Scanners

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Types of scanners

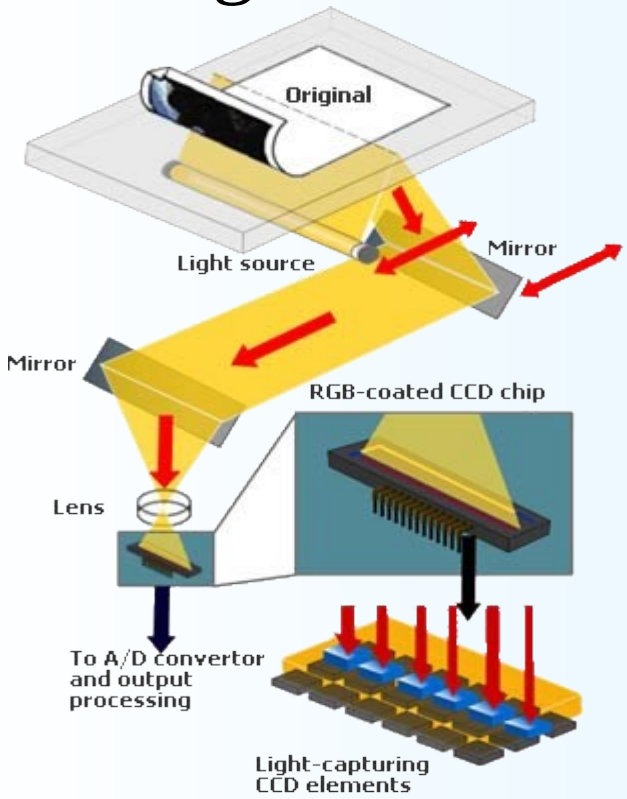
Flatbed scanners
Sheet-fed scanners
Drum scanners
Handheld scanners
Standard camera
3D scanners

CCD (Charge-coupled device)
CMOS (Complementary metaloxide semiconductor)
CIS (Contact image sensor)
PMT (Photomultiplier tube)

Flatbed scanners

They work similarly to photocopiers

The light from the moving light source (CCFL, xenon) is reflected from the object and is directed through the mirror and lens system to a CCD chip



The photons are converted into an electric current in the sensor

The more light falls on the sensor, the higher the current occurs

Using R, G, and B filters, it is possible to obtain color information of the scanned document

Sheet-fed scanners

They work similarly to desktop scanners. Instead of a moving light source and an optical system, the scanned document is moving

Drum scanners

The light source, the optical system and the sensor are in the sensing head

The scanned document is placed on a rotating drum

Handheld scanners

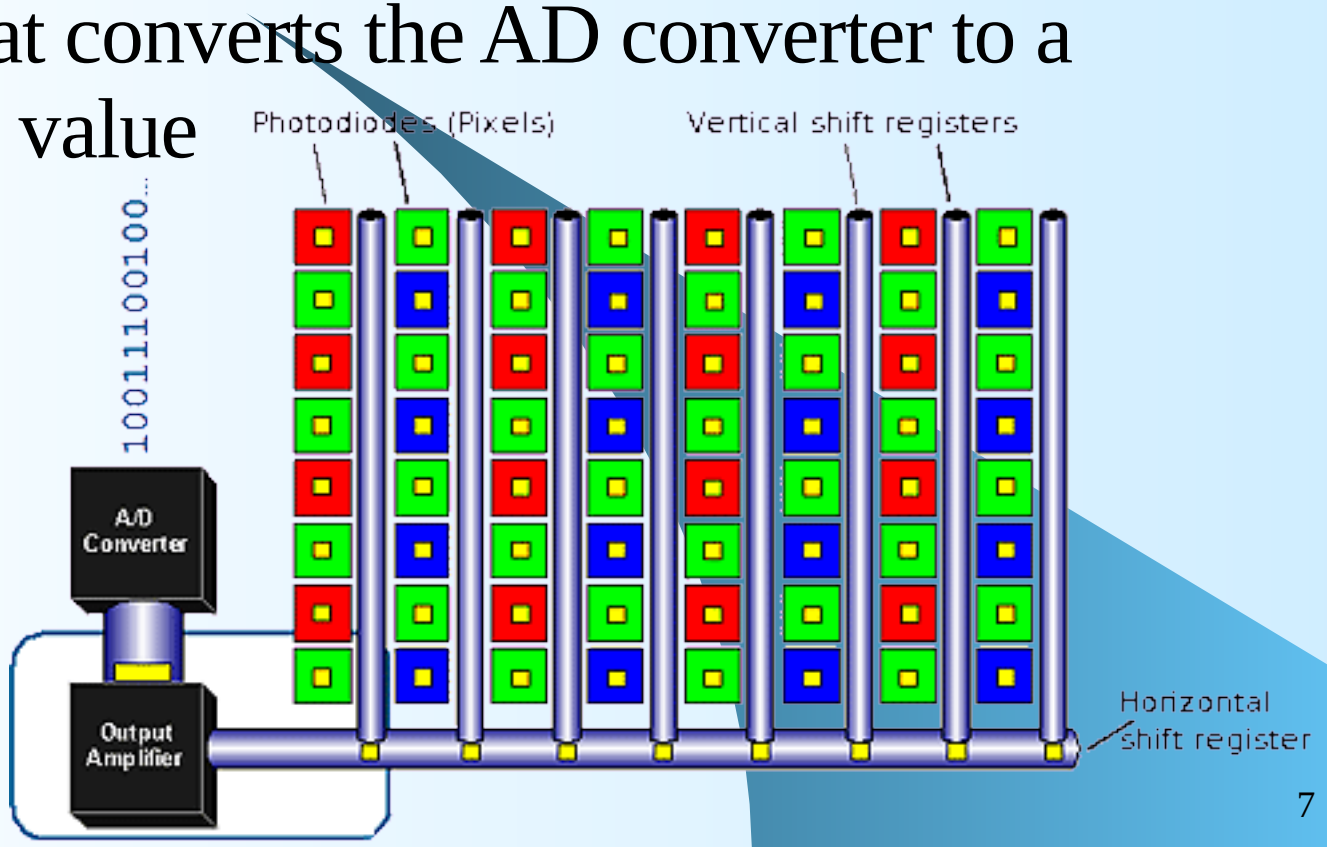
Bar code reader

There is a light source (laser beam) and a sensor that senses the reflected beam

CCD a CMOS technology

The CCD sensor is a field of light-sensitive capacitors (photodiodes) for R, G and B

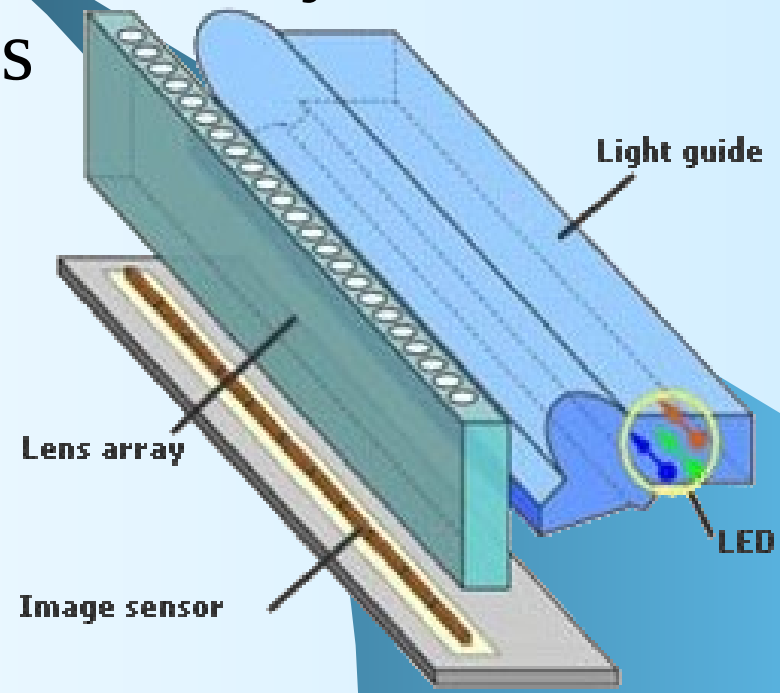
The energy of photons is converted to an electrical current that converts the AD converter to a numerical value



CIS technology

The CIS replaces the CCD, light source and optical system with a strip containing small light-emitting LEDs.

The diodes illuminate the scanned object and the reflected light is then scanned by the sensor strip, which is near the LEDs

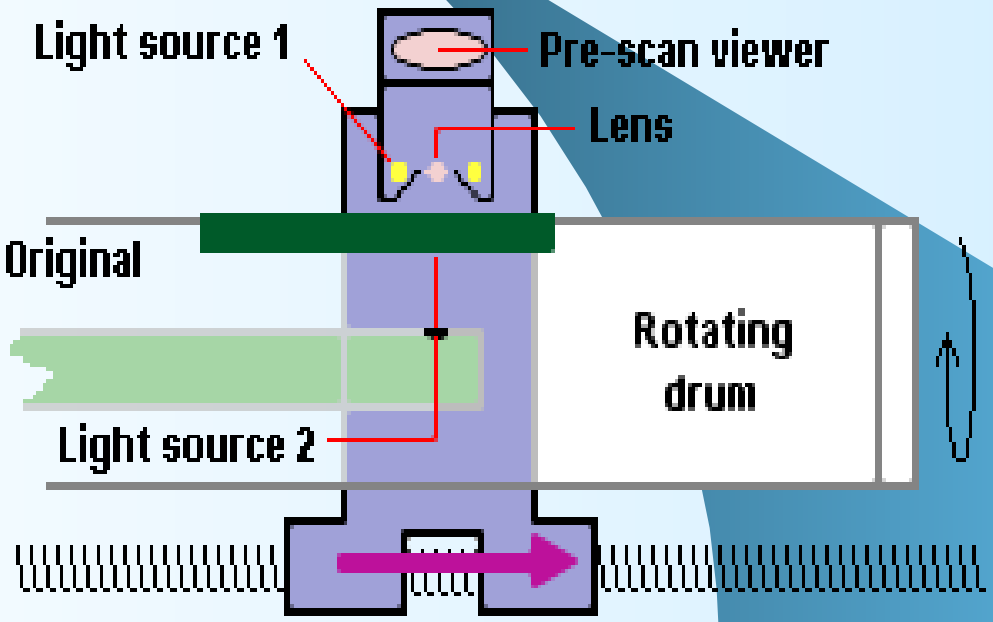


PMT technology

This technology is used in professional scanners

The document is scanned on a rotating drum. The head contains a light source and sensor (PMT tube) and moves in the horizontal direction

Usually, the document is scanned by columns



Technical parameters of 2D scanners

Resolution in DPI (hardware, software with interpolation) – 300 DPI - 4800 DPI

Color depth – 24b - 36b

Dynamic range – the range of shades it can recognize – 0.0 - 4.0

The quality of the optical system (plastic vs. glass)
Range of AD converter (bit depth) – 8 - 16

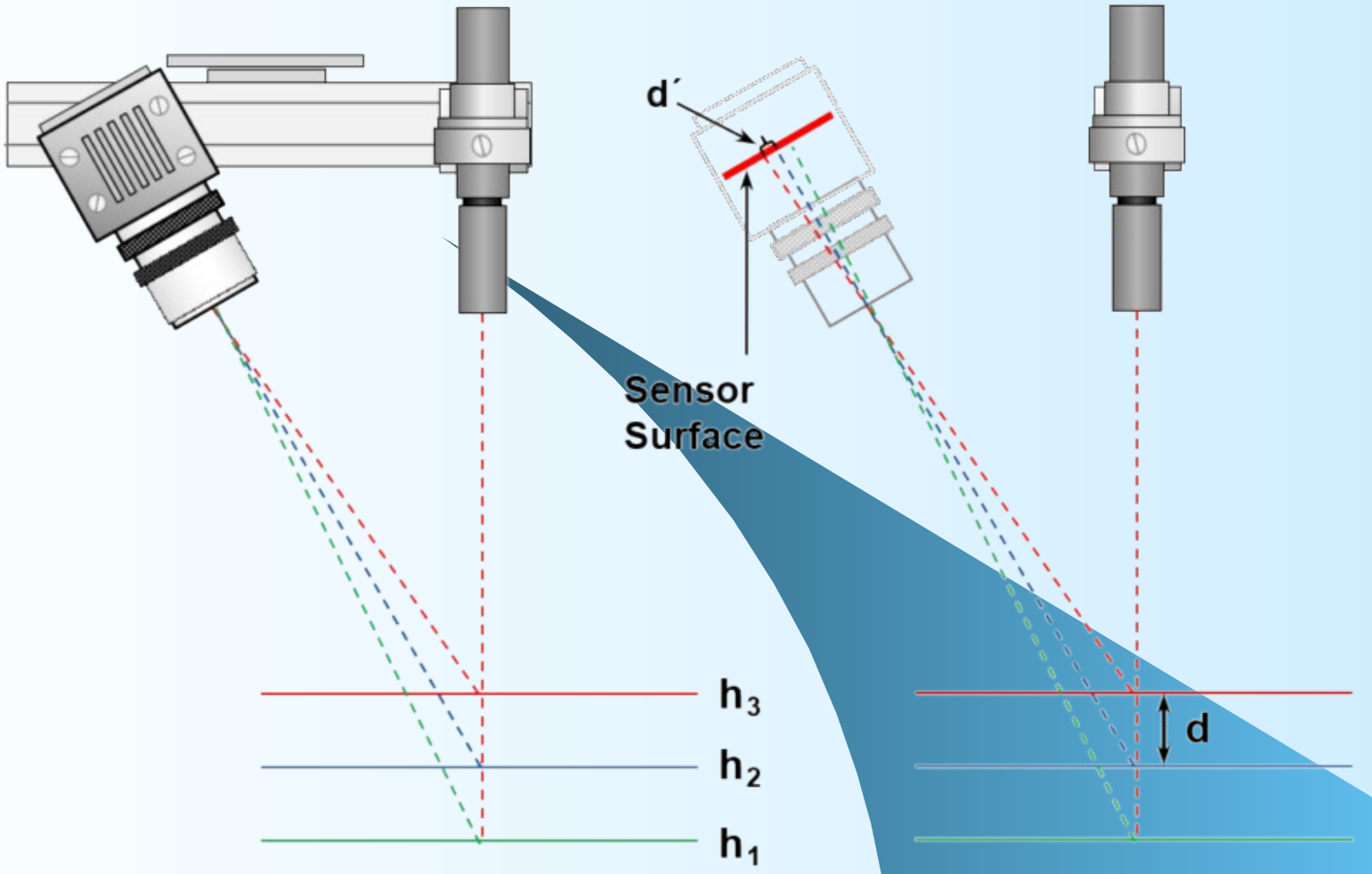
3D scanners

- Laser triangulation
- Photogrammetry (stereo vision)
- Structured light scanning
- Laser pulse scanner (time of flight)
- Contact-based scanner

Laser triangulation

- Use either a laser line or a single laser point to scan across an object
- The laser beam from the 3D scanner is reflected from the 3D scanned object
- Its initial trajectory is modified and picked up by a sensor
- From the modification of the laser trajectory and trigonometric triangulation, the system can calculate the distance from the object to the scanner
- When the 3D scanner collects enough distances, it is capable of mapping the surface's object and of creating a 3D scan

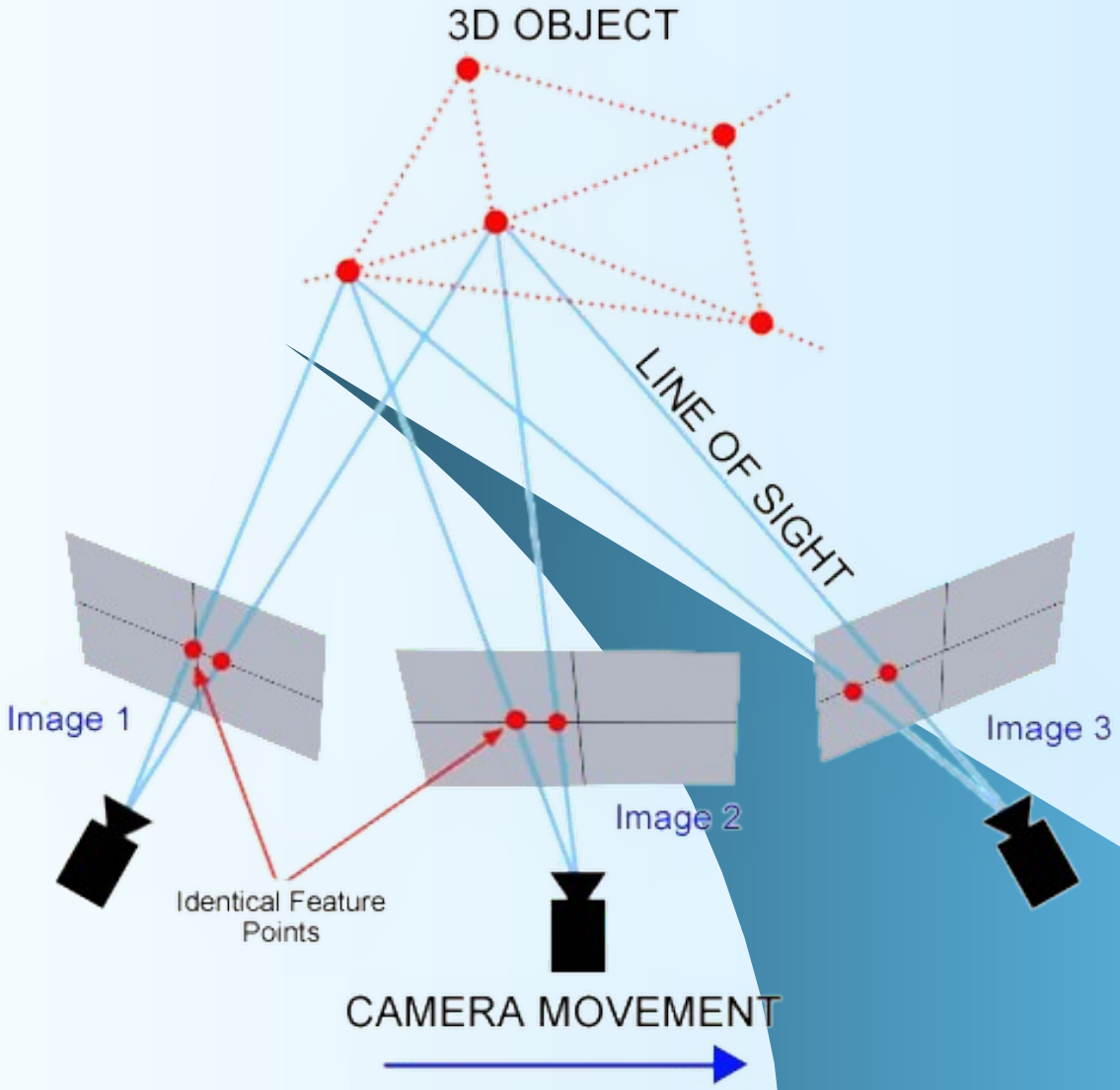
Laser triangulation



Photogrammetry

- Technique for recovering the exact positions of surface points
- It is based on a mix of computer vision and powerful computational geometry algorithms
- Method analyzes several photographs of a static subject, taken from different viewpoints
- Good algorithm and the parameters of the camera such as focal length and lens distortion we need to automatically detect pixels corresponding to a same physical point

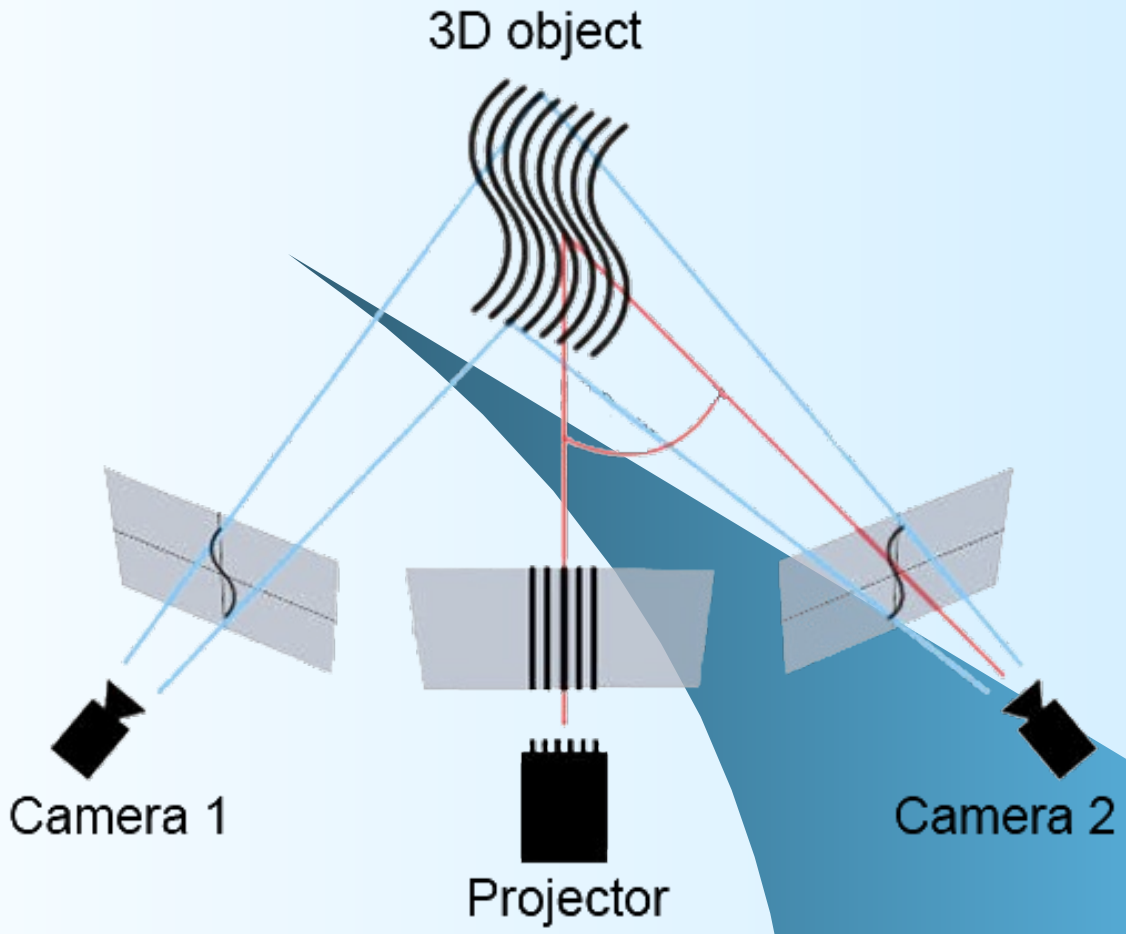
Photogrammetry



Structured light scanning

- Uses trigonometric triangulation like laser triangulation
- Works with the projection of a series of linear patterns onto an object
- Light is generated, for example, by Digital Light Processing (DLP) technology
- The projected pattern is usually a series of light rays but can also be a randomized dot matrix

Structured light scanning



Laser pulse scanners

- It is known as Time-of-Flight scanners or Lidar
- Measure how long a casted laser takes to hit an object and come back
- Because the speed of light and time when reflected beam hits the sensor is known, the exact distance between the 3D scanner and the object can be calculated
- Since each measure only collects one point, the 3D scanner needs to cast its laser 360 degrees around that point

Laser pulse scanners

Contact-based scanner

- It is a form of digitization
- A touching probe is moved on the surface to various points of the object to record 3D information
- The probe is sometimes attached to an articulated arm capable of collecting all its respective configurations and angles for more precision