Agent Supply Access Detection Using a Time Of Flight Sensor

This disclosure relates to the field of protecting 3D printing electronics working in a dusty environment, in this case how to detect the door opening to access to an agent supply with integrated cryptographic device (Acumen).

A system is disclosed that presents a way to detect the door opening inside the printer where a powder cloud could be present. If the powder is conductive and there are electronics close to this cloud, they could be damaged. For non-conductive powders (example plastic powder), the powder could contaminate critical components in the electronics like humidity sensors.

In some 3D printing environment agents or Inks supplies may have an encryption electronic circuit (usually Acumen) to handle the security of that device. Before starting the electronic communication with this circuit, it is crucial to do a detection of the presence of the supply. In 2D printers, this is achieved using a mechanical system based on a switch.

In a dusty environment, like the environment inside a 3D printer, mechanical non-protected switches, could be contaminated by dust and cause a malfunction in the long term due to the deposition of the powder inside the contactor of the mechanical switch. One possible solution would be to use a high Ingress Protection (IP) switches (IP6 or higher), however this solution is not cost effective, especially if the printer is using several supply agents. On the other hand, due to the presence of metallic parts in mechanical switches accessible to the user, there is the possibility of generating ESD discharges that could cause malfunction in the electronics such as it has been seen in the past.

In figure 1 a typical solution of open door detection is shown using a mechanical switch.

An alternative solution proposed in this disclosure is a time of flight sensor that could be used to detect the presence of the supplies instead of the mechanical switches.

In figure 2 the open-door detection solution using a time of flight sensor is shown.

The time of flight sensor is an optical sensor that calculates the distance of an object by measuring delay time between emitted and received waves. Depending on the distance, the precision of the measure could be in the order of millimeters and given the usage of this sensor in the cameras of the mobile devices, the cost of the sensor is usually low.

The idea is to use a door for all the supplies and instead of using a mechanical sensor attached to that door, use a time of flight sensor to detect if that door is opened or closed. There is no need that the sensor will be attached to the door, so the ESD risk is then minimized if the sensor is placed in a position no accessible by the user. On the other hand, since no mechanical parts are used and no interaction with the user is required, the risk of damaging the contacts are zero.
Figure 1 Door open detection using a mechanical switch
Figure 2 Door open detection using a time of flight sensor
Figure 3 Traditional way of implementing multiple acumen solutions
Figure 4 Multiple acumen solutions using I2C over Ethernet

*Disclosed by Sergio de Santiago Dominguez, Pedro Garcia and Michele Vergani, HP Inc.*