Photovoltaic cells efficiently powering a cooling system

Electronic devices over the whole world face the same global issue, namely heat management. The market competition constantly pushes the development of electronic components to become smaller and more efficient, resulting in more generated heat. It is of high importance to handle the present and future heat problems and to find a way to efficiently transfer the excessive heat. A promising way of doing this is by active cooling, which consequently need energy to function. This adds to the already existing global need for external power sources that in the same time are environmentally friendly.

This thesis has focused on the heat problems of surveillance cameras, particularly when exposed to direct sunlight and hot temperatures. A case study at Axis Communications AB was conducted focusing on the P32 camera and on how to meet the need for cooling. The camera is currently protected from direct sunlight using a weather shield. However, this weather shield is not enough for cooling purposes. The tricky part with shielding the camera in this way is that the air beneath the shield and the camera is captured and stands almost still. This makes the temperature higher which in turn adds to the heat problems.

We have had the opportunity to design for a new weather shield that could, just as the earlier shield protect from direct sunlight, but also to function as an external power source. This new power source could then power an active cooling system to lower the camera temperature. Photovoltaic (PV) cells, i.e. solar cells, were to be the power source, integrated in the weather shield. The primary focus of the project was to design this PV system to actively cool the P32 camera by integrating it with a shield. It was also decided that the case study would focus on cameras located in Dubai, in order to design the PV cell system according to the sun's movement in that geographic location.

By using principles presented by Ulrich & Eppinger's product development method, several different concepts were generated. The project resulted in a final concept based on data and input gathered from Axis staff, consultation with team members and others. The final concept was a new weather shield prototype with four small scale PV modules integrated on three sides of prototype. The PV cell system was optimized for generating power during hours of the day when high irradiance coincides with high temperatures, specifically in Dubai. When the prototype was finished and the PV modules were connected to a cooling system, namely two small fans also integrated in the prototype, we could run temperature tests in a solar simulation lab. This was to simulate the conditions in the site of Dubai and to see if the new prototype could cool the P32 camera better than the original weather shield. The results showed that the prototype actually did lower the camera temperature significantly. This decrease in temperature was equally due to the new shield and due to the fact the two fans actively cooled the air surrounding the camera.

Since the use of PV cells in small scale applications such as this, is relatively new for Axis, it is hopefully a project that can be further developed. The project has provided a proof of

concept, where a small-scale PV system powers an active cooling system for one particular camera in a specific region. However, this external power source can be optimized for other regions as well and does not necessarily have to power a cooling system directly but could for instance also be used for storing energy or powering another energy demanding system. We believe that there are many possible applications for this PV system and our project has provided an example of what such a system can do.

It was interesting to see that our prototype could lower the internal camera temperatures surprisingly well. It was also interesting to see that the PV cells we used in the project had a relatively high efficiency, but that the efficiency will most probably continue to increase for PV cells. Meaning that in the future, if the efficiency doubles, our prototype could generate as much power but be half as large. Or, it could be of the same size but produce twice as much energy. Either way, that would make such a product even more competitive on the market!