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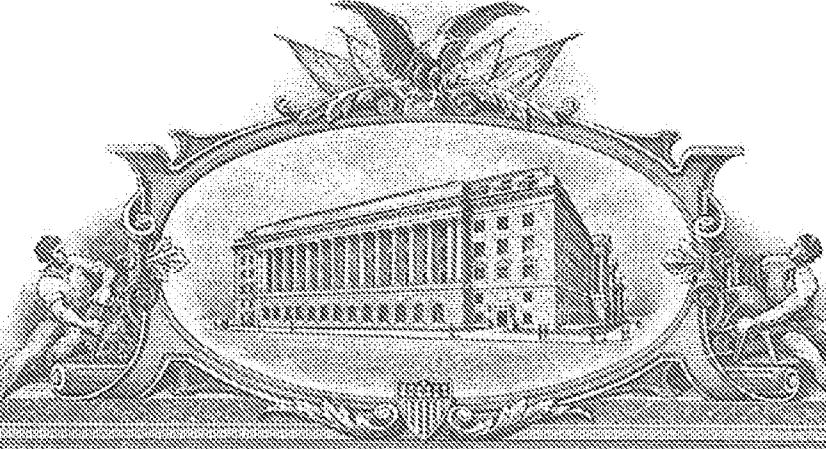
Application number: 63486862

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# THE UNITED STATES OF AMERICA

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UNITED STATES DEPARTMENT OF COMMERCE

United States Patent and Trademark Office

*April 01, 2024*

THIS IS TO CERTIFY THAT ANNEXED HERETO IS A TRUE COPY FROM  
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APPLICATION THAT MET THE REQUIREMENTS TO BE GRANTED A  
FILING DATE UNDER 35 USC 111.

APPLICATION NUMBER: 63/486,862  
FILING DATE: *February 24, 2023*

THE COUNTRY CODE AND NUMBER OF YOUR PRIORITY  
APPLICATION, TO BE USED FOR FILING ABROAD UNDER THE PARIS  
CONVENTION, IS **US63/486,862**



Certified by



Under Secretary of Commerce  
for Intellectual Property  
and Director of the United States  
Patent and Trademark Office

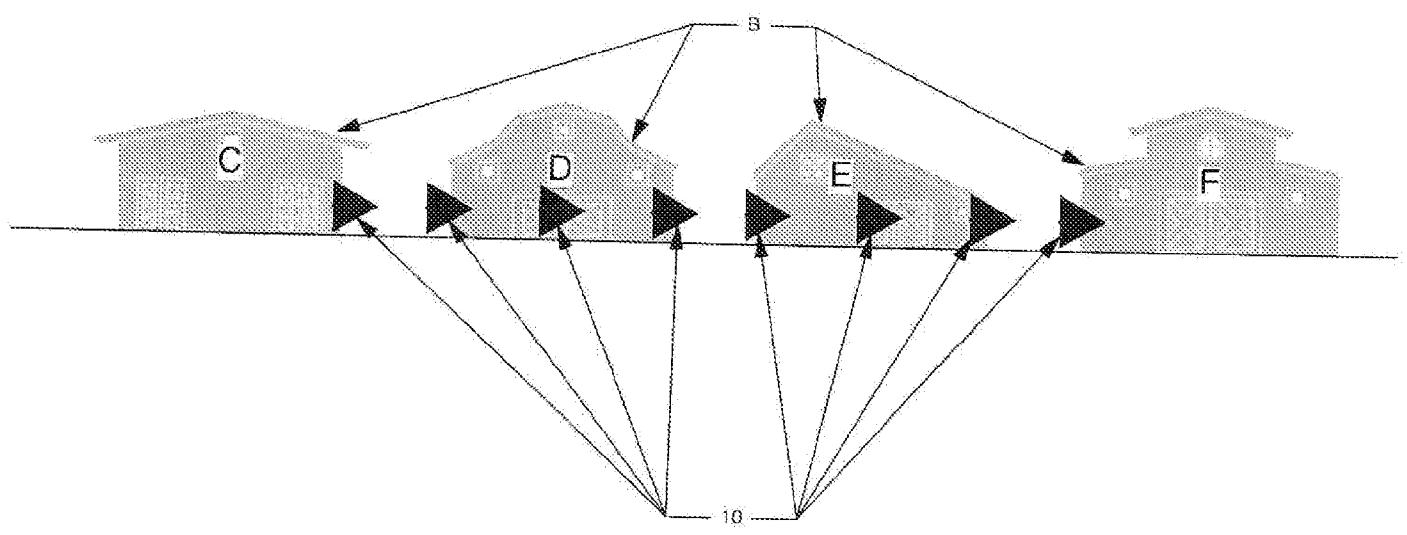


FIGURE 1

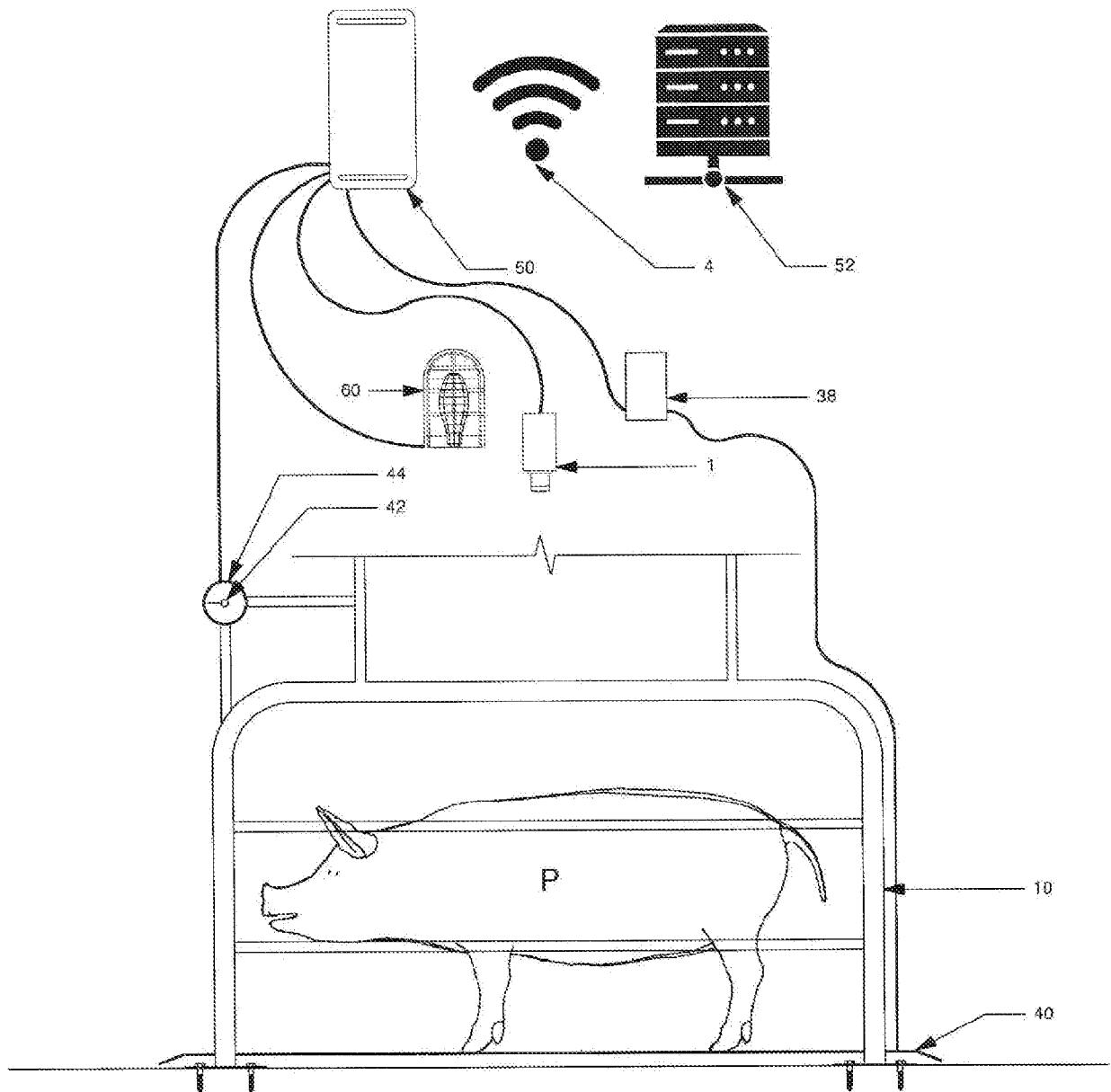


FIGURE 2

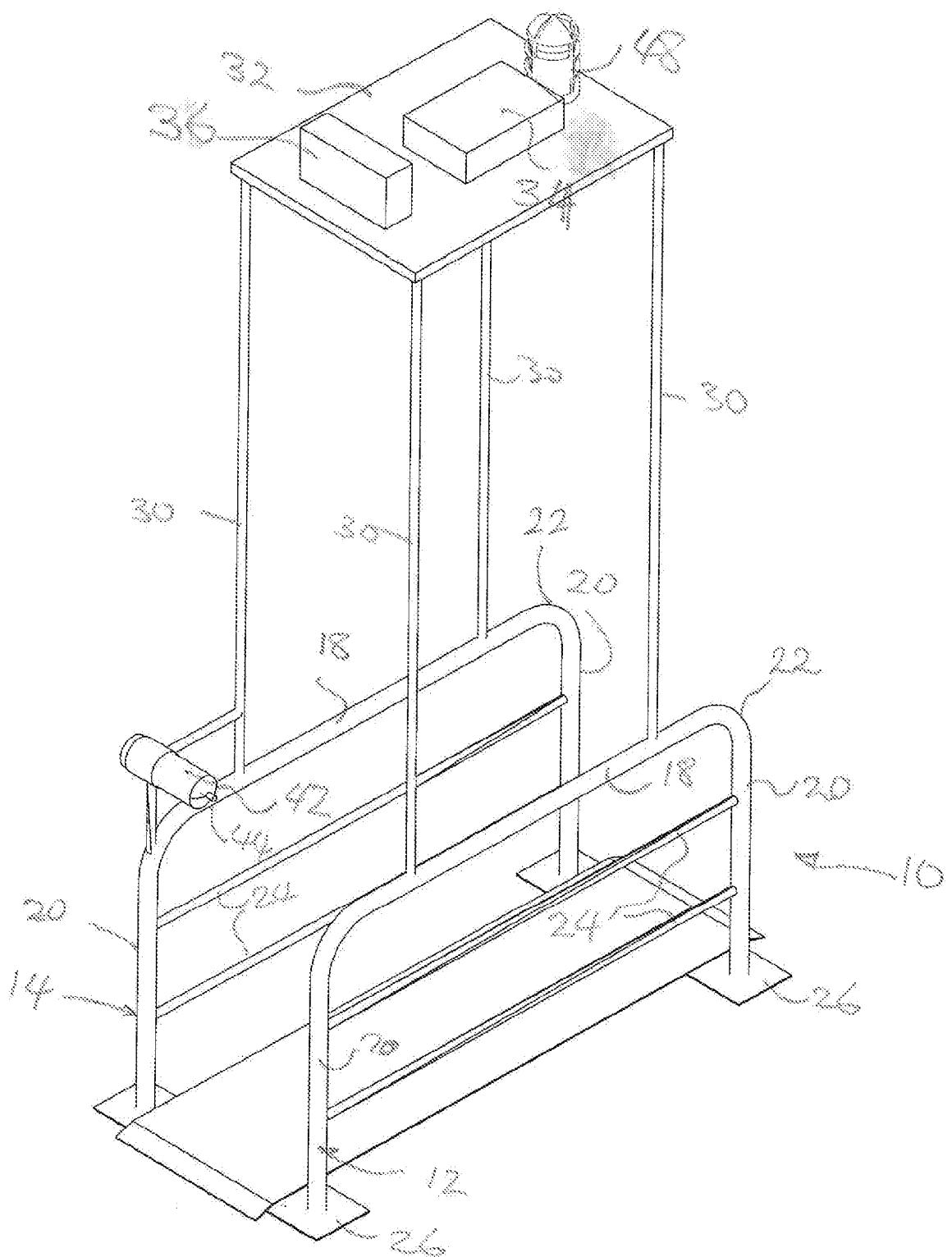


FIGURE 3

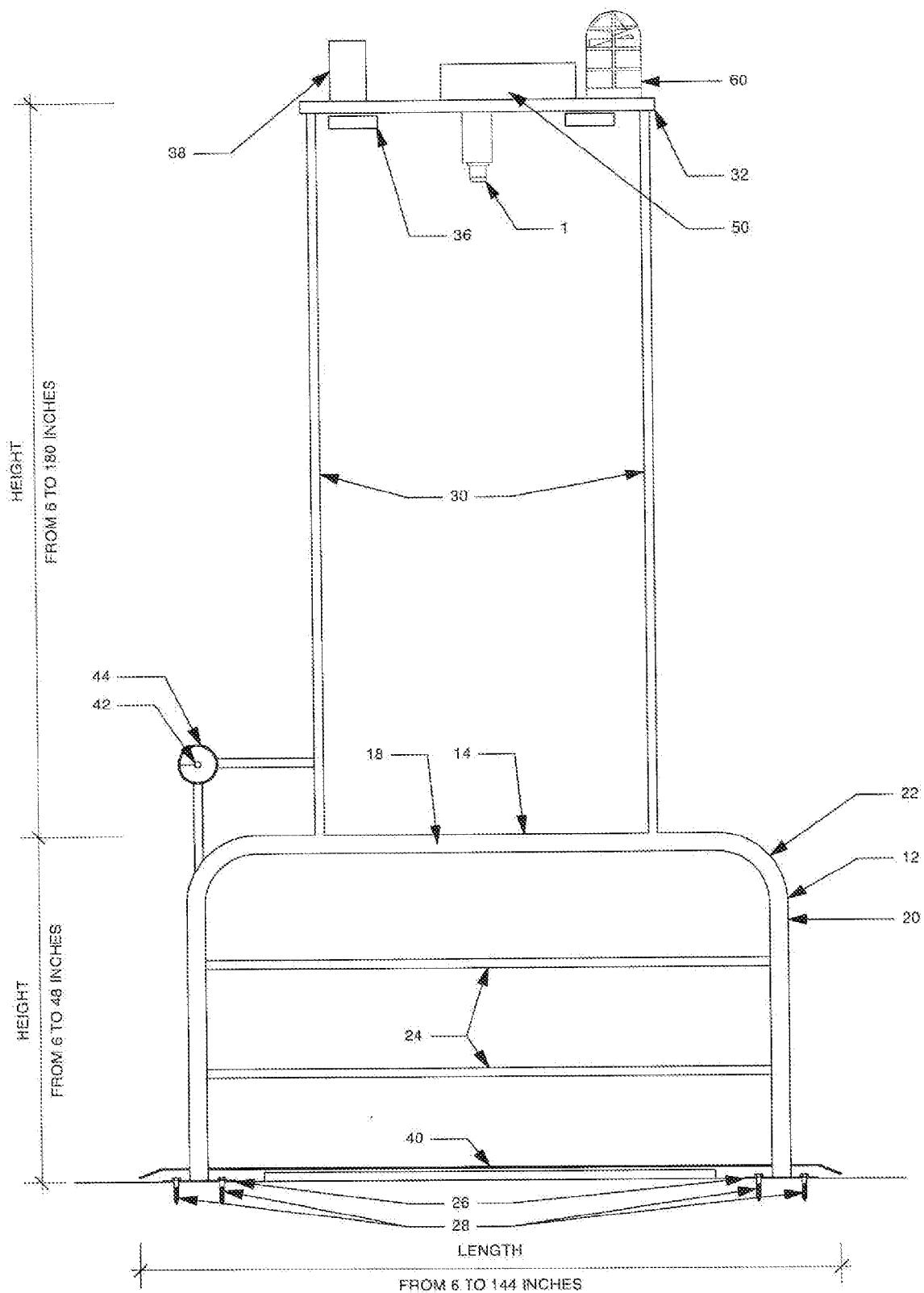


FIGURE 4

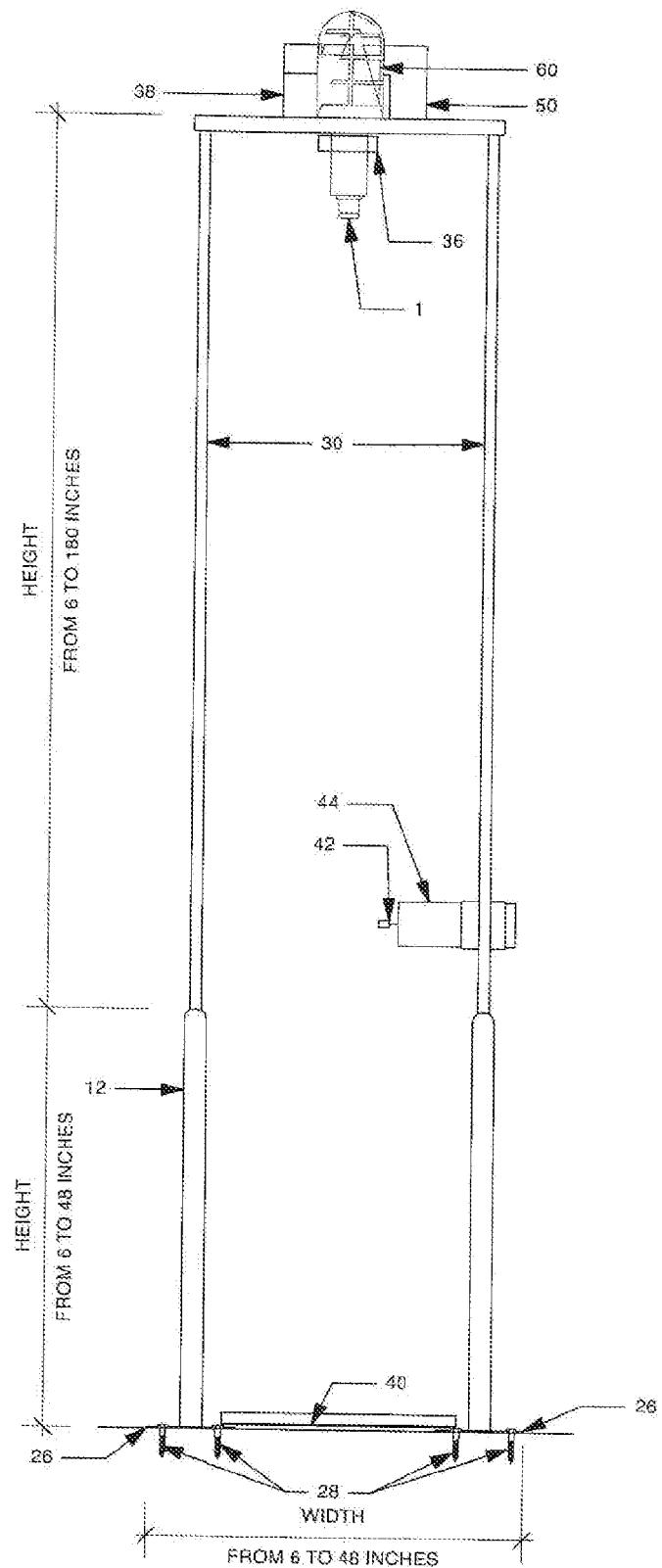


FIGURE 5



## ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #  
**63/486,862**RECEIPT DATE / TIME  
**02/24/2023 04:49:47 PM ET**ATTORNEY DOCKET #  
**730-002USPR**

### Title of Invention

LIVESTOCK ASSESSMENT STATION WITH COMPUTER VISION

### Application Information

APPLICATION TYPE	Utility - Provisional Application under 35 USC 111(b)	PATENT #	-
CONFIRMATION #	3980	FILED BY	Renee Joseph
PATENT CENTER #	61649551	FILING DATE	-
CUSTOMER #	109398	FIRST NAMED INVENTOR	Charles GRANT
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Marc Lampert

### Documents

**TOTAL DOCUMENTS: 4**

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
730-002USPR ADS.pdf	8	Application Data Sheet	2174 KB
730-002USPR patent application as filed.pdf	8	Specification	227 KB
730-002USPR patent figures as filed.pdf	5	Drawings-only black and white line drawings	672 KB
730-002USPR micro entity form.pdf	2	Certification of Micro Entity (Gross Income Basis)	178 KB

### Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
730-002USPR ADS.pdf	19A08C48950335735347D856FE77B49A3FD18FBB6E0B165B09 4EA456808CF45E96D54235964986C78A68505F8C4A98897E0F F56E1EA78D6092CDF702F9FA9693
730-002USPR patent application as filed.pdf	2C300A8EB3BB86EAF55DC926B958CC76E64119B7C7BE9E4D D732CE5D0A87B5054E927BBBBBD242FD84A47EBA8B41E018 C1FBC44F2F83B5FD44DBA869C09E9AD8
730-002USPR patent figures as filed.pdf	7E02AFDF16DE2B2F42D2B6F23D1A7AE437A7D80CC87F6E4A 49114CB3803B05B5808898ACC87DC33BE6F206207DF8A4BE2 911E29B28ACC6661E2C06D29C1DBCC1
730-002USPR micro entity form.pdf	888E284825F0B762B52FC9DC676DA5FAD688949C42A3BE327 3F3339E03A6E2A3B2694E62429DFE263E9495F3749A8A150C2 007DE3E6F8AB679826DB7E5566393

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#### New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

#### National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

#### New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

<b>Application Data Sheet 37 CFR 1.76</b>		Attorney Docket Number	730-002USPR
		Application Number	
Title of Invention	LIVESTOCK ASSESSMENT STATION WITH COMPUTER VISION		
<p>The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.</p> <p>This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.</p>			

## Secrecy Order 37 CFR 5.2:

<input type="checkbox"/> Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)
--

### Inventor Information:

Inventor	1	<input type="button" value="Remove"/>																		
Legal Name																				
Prefix	Given Name	Middle Name	Family Name	Suffix																
<input type="button" value="▼"/>	Charles	William Alan	GRANT	<input type="button" value="▼"/>																
Residence Information (Select One)		US Residency	<input checked="" type="radio"/> Non US Residency	Active US Military Service																
City	Falcon Lake	Country of Residence	i	CA																
<p><b>Mailing Address of Inventor:</b></p> <table border="1"> <tr> <td>Address 1</td> <td>Block 12, Lot 46</td> </tr> <tr> <td>Address 2</td> <td></td> </tr> <tr> <td>City</td> <td>Falcon Lake</td> <td>State/Province</td> <td>MB</td> </tr> <tr> <td>Postal Code</td> <td>ROE 0NO</td> <td>Country</td> <td>i CA</td> </tr> <tr> <td colspan="4">All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the Add button.</td> </tr> </table>					Address 1	Block 12, Lot 46	Address 2		City	Falcon Lake	State/Province	MB	Postal Code	ROE 0NO	Country	i CA	All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the Add button.			
Address 1	Block 12, Lot 46																			
Address 2																				
City	Falcon Lake	State/Province	MB																	
Postal Code	ROE 0NO	Country	i CA																	
All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the Add button.																				
				<input type="button" value="Add"/>																

### Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below. For further information see 37 CFR 1.33(a).			
<input type="checkbox"/> An Address is being provided for the correspondence information of this application.			
Customer Number	109398		
Email Address	office@bholeiplaw.com	<input type="button" value="Add Email"/>	<input type="button" value="Remove Email"/>

### Application Information:

Title of the Invention	LIVESTOCK ASSESSMENT STATION WITH COMPUTER VISION		
Attorney Docket Number	730-002USPR	Small Entity Status Claimed	<input checked="" type="checkbox"/>
Application Type	Provisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	5	Suggested Figure for Publication (if any)	

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

<b>Application Data Sheet 37 CFR 1.76</b>		Attorney Docket Number	730-002USPR
		Application Number	
Title of Invention	LIVESTOCK ASSESSMENT STATION WITH COMPUTER VISION		

### Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

### Publication Information:

Request Early Publication (Fee required at time of Request 37 CFR 1.219)

**Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

### Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).

Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	<input checked="" type="radio"/> Customer Number	US Patent Practitioner	<input type="radio"/> Limited Recognition (37 CFR 11.9)
Customer Number	109398		

### Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.

When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	<input type="button" value="▼"/>	<input type="button" value="Remove"/>	
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	<input type="button" value="▼"/>		

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the Add button.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

<b>Application Data Sheet 37 CFR 1.76</b>		Attorney Docket Number	730-002USPR
Application Number			
Title of Invention	LIVESTOCK ASSESSMENT STATION WITH COMPUTER VISION		

## Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)<sup>i</sup> the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Application Number	Country <sup>i</sup>	Filing Date (YYYY-MM-DD)	Access Code <sup>i</sup> (if applicable)	Remove

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button.

## Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.

NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

<b>Application Data Sheet 37 CFR 1.76</b>		Attorney Docket Number	730-002USPR
		Application Number	
Title of Invention	LIVESTOCK ASSESSMENT STATION WITH COMPUTER VISION		

## Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

**NOTE:** This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

### 1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

**A. Priority Document Exchange (PDX)** - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

**B. Search Results from U.S. Application to EPO** - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

### 2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

**A. Applicant DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

**B. Applicant DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

**NOTE:** Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

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<b>Application Data Sheet 37 CFR 1.76</b>		Attorney Docket Number	730-002USPR
		Application Number	
Title of Invention	LIVESTOCK ASSESSMENT STATION WITH COMPUTER VISION		

## Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

<b>Applicant</b>	1	<input type="button" value="Remove"/>
<p>If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.</p>		
<input type="button" value="Clear"/>		
Assignee	Legal Representative under 35 U.S.C. 117	Joint Inventor
Person to whom the inventor is obligated to assign.	Person who shows sufficient proprietary interest	
If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:		

Name of the Deceased or Legally Incapacitated Inventor:			
If the Applicant is an Organization check here. <input checked="" type="checkbox"/>			
Organization Name	10157073 MANITOBA INC.		
<b>Mailing Address Information For Applicant:</b>			
Address 1	10 Donald Street		
Address 2			
City	Winnipeg	State/Province	MB
Country	CA	Postal Code	R3C 1L5
Phone Number		Fax Number	
Email Address			
Additional Applicant Data may be generated within this form by selecting the Add button.			<input type="button" value="Add"/>

## Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

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<b>Application Data Sheet 37 CFR 1.76</b>		Attorney Docket Number	730-002USPR
		Application Number	
Title of Invention	LIVESTOCK ASSESSMENT STATION WITH COMPUTER VISION		

<b>Assignee</b>	1
Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.	
<input type="button" value="Remove"/>	

If the Assignee or Non-Applicant Assignee is an Organization check here. <input type="checkbox"/>				
Prefix	Given Name	Middle Name	Family Name	Suffix
<input type="button" value="▼"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="button" value="▼"/>

<b>Mailing Address Information For Assignee including Non-Applicant Assignee:</b>				
Address 1	<input type="text"/>			
Address 2	<input type="text"/>			
City	<input type="text"/>	State/Province	<input type="text"/>	
Country	<input type="text"/>	Postal Code	<input type="text"/>	
Phone Number	<input type="text"/>	Fax Number	<input type="text"/>	
Email Address	<input type="text"/>			
Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button. <input type="button" value="Add"/>				
<input type="text"/>				

<b>Signature:</b> <input type="button" value="Remove"/>				
<p><b>NOTE:</b> This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). However, if this Application Data Sheet is submitted with the <u>INITIAL</u> filing of the application and either box A or B is <u>not</u> checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).</p> <p>This Application Data Sheet must be signed by a patent practitioner if one or more of the applicants is a juristic entity (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, all joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of all joint inventor-applicants.</p> <p>See 37 CFR 1.4(d) for the manner of making signatures and certifications.</p>				
Signature	<input type="text"/> /MARC LAMPERT/			Date (YYYY-MM-DD) <input type="text"/> 2023-02-24
First Name	<input type="text"/> Marc	Last Name	<input type="text"/> Lampert	Registration Number <input type="text"/> 76572
Additional Signature may be generated within this form by selecting the Add button. <input type="button" value="Add"/>				

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

<b>Application Data Sheet 37 CFR 1.76</b>		Attorney Docket Number	730-002USPR
		Application Number	
Title of Invention	LIVESTOCK ASSESSMENT STATION WITH COMPUTER VISION		

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

## **Privacy Act Statement**

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

# Livestock Assessment Station with Computer Vision

## Abstract

A mobile swine assessment station for automatically identifying and assessing a monogastric animal, in particular a pig, is described. The assessment station utilises computer vision to capture characteristics that enable identification of the pig from a computer image. The computer images enable an assessment including checking for overall animal health and well-being, rate of growth, market-readiness, estimated time of arrival at the processing plant, carcass quality, and environmental footprint. Bounding boxes are drawn around the pigs passing through the station and still images of the pigs are extracted from videos taken. The assessment station includes a walk-through support structure to orient the animals in a consistent position and a camera that is triggered when pigs are in that consistent position. During the model training period, the images captured with the camera are aligned with weight readings from a load-sensor floor scale located on the walk-through path and the images are transferred to a server where they are stored and labelled with time, date, floor scale weight, and any other pertinent data observation. At the server, computer vision methods use pattern recognition algorithms to train the computer on large numbers of the labelled image data. The developed algorithms are transferred to the local computer that processes the input images in real time and finds patterns in those images to identify the pigs and execute the listed assessment tasks, without a need for a load-sensor floor scale. If the assessment indicates the pigs meet a predetermined condition, the computer activates a livestock spray head at the support to mark the pigs with the livestock spray to indicate that they meet that certain specified criterium.

## **Field of the Invention**

**0001.** The invention relates to a method and apparatus for assisting in the management of livestock.

## **Background of the Invention**

**0002.** The provision of livestock from the producer to the food processing industry is a highly integrated and carefully managed process. To be profitable, the producer must produce animals in good condition in a reliable time frame while having regard for best practices of animal welfare. This requires careful management of the livestock and awareness of their condition and growth.

**0003.** Typically, this has been done by experienced herdsmen who monitor the livestock, adjust the feed rations, identify those that may have health conditions and determine when the animal is ready for market. However, the use of skilled people in this role is expensive, and people with this skill set are increasingly rare, and the results depend on the ability of the herdsmen to assess the condition of the animal amongst a herd of similar animals.

**0004.** Attempts have been made to apply technology to this situation to address some of the difficulties that arise and produce a more consistent supply of animals.

**0005.** The first problem relates to the identification of individual animals, such as grower pigs so they can be tracked throughout their lifetimes in the barn and on into the pork processing facility. [1, Thölke, H.; Wolf, P. Economic Advantages of Individual Animal Identification in Fattening Pigs. *Agriculture* 2022, *12*, 126., 2, Zhang L, Gray H, Ye X, Collins L, Allinson N. Automatic Individual Pig Detection and Tracking in Pig Farms. *Sensors* (Basel). 2019 Mar 8;19(5):1188] Tracking of individual animals has become increasingly important to consumers who demand to know more about the food they consume. If there is a disease outbreak in the human population caused by foodborne pathogens in pork products, individual identification of grower pigs and the cumulation of data throughout the pig's lifetime, makes it possible to trace the cause of the outbreak back to the individual animal, should the cause be there. Identification of animals allows the tracking of treatments for individual animals providing evidence for regulators and consumers that demonstrates that proper disease treatment and control processes have been followed. Tracking of individual animals also allows measures of productivity and efficiency like growth rate and feed conversion to be assessed at the level of the individual animal rather than the group, so genetic lines can be better tracked for breeders and feed can be better adjusted according to individual rather than group specifications.

**0006.** Also, if the feeder pigs can be tracked across the divide between the barn they come from and the processing plant where they are to be slaughtered then individual animals can be linked to their carcasses thereby allowing data to guide breeding and feeding of animals for optimal carcass qualities. Currently, producers receive kill sheets with their payments for shipment of market pigs, but they cannot link the kill sheet information back to individual pigs shipped so discrepancies in grading or payment cannot be known or challenged, and information for the producers to make adjustments to breeding and feeding regimes is limited. This changes when individual animals are identified in the barn and

later matched up with carcasses in the processing plant and reported on kill sheets provided to the producers.

**0007.** Tracking of feeder pigs can currently be accomplished with electronic ear tags or injected transponders and UHF RFID readers; however, this method of identification is problematic in that it is labor-intensive in terms of installation of the ear tags or transponders at birth, can be unreliable when ear tags come dislodged and are lost, and costly in terms of the cost of the ear tags and transponders themselves and the required UHF RFID reader(s). Electronic ear tags and transponders are also a concern at the processing plants where they must assure that no such foreign material gets lodged in the meat, which can be problematic. For these reasons, grower-finisher pigs typically only get electronic ear tags or injected transponders in breeding and research barns, and not in commercial barns. [3, Zhang L, Gray H, Ye X, Collins L, Allinson N. Automatic Individual Pig Detection and Tracking in Pig Farms. Sensors (Basel)]

**0008.** The second problem relates to assessing the general health and well-being of individual feeder pigs. Early detection and treatment of respiratory problems is important for animal health and well-being. Respiratory ailments can be detected through coughing, rapid breathing, eye and ear-based temperature and heart rate all can be observed by a skilled technician, but by the time these ailments are detectable, the condition may be severe.

**0009.** Computer vision has been proposed to allow early intervention and treatment regimes to be triggered and implemented as early as possible for maximum effectiveness. [4, Jorquera-Chavez M, Fuentes S, Dunshea FR, Warner RD, Poblete T, Morrison RS, Jongman EC. Remotely Sensed Imagery for Early Detection of Respiratory Disease in Pigs: A Pilot Study. Animals (Basel). 2020 Mar 9;10(3):451] Animal lameness can also be ascertained by computer vision, [5, Kang, X, Zhang, X, Liu, G. Accurate detection of lameness in dairy cattle with computer vision: A new and individualized detection strategy based on the analysis of the supporting phase, Journal of Dairy Science, Volume 103, Issue 11, 2020, Pages 10628-10638] again allowing for early diagnosis and treatment, where possible.

**0010.** The third problem is the assessment of rate of growth of livestock such as grower pigs. Lean growth rate is the major factor for determining the daily requirements for amino acids for the growing pigs, and therefore is a major determining factor for the mix of diet to be fed to those pigs. Assessing rate of growth for growing pigs allows diet specifications to be timely and accurate.

**0011.** To determine rate of growth feeder pigs, they need to be weighed regularly to determine their change in weight. The weighing of feeder pigs with traditional load-sensor scales is stressful for pigs which can slow their growth. The stress caused by load-sensor weighing is also an animal welfare concern and therefore should be minimized. Accuracy of weighing can also be an issue since load-sensor scales require frequent calibration and can be affected by pig manure and general pig activity around them. Also, when pigs become stressed due to confinement on a scale, they tend to flail about making accurate readings of load-sensor scales difficult.

**0012.** The fourth problem relates to the assessment of market readiness for animals set for delivery to pork processing facilities. Payment grids provided by pork processors define the desired weight range for market-ready grower pigs. These grids list premiums for delivering pigs in the desired weight range and discounts for missing that range, either above or below, with the delivered pigs. Typically, feeder pigs are not weighed on a load-sensor scale prior to shipping to a processing plant because scaling in this way is labor-intensive and the pigs can be stressed by the process of weighing which can lead to diminished quality of the meat. [6, Stajković, S, Teodorović, V, Baltić, M, Karabasil, N. Pre-slaughter stress and pork quality. 2017 IOP Conf. Ser.: Earth Environ. Sci. 85 012034] Rather, trained technicians walk through the groups of pigs slated for delivery and mark with livestock spray those selected for loading because they appear to be of the desired weight. This process can be highly inaccurate and can lead to kill sheets with substantial discounted valuations because many of the animals do not fall into the target weight range. [7, Abner, V.A. (2021) Accurate and Rapid Weight Assessment of Finishing Pigs, A thesis submitted to the Graduate Faculty of North Carolina State University in partial fulfillment of the requirements for the degree of Master of Science Animal Science Raleigh, North Carolina 2021]

**0013.** The fifth problem relates to discrepancies between the pork producers and pork processors in their assessments of market readiness of feeder pigs. Market readiness assessment (mainly pig weight) can differ between the producing barn and the processing plant and the lack of tracking of the identities of the feeder pigs across the divide, prevents these discrepancies in weight, or grading, or payment from being clearly identified and settled.

**0014.** The sixth problem relates to determining the estimated time of arrival for the pig at the processing plant. Pork processing plants schedule their workforce and processing facilities for planned daily throughput. That planning and scheduling relies on estimated times of arrival for pigs from producers who have pigs contracted with them. Problems arise when estimated times of arrival vary from those expected and inefficiencies in processing result due to errors in allocation of workers and facilities.

**0015.** The seventh problem relates to carcass quality. Producers raise and deliver live pigs and processing plants convert them into hog carcasses. It is carcasses that the processors are procuring, and the pig valuations allocated to the producers reflect the quality of those carcasses. The problem is that many of the carcasses procured by processors do not meet the specifications needed for optimal valuations, so the valuations are discounted in settlements to the producer.

**0016.** The eighth problem relates to environmental footprint of swine operations. Feed produced and fed to grower pigs is swine's largest contributor to greenhouse gas emissions, energy usage, water usage, and land occupation. [8, Heller, M. Food Product Environmental Footprint: Pork. 2017. A Report by: Sustainable Systems, University of Michigan, (Oct 10, 2022)] Any increase in feed efficiency reduces that environmental footprint.

**0017.** It is therefore an object of the present invention to obviate or mitigate the above disadvantages by providing a method and apparatus in which identification and assessment

of the animal may be conducted in a minimally invasive manner and the results integrated into the supply chain.

## **Summary of the Invention**

**0018.** According to the first aspect of the invention there is provided an assessment station for assessment of livestock comprising a pair of laterally spaced barriers to define an open ended walk-through passage, a floor between the barriers with fiduciary on the floor to provide a datum, a vision system mounted above the barriers directed to the floor and including a camera to obtain a sequence of images of an animal passing along said passage, and a computer vision system to analyse said images and determine the identity and condition of said animal.

## **Description of Preferred embodiment**

**0019.** An embodiment of the invention will now be described by way of example only with reference to the accompanying drawings in which:

**0020.** Fig. 1 is a schematic view of a complex made up of a series of barns and a processing plant;

**0021.** Fig. 2 is a schematic representation of a system for identifying and assessing livestock;

**0022.** Fig. 3 is a perspective view of the assessment station of Fig. 2;

**0023.** Fig. 4 is a side view of the assessment station of Fig. 2; and

**0024.** Fig. 5 is an end view of the assessment station of Fig. 2.

**0025.** Referring first to Figs. 1 and 2, livestock, which is shown as a grower pig P but could be other livestock such as beef calves or feeders, or lambs, are raised in a series of barns and delivered to a slaughter plant that forms a complex B. As the animals mature, they are moved between different parts of the complex often located on different physical sites, in the case of pigs from the sow barn C where the piglets will weigh 6-9kg. through the nursery D where they weigh up to 22kg, to the feeder barn E where they may reach weights of 100+kg and to the slaughter plant F where they are converted into a carcass. In each area up until slaughter the pigs are contained in pens and are supplied with food from sows (piglets) or feed and drinking stations (nursery and grower pigs).

**0026.** An assessment station 10 is in each area of the complex on a path that the pigs travel. Each time the pigs leave one part of the complex and enter another they pass through a station on each side. In this way individual pig movements are tracked, and the pigs can be assigned values for settlement if the animal ownership changes hands between parts of the complex. While residing in complex parts D and E, the pigs are also walked through an internal station on numerous occasions, with frequency determined by the information needs of the management, to track rate of growth, health status, expected times of arrival, carcass quality, market readiness, and environmental footprint. In the parts of complex D and E, for example, the assessment station may be positioned in a partition sub-dividing a particular area of the barn or in a doorway through which the livestock must pass to for example, get to a feeding station, or the assessment station may be positioned in an

alleyway through which the pigs are routinely walked through, or the assessment station may be positioned in an exit doorway where the pigs are walked through to be loaded on a truck for transport to the next part of the complex. The assessment station 10 need not be permanently located at a particular location and can be moved between different locations within the barn complex as needed.

**0027.** The assessment station 10 is shown in more detail in Figs. 3, 4 and 5 and includes a pair of shoulder bars 12, 14, that are laterally spaced and attached to the floor. Each of the shoulder bars 12, 14 has a pair of posts 20 connected by a horizontal rail 18. The posts and rails are formed from tubing to provide a smooth exterior surface and the transition of the rail 20 to post is provided by a smoothly curving elbow 22 to avoid sharp edges.

**0028.** A pair of horizontal bars 24 extend between the posts 18 and are spaced apart vertically to inhibit the passage of the livestock between the posts.

**0029.** The lower end of the posts 20 have flanges 26 with holes to receive bolts 28 and secure the shoulder bars 12, 14 to the floor of the barn. The bolts 28 may be secured into the floor substrate or to the gap between slats as are commonly found in barn structures to hold the shoulder bars 12, 14 at the required spacing.

**0030.** A pair of poles 30 are connected to the rail 20 and project vertically upward. The poles 30 are positioned inwardly from the ends of the rail 20 and connected at their upper end by a top plate 32. The top plate 32 is solidly secured to the poles 30 so the entire station can be moved intact and reinstalled at different locations while holding the camera distance and lighting constant.

**0031.** The top plate 32 supports a camera 1 at a fixed distance from the floor and centered between the laterally spaced shoulder bars 12 and centered between the two ends of the shoulder bars 14. There is a light 36 to illuminate the floor between the shoulder bars 12, 14 and also a top light 48 to signal to the users the state of the operating system of the station with colored light signals including “ready to receive a pig” (white light), “tracking pig” (blue light), “image taken” (purple light), “pig has reached a specified weight” (green light), and “pig has not reached a specified weight” (red light). The floor is configured to accommodate a load-cell floor scale 40 that is responsive to the passage of livestock across the floor to give an indication of weight, as will be described more fully below. The load cell is in place only during the training phase of the algorithm and is thereafter removed and no longer needed.

**0032.** One or more spray heads 42 are secured to one of the poles 30 just above the rail 18 and positioned centrally between the shoulder bars 12, 14. When triggered by the computer, the spray is directed on the back end of the animals as they exit the assessment station. Each of the spray heads 42 includes a remotely activated nozzle 44 to spray downwardly. A self contained aerosol of marker fluid is preferred with an actuator to operate the nozzle is preferred but a separate pressurised reservoir connected by a tube to the nozzle can be used where large numbers of livestock are to be assessed.

**0033.** The dimensions of the assessment station 10 will depend on the size of livestock to be processed. The length of the shoulder bars should be greater than the anticipated length of the livestock and typically will be between 6 and 144 inches. The height of the rail 18 from the floor may be between 6 and 48 inches and the height of the poles between 6 and

180 inches. The spacing of the shoulder bars 12, 14 is sufficient to permit free passage of one animal but not so far apart as to permit two side by side. Typically, a spacing of between 6 and 48 inches is appropriate.

Pig (Weight lbs, L/W/H inches)				Station (inches)		
Weight	Length	Width	Height	Shoulder Bar Length	Spacing between Bars	Rail Height
12	17-18	6-7	12-14	20-22	8-9	15-18
50	30-34	8-10	17-20	36-40	10-12	18-22
100	34-38	11-12	22-26	40-44	12-14	24-28
150	36-40	12-13	25-28	42-46	14-16	28-32
220	45-52	14-16	28-33	48-54	15-18	30-36
250	57-68	16-19	34-39	58-70	17-20	36-40
300*	72-76	20-25	39-42	74-80	22-27	40-44
500*	84-90	35-38	45-47	95-110	37-40	46-48

\*Sow

**0034.** The camera 34 and the scale head 38, which is connected by cable to the load-sensor floor scale 40, are connected by cables to a computer 50. The computer 50 implements programs to assess the images using computer vision and pattern recognition applications and correlate the images to the load cell data. The processed data is communicated to a server 52. The server 52 stores the images and data and trains the vision and pattern recognition applications on the computer 50 to identify individual livestock and conduct the full assessment of such livestock.

**0035.** The identification data stored on the server can also be made available to the processing plant which can use an assessment station to identify the livestock delivered and associate it with a carcass using their internal tracking protocols.

**0036.** In use, one or more assessment stations 10 are located within the barn complex and ideally in a path along which the livestock is constrained to move. By way of example, an assessment station 10 is located in the feeder barn E to monitor feeder pig rate of growth and another assessment station 10 is located in a doorway separating the barn from an outside lot for the pigs to pass through when they are loaded to be transported to the processor F.

**0037.** The herd to be assessed passes between the shoulder bars as a single line of animals. The configuration of the bars as an open-ended passage allows the animals to proceed without undue stress and the elevated structure of the top-plate inset does not present a barrier to passage. The requirement for the pigs to walk over the load-sensor floor scale is only in effect during the model training stage, otherwise they simply walk through the station with their feed on the normal slatted barn floor.

**0038.** During the model training stage, the load cell 40 is activated with the camera 1 and provides a stream of data correlated to the sequence of images produced by the camera 1. The load cell data will fluctuate due to the motion of the animal across the floor but is be processed using multiple consecutive images and mathematical equations to provide a reliable indication of the mass of the stationary animal.

- 0039.** The stream of video images are viewed and an image selected that places the animal at a consistent location within the limits set by the assessment station. The selected image is processed by the pattern recognition engine to identify the animal and to obtain an assessment of its physical characteristics.
- 0040.** A calibration is thus obtained that allows mass to be assessed from the image. In further passes through the assessment station 10, the ongoing use of the load cell is not required, and pigs can be moved through the station at high speed without loss of accuracy. If the genetics of the animal changes or varies farm-to-farm, a re-calibration can be made at each farm to take in to account the different characteristics. Algorithms can thus be trained to make them custom applications for each farm highly accurate.
- 0041.** The vision system may also be utilised to identify characteristics associated with early stages of a disease, such as lameness, glazing of the eye, ear-based temperature, or respiratory rates. If a condition is detected, the spray head 42 may be activated to mark the animal and allow it to be identified in the herd for further investigation.
- 0042.** Successive passes of the animals through the assessment station 10 allow the development of the animals to be monitored and ultimately their market readiness assessed. By monitoring the growth, the anticipated delivery to market can be forecasted and communicated with the processing plant to allow efficient scheduling.
- 0043.** The consistent monitoring also allows feed patterns to be assessed and adjusted to optimise utilisation of feedstock to reduce waste and environmental footprint.
- 0044.** As the animals mature, they will attain a size suitable for market. As they pass through the assessment station, those animals meeting marketable conditions are detected and marked by one of the spray heads 42. Alternative the farmer can use a swing gate that opens one way for market-ready pigs to proceed to the truck for transport to the slaughter plant and the other way for pigs not-yet-ready to be returned to their pens. The identity of the animals is also noted.
- 0045.** At the processing plant, the animals are again passed through an assessment station and identified using the data base made available by the producer and the identification protocol utilised by the processor cross referenced to that of the producer.
- 0046.** After processing, the processing plant provides a listing and evaluation of the carcasses, together with their grading. The grading of individual carcasses can be compared by the producer with the records of live animals from the barn and any discrepancies identified and queried. The feedback for the processor allows further refinement of the vision system to modify the evaluation of market readiness.
- 0047.** The provision of the assessment station ensures that the animals may be monitored in a consistent basis with minimal stress and trauma and with minimal human intervention.