NSSN
NSW Smart Sensing Network

FACT SHEET

NEW TECHNOLOGY FOR SORTING AND RECYCLING

FROM ADVANCE SENSING TO ARTIFICIAL INTELLIGENCE

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New technology for sorting and recycling

NSW Smart Sensing Network

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Recycling is an important part of the waste stream. The NSW Waste Less, Recycle More program has found success in increasing recycling rates to up to 47% for household waste. In addition to environmental benefits, recycling contributes to local financial systems by driving a circular economy. Efficient recovery is usually cheaper than accessing raw materials. Proper sorting and processing to arrive at contamination free materials is key to optimised recycling efforts. High sorting speeds are important to make sure we can keep up with the waste generation rate. There are clear opportunities to harness developing technology and innovation to improve sorting of recyclable materials throughout their life cycle, improving yields, quality and ultimately profitability of many processes.

Smart Sensing with single molecule sensing, multi-sensing modes, and sensor fusion, paired with artificial technology such as machine learning (ML) and data analytics have the potential to enhance the recycling industry.

Advances in sensing technology

Single molecule sensing

Single molecule sensing is an idea that stems from life sciences to detect and identify a molecule from small samples. The motivation is to get richer data from even the smallest sample. The concept can be repurposed in the recycling domain to identify the smallest contaminant – one molecule. The research vision is to incorporate such sensors on the conveyor belt.

Multiple sensing modes

Different sensors that are good at sensing different materials or different characteristics can be programed to work together in configurations that increase the speed, accuracy, and precision of recycling sorting. A multi-material recognition sensor array can be put at the beginning of the conveyor belt to separate the mixed material then directed to more specialised sensors.

Another method to use multiple sensors to get better understanding of the sense environment is known as sensor fusion. This method uses all information from the sensors at the same time to detect and identify the object. Different optical sensors are good at detecting different aspects of the materials, such as transparency, polymers compositions, and colors. If used at the same time, we get these properties about the object and sort them accordingly, before travelling further down the conveyor belt. High speed imaging coupled with these different optic sensors has the potential to enable rapid sorting.

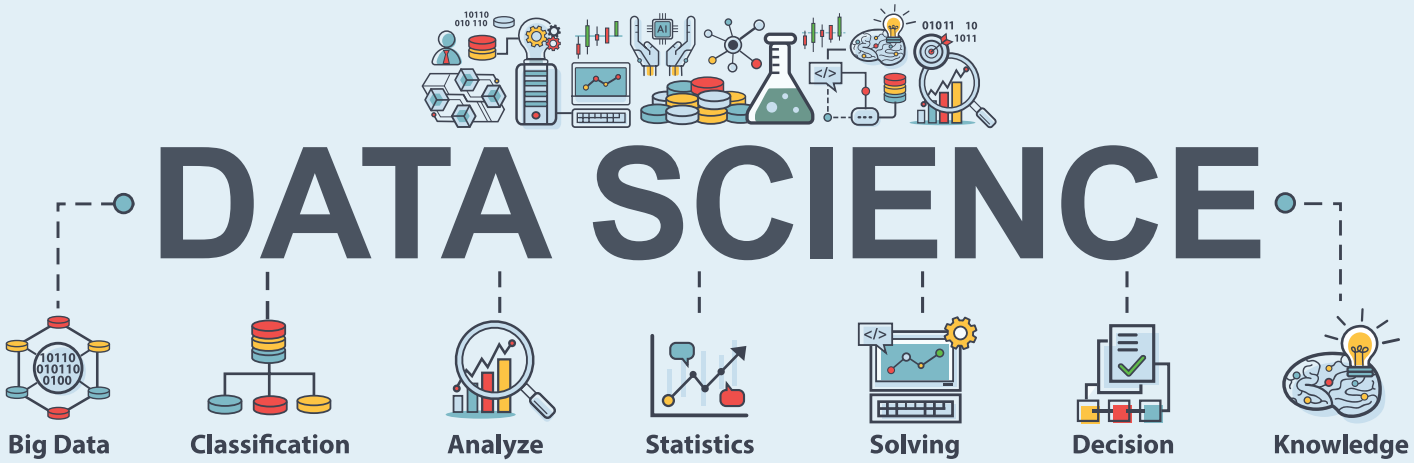
Artificial intelligence and machine learning

The ability to classify and sort is a fundamental activity that AI and ML is very well predisposed too. Its most popular application is in computer vision to detect and recognise objects. A large database consisting of a variety of images with the corresponding object name as target is used to train an ML algorithm. The result is a model to be installed onsite without the need to store a large database anymore. The ML algorithm is flexible such that they can take any kind of data, such as audio, and hyper-spectral images, as long as it has the target data to learn from. Data analytics has superpowered many applications such as getting insights into customer behavior *w*and optimizing advertisement placement.

Machine learning techniques have been extensively used in different research from picking out elements from an entire streetscape and recognising coughing using smart phones. The recycling industry has taken up ML approaches with the optical sorting to recognize certain plastic material followed by air ejection or robotic arm. Research is ahead of industry in other aspects of optical sorting, such as multi-material recognition, transparent plastic bottle colour recognition, ability to discern overlapping bottles and more. The ML algorithms are flexible to the recognition target required. It can detect in stead of recognise shapes and color to estimate the previous content and potential contaminant.

Reverse vending machine (RVM) is enhanced with ML model to recognise bottles and cans. Successes can be improved with optimised uptime. The main cause for RVM downtime is when the bin is full. Data analytics research can assist in getting insights into the pattern for when the bin is full, for optimised bin collection and minimised downtime. This kind of research is also applicable to household curbside collection to gain insights such as contamination rate of different suburbs. There have been similar studies in different municipal around the world including Australia for scheduling and routing optimisation.

These powerful algorithms have low barrier of entry recently in light of advancements in edge computing, graphical processing unit (GPU), and cloud computing. Their real-world application is moving from rare research activities, to being more common and ready for industry uptake.



Translation from research to industry

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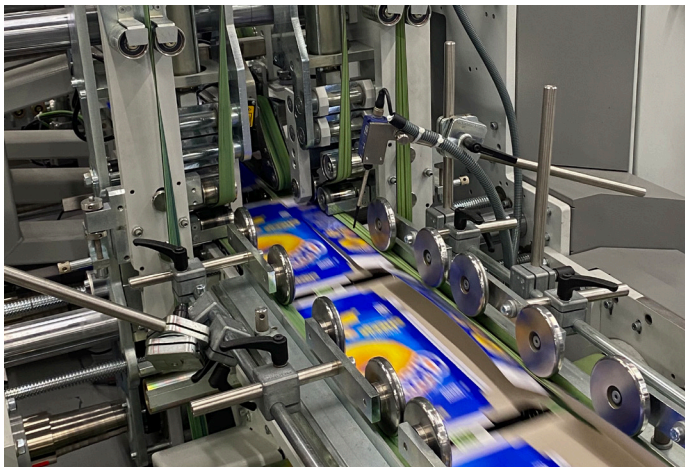
The NSSN is well positioned to guide interested parties in industry, government and universities to work together on exciting new projects

Industry Partners

The project's industry partners are making an investment in the future by funding this research to the tune of nearly $1.5 Million.

Labelmakers started back in 1987 printing self-adhesive labels, and grew to become Australasia's largest and most innovative label supplier. Packaging has changed considerably over the last three decades and they have developed solutions that have responded to the changing needs of our customers. Self-adhesive labels are now just one of six core labelling products. Labelmakers are supporting this project as part of their commitment to exploring opportunities that expand our business to continue to grow our offerings to our customers while remaining competitive in a global market and looking at ways to further reduce our carbon footprint.



PEGRAS Asia Pacific, is a technical solution consulting company based in NSW. For seneral years they have been collaborating with the NSSN and many industry partners to solve real world problems.

With a network of consultants in Australia, Europe and Asia, PEGRAS has provided solutions for various companies, including Audi, BioOil, Continental, Siemens, and TOYO.

Building on immense background knowledge of print and packaging, their business focus includes developing solutions for the Circular Economy needs of plastic recycling. PEGRAS developed the initial proof of concept chemistry that has evolved into this CRC-P project and provides a chemical and engineering lead.

To find more about the project out how the NSSN can help solve your challenges in other areas, please contact Dr Don McCallum at 0433 496 778 or don.mccallum@nssn.org.au

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