

A SYSTEM FOR INSPECTING AN ARTICLE

FIELD OF INVENTION

- 5 The invention relates to article inspection. More particularly, the invention relates to a system for inspecting an article on a conveyor belt.

BACKGROUND OF THE INVENTION

- 10 Physical condition of raw materials is one of the factors that affect overall quality of a product. Therefore, inspection of the physical condition of the raw material is an essential procedure to uphold the overall quality of the product. In a production line, inspection of the physical condition of the raw materials is conducted on a conveyor prior to processing. Conventionally, cameras and sensors are adopted to collect data of
15 the raw materials for inspection as the raw materials travel along the conveyor belt.

- Over the years, various systems for inspecting physical condition of an article were developed. For instance, China Patent Application Publication No. CN104399674A discloses a machine vision inspection system that allows an object on a conveyor belt
20 to be inspected from multiple angles. The system generally comprises an electric rail, a pair of side support members, a top support member, and a plurality of cameras. Each of the side support members are slidably disposed on the electric rail on opposing sides of the conveyor belt, whereas the top support member are disposed on top of the support members. The camera is rotatably connected to a fixed plate on each of the side support
25 member such that facing angle of the camera is adjustable during inspection. Furthermore, the camera is connected to a sliding block on the top support member for inspecting a top surface of the object.

However, the machine vision inspection system is not capable of detecting a reverse

movement of the conveyor belt. Additionally, in the event of the reverse movement of the conveyor belt, the cameras will capture duplicate images of the object when the object moves backward to the inspection area. Consequently, this leads to repeated analyses of the duplicate image that produce to redundant and duplicate results, thereby
5 reduces efficiency of the inspection process.

Accordingly, it would be desirable to provide a system for inspecting physical condition of an article that overcomes the abovementioned problems. This invention provides a solution to the problems.

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SUMMARY OF INVENTION

One objective of the invention is to provide a system for inspecting an article that prevents capturing duplicate images of the article during reverse movement of a
15 conveyor belt. Particularly, the system comprises one or more movement sensors for monitoring the inspection process, especially in detecting movement direction of the conveyor belt, and a control module that regulates operation the system, wherein the control module is configured to halt operation of an image acquisition module upon detecting the reverse movement of the conveyor belt by the movement sensors.

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In a first aspect of the invention, there is provided a system for inspecting an article, comprising a conveyor having a conveyor belt for moving the article thereon in a first direction; a sensing module comprising one or more movement sensors for detecting movement direction of the conveyor belt; an image acquisition module comprising at
25 least one image acquisition device for capturing image of various perspectives of the article; and a control module for regulating operation of the system; wherein the control module is configured to halt the operation of the image acquisition module when the movement sensors detect a movement of the conveyor belt in a second direction that opposes the first direction.

Preferably, the sensing module further comprises any one or combination of a personnel sensor for detecting presence of a personnel handling inspection of the article at a predetermined location, and one or more article sensors for detecting presence of the
5 article on the conveyor belt.

Preferably, the article sensors include any one or combination of a proximity sensor and a contact sensor.

10 Preferably, the movement sensors are a pair of photoelectric sensors located opposite to each other across the conveyor belt.

Preferably, the various perspectives of the article are different side surfaces of the article.
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Preferably, the image acquisition module comprises four image acquisition devices, each for respectively capturing the images of the corresponding perspective of the articles on the conveyor belt in a sequential manner when the article is moved by the conveyor in the first direction.

20 Preferably, the system is implemented with a Message Queuing Telemetry Transport (MQTT) protocol for communication between the conveyor, the sensing module, the image acquisition module, and the control module.

25 Preferably, the system further comprising an image processing module for processing the captured images of the article.

Preferably, the system further comprising an alert module for providing either or both an audio or visual alert when an abnormality in the article is detected.

Preferably, the system further comprising a display for showing either or both a status of the conveyor and condition of the article.

- 5 In a second aspect of the invention, there is provided a method for inspecting an article comprising the steps of moving the article on a conveyor belt of a conveyor in a first direction; and capturing images of the article from various perspectives by one or more image acquisition devices of an image acquisition module; wherein the image acquisition module has its operation halted by a control module when a movement of
10 the conveyor belt in a second direction that opposes the first direction is detected by one or more movement sensors.

Preferably, the method further comprising the step of detecting presence of a personnel handling inspection of the article at a predetermined location by a personnel sensor.

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Preferably, the further comprising the step of halting operation of the conveyor by the conveyor controller upon detection of the personnel for allowing either or both loading and removal of the article from the conveyor belt.

- 20 Preferably, the method further comprising the step of detecting presence of the article on the conveyor belt by an article sensor being a proximity sensor after the article is loaded onto the conveyor belt.

- 25 Preferably, the method further comprising the step of capturing an image of one side surface of the article by the image acquisition module upon detection of the article after being loaded onto the conveyor belt.

Preferably, the method further comprising the step of driving movement of the conveyor belt in the first direction to move the article thereon along a conveyor path by the

conveyor controller upon detection of the article, by one or more article sensors being contact sensors, at downstream positions of the conveyor path with respect to the first direction.

- 5 Preferably, the method further comprising the step of capturing images of remaining side surfaces of the article by the image acquisition module as the article moves in the first direction.

One skilled in the art will readily appreciate that the invention is well adapted to carry
10 out the objects and obtain the ends and advantages mentioned, as well as those inherent therein. The embodiments described herein are not intended as limitations on the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

15 For the purpose of facilitating an understanding of the invention, there is illustrated in the accompanying drawing the preferred embodiments from an inspection of which when considered in connection with the following description, the invention, its construction and operation and many of its advantages would be readily understood and
20 appreciated.

Fig. 1 is a schematic diagram illustrating a system for inspecting an article.

Fig. 2 is a schematic diagram illustrating an arrangement of movement sensors
25 on a conveyor.

Fig. 3 is a schematic diagram illustrating a method for inspecting the article.

DETAILED DESCRIPTION OF THE INVENTION

The invention will now be described in greater detail, by way of example, with reference to the drawings.

- 5 Fig. 1 illustrates a schematic diagram of a preferred embodiment of a system (100) for inspecting an article (101) on a conveyor belt (110) of a conveyor. Preferably, the system (100) is employed in manufacturing industry for inspecting the article (101) on the conveyor belt (110), wherein the article (101) can be a raw material or an end product to ensure quality thereof. More preferably, the system (100) is employed in a
10 paper manufacturing industry for inspecting condition of the article (101) on the conveyor belt (110) prior to processing, wherein the article (101) is a pulp bale. The pulp bale is a raw material in the manufacturing of paper, which is packaged in the form of a cuboidal body. Preferably, the condition of the articles (101) can be but not limited to physical conditions and/or text, logo or pictures that may indicate brand of the article
15 (101). More preferably, the condition of the article (101) is the brand of the article (101). The brand is preferably printed on at least one side surface of the pulp bale. The system (100) generally comprising the conveyor, a sensing module, an image acquisition module, and a control module (140).
- 20 In the preferred embodiment of the invention, the conveyor belt (110) of the conveyor moves the article (101) thereon in a first direction or a second direction. The first direction is preferably a forward direction, whereas the second direction is preferably a reverse direction. The article (101) is moved in the first direction from a first area to a second area for processing, or moved in the second direction from the second area back
25 to the first area when an abnormality is detected. Preferably, the first area is a pulp bale loading and/or unloading area, whereas the second area is a pulp bale cutting area.

The sensing module comprises one or more movement sensors (120) for detecting movement direction of the conveyor belt (110). Preferably, the movement sensors (120)

are arranged parallel and side by side to one another at longitudinal sides of the conveyor belt (110), as illustrated in Fig. 2. Each of the movement sensors (120) comprises a light emitting unit and a receiving unit arranged directly opposite to one another at the longitudinal sides of the conveyor belt (110) such that a beam of light is emitted from the light emitting unit to the receiving unit across the conveyor belt (110) to detect movement direction of the conveyor belt (110). The movement sensor (120) is triggered when the beam of light is obstructed by the presence of the article (101) between the light emitting unit and the receiving unit. Referring back to Fig. 1, the first movement sensor (120) is positioned closer to the first area, whereas the second movement sensor (120) is positioned next to the first movement sensor (120) and closer to the second area. When in use, the movement sensors (120) detect movement direction of the conveyor belt (110) by detecting an order in which the movement sensors (120) are triggered. Particularly, the conveyor belt (110) is moving in the first direction if the article (101) thereon triggers the first movement sensor (120) before the second movement sensor (120). On the contrary, the conveyor belt (110) is moving in the second direction if the article (101) thereon triggers the first movement sensor (120) after the second movement sensor (120). Preferably, the movement sensor (120) is a photoelectric sensor. By way of example, the photoelectric sensor can be a through-beam sensor or a diffused light sensor.

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The sensing module further comprises any one or combination of a personnel sensor (121) and one or more article sensors (122). Preferably, the personnel sensor (121) detects presence of a personnel (102) handling inspection of the article (101) at a predetermined location, whereas the article sensors (122) detect presence of the article (101) handled by the personnel (102) and/or on the conveyor belt (110). The personnel sensor (121) can be in the form of a magnetic sensor disposed at the first area to detect the personnel (102) for loading and/or unloading of the article (101), whereby the personnel (102) can be a worker and/or an equipment operated by the worker such as a forklift to handle the loading and/or unloading work. The predetermined location is

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preferably the first area. On the other hand, the article sensor (122) includes any one or combination of a proximity sensor and the contact sensor. In the preferred embodiment of the invention, the proximity sensor detects the article (101) to be placed on the conveyor belt (110) that is handled by the personnel (102), whereby the article (101) is static. On the other hand, the contact sensor is arranged on a conveyor path to detect the article (101) when it is moved by the conveyor belt (110). By way of example, the proximity sensor can be a laser sensor or an ultrasonic sensor. The contact sensor that is arranged on the conveyor path can be in the form of a roller or a wheel to detect the presence of the article (101) on the conveyor belt (110) while facilitating movement of the articles (110) along the conveyor path. The conveyor path is defined by the length of the conveyor belt on which the article is placed and moved from the first area to the final area for the inspection process to be carried out.

The image acquisition module comprises at least one image acquisition device (130) for capturing images of various perspectives of the article (101). The various perspectives of the article (101) are preferably different side surfaces of the articles (101). More preferably, the various perspective of the article (101) is the four different side surfaces of the article (101) where the brand of the article (101) is printed on. In an exemplary embodiment of the invention, the image acquisition module may comprise the image acquisition device (130) mounted on the conveyor for capturing the image of the perspective of the article (101) when the condition of the perspective of the article (101) to be inspected is known and standardized, whereby the inspection of the remaining perspectives of the article (101) is unnecessary. Preferably, the image acquisition module comprises a plurality of the image acquisition devices (130), each positioned in proximity to the respective side surfaces of the article (101) to respectively capture the images thereof. More preferably, the image acquisition module comprises four image acquisition devices (130) for respectively capturing the images of the corresponding side surfaces of the article (101) on the conveyor belt (110). Advantageously, this allows a thorough inspection of the article (101). The image

acquisition devices (130) preferably captures the images of the corresponding side surfaces of the article (101) in a sequential manner when the article (101) is moved by the conveyor in the first direction. Preferably, each of the image acquisition devices (130) is fixedly mounted on the conveyor via a mounting pole. This provides a rigid support to the image acquisition devices (130) during operation of the system (100). Alternatively, each of the image acquisition devices (130) is mounted on the conveyor via a rail. This allows at least two degree of freedom in movement of the image acquisition devices (130) along the rail when capturing images of the corresponding side surfaces of the article (101).

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Preferably, the control module (140) is operably connected to the conveyor, the sensing module, and the image acquisition module to regulate the operation of the system (100). The control module (140) regulates the operation of the system (100) based on the signal received from the sensing module during operation. Preferably, a conveyor controller is provided for controlling operation of the conveyor. For example, upon detecting the presence of the personnel (102) handling the article (101) at the first area, the conveyor controller receives a signal from the personnel sensor (121). The conveyor controller then transmits an instruction to the conveyor such that the operation of the conveyor belt (110) is halted to allow loading and/or unloading of the articles (101).

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Subsequently, upon detecting the presence of the article (101) by the article sensors (122) at the first area, the control module (140) receives signal from the article sensor (122). The control module (140) then transmits the instruction to the image acquisition device (130) to capture the image of the side surface of the article (101) that faces outwardly with respect to the personnel (102). Upon detecting the presence of the article (101) by the article sensors (122) on the conveyor belt (110), the control module (140) receives signals from the article sensors (122). The conveyor controller then transmits the instruction to the conveyor to move the articles (101) on the conveyor belt (110) in the first direction along the path of the conveyor. At the same time, the control module (140) transmits the instruction to the image acquisition modules to capture the images

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of the remaining side surfaces of the article (101). The article sensors (122) on the conveyor belt (110) ensures that the conveyor belt (110) moves in the first direction upon detecting the presence of the article (101) as long as the personnel sensor (121) does not detect the presence of the personnel (102) and/or the conveyor belt (110) is not moving in the second direction. Alternatively, upon detecting the presence of the article (101) by the article sensors (122) at the first area and/or on the conveyor belt (110), the conveyor controller and the control module (140) receive signals from the article sensors (122). The conveyor controller then transmits the instructions to the conveyor to move the articles (101) on the conveyor belt (110) along the conveyor path in the first direction, whereas the control module (140) transmits the instruction to the image acquisition module of the image acquisition module to capture the images of various perspectives of the articles (101).

Furthermore, upon detecting the movement of the conveyor belt (110) in the second direction, the control module (140) receives a signal from the movement sensor (120). Subsequently, the control module (140) transmits an instruction to the image acquisition module such that the operation of the image acquisition device (130) is halted. Advantageously, this prevents the image acquisition device (130) to capture duplicate images of the article (101) during movement of the conveyor belt (110) in the second direction, which leads to repeated analyses that produce redundant and duplicate results.

In the preferred embodiment of the invention, the system (100) employs Message Queuing Telemetry Transport (MQTT) protocol as a communication protocol between the conveyor, the sensing module, the image acquisition module, and the control module (140). Advantageously, the MQTT protocol allows asynchronous communication between the devices to achieve a real-time data exchange between the devices. Additionally, messages published and subscribed via the MQTT for the communication between the conveyor, the sensing module, the image acquisition module, and the control module (140) are solely for input/output of the respective

devices and modules which will not be logged or stored in any of the devices and modules. Alternatively, other suitable communication protocols such as Modbus and Hypertext Transfer Protocol may be used.

- 5 Preferably, the system (100) further comprising an image processing module (150) for processing the captured images of the article (101) to identify the abnormality in the article (101). The image processing module (150) is in communication with the image acquisition module. Preferably, the image processing module (150) can be an industrial computer that is capable of processing the images. By way of example, the image
- 10 processing module (150) may adopt a neural network that processes the captured images of the article (101) using image processing algorithms, such as feature extraction algorithms and object detection algorithms. The system is preferably provided with a database for storing the captured images for future references.
- 15 In addition, the system (100) preferably comprises an alert module (160) that provides an audio alert and/or a visual alert when the abnormality is detected such that corrective measures can be taken by the personnel (120). The corrective measures are such as replacement of the abnormal article (101) with a desired article (101), resumption of the movement of the conveyor belt (110) in the first direction, and resetting of the
- 20 control module (140) to resume normal operation of the system (100). The desired article (101) is preferably the article (101) that is free of abnormality. Preferably, the abnormality can be a defect on the physical condition of the article (101) and/or incorrect brand of the article (101) loaded on the conveyor belt (110). The defect on the physical condition of the article (101) may include but not limited to dirty article (101),
- 25 stained article (101), and broken article (101). More preferably, the abnormality is the incorrect brand of the article (101) loaded onto the conveyor belt (110). In the event where the incorrect brand of the article (101) is detected, the alert module (160) provides the audio alert and/or the visual alert such that the personnel (102) can verify the outcome and replace the incorrect brand of the article (101) with the desired article

(101). In the paper manufacturing industry, incorrect brand of the pulp bale loaded may be processed together with the desired brand of the pulp bale, thereby affecting the quality and/or grade of the paper produced.

- 5 Preferably, the system (100) further comprises a display for showing a status of the conveyor and/or the condition of the article (101). The status of the conveyor includes operation status of the conveyor and the movement direction of the conveyor belt (110). Preferably, the condition of the article (101) is displayed after the processing of the images of the articles (101) in a real-time manner to allow real-time monitoring on the
10 condition of the article (101) on the conveyor belt (110).

- Fig. 3 illustrates a method (200) for inspecting the article (100). The method begins by loading the article (101) onto the conveyor belt (110) by the personnel (102) handling the article (101) such that the conveyor moves (201) the article (101) from the first area
15 to the second area in the first direction. The personnel (102) handling the article (101) can be the worker or the worker that is operating the forklift. Prior to the loading of the article (101), method comprises the step of detecting the presence of the personnel (102) handling the article (101) at the first area by the personnel sensor (121). Upon detecting the presence of the personnel (102) handling the article (101), the method (200)
20 comprises the step of halting the operation of the conveyor, by the control module (140), for allowing loading and/or unloading of the article (101).

- The method (200) then proceeds with the step of capturing (202) the image of the articles (101) from various perspective by one or more image acquisition device (130)
25 of the image acquisition module. Preferably, the presence of the article (101) is first detected by the article sensor (122) prior to loading of the article (101). Upon detecting the presence of the article (101) that is being handled by the personnel (102) in the first area, the image acquisition module receives the instruction from the control module (140) to capture (202a) the image of the side surface of the article (101) that faces

outwardly with respect to the personnel (102).

Then, the presence of the article (101) on the conveyor belt (110) is detected by the article sensors (122) that are arranged on the conveyor path after the loading of the article (101) and in absence of the personnel (102) in the first area. The method (200) further comprises the step of driving movement of the conveyor belt (110) in the first direction to move the article (101) thereon along the conveyor path by the control module (140) upon detection of the article (101) by the article sensors (122). The article sensors (122) are preferably arranged along the conveyor path and at downstream positions of the conveyor path with respect to the first direction. The article sensors (122) arranged on the conveyor path are preferably the contact sensors. The article sensor (122) that are arranged on the conveyor path can be in the form of the roller or the wheel to detect the presence of the article (101) on the conveyor belt (110) while facilitating movement of the articles (101) along the conveyor path.

Subsequently, the method (200) comprises the step of capturing (202b) the image of the remaining side surface of the article (101) by the image acquisition device (130) as the article (101) moves in the first direction along the conveyor path. Particularly, upon detecting the presence of the article (101) by the article sensors (122) on the conveyor belt (110), the conveyor controller transmits the instructions to the conveyor to move the article (101) on the conveyor belt (110) in the first direction along the conveyor path, whereas the control module (140) transmits the instruction to the image acquisition module to capture the images of the remaining side surfaces of the article (101), respectively.

In another embodiment of the invention, the step of detecting presence of the article (101) by the article sensor (122) is performed after the loading of the article (101) onto the conveyor belt (110). The image of one of the side surface of the article (101) is captured (202a) by the image acquisition device (130) upon detection of the article

(101) by the article sensor (122). The method (200) then proceeds to the step of driving movement of the conveyor belt (110) in the first direction to move the article (101) thereon along the conveyor path by the control module (140) upon detection of the article (101) by the article sensors (122). Subsequently, images of the remaining side
5 surfaces of the article (101) are captured (202b) by the image acquisition device (130) as the article (101) moves in the first direction.

The captured images are then processed (203) by the image processing module (150), whereby the neural network with the image processing algorithm is adopted to identify
10 (204) the abnormality in the article (101). The captured images are preferably stored in the database prior to image processing for future references.

Preferably, the visual alert and/or the audio alert is provided (205) by the alert module (160) when the abnormality in the article (101) is identified by the image processing
15 module (150). Then, identified abnormality in the article (101) is verified (206) by the personnel (102), which may be performed by means of visual inspection. In the event where the verification of the identified abnormality is positive, the movement direction of the conveyor belt (110) is switched (207) from the first direction to the second direction by the personnel (102) via the control module (140). As a result, position of
20 the abnormal article (101) on the conveyor belt (110) is returned to allow replacement. In addition, the operation of the image acquisition device (130) is halted by the control module (140) when the movement of the conveyor belt (110) in the second direction that opposes the first direction is detected by the movement sensors (120). Advantageously, this prevents the image acquisition device (130) from capturing
25 duplicate images of the article (101) during the movement of the conveyor belt (110) in the second direction, which leads to repeated analyses that produce redundant and duplicate results. Then, the movement direction of the conveyor belt is resumed (208) to the first direction after the replacement of the abnormal article (101) with the desired article (101). On the contrary, outcome of the image processing module (150) is

overridden (209) by the personnel (102) in the event where the verification of the identified abnormality is negative. When there is no abnormality identified in the article (101) the alert module (160) remains inactive and the conveyor continues to operate by moving (210) the article (101) in the first direction.

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Furthermore, when the movement sensor (120) detects (211) a change in the movement of the conveyor belt (110) from the first direction to the second direction, the personnel (102) is alerted by the alert module (160) such that a visual verification can be performed by the personnel (102) to verify (212) whether the movement of the conveyor belt (110) in the second direction is intentional. In the event when the movement of the conveyor belt (110) in the second direction is intentional, the personnel (102) proceeds to replace (213) the abnormal article (101) with the desired article (101). Then, the movement direction of the conveyor belt (110) is resumed (214) to the first direction after the replacement. On the contrary, in the event when the movement of the conveyor belt (110) in the second direction is unintentional, the personnel (102) proceeds to resume (215) the movement direction of the conveyor belt (110) to the first direction upon verification. The desired article (101) is moved by the conveyor on the conveyor belt (110) in the first direction towards the second area for subsequent processing (216).

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The present disclosure includes as contained in the appended claims, as well as that of the foregoing description. Although this invention has been described in its preferred form with a degree of particularity, it is understood that the present disclosure of the preferred form has been made only by way of example and that numerous changes in the details of construction and the combination and arrangements of parts may be resorted to without departing from the scope of the invention.

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CLAIMS

1. A system (100) for inspecting an article (101), comprising
a conveyor having a conveyor belt (110) for moving the article (101) thereon in a first
5 direction;
a sensing module comprising one or more movement sensors (120) for detecting
movement direction of the conveyor belt (110);
an image acquisition module comprising at least one image acquisition device (130) for
capturing image of various perspectives of the article (101) moving in the first
10 direction upon detecting a presence of the article (101); and
a control module (140) for regulating operation of the system (100);
wherein the control module (140) is configured to halt the operation of the image
acquisition module when the movement sensors (120) detect a movement of the
conveyor belt (110) in a second direction that opposes the first direction, preventing
15 the image acquisition device (130) from capturing duplicate images of the article
(101) during movement of the conveyor belt (110) in the second direction.
2. The system (100) according to claim 1, wherein the sensing module further comprises
any one or combination of a personnel sensor (121) for detecting presence of a
20 personnel (102) handling inspection of the article (101) at a predetermined location,
and one or more article sensors (122) for detecting presence of the article (101) on
the conveyor belt (110).
3. The system (100) according to claim 2, wherein the article sensors (122) include any
25 one or combination of a proximity sensor and a contact sensor.
4. The system (100) according to any one of the preceding claims, wherein the
movement sensors (120) are a pair of photoelectric sensors located opposite to each
other across the conveyor belt (110).

5. The system (100) according to any one of the preceding claims, wherein the image acquisition module comprises four image acquisition devices (130), each for
5 respectively capturing the images of the corresponding perspective of the articles (101) on the conveyor belt (110) in a sequential manner when the article (101) is moved by the conveyor in the first direction.
6. The system (100) according to any one of the preceding claims, wherein the system
10 is implemented with a Message Queuing Telemetry Transport protocol for communication between the conveyor, the sensing module, the image acquisition module, and the control module (140).
7. The system (100) according to any one of the preceding claims, further comprising
15 an image processing module (150) for processing the captured images of the article (101).
8. The system (100) according to any one of the preceding claims, further comprising
20 an alert module (160) for providing either or both an audio or visual alert when an abnormality in the article (101) is detected.
9. The system (100) according to any one of the preceding claims, further comprising
25 a display for showing either or both a status of the conveyor and condition of the article (101).
10. A method (200) for inspecting an article (101) comprising the steps of
moving (201) the article (101) on a conveyor belt (110) of a conveyor in a first direction;
and
capturing (202) images of the article (101) from various perspectives while the article

- (101) is moving in the first direction upon detecting a presence of the article (101),
by one or more image acquisition devices (130) of an image acquisition module;
wherein the image acquisition module has its operation halted by a control module
(140) when a movement of the conveyor belt (110) in a second direction that
5 opposes the first direction is detected by one or more movement sensors (120),
preventing the image acquisition device (130) from capturing duplicate images of
the article (101) during movement of the conveyor belt (110) in the second
direction.
- 10 11. The method (200) according to claim 10, further comprising the step of detecting
presence of a personnel (102) handling inspection of the article (101) at a
predetermined location by a personnel sensor (121).
12. The method (200) according to claim 11, further comprising the step of halting
15 operation of the conveyor by a conveyor controller upon detection of the personnel
(102) for allowing either or both loading and removal of the article (101) from the
conveyor belt (110).
13. The method (200) according to claim 12, further comprising the step of detecting
20 presence of the article (101) on the conveyor belt (110) by an article sensor (122)
being a proximity sensor after the article (101) is loaded onto the conveyor belt
(110).
14. The method (200) according to claim 13, further comprising the step of capturing
25 (202a) an image of one side surface of the article (101) by the image acquisition
module upon detection of the article (101) after being loaded onto the conveyor belt
(110).
15. The method (200) according to claim 14, further comprising the step of driving

movement of the conveyor belt (110) in the first direction to move the article (101) thereon along a conveyor path by the conveyor controller upon detection of the article (101), by one or more article sensors (122) being contact sensors, at downstream positions of the conveyor path with respect to the first direction.

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16. The method (200) according to claim 15, further comprising the step of capturing (202b) images of remaining side surfaces of the article (101) by the image acquisition module as the article (101) moves in the first direction.