

AUTOMATED ROAD-CONDITION ASSESSMENT:

Harnessing the power of machine learning and image recognition.

THE BUSINESS CHALLENGE.

The development and maintenance of road networks play an important role in the economic development of a country. The proper upkeep of roads improves their safety, reduces the cost of transportation, both in terms of money and time, and enables better regional and international economic integration.

South Africa maintains a total road network of approximately 535 000 km. Of this, 366 872 km are non-urban and 168 000 km are urban.

Road-surface assessment surveys rely on teams of people to manually assess road surfaces according to a list of criteria. Teams walk down every road, taking note of the road surface quality, and documenting various markers, such as cracks and potholes, in the process of mapping the road network's quality. Common criteria include: the adherence, the micro-texture, the macro-texture, and the surface degradation of roads. The resulting information is integral in the better planning of road development and maintenance.

Presently, the financial and temporal costs of manual road-surface assessments can be staggering. It can take a human up to an hour to cover just one kilometre. In South Africa, this would amount to 168 000 hours of labour in urban areas alone. The manual approach is highly subjective, qualitative, and sometimes inaccurate. Evaluation results may vary due to personal judgment, distress type, or severity. The subjective nature of this work may, moreover, impact the data, rendering it unreliable and misleading. Unreliable data can result in non-optimal allocation of agency funding and resources. It is therefore imperative for agencies to ensure that high quality road condition data is collected and processed.

WHO IS IMQS?

MQS builds specialised, GIS-centric software for the Infrastructure Asset Management market. This means that we are committed to conceptualising and constructing solutions for real-world problems that impact the lives of people, at all levels and from all communities, on a daily basis. It is our business to think of innovative ways to enhance the value of your organisation's physical assets, while you focus on the work that matters – delivering key services to your valued customers.

IMQS's software is currently enabling effective decision-making, service delivery and customer satisfaction in over 100 government and private organisations in South Africa and the internationally.

KEY POINTS

- Automated Road quality assessment
- Image recognition
- Machine Learning
- Local Government
- Smart Governance

BENEFITS

- Reduces time and cost of performing road-surface surveys.
- Eliminates human error
- Ensures consistency in survey data
- Integrates with IMQS Asset Register and Project Control System
- Buttresses integrated lifecycle asset management

Currently, available technological solutions that cater for condition assessment are expensive, especially in developing markets where budgets are limited. These solutions often consist of expensive equipment and specialised vehicles. Special skills are required to operate the technological solutions. Finally, a large time lapse exists between condition assessment and acquiring the resulting data.

THE SOLUTION.

Reliable and cost-effective automation can help overcome the above challenges. IMQS Software has developed its own automated road-assessment solution by harnessing the power of machine learning and image recognition. This solution requires no specialised skills, and considerably increases the speed of acquiring reliable road-condition data.

Machine learning is an application of artificial intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed. Computer programs are developed that can access data and use it to learn for themselves. The process of learning begins with observations or data, such as examples, direct experience, or instruction, in order to look for patterns in data and make better decisions in the future based on the examples that are provided. The primary aim is to allow the computers to learn automatically without human intervention or assistance and adjust actions accordingly.

IMQS has successfully merged machine learning with image recognition. A tripod with suction cups is mounted to the front of a vehicle. An SLD camera on the tripod is pointed to the road, capturing road data according to preconfigured parameters / criteria. The camera stores GPS coordinates while it is filming. The resulting video footage is processed using a Convolutional Neural Network (CNN), which finds the relevant features in the road surface, such as cracks and potholes.

CNNs have proven to be useful in analysing visual imagery. They make use of sequential layers and an input file that contains the "weights" of the parameters. Compared to Fully Connected Networks, CNN's rely on fewer parameters and are cheaper in terms of memory and computing power. When harnessing the power of CNN, IMQS starts from a clean slate and trains the network to understand what it sees in the camera footage. As the machine learns, the process becomes more reliable and the data ever more accurate.



The captured information is finally used to build an accurate map of the road network, which shows, with precision, the surface quality on every part of the road.

THE ACHIEVED BENEFITS.

This IMQs solution substantially reduces the time and cost of performing road-surface surveys. This technologically driven method, decreases the survey time to an estimated average of 30 km per hour. Moreover, a conservative estimate establishes a reduction of costs by a factor of ten, while no specialised skills are needed to operate the hardware. Finally, due to the consistency inherent in the computer algorithm, a major achievement is a far greater consistency in survey data.

This IMQS solution is built to seamlessly integrate with existing geographically enabled IMQS products, such as the IMQS Asset Register and Project Control System, but will also integrate with a municipality's preferred asset management system. In so doing, it buttresses the existing integrated lifecycle asset management approach that makes IMQS a leader in the infrastructure asset management industry.

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