However, there are many deficiencies in the use of mug shots. For example, witnesses become fatigued and can no longer distinguish among the faces adequately after about 30 minutes of scanning mug shots. Also, there is no standardization across police departments as to the specifications for taking mug shot pictures. Standardization is needed for lighting, positioning of the subject to be photographed, camera type, lenses, lens aperture, type of film, developing, and printing procedures. Because of this lack of standardization, detectives usually ask witnesses to ignore complexion, particularly for non-white criminals.

2. Facial Compositors

Facial compositors are devices for making a likeness of a suspect by combining the various facial features into a single image. This combination is accomplished through the use of a mechanical or electromechanical device. There are two such commercial devices that are well-known to police investigators. One is known as the Identi-Kit and the other is know as the MIMIC. Each of these is described below.

a. The Identi-Kit

The small, portable kit consists of 545 transparencies grouped into eight physical-feature categories: head gear, hair line, beards, hair, chin, lips, glasses, and eyebrows. A trained operator is needed to administer the compositing procedure. The procedure begins by obtaining the answers to four questions regarding the suspect's weight, height, age and hairline.

The answers to these four questions are used in entering a table to choose the initial four overlays which are combined to form the first composite (roughly 1800 combinations are possible). The witness is asked to look at the composite and suggest ways in which it could be changed to look more like the suspect. After a succession of such changes the witness is asked to suggest added features (for example, beards and glasses), which are not included on the basic overlays. The overlays are composited by mounting them on a small plastic board. They are held in position by small notches in the overlays. Changes in the vertical location of the features within the face can be made by choosing different notches on each of the overlays. Each of the overlays is numbered, as are the notches, yielding a numerical profile of the person's face. These numerical profiles can be stored and used in a retrieval system.

Improvements in obtaining likenesses could be made by improving the human engineering of this device. Other limitations observed include the inconvenience involved in mounting one overlay upon another. The features are line drawings, and are, therefore, limited. Only front views are shown. Also, the classification of the features does not follow any consistent pattern.

b. Stoelting's MIMIC

The Stoelting Company of Chicago has developed a device that can be used to make facial composites of suspects using verbal descriptions by witnesses. The following provides a description of the device called the Multiple Image Maker and Identification Compositor (MIMIC).

The MIMIC makes facial image composites by a rear-projection technique employing six reels of overlayed 35 mm films. Each reel provides variations of a facial feature (i.e. hair, eyes, chin, nose, mouth, and accessories such as glasses, mustache, and hats). The following has been noted with respect to this device:

(1) The film becomes scratched through use.

(2) The transport time of the reels varies. For the first four seconds, the transport action is slow to allow for making small adjustments. After this initial slow motion, the transport automatically speeds up. It takes about 30 seconds to traverse one entire reel.

(3) Features are placed on the film in a logical and orderly manner. Additional features are added to keep that order consistent.

(4) The MIMIC can composite both front views and profiles.

(5) The MIMIC is not as portable as the Identi-Kit. MIMIC dimensions are: 18 1/8" x 20 5/8" x 24".

(6) It takes from 20 to 30 minutes to make a composite.

A photo can be made of the final image, using a Polaroid camera. A code of the final image is then entered on the record sheet.

The facial features used in the MIMIC are shaded and were drawn by airbrush techniques whereas the Identi-Kit features are simple line drawings. For the MIMIC, a classification scheme was developed and features designed accordingly.

Stoelting indicated that they are having trouble categorizing the wide variety of women's hair styles.

3. Artist's Sketches

Another method of developing facial composites or likenesses is to employ the talents of an artist. Within the state, this method is used in the New York City and Nassau County Police Department when scanning of mug shot files yields no results, but witnesses are still able to describe the suspect. The procedures used to obtain descriptive information from witnesses varies with each artist.

When the artist receives adequate information from the witness (about 90% of the time), he is usually able to execute a reasonable likeness of the suspect. This conclusion is based on comments made by a number of artists who displayed sketches of suspects that had been apprehended with the aid of the artist's renditions. The sketches did not always appear to be close likenesses even though they eventuated in apprehension.

The effectiveness of the use of artists or electromechanical devices depends on several factors. These factors include the amount of time the witness had to observe the perpetrator of the crime, the witness' skill as an observer, as well as the degree of stress felt by the witness during the crime. Also important is the ability of the artist or operator in the technique of extracting information from the witness.

4. Computer-Based Systems

Some law enforcement departments have made efforts in the direction of developing computer-based systems for identifying

suspects using PA information. Some of these are described below.

a. Detroit's System

Detroit's computer-based MO* system uses a 1401 IBM computer with MO information stored on magnetic tapes. These also include PA information. Each of these file records has an information storage identification number. The files cover the crimes of robbery, burglary and rape. There is also on file at the Detroit Police Department a bank of mug shots for each person in the tape files, each having its corresponding tape file number. The procedure developed for using this system is as follows:

> When the program starts a search, it compares the crime descriptors on the search card with those stored on the record tapes by three crime types (either burglaries, robberies, or sex offenses). If there is a match with one of these three, four other basic descriptors are compared (sex, age, race, and height) before continuing. If the four basic descriptors are not matched, the program continues to the next crime record in computer storage. Once the four basic items are matched, other descriptor matches are sought. Each descriptor match is then counted.
>
> When the search is completed, the identification numbers of matched suspects is printed out with a coefficient indicating the hit percentage for each. The officer requesting the search then goes to the mug shot photo file and manually retrieves the pictures of the suspects whose identification numbers appeared on the search routine print-out. These photos are then shown to witnesses for verification as to who might have been the perpetrator of the crime reported.

*MO: Modus Operandi, method of operation of a criminal.

b. Washington, D. C.'s System

The city of Washington, D. C. has also instituted a computerized search routine. This system was modelled after the one developed in Detroit, according to the Washington, D. C. Police Department. The system makes computer searches much the same as described above, except that most descriptive information regarding MO is not used.

c. The Lockheed DIALOG System

This system is a computerized criminal identification system based on its DIALOG random access data retrieval system. At its present stage of development, the system is a prototype for the California Criminal Justice Information System.

With this system, the investigating police officer feeds a description of a suspect to the computer. The computer is used to identify persons with criminal records whose description matches the wanted person. The system also produces a detailed status report on the possible suspect. This description is displayed on a computer terminal screen.

5. Video Recording Systems

The city of Miami, Florida Police Department (MPD) has in operation a video system for obtaining personal appearance information about suspects. The system is used to record on video tape a brief interview of suspects brought into the station. Suspects are asked a number of questions while they are being taped with the video equipment. Questions and answers are recorded on the audio track of the same tape. The suspect answers these questions during the first 30 seconds while he is facing the camera. During the last 15 seconds he is asked to face to the right and then do an about face, before again turning to face the camera. This procedure records both profiles in addition to the full front and intermediate positions. Little resistance to being taped is met from suspects.

Conditions under which video tape recordings are made are standardized with respect to lighting, focus, etc. This reduces differences from the operation of the system by more than one person.

B. TECHNOLOGY AVAILABLE FOR USE

1. Computer Technology

Each of the computer-based systems discussed in the previous section rely heavily on the state-of-the-art in computer technology to gain their capability. The purpose of this section is to discuss those aspects of present day computer technology which could be capitalized on in the APPADS design.

A computer such as the Burroughs 5500 or 6500 is characterized by extremely fast computing speed.

2. Communication, Storage, and Display Technology

a. Transmission

The concept of a computer controlled central file which can be accessed from terminals over a wide area requires that data be transferred over a long distance. The data of interest to APPADS, can be transmitted in the following ways:

(1) Analog data transmission - The analog data to be transmitted consists primarily of pictorial information which includes photographs, fingerprints, sound/motion imagery, handwriting samples and documents. The normal procedure used to send an image (motion imagery can be handled as a sequence of images) is to raster scan the image, as in facsimile and TV transmission. If 15 minutes is allotted to transmit a photograph (with about 200 lines/inch resolution) an 8-1/2 x 11 picture can be transmitted over a bandwidth of about 3.5 kilo-hertz. This is the normal bandwidth of a voice telephone line. If higher rates are required as

in TV video transmission where a new image (500 lines) is transmitted every 1/30 second, bandwidths of about 4 mega-hertz are required for black and white images. Bandwidths up to 6 mega-hertz are required for color TV. Sophisticated coding techniques and the removal of information redundancy in images can result in lower bandwidth requirements with satisfactory results.

(2) Digital data transmission - The digital data to be transmitted consist of numerical data (attribute codes, serial numbers, registration numbers, etc.) and numerically coded text (names, colors, etc.). All digital data can be coded into binary representation and transmitted in this form.

(3) Teletype Equipment - This is commercially available equipment that can be rented or purchased. Interfaces to standard transmission circuits are generally available. Equipment small enough and usable in vehicles with radio links has been developed and is being demonstrated by the Kleinschmidt Division of the SCM Corporation.

b. Buffer Storage Equipment

In any system where data are transmitted between equipments operating at different data rates, buffer storage equipment is necessary.

Buffer storage of digital information can take on many forms depending on the data transfer rates required. These variations include punched tape storage, digital core storage and video storage.(e.g. scan-conversion tubes, video-disc storage and video tape storage).

c. TV Cameras and Displays

There are commercial units applicable to the APPAD system which are available from a number of manufacturers. Color

equipment, though not as available, is used commercially and is compatible with the requirements of APPADS to a great extent.

(1) Color video systems - These systems represent a much more highly complex technology than does black-and-white video. Therefore, the definite need for color should be established before the costs and difficulties associated with its use are decided upon. Chapter VII discusses needed research in this area.

(2) Facsimile Equipment - Facsimile equipment operating over voice bandwidth transmission circuits is available from a number of manufacturers. Transmission of color facsimile is not generally available. Development of such equipment could be considered, and in the simplest case, would require that the transmission time of a color image be tripled over that for black and white (now about 15 minutes for an 8-1/2" x 11" picture).

d. Pictorial Storage

The storage at APPADS Central of pictorial information is expected to consist of photographs, fingerprints and sound/motion imagery. In terms of information content, pictorial storage implies high data capacity requirements. Other important considerations are the rapid access to any record in the file and the process of entering new records into the file. Current technology provides for the storage of pictorial images as photographs (motion picture film for motion imagery) or as recorded images on magnetic tape.

The storage of sound/motion imagery on magnetic tape for identification purposes has been demonstrated by the Miami Police Department using equipment produced by the Ampex Corporation. This equipment was described earlier in this chapter and its successful usage demonstrates the applicability of magnetic tape. The inputs and outputs of these tape readers and recorders have the added advantage of being compatible with standard TV video transmission circuits.

3. Additional Peripheral Devices

a. The Westinghouse Recording System

An image recording device that can be used for APPADS is made by the Westinghouse Research Laboratories of Pittsburgh, Pennsylvania. The device uses a technique for recording television on phonograph records. When available, channel bandwidth is much too narrow for ordinary television use, and when low rates of picture presentation are acceptable, slow-scan television can be employed. The Westinghouse system is called PHONOVID, and it takes advantage of the above factors by using the bandwidth capabilities of the ordinary twelve-inch 33-1/3 rpm phonograph record to present still pictures. The quality of these pictures is comparable to broadcast television at a rate of one picture per six seconds.

b. The SCM Telescripter

This device is a small mobile teletype receiver for use in squad cars and is being tested by some police departments. The telescriptor receives and automatically records information bulletins so that patrol officers are free to turn their attention elsewhere. Later, the messages are there and waiting for the officers. Callbacks or tedious writing are not required with the telescripter. Time is also saved by avoiding repetition of messages missed by one car or another. The messages are coded, which provides security in the transmission channel. The coded tone signals that actuate the telescripter are unintelligible to voice receivers. They can be heard, but no message content can be extracted from them easily.

III. SYSTEM DESIGN

This section discusses the design of a proposed APPADS. The first part deals with the information content and system files. The remaining parts deal with descriptions of functional design concepts, system operation and operation and system hardware. The

APPAD system design is aimed at providing a file of personal attribute information that could be accessed by law enforcement officers throughout the state.

The description of the APPAD system design includes a number of major and minor components that are envisioned now for the complete system, although the final addition of minor components to the system would not be made until several years from now. From the point of view of the achievement of the APPAD system goals, these minor components are considered useful. Nevertheless, it is recognized that the decision to include some of these minor components must be dictated not only by systems considerations, but also by practical considerations such as costs and number of units to be purchased. Therefore, some of the minor components might eventually be excluded from the APPAD system.

A. FILE CONTENT

An attempt has been made to answer the question, "How many measurable ways are there that man varies in his personal attributes?" Without being exhaustive, a very large number of ways were analyzed and a few of them were described previously. The next question is "Which available personal attribute descriptors should be used in the APPADS?" The descriptors under consideration fall into three categories: (a) Those which definitely belong in the APPADS; (b) Those which definitely do not belong in the APPADS; and (c) Those which need further study to determine their utility as APPADS descriptors. The first category breaks down further into two subcategories: (a) those descriptors that are now understood sufficiently to use immediately; and (b) those descriptors which need further study before they can be used.

The descriptors which are presently suggested for the APPADS are:

- Date of Birth
- Weight
- Facial features
- Hair line, texture, set, color
- Height
- Build
- Speech, e.g.:
  - Foreign dialect, sectional pronunciations
  - slang, colloquialisms, defects
  - Pitch

Defects, e.g.:	Sensory Aids, e.g.:
Missing fingers and limbs	Glasses
Skin Defects and Alterations	Hearing Aids

B. SYSTEM COMPONENTS

The following describes a statewide identification system based on personal attributes and is presented to indicate how such a system should be designed for New York State. In the main it is not dependent on any new technological advances. Its successful implementation will depend primarily on a coordinated assembly of standard, or appropriately modified subsystems, and some engineering development.

Generally the system would consist of a central site (APPADS Central) located in Albany and several remote terminals. The APPADS Central would consist of a Burroughs 6500 Computer, all of the resident file information, and a staff of programmers and expert APPADS investigators. A number of different types of terminals would be employed as needed. Primary terminals would be rather complete facilities capable of the input/output of the entire spectrum of APPADS information. Secondary portable and mobile* terminals would be added at a later time to fill out the needs of the state as the system evolves. The terminal configurations are described below, followed by a discussion of system operation and the management and retrieval techniques.

1. Terminal Configurations

All of the descriptor files are located at the APPADS Central. Each of the primary terminals in major population areas is linked to the APPADS Central by means of high speed digital data link and a video line. Each of the secondary terminals is

*Mobile terminals are components that can be considered speculative at this time and would certainly not be included in any initial implementation of the APPAD System. Final decisions regarding the inclusion or exclusion of mobile terminals can therefore be deferred. These terminals are included in the present discussion for the sake of completeness.

linked by a low speed telephone line to a primary terminal to APPADS Central. A portable terminal would be available at each primary terminal and linked via a standard telephone line.

a. Primary Terminal

There would be approximately 15 primary terminals in the major population areas. Each would consist of video and digital data interfaces, a video buffer store for the storage of pictorial information and a digital buffer store. The output devices would include:

(1) TV console for displaying pictorial information.

(2) Polaroid camera unit for hard copy recording of auxiliary data.

(3) A printer for hard copy recording of auxiliary data.

(4) Interfaces for the interchange of data between the primary terminal and the secondary, portable, and mobile terminals.

(5) Facsimile receiver to record pictorial information for a permanent record.

The input devices would consist of:

(1) TV camera and microphone for the transmission of sound/motion imagery to APPADS Central.

(2) Facial compositor for generation and coding of attributes. (May or may not be on-line.)

(3) Facsimile transmitter to transmit pictorial information to APPADS Central.

b. Secondary Terminals

The secondary terminals would be located at county seats, towns, and populous city precincts which are not served by a

primary terminal. Secondary terminals would be linked to a primary terminal or to APPADS Central by standard telephone circuits. Outputs would be still photographs and an auxiliary data printout. Inputs would include still photographs, and coded attributes. A facsimile transmitter would be used for originating still pictorial information.

c. Mobile Terminals

These would be installed in patrol vans linked to the primary or secondary terminals via the standard mobile radio link. Inputs would consist of attributes inserted using a small keyboard. Physical attributes would be coded and transmitted on the same keyboard. A facsimile receiver would be used for the receipt of pictorial data and a small printer for auxiliary data output. These terminals would be used where cooperation of the witness to come to a primary or secondary terminal is not obtained.

d. Portable Terminals

These would be identical to the mobile terminals in composition, but would be packaged in portable containers and the data would be transmitted via a standard telephone line. These terminals would serve the same purpose as the mobile terminals but would also be used to interview witnesses when they are confined (e.g. in a hospital). A video tape recorder could be used to present video lineups in such cases, but such an operation would not be on-line.

2. System Operation

Although the expected turn around times are not exactly determined, a sequence of events with expected times involved can be outlined for a number of typical situations, as follows.

a. Retrieval Request Initiated at a Primary Terminal

Typically a witness to a crime would be interviewed by a detective who would code the suspect attributes into the digital store. A facial compositor interview would be used for requesting and automatically coding the personal attribute information. A search-retrieval request would be initiated based on the coded profile. The request would be accepted (1-5 seconds) and transmitted to APPADS Central. There, the coded profile of attributes would be stored until a query program is available (1-5 seconds). Depending upon the number of attributes and computer work load, a fixed number of suspects would be selected by the computer (1-5 seconds). Photographs (10-50 secs.) of these suspects would be retrieved (2-10 minutes) and transmitted back to the terminal. (Although an image may be in the process of being transmitted to another primary terminal, because of video multiplexing, the picture transmission type would be dependent only on the number of other photographs being sent.) When photos are received they are entered in the video buffer store, thereby releasing the video line for other photo transmissions. This entire procedure would take 3-15 minutes. The witness examines the photographs on the TV display at his own pace. At this point, if a suspect is not identified, the attributes which were provided are modified and a new set of photographs is obtained. When one or more likely suspects are selected, a request for a given number of sound/motion image clips is made including the suspects tentatively identified. A request for a sound/motion image transfer is made. If no other sound/motion images are being transmitted, the request is granted and completed in 2-5 minutes with the sound/motion imagery then residing in the video buffer store. Each clip is approximately 20 seconds long. Following the sound/motion imagery transfer the video line is released. The witness can study all of the photographs

and sound/motion clips at his own pace for proper identification. The turn around time would take approximately 15 minutes, not counting witness interview and picture examination. Hard copy of any picture now residing on the disc can be made immediately (10 seconds) using a polaroid camera or facsimile receiver. Data are obtained on the printer for use by the investigating officer. A clip from the video buffer store can be made for use during prosecution. If the attributes provided by the witnesses are reliable and complete enough, the search could result in a low number of candidates. Under this circumstance the transmission of photographs could be omitted.

b. File Update and New Entries at the Primary Terminal

Additions to the resident file are entered into the system by a recording officer at APPADS Central or remote site. A detailed attribute list is coded for each addition and the biographical data are entered in the digital store. Fingerprints and photographs as well as a sound/motion image reside in the video store. An update request results in the transfer of the attribute list together with the fingerprints to the Central file (1-3 minutes) where a search through the wanted list is made. If the suspect is wanted, the remote site is immediately notified. The photographs, motion imagery clips and biographical data can reside in the video and digital store of a terminal waiting update request approval during a low traffic period at which time the information is transferred into the pictorial and digital file at APPADS Central.

3. System Hardware

In general the system described uses components which exist and are operating in at least a laboratory environment. Much of the equipment is also presently used in a commercial environment. In the following sections, individual elements of the system will be presented giving possible implementations and discussing any development work required. A major developmental effort will be required to assemble these elements into an

efficient, balanced and reliable system. The basic concept of a central digital computer with digital and video transmission of information provides for a system that is evolutionary in form, expandable in size and extendable in performance.

a. APPADS Central Equipment

The Central Site would consist of the Burroughs 6500 computer, digital and pictorial files and transmission line interfaces.

(1) Central Computer and Digital Files

The Burroughs 6500 computer is of advanced capability in the area of dynamic programming and Input/Output interfacing techniques. An important advantage of the dynamic programming capabilities is the characteristic of graceful deterioration. This results in no interruptions in service if component failure occurs. Only a decrease in turn around time would occur at high traffic rates. The Burroughs disc files to be used are multi-head types allowing for a rapid access time. This is important to minimize file search time.

(2) Pictorial Files

The pictorial files consist of photographs, fingerprints, and sound/motion imagery. All three files are normally ordered by serial number although some attribute ordering may be desirable for decreasing access time. At least race, sex, height and date of birth orderings are needed for increased accessibility.

(3) Photographic Files

These files consist of mug shot photographs. To minimize turn around time, automated retrieval methods could be used. A small number of resident records could be stored in individual cartridges. Using this approach, any resident record can be accessed in the average of

6-1/2 seconds to a file of approximately 500,000 resident records.

(4) Sound/Motion Imagery Files

These consist of video tape or motion picture film records. The choice between these two storage media would be made during a preliminary system study. A video tape can hold approximately 100-200 records approximately 20 seconds in length. One of the 1000 cartridges could be retrieved in about ten seconds, and approximately three minutes would be required to locate a specific record contained on a reel. For example, as much as 12 minutes would be required to accommodate a request for four distinct records. This time could be reduced to approximately three minutes by using four playback units.

(5) Record Generator and Video Converter

The Video Converter would consist of one or more video tape recorders (or film projector and TV camera combinations) to generate a video (TV compatible) signal suitable for transmission to the primary site. The record generator would be a video tape recorder (or a TV display and a motion picture camera) which is used to enter records into the pictorial files.

(6) Video Buffer and Facsimile Receiver

This unit would be a video disc or tape recorder used as a buffer which can record scanned photographs or fingerprints appearing at video rates. It would play back the photograph at rates low enough for recording on the facsimile receiver (or into the low speed telephone line to the secondary terminals). One video recorder can store 600 TV frames (600 photographs or fingerprints), whereas a tape recorder can handle considerably more. The choice of recorder used would

be determined by the expected storage requirements and access time considerations. The facsimile receiver would be used primarily for a hard copy record of those fingerprints obtained from the remote terminals that need immediate examination.

(7) Input/Output Buffers: Digital, Telephone and Video Interfaces

These are digital buffers used primarily to match the data rates of the data transmission system to the data rate of the computer. Interfaces are required at each telephone circuit to convert the signal form of these circuits to conventional video and data forms required by the APPADS Central components. These interfaces are normally supplied as part of the data transmission system.

b. Primary Terminal Equipment

The primary terminal equipment consists of a terminal controller, pictorial transducers, attribute coders and buffer stores.

(1) Video and Digital Interfaces

This equipment is normally part of the data transmission system and converts the signal form on the telephone line to a form appropriate for use by the terminal components.

(2) Video Buffer Store

This equipment would consist of a video disc recorder or a video tape recorder. Its first purpose is to provide intermediate storage of video signals as the photographs or motion pictures are received from APPADS Central, releasing the video line for use by other terminals. Once recorded, a witness can view these photographs and/or motion/sound imagery clips at his own

pace. It is also used to preview pictorial data during file updating and prior to transmission to the central site. Its third purpose is to provide for storage of that pictorial information which was received at a video rate, and transmit it to secondary terminals at the lower rate required by the low speed telephone circuits.

(3) Digital Buffer Store

This equipment is used primarily for message assembly as well as data rate conversions required between the high speed data link and the lower data rates required in the terminal. The lower rate is also required before data may be sent to the secondary terminals.

(4) TV Camera and TV Display

These items would be commercial quality closed-circuit television components. The display would be driven by video from the video buffer which would display still photographs and motion pictures. The TV camera is used primarily to enter sound/motion imagery into the APPADS Central file (via the video buffer store).

(5) Printer and Attribute Coders

The physical attribute coder would be a facial compositor, yet to be devised, which superimposes coded human facial features from witness' descriptions. The device automatically generates a code based on the facial features chosen. These codes would be combined with other attribute codes keyed into the buffer store by an interviewer. The printer would be used for code verification prior to transmission and for printout of messages (including resident auxiliary information) from APPADS Central. The printer would be part of a standard teletype unit used for communication to APPADS Central and the other terminals.

(6) Polaroid Camera, Facsimile Receivers and Transmitters

Camera and facsimile receivers would be used for hard copy records of still pictorial data such as fingerprints and photographs taken from the TV display, the video buffer or from secondary terminals. The facsimile transmitter is used primarily to transmit photographs and fingerprints to the APPADS Central files.

c. Data Transmission Systems

The basic data transmitted are TV-type video and digital data. The educational channel would be available, and facilities and cables are available for rental from the New York Telephone Company.

(1) Video Transmission

For this portion of the system a standard video circuit connecting all primary terminals would be used.

(2) Digital Data Transmission

The digital link from the primary terminals to APPADS Central would have to be of high quality to insure that these circuits would not degrade the performance of high speed data links. Digital transmission circuits (other than those from primary terminals to APPADS Central) since they operate at a low speed, would be standard voice-bandwidth telephone lines. These could be either a private line or a standard voice-circuit initiated with a telephone call. Installation of special lines to all secondary terminals is not envisioned because of high initial costs.

4. APPADS Central File Management and Information Retrieval System

This section describes techniques for building, using and maintaining a central file which holds personal attribute data to aid in the identification of suspects. The central file would

reside in peripheral digital storage devices (probably magnetic discs) attached to the APPADS Central computer. The computer would also be connected to remote communication lines and would control automatic photo and fingerprint storage devices such as those described in Chapter III.

Under command from the remote terminals, the central file management system would perform the following basic services:

a. Retrieval of File Entries

Using supplied descriptive attributes and/or identification numbers, the system would search its files for all those entries matching the entered parameters. For each hit, the system would output stored identification and descriptive data, such as name, address, age and police record, and also provide an address to the photograph file equipment to retrieve pictorial data (photographs, fingerprints, and sound imagery clips) which would be transmitted back to the requesting terminal.

b. Updating the File

In this mode, the system would accept new descriptive data which would be used to initiate a new record in the file or to modify or extend the information in an existing file record. In the case of a new entry the system would assign a unique central file identification number which would be passed back to the entering terminal.

c. Purging the File

Upon receipt of a central file identification number the system would delete all information on this person from the file. Purging would be used in the event of confirmed death, or after a fixed period of time of inactivity. File purging would make room for more current entries.

5. Information Retrieval Philosophy

The overall design focuses around two basic search procedures. For the more general case of an unknown suspect (no information available), a more involved search procedure is performed. The approach involves several layers of coordinate search, the output of each search resulting in a reduced hypervolume of possible suspects. Descriptor weighting at each level of coordinate search is performed in order to limit the layer outputs to the most highly correlated suspects. The final output will be a list of suspects, including photos from which a witness may make positive identification.

For the case of a suspect for which some information is available, a limited search, i.e. by name, might be performed. The end result is a group of individuals whose name partially agrees with the suspect. This list is reduced further through utilization of a weighting coefficient applied to certain key descriptors, so as to obtain those individuals whose total identification weight falls about a preset correlation threshold. These entries are retrieved from the file. The witness may then scan the photographs of those individuals retrieved and attempt to make a positive identification.

Key Descriptor Weighting

If neither fingerprint nor identification number data are available, the system then utilizes certain key descriptor information (sex, race, height, build) from the personal attributes table to develop a weighting coefficient for the particular candidate.

For each physical characteristic, a weight (W_{ij}) is assigned for the following conditions:

(1) Is information available on the particular physical characteristics? (Yes, No)

(2) Does the information agree? (Yes, No)

A total weighting coefficient (W_T, for n key descriptors) is then computed from:

$$W_T = \sum_{i=1}^{n} \sum_{j=1}^{n} W_{ij}$$

The total weight is next compared against a preset coefficient of identification threshold, (T) for:

$W_T \geq T$ Retrieve the data from core and print it out.

$W_T < T$ Ignore this entry.

Depending on the value of the weighting threshold, T, the list length of final suspects may be varied.

The weighting coefficients allow each descriptive parameter match to be weighted in accordance with the amount of information provided by the particular parameter. Thus, frequently occurring suspect descriptors, such as brown hair and a six foot height, would carry very little weight, but an unusual descriptor match like a facial scar or tattoo, would carry a relatively high weight. The total weighting coefficient is thus an indication of the likelihood of particular identification. As the system develops, these weights may also be varied according to the reliability of the witness on each descriptor.

6. Updating the Central File

When adding new data for existing file entries, the CFID* must be provided. This locates the directory and all linked subtable data and permits simple insertion of the entered data in existing table fields. In a case where special data, such as attribute codes or personal identification numbers are being entered for the first time, new entries must be created in these tables and linked back to the directory.

*CFID: Central File Information Directory

As another updating consideration, when new photographs or sound/motion imagery clips are generated, the central computer must be informed of the appropriate photo or imagery retrieval equipment address so that it can be stored in the directory block. Various evolutionary paths, however, would lead to the same final configuration.

7. Terminal Capabilities

The pictorial data displayed at the secondary terminals are assumed to consist of photographs and fingerprints. These are received and transmitted at relatively low rates. Increasing this rate and the transmission of sound/motion imagery clips can be conjectured if the bandwidth of the data lines are increased. However, non-standard video terminals would be required and special telephone circuits would have to be employed. Development of such a system might be warranted if sufficient secondary terminals of higher capability are required.

It should be pointed out that further study may reveal ways to achieve the same goals in the implementation of the total APPAD System with less equipment, with equipment costing less, or through other procedures. For example, the costs of some of the terminals may be shared by the communities in which the terminals would be located.

C. MANDATORY INPUTS

One cannot legitimately withdraw any more out of a bank account than what is deposited into it. The APPADS is an information bank. Police departments will not be able to make much use of it unless they make entries. It is, therefore, necessary that procedures be instituted which will make mandatory that the appropriate entries be made by all participating police departments. In addition, it is necessary that the methods employed be so designed that errors are not made. That is, although personnel may fully intend to cooperate, pressures of their job or peculiar incidents may prevent them from doing so. For example,

the Miami Police Department has their video taping studio right on the ground floor where suspects are brought in. The room where they are fingerprinted and have their mug shots taken is elsewhere. Just by virtue of their physical plant layout, it is difficult to omit the video taping of suspects. If the paperwork which accompanies any suspect is formatted so that each of the steps during the procedure require completion of the previous procedure, or that release of the suspect to bond or detention requires completion of each of the required procedures, these errors can be avoided.

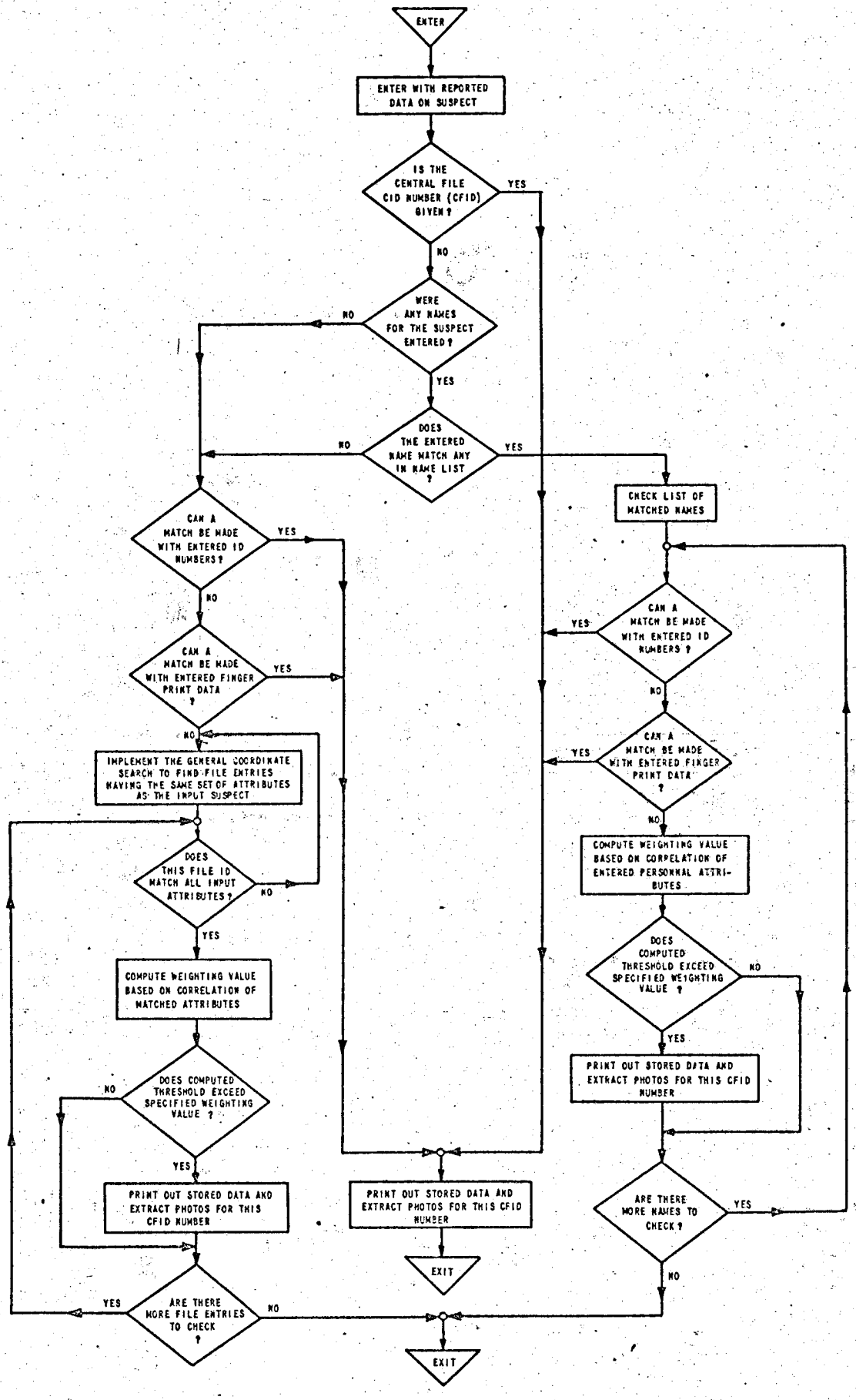

Figure 1 INFORMATION RETRIEVAL GENERAL LOGIC FLOW

SECTION III

PHASE TWO -
IDENTIFICATION AND RECOGNITION STUDIES

PHASE TWO

The objectives of this phase of the project were to review studies and methods aimed at achieving an understanding of how people recognize or identify others on the basis of personal appearance. Also included in the objectives of this phase was to perform a series of experiments which were designed to explore further variables that may influence the identification process. Based on the review of previous research and findings of the present experiments, conclusions are provided along with recommendations for additional research needed in personal appearance identification.

The specific goals of the second phase were:

1. To determine that subset of data elements necessary for a human witness to identify a criminal suspect, and to determine what graphic aids are necessary to elicit the information from the witness.

2. To ascertain for the identification process the value of the physical parameters of photographic records of criminal suspects.

3. To determine the increased effectiveness which may result from the use of motion imagery as well as voices in the identification of criminal suspects.

I. REVIEW OF PREVIOUS WORK

Some of the questions regarding personal appearance identification have been addressed by previous psychological research. A review of that literature was conducted and is summarized here.

The human processing of sensory information involves the input, storage, selection, attention and interpretation of information. This processing is influenced by such psychological factors as recognition, motivation, instructions, and reaction time. The factor of recognition involves memory, which is influenced by time and the number of events between the original memory input and the time when an item in memory is to be retrieved. It is usually easier to recognize a word event or picture than to recall one of these.

Also, the principle of recency (items viewed last) applies to memory for pictures, while the principle of primacy (items viewed first) applies to memory for words. Children remember words better than pictures. Adults remember pictures (98%) better than words (88% to 90%) by a ratio of 1.15 to 1.0. For homogeneous series of pictures recognition rates drop to about 71% to 74%. Both pictures and words are forgotten at equal rates. The longer the series of pictures to be recognized the poorer is the performance.

The perception of form is involved in the identification of objects, including pictures of faces. Certain transformations influence form perception and memory. The transformation of faces significantly influences recognition of faces because they are mono-oriented (i.e., seen most frequently in one direction, upright). Inverted pictures are difficult for children of about 3 to 7 years to recognize, less difficult for youngsters from about 10 to 14 years and the task again is difficult for adults. Inversion of pictures of faces adversely affects recognition more than inversion of pictures of objects, even though recognition of faces is easier than recognition of objects. Greater confidence

in the subject's report of recognition of a picture was found to be associated with more accurate performance.

There are no differences in the ability of men versus women to recognize pictures of general interest. No previous evidence was found that rendering a picture in color versus black and white makes any significant difference other than the fact that people like pictorial images in color more than those in black and white.

Following the review of previous work in the area of the recognition of images, a series of studies was conducted. These studies are summarized in the sections that follow.

II. SEARCH FACTORS INFLUENCING PERSONAL APPEARANCE IDENTIFICATION

This study was aimed at answering three major questions: (1) Is performance enhanced by prior knowledge that an identification task will follow? (2) Does observation exposure time influence the decision? (3) Is it advantageous to view only a limited number of facial pictures in order to make a correct identification?

Subjects (Ss) were randomly assigned to either of two conditions (64 Ss to each condition). Prior to being shown the inspection pictures, Ss in Condition I were informed that they would subsequently search for the targets they would soon see among the inspection pictures; while Ss in Condition II were not given such knowledge. Within each Condition there were two groups of 32 Ss each. In one group, the exposure duration of the inspection slides totalled 10 seconds, while the exposure duration for the other group totalled 32 seconds. Within each of these groups were two sub-groups of 16 subjects each. For one sub-group the target slide was located in the 40th position of the test series of 150 slides, while for the other sub-group the target slide was located in the 140th position in the series.

The results of this study showed that some people are easier to recognize than others, and that a longer exposure to the target face coupled with an earlier target position in the search series enhance performance of correct identification. Knowing in advance that one will have to identify a suspect later does not appreciably improve a witness' ability to identify that suspect. However, such prior knowledge does help to improve the witness' ability to know who was not the suspect (i.e. correctly rejecting a decoy or false target). Such a correct rejection is improved when the target person has been viewed for the longer duration at original exposure, and when the target appears early in the search sequence.

The practical implications of this study for law enforcement agencies, and for systems such as NYSIIS are important. Witnesses' performances deteriorate when they view an excessively large number of mug photos. Witness performance is better when just a few photos must be reviewed. Therefore, some automatic method of reducing the total number of mugs to be viewed would be an advantage. A computerized pre-screening of possible suspects would be valuable, if the number of suspects could be reduced to 50 or less.

That prior knowledge helped to improve witness performance suggests that training in identification may be a valuable asset if that training is provided to potential victims such as shopkeepers, gas station attendants, and bank clerks.

III. EFFECTS OF POSE POSITION ON IDENTIFICATION

Under usual suspect identification procedures a witness is brought into the local law enforcement agency and asked to identify the suspect from numerous photos (i.e. mugs) of people who have previously been booked. The types of mug shots differ from agency to agency, and the question is whether there might be a difference in accuracy of identification as a function of the type of format of the photograph.

Under most identification procedures, witnesses are shown a front and a profile picture of the suspect, but seldom are witnesses shown portrait pictures. Portrait pictures may be considered to contain more information (i.e. more features are visible) than either front face, or profile pictures. Therefore, it is possible that a portrait pose might lead to higher recognition performance than either the front or profile poses. The purpose of this study was to explore the recognition performance under conditions of four different poses: front, profile, right portrait and left portrait.

Subjects were randomly assigned to one of four conditions described above.

The results of this study indicate that there is no statistically best pose position for identifying human faces from pictures, although the front position tends to be better than profile or either of the two portraits. The assumption that the portrait pose contains more information useful to the witness cannot be supported. One reason for this finding may be that it is difficult to obtain a front view photograph of an individual that is indeed a straight ahead front view. Only a few degrees of movement in either direction from straight ahead are needed to show some outline of the nose profile shape. Therefore, a portrait pose may not be very different than most front view poses of the same individual.

The results of this study bear at least one implication of practical value. The widespread practice of the use of front views and profiles need not be altered at this time. Therefore, the costs that might be involved in making any modifications in poses for mug shots may be saved.

IV. PHOTOGRAPH TYPE AND CROSS-RACIAL FACTORS IN FACIAL IDENTIFICATION

It seems reasonable to speculate that the identification process should be enhanced by the use of color pictures as compared to black and white pictures. Certain features, such as complexion, are much more discriminable in color. The different hues in a color picture provide a dimension of information non-existent in black and white.

The old adage, "All Orientals look alike" underlies the hypothesis that intra-racial identification should result in a higher hit rate than inter-racial identification. A more specific explanation is based upon the assumption that people have more association with others of their own race and, hence, learn to make finer discriminations among them.

The purpose of this study was to examine the effects of color versus black and white photographic format on identification; and to examine the effect of intra-racial (within race) versus inter-racial (between races) identification. Two experiments were conducted to study these problems.

A. EXPERIMENT I

The basic question asked in this study was, "Do color photographs lead to better facial identification than black and white photographs?"

After viewing a target person who had walked into the room for about 30 seconds to pass out answer sheets, Ss looked at a series of 150 projected slides containing pictures of male faces. The Ss' task was to indicate for each slide whether the face was or was not the target person. In addition to this yes-no decision, Ss gave a confidence rating of the decision on a three-point scale - possibly, probably or certain. The target face actually appeared twice: in the 40th and 140th positions. The identification task began about eight minutes after the target person had left the room.

No effects were significant. Indeed, it is worthwhile to note that the means for color and black and white pictures were 4.99 and 4.93 respectively. Considering the performance measure used, the second decimal place is, of course, fictitious accuracy. The overall means for the 40th and 140th positions were exactly the same, 4.95.

A number of reasons may be given for the unexpected findings of this study:

1. The high level of performance (84% hits) may have washed out any differences that may have occurred.

2. The short interval between original target exposure and search may have led to such high performance as well as the use of real targets, and that the target picture appeared twice in the series.

Thus, when all conditions favor accurate witness identification, the use of black and white or color mug shots does not influence witness performance. Under adverse conditions the problem may well be different. A more sensitive study design was called for by the results of this study. Such a study was conducted and is reported in a later section, comparing still photography with dynamic photography.

B. EXPERIMENT 2

The second experiment was concerned with cross-racial factors in identification. The specific races involved were caucasian (white) and negro (blacks) - all Americans.

Task - The task was quite similar to that described for Experiment 1. The Ss observed a target person who entered the room and passed out answer sheets. A sequence of 132 slides was then shown, and Ss indicated a yes-no decision and confidence rating for each slide. In this experiment, each S went through the procedure twice, once with a white target and pictures and once with a black target and pictures. Except for differences in the slide series described above, the procedure was the same as in Experiment 1.

An analysis of variance revealed a higher performance on white targets. An analysis of the FA-CR scores produced similar results. Performance was better (more correct rejections and fewer false alarms) when the target and decoys were whites.

The results of Experiment 2 provide implications on the usefulness of witnesses, at least caucasian witnesses. The performance of a witness is likely to be better if the target is white than if he is black. It may be, however, that the reverse of this conclusion is not true; namely, that blacks are better at identifying blacks than at identifying whites. This is based upon the assumption that blacks may be able to discriminate whites as well as blacks since more than 90% of the American population are whites, who have in the past held a dominant position in society. Whether the hypothesis is true or not is subject to investigation.

A study performed in South Africa sheds some light on this question. Pettigrew, Allport and Barrett (1958) studies the perception of race (i.e. identification of blacks, Indians and whites by blacks, Indians and whites, and vice versa) in South Africa under conditions as influenced by binocular resolution (i.e. resolving a percept when an image is presented to one eye that is different from another image presented simultaneously to the other eye). They found that when both eyes receive the image of two different members of the same race and sex, the majority of Ss give correct racial identifications. The accuracy is greatest for the two most discernible groups, Europeans and full-blooded Africans. When a different race is presented to each eye (e.g. one white person and one black person) they are seen most often as intermediate.

V. ANALYSIS OF FACIAL FEATURES USED IN IDENTIFICATION

The purpose of this study was to provide an objective basis for the selection of facial features to be examined in the study to follow this one (Section VI). Two basic questions here were of interest:

1. What particular techniques and facial features are used most frequently in distinguishing one face from another, and what names are used most frequently for these features and techniques?

2. Do the techniques and facial features used by good identifiers differ from those used by poor identifiers?

As an adjunct to each of the three previous studies, (Sections II, III, & IV) each subject filled out a questionnaire requesting the subject to state which techniques and which facial features he used in making his identifications.

A total of 144 separate feature responses were given by the 289 Ss. A frequency score was obtained for each of the 144 responses by counting the number of Ss using each of the 144 total responses. The responses consisted of those words used by Ss to describe the features and techniques they employed in making identification under their respective experimental conditions.

From the 144 responses, 78 categories were generated through the procedure of grouping. The 78 groups, and the items from the original 144 responses making them up were tabulated.

The content analysis identified the following features as those most frequently used:

1. nose
2. eyes
3. face shape
4. hair color
5. chin
6. eye color
7. mouth
8. lips
9. complexion
10. skin coloring
11. nose shape
12. eyebrows
13. hair
14. ears

The approach to answering the second question was to study the responses of good identifiers vs the responses of poor identifiers and find the differences between the responses of the two groups.

The H-M (Hit-Miss score) was used as a criterion of identification performance. Only those subjects who had an H-M of 6 (YES, CERTAIN) and those subjects who had an H-M of 1 (NO, CERTAIN) were compared, since these were the only subjects who were certain of their answers. For the purpose of this discussion, the words "good identifier" will mean a subject with an H-M of 1. By distributing the total number of subjects using a specific response into their respective H-M score groups, it was possible to see which responses (i.e. techniques or features) were used more by good identifiers than by poor identifiers and which were used more by poor identifiers than by good identifiers.

Responses used most frequently by good identifiers but not poor identifiers were:

Facial markings
Ears
Eye color
Teeth

Responses used most frequently by poor but not good identifiers were:

Complexion
Lips
General appearance
Weight
Facial features
Eyebrows
Hair color
Intuition
Eyes

It is possible that subjects who performed better may have concentrated on a small number of features, while subjects with low H-M's may have used a larger number of features. The number of features used by the two groups was compared using a t-test. The results of that test were not significant. It should be noted that responses such as whole face, general appearance, and other global descriptions of features that tended to be used mostly by poor identifiers were counted as only one feature.

It was observed that facial marks showed the greatest difference score and that the score was positive. Facial marks (moles, beauty marks, facial markings, and freckles) can be thought of as having high information content because they help to reduce the number of alternative targets to be considered. This result supports the assumption that the identification performance of a subject is a function of the facial features employed by the subject in the identification task.

VI. THE ANALYSIS OF FACIAL FEATURE DIMENSIONS

The content analysis in the previous study identified the following features as those most frequently used: 1) nose; 2) eyes; 3) face shape; 4) hair color; 5) chin; 6) eye color; 7) mouth; 8) lips; 9) complexion; 10) skin coloring; 11) nose shape; 12) eyebrows; 13) hair; 14) ears.

From these 14 features, 8 where chosen to be studied. These 8 features were nose, eyes, face shape, chin, hair, mouth, eyebrows, and ears. It was decided not to use hair color, eye color, complexion, and skin coloring because black and white photos were to be used. Also lips and nose shape were difficult to differentiate from mouth and nose respectively on the photographs. In addition to the 8 features, it was decided to study the whole face for a total of 9 features to be studied. Questions examined included:

1. What are the dimensions of a feature?

2. Can it be separated into a number of representative categories? If so, how many? (e.g. How many different types of noses are there?)

3. What is the proto-typical representative of each category? (e.g. What particular nose most typifies category A?)

4. Can an appropriate name be applied to each category of a feature?

The approach was to present subjects with many photographs of a facial feature, have the subjects sort the pictures into categories, and have the subjects describe how they sorted. The photographs were all pictures of the same features, for example, all noses, but each photo was of a different nose. The Ss were instructed to put similar photos in the same category or in categories close to each other. The instructions stated that the amount of similarity (or dissimilarity) was to determine the amount of closeness (or separation). Each subject sorted 50 photos of each of the 9 features.

The negatives for the stimulus photos were "mug" shots provided by the Erie County Sheriff's Department. The individual features were isolated by using an appropriate mask covering all but the intended feature. The use of police mug shots helped minimize artificial variance between any two stimulus photos. That is, the same camera, lighting, lens setting, etc., were used when taking the mug shots.

The same procedures were followed for each of four experiments in this study. The four experiments differed only in terms of the mug shots used. One experiment used mug shots of white men, another used those of black men, another used mug shots of white women, and the fourth used those of black women.

The variables that influenced the factors which emerged from the analyses of facial features of white men were for the most part the same as those for white women and for black men and women. One exception was that analyses of the dimensions of ears of women were not performed because the hair styles they wore covered the ears in many instances. Another exception was for women's eyebrows, the plucking of eyebrows influenced their appearance, as did the use of cosmetics both on women's eyebrows and lips. The use of hair cosmetics on white men, black men and black women was also a point of difference in comparison to the hair of white women. In addition, considerations of skin color (i.e. dark versus light) occurred more frequently for white men and women than for black men and women.

A summary of the variables influencing each of the features studied is given below:

Hairlines: degree of receding of hair, height of hairline on forehead, widow's peak versus square or irregular hairline, straight versus curly hair, amount of hair on top and sides, and neatness of hair.

Eyebrows: thickness of the eyebrow, the amount of hair (i.e. density) bushiness, plucked versus not plucked, slant, straight, arched, curved, height above eyes, light versus dark color, use of make-up, and wearing of eyeglasses.

Eyes: whether the eye opening was narrow (slits) or wide (round) whether or not the eyelid was visible, the amount of tissue above the eye and the thickness (puffiness) of that tissue, the slant of the eyes, whether or not the eyes were set deep into the sockets, age wrinkles around the eyes, darkness or lightness of the pupils, and the amount of white (sclera) showing below the pupil.

Nose: nostrils (whether or not they showed, size, and degree of flare), whether or not the nose is turned up or down, size and pointiness of tip, bridge width, septum (flat or hanging down), and prominence of nose.

Mouth: amount of fullness or thickness of the lips (including the relative fullness of the upper versus the lower lip), the definiteness of the shape or outline of the lips, the horizontal width of the mouth, the lip line (line between upper and lower lip) use of lipstick, whether or not the mouth was open, age, cupid's bow (the indentation and tips) and whether the corners are turned up or down.

Chin: shape of the chin (V-shape, round, and square), prominence of the chin, single versus double (or some triple) chins, thinness, and age (jowls and wrinkles).

Ears: size, whether they stuck out or were close to the head at the top, bottom or both, and whether the earlobe was attached or detached.

Head Shape: square, round, oval, inverted triangle, also included were size, age, angularity, narrowness, and masculinity.

Face: thinness or fatness of the face, degree of roundness, age (including wrinkles), inverted triangle, rectangle, oval, features, use of cosmetics, attractiveness, and intelligence. The specific features that influenced the factors included the nose, the hair style, and the cheekbones.

VII. IDENTIFYING SUSPECTS ON THE BASIS OF THEIR UTTERANCES

One of the difficulties encountered in recording (booking) interviews of suspects is that the questions asked of them may tend to provide information that would bias a judgment where that suspect is involved. For example, if one were to ask a suspect what his occupation was, his answer may tend to place him in an unfavorable light in the eyes of a jury. On the other hand, it is important to have some idea of the way in which the suspect pronounces words, and the accents and intonations he uses in speaking. This type of information would be useful in helping to determine the identification of a suspect in many cases.

The approach to this problem is to establish a set of criteria for utterances by suspects that would be feasible to use and would at the same time not tend to incriminate the suspect. These criteria can then be followed in the development of utterances for booking interviews which are recorded for playback later.

This report provides a first step towards the development of such criteria and the utterances that can be employed which meet these criteria. These criteria are based on a review of the relevant literature on the identification of talkers.

In summary, the following conclusions may be made on the basis of the most recent studies on talker recognition.

1. Listeners can identify a talker better than those who visually examine a spectrogram.

2. Electronic and mechanical devices can use only small speech samples (monosyllables) to identify talkers.

3. Gross identifications (e.g. age and sex of the talker) could be made with certain speech elements (e.g. voiceless fricatives), but finer grained identifications require larger samples (i.e. using sentences rather than words, syllables or phonemes).

4. Important factors used by listeners to identify male talkers involved the interaction between talkers and listeners as follows:

   a. the degree to which the talker's voice appealed to the listener.

   b. the roughness of the talker's voice.

   c. the magnitude or masculinity of the talker's voice.

   d. the degree of anxiety of the talker which the listener sensed.

The results of these studies underline the importance of following criteria for utterances.

1. The utterances should include all of the most frequently cited phonemes (individual sounds in the English language).

2. The utterances should not take too long to administer and yet should not be too limited a sample of speech. Sentences containing all of the American English phonemes and frequently occurring clusters meet these criteria.

3. The utterance should be simple with regard to the intellectual demands made upon the suspect. This requirement is aimed at reducing any biasing effects that may be attributed to any popularly held notions that criminals are not well educated or that they are less intelligent than the average person.

4. The utterances should at the same time not be too simple, because the suspect may then balk at making them.

5. Most importantly, the utterances should be designed to reveal the ways in which the suspect pronounces words and to reveal the intonations, or any accents the suspect may have. However, the content of the utterances should not reveal biographical data about the talker, because such data may tend to be unduly incriminating to that person.

6. The utterances are recommended for use in all cases in which booking interviews are recorded which include the audio recording of what the suspect says. This aim is to employ standards which can be used to compare the utterances of all suspects whose interviews are recorded.

The following can be used for those suspects who have difficulty reading, or who are limited in their intellectual capacity. These utterances consist of meeting the requests of the interviewing officer. The requests of the officer are shown in capitals. Anticipated responses are underlined.

1. COUNT FROM ONE TO TEN

   One, two, three, four, five, six, seven, eight, nine, ten.

2. NAME THE MONTHS OF THE YEAR

   January, February, March, April, May, June, July, August, September, October, November, December.

3. TELL ME THE OPPOSITE TO EACH WORD AS I READ IT TO YOU:

a.	LOW	High
b.	GIRLS	Boys
c.	IN	Out
d.	PUSH	Pull
e.	MOTHER	Father
f.	BELOW	Above
g.	RIGHT	Wrong
h.	PULL	Push
i.	BLACK	White

4. WHICH WOULD MOST PEOPLE CHOOSE, LEISURE OR PLEASURE?

   Pleasure
   or
   Leisure

An experiment was conducted, to determine whether use of the opposites (#3 above) could feasibly be used, because of possible confusions. For example, for the word "right," some people might respond with the word "left," while others might respond with the word "wrong."

In that study, two sets of data were gathered. One set was obtained from video taped mug records of actual suspects arrested by the Miami, Florida Police Department. The other set of data was gathered by CAL Staff members from video taped "mug" records of paid volunteer students at the State University College at Buffalo, New York.

Results of the experiment were as follows:

Counting - Of the 269 persons who counted from one to ten, one individual did not know how to count, and one other person omitted the number 9.

Reciting the months of the year - Of the 269 people who were asked to recite the months of the year 41 made errors. Of these people, five were in the student group and 36 were in the suspects group.

Opposites - The opposites data was obtained on the 67 first two-weeks MPD group and on the 110 students. A total of 117 erroneous responses were given by the two groups, 83 by the group of suspects and 34 by the group of students.

Based on the responses of suspects as summarized here, it was decided to discontinue use of the opposites (including the pleasure-leisure opposites) in the video tape booking of suspects by the Miami Police Department. It was felt that the utterances made by suspects in counting from one to ten and in reciting the months of the year a sufficient sample was obtained from which to get an unbiased impression of a suspect's speech.

The use of the one-to-ten counting and reciting of the months of the year has been adopted by the Miami Police Department, and has been accepted by the Florida Attorney General's Office and have been accepted in court cases in both Federal and State Circuit courts in Florida. Thus, the results of this effort of the current program have already been put into practice.

VIII. THE EFFECT OF DISTRACTION ON IDENTIFICATION BY WITNESSES

In the course of criminal identification procedures it is often necessary to estimate the effect on the witness of distractions occurring during the crime. Can we expect that features such as the presence of a weapon, damage to property, or injury to a victim will distract the witness and impair his ability to identify the criminal; or does the presence of such novel or distinctive stimuli aid in the recall of the entire crime scene; or finally, does the presence of distractors have little or no effect on the subsequent recognition of the criminal?

This study was performed to aid in the evaluation of the effects of such factors. Two films representing the commission of the same crime were used. In one film (Film A) during the commission of the crime a weapon was brandished and the victim was beaten and noticeably injured. In the other (Film B) the same crime was depicted but no weapon appeared and there was no beating or injury. Subjects were shown either Film A or B and then asked to identify a picture of the criminal from a series of color slides, using a seven-point rating scale.

Both films depicted a gas station robbery lasting 1.5 minutes. In each film there were two characters, an attendant and the criminal. In Film B the criminal entered and asked for change. When the cash drawer was open the criminal demanded the money in the cash drawer. He then pushed the attendant away and took the money and fled. Film A was identical to Film B except that Film A included the following:

1. When the criminal demanded the cash he brandished a large revolver.

2. Instead of pushing the attendant, he struck the attendant with the revolver.

3. In the final portion of the film, the attendant was shown bleeding copiously from the head.

An analysis of the identification performance of the two groups revealed that there were no significant differences between the two groups.

The results appear to indicate that the accuracy of witness identification is not greatly affected by distractions during the crime. It should be recognized, however, that the distractors were presented on film and may not have aroused the emotional disturbances possible in an actual crime. That is, these may well have been the type of TV events to which many TV viewers have become accustomed.

IX. A COMPARISON OF THREE MEDIA USED IN IDENTIFICATION PROCEDURES

In the identification process the witness is often provided with the likeness of a number of suspects and asked to select the criminal from among them. The most common situation is where the witness is given monochromatic (black and white) photographic material from which to make his identification. Recently other media have become available. In particular, color photographs and monochromatic video tape sequences have been considered and adopted by various law enforcement agencies. The purpose of the study described below was to provide information as to the efficacy of the three identification media mentioned.

Subjects were shown a sound-color movie depicting a scene in a department store and asked to remember one of the characters. One hour after they viewed the film the Ss were assigned to one of three groups. The first group viewed a series of individuals, each depicted in taped video sequences. The second group viewed individuals, each depicted in color slide pairs. The third group viewed individuals, each depicted in black and white slide pairs. In all three conditions the subjects were required to identify the character in the film from among 33 individuals.

Three female customers, a male customer, and a male clerk appeared in the film. In the film the clerk waits on one of the female customers and then cashes the check for the male customer. The remaining two customers wait impatiently. During the check cashing, both the clerk and the male customer are seen in various positions including front and profile. Both move about and speak.

The analysis revealed that using either monochromatic video sequences or color still photography can lead to more accurate identification than using monochromatic still photography. That is, subjects who searched for the suspect in the color slides and those who searched for the suspect in the black and white video clips performed better in identifying the suspect than did those who used the black and white still photography.

It should be pointed out that this experiment was intentionally designed to yield conservative results. For example, the results could have been even more distinctive if a suspect with an unusual speech trait or with a distinctive posture, or with an unusual gait had been used. As it is, the results of this study indicate that color is superior than black and white photography. Moreover, video sequences in black and white showed to be as good as color still photography. The implication is that even though the video was in black and white, the dynamic cues offered by video improved identification as much over black and white still photography as does color still photography. In other words about an equal improvement in identification was obtained by use of color as by use of dynamic imagery. This result is important because it suggests strongly that color video may well yield additional improvement over still color photography or over black and white video. Time and funds within the present effort did not allow the verification of this hypothesis at this time.

The practical implications of this study are important. Consideration of the use of dynamic imagery such as television can lead to a higher number of accurate identifications of suspects by witnesses. The added advantage of color television over black and white television is also implied. However, such an assumption remains to be verified objectively.

SECTION IV

CONCLUSIONS

CONCLUSIONS

The results of the work reported herein, have led to a number of conclusions. These conclusions are given below.

1. The use of personal appearance data for law enforcement purposes serves a vital function, particularly in the investigative processes. This is evidenced by the fact that all major police departments maintain this type information, even though it is utilized manually. Some major departments such as Detroit, New Orleans and Washington, D. C. have computerized this data in conjunction with their Modus Operandi files.

2. It appears that most of the components for configurating an automated system, using computer processing and a mass image retrieval system are available as off-the-shelf items.

3. The use of color dynamic imagery (video and voice) will probably provide the ultimate efficacy in recording technology. Black and white video, with voice would yield a significant improvement over existing methods. The substitution of color for the present black and white still photographs should yield considerable improvement in the present method also.

4. The kinds and number of each attribute used in the identification and recognition process appears to be reducible to manageable sub-sets of parameters for photographic classification and efficient computer searching.

5. Average individuals can be trained to improve their identification and recognition processes.

6. The reliability of a witness identification can be "calibrated" upon examining the type parameters he used to base his identification.

7. Elapsed time and a minimal number of "possibles" are important parameters for improving the reliability of "identifications."

SECTION V

RECOMMENDATIONS

RECOMMENDATIONS

The results of the work performed on this project have led to the development of a number of recommendations. These recommendations are given below.

1. Based on the needs and potential uses brought out in this study, it is recommended that an automatic processing of personal appearance data systems APPADS be implemented.

2. It is recommended that the APPADS system include a central file terminal located at NYSIIS in Albany, New York, with primary and secondary terminals at respective primary and secondary population centers in the State of New York.

3. It is recommended that the APPADS system, or any law enforcement identification system, must be capable of reducing the possible candidate list to fifty or less images of suspects.

4. It is recommended that when funding permits, priority preference be given to dynamic color imagery first, dynamic black and white imagery next, followed by static color imagery and static black and white imagery, respectively.

5. It is recommended that in the use of static imagery, front views and profiles need not be discontinued.

6. It is recommended that in the use of dynamic imagery (e.g. video tape) booking procedures, suspects be asked questions such as their name, height, weight, social security number (if any), to count from one to ten, and to recite the months of the year. Asking for additional personal information about occupation or trade is not recommended in video taping, since such questions may bias judgments against the innocent.

7. It is recommended that the use of an improved automatic (i.e. convenient and rapid) facial compositor be given consideration making use of facial feature dimensions as identified in the present research.

8. It is recommended that a design phase be conducted for a prototype APPADS module that would allow convenient storage and retrieval of personal appearance information.

9. It is recommended that more training in personal appearance identification be provided for law enforcement officers and for potential crime victims and witnesses (e.g. bank clerks, gas station attendants, and shop keepers). For law enforcement officers this training should include interview techniques, personal appearance classifications, and information regarding human judgment. For potential witnesses and victims only the latter two would be needed.