



Algorithm training from the crowd

smart image segmentation for autonomous driving

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Imagine your car arriving automatically as soon as you close the door to your flat, having found a parking space nearby last night all by itself – without human involvement. Is this just fantasy?

Today's cars are capable of parking themselves, keeping distance automatically on the motorway, warning when other road users cross the rear area when reversing out of a parking space. Despite all that progress, we are still far from fully self-driving cars, even though some manufacturers speak a great deal about it. What we currently have is piloted driving, as humans must still make the decisions, drive and supervise the car.

The Berlin-based company Crowd Guru is trying to bring us closer to the future with a crowd that trains a self-driving algorithm. This requires close cooperation between people and technology. The training data is based on thousands of photos of everyday traffic situations supplied by the customer: overcrowded crossings, motorways, dense

city traffic or nearly empty country roads. The images show day and night scenes as well as all imaginable weather

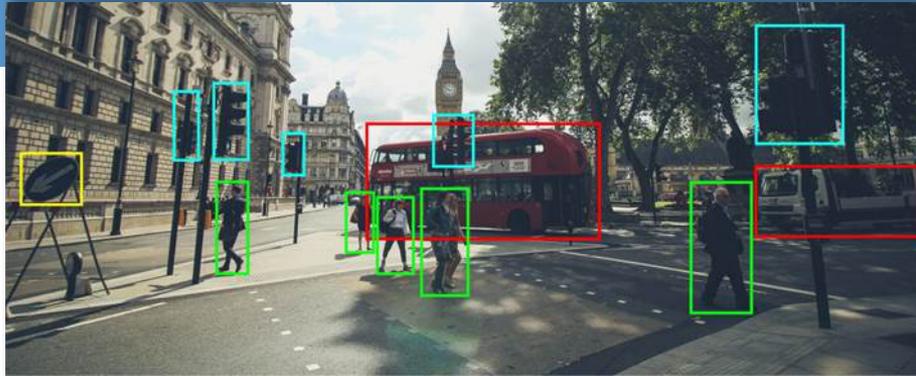
conditions. This is necessary to illustrate the broadest possible range of traffic situations to provide the software with **a large database**.

The actual task of the crowd can be divided into two stages: First they segment the images and then colour-annotate them. For example, the sky is tagged blue, the road grey, the pavement purple and the people green. Depending on the initial image, the results can range from monotonous to an abstract patchwork of colours. The quality managers at Crowd Guru check the images and adjust if necessary. Finally, the results are delivered to the customer, who can use the segmented images immediately and without restrictions to train his algorithm.

Crowd Guru is a German crowdsourcing service provider and one of the pioneers and market leaders in the German-speaking market. Besides machine learning and algorithm training, its services include categorisation, content moderation, content creation, research, product data management and lead generation. It processes over 30 million micro jobs according to crowdsourcing principles every year.



"It is particularly exciting for us to be able to shape our own mobile future," says Hans Speidel, CEO of Crowd Guru, "While we have been using crowdsourcing and image processing such as tagging or categorisation as standard for years, this is our first foray into autonomous driving." Despite Crowd Guru's experience with image processing, image segmentation for autonomous driving required the company to make some important changes. Crowd Guru implemented semi-automatic pre-segmentation specifically for this job: At the push of a button, the individual image areas (sky, cars etc.) are pre-segmented. "We make it easier for the crowd to segment and annotate objects in an image. The crowd



Traffic Lights

Road Signs

Humans

Verhicles

Crowd Guru's solution offers full and partial annotation options.

then only has to make some minor changes," says Alexander Kindziora from Crowd Guru IT, who adapted the software. It is possible to adjust the pre-segmentation settings to produce rough or detailed results. However, full-screen segmentation and annotation represents only one of the features offered by Crowd Guru's software. Depending on customer requirements, it can be used to produce full segmentations, bounding boxes or 3D point cloud annotations. There is no maximum number of segments per image - even images with a variety of information

internal solution rather than outsource the job to an external provider.

Changes in the running process

The CEO of Crowd Guru, Hans Speidel answers this in the negative: "In the end, we can deliver results that are more accurate and faster than any in-house solution. If you do this in-house, you need to recruit and train staff plus you may have to write the software, test it, check the results, test it again - and in the worst-case scenario, you may have to go back to the drawing board.

can be processed in this way. Thanks to the scalable crowd, even big orders can be processed quickly. Still, the question remains whether it would not be easier, cheaper and faster to find an

By this time, we would have typically already delivered the order, while an in-house solution would be still in the development stage. This is the big advantage of crowdsourcing: You have access to a pool of qualified and specialised crowdworkers who work in parallel." Most orders are temporary, one-off projects and to implement them in-house could hardly be classed as efficient. . Thanks to long-standing experience, Crowd Guru can tell you exactly how long it will take to process the images and whether crowdsourcing is the right solution for the specific task.

A great feature is that changes can be made even if the process is already running. If the customer's specifications change, the process can be adapted within a short period of time. The delay is marginal. As a matter of fact, the customer has many customisation options and can tailor the workflow precisely to his needs. The result is that the images can be processed and delivered very quickly. "We

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always deliver a final image, which is ready to be used by the customer from the get-go," explains Hans Speidel.

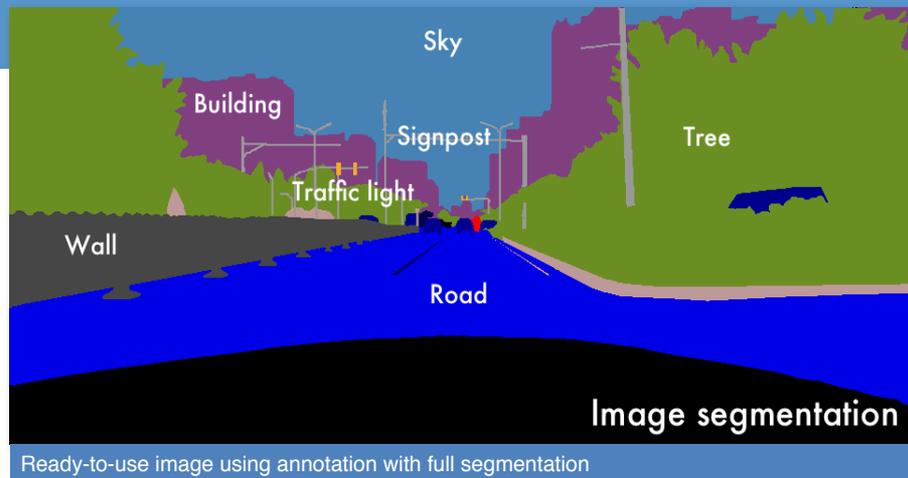
Thanks to a combination of software support and access to a pool of qualified and specialised crowdworkers who work in parallel, Crowd Guru can deliver fast and efficient image segmentation, which can be tailored to the customers' needs. It is clear that such tasks should not be left to algorithms alone: While artificial intelligence can be used to support human intelligence and imagination, it cannot replace it. This is especially true when dealing with safety-related topics where it makes sense to let humans and machines work together. Crowd Guru's workflow and quality management processes are well-coordinated to benefit both customers and crowd workers in equal measure.

Shaping the future

Segmentation and annotation-related

services are increasingly in demand at Crowd Guru. This is still about machine learning and artificial intelligence. "An increasing number of companies want to take advantage of

of artificial intelligence, but they are unsure about the processing of input data. With our crowd solution we can help these companies quickly and efficiently," says Hans Speidel.



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