outset, what parts of the program and the underlying data structures must be represented in parallel form. Not only is this requirement not optimal from the perspective of implementation; it entails an additional requirement that the programmer have intimate understanding of the underlying parallel structure. Often, it is not possible to have such understanding because hardware and software are designed simultaneously. The present sequence data type overcomes both the implementation and parallel-structure obstacles. In so doing, the sequence data type provides unified means by which the programmer can represent a data structure for natural and automatic decomposition to a parallel computing architecture.

Sequences exhibit the behavioral and structural characteristics of vectors, but the underlying representations are automatically synthesized from combinations of programmers' advice and execution use metrics. Sequences can vary bidirectionally between sparseness and density, making them excellent choices for many kinds of algorithms. The novelty and benefit of this behavior lies in the fact that it can relieve programmers of the details of implementations.

The creation of a sequence enables decoupling of a conceptual representation from an implementation. In essence, a sequence is a fundamental extension of a vector. In the most general case, the length and internal structure of a sequence can be changed during run time, enabling the efficient addition and removal of elements around given positions. Because sequences are not subject to predefined limits in length, they can be used equally to store small and large collections of elements.

Sequences have efficient representations in both time and space for given patterns of use. When the use pattern of a sequence is simple, then the user has the option of causing its basic operations to be coded in line for maximal efficiency.

The underlying representation of a sequence is a hybrid of representations composed of vectors, linked lists, connected blocks, and hash tables. The inter-nal structure of a sequence can automatically change from time to time on the basis of how it is being used. Those portions of a sequence where elements have not been added or removed can be as efficient as vectors. As elements are inserted and removed in a given portion, then different methods are utilized to provide both an access and memory strategy that is optimized for that portion and the use to which it is put.

Hand-Held Ultrasonic Instrument for Reading Matrix Symbols

All necessary functions would be performed within a compact package.

Marshall Space Flight Center, Alabama

A hand-held instrument that would include an ultrasonic camera has been proposed as an efficient means of reading matrix symbols. The proposed instrument could be operated without mechanical raster scanning. All electronic functions from excitation of ultrasonic pulses through final digital processing for decoding matrix symbols would be performed by dedicated circuitry within the single, compact instrument housing.

The instrument (see figure) would be placed on a selected area on an object of interest believed or suspected to contain a matrix symbol (hereafter denoted, simply, the target). Intimate contact for the purpose of coupling of low-energy ultrasound would be ensured by use of either a flexible membrane camera face or a replaceable gel pad. Ultrasound pulses would be transmitted from a transducer, through the membrane or gel pad, into the target. A portion of each ultrasonic pulse, as modified by any matrix symbol present in the target, would be reflected through the membrane or gel pad to an ultrasound-imaging integrated-circuit chip, which would convert the resulting spatial variation of ultrasound pressure to voltages that could be used to construct a video image of the matrix symbol (if any).

A set of circuit boards above the ultrasound-imaging chip converts the output of the chip into a useful video format and would coordinate timing between the transducer pulses and the acquisition and processing of image data. The system is fully portable and battery powered. The instrument includes the following other boards:

- A pulser board would control the current pulses that drive the acoustic transducer.
- A board comprising a liquid-crystal display unit and its driver circuitry would enable display of the video image in the future. It could include a decoder board that would translate the video image of a matrix symbol into a recog-

An **Ultrasonic Camera** and associated electronic circuitry would generate and decode a video image of a matrix symbol hidden below the surface of the target.

nizable set of binary data. This board would be identical to that used in a commercial bar-code reader. Upon observing a matrix symbol in the video display, the operator would press a trigger switch to activate the decoder. The output of the decoder could be made available to a data-collection system for recording of the information in the matrix symbol.

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