

Automatic determination of damage to cultural assets by means of artificial intelligence

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Goal and motivation This paper presents a new procedure that automatically detects damage to cultural assets and informs the user. The procedure is based on artificial intelligence (AI) methods. To detect damage, various sensor types such as non-contact temperature and humidity measurement are combined with a camera system. With the help of Convolutional Neural Networks (CNNs), an AI technology, the conditions of the object to be observed are automatically determined from the data.

The automatic detection of damage to cultural assets is particularly useful if they cannot be directly monitored by a person, or if permanent damage monitoring by persons is too time-consuming and expensive. Examples include the windows of cathedrals, which are usually installed at high altitudes, as well as church organs, in which the permanent mold monitoring outside and inside the organ can be easily realized.

Concept and realization For the application of the method, a system as shown in Figure 1 will be developed, which consists of the two main components a local microcontroller with camera as well as sensors and a cloud-based data storage with web server functionality

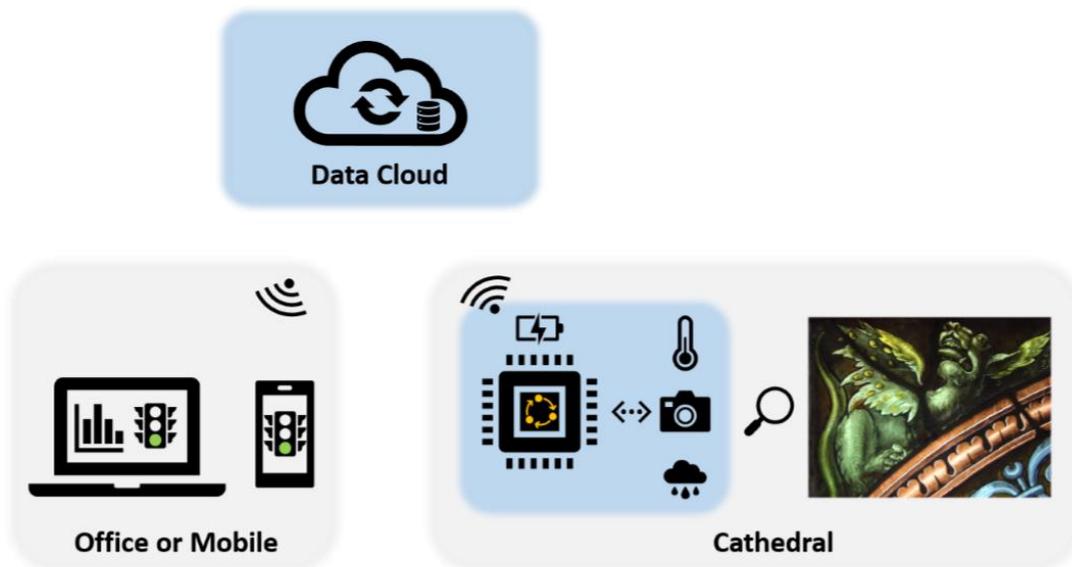


Figure 1 System Architecture

From the sensor data determined locally on the object and the camera image, the state of the cultural asset is automatically calculated on the microcontroller using CNN algorithms and transmitted to the cloud server. A CNN is a special neural network that has been developed for image processing. CNNs are already used in an industrial context, e.g. for autonomous driving or quality control in production plants. Image processing is also used in the context of cultural assets. In this context, however, only in

the area of virtual 3D reconstruction for surveying and documentation of cultural assets. A use of CNNs for damage detection of cultural assets is new according to the current state of literature research.

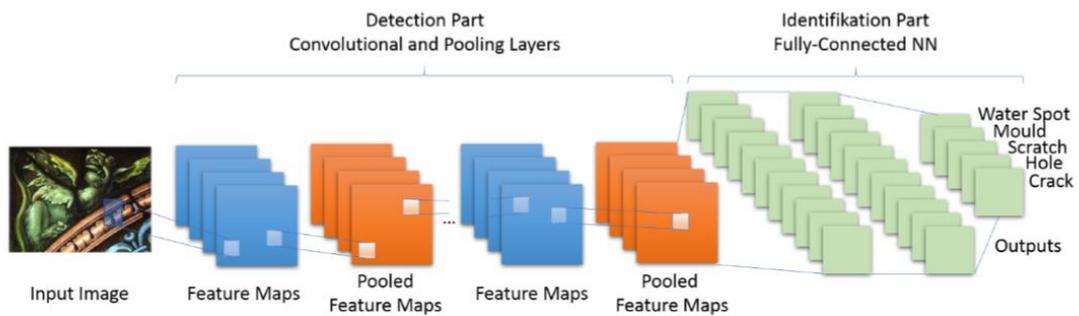


Figure 2 Structure of CNNs

The principle of a CNN is to emulate the brain of living beings and thus their pattern recognition capabilities in the computer. Figure 2 shows the structure of a CNN. The initial image is gradually broken down into its characteristics from simple to complex in order to extract the properties to be detected at the end.