A new tool for beef performance recording in Italy

Mauro Fioretti
R&D Office
A.I.A. Associazione Italiana Allevatori

Reliable performance recording on beef cattle is required for selection and extension services

Accurate recording of animal performances is the basis for

- estimation of the genetic merit of animals for economic and/or relevant productive traits like growth, fertility etc.
- Farmer's evaluation of his management (producing animals with the best possible conformation, as efficiently as possible)

Body live weight is a key recorded trait in beef production

- It is normally determined using a scale

- Especially in extensive beef cattle management systems, live weight is difficult to be recorded directly, either because scales are available only in some farms or mobile scales are difficult to transport and install.

- To overcome these difficulties an alternative way of estimating body weight has been investigated in Italy, focusing on the high correlation between **circumference of chest** and body weight (usually greater than 0.90).

- **Chest circumference** of animals, taken by a measuring tape, may be indeed used as a proxy trait for growth traits in beef performance recording

- particularly, live weight can be estimated from chest circumference using a *transformation formula* that includes both the age of the animal, and its chest circumference.

- Transformation formulas are specific for animal's **breed** and **sex**.

- To be correctly measured by tape, however, animals need to be immobilized

- This step is time consuming and often a source of stress on the animal (*and on operator too*..), especially in extensive system, where animals are minimally handled and thus not used to be close to human operators.

- Immobilizing animals is not sufficient to create a safety environment and guarantee full operator's security during the chest measurement by tape.

- To overcome these problems AIA considered the idea of a device that would not require to be close to the animal when making a performance recording

- The idea was developed in a device that could precisely estimate the chest girth of the animal thus allowing a live weight estimation.

- The developed device :
  - is simple and user-friendly
  - is based on a standard digital camera, connected to a netbook and equipped with two laser beamers.
- It is now sufficient to take a series of 3-5 raw images of an animal (on which the two points generated by laser could be identified) to estimate *a highly reliable chest girth* using a high performing proprietary algorithm.
- Automatic progress from image processing to chest circumference estimation
- No operator work is required except identifying the animal and take pictures

Technical highlights

The developed solution implements a new method for interpreting information collected from the cameras, through the projection of a laser pattern, for the estimation of chest circumference.

The system integrates

- a **GPS** for geographical location
- a **laser beamer**
- a **digital camera**
- a **computerized control unit** (connected to all devices)

Developing constraints

- **Measures on "free" (not tied) animals**
  - Maximizing operator's safeness
  - Minimize animal's stress

- **Measures in real time, minimizing recording times**

- **Measure accuracy**

- **Ergonomic device**
  - Shock resistant
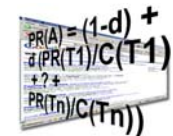 - Waterproof
  - User friendly

Developed solution

- **Use of a digital camera**
  - No contact with animals
  - Distance is not a problem

- **Portable elaboration system**
  - Wire or Wireless data transmission
  - Advanced image processing algorithms

- **Vocal interface + remote control**
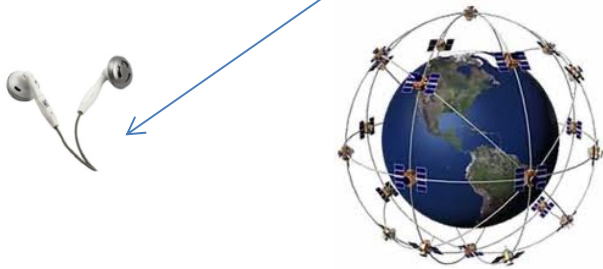 - User friendly system
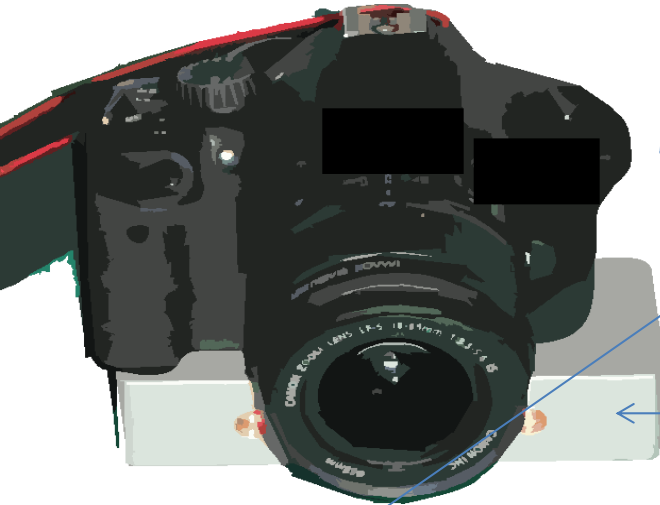 - Very intelligible vocal synthesis

- **Unmodifiable proofs**
  - Watermarked images with
    - Hour
    - Date
    - GPS location

Components

- – Common digital camera with standard lens
  - – To take images of the animal
- – Earphone
- – Laser beam projector
  - – Two parallel laser beams
  - – Aligned with camera optics
  - – Safe for animals
  - – Constant distance between them regardless distance
- – GPS Device
- – Netbook & dedicated software

How it works – The operator's side

1. An animal in paddock/pasture/box is chosen to be measured

2. The animal is identified:
   ✓Animals ID are preloaded in the netbook

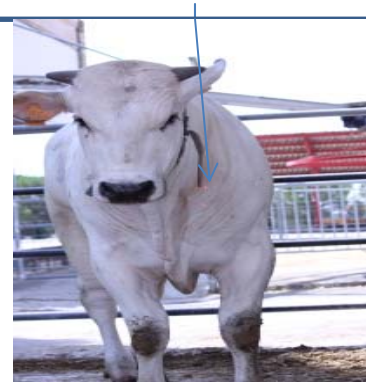   ✓The system speaks in the earphone pronounciating each preloaded ID

   ✓When the right ID is pronounced, the operators stops the list and the system gets ready for image taking and processing for the chosen animal

SYSTEM READY

How it works – The operator's side

3. The operator points the laser beams on the part of the animal on which he would measure with the tape

4. A synthetic voice from the system ask to the operator (earphone) to take a picture

5. The operator takes some front and side pictures

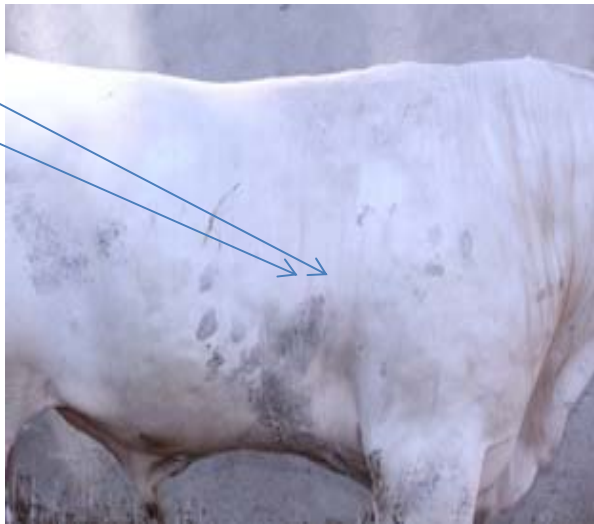# How it works – The operator's side

6. The operator is informed in real time (synthetic voice by earphone) when no more images are required from the software

7. The operator waits for the device to be ready for another animal, then identifies another animal to start again…….etc

How it works – the device side

1. Laser beams are projected on animal's surface; two laser points are visible on animal's body

2. Laser points are detected by digital camera's system

3. Digital camera focuses on the animal part in which laser points are

How it works – the device side
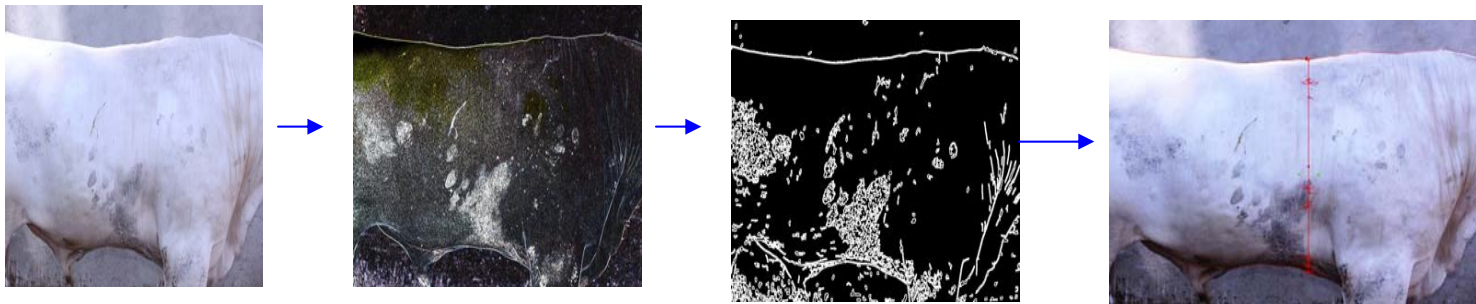
Scattare!!!
Shoot !!!

4. A synthetic voice from the system ask to the operator (earphone) to take a picture

5. Images are taken and transferred to software

How it works – the device side

6. Processing
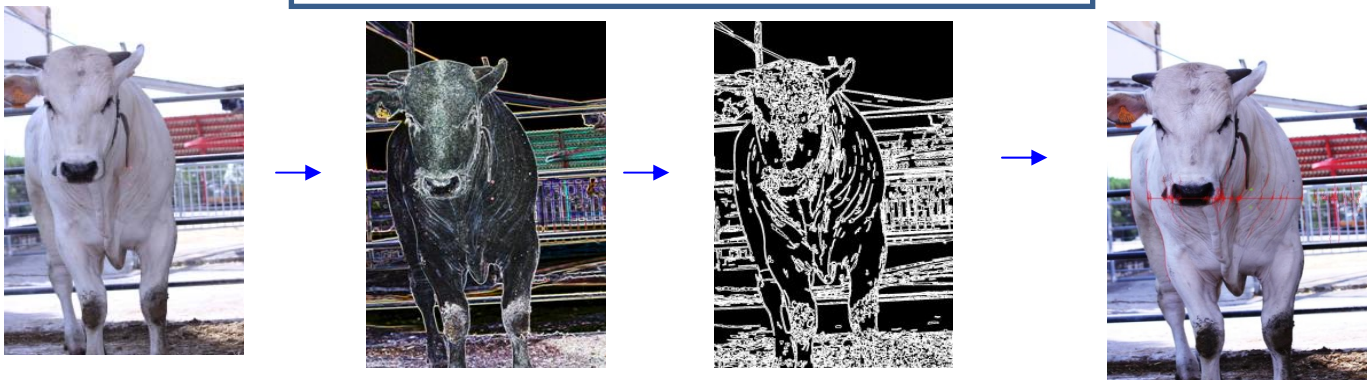**side..** ……………
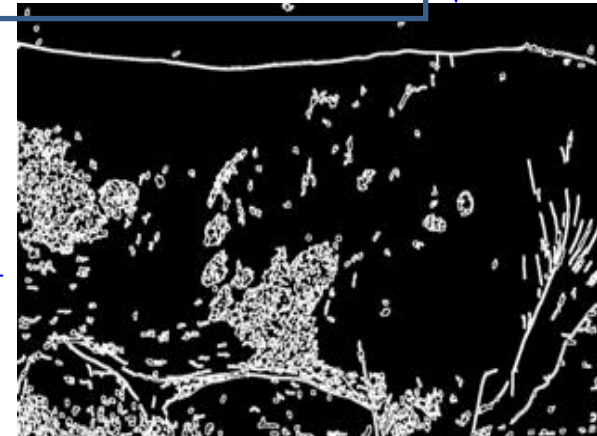

and **front** images

Image processing


Edge enhancement

Color elimination

Dedicated software

Measure estimation

ALL THESE OPERATIONS ARE AUTOMATICALLY PERFORMED BY THE SOFTWARE => NO HUMAN ERROR, HIGH REPEATABILITY OF MEASURE

How it works – the device side

Reconstruction of chest circumference

Front (3) and side (1)
measures are
the axis of an ellipse

The ellipse
circumference is the
estimation of chest
circumference
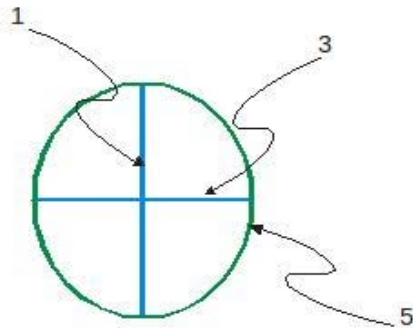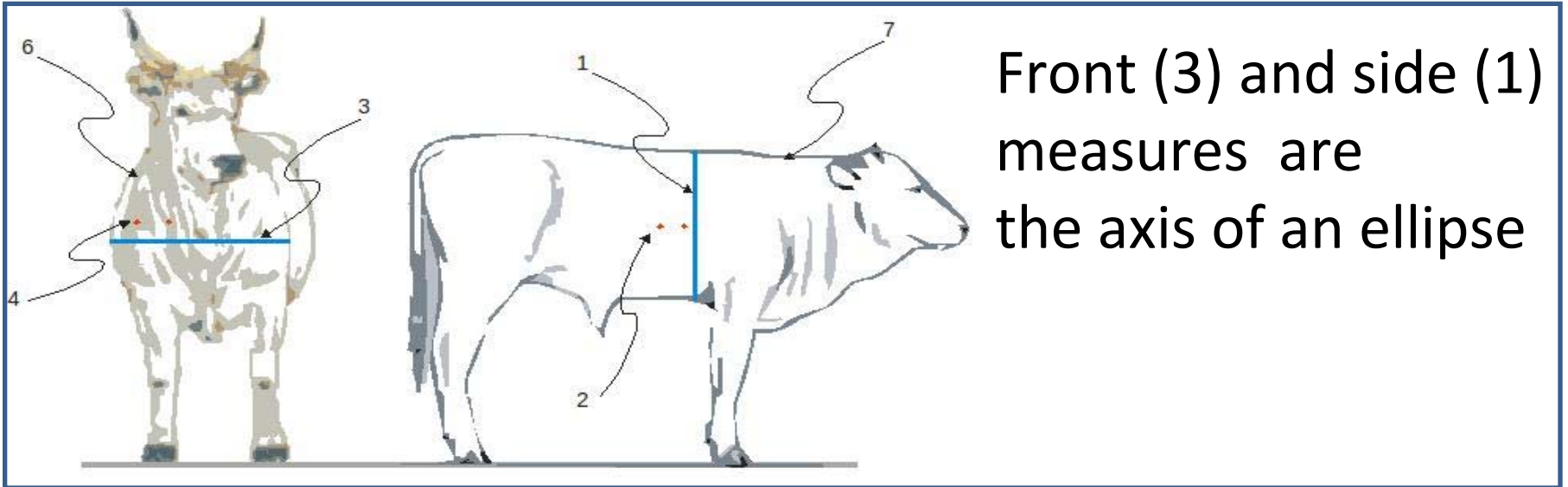
How it works – the device side

Every time a new picture is taken, the software automatically **estimates a new measure** for the side/front axis and a new chest girth is estimated.

The variation coefficient of the nth respect to $(n-1)$th chest girth estimated measure is calculated

When a convergence criterion is met, then there is no need of new digital images => system **tells** to the operator (earphone) to stop taking pictures

How it works – the device side

7. Pictures are stored in the computer and **watermaked** with **GPS location**, **animal ID**, **date** and **time**

   Estimated measures are stored too

   All data can be then sent to a central database

System gets ready for another animal

Results

- Basing on fields experience in different environmental conditions, the difference between chest girth measured with tape and estimated with the developed device is **very low**

Animal ID	Breed	Tape chest girth	Estimated chest girth by opto-informatic device	Farm	Difference tape - estimated chest girth (% on tape)	Difference tape - estimated chest girth (% on tape) <0	Difference tape - estimated chest girth (% on tape) >0
88	Marchigiana	194.0	197.0	Anabic	1.55%		1.55%
89	Marchigiana	195.0	193.8	Anabic	-0.62%	-0.62%	
90	Marchigiana	193.5	191.2	Anabic	-1.19%	-1.19%	
91	Marchigiana	191.5	192.9	Anabic	0.73%		0.73%
94	Chianina	200.5	202.6	Anabic	1.05%		1.05%
97	Chianina	204.5	204.8	Anabic	0.15%		0.15%
98	Chianina	202.0	202.5	Anabic	0.25%		0.25%
104	Chianina	196.0	195.4	Anabic	-0.31%	-0.31%	
106	Chianina	203.0	202.0	Anabic	-0.49%	-0.49%	
109	Chianina	191.0	190.8	Anabic	-0.10%	-0.10%	
7997	Chianina	192.0	190.9	CRA	-0.57%	-0.57%	
8002	Chianina	170.0	171.9	CRA	1.12%		1.12%
4651	Chianina	177.0	178.0	CRA	0.56%		0.56%
8028	Chianina	172.0	173.2	CRA	0.70%		0.70%
4669	Piemontese	175.0	173.0	CRA	-1.14%	-1.14%	
7970	Piemontese	164.0	163.9	CRA	-0.06%	-0.06%	
8082	Piemontese	160.0	155.1	CRA	-3.06%	-3.06%	
4643	Maremmana	187.0	186.2	CRA	-0.43%	-0.43%	
7968	Maremmana	185.0	182.7	CRA	-1.24%	-1.24%	
8015	Maremmana	172.0	171.9	CRA	-0.06%	-0.06%	
				Mean	-0.16%	-0.77%	0.76%
				St. Dev.	1.04%	0.84%	0.46%
				Min.	-3.06%	-3.06%	0.15%
				Max.	1.55%	-0.06%	1.55%

Use of measured chest circumference

Estimated chest circumference (expressed in cm) are transformed in live weight (kg) basing on algorithms working by

- *Breed*
- *Sex*
- *Animal age at test*

following ICAR's guidelines

Advantages

- **Handy and ergonomic device**
- **Accessible price**
- **Few and simple rules to be followed**
- **Maximum operator safety**
- **Fast recording**
- **Uneditable and georeferenced images**
- **Creation of a multimedia database available for further researchs and developments (biometric measures, etc)**

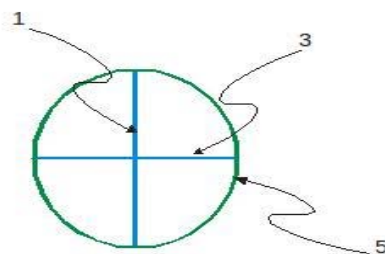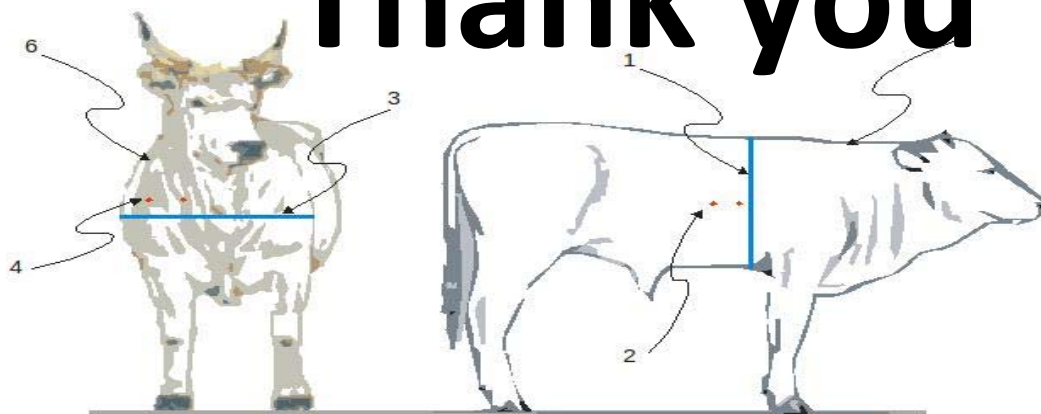# The device is patented by A.I.A.

For (next) future

- ## Software down-sizing

  - Linux

  - Android (smartphone : digital camera, image processing, data transmission)

Thank you