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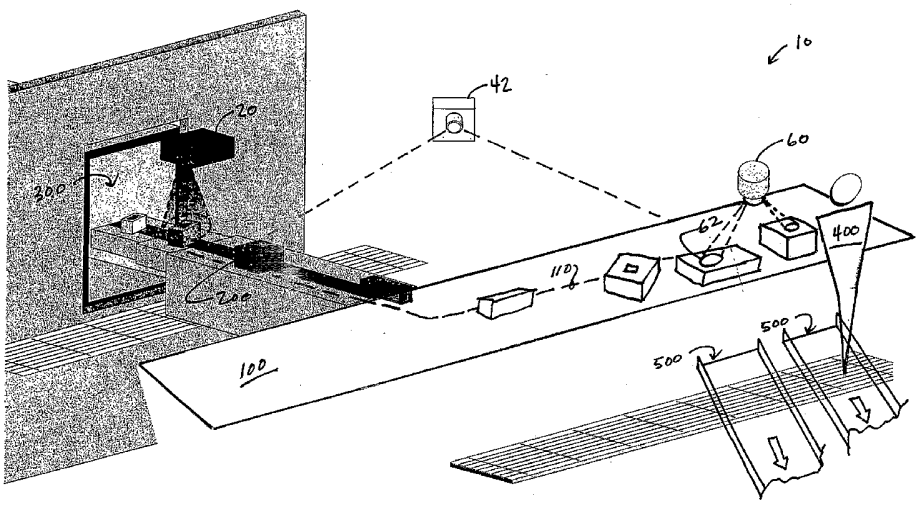


(57) Abstract: A system for projecting a display onto an item or parcel is disclosed, using an acquisition device to capture indicia on each parcel, a tracking system, a controller or computer to select the display based on the indicia, and one or more display projectors. In one embodiment the display includes or connotes a handling instruction. The system in one embodiment includes a laser projection system to paint the selected display directly onto a selected exterior surface of the corresponding parcel, for multiple parcels simultaneously. The system may be configured to move each display in order follow each moving parcel so that each display remains legible to a viewer in a display zone where handling takes place. This Abstract is provided quickly inform a reader about the subject matter, and not for use interpreting the scope or meaning of the claims.

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# SYSTEM FOR PROJECTING A HANDLING INSTRUCTION ONTO A MOVING ITEM OR PARCEL

## BACKGROUND

Technical Field. The following disclosure relates generally to the field of handling, tracking, and processing of items. More particularly, the present invention provides a system and method for tracking the movement of items or parcels in a work area and displaying a handling instruction for each parcel.

Description of Related Art.

The process of sorting items or parcels bound for a variety of destinations throughout the world typically involves several sorting steps. A preliminary sort may be followed by several intermediate sorts, intermediate transport steps by air or rail or feeder truck, and additional sorting at one or more intermediate hub facilities before a parcel is placed in a vehicle such as a package car for delivery to the final destination. The task of sorting and processing multiple items or parcels involves a variety of technical and logistical challenges.

Modern sorting systems may use a complex system of conveyors to sort incoming parcels into a variety of sectors based upon a particular characteristic, such as a delivery destination or zip code. The particular characteristic for each parcel may be indicated or displayed on the parcel using indicia. Indicia may include printed text on a label, codes or abbreviations printed on a label, data encoded in a symbol or tag, or any of a variety of other methods.

Although parcel sorting has been greatly improved through the use of modern technologies such as code readers and computer-controlled conveyor systems, the sorting process still requires a knowledgeable and attentive labor force to coordinate and track the parcels during sorting. The sorting environment may be described as dynamic and busy, where personnel experience a constant barrage of various stimuli requiring quick decision-making and physical activity. Items or parcels may be moved between various zones in a facility using a flexible array of conveying segments such as conveyor belts, slides, chutes, trays, bags, or carts.

Large-scale item processors may have a substantial investment in the numerous facilities, plant equipment configurations, and training required to meet its sorting and handling needs. Often, the use of new technology is hampered by

the high cost of inserting technology into existing manual systems, physical space constraints, and the expense of varying an existing flow of items or parcels in a facility or processing environment.

In many existing sorting systems, each intermediate sort may require a separate handling instruction on a label applied to the parcel. Some systems may print a handling instruction in ink directly onto the parcel during each intermediate sort. The repeated processing and labeling of a parcel during multiple sorts represents a significant cost and creates a risk of error during every step. Often, the text on a printed label is somewhat small and difficult to read. The font size on the label may be limited by the anticipated use of multiple sorting labels on a single parcel, causing time delays and limiting sorter efficiency.

The additional time and costs associated with applying an additional label for every intermediate handling instruction represents a significant barrier to efficiency and profitability in the parcel sorting and loading process. Multiple sort labels may lead to confusion and incorrect sorting. The costs of applying a label include paper and ink, a printing device, and a printing station at every location where a label is needed. Adding a printing station typically consumes valuable floor space in a sorting facility that may already have limited space. Also, additional personnel are typically required to monitor the proper functioning of a label applicator. Most label printing systems typically cause periodic and recurring delays due to printer malfunctions, duplicate or overlapping labels, non-sticking labels, inaccurate labeling, as well as routine printer maintenance. These tasks created by the use of multiple labels impose a considerable expense on the sorting process. The label printing step also introduces a time delay during each and every intermediate sort process which, for large batches of parcels, can amount to a significant increase in processing time.

Thus, there exists a need in the art for a system for applying a handling instruction to each of a plurality of parcels or items, while meeting the efficiency objectives of a modern sorting and handling facility. There is also a need for an apparatus that can apply the handling instruction without delaying the process. A related need exists for developing a low-maintenance system that requires little or no skilled supervision. Finally, there exists a need for a comprehensive system for

applying a handling instruction to each parcel or item quickly, accurately, and with minimal supervision.

Certain illustrative and exemplary systems, methods, and apparatuses are described herein in connection with the following description and the accompanying drawing figures. The examples discussed represent only a few of the various ways of applying the principles supporting the material disclosed and, thus, the examples are intended to include equivalents. Other advantages and novel features may become apparent from the detailed description which follows, when considered in conjunction with the drawing figures.

## SUMMARY OF THE INVENTION

The following summary is not an extensive overview and is not intended to identify key or critical elements of the apparatuses, methods, systems, processes, and the like, nor is it intended to delineate the scope of such elements. This Summary provides a conceptual introduction in a simplified form as a prelude to the more-detailed description that follows.

The example methods, products, and systems described herein facilitate the handling, tracking, and processing of items or parcels moving through a facility or work area.

In one aspect of the present invention, a system for processing one or more items may include an acquisition device to capture indicia about an item, one or more projectors positioned near a display zone where the item may be processed, and a controller in communication with the acquisition device and the one or more projectors, wherein the controller receives the indicia from the acquisition device, selects a display based upon the indicia, and sends the display to the one or more projectors. The one or more projectors may be positioned to project the display adjacent the item.

The indicia may include an optical code and the acquisition device may include an optical scanner. The indicia may include a bar code and the acquisition device may include a bar code scanner. The indicia may include an RFID tag and the acquisition device may include an RFID reader.

The projectors may be positioned to project the display onto on one or more exterior surfaces of the item. Also, the projectors may be configured to select a most visible surface relative to a viewer located within the display zone, and the projectors may be positioned to project the display onto the most visible surface. The one or more projectors may include a laser projection system.

The controller may include a computer with memory and a database for storing the indicia.

The display may be configured to communicate a handling instruction to a viewer of the display. The display may be selected from a set of standard displays.

In the system, where the item may be moving along a path generally toward the display zone, the system may also include a tracking system to capture a plurality of locations and corresponding times for the item, and the tracking system may include one or more tracking cameras. In such a system, the controller may be further configured to (1) select as a current location the most recent one of the plurality of locations and (2) direct the one or more projectors to project the display adjacent the item at the current location, such that the display follows the item along the path. The plurality of locations may include item coordinates relative to an established system of coordinates, an angular orientation relative to the established system of coordinates, and dimensional data about the item.

In another aspect of the system, the the controller may be further configured to (1) receive the plurality of locations and corresponding times; (2) compare the item coordinates to a fixed location of the display zone; and (3) send a start signal to the one or more projectors when the item coordinates fall within the fixed location of the display zone, the start signal configured to prompt the one or more projectors to project the display. The controller may be further configured to select as a current orientation the most recent one of the angular orientations, and direct the one or more projectors to project the display adjacent the item at the current orientation, such that the display follows the item along the path and remains legible.

In another aspect of the present invention, a method may be provided for processing a plurality of items. The method may include the steps of (a) acquiring indicia about an item in the plurality of items; (b) capturing an item location for the

item; (c) selecting a display based upon the indicia; (d) projecting the display adjacent the item; and (e) repeating steps (a) through (d) for a subsequent item in the plurality of items.

The step of acquiring indicia may include providing an acquisition device configured to read the indicia. The step of projecting the display may include projecting the display onto one or more exterior surfaces of the item. The step of projecting the display may also include selecting a most visible surface relative to a viewer located within the display zone, and projecting the display onto the most visible surface.

In one aspect, the method may also include projecting one or more of the displays simultaneously.

The step of projecting the display may also include communicating a handling instruction to a viewer of the display. The step of selecting a display may also include providing a set of standard displays, and selecting the display from the set.

In another aspect, the step of capturing an item location may also include: (1) capturing one or more intermediate locations of the item as it moves along a path generally toward a display zone; (2) storing each of the one or more intermediate locations; (3) selecting as a current location the most recent one of the one or more intermediate locations; (4) comparing the current location to a fixed location of the display zone; and (5) executing the step of projecting the display when the current location falls within the fixed location of the display zone. The step of capturing an item location may also include projecting the display adjacent the item at the current location, such that the display follows the item along the path and remains legible.

These and other objects are accomplished by the methods, products, and systems described herein and will become apparent from the following description of a preferred embodiment in conjunction with the accompanying drawings in which like numerals designate like elements.

## BRIEF DESCRIPTION OF THE DRAWING

The invention may be more readily understood by reference to the following description, taken with the accompanying drawing figures, in which:

**Figure 1** is a perspective illustration of a tracking and display system, according to one embodiment of the present invention.

**Figure 2** is an overhead illustration of a tracking and display system, according to one embodiment of the present invention.

**Figure 3** is an overhead schematic layout of a tracking and display system, according to one embodiment of the present invention.

**Figure 4** is a schematic diagram of a tracking and display system, according to one embodiment of the present invention.

**Figure 5** is a flow chart illustrating a series of tasks accomplished in a tracking and display system, according to one embodiment of the present invention.

## DETAILED DESCRIPTION

This application claims the benefit and priority of a U.S. provisional application for patent filed March 4, 2003, and assigned Application No. 60/451,999, which is incorporated herein by reference in its entirety.

### 1. Introduction

Exemplary systems, methods, and apparatuses are now described with reference to the drawing figures, where like reference numerals are used to refer to like elements throughout the several views. In the following description, for purposes of explanation, numerous specific details are set forth in order to facilitate a thorough understanding of the systems, methods, apparatuses, and the like. It may be evident, however, that the exemplars described may be practiced without these specific details. In other instances, common structures and devices are shown in block diagram form in order to simplify the description. Indeed, this invention may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will satisfy applicable legal requirements.

The embodiments of the present invention may be described below with reference to block diagrams and flow chart illustrations of systems, methods,

apparatuses, and computer program products according to an embodiment of the invention. It will be understood that each block of the block diagrams and flow chart illustrations, and combinations of blocks in the block diagrams and flow chart illustrations, respectively, may be implemented by computer program instructions. These computer program instructions may be loaded onto a general-purpose computer, special-purpose computer, or other programmable data processing apparatus to produce a machine, such that the instructions that execute on the computer or other programmable data processing apparatus create means for implementing the functions specified in the flow chart block or blocks.

These computer program instructions may also be stored in a computer-readable memory that can direct a computer or other programmable data processing apparatus to function in a particular manner, such that the instructions stored in the computer-readable memory produce an article of manufacture including instruction means that implement the function specified in the flow chart block or blocks. The computer program instructions may also be loaded onto a computer or other programmable data processing apparatus to cause a series of operational steps to be performed on the computer or other programmable apparatus to produce a computer implemented process such that the instructions that execute on the computer or other programmable apparatus provide steps for implementing the functions specified in the flow chart block or blocks.

Accordingly, blocks of the block diagrams and flow chart illustrations support combinations of means for performing the specified functions, combinations of steps for performing the specified functions and program instruction means for performing the specified functions. It will also be understood that each block of the block diagrams and flow chart illustrations, and combinations of blocks in the block diagrams and flow chart illustrations, can be implemented by special purpose hardware-based computer systems that perform the specified functions or steps, or combinations of special purpose hardware and computer instructions.

It will be appreciated that some or all of the processes and methods of the system involve electronic and/or software applications that may be dynamic and flexible processes so that they may be performed in other sequences different than

those described herein. It will also be appreciated by one of ordinary skill in the art that elements embodied as software may be implemented using various programming approaches such as machine language, procedural, object oriented, and/or artificial intelligence techniques.

The processing, analyses, and/or other functions described herein may also be implemented by functionally equivalent circuits like a digital signal processor circuit, a software controlled microprocessor, or an application specific integrated circuit. Components implemented as software are not limited to any particular programming language. Rather, the description herein provides the information one skilled in the art may use to fabricate circuits or to generate computer software to perform the processing of the system. It will be appreciated that some or all of the functions and/or behaviors of the present system and method may be implemented as logic as defined above.

Many modifications and other embodiments may come to mind to one skilled in the art who has the benefit of the teachings presented in the description and drawings. It should be understood, therefore, that the invention is not be limited to the specific embodiments disclosed and that modifications and alternative embodiments are intended to be included within the scope of the disclosure and the exemplary inventive concepts. Although specific terms may be used herein, they are used in a generic and descriptive sense only and not for purposes of limitation.

## 2. Definitions

As used in this application, the term "singulated" refers to a series of items or parcels positioned in a single-file line, one after the other. The handling of items or parcels may be greatly simplified by converting a flow of overlapping items crowded together (non-singulated) into a stream of singulated items to be processed. In a conveying system where items or parcels are moving through a facility or work area, a specialized conveyor or singulator may be used to produce a singulated flow.

As used in this application, the term "display" when used as a noun refers to a presentation, an exhibit or showing by which information is conveyed to a viewer or operator.

As used in this application, the term "computer component" refers to a computer-related entity, either hardware, firmware, software, a combination thereof, or to software in execution. For example, a computer component can be, but is not limited to being, a server, a processor, a process running on a processor, an object, an executable, a thread of execution, a program, and a computer. By way of illustration, both an application running on a server and the server itself can be a computer component. One or more computer components cans reside within a process and/or thread of execution and a computer component can be localized on a single computer and/or distributed between and among two or more computers.

"Software," as used herein, includes but is not limited to, one or more computer readable and/or executable instructions that cause a computer, computer component and/or other electronic device to perform functions, actions and/or behave in a desired manner. The instructions may be embodied in various forms like routines, algorithms, modules, methods, threads, and/or programs. Software may also be implemented in a variety of executable and/or loadable forms including, but not limited to, a stand-alone program, a function call (local and/or remote), a servelet, an applet, instructions stored in a memory, part of an operating system or browser, and the like. It is to be appreciated that the computer readable and/or executable instructions can be located in one computer component and/or distributed between two or more communicating, co-operating, and/or parallel-processing computer components and thus can be loaded and/or executed in serial, parallel, massively parallel and other manners. It will be appreciated by one of ordinary skill in the art that the form of software may be dependent on, for example, requirements of a desired application, the environment in which it runs, and/or the desires of a designer or programmer or the like.

"Database," as used herein, refers to a physical and/or logical entity that can store data. A database may be, for example, a stand-alone database, a relational database, a set of relational databases, a table, a file, a list, a queue, a heap, and so on. A database may reside in one logical and/or physical entity and/or may be distributed between two or more logical and/or physical entities.

The systems, methods, apparatuses, and objects described herein may be stored, for example, on a computer readable media. Media may include, but are

not limited to, an ASIC, a CD, a DVD, a RAM, a ROM, a PROM, a disk, a carrier wave, a memory stick, and the like. Thus, an example computer readable medium can store computer executable instructions for a method for managing transportation assets. The method includes planning a route for a transportation asset based on the analysis of data retrieved from an experience-based route database.

To the extent that the term "includes" is employed in the detailed description or the list of exemplary inventive concepts, it is intended to be inclusive in a manner similar to the term "comprising" as that term is interpreted when employed as a transitional word in a claim. Further still, to the extent that the term "or" is employed in the list of exemplary inventive concepts (for example, A or B) it is intended to mean "A or B or both." When the author intends to indicate "only A or B but not both," the author will employ the phrase "A or B but not both." Thus, use of the term "or" herein is the inclusive use, not the exclusive use. *See* Bryan A. Garner, A Dictionary Of Modern Legal Usage 624 (2d ed. 1995).

### 3. System Components

Generally, the various embodiments of the present invention relate to systems and methods for tracking the movement of items or parcels within a work area and displaying a handling instruction for each item or parcel. The present invention may be used for processing either singulated or non-singulated items. **Figure 4** is a schematic diagram of a system according to one embodiment of the present invention. The system **10** may include a controller or computer **45** linked to one or more scanners or acquisition devices **20**, tracking systems **40**, and projectors **60**. As shown, the computer **45** may include a memory component and a database **80**. The controller or computer **45** may also include a programmable logic controller (PLC) or other control system capable of monitoring and providing communication between the components described herein. Each link illustrated between the components represents a line of communication capable of transmitting data, messages, input, output, and the like.

**Figure 3** is an overhead schematic layout of a system **10** according to one embodiment of the present invention. As shown, the system **10** may include one or

more acquisition devices **20** positioned at or near various portals **300** where parcels enter the work area or facility. The tracking system **40** may include an array of tracking cameras **42** strategically located to cover the entire area. The dotted lines represent the path **110** traveled by parcels through work area. Each path **110** generally begins at the portal **300** and ends at or near a display zone **50**, where each parcel is handled or processed. The projectors **60** may be configured to project a display **62** near or onto each parcel when it is located in or near the display zone **50**.

**Figure 2** is an overhead illustration of a system **10** according to one embodiment of the present invention. As shown, the system **10** may include an acquisition device **20**, an array of tracking cameras **42**, and one or more projectors **60**. Each item or parcel **200** may include a label or other indicia **30**. In one embodiment, the display **62** chosen to be projected onto each parcel **200** is correlated to the data contained in the indicia **30**, so the display **62** matches the indicia **30** for each particular parcel **200**. In one embodiment, the display **62** appears when each parcel **200** is located within or near a display zone **50**. As shown, the display **62** (depicted in the shape of a hexagon) may include a handling instruction **130** (depicted by the letter H), directing the viewer **400** to process the parcel **200**, for example, by moving the parcel **200** to a particular segment **500**.

**Figure 1** is a perspective illustration of a system **10** according to one embodiment of the present invention. As shown, the system **10** may include an acquisition device **20**, a tracking camera **42**, and a projector **60**. The system **10** may include one or more acquisition devices **20** at one or more portals **300** where information is acquired about one or more items or parcels **200** as they enter a work area or facility. The system **10** may include one or more tracking cameras **42** as part of a tracking system **40** (**Figure 3**) configured to fix, track, and follow the location of each item or parcel **200** as it moves through a facility. In one embodiment, the parcels **200** may move along a general path **110** using, for example, a series of conveyors **100**. The system **10** may include one or more projectors **60** configured to project a display **62** onto the surface of each parcel **200**. The projector **60** may also be configured to move the display **62** such that it follows each parcel **200** in motion and the display **62** remains legible to a viewer **400**. In

response to the display **62**, the viewer **400** may be instructed to process the item or parcel **200**, for example, by moving the parcel **200** to a particular segment **500** selected from among a number of available segments **500**. A segment **500** may be a conveyor belt, chute, door, bay, feeder truck, package car, or any location or moving link along a path toward the destination of the parcel **200**.

The display **62** may be selected to match the indicia **30** for each particular parcel **200**. In one embodiment of the present invention, the system **10** may include one or more projectors **60** configured to project multiple selected displays **62** onto the surfaces of multiple parcels **200** simultaneously. The projector **60** or projection system may be provided that is capable of projecting the selected display **62** onto each one of several parcels **200** as they approach the viewer **400**. By viewing multiple displays **62** on approaching parcels **200**, the viewer **400** may gain valuable insight into the upcoming tasks to be performed, increasing efficiency and saving valuable time.

## 4. System Tasks

In one embodiment, the system of the present invention may include methods and apparatuses to accomplish the general tasks shown in **Figure 5** for each item or parcel **200** of interest: acquire **120**, track **140**, match **160**, project and follow **180**, and release **190**. In **Figure 5**, the column headings show the device or system that may be used to accomplish a particular task. The tasks of acquiring the parcel location **121** and acquiring or scanning the indicia **30** (task **123**) appear in the first shaded column and therefore may be performed by the acquisition device **20**. The tasks may be executed in order, generally, although the track task **140** and the match task **160** may occur in either order or simultaneously. The "project and follow" task **180** generally includes both the projection of a display **62** and the following of the parcel **200**, because the display **62** must follow the parcel **200** in order to remain visible. After a parcel **200** has been processed or handled according to the instructions in the display **62**, the release task **190** may include the end of active tracking and display and the archiving of the data gathered.

In one embodiment, the system of the present invention may accomplish the general tasks shown in **Figure 5** for a multiple items or parcels **200** simultaneously. In other words, the tasks – acquire **120**, track **140**, match **160**, project and follow

**180**, and release **190** – may be accomplished, for example, on every parcel **200** in an incoming flow of singulated or non-singulated parcels to be processed.

### 4.1 ACQUIRE

Referring to the flow chart of tasks in **Figure 5**, the acquire task **120** may be accomplished by an acquisition device **20**. In one embodiment, an acquisition device **20** may acquire, capture, scan, or otherwise read a label or indicia **30** (task **123**) on each of one or more parcels **200**. As shown in **Figure 2**, each parcel **200** may include a label or other indicia **30**. The indicia **30** may include a code such as a unique parcel identifier that may be used to differentiate the parcel from the others. The indicia **30** read by the acquisition device **20** may be transmitted to a computer **45** and stored (task **124**) in memory such as a database **80** for processing and later retrieval. In one embodiment, for each one of a plurality of parcels **200**, the computer **45** may receive and store a scan of the indicia **30**, and one or more fields for storing the data contained in the indicia **30**.

The indicia **30** may be a bar code, maxi-code, UPC symbol, RFID tag, text readable an optical character recognition (OCR) scanner, or any component capable of holding a parcel identifier. In one embodiment, the acquisition device **20** captures the data encoded or otherwise embedded within the indicia **30** by scanning, optically reading, or otherwise acquiring the data (task **123**). The acquisition device **20** may be an image camera, a bar code reader, an optical scanner, an optical character recognition (OCR) scanner, an RFID reader, or any system capable of reading or otherwise obtaining a parcel identifier from the particular indicia **30** in use. In one embodiment, the acquisition device **20** may be specifically chosen or tailored to read or capture data from a particular type of indicia **30**.

In one embodiment, an acquisition device **20** may acquire or capture an initial location (task **121**) for each one of a plurality of parcels **200**. The location data may include all three dimensions (x, y, z) and a time of acquisition. In addition, the acquisition device **20** may be configured to measure the dimensions of each item or parcel **200**, and its orientation relative to known coordinates. In another embodiment, a tracking system **40** may measure the parcel **200** and its location. The data gathered for all the parcels **200** by the acquisition device **20** may

be transmitted to a computer **45** and stored (task **122**) in memory such as a database **80** for processing and later retrieval.

### 4.2 TRACK

Once the acquire task **120** is completed, the tracking cameras **42**, as shown in **Figure 2**, may cooperate as part of a tracking system **40** to monitor the intermediate locations of each parcel **200** at various intermediate times (task **141**). The group of parcels **200** may be propelled or moved along a fixed or random path by one or more conveyors **100** or handling systems. In one embodiment, one or more tracking systems **40** may work together to continually monitor and update the location of each parcel **200** (track task **140**). The tracking systems **40** may fix a position, for each one of a plurality of parcels **200**, at a plurality of interim locations and corresponding times. A parcel number or other unique identifier may be used to enable the tracking system **40** to track multiple parcels simultaneously.

The intermediate location data gathered by the tracking system **40** (task **141**) may be transmitted to a computer **45** and stored in a database **80** for processing and later retrieval. In one embodiment, for multiple parcels **200**, the computer **45** may receive and store each intermediate parcel location (task **142**) including an acquire time, parcel dimensions (length, height, width, girth), and a parcel orientation relative to a known plane or coordinate system. In one embodiment, the system **10** of the present invention may include a grid or other type of established coordinate system superimposed upon a work area or facility, to be used by the system components to fix the locations relative to known reference points.

In one aspect of the invention, as shown in **Figure 2**, the tracking cameras **42** and the one or more projectors **60** may be positioned to focus on each parcel **200** as it travels along its path. It should be noted that, although multiple physical obstacles may be present in a sorting facility, such as conveyor structures and building columns, the tracking systems **40** may be configured to continually monitor the location of multiple parcels **200**. The system **10** may include a series of fixed, retro-reflective targets positioned throughout the facility to generate optical feedback signals to the tracking cameras **42** and to the computer **45**. Data from the fixed targets may be used to keep the tracking cameras **42** and the

projectors **60** properly oriented with respect to known locations in the facility. Location data gathered by the tracking system **40** and communicated to the computer **45** may be used by the projectors **60** to accurately project a legible display **62** onto the parcel **200** as it travels along its path.

In another aspect, the system **10** of the present invention in one embodiment may include a series of recognizable markers placed on each worker or viewer **400** located in the work area or facility. The markers may include indicia unique to each viewer **400** to enable the system **10** to monitor the location of each viewer **400** and, in one embodiment, to monitor and/or minimize the viewer's exposure to scanning, tracking, or projecting energy.

In one embodiment, the tracking system **40** may include the system and components described in the commonly-owned U.S. patent application entitled, "Item Tracking and Processing Systems and Methods," invented by Anderson and Ramsager, filed January 23, 2004, and assigned Application No. 10/N, which is incorporated herein by reference in its entirety.

In one embodiment, the tracking system **40** of the present invention may include a motion tracking system such as the type available from Intelligent Video Systems or Epix, Inc. The tracking system **40**, in one embodiment, may include one or more fixed, perspective-view cameras and one or more movable dome cameras. The tracking cameras **42** may be positioned and calibrated using methods known in the art of object tracking. The tracking cameras **42** may include both fixed and movable, pan-and-tilt cameras, which may be positioned in a prescribed array or matrix or may be placed randomly at strategic locations.

In one embodiment, the tracking system **40** may include a tracking computer **145** specially configured to direct and control the tracking cameras **42** and other components of the tracking system **40**. The tracking computer **145** may include a tracking engine or other software particularly suited for tracking multiple objects or parcels **200**, performing telemetry calculations, processing video images, calculating the positions of moving objects, and the like. Like the system computer **45**, the tracking computer **145** may include one or more databases to store data about each item or parcel **200** being tracked. To facilitate the exchange of data, the tracking computer **145** may be in communication with the system computer **45**.

The data gathered by the tracking system **40** may be transmitted via a link (shown in **Figure 4**) to a computer **45** and stored in a database **80** for processing and retrieval. In one embodiment, the computer **45** may receive and store a plurality of intermediate locations (in up to three dimensions, and including an intermediate time) for multiple parcels **200**.

### 4.3 MATCH

Once the acquire task **120** is completed, the computer **45** may receive, store, and process the indicia **30** and the data contained therein. The indicia **30** may include data embedded in a label or other marking on each parcel **200**. In one embodiment, the display **62** may be correlated to the indicia **30** on each parcel **200**. When multiple parcels **200** are being processed together, the system **10** in one embodiment correlates each indicia **30** acquired from each parcel **200** and selects a particular display **62** for each parcel **200**.

In one embodiment, a display **62** is selected based upon the data contained in the indicia **30** (task **161**). In other words, the system **10** of the present invention matches (task **160**) the appropriate display **62** to the particular parcel **200** being processed. The display **62** may also include a handling instruction **130** correlated to or specifically tailored for a particular parcel **200**. The process of correlating or matching the indicia **30** (task **161**) may be accomplished by the computer **45**.

In one embodiment, the display **62** may include text, numerals, symbols, icons, arrows, or combinations thereof, designed to convey a message or handling instruction **130** to the viewer **400**. The display **62** may include one or many colors. The display **62** may be minimal to convey simple instructions, or more complex and involved to convey complex or multiple instructions. For example, a display **62** may include a handling instruction **130** in the form of an abbreviation such as "TF" to instruct the viewer **400** to place a parcel **200** on a "Top Front" conveyor or shelf. Similarly, a numeral such as "15" may be used in the display **62** to instruct the viewer **400** to move a parcel to a location identified by the number fifteen, such as a conveyor belt, chute, door, bay, feeder truck, or package car. The handling instruction **130** may be a combination, such as "TF-15" indicating a "top front" position in or near location number fifteen.

In one embodiment, the system **10** of the present invention may include a standard set of displays or symbols. The display **62** selected may be one from the standard set. The standard set may include symbols or icons developed to convey special circumstances, from fault messages to special handling instructions. For example, a symbol indicating a failure to read the indicia **30** on the parcel label may be used to inform the viewer **400** that a parcel **200** is not being actively tracked. Other symbols may be developed to tell the viewer **200** to manually process a package; for example, to carry a parcel **200** by hand to a special handling location. The various symbols designed, in one embodiment, may be added to a standard set of displays. The projectors **60** in one embodiment are capable of processing and displaying a variety of icons in different shapes, sizes, and colors, in order to convey information to the viewer using symbols.

The display **62** may be transmitted to the projector **60** (task **182**) as soon as the selection task is complete, or it may be transmitted later, such as when the item or parcel **200** enters a display zone **50**. When multiple parcels **200** are being processed together, the selected display **62** for each parcel **200** may be transmitted to the projector **60** or projection system (task **182**) for each and every parcel. Then, in one embodiment, the projector **60** may project the selected displays **62** onto each of the corresponding parcels **200** simultaneously, when the parcels **200** approach or enter the display zone **50**.

### 4.4 PROJECT & FOLLOW

In one embodiment, the project and follow task **180** may begin when each item or parcel **200** approaches or enters nears a display zone **50**, where each parcel **200** is generally handled or processed by a worker or viewer **400**. A start signal may be transmitted (task **181**) when the tracking system **40** senses a parcel **200** enter the display zone **50**. Multiple start signals may be transmitted in circumstances where multiple parcels **200** are processed simultaneously.

In one embodiment, the projector **60** may be configured to project a display **62** adjacent or near a parcel **200** or directly onto a surface of a parcel **200** (task **183**) and to follow the parcel **200** as it moves along its path (task **185**). The 'following task' **185** may be accomplished, in one embodiment, using current location data received from the tracking system **40** (task **184**).

In one embodiment of the present invention, the system **10** may include one or more projectors **60** configured to project multiple selected displays **62** simultaneously, onto the surfaces of each corresponding parcel **200** being processed (task **183**). In this aspect, the viewer **400** may see multiple displays **62** on several approaching parcels **200**, providing valuable insight into the upcoming tasks to be performed and saving valuable time. The projector **60** may illuminate a display **62** on each of several parcels **200** approaching a viewer **400** in a display zone **50**. Seeing several displays **62** may allow the viewer **400** to understand the imminent tasks and plan ahead. For example, if two of the parcels **200** have a similar display **62**, such as TF-15, the viewer **400** may process those two parcels together (by moving them both toward the location corresponding to the TF-15 display) and thereby save time and effort.

The system **10**, in one embodiment, may use data gathered by the tracking system **40** and stored in the controller or computer **45** to calculate or derive the most visible surface of a parcel **200** relative to a viewer **400** standing or otherwise located in the display zone **50**. In this embodiment, dimensional data about a parcel **200** may be used to calculate or derive the size and shape of one or more exterior surfaces. From these calculations, and given the position of a viewer **400** in or near the display zone **50**, the system **10** of the present invention may direct the projector **60** to project the display **62** onto the exterior surface most visible to the viewer **400**.

A display **62** and handling instruction **130** may be temporary; that is, lasting only as long as the instruction is helpful or, in other cases, as long as the parcel **200** is traveling along a known or knowable path **110** (**Figure 3**). Once the instruction **130** is followed and the parcel **200** is handled accordingly, the need for such an instruction **130** may end. In one embodiment, the display **62** may be projected when a parcel **200** nears or enters a display zone **50**, and the display **62** may follow the parcel **200** until it leaves the display zone **50**. A display zone **50** may be established around an area where one or more workers or viewers **400** may desire or benefit from viewing the display **62** being projected onto each parcel **200**. In one embodiment, a display zone **50** may be described with reference to a fixed location defined by known coordinates.

The projector **60** selected for the system **10** of the present invention may vary in complexity from a simple spotlight or slide projector to a more complex graphics projector or laser projection system. In one embodiment, the handling instruction **130** portion of the display **62** may simply direct the viewer **400** to grasp or pick a parcel **200** or let it continue on its path. For such a system, the projector **60** may be a simple spotlight configured to illuminate each selected parcel **200** and leave the non-selected parcels dark. In other embodiments, where a more complex handling instruction **130** may be needed to assist the viewer **400** in deciding among multiple options, the display **62** may require more detail and thus, may require a more complex projector **60**. The projector **60** or projection system, in one embodiment, may project different displays **62** onto multiple items or parcels **200** simultaneously.

In one embodiment, the projector **60** of the present invention may include a laser projection system such as the one available from Laser Projection Technologies. For a laser projection system, the tracking system **40** in one embodiment may include a series of retro-reflective targets positioned to generate optical feedback signals that help keep the projector **60** properly oriented. The projector **60** may also include software to read and convert legible data (such as symbols, text, or other indicia) into a traced laser pattern for the display **62**. The task of matching or correlating the indicia **30** on each parcel **200** to a particular display **62**, as described above, will generally produce a display **62** (text, icon, symbol, or combinations thereof) which may be converted into a pattern to be traced by the laser beam in order to produce a visible display **62** on each parcel **200**. A laser projection system may be generally capable of projecting different displays **62** onto multiple items or parcels **200** simultaneously. In another aspect, the projector **60** of the present invention may include a laser projector such as the one available from Lightspeed Design Group. The projector **60** in one embodiment may include both a laser and a graphics projection system to control the color, polarization, and collimation of the laser beam.

The projector **60**, as shown in **Figure 2**, may be configured to project a display **62** onto one or more of the outer surfaces of each parcel **200**. The display

62 may include a handling instruction 130. In one embodiment, the display 62 may be correlated or matched to the indicia 30 on the parcel 200, as described above.

The one or more projectors 60 may also be configured, in one embodiment, to follow each parcel 200 along a moving path (task 185), so that the handling instruction 130 remains legible to one or more viewers 400. By "follow the parcel" it is meant that the projectors 60 may rotate or otherwise move from a generally fixed position so that the projected display 62 remains pointed toward the parcel 200 (or each of several parcels 200 simultaneously) and each display 62 remains generally legible to a viewer 400. In one embodiment, each projector 60 may be configured to move, along a track for example, in order to maintain the legibility of the projected display 62. In one embodiment, the system 10 may be configured to move or rotate the projector 60 in tandem with the parcel 200, so the display 62 remains near or moves in conjunction with the parcel 200. Where multiple parcels 200 are being processed, the system 10 in one embodiment may be configured to move or rotate one or more projectors 60 in tandem with the parcels 200, so that each display 62 remains near or moves in conjunction with each corresponding parcel 200.

In one embodiment, the display 62 including any handling instruction 130 may be sized and shaped by the projector 60 to fit neatly upon one of the outer surfaces of each parcel 200. The acquisition device 20 and/or the tracking system 40 may acquire various measurements of each parcel 200 (task 121) and return the size data to the computer 45 (task 122). The size and shape of each selected display 62 and handling instruction 130, of course, may change as each parcel 200 travels along a path or otherwise changes its orientation or pose with respect to the projector 60. The system 10 in one embodiment may calculate the desired change for each display 62, and the corresponding motion of each projector 60, to accurately follow each moving parcel 200 in a group of multiple parcels 200.

The projector 60 may also be configured to project the display 62 onto the surface best suited to receive the display and exhibit the display 62 to a viewer. For example, the projector 60 may project the handling instruction 130 onto the top of a parcel 200 passing directly beneath the projector 60, whereas the display 62

and handling instruction **130** may be projected on the side of another parcel **200** depending in part on the position of the projector **60**.

Display of the same display **62** on multiple surfaces of the same parcel **200** may also be accomplished in one embodiment because one or more viewers **400** may need to see a handling instruction **130** from different viewpoints. Display of the handling instruction **130** onto a surface separate from, yet related to, the parcel **200** may also be accomplished in one embodiment. For example, for very small or flat parcels, a vertical placard or other screen surface may be attached or otherwise linked to a parcel **200** to receive the projected display **62**.

In one embodiment, the parcel **200** may include one or more labels or surfaces specially coated to produce a permanent instruction when it receives a display **62**. In the case of a laser projection system, for example, a paper label may be used with ink that responds to laser light in such a way that a permanent instruction becomes visible. Other tags or devices capable of storing information received from a projected display **62** may accompany the parcel **200**.

### 4.5 RELEASE

In one embodiment, the system **10** of the present invention may be configured to release each parcel **200** (task **190**) when it has been processed. The release task **190** may include ending the active tracking of each parcel **200** (task **191**), archiving or clearing the data stored in the computer **45** (task **192**), and/or ending the active projection of the display **62** (task **193**). In general, the system tasks are complete when each parcel **200** has been processed or otherwise handled by a viewer **400** who may move the parcel **200** to a next particular segment **500** according to the handling instruction **130** included or understood within the display **62**. The release task **190** for a group of parcels may be performed at different times, of course, when each parcel **200** has been processed.

The system **10** in one embodiment may be used in conjunction with other systems **10** in a series of related segments **500** in a work area or facility. For example, after a first system **10** has released a parcel **200** (task **190**), a second system may acquire the parcel (task **120**) and begin the process anew for another link or segment in a chain or series of item processing steps.

## 5. Tracking Parcel Contents

The system **10** of the present invention may have applicability beyond the sorting or processing of items or parcels **200**. Existing packaging facilities may use a "pick to light" system that is programmed to illuminate a light near a bin containing an item to be placed in a package. As the packer moves through a facility, additional lights are illuminated near the next item to be packed. The system may also include a display near the bin to indicate the quantity of items to be packed. Selection and packing of an item may be acknowledged by pressing a button near the bin. In use, this type of system requires extensive and complex electrical wiring that must be installed throughout the facility before packing work can begin.

In another aspect of the present invention, a projection system **10** according to one embodiment may include one or more tracking systems **40** and projectors **60** to display a handling instruction **130** in the form a packing instruction or packing list onto a parcel **200** to be filled with items. The projectors **60** may also display a series of item names and quantities onto the parcel **200**, in order to provide real-time instruction to the person picking the items and packing the parcel. In one embodiment, the projectors **60** may display the next item instruction along with one or more future instructions, to provide information in advance and further speed the packing process. Tracking systems **40** positioned in various locations throughout a facility may be configured to track each parcel **200** as it moves through different areas.

In one embodiment, the projectors **60** may also display a quantity indicator near the bin containing an item to be packed. As the tracking system **40** follows the parcels **200** through the facility, sending data to the computer **45**, the projectors **60** may display the next quantity indicator on the next bin, and so forth. The projection system **10** may include a bar code scanner or other sensors to confirm the correct selection and packing of each item. In general, the overhead tracking system **40** and projectors **60** may provide a flexible and simple alternative to the hard-wired lights and switches of a traditional "pick to light" system.

Like the system **10** illustrated in **Figure 4**, the system **10** of this embodiment of the present invention may include a computer **45** linked to one or

more scanners or acquisition devices **20**, tracking systems **40**, and projectors **60**. An acquisition device **20** may include a scanner to optically read the packing list data embedded within the indicia **30** on a label placed on an empty parcel **200** to be filled. The acquisition device **20** may then transmit the data embedded in the indicia **30** to the computer **45**. The tracking system **40** and tracking cameras **42** may follow the parcel **200** through the facility, so that the computer **45** always has current location data for the parcel **200** relative to the known locations of certain bins filled with items. The projectors **60** in this embodiment may project a display **62** including packing instructions **103** onto the parcel **200** and/or onto the bins, as required, to increase packing efficiency. Many of the same advantages gained from projecting a handling instruction **130** onto a parcel **200** can be realized in the context of projecting a packing instruction.

## 6. Conclusion

The described embodiments of the invention are intended to be merely exemplary. Numerous variations and modifications will be apparent to those skilled in the art. All such variations and modifications are intended to fall within the scope of the present invention as defined in the appended list of exemplary inventive concepts.

What has been described above includes several examples. It is, of course, not possible to describe every conceivable combination of components or methodologies for purposes of describing the systems, methods, computer readable media and so on employed in planning routes. However, one of ordinary skill in the art may recognize that further combinations and permutations are possible. Accordingly, this application is intended to embrace alterations, modifications, and variations that fall within the scope of the appended list of exemplary inventive concepts. Furthermore, the preceding description is not meant to limit the scope of the invention. Rather, the scope of the invention is to be determined only by the appended list of exemplary inventive concepts and their equivalents.

While the systems, methods, and apparatuses herein have been illustrated by describing examples, and while the examples have been described in considerable detail, it is not the intention of the applicants to restrict or in any way limit the scope of the appended list of exemplary inventive concepts to such detail.

Additional advantages and modifications will be readily apparent to those skilled in the art. Therefore, the invention, in its broader aspects, is not limited to the specific details, the representative systems and methods, or illustrative examples shown and described. Accordingly, departures may be made from such details without departing from the spirit or scope of the applicant's general inventive concepts.

## CLAIMS

What is claimed is:

1. A system for processing one or more items, comprising:

an acquisition device to capture indicia about an item;

one or more projectors positioned near a display zone where said item may be processed; and

a controller in communication with said acquisition device and said one or more projectors, wherein said controller receives said indicia from said acquisition device, selects a display based upon said indicia, and sends said display to said one or more projectors,

said one or more projectors positioned to project said display adjacent said item.

2. The system of claim 1, wherein said indicia comprises an optical code and said acquisition device comprises an optical scanner.

3. The system of claim 1, wherein said indicia comprises a bar code and said acquisition device comprises a bar code scanner.

4. The system of claim 1, wherein said indicia comprises an RFID tag and said acquisition device comprises an RFID reader.

5. The system of claim 1, wherein said one or more projectors is positioned to project said display onto on one or more exterior surfaces of said item.

6. The system of claim 1, wherein said one or more projectors is configured to select a most visible surface relative to a viewer located within said display zone, and

wherein said one or more projectors is positioned to project said display onto said most visible surface.

7. The system of claim 1, wherein said one or more projectors comprises a laser projection system.

8. The system of claim 1, wherein said controller comprises a computer with memory and a database for storing said indicia.

9. The system of claim 1, wherein said display is configured to communicate a handling instruction to a viewer of said display.

10. The system of claim 1, wherein said display is selected from a set of standard displays.

11. The system of claim 1, wherein said item is moving along a path generally toward said display zone, said system further comprising:

a tracking system to capture a plurality of locations and corresponding times for said item, said tracking system comprising one or more tracking cameras.

12. The system of claim 11, wherein said controller is further configured to:

select as a current location the most recent one of said plurality of locations;

direct said one or more projectors to project said display adjacent said item at said current location, such that said display follows said item along said path.

13. The system of claim 11, wherein each of said plurality of locations comprises:

item coordinates relative to an established system of coordinates;

an angular orientation relative to said established system of coordinates; and

dimensional data about said item.

14. The system of claim 13, wherein said controller is further configured to:

receive said plurality of locations and corresponding times;

compare said item coordinates to a fixed location of said display zone; and

send a start signal to said one or more projectors when said item coordinates fall within said fixed location of said display zone, said start signal configured to prompt said one or more projectors to project said display.

15. The system of claim 13, wherein said controller is further configured to:

select as a current orientation the most recent one of said angular orientations;

direct said one or more projectors to project said display adjacent said item at said current orientation, such that said display follows said item along said path and remains legible.

16. A method of processing a plurality of items, comprising:

(a) acquiring indicia about an item in said plurality of items;

(b) capturing an item location for said item;

(c) selecting a display based upon said indicia;

(d) projecting said display adjacent said item; and

(e) repeating steps (a) through (d) for a subsequent item in said plurality of items.

17. The method of claim 16, wherein said step of acquiring indicia further comprises providing an acquisition device configured to read said indicia.

18. The method of claim 16, wherein said step of projecting said display further comprises:

projecting said display onto one or more exterior surfaces of said item.

19. The method of claim 16, wherein said step of projecting said display further comprises:

selecting a most visible surface relative to a viewer located within said display zone; and

projecting said display onto said most visible surface.

20. The method of claim 16, further comprising:

projecting one or more of said displays simultaneously.

21. The method of claim 16, wherein said step of projecting said display further comprises:

communicating a handling instruction to a viewer of said display.

22. The method of claim 16, wherein said step of selecting a display further comprises:

providing a set of standard displays; and

selecting said display from said set.

23. The method of claim 16, wherein said step of capturing an item location further comprises:

capturing one or more intermediate locations of said item as it moves along a path generally toward a display zone;

storing each of said one or more intermediate locations;

selecting as a current location the most recent one of said one or more intermediate locations;

comparing said current location to a fixed location of said display zone; and

executing said step of projecting said display when said current location falls within said fixed location of said display zone.

24. The method of claim 23, wherein said step of capturing an item location further comprises:

projecting said display adjacent said item at said current location, such that said display follows said item along said path and remains legible.

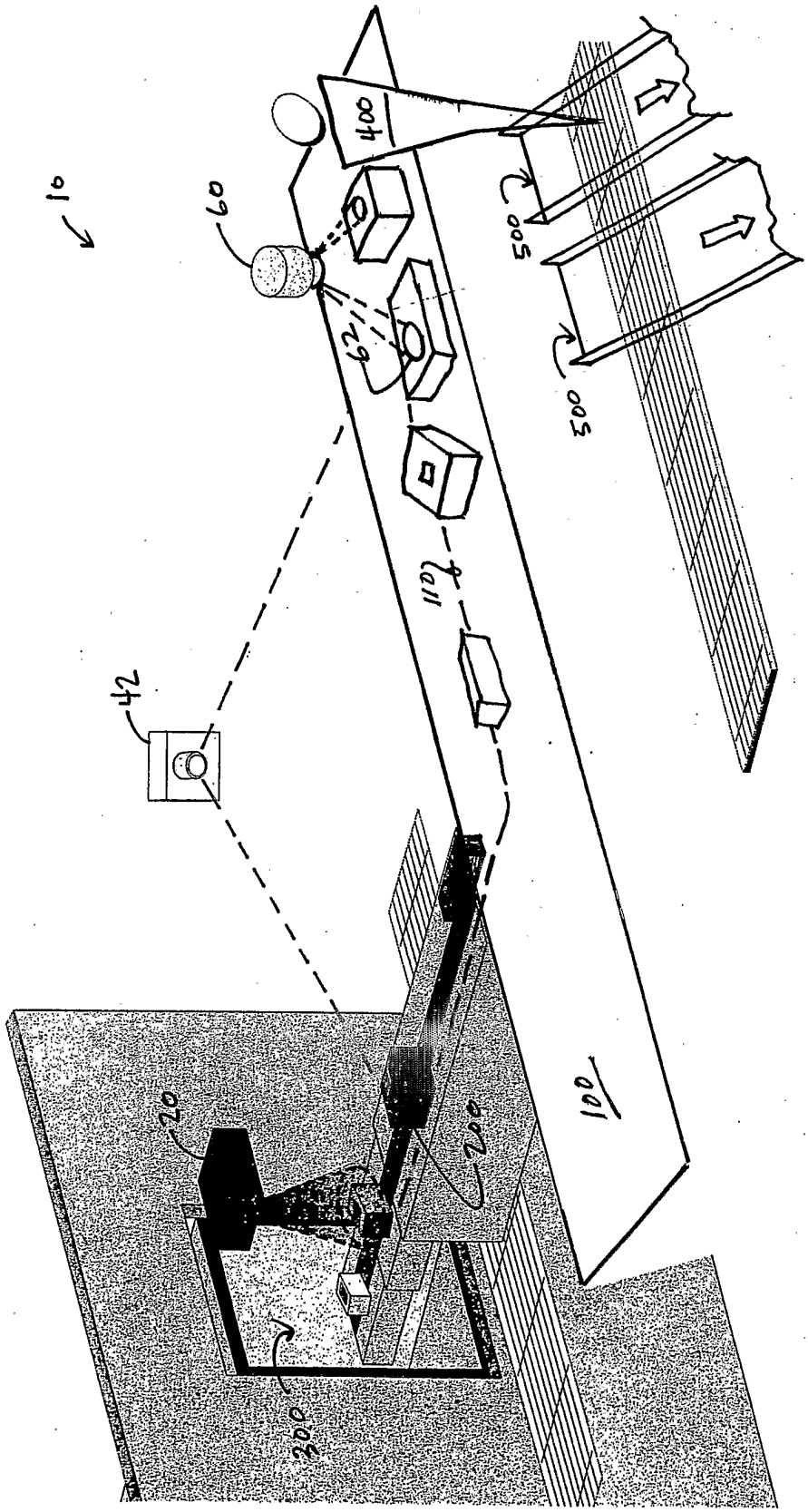


Fig. 1

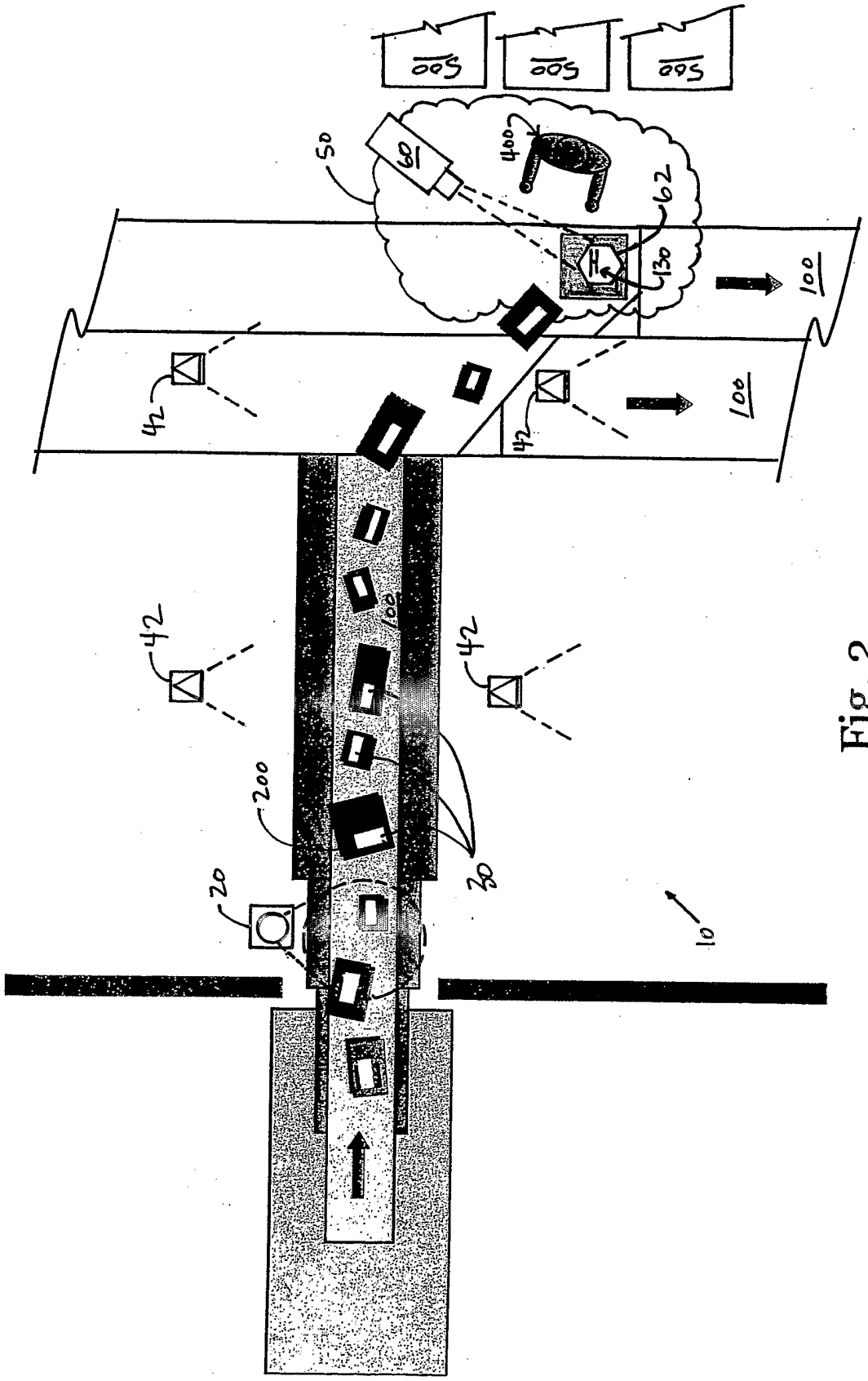


Fig. 2

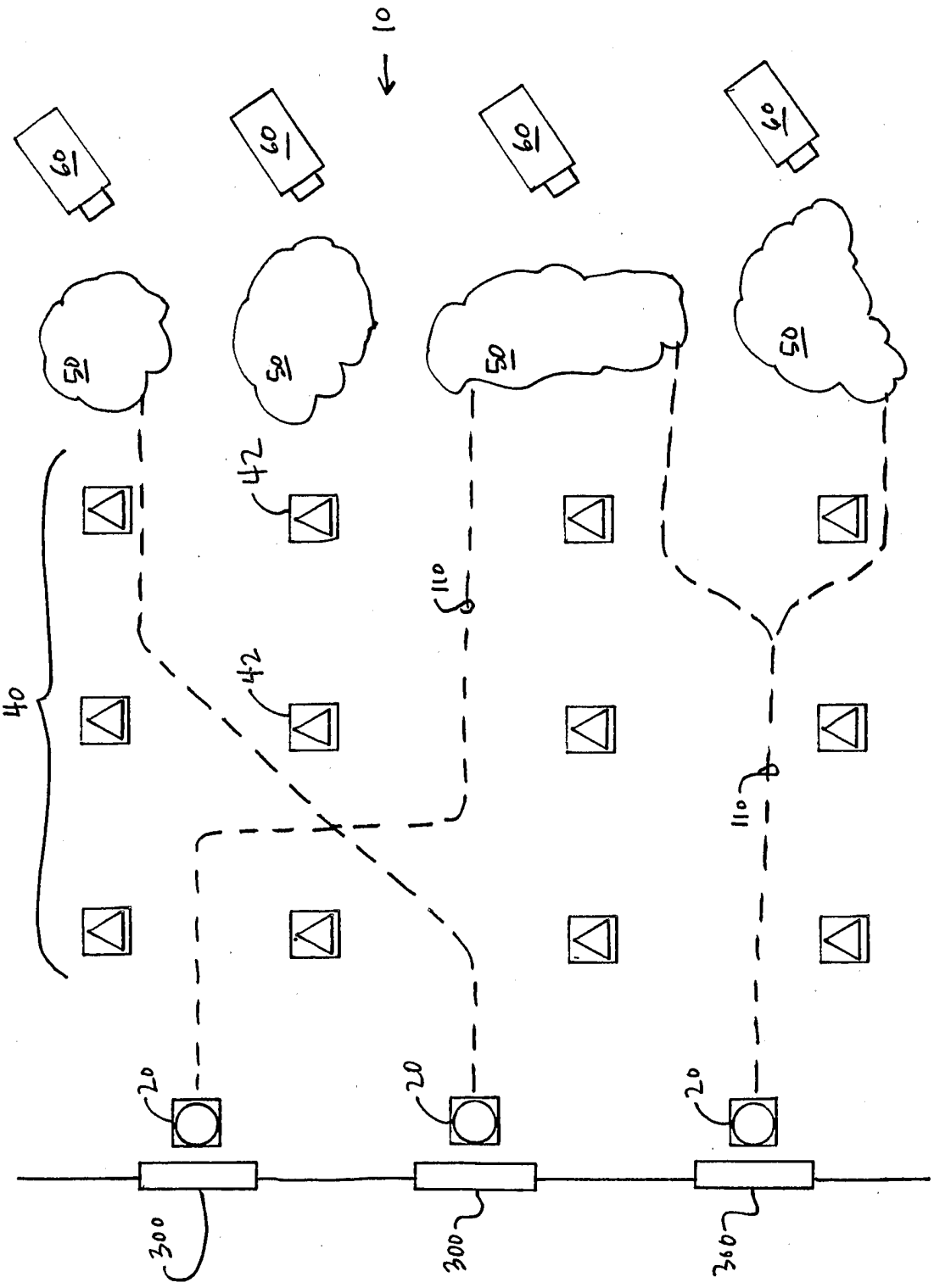


Fig. 3

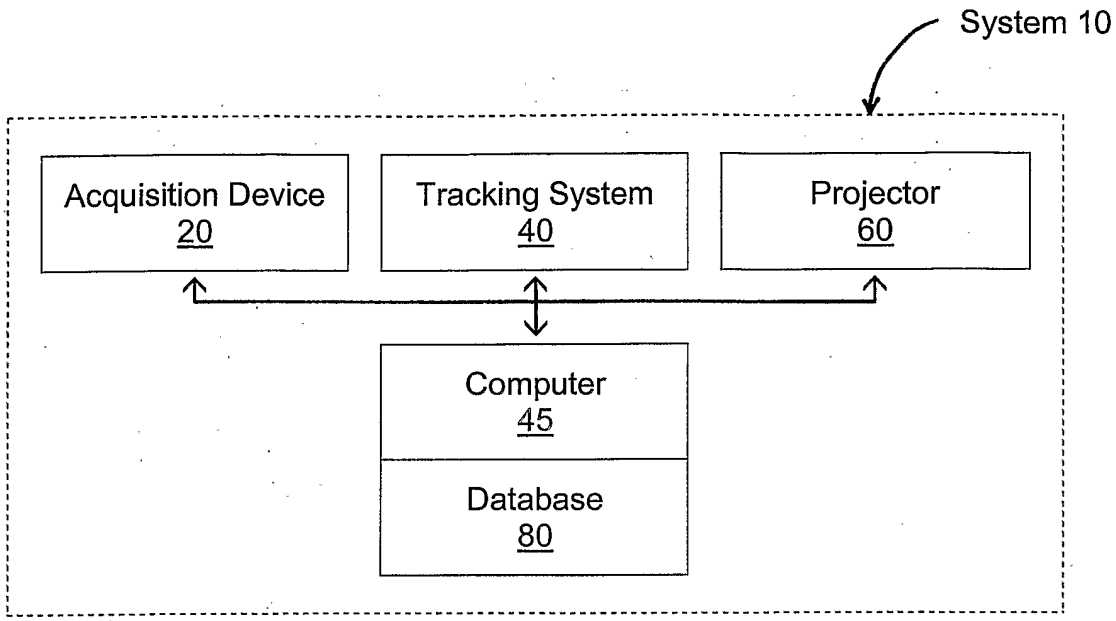
System 10
Acquisition Device
20
Tracking System
40
Projector
60
Computer
45
Database
80

Fig. 4

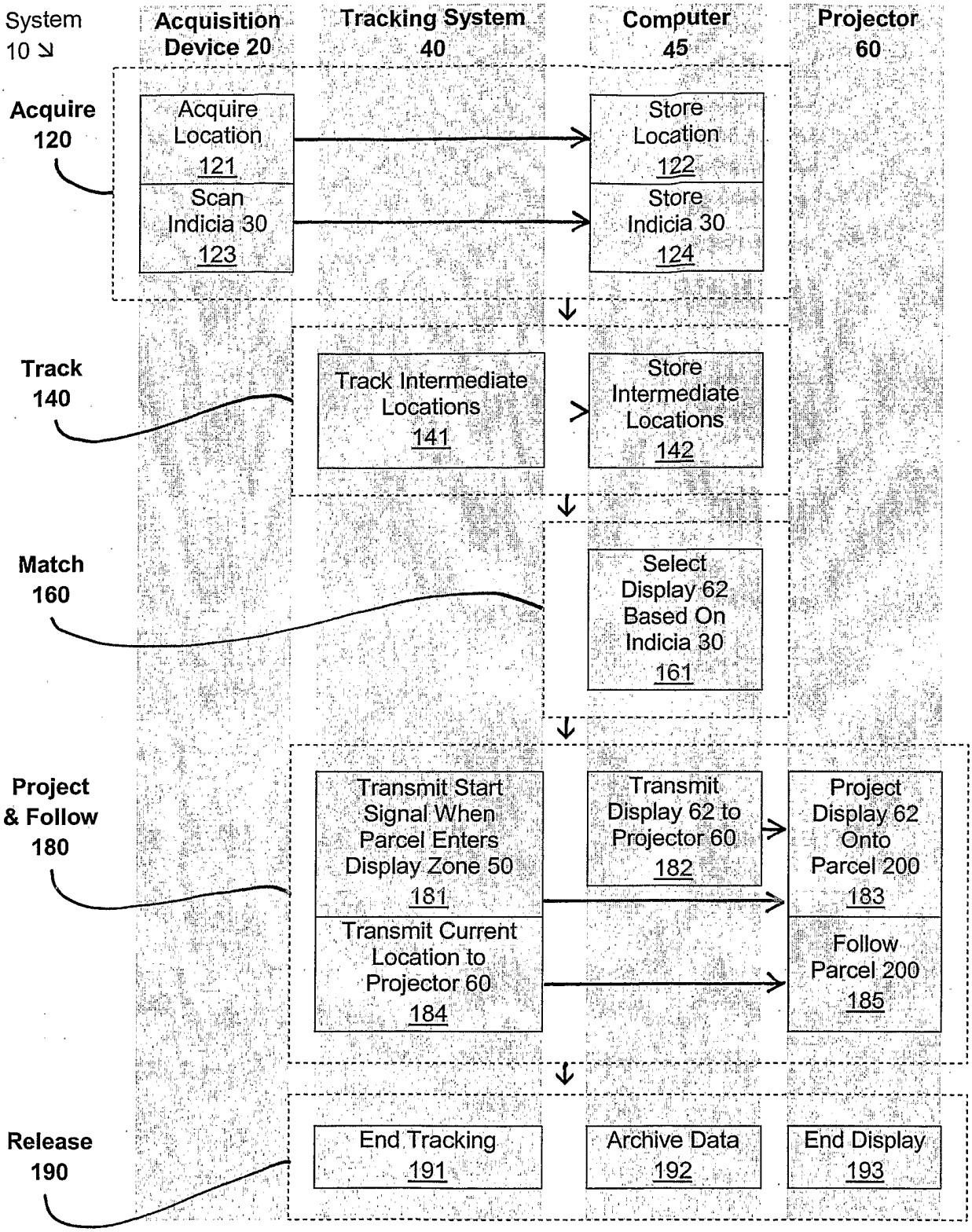
System 10
Acquisition Device 20
Tracking System 40
Computer 45
Projector 60
Acquire 120
Acquire Location 121
Scan Indicia 30 123
Store Location 122
Store Indicia 30 124
Track 140
Track Intermediate Locations 141
Store Intermediate Locations 142
Match 160
Select Display 62 Based On Indicia 30 161
Project & Follow 180
Transmit Start Signal When Parcel Enters Display Zone 50 181
Transmit Display 62 to Projector 60 182
Project Display 62 Onto Parcel 200 183
Transmit Current Location to Projector 60 184
Follow Parcel 200 185
Release 190
End Tracking 191
Archive Data 192
End Display 193

FIG. 5