PRODUCTS OVERVIEW

Conveyor Innovations International Pty Ltd

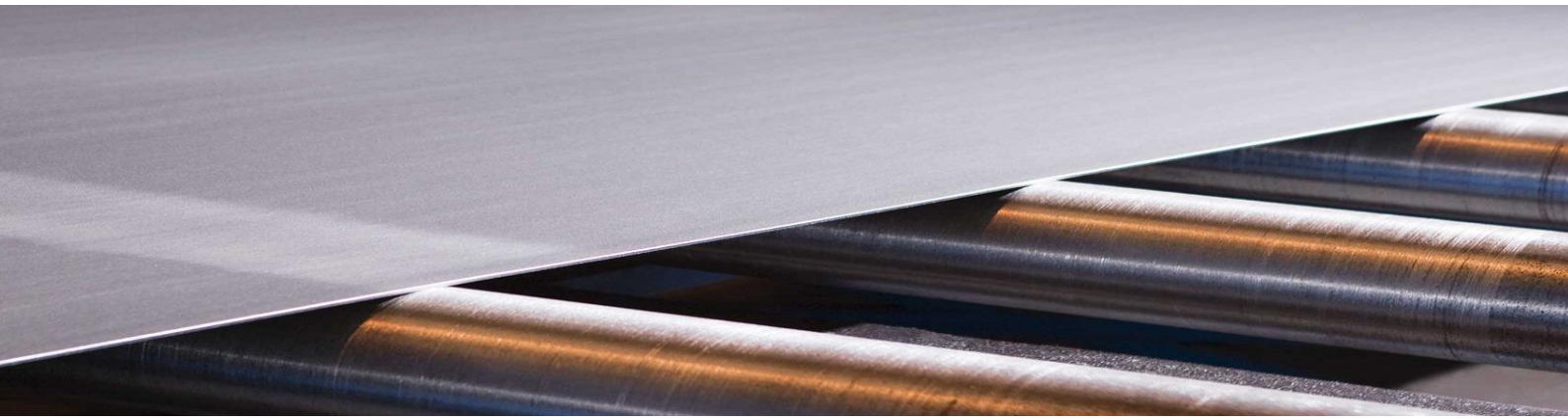
Prepared May, 2020

ACN 111 471 802 (CII)

Website: ci-int.com
Email: justin.geddes@ci-int.com

13 KYLE STREET . EMERALD . QUEENSLAND

TEL +61 7 4986 4550



CONVEYOR
INNOVATIONS INTERNATIONAL

Table of Contents

Conveyor Innovations International Pty Ltd

Prepared May, 2020

Company Details

Phone	**(07) 4986 4550**
Location	**13 Kyle Sreet, Emerald Qld**
Correspondence	**PO Box 1937 Emerald, Qld 4720**

Contact

Colin Longton	Managing Director	colin.longton@ci-int.com	**0412 514 131**
Justin Geddes	Director of Operations	justin.geddes@ci-int.com	**0403 052 528**

1. Introduction

Conveyor Innovations International Pty Ltd ("**CII"**) is an Australian company that specialises in the design, manufacture and supply of conveyor idler rollers in Emerald Queensland.

As part of its R & D, CII has been developing an intelligent roller - the iRoller, using Bluetooth technology and monitoring software that is "cloud based".

The iRoller purpose is to install the iRoller on materials handling conveyors at mines and ports. The rollers will:

1. automate predictive maintenance in real time for their entire conveyor systems;
2. establish accurate remote supervision;
3. lower operating costs; and
4. improve productivity and reduce the occupational health and safety risks, associated with personnel working on conveyors.

Monitoring

iRollers can be monitored in real time:

1. at the site office via PC's and remotely by mine personnel, the mine operator and CII; *and*
2. by site personnel who are inspecting conveyors using IOS and Android devices such as iPhones, iPads, smart phones, and tablets.

iRollers can be introduced to sites in small numbers and installed on conveyors over time.

The iMonitor is the electronic brain attached to the iRoller. The device can be licenced by CII to 'other' manufacturers, and installed on their idler rollers, with a minimum of factory retooling.

The iMining App is being developed for the iRoller, and also makes provision for input of data by inspection personnel for the dumb rollers, its software, and at the time of inspection.

2. The Company and Management Team

(1) The Company

CII is based at Emerald, Queensland

In 2012 it became involved in the development of high quality, reliable conveyor idler rollers for use in materials handling conveyors at mines which it then began to manufacture and sell in the Bowen Basin in 2015.

CII and development partners, Universal Bearings (34 years of industry experience), have jointly developed the current technology into CII's conveyor idler rollers.

In 2017, CII began to concentrate on the development of an intelligent conveyor idler roller. The iRoller was for all intent purposes developed to support the mining industry's goal of automation for mining operations - from pit to port.

(2) Board of Directors

The Company has two directors, who have both been with CII since 2012:

(a) **Colin Longton – Managing Director**

Colin graduated from the University of New South Wales in 1972 with a B.Comm. His corporate and management consulting experience focused on business start-ups including Vodafone in Australia, and as a Management Consultant and business operator.

(b) **Justin Geddes – Director of Operations**

Justin's background is in law. He holds an LLM (Corp and Comm) from Bond University.

Until 28 March 2013 Justin practiced as a commercial lawyer full time. At the time of his retirement he was one of two directors of the Firm Derek Geddes, then one of the largest firms on the Gold Coast. Justin has 35 years' experience as a lawyer and still retains his Queensland Law Society, Practicing Certificate.

Since 2018, Justin has lived in Emerald and is working there operationally for CII full time.

(3) iMonitor Project Team

The key team members are Russell Morgan and Professor David Thiel.

Russell Morgan: Product Development Engineer

Russell has over 50 years' experience in the electronics and micro-processor fields, including programming these devices. He designed the iMonitor Circuit Board used in the iRoller.

Russell was awarded the Griffith University Medal for his part in the establishment of the Griffith University School of Micro Electronic Engineering.

Russell has worked closely with Professor David Thiel for many years.

Professor David Thiel: Griffith University

Professor David Thiel is currently Deputy Head of School of Research at the Griffith School of Engineering, and Director of the Radio Science Laboratory.

David is a chartered professional engineer (F.I.E.Aust, CPEng.) registered in Australia, and holds a PHD, MSC and BSC.

His experience includes a long history of research and consultancies in wireless sensor networks. David manages the application of these networks for mining and exploration, human monitoring, and infrastructure monitoring. David has co-authored about 150 papers at international conferences.

David is integrally involved with the development of the iMonitor. Both he and his team have designed the aerial incorporated on the iMonitor circuit board.

Additionally, he has also established a team who are currently working with HoloLens (a Microsoft product). They have developed a 3D conveyor monitoring program for CII, in concept form.

3. iRoller

(1) Overview

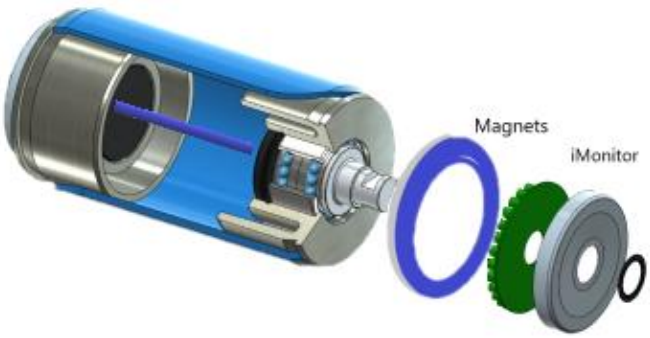
The iRoller network relies on the following key components:

1. **the iRoller** is a conveyor idler roller that has the iMonitor attached to it; collectively referred to as the iRoller.

2. **the iMonitor** is attached to one end of the iRoller, and is a Bluetooth 5 microelectronic device for monitoring the iRoller.

3. **Network Controllers** are microelectronic devices used to monitor a group of iRollers on a conveyor, and to send the data to a Master Network Controller near the tail pulley. The Master Controller will in turn relay the data to a computer on the site or send that data via a sim card into the "cloud"[1].

4. **iMining Software** is cloud based software to monitor the signals from the iRollers and report on idler roller health. The information can be viewed on an IOS or android device, or on a PC; [2]



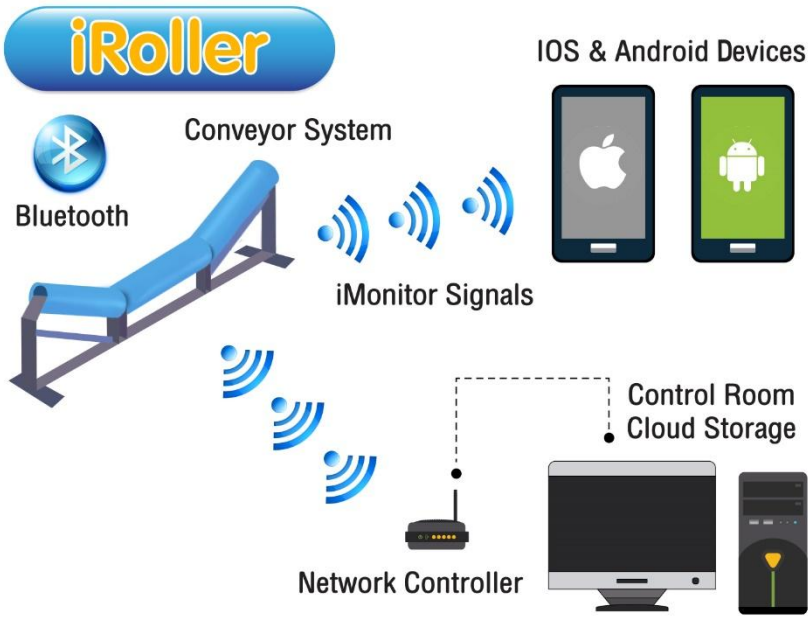
(2) The iRoller Network

A system of highly integrated hardware and software:

---

1 The Network Controllers are Bluetooth 5 devices with the Master Controller being Bluetooth or a LoRaWAN device

2 The iMining software can also monitor iRoller signals directly via IOS and Android devices such iPhones, iPads, smart phones and tablets



(3) Selection of Bluetooth 5

The Bluetooth 5 communication protocol was chosen due the following 'mining environment' related performance characteristics:

(a) backwards compatibility and a standardised protocol with individual addressability;

(b) 2.4 GHz[1] operating frequency, 8 x data input, and multiple data channels;

(c) Cyclic Redundancy Check (CRC) for error detection and error correction with a quicker and more secure paring process;

(d) A range of about a 300-400 metres (direct line of sight).

(4) iMonitor

(a) Characteristics

The iMonitor consists of two parts:

(i) **a set of magnets** that are set into an inner seal which is affixed to the endcap of the roller. These rotate when the roller rotates.

(ii) **the iMonitor** (diameter 88mm), a separate module forming part of the (outer) weather shield that remains stationary while the rest of the roller rotates.

---

[1] 2.4 billion waves per second

The iRollers have been designed to work in a mesh network and to talk with one another to relay signals.

The software is upgradable in situ.

(b) **Key Metrics**

Each iMonitor will monitor the following in real time:

1. Current Bearing Temperature;
2. Current Vibration Monitoring; (±2g/±4g/±8g/±16g scales)
3. Current RPM - Current Belt Speed;
4. Hours of Operation;
5. Expected life period;
6. Self-Powered.

Optional elements include:

- Acoustic Monitoring; and
- GPS.

(a) **Energy Harvesting**

A circular array of small neodymium magnets with alternative polarity positioned in the inner seal on the moving roller endcap is being used to harvest energy to run the sensing system and to provide belt velocity information.

The magnets are located on the moving part of the idler roller endcap and an induction coil fixed to the non-moving part.

The sensor unit harvests the energy from the moving parts and stores this energy for signal processing, radio communications, and is an early warning system.

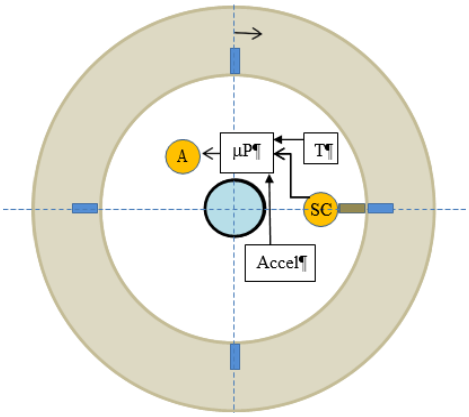
A super-capacitor or rechargeable battery can be used to store the accumulated electrical energy. At this time CII has opted to accumulate the energy in a super capacitor.

(b) Sensor Characteristics

The sensors measure the temperature, speed of rotation and abnormal vibrations in the roller. This is accomplished using a relatively small microcontroller unit and a MEMS accelerometer sensor.

A microcontroller system is being used to log and interpret the signals. A small accelerometer in the iMonitor is being used to measure the bearing vibration via a frequency controlled switched capacitor filter and rectifier circuit.

- The axle is represented in (blue).
- The rotating bearing is fitted with a dust cap (white) containing the induction coil (brown),
- the super capacitor (SC) supplies current to the microprocessor (□P) using an integrated radio transceiver attached to an antenna (A), and is located on the circuit board.
- The accelerometer (Accel) and temperature sensor (T) also feed data to the microcontroller.



(c) iRoller Parameters

The processor is programmed to provide information about the following idler roller parameters that range from 101.6 mm to 270.76 mm in diameter.

	Roller Sizes						
	Inches	mm	Size	Function	Country	Circ mm	Type
1	4.000	101.60	1			319.19	Roller - 4 Inch
2	4.250	107.95	2		SA	339.13	Roller - 4.25 Inch
3	5.000	127.00	3			398.98	Roller - 5 Inch
4	5.230	132.84	4	Impact		417.34	Roller - 5.23 Inch
5	6.000	152.40	5			478.78	Roller - 6 Inch
6	6.250	158.75	6	Impact		498.73	Roller - 6.25 Inch
7	7.000	177.80	7			558.58	Roller - 7 Inch
8	7.620	193.55	8			608.05	Roller - 7.62 Inch
9	7.640	194.06	9			609.64	Roller - 7.64 Inch
10	8.625	219.08	10			688.24	Roller - 8.625 Inch
11	8.649	219.68	11			690.16	Roller - 8.649 Inch
12	8.662	220.01	12			691.20	Roller - 8.662 Inch
13	9.000	228.60	13			718.17	Vacant
14	9.500	241.30	14			758.07	Vacant
15	10.660	270.76	15			850.63	Green Pulley - 10.66 Inch
16	10.740	272.80	16			857.01	White Pulley - 10.74 Inch

Conveyor speed is critical for energy harvesting.

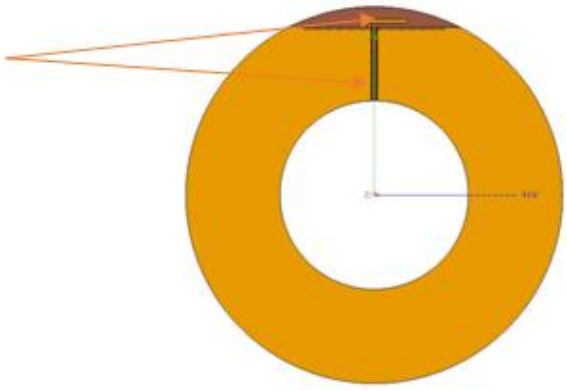
	Roller Size		Belt Speed in Metres per Seconds - showing the minimal Belt Speed vs Roller Size											
	Inches	mm	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3	1.4	1.5	2
1	4.000	101.60	3.05	3.66	4.27	4.88	5.49	6.10	6.71	7.32	7.93	8.54	9.15	12.20
2	4.250	107.95	2.87	3.45	4.02	4.59	5.17	5.74	6.32	6.89	7.47	8.04	8.61	11.49
3	5.000	127.00	2.44	2.93	3.42	3.90	4.39	4.88	5.37	5.86	6.35	6.83	7.32	9.76
4	5.230	132.84	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60	6.07	6.35	7.00	9.33
5	6.000	152.40	2.03	2.44	2.85	3.25	3.66	4.07	4.47	4.88	5.29	5.69	6.10	8.14
6	6.250	158.75	1.95	2.34	2.73	3.12	3.51	3.90	4.30	4.69	5.08	5.47	5.86	7.81
7	7.000	177.80	1.74	2.09	2.44	2.79	3.14	3.49	3.84	4.18	4.53	4.88	5.23	6.97
8	7.620	193.55	1.60	1.92	2.24	2.56	2.88	3.20	3.52	3.48	4.16	4.48	4.80	6.41
9	7.640	194.06	1.60	1.92	2.24	2.56	2.88	3.19	3.51	3.83	4.15	4.47	4.79	6.39
10	8.662	220.01	1.41	1.92	1.97	2.25	2.54	2.82	3.10	3.38	3.66	3.94	4.23	5.64
11	8.625	219.08	1.41	1.70	1.98	2.26	2.55	2.83	3.11	3.40	3.68	3.96	4.24	5.66
12	8.649	219.68	1.41	1.69	1.98	2.26	2.54	2.82	3.10	3.39	3.67	3.95	4.23	5.64
13	8.649	219.68	1.22	1.46	1.71	1.95	2.20	2.44	2.68	2.93	3.17	3.42	3.66	4.88
14	10.000	254.00	1.22	1.46	1.71	1.95	2.20	2.44	2.68	2.93	3.17	3.42	3.66	4.88
15	10.000	254.00	1.14	1.37	1.60	1.83	2.06	2.29	2.52	2.75	2.98	3.21	3.43	4.58
16	10.660	270.76	1.14	1.36	1.60	1.82	2.05	1.27	2.50	2.73	2.95	3.18	3.41	4.54

For example, in relation to the above table, the minimum conveyor speed would be 0.8 m/s for a roller that has a 152.4 mm diameter. This area is being constantly refined with a view to reducing sustainable energy to a belt speed of 0.5 m/s, for a roller which has a 152.4 mm diameter.

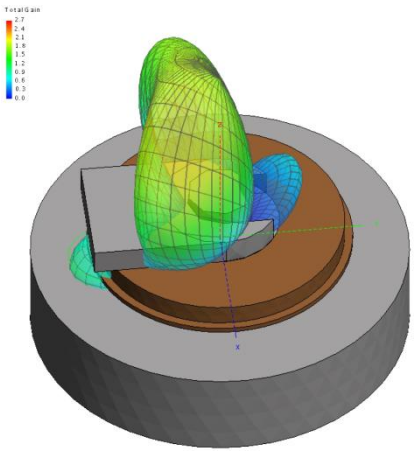
(d) Signals and Signal Processing

The antenna is located on the circuit board. The iMonitor attached to the iRoller, receives and transmits signals.

The antenna



Signal at resonant frequency.



(5) The Network Controllers

The work on the Network Controllers is well advanced. It is proposed that these will link to the electrical system on the conveyor, providing its energy source.

A Bluetooth network on each conveyor using a large number of iRollers, would generally have two types of Controllers:

(a) **Network Controllers** designed to detect and relay signals from:

(i) the iMonitors; *and*

(ii) other Network Controllers. [3]

(b) A Master Network Controller is located near the tail pulley and sends and receives signals from the Network Controllers to the computer server, on site or into the 'cloud'. The signals can be Bluetooth or LoRaWAN.

The signal of any iMonitor installed on a conveyor idler roller, by any manufacturer, can be read by the iMining App on OIS and Android device in the field.

The Network Controller will be placed along the conveyor about 100 metres apart;

A conveyor that is about 1000 metres long would have about One (1) Master Controller and 10 Network Controllers. The Master Controller will be tasked with isolating the signals only from the Network Controllers.

(6) Cost

Present indications reflect that the costs will be:

- $15.00 per iMonitor module (including magnets, one iMonitor per iRoller);
- $100.00 -120.00 per a Network Controller; *and*
- $150.00 - $200 per Master Controller – which will send the signals to a control centre or the cloud.

4. iMining App

A key part of the technology is the iMining App software.

(1) Key Attributes

(a) Key Information

The iMining App is being developed to contain a series of attributes:

(i) cloud based;

(ii) capable of monitoring:

---

[3] Both the iMonitors, the Network Controllers and Master Controller each has a unique address.

(A) existing conventional dumb roller types of any brand, where the data is manually entered into the App;

(B) iRollers (including the rollers of any licensed company) that use the iMonitor in their product;

(iii) multiple conveyors can be monitored concurrently:

(A) on one mine site or port; *or*

(B) across multiple mine sites or ports (or both);

(iv) enables monitoring at the site office, and also remote monitoring, with tables that show potential failures and graphs.

(b) Application

The software will be downloadable onto PC's, IOS and android devices;

(c) Integration

The software is being designed so that its data can be integrated with SAP, PRONTO, and other mine systems.

(d) Roller replacement

CII is developing the software that will detect and make an automatic allowance (and adjustment) for any iRoller that replaces an existing iRoller.

Where a large numbers of rollers are required to be changed out at one location, then a simple data entry would need to be entered.

(2) IOS and Android Information

The development to date is concentrating on a hierarchy for the software by way of example is a follows:

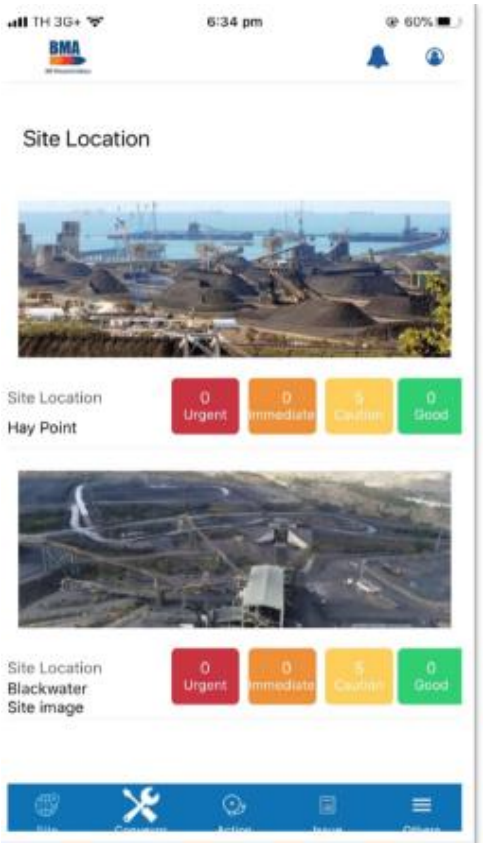
(a) Entry Page Username and Password.

(b) The user is then taken to a screen showing:

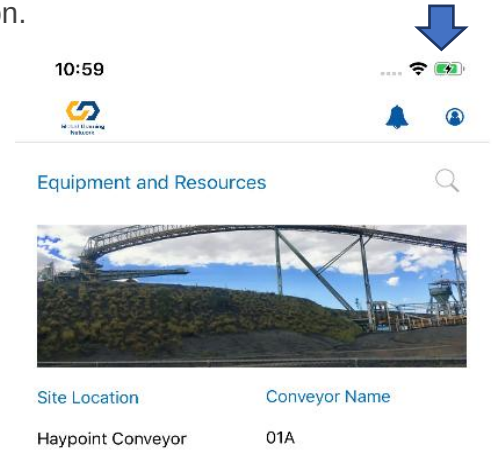
(i) The name of his or her mine or port, and the conveyors by name (scroll up and down list and search facility); *or*

(ii) multiple mines or ports that the user may be monitoring. (scroll up and down list and search facility).

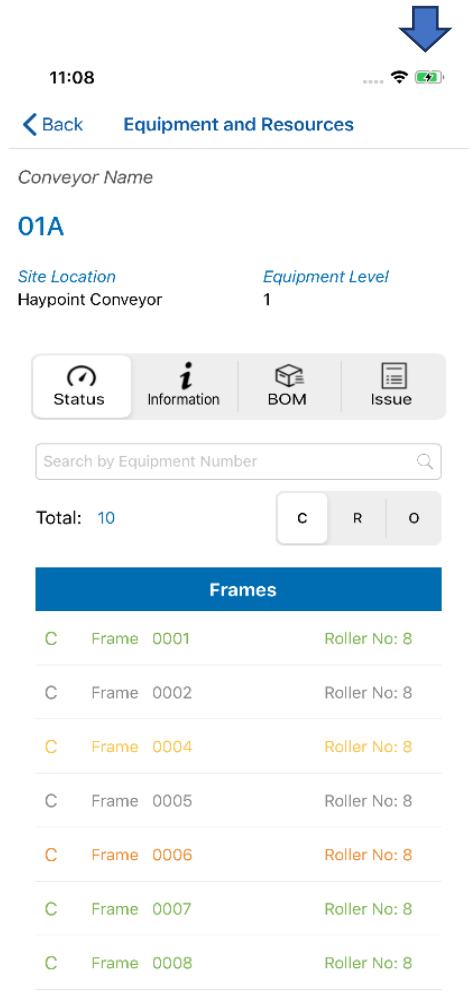
The user can then select the individual mine or port and is then taken to the list above.



(c) **Select Conveyor by Name** and an Image can be inserted for ease of identification.

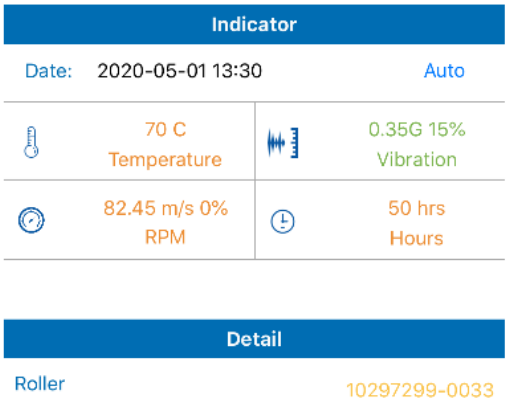


(d) **Select the conveyor** and it will show scroll list where you can scroll down through carries and returns or other – impact rollers, scrapers, pullies etc



(e) **Individual rollers can then be selected.**

The first roller appears at the bottom of the screen.



The others, and the frame, appear when flicking left to right with your thumb on the coloured roller (as it appears towards the bottom of the screen).

Other Buttons relating to roller information, whether the frame is an automatic (iRoller), and where dumb rollers have to be selected manually. Issues (photos) can be logged of any failures. There is a BOM so you can visually view the details of any roller or frame in 3D.

(3) Software development for PC

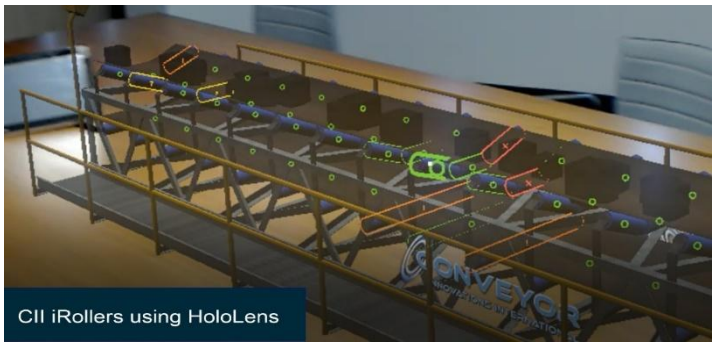
Work will commence on this as soon as the iMining App for IOS and Android devices has been completed. This is expected to occur around July-August 2020.

(4) HoloLens

This is a Microsoft product that uses special glasses to view augmented reality in 3D. Its purpose is to drive what is becoming known as the 4th Industrial Revolution of the internet of things. Work has been undertaken in this area by Griffith University on behalf of CII, and a concept program produced.

Holo Lens can be significantly useful for the monitoring of mine sites and ports as it will enable personnel to monitor the whole conveyor system in 3D Holographic Form.

CII's aim is to ultimately develop the graphics in HoloLens for viewing on PC at site, or remotely, so the whole of operation can be viewed in real time. (Image below)



Rollers can be monitored in real time. The colours reveal roller status: (1) Red is for danger, urgent, (2) orange warning and (3) Yellow for caution - I am not OK.

5. Commercialisation

(1) Background

The development time for the iRoller has been 3 years in the making.

As part of this process, CII obtained a Queensland Commercialisation Grant in 2018 for $100,000 which was applied towards the development of the iMonitor.

CII aims to have an iRoller and also the beta versions of the iMining App in place later this year (2020).

(2) Commercialisation Process

CII proposes to introduce the technology into the market in stages:

Trials of the iRoller

CII has been working with various mines that would be happy to trial the iRollers and monitor their performance on the iMining App initially, by mine personnel on site, and via their IOS and Android devices.

During this process CII will upgrade the iMining App where necessary, as well as the development of the Network and Master Controllers. Our aim is to work on the PC version later this year.

(3) Seeking Development Partners

(a) CII is seeking a development partner so that it can secure the ongoing payment of the international payment of the Patents for the iMonitor;

(b) It is also seeking to Licence its technology to multinational companies with a view to licencing:

- the iMonitor; *and*
- the iMining App.

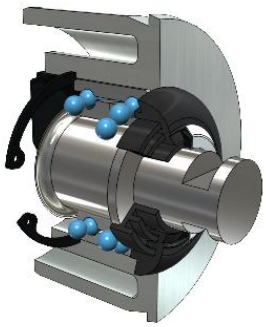
6. Intellectual Property

The IP has been retained in a related company “Conveyor Innovations Pty Ltd” with emoola.com Pty Ltd, a company of which Russell Morgan is the sole director, and sole shareholder.

Patents Pending

Patents currently underway includes:

(1) a provisional patent for the Generation 8 Roller, Application No. 2016903718



(2) a provisional patent for the Generation iRoller, Application No. 2017900275

Trademarks

Trademark (in progress) for the “iRoller” - 1826962 AU/GN.

Trademark (in progress) for the “iMonitor” – 1842771AU/GN.

Steps are underway to register the iMining App.

7. Summary

The iRoller is an evolutionary step in the monitoring of material handling conveyors.

The iRoller and the iMining App aim to achieve the following:

(a) condition monitoring of rollers in real time at a micro level;

(b) comprehensive performance metrics reporting;

(c) reduce unscheduled stoppages (saving mine and port costs);

(d) enable offsite monitoring;

(e) enable mines and ports to predicatively plan iRoller change outs through a gradual conversion that will not require extensive conveyor cabling.

The iMonitor will be available to licence to other manufactures to use with the minimum of factory retooling.

The iRoller will create a product that can be marketed locally and internationally.

The iMonitor part of the iRoller will be relatively inexpensive and with the advent of Bluetooth 5 viable for use on conveyors and for pulleys.

The costs of the iRoller will be relatively inexpensive at about:

- $15.00 per iMonitor module including magnets;
- $100.00 -120.00 per a Network Controller; and
- $150.00 - $200 per the Master Controller – which will send the signals to a control centre or the cloud.

The cost will reduce with volume.