Serial No. 322,653

Filing Date 11 October 1994

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NOTICE

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Navy Case No. 76,545 PATENTS

PERSONAL IDENTIFYING RECOGNITION SYSTEM

This invention relates to identification of persons by acquisition and processing of sets of data, each having a specific signature portion, the present application being a continuation-in-part of prior copending application Serial No. 08/028,012, filed March 18, 1993, the disclosure of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

Data acquisition systems through which selected features of input data are utilized to identify persons, are generally known in the art as biometric systems. Such systems often lack the capability of meeting person identification demands because of both accuracy and costliness. Other data acquisition and person identification proposals heretofore required large databases, large computer storage facilities and massive processing power so as to render such proposals unfeasible. It is therefore an important object of the present invention to reduce computational complexity by using an artificial neural network-based system through which person identifying features are extracted from acquired data for rapid and accurate person recognition purposes.

SUMMARY OF THE INVENTION

In accordance with the present invention, person identifying features are sensed, digitized and stored as acquired data from which sets of numerical values are extracted and processed through an artificial neural network for evaluation purposes. Features so extracted from data sources such as facial photographs, voice patterns and fingerprints, as well as recorded Personal Identification Number (PIN) are utilized collectively to recognize and identify each person.

The aforementioned artificial neural network consists of active neurons forming a training set through which the extracted data on person identifying features is processed during a training phase by comparison between mass centers and neuron centers adjusted to represent statistical data centers for spheres of influence with decreasing radii. Acceptable person identifying features are thereby determined and classified according to shortest distance from the neuron center. Adaptive clustering of data on different classes of persons is so achieved in a non-algorithmic manner during a rapid test phase based on a generalization capability acquired by sensor exposure to relatively few features of the person being targeted within a real environment during the aforementioned training phase.

BRIEF DESCRIPTION OF DRAWING FIGURES

A more complete appreciation of the invention and many of the attendant advantages thereof will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawing wherein:

FIG. 1 is a functional block diagram of a person recognition system in accordance with the present invention;

FIG. 2 is a more detailed functional block diagram of the artificial neural network diagrammed in FIG. 1; and

FIG. 3 is a perspective view of a person within a surrounding environment as an exemplary source of biometric data sensed by the system of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

Referring now to the drawing in detail, FIG. 1 functionally diagrams operation of the system of the present invention, generally referred to by reference numeral 10. Input data relating to persons within real environments often having a data degrading characteristic, is gathered during a data acquisition phase 12. The gathered data is then digitized and preprocessed during a stage 14 to eliminate extraneous data. Extraction of person identifying features from such preprocessed data is performed during a feature extraction stage 16. The extracted feature data then undergoes training or testing procedures through an artificial neural network 18 in order to provide proper inputs for person recognition readout 20. The output of the artificial neural network 18 also provides feedback for the preprocessing stage 14 and feature extraction stage 16. Operation of the artificial neural network 18 is thereby adjusted in response to variations in the preprocessing 14 of the input data and feature extraction 16.

FIG. 2 functionally diagrams the artificial neural network 18 through which feature extracted data undergoes a training process 22 before being fed to a person readout decision operation 24. Results of the readout decision affects the training process 22 through a network parameter variation process 26. The person feature extraction procedure 16 on the other hand is affected by a feature analysis variation process 28. The feature variation process 28 also affects data preprocessing 14 through a preprocess variation procedure 30 as diagrammed in FIG. 2.

By way of example, FIG. 3 depicts a scene being viewed, generally referred to by reference numeral 74, which includes features of a person 76 in the form of a face, voice, or fingerprint within a real surrounding environment. Such scene 74 is sensed by input sensory means to provide the input data which is digitized during the pre-processing stage 14 and then processed

by a heuristic procedure during feature extraction 16 to separate data on the feature portion of the person 76 from different environmental surroundings. Such procedure involves the development of a set of person feature vectors associated with the digitized data fed to the artificial neural network 18. Each of such vectors, is made up of multiple element [X]=[X], X2,....Xn], where Xn is one of the "n" feature elements of the associated feature vector.

During the training phase 22 in the neural network 18, only one set of feature elements will be processed at a time. Feature vectors established in this way will be used for person identification. During identification, all feature vectors will be computed in real time and matched by the neural network with data already stored. The matching data may be stored for example on an automatic teller machine (ATM) card issued by banks to its customers. The stored data on such a card may include a personal identification number (PIN) as denoted by 11a in FIG. 1 and a recorded fingerprint corresponding for example to a fingerprint image 78 viewed in the scene 74 as shown in FIG. 3. Thus, data on the facial vision of the person 76 being viewed as denoted by 12b in FIG. 1, and stored data such as sound or voice denoted by 12a in FIG. 1, originating from person 76 to be identified as well as the fingerprint 78 aforementioned, is gathered during the acquisition stage 12 for simultaneous parallel processing during stage 14. Due to uncertainty in matching some of the features through the neural network 18, fuzzy logic rules will be implemented to assign probability of correct identification for each set of feature vectors. Depending on the contribution value (weight) of a feature vector, a numerical coefficient will be factored in. The result of this process yields a correct identification of a person based on two or more feature vectors.

Obviously, other modifications and variations of the present invention may be possible in light of the foregoing teachings. It is therefore to be understood that

the invention may be practiced otherwise than as specifically described.

PERSONAL IDENTIFYING RECOGNITION SYSTEM

ABSTRACT OF THE DISCLOSURE

Input data acquired by various means including optical sensors is gathered and signal processed for extraction of data features related to identification of a person within a viewing scene being evaluated by an artificial neural network. The extracted data features are matched during evaluation with recorded data, such as that on an identification card issued to the person being identified, to accurately and rapidly achieve said evaluation by the neural network.

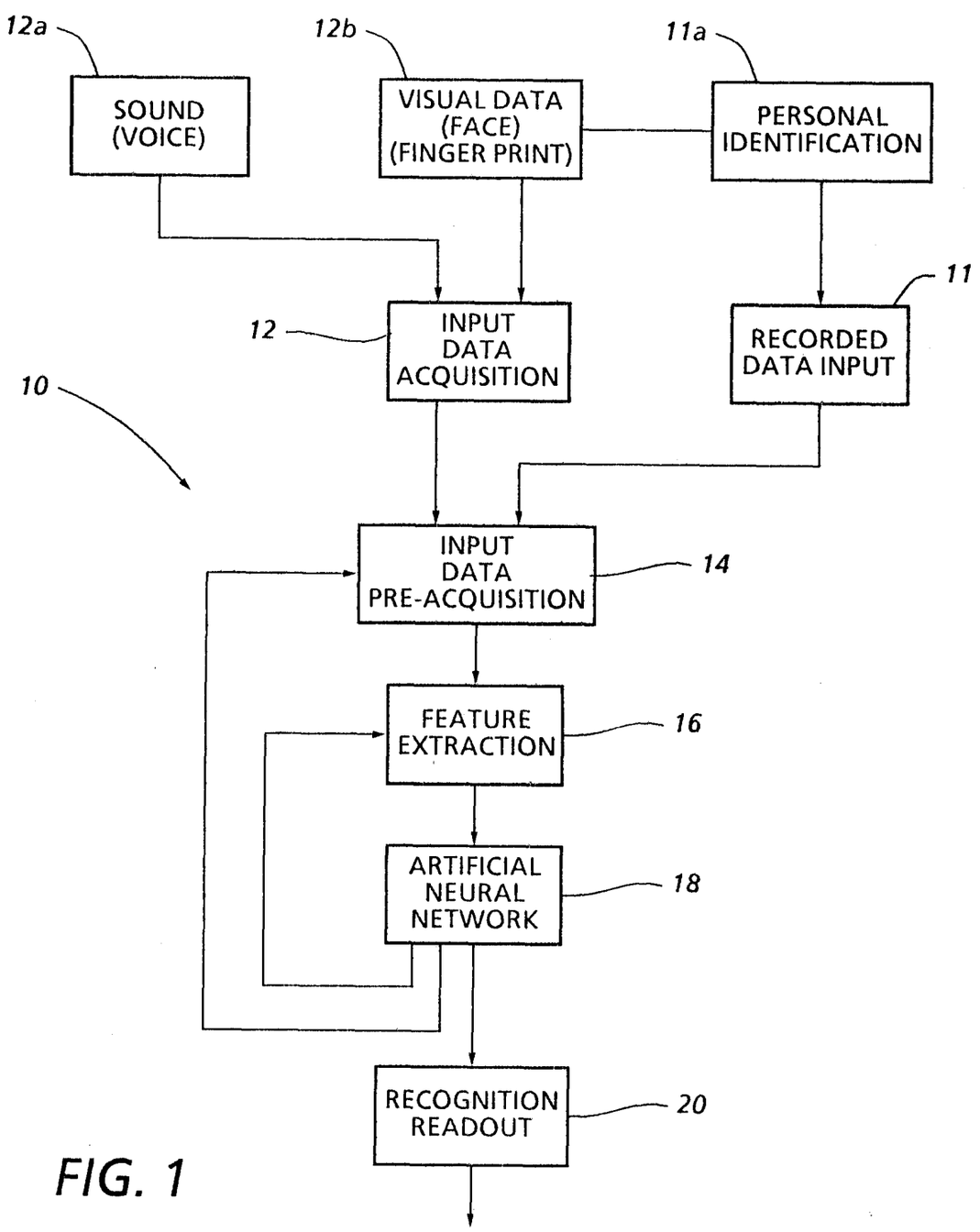
12a
SOUND (VOICE)
12b
VISUAL DATA (FACE) (FINGER PRINT)
11a
PERSONAL IDENTIFICATION
11
12
INPUT DATA ACQUISITION
RECORDED DATA INPUT
10
INPUT DATA PRE-ACQUISITION
14
FEATURE EXTRACTION
16
ARTIFICIAL NEURAL NETWORK
18
RECOGNITION READOUT
20

FIG. 1

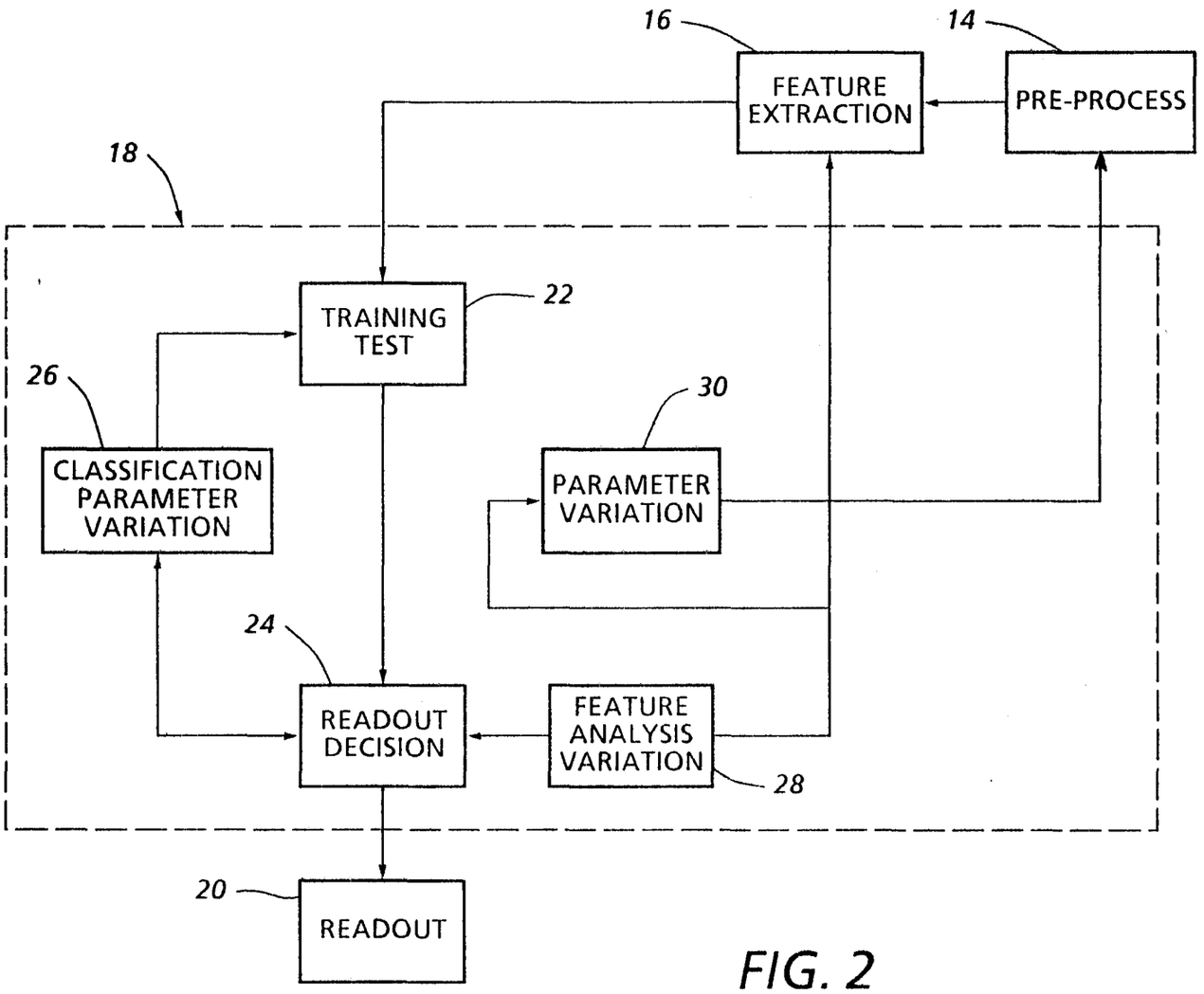
16
14
FEATURE EXTRACTION
PRE-PROCESS
18
22
TRAINING TEST
26
30
CLASSIFICATION PARAMETER VARIATION
PARAMETER VARIATION
24
READOUT DECISION
FEATURE ANALYSIS VARIATION
28
20
READOUT

FIG. 2

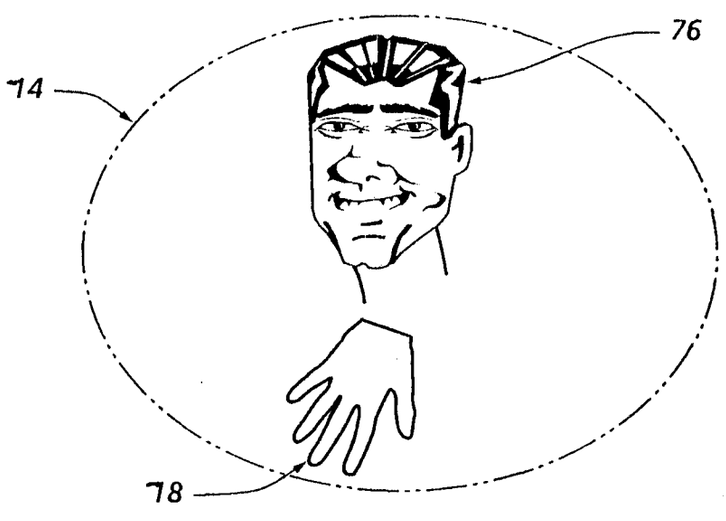
76
74
78

FIG. 3