SAE

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Swimming Analysis Equipment

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Presentation of the group

Swimming Analysis Equipment

Maite Alcalá:
CEO and Regulatory director

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Marketing and logistics director

Adalid Guzmán:
Technical departament

Description of SAE

Swimming Analysis Equipment

Figure 1: Swimmer using SAE

Figure 2: SAE presentation

Figure x:

Swimming Analysis Equipment

Description of SAE : Measurement

Acceleration

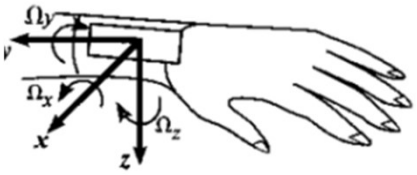

Figure 3: Coordinate system of SAE **[1]**

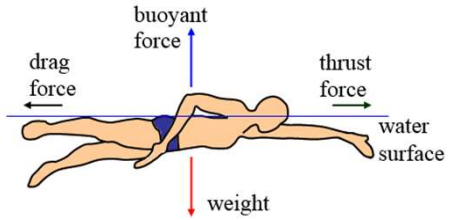

Figure 4: Active forces while swimming

Direction

Force

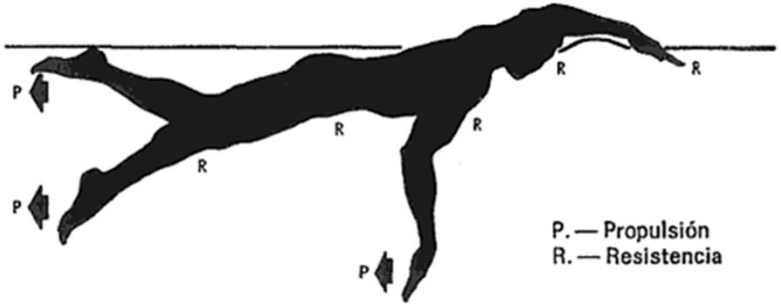

Figure 5: Diagram of forces present in Front Crawl. Profile view

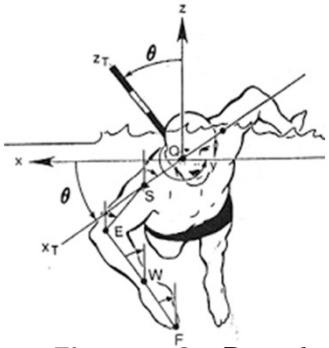

Figure 6: D. of forces present in Front Crawl. Frontal view

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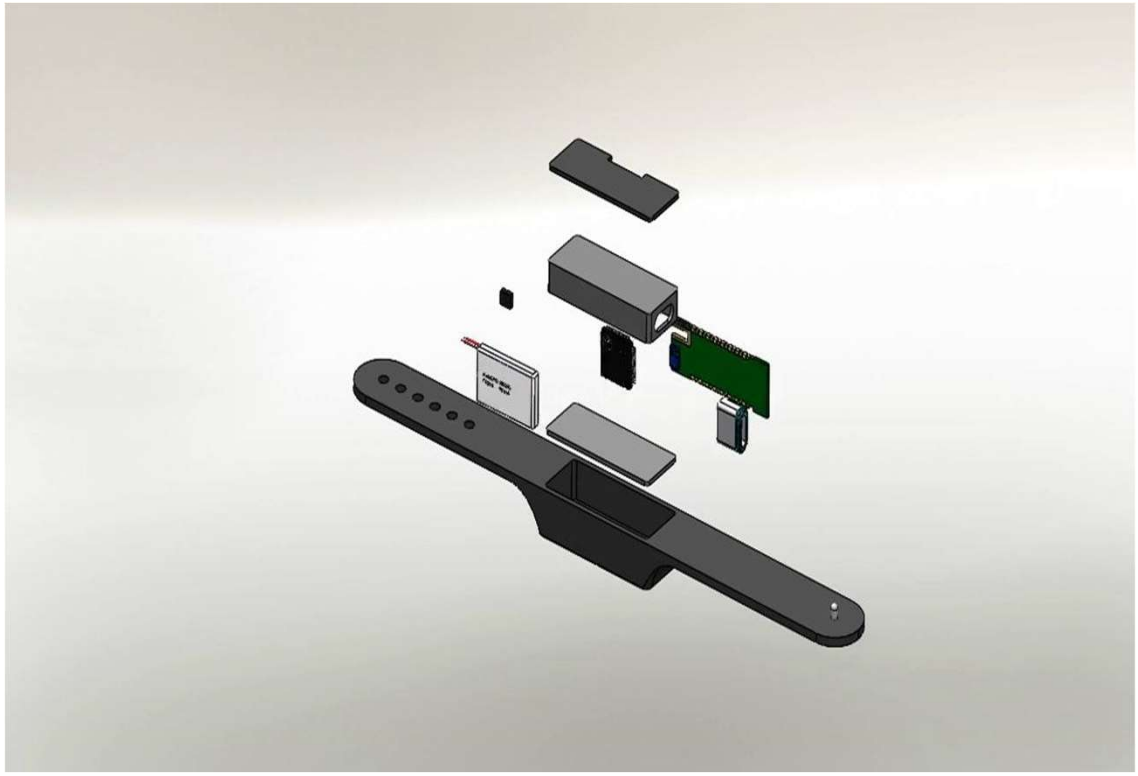
SAE TECHNOLOGY



Video 1: Components of SAE in exploded view

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SAE TECHNOLOGY

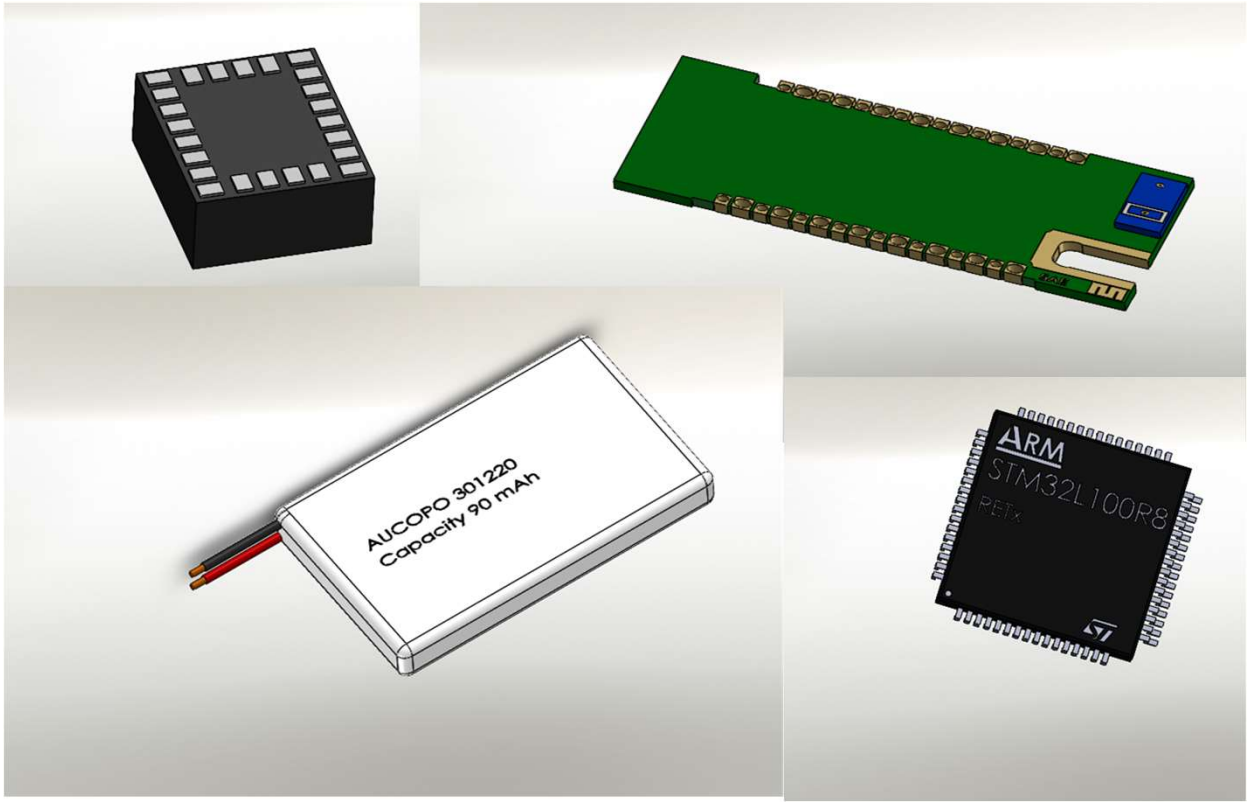

Figure 7: Main electronic components of SAE

SAE TECHNOLOGY

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IMU

- 3 acceleration channels, 3 angular channels and 3 magnetic field channels
- Data output: 16-bit
- Embedded FIFO
- “Always-on” eco power mode 1.9 mA
- ±2/±4/±8/±16 g linear acc. full scale
- ±4/±8/±12/±16 gauss magc. full scale
- ±245/±500/±2000 dps ang. rate full scale **[2]**

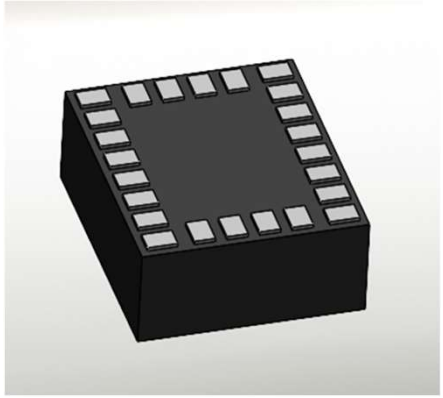

Figure 8: LSM9DS1 iNEMO,inertial module:3D accelerometer, 3D gyroscope, 3D magnetometer/ STMicroelectronics

SAE TECHNOLOGY

Swimming Analysis Equipment

MICROCONTROLLER

- Power supply : 1.8 to 3.6 V

- Temperature range : -40 to 85 °C

- Core : 32bit

-10 nA ultra-low I/O leakage

- Memory : 128Kbytes of flash, 10kBytes of RAM. **[3]**

Figure 9: STM32L100R8/ STMicroelectronics

SAE TECHNOLOGY

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BATTERY

-Supply voltage : 3.8V

-Charge voltage : 4.35V

-Capacity : 55mAh

-Dimensions : 20x12x3 mm

-Weight : 1.9g

-Saving battery : no display, ultra-low-power components **[4]**

Figure 10: AUCOPO 301220/ AUCOPO

AUCOPO万宝能源

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Description of the operation and mode/s of the SAE

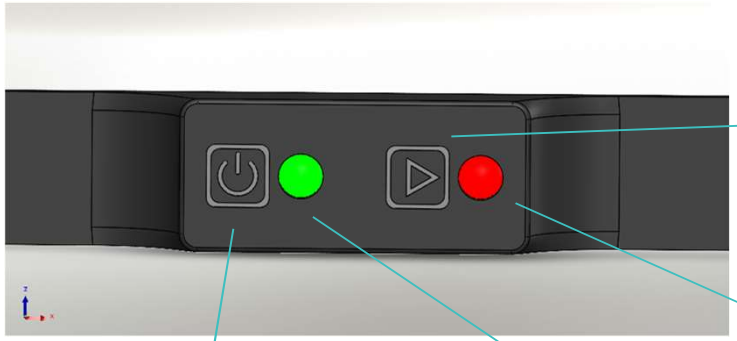


Figure 11: SAE

Recording LED:

- Static light: **device turned on**
- Fast flashing: **calibrating**
- Slow flashing: **recording**

RECORDING BUTTON

- Short press: **start recording**
- Long press: **calibration**

POWER BUTTON

- Short press: **turn on**
- Long press: **turn off**

Battery LED:

- Green: **up to 20% of the charge**
- Red: **less than 20% of battery**

Description of the software

Swimming Analysis Equipment

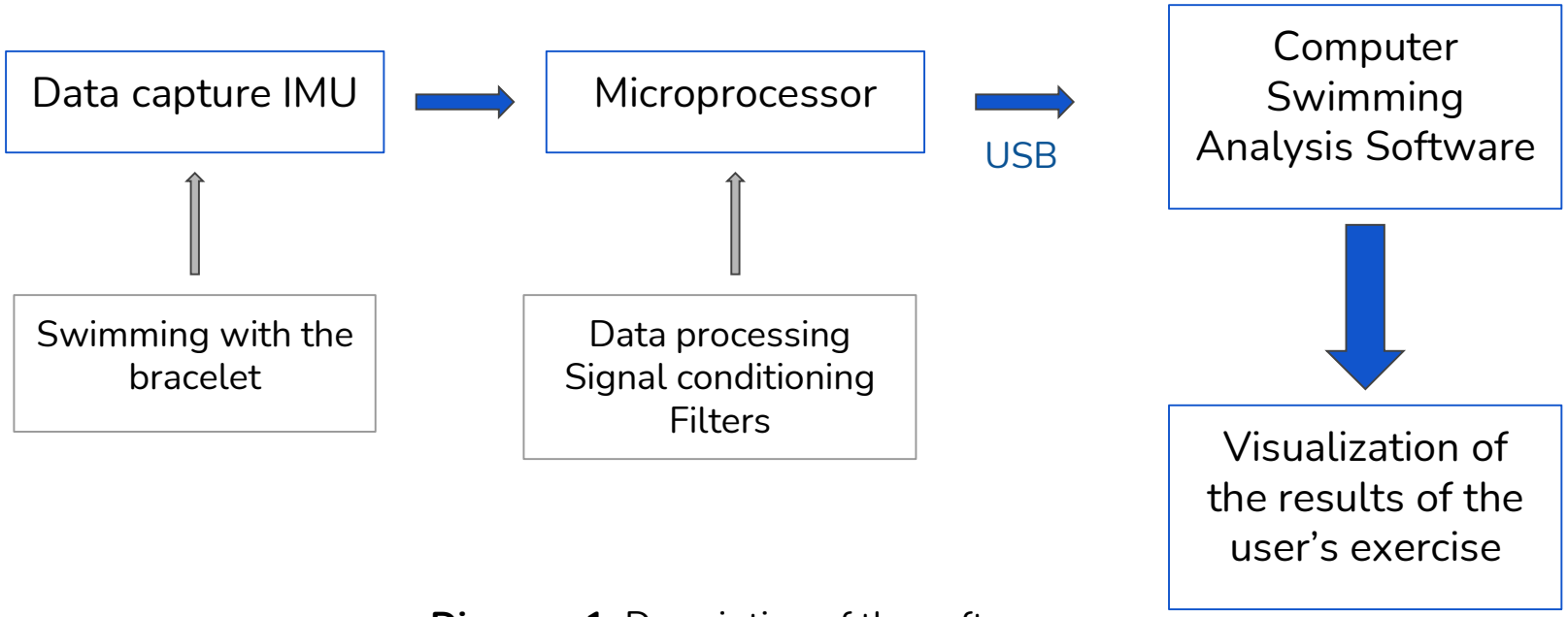


Diagram 1: Description of the software

Description of the software

Swimming Analysis Equipment

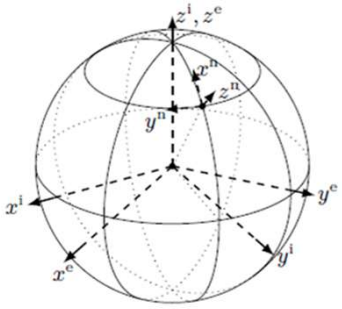


Figure 12: Gyroscope Navigation frame to Body frame

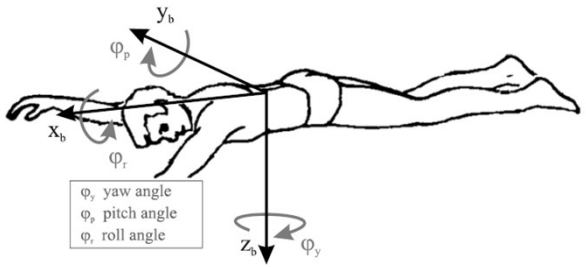
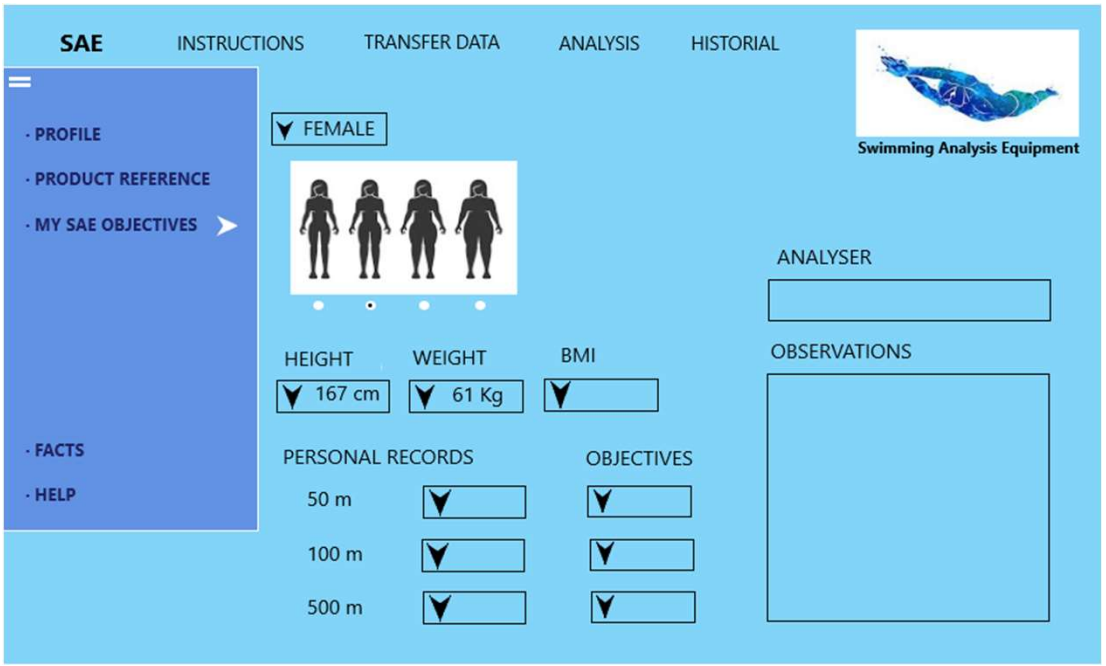


Figure 13: Body Coordinate System: axis and angles

Instructions and Usage

Swimming Analysis Equipment

www.swimminganalysisequipment.com



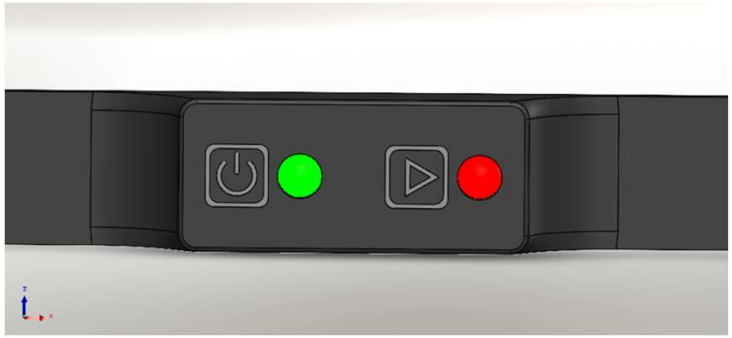
Figures 14,15: Swimming analysis software log in and objectives

Software and Analysis

Figure 16: SAS graphics presentation

Swimming Analysis Equipment

Instructions and Usage



Figures 17: Position when calibrating SAE and its buttons

Applicable regulation

Swimming Analysis Equipment

UNE-EN 60601-1 for basic Safety and Performance requirements for electromedical equipment.

MUST PROVE

- -Safety
- -Electromagnetic compatibility
- -Contact to water
- -Temperature and humidity environment
- -Biocompatibility

Quality Control

Swimming Analysis Equipment

Quality control tests:

- Test in normal pool
- Testing in a salt water pool
- Immersion test with the device
- Water jet test
- Movement capture test
  - Dry test
  - Pool test
- Electromagnetic compatibility test

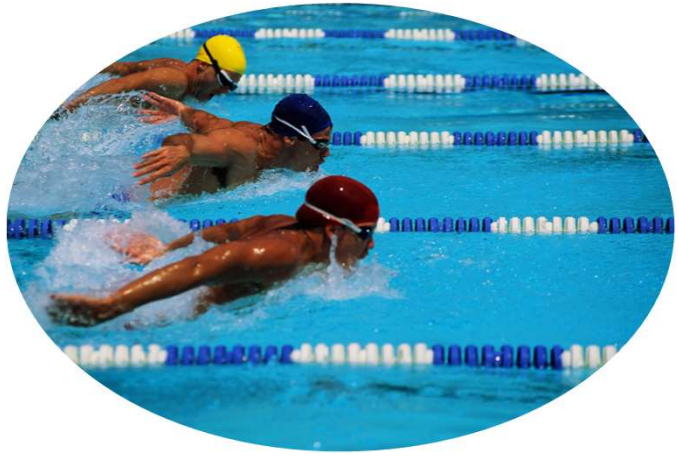


Figure 18: Data Capture

Quality Control

Swimming Analysis Equipment

Quality in manufacturing ➡ Product design must receive a rigorous quality review and engineering readiness before it is released into production

Quality of end device ➡ All the failure modes that may occur with products that are defective from the factory and / or possible failures that users purchasing the product have will be taken into account when creating next product batches in order to improve the quality of this and increase its useful life.

Swimming Analysis Equipment

Risk Analysis: Evaluation of probability and severity

Probability of risk	Description
6- Always	Always happens
5-Frequent	$\geq 10^{-3}$
4- Probable	$< 10^{-3}\ and \geq 10^{-4}$
3- Occasional	$< 10^{-4}\ and \geq 10^{-5}$
2-Remote	$< 10^{-5}\ and \geq 10^{-6}$
1-Improbable	$< 10^{-6}$
0-None Observed	Never happens

Table 1: Probability

Severity of the Harm	Description
5-Catastrophic	Results in patient death
4- Critical	Results in permanent impairment or life threatening injury
3- Serious	Results in injury or impairment requiring professional medical intervention
2-Minor	Results in temporary injury or impairment not requiring professional medical intervention
1-Negligible	Inconvenience or temporary discomfort

Table 2: Severity

Risk Analysis: FMEA I

Swimming Analysis Equipment

OPERATION	FUNCTION	FAILURE			INDEX		
		MODE	EFFECT	CAUSE	SEVERITY	PROBABILITY	RISK
Swimming Analysis Equipment	Equipment on the wrist in Front Crawl	Erroneous data transfer. 1a	Incorrect study of your style in crawl	misuse of the equipment, wrong software programming, noises and interferences...	3	2	6
		Equipment inestability. 1b	Wrong data capture	Turbulent pool water, poor equipment placement	2	3	9
		Leakage current. 1c	Damage to the swimmer	Breakage of the protective case of the equipment	4	2	8
		Incorrect measurement. 1d	Obtaining incorrect data and inability to assess swimming style	Incorrect positioning of the equipment on the wrist or presence of interference in the measurement	3	3	9

Risk Analysis: FMEA II

Swimming Analysis Equipment

		Breakage. 1e	Inability to use the equipment again and posibility of damage to the client	Friction of the body with the chest, defective protective box...	3	2	6
	Equipment on the chest in Front Crawl	Incorrect measurement. 2a	Obtaining incorrect data and inability to assess swimming style	Incorrect positioning of the equipment on the chest	2	3	6
		Leakage current. 2b	Damage to the swimmer	Breakage of the protective case of the equipment	5	2	10
		Breakage. 2c	Inability to use the equipment again and posibility of damage to the client	Friction of the body with the chest, defective protective box...	4	2	8
	Hand held measuring equipment	Incorrect measurament. 3a	Obtaining incorrect data and inability to assess swimming style	Incorrect positioning of the equipment	3	4	12
		Breakage. 3b	Inability to use the	the equipment	4	4	16

Risk Analysis: FMEA III

Swimming Analysis Equipment

			equipment again and posibility of damage to the client	may fall to the bottom of the pool, where the box that surrounds the equipment may break			
	Equipment worn on the chest or wrist in a style of swimming other than swimming or in another sport	Incorrect output. 4a	The desired informatio n is not obtained	The equipment is not programm ed for these uses	3	5	15
		Breakage. 4b	Inability to use the equipment again and posibility of damage to the client	Breakage of the elastic band due to friction when using it in areas of the body for which it is not intended or breakage of the protective box due to incorrect use while the Arduino board is unprotecte d	4	5	20

Table 3: FMEA

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Risk Analysis: Acceptance of the risk

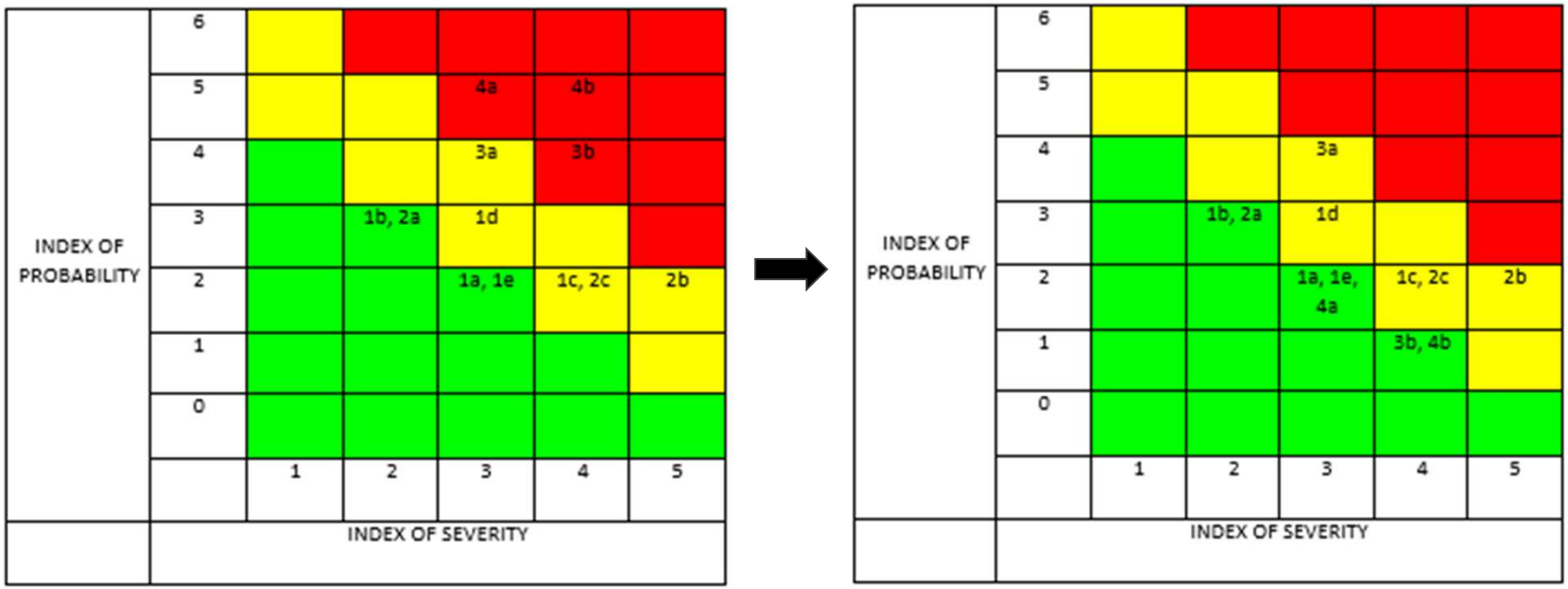

Diagram 2: Acceptance of the risk

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WHAT DO WE EXPECT FROM THE FUTURE

Goals in the future:

-Cover all swimming disciplines

-Mesure all parameters in different parts of the body

-Move to other sports

Swimming Analysis Equipment

References

[1] Fag. 4/ Pag. 700/ Microcomputer-based Acceleration Sensor Device for Sports Biomechanics: “Stroke Evaluation by Using Swimmer’s Wrist Acceleration”/ Y. Ohgl/ doi: https://doi.org/10.1109/ICSENS.2002.1037188

[2] Pag. 1/ DatasheetLSM6DS3/ STMicroelectronics/https://www.st.com/resource/en/datasheet/lsm6ds3.pdf

[3] Pag. 1/ Datasheet STM32L100R8/ STMicroelectronics/ https://www.st.com/resource/en/datasheet/stm32l100r8.pdf

[4] Aucopo 301220 especifications/ AUCOPO/ http://www.aucopo.com/index.php?m=content&c=index&a=lists&catid=100

THANKS FOR YOUR ATTENTION

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