Systemtheremino

Theremino
Cobot Security

Security features of Cobots

A cobot must be able to work side by side with a human being without posing a danger. It must have rounded surfaces and in all possible rotations the parts of him must not get too close to each other, otherwise they could pinch the skin or fingers like a nutcracker.

The safety of a Cobot must be intrinsic.
The mechanics itself does not have to dispose
of strength and speed capable of doing harm.

This is a simple principle, easy to understand,
no software, no electronics.

No rules or protocols that can go wrong
and no mechanisms that can break.

The basis of a Cobot's safety are not the rules, certifications and electronic or software systems, because the software can make mistakes, the electronics can break and the certifications could be incomplete or misinterpreted.

The security mechanisms based on software, protocols and certifications, in addition to not being sufficient, can also increase the danger of the system because they generate a false trust in humans, who are therefore led to trust blindly and take risks.

On the next page we will analyze an example
of what can happen to trusting security systems.

An example not to follow

Watch***this video***about a robot who broke a child's finger.

The robot, as soon as it encountered an anomaly, correctly immobilized itself, as the safety protocols state.

But then the operators (top right) couldn't unlock it and two other people couldn't force the gripper and free the finger.

And as a final joke the protocol freaks blamed the child, who according to them,***did not respect the safety times***.

What was the mistake

You can't blame the child or even the robotic arm that had all the safety mechanisms and stopped "correctly". Indeed, as the organizers of chess tournaments say,***he had never been wrong before*****.**

The mistake was to use a robot capable of taking a finger and breaking it to lift pieces weighing a few tens of grams.

Instead

The safety of a Cobot must be intrinsic, i.e. the mechanism itself he must not have strength and speed capable of doing harm.

Safety of industrial robots

Some manufacturers try to pass off their products that were born for industrial use as Cobots.

They write pages and pages of directives on what, according to them, should be the protocols and certifications to be used to tame their dangerous robots and make them harmless.

they addchecks upon checksand they addmechanisms that control other mechanisms.

Sometimes the control systems are more than 10 and reach up to 17 in some UR (Universal Robots) versions.

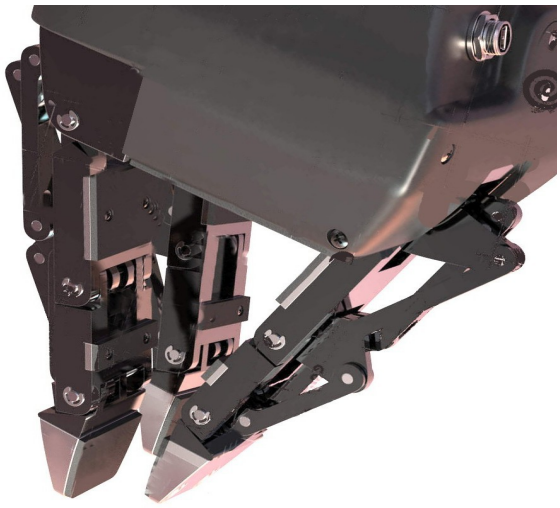
But read for example***this document***, And***this also***, to learn about risks that no security mechanism, however complex, could predict.

Rounded surfaces are not enough
and no matter how much control software you add,
if a robot has the strength to break a finger or an arm, sooner or later it will.

So, according to our view,
industrial robots can never be true Cobots.

Those Robots must be enclosed in a fence and no one must enter it when they are on. Adding new certifications does not increase security, in fact it decreases it, because it increases confusion about what is secure and what is not.

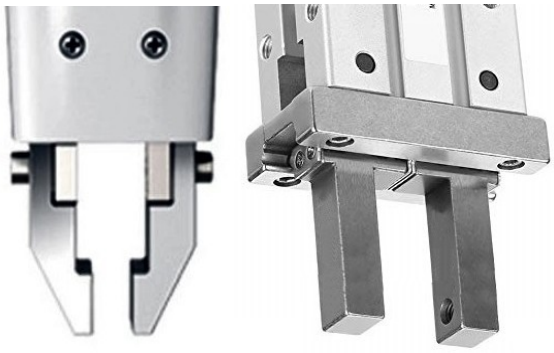
Hazardous components



With contraptions like this sooner or later someone will get hurt,
it doesn't matter what and how many security mechanisms one can conceive.

The pliers that broke the poor boy's finger in the previous pages were of the "parallel" type, similar to these two, but with four points.

To move chess pieces, and for all other light work, suitable for Cobots, there is no need to use such grippers, light plastic grippers are enough.



In other words, if the forceps catches the finger and the child pulls,
it must be the caliper that breaks, not the finger.

This principle also applies to all the other parts of the Cobot, which must always give way when colliding with a human.

And if the human is strong, then it is the very structure of the Cobot that must break.

Security features

"The safety of a Cobot must be intrinsic, the mechanism itself he must not have strength and speed capable of doing harm"

Intrinsic safety is obtained with an adequate design of the mechanics and the motors themselves.

Here are the characteristics that a Cobot must have to collaborate safely with a human:

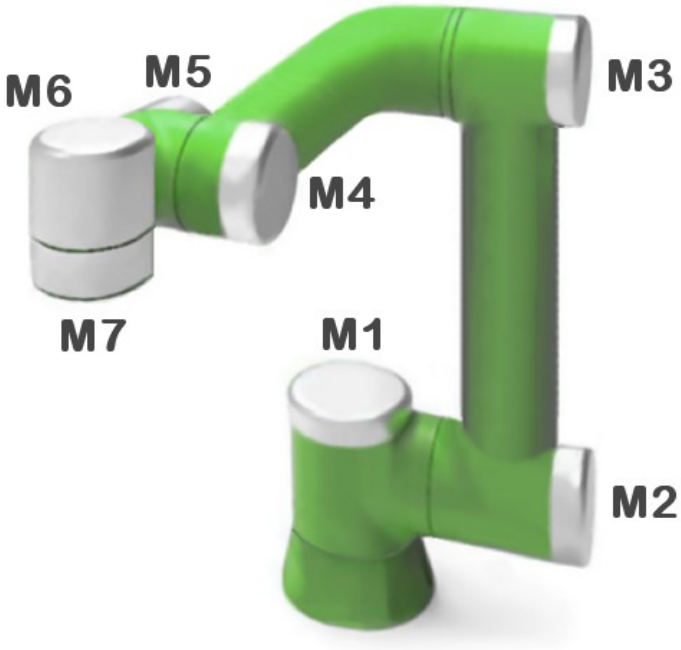
- It must limit the torque mechanically in the motors and couplings.
- It must have no greater strength than humans.
- It must not have parts that can pinch the skin and fingers.
- It must not have software or electronic safety mechanisms, but it must be intrinsically safe, thanks to its basic mechanics.
- If it encounters an obstacle, it must not stop in an emergency, and worse still trigger the brakes usually specified by the protocols, but must remain operational, with limited force, exactly as a human being would, and then continue the movement when the obstacle is removed.
- It must move slowly if there are humans within a few meters or have all surfaces soft to cushion any impacts.

These are not rules but simple common sense,
easy to understand and implement
and without mechanisms that can break.

Safe components for Cobots

A Cobot must have rounded surfaces and in all possible rotations its parts must not get too close to each other.

Particular attention must be paid to areas near the axes of rotation, where the torque is greatest, because those points could pinch the skin or fingers like a nutcracker.



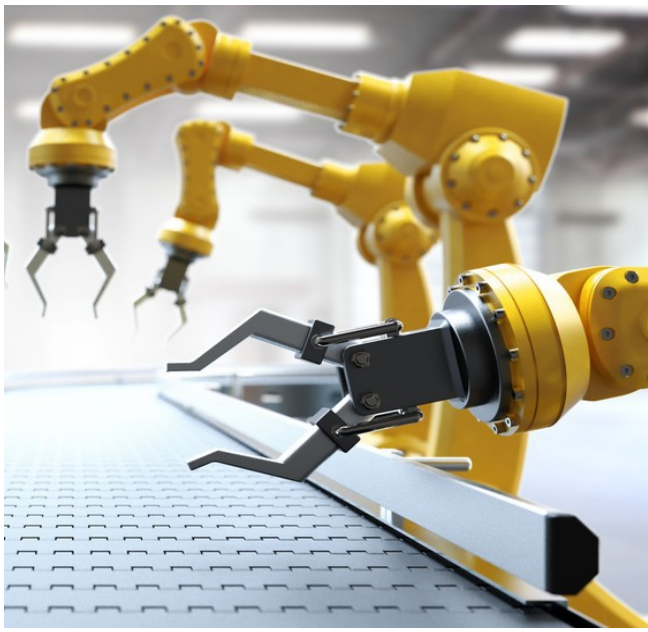
- **M1 BASIC**it is the rotating base
- **M2 SHOULDERS**it's the shoulder
- **M3 ELBOW**it's the elbow

- **M4 .. M7 HAND**I am the hand

- **M4, M5 WRIST**I am the wrist
- **M6 ROTATION**rotate tools
- **M7 END EFFECTOR**

The End Effector is an interchangeable tool which could be a pliers, a screwdriver, a suction cup or other tools for soldering, gluing, etc.

To design a safe Cobot, attention must also be paid to the dangerousness of the tools which must be light and suitable for the task to be performed.



Safe tools for Cobots

Here are some examples of tools suitable for a Cobot.

These plastic tongs are very light and safe, they couldn't break a finger even if they wanted to.

The nose pliers have interchangeable rubber fingertips, shaped according to what you have to take.

For example, a cylindrical foam tube cut into two halves could be used to lift the chess pieces.

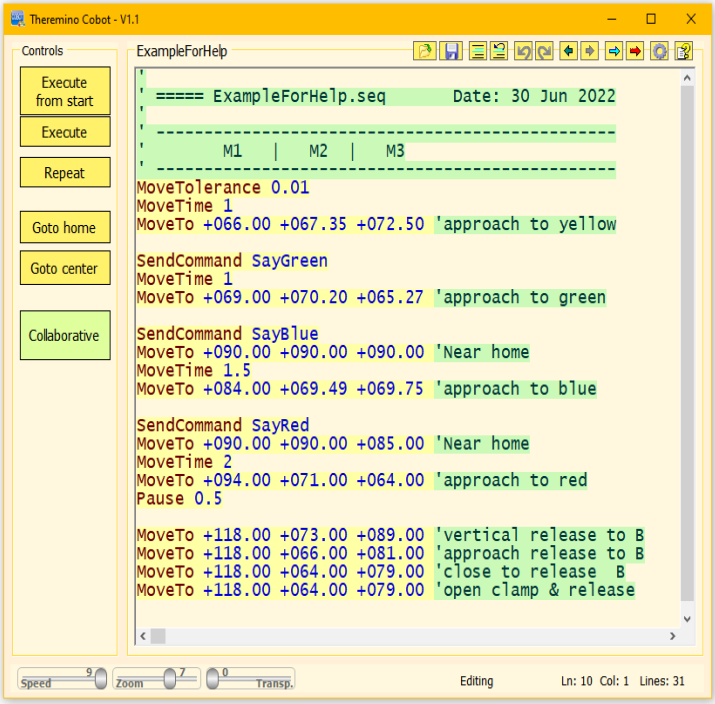
In addition to being safe, needle nose pliers are slim and vary in size the beaks can be replaced with others of different length and shape, to reach difficult points without interference with lateral obstacles.

The Theremino Cobot application

This application provides the necessary to move a Cobot, i.e. a robotic arm or any other mechanism designed to collaborate with humans.

Devices with one or more motors, arranged in any configuration, can be controlled and it is not necessary to specify the dimensional characteristics of the mechanisms.

We have eliminated the three-dimensional description with all the complications and imprecisions that it entails and we delegate the calculations to a 100% precise analog computer, i.e. the mechanics itself.



Using these methods you can program the movements of a Cobot in a simple and intuitive way.

Software security

As we have seen in the previous pages, the safety of a Cobot requires first of all an adequate design of the mechanics.

You can add something to security with software too, but it doesn't have to be a fundamental element and the basic security must be there even if the software fails.

With this in mind, the Theremino Cobot application contains options to slow down movements when there is a human in the Cobot's work area.

This is a convenience that can avoid unpleasant blows
if you collide with the Cobot moving at high speed.

But we still remember that all software mechanisms can fail,
therefore the Cobot itself must not be capable of causing serious injury.