

TARSENS

Tactical Advanced Reconnaissance and Sensor Enhanced Network of Systems

About TARSENS R&D

- Founded in 2017 to solve the most complex problems in the agricultural production by three agricultural engineers;
 - Mother; Plant Protection, MSc.,
 - Father; Field Crops, MSc.,
 - Son; Animal Sciences, BSc., Biosystems Engineering, MSc.,
- Received a grant from TÜBİTAK, Scientific Research Council of Türkiye,
- Completed several private and government funded projects,
- Been listed under success stories on ESA & AIRBUS backed Hackathon, Recognized by NIKKEI (JP), ADFCA (AE), BDTI (US),
- Provided advisory to many holdings, companies, non-profits, private citizens and government organizations

About Founder, Mr. Celil Serhan TEZCAN

- Inventor
- 4th gen farmer, 2nd gen Agricultural Engineer
- Physics PhD Student @ Lithography, Photonics
- Experience with;
 - Embedded Systems – Wireless Sensor Networks, Linux
 - Real-time and faster-than-real-time image processing, OpenCV
 - Robotics, UGVs and UAVs,
 - Remote and proximal sensing
 - Edge and cloud computing expert

Main topics of this portfolio / presentation

- Wireless Sensor Networks
 - Wireless Sensor Networks are systems of distributed, interconnected sensors that collect and transmit data wirelessly for real-time monitoring and analysis.
- Robots; UGVs and UAVs
 - Robots, including Unmanned Ground Vehicles (UGVs) and Unmanned Aerial Vehicles (UAVs), perform automated tasks and gather data in agriculture to enhance efficiency and precision.
- YieldEstimator
 - World's best accuracy yield estimation system for vineyards
- Remote and Proximal Sensing
 - Remote and Proximal Sensing use various technologies to collect and analyze data from afar or close-up, providing critical insights for monitoring and managing agricultural environments.
- Generative AI for different applications
- Occupational safety and health
- Other projects, products, applications, services, consultancies
 - Industrial inspection, infrastructure monitoring, agricultural applications, defense applications, space applications

Wireless Sensor Networks

R&D Order: Wireless Sensor Networks (WSN)

- **Customer Problem**

- Challenge: Monitoring variables in a greenhouse with extended battery life wireless sensor nodes.

- **Our Solution**

- Innovation: 8 years battery life, hot-swap sensor change, multi-channel backup wireless sensor network nodes.

- **Proven Results**

- Impact: Collected over 3.5 billion data points, published scientific papers.

Wireless Sensor Networks (WSN)

- Wireless sensor networks (WSNs) are systems of distributed sensor nodes that communicate wirelessly to gather and transmit data.
- Sensors monitor various parameters like temperature, humidity, or motion, and send the data to a central system or directly to other nodes.
- Nodes are typically battery-powered and designed to be small, low-cost, and energy-efficient for extended deployment.
- Applications span multiple fields, including environmental monitoring, smart agriculture, healthcare, and infrastructure management.
- WSNs enable real-time data collection and analysis, enhancing decision-making and responsiveness in various scenarios.

BEEZ! – High Endurance WSN

- Started as a government university funded project, in 2013
- Designed from ground-up by founder of TARSENS with the specs below for the Project;
 - Industrial-Scientific-Medical (ISM) band communication (2.4GHz)
 - Hot-swap sensor change (humidity, temperature, air pressure, luminosity, gas)
 - Extremely long battery life (2xAA = 8 years under ideal 25°C office conditions)
 - Multi-hop network with multi-channel backup (star within a star)

BEEZ! – High Endurance WSN

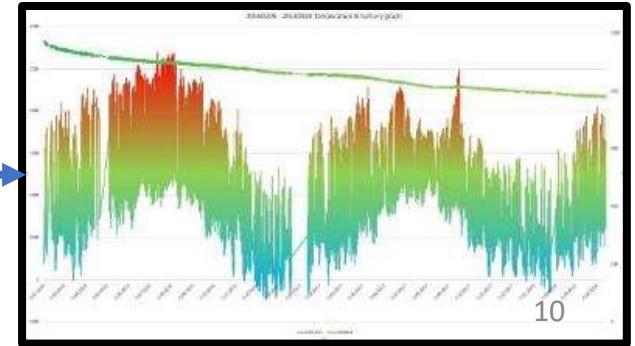
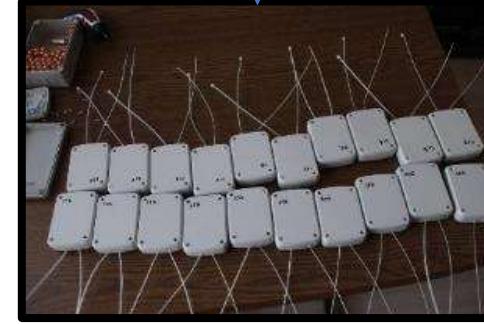
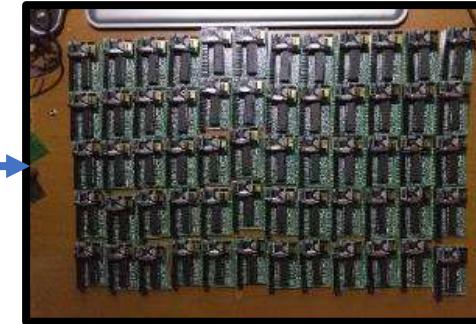


**Location of Project,
Bursa Uludag University
Agricultural Sciences Faculty**

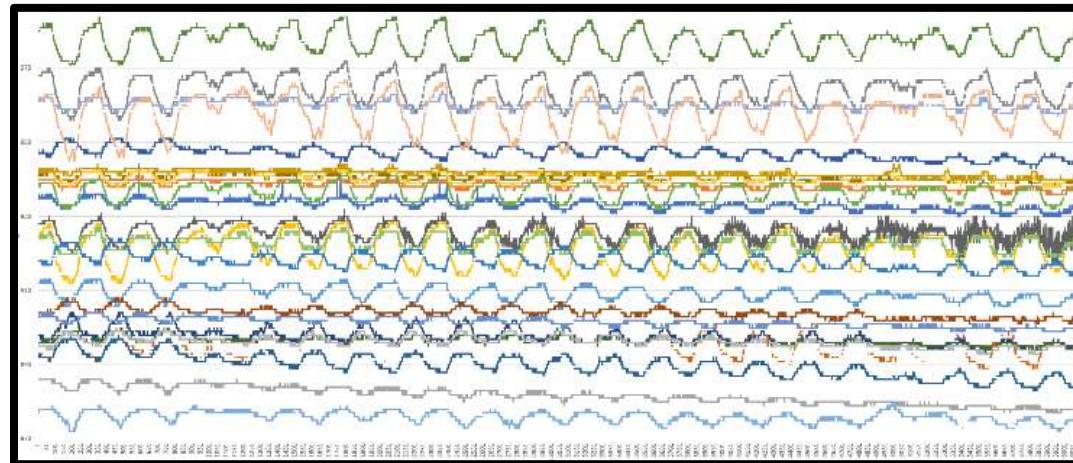
System designed as
Nodes -> Greenhouse relay
Greenhouse relay -> Faculty relay
Faculty relay -> Cloud



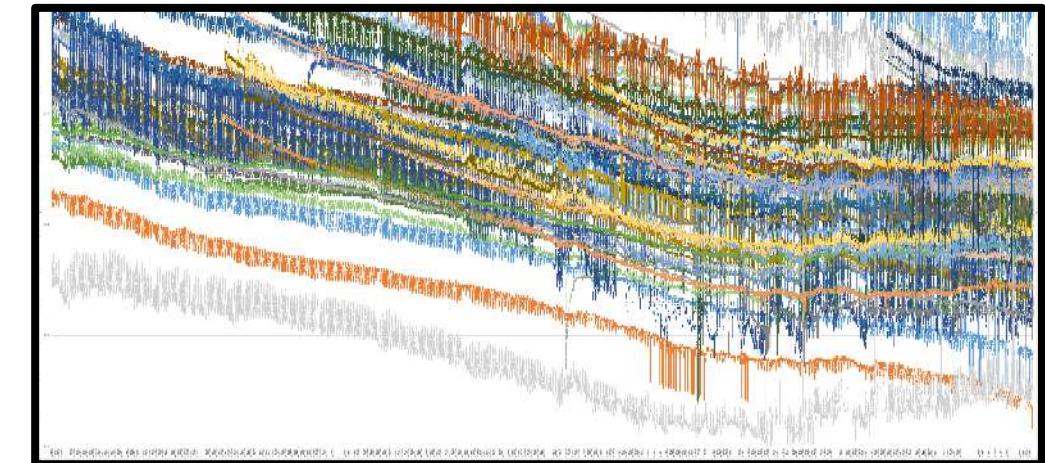
BEEZ! – Development Photos



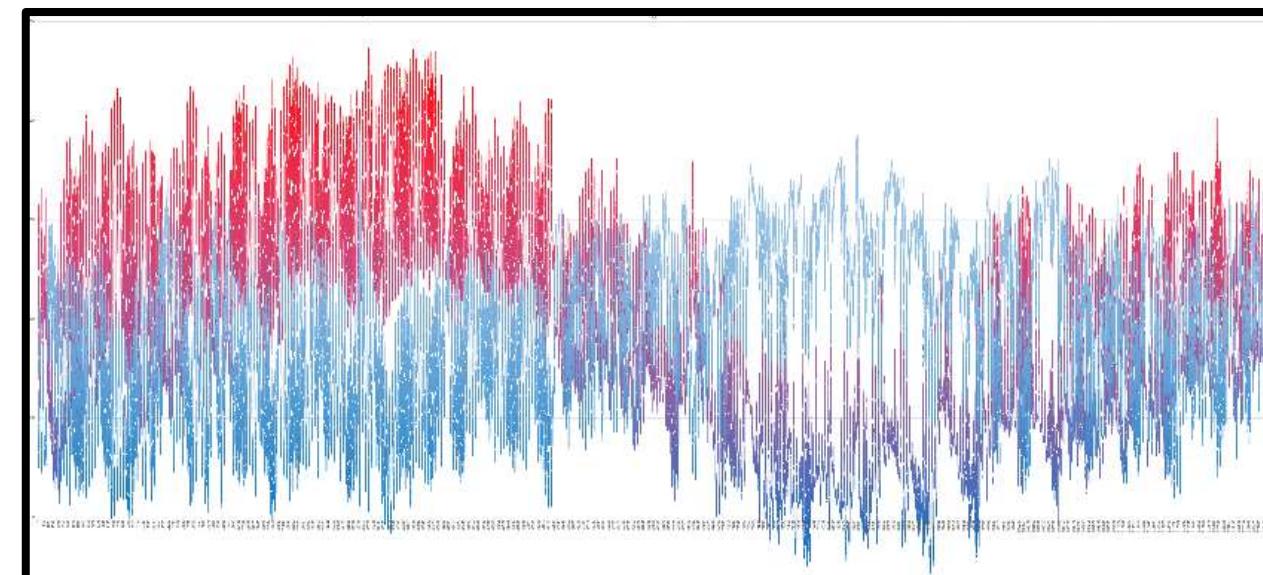
BEEZ! – Monthly, Yearly Battery & Temperature Graphs



1 Month battery level graph



430 days battery level graph

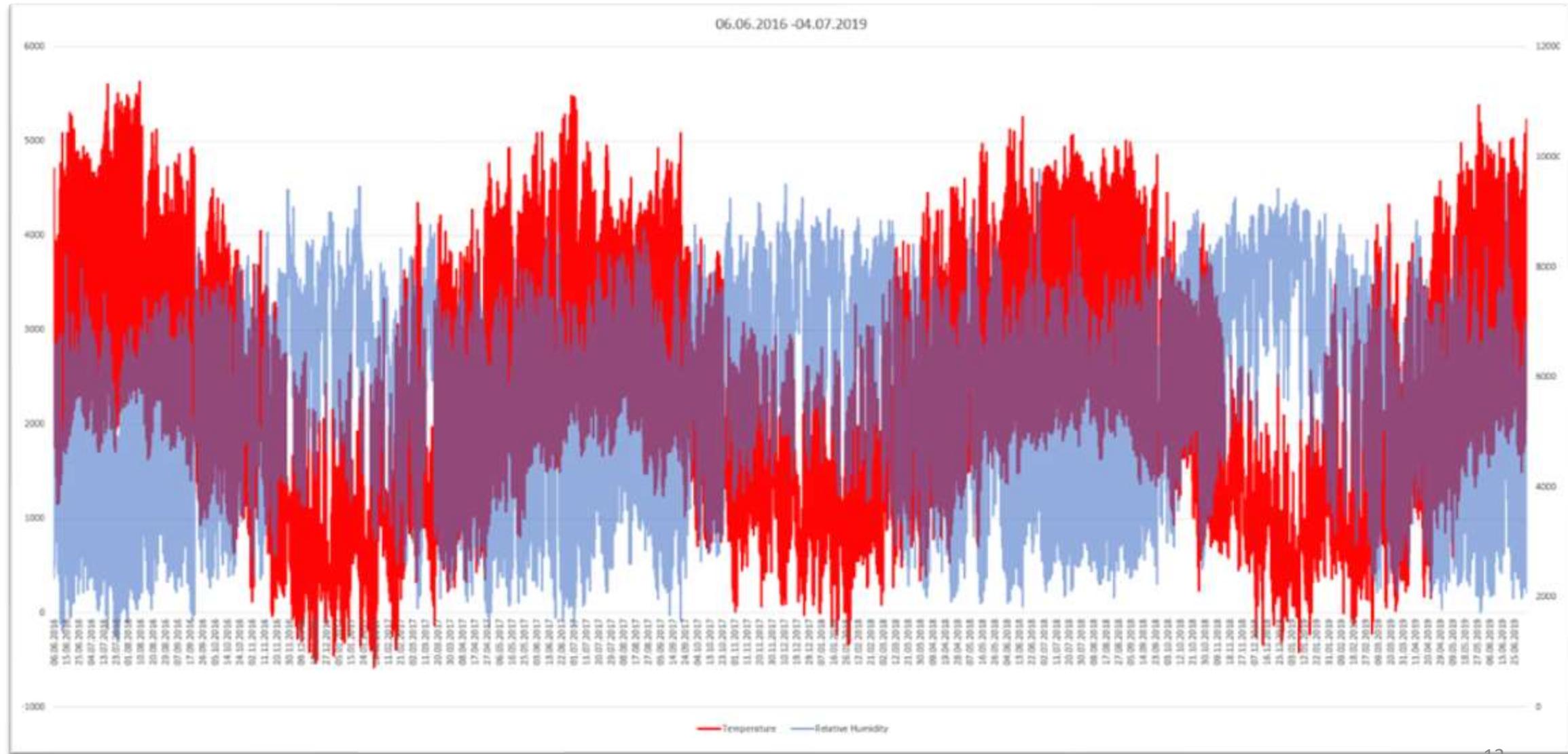


430 days temperature humidity graph

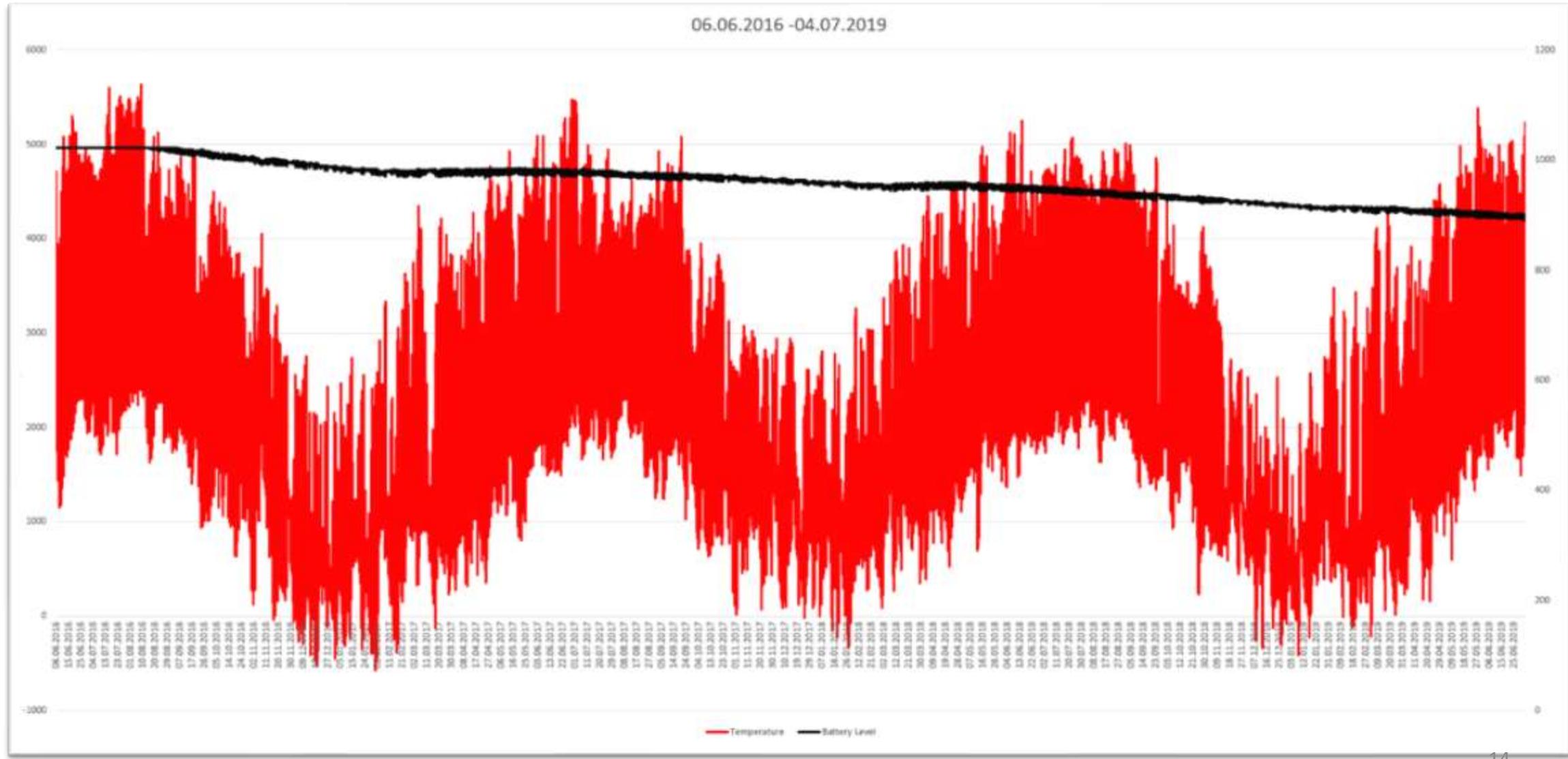
BEEZ! – End of 3.5 years battery levels



BEEZ! – 3 Years Temperature & Humidity Graph



BEEZ! – 3 Years Temperature & Battery Graph



BEEZ! – High Resolution Temperature Monitoring

59		59		59		59		59		59		59		59		59		59									
71	12,28	12,68	12,08	12,25	12,40	57	71	1,67	2,48	1,87	2,38	1,66	57	71	21,10	18,81	27,81	21,52	21,70	57							
43	12,20	12,70	12,67	12,66	12,45	43	1,54	1,79	1,90	1,99	2,34	43	18,96	20,05	20,52	17,73	52	43	4,74	4,82	4,28	4,92	5,15	52			
42	18,11	12,83	12,78	12,70	12,58	42	1,40	1,76	1,89	2,01	2,43	42	15,81	19,88	19,38	20,28	16,21	42	4,57	4,77	4,86	4,93	5,20	1			
72	12,45	12,62	12,60	12,64	12,33	70	72	1,73	1,87	2,01	2,08	2,57	72	18,82	20,87	21,06	21,58	21,80	70	72	4,69	4,80	4,85	4,88	5,06	70	
45	12,90	12,75	12,67	12,62	12,37	36	45	2,22	2,01	2,10	2,07	2,46	36	45	20,26	22,13	20,76	20,89	19,29	36	45	5,02	4,90	4,82	4,89	4,99	36
64	13,35	12,88	12,75	12,59	12,20	18	64	2,70	2,16	2,20	2,07	2,35	18	64	21,59	21,39	20,47	20,19	16,77	18	64	5,35	5,00	4,95	4,89	4,92	18
50	13,16	12,93	12,73	12,62	12,31	25	50	1,47	2,08	2,12	2,03	2,29	25	50	20,87	21,19	20,40	20,28	17,22	25	50	5,23	4,96	4,96	4,89	4,95	25
17	12,97	12,77	12,69	12,62	12,35	59	17	2,23	2,00	2,04	1,99	2,19	59	17	20,15	20,97	20,21	20,22	17,16	59	17	5,10	4,92	4,92	4,87	4,92	59
20	18,17	12,84	12,77	12,66	12,46	23	20	2,42	2,06	2,09	2,01	2,23	23	20	18,60	20,51	19,84	20,25	17,66	23	20	5,40	5,01	5,01	4,91	4,87	23
66	13,03	12,79	12,70	12,62	12,36	11	66	2,08	1,95	1,95	1,95	2,10	11	66	19,04	20,92	19,92	20,13	17,11	11	66	5,00	4,98	4,88	4,85	4,89	11
73	12,88	12,75	12,68	12,63	12,40	52	73	1,73	1,84	1,88	1,92	2,07	52	73	19,48	20,77	20,08	20,23	17,95	52	73	4,59	4,75	4,76	4,80	4,80	52
80	12,41	12,59	12,53	12,55	12,26	29	80	1,76	1,85	1,87	1,89	1,97	29	80	16,81	19,89	19,22	19,82	16,56	29	80	4,76	4,80	4,80	4,81	4,80	29
61	13,17	12,84	12,76	12,66	12,44	61	7,42	2,05	2,05	1,95	2,05	64	61	18,60	20,51	19,92	20,75	17,58	64	61	5,40	5,00	4,94	4,83	4,72	64	
74	18,23	12,86	12,77	12,66	12,45	55	74	1,75	1,84	1,89	1,92	2,05	55	74	19,90	20,91	20,25	20,93	17,58	55	74	4,68	4,77	4,76	4,79	4,72	55
53	12,50	12,54	12,64	12,58	12,33	3	53	1,03	1,62	1,72	1,90	2,13	3	53	17,60	20,26	19,93	20,51	18,60	3	53	4,23	4,63	4,63	4,73	4,63	3
14	12,75	12,73	12,74	12,74	12,77	60	14	2,29	1,99	1,95	1,86	1,78	60	14	16,97	19,88	19,05	19,56	15,70	60	14	5,25	4,95	4,90	4,82	4,71	60
63	12,95	12,81	12,84	12,81	12,98	1	63	1,10	1,64	1,72	1,87	2,04	1	63	19,54	21,00	20,96	21,31	20,78	1	63	4,41	4,70	4,75	4,83	4,93	1
12.1.2016		00:00:00		18.1.2016		08.02.29		24.1.2016		13:26:27		30.1.2016		04:49:26		4.2.2016		14:02:45		8.2.2016		11:26:15		13.2.2016		18:06:44	
Tmax	13,35°C	Tmin	11,06°C	Tmax	3,70°C	Tmin	1,03°C	Tmax	27,81°C	Tmin	15,7°C	Tmax	5,40°C	Tmin	4,25°C	Tmax	24,95°C	Tmin	20,13°C	Tmax	23,82°C	Tmin	9,37°C	Tmax	26,30°C	Tmin	23,15°C

59		59		59		59		59		59		59		59		59		59									
71	36,84	34,31	38,31	30,46	32,51	57	71	1,81	2,35	1,81	2,03	1,71	57	71	20,71	19,70	19,27	17,82	18,77	57							
43	35,50	34,87	35,73	35,16	36,64	32	43	1,75	2,15	2,21	2,32	2,43	32	43	15,62	19,18	19,18	19,07	19,18	32							
42	34,16	34,32	34,36	34,41	34,52	4	42	1,68	2,15	2,24	2,38	2,63	4	42	18,92	19,84	19,95	19,09	19,38	4							
72	35,05	34,41	33,83	33,53	31,50	70	72	2,13	2,26	2,31	2,36	2,45	70	72	18,64	18,82	18,73	18,75	18,35	70							
45	34,84	34,42	34,06	33,87	32,64	36	45	2,87	2,42	2,44	2,41	2,53	36	45	18,82	18,88	18,78	18,77	18,39	36							
64	34,62	34,42	34,29	34,21	33,78	18	64	5,01	2,56	2,57	2,46	2,60	18	64	18,93	18,83	18,79	18,43	18	64							
50	34,76	34,49	34,42	34,35	34,14	23	50	2,87	2,52	2,54	2,46	2,65	23	50	18,80	18,98	18,88	18,87	18,72	23							
27	34,90	34,53	34,45	34,34	34,12	69	27	2,73	2,47	2,51	2,45	2,64	69	27	18,61	18,83	18,81	18,86	18,72	69							
20	34,88	34,55	34,54	34,45	34,45	23	20	5,01	2,57	2,59	2,49	2,69	23	20	18,77	18,90	18,92	18,95	19,00	23							
68	35,40	34,68	34,57	34,36	34,11	11	68	2,63	2,44	2,48	2,44	2,63	11	68	18,63	18,84	18,82	18,86	18,73	11							
73	35,91	34,81	34,57	34,24	33,62	52	73	2,28	2,31	2,35	2,36	2,61	52	73	18,48	18,79	18,78	18,85	18,71	52							
30	34,46	34,37	34,24	34,29	33,73	29	30	2,33	2,35	2,39	2,41	2,57	29	30	19,05	19,95	18,88	18,81	18,46	29							
61	34,88	34,46	34,19	34,02	33,12	54	61	3,02	2,55	2,52	2,39	2,39	54	61	18,77	18,88	18,84	18,86	18,70	54							
74	34,02	34,19	33,99	33,97	33,12	55	74	2,27	2,35	2,35	2,35	2,39	55	74	18,08	18,67	18,67	18,82	18,79	55							
53	35,25	34,54	34,13	33,85	32,51	3	53	1,64	2,11	2,13	2,25	2,20	3	53	18,40	18,78	18,81	18,91	18,93	3							
14	33,65	34,16	34,23	34,37	34,42	60	14	2,73	2,46	2,39	2,29	2,11	60	14	19,04	18,95	18,87	18,82	18,51	60							
63	31,70	33,50	33,53	33,99	33,66	1	63	1,96	2,22	2,26	2,33	2,41	1	63	17,20	18,34	18,25	19,51	17,88	1							
Tmax	38,31°C	Tmin	30,45°C	Tmax	5,02°C	Tmin	1,64°C	Tmax	20,71°C	Tmin	17,2°C	Tmax	13,72°C	Tmin	11,5°C	Tmax	9,56°C	Tmin	8,1°C	Tmax	28,00°C	Tmin	20,41°C	Tmax	13,73°C	Tmin	9,56°C

BEEZ! – High Endurance WSN

- Results of the Project published as 2 papers, 1 poster,
- Overall, in 3.5 years of deployment,
 - In total 120 nodes produced, 92 of them deployed, 28 of them spared for other R&D purposes,
 - 320 million lines of data collected, that equals to ~3.5 billion data points,
 - Atmospheric changes, population changed and other variables inspected,
 - Temperature range measured as -4°C to 72°C,
 - In the end of the Project, devices collected and batteries measured, they still had more than 2 years of battery life remaining.

BEEZ! – Scientific Research

KSÜ Tarım ve Doğa Derg 25 (5): 1127-1133, 2022
 KSÜ J. Agric Nat. 23 (5): 1127-1133, 2022
<https://doi.org/10.18016/ksutarimdoga.vi.910496>



The Effect of Some Meteorological Parameters on Wireless Data Transmission

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<https://orcid.org/0000-0002-3423-9402>, <https://orcid.org/0000-0002-5591-4788>

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ABSTRACT

It is essential to bring together the data measured in agricultural lands, greenhouses and animal shelters transmit to follow the data online. Wireless and wired systems have advantages and disadvantages. In wired systems, there is a cost of cabling, but data can be transmitted more securely. In wireless systems, system installation is cheap, but there are losses in data transmission. Wireless data transmission carried out in the outdoor environment takes place under surrounding climatic conditions. In this study, the effect of atmospheric meteorological factors on data loss in wireless data transmission system was tried to purpose, the losses that occur during measured in the greenhouse in Bursa Ulu Agriculture Research Farm to the office 1 Temperature, humidity, precipitation, wind pressure were used as meteorological parameters from the civil use frequency range 2400-2480 MHz were used as data transmission package was used for the correlation analysis. According to the results of the correlation analysis it has a statistically significant effect on the

Biosystems Engineering

Research Article

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Wireless data transmission



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 N(1), 263-269, 2021

BŞEÜ J
<https://doi.org/10.3519>

e-ISSN:2455-7379 (<http://dergipark>)

Determination of the Variations on Battery Consumption According to Temperature and Relative Humidity of Silicon Labs Si7021 Wireless Sensor Systems in Greenhouse

Serada Silicon Labs Si7021 Kablosuz Sensör Sistemlerinin Sıcaklık ve Nem Göre Pil Tüketimindeki Değişimlerinin Belirlenmesi

Celil Serhan Tezcan¹, Kemal Sulhi Gündoğdu²

Geçti / Received: 15.02.2021 Revise / Revised: 22.05.2021 Kabul / Accepted: 22.05.2021

ABSTRACT

Climatic parameters need to be monitored and necessary arrangements should be made according to these observations in order to be suitable for greenhouse climate conditions in agricultural products. In agricultural production, it is important to know the temporal change of climatic values belonging to different locations of the greenhouse in order to ensure the comfort of plant growing environment. Today, the use of sensors determining



Tarımda Kablosuz Algılamacı Ağları

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cstezcan@gmail.com



Kablosuz sensör ajan, kurulum yapılan geregi köye olmas, bakımı ve onarım maliyetini azaltması ve veri toplama sebeplerinin genis olması nedeniyle son yıllarda açık yada kapaklı ortamlarda tercih edilen hale gelmiştir.

Uludağ Üniversitesi Ziraat Fakültesi bünyesindeki doğal havalandırma cam serası yerinden yapılmıştır, mikrometrel olmayan yapılarının sıcaklık modellenmesi üzerinde çalışılmıştır. Alanın verilerde açık görüşmeli gibi, aynı sensör nektarlarından gelen veriler, farklı gürültelerde, ortalamadan çok uzak değerler göstermektedir. Buların međeni sensörlerin kalibrasyonunun başarısız olduğu, bulunukları nektarlarında çantalar kırık olması veya sualtı sistemine yakınlığından 1 Mart tarihinden itibaren isteme ve doğal havalandırma sistemleri kapasiteleri sera içерisindeki ortam modellenmesi yapılarak önceki değerlerle eşleştirilmiştir.

Tarımda kablosuz sensör ajanındaki algılamacı derseleri, 2425-2460 ve 2475 MHz frekansları, her döngüde 32 byte veri aktarabilecek kablosuz iletişim karna şapka. Algılama şartlarında frekans 1 MHz aralıklarla değiştirilebilmektedir, her frekans için 128 alt kanal tanımlanabilmektedir ve algılama kanalları 300 saniyede 3 frekansı toplamda 3 paket gönderilebilecek sıcaklık sensörleri olarak DS18B20

pekiđe hazırlanmıştır. Metal kafelerin kablosu ileşimi bozdugu bilindiğinden, bu tür ortamlarda hangi frekansı daha fazla kaybolduğu sağlanmak istenmiştir.

Başka ve sajılı veriler kıyalanlığında her frekansı sera içerisinde %1, sera ile merkez arasında N2 paket, tozlu ortamda görememekte. Yapılan 2 ayrı toplama süreçünde,

2425 MHz frekansındaki sensörlerin verileri 2475 MHz frekansına göre 93708 bir kayıp gözardığı belirlenmiştir.

Aynı şekilde 2475 MHz frekansındaki veriler 500 metre uzaklıktaki arası açık ortam toplam

cok paket gönderilebilir. Saptanmıştır ki 2475 MHz frekansı taranmasında 2400-2460 MHz kablosuz dâğıtıcı, televizyon, bl

otostarca yoğun oluplarından veri saptanmıştır. 2460 - 2483 MHz aralığı saptanmıştır.

Gelişen sistem sayesinde, ağdan gelen veriler bir veritabanına

hangi bölge sıcaklığı, nem, ıqk deňk

sayedilmişdir. Sensörler sera'nın sağ

metre aralıklarla yerleştirilmiş olup, bu

percene, açılıklarına ve isteme

konumundandır. Algılama kartları

bootoader çalıstan Atmega328P bu

sıcaklık sensörleri olarak DS18B20

1st International, 14th National Congress on Agricultural Structures and Irrigation 26-28 September 2018 Antalya

Sera İçi Kablosuz Sensör Sistemlerinin Pil Performansının Belirlenmesi

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Özet: Sera内 gerçekleştirilen tımarlı üretmede, sermin farklı komurlarına ait iklim değerlerinin zamanla bağlı değişiminin bilinmesi, bitki yetişme ortam konforunu sağlaması için önemlidir. Günümüzde farklı iklim parametrelerini belirleyebilecek sensorların kullanımı yaygınlaşmaktadır. Sensor sistemlerin pil ile kablosuz iletişim teknolojisi içeren çoklu bir yapıda tasarlanmasının, serin içasmine istenilen komuma, yükseklik konumlardanın sınırları kolaylaştırılmaktadır.

Bu çalışmada, sera içi içindeki parametrelerin belirlenmesi için kurulan kablosuz sensor sistemlerin pil performansının belirlenmesi尝试されました. Yaz aylarında, sera içi ve dışındaki sıcaklık değerleri arasındaki fark oldukça artmaktadır. Temmuz ve Ağustos aylarında sera içi sıcaklık değerleri çok yükselmektedir. Bazi günlerde sera içi sıcaklık 60°C'ye kadar çıkabilmektedir. Kış aylarında ise serin boz kaldırımları, sera içi sıcaklık değerleri dört ortam sıcaklığına yakın seviyelere düşmektedir. Sera içi sıcaklığındaki bu değişiklikler, sensör pil performanslarını etkileyebilmektedir.

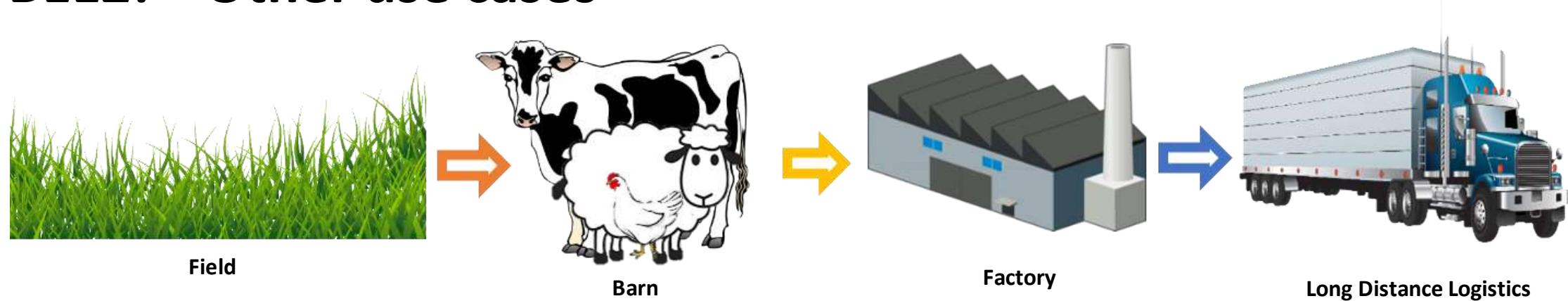
Sonuç olarak, sera içi sıcaklığına bağlı olarak pil voltajı seviyesi değiştiği gözlenmiştir. Sera içi sıcaklığı ile pil voltajı seviyesi arasında ($p<0.01$) önem düzeyinde bir ilişkili olduğu test edilmiştir. Günlük saat, ay ve tarih ile aynı pil voltajı arasında ($p<0.01$) 0.01 önem düzeyinde bir ilişkili edilmiştir. Aylar ile pil voltajlarının yıllık seviye değişimleri arasındaki ilişki önemiz ($p<0.05$) bulunmuştur. Yıllar ile pil voltajlarının yıllık seviye değişimleri arasında ($p<0.01$) önem düzeyinde önemli bir ilişki bulunmuştur.

Anahtar Kelimeler: Kablosuz sensorler, Pil tüketimi, Sera

Determining Battery Performance of Greenhouse Internal Wireless Sensor

Click on images to read papers

BEEZ! – Other use cases



Robots UGVs and UAVs

Robots; UGVs and UAVs

- Unmanned Ground Vehicles (UGVs) and Unmanned Aerial Vehicles (UAVs) are increasingly used in agriculture for tasks such as crop monitoring and management.
- UGVs can autonomously navigate fields to perform tasks like planting, weeding, and applying herbicides or pesticides with precision.
- UAVs equipped with cameras and sensors provide aerial views for monitoring crop health, detecting pests, and assessing soil conditions.
- Laser weeding and other advanced techniques are employed by these robots to target weeds without chemicals, reducing environmental impact.
- Precision agriculture benefits from the data collected by UGVs and UAVs, optimizing resource use and improving crop yields through targeted interventions.

Unmanned Aerial Vehicles (UAVs)

- Celil Serhan TEZCAN started working with UAVs back in 2013 with off the shelf parts and DJI Phantom series, over the years, he has developed several methodologies that are helpful and efficient ways to process their data, prevent accidents and so on.
- Image processing will be explained in Remote & Proximal sensing slides. In this section we're going to showcase hardware solutions as well as some produced works.

Unmanned Aerial Vehicles (UAVs)

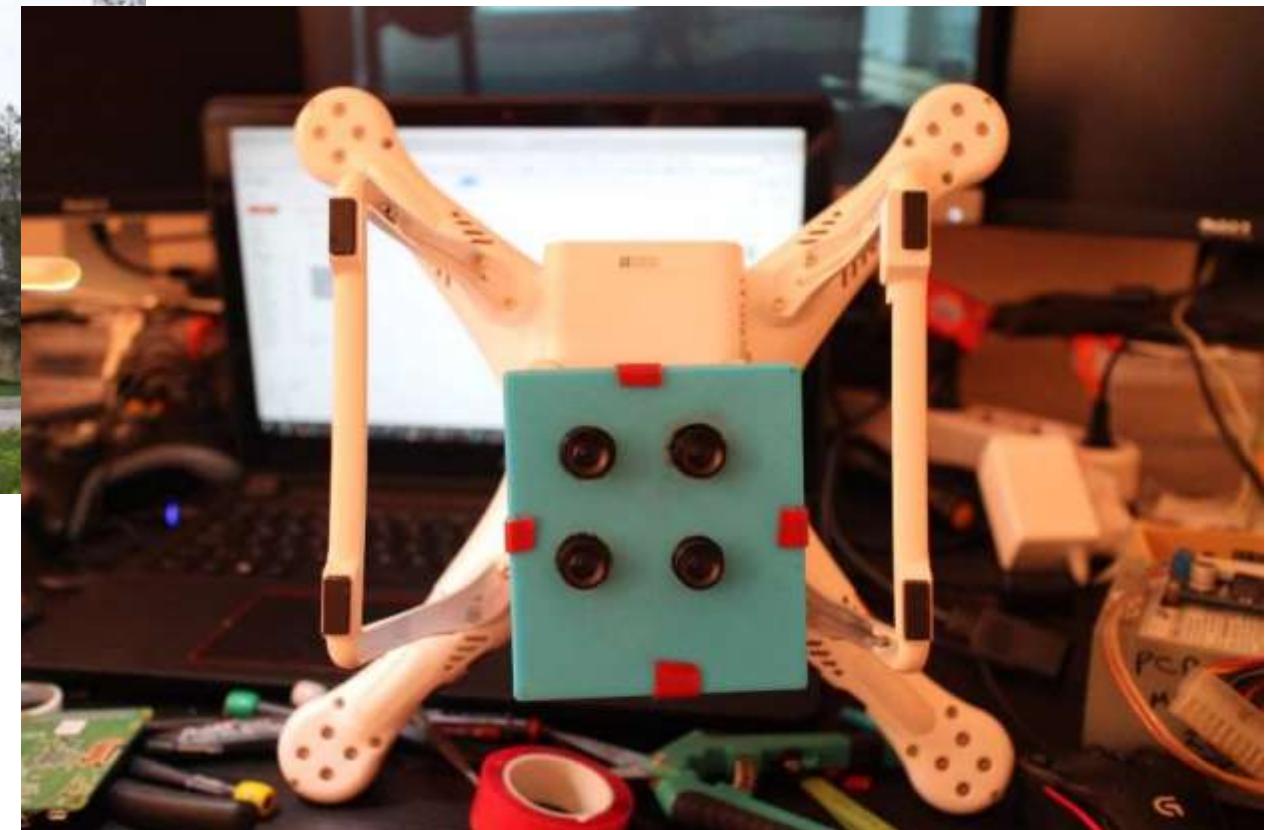


Off the shelf drone parts

UAVs – Spectralix – Multispectral Camera

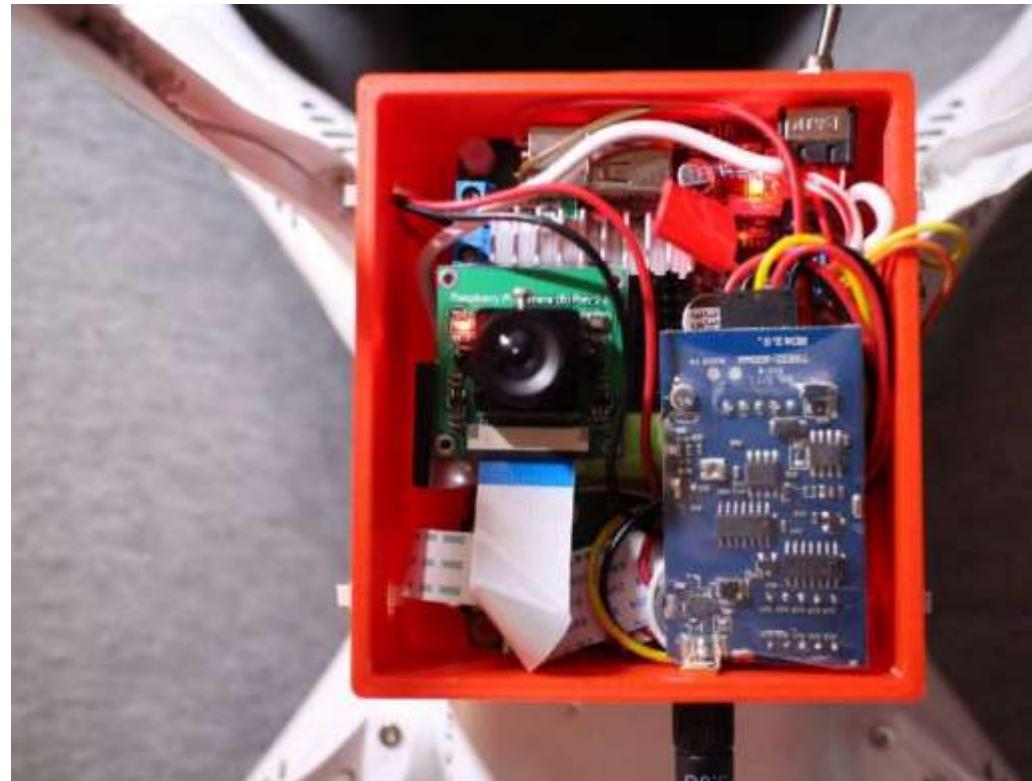


Multispectral camera, early prototype with
3 bands + RGB camera, GPS and onboard
battery

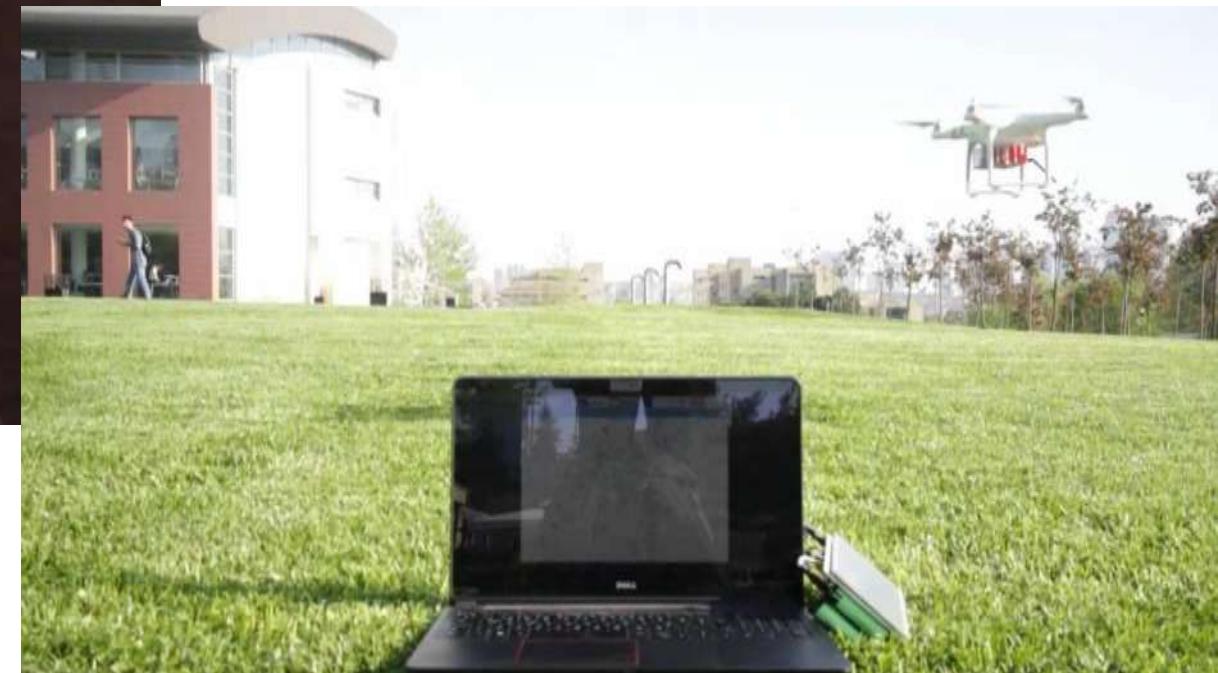


Multispectral camera, late prototype with 4
bands GPS and onboard battery

UAVs – Spectralix Live NDVI Camera



Realtime NDVI calculating system with FPV transmitter



<https://www.youtube.com/watch?v=2QLaMIUqOvY>

R&D Order: Unmanned Aerial Vehicles (UAVs)

- **Customer Problem**
 - Challenge: Better approach to collision avoidance.
- **Our Solution**
 - Innovation: Triple camera system for collision avoidance.
- **Proven Results**
 - Impact: No real life result achieved.



UAVs – Collision Avoidance (Patent, TR2022/014624)

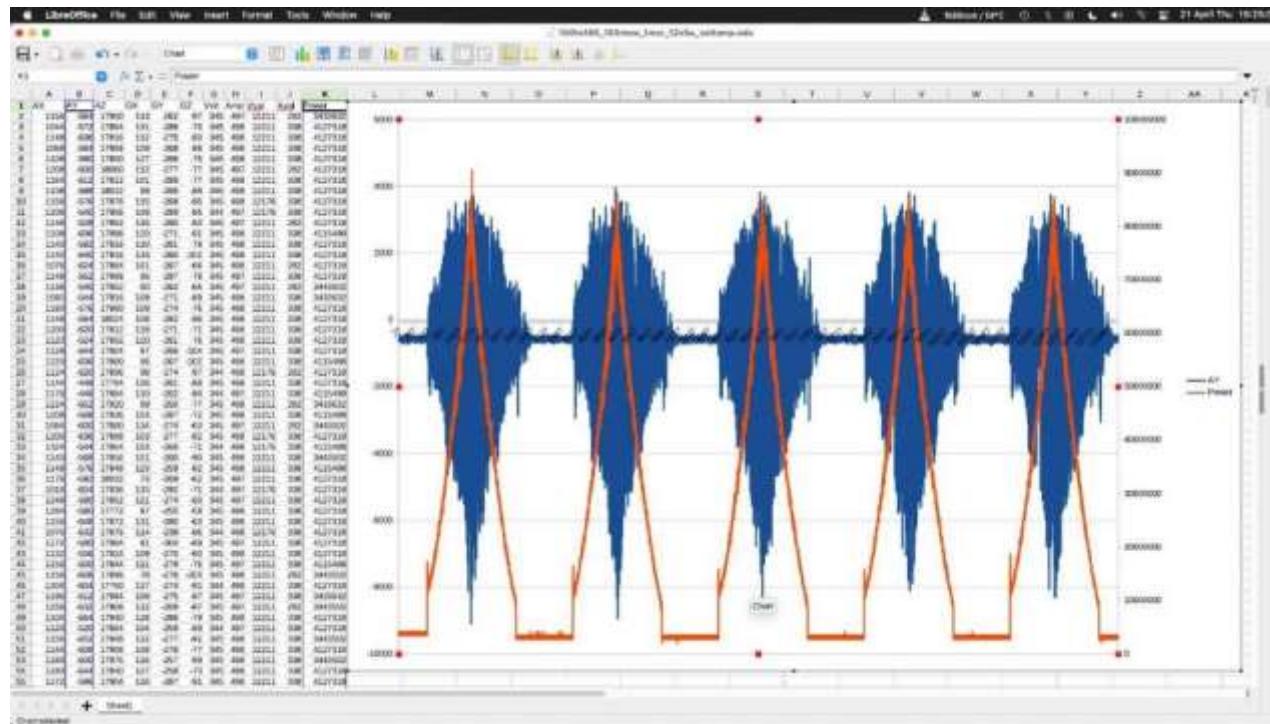
- Stereo cameras for collision avoidance often misses the third dimension of things and when it comes to flying objects it is a very crucial information. In this patent we have solved this problem by adding one more high-speed camera to the mix.
- TRiO is the perfect system for collision avoidance of UAVs up to 1000kph/600mph flight speeds.

UAVs - Propeller balance detection system

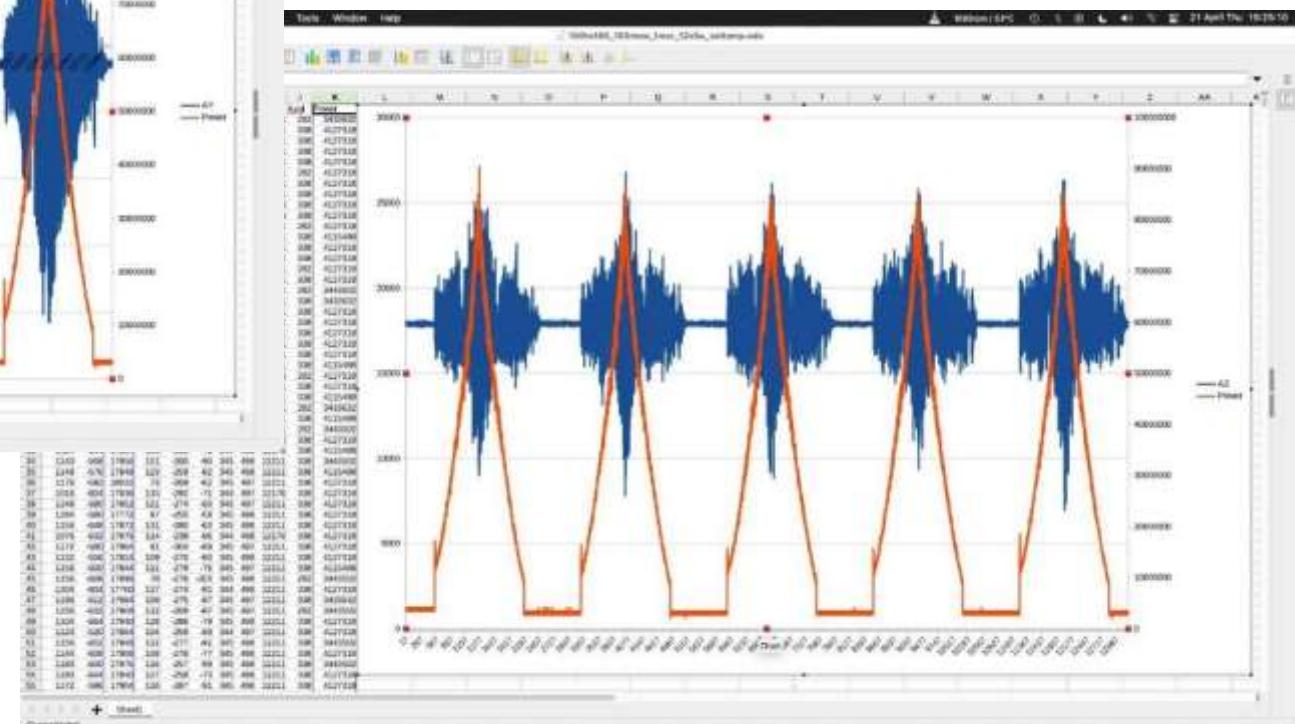


Under ideal conditions, propellers must be well balanced to eliminate noise and vibration, but with the air resistance (dust, insects) they get dirty and often crack and that causes imbalance, imbalance leads to shorter battery life, motor problems and often loss of drone

UAVs - Propeller balance detection system



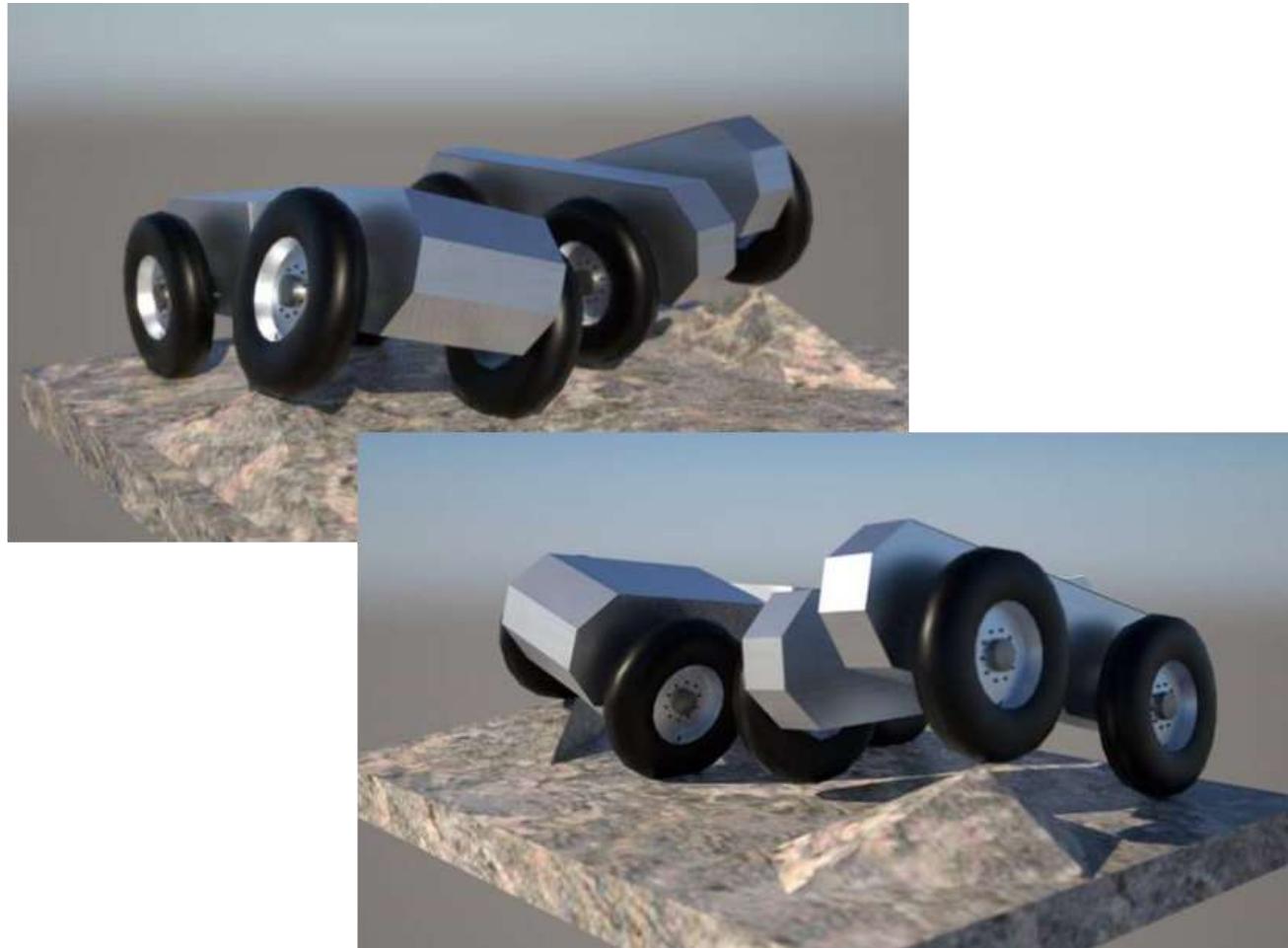
Graphs showing motor power consumption and propeller vibration



Graphs showing motor power consumption and propeller vibration

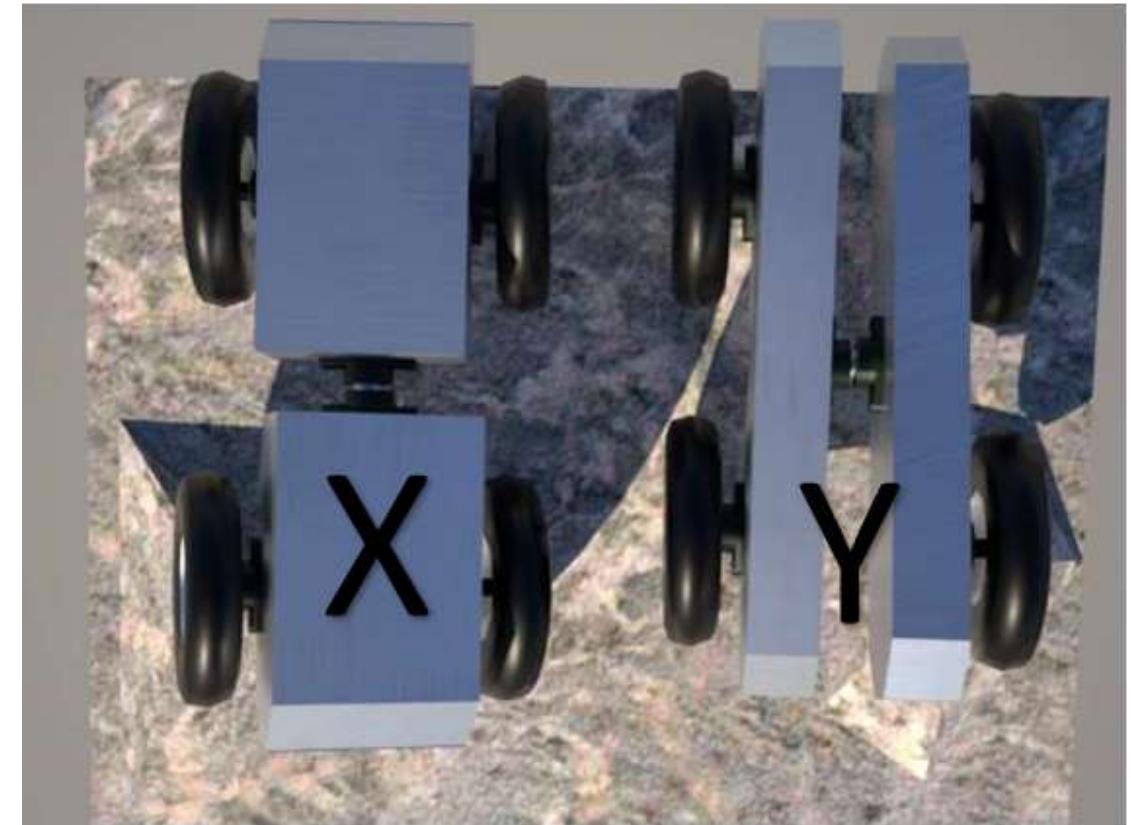
R&D Order: Unmanned Ground Vehicles (UGVs)

- **Customer Problem**
 - Challenge: Monitoring caterpillar damage on hemp production without humans, using drones, robots or cctv cameras.
- **Our Solution**
 - Innovation: Developed Caterpillar Xs flex body robot for swarm operations.
- **Proven Results**
 - Impact: Due to pandemic there were no proven results on hemp but the device was successful on wheat plantations on field and in vineyards.



Unmanned Ground Vehicles (UGVs)

- Designed to operate in environments very similar to defense setting with high endurance for heat, distance, harsh field conditions.
- We have designed such system with flexibility in mind and succeeded at that with our Caterpillar Xs system, our Caterpillar Ys remains as a design and available on Order!

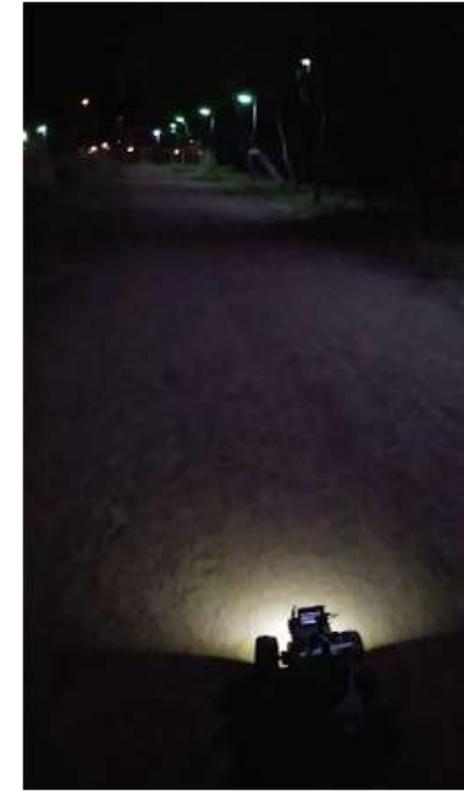


UGV – Before Caterpillar Xs, Mapping Rovers



https://www.youtube.com/shorts/U1l_GamIpjg

UGV – Before Caterpillar Xs, Mapping Rovers



https://www.youtube.com/shorts/DOpBp_QLDcc

UGV – Caterpillar's first prototype



<https://www.youtube.com/watch?v=xlZhr1MNIg>

UGV – Caterpillar's first prototype



<https://www.youtube.com/watch?v=wUEpZToU67M>

UGV – Caterpillar's first product



UGV – Caterpillar Xs in a vineyard



<https://www.youtube.com/watch?v=Hk76lZCcl2o>

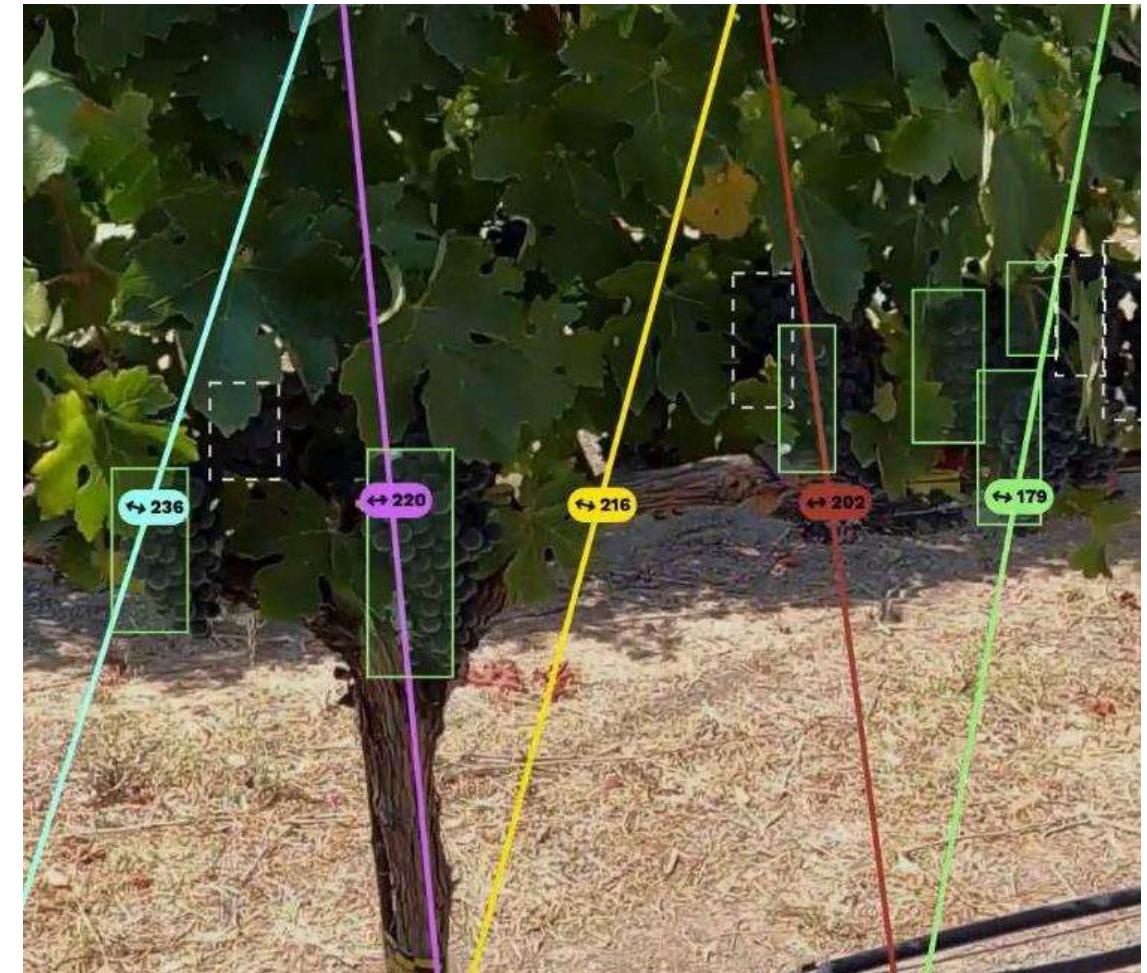
YieldEstimator

World's «best» accuracy system for vineyards.

- Claiming the «best» in the title wasn't easy.
- YieldEstimator AI system backend has over 1 million hand labeled grape bunch images, trained on thousand-hour-gpu runtime to create perfect accuracy on Vertical Shoot Positioning (wall trellis) and Pergola (closed trellis) systems.
- Even more grape images created by the generative networks on various settings to challenge system to push accuracies even more.
- It is able to detect and geolocate grape bunches with perfect accuracy each time.

R&D Order: YieldEstimator for Vineyards

- **Customer Problem**
 - Challenge: Counting grape bunches in a vineyard with high accuracy.
Customer used to count 20th vine at 20th row then multiply.
- **Our Solution**
 - Innovation: Edge AI system that was able to count every vine in all rows.
- **Proven Results**
 - Impact: Precision increased 400 times, accuracy was above 95% on that vineyard. Later hit 99.778% accuracy in various other vineyards using just an action camera or an iPhone.



Started as a herd monitoring system



Later turned into a vineyard – grape bunch counting system



- GoPro Hero 9/10/11/13



- 128GB-512GB MicroSD card



- USB Type C Cable



- Powerbank/lighter adapter



- Mounting apparatus



Requires this set to operate

Works best on Vertical Shoot Positioning



Had different trials, tests

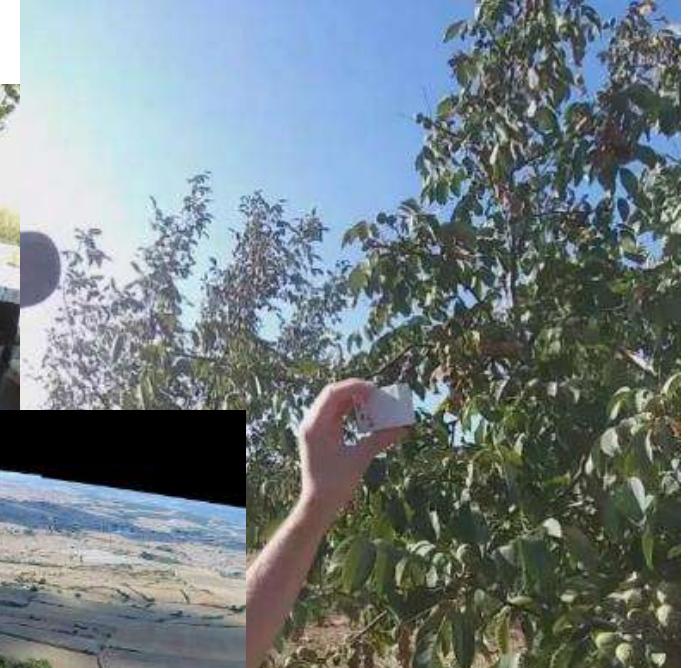


Perfect data is visible bunches



<https://www.youtube.com/watch?v=EQcNNuuwosg>

First field demo held on walnuts



1st demo of YieldEstimator Blog; <https://tarsens.wordpress.com/tarsens-yield-estimator-demonstration/>

First field demo on walnuts with Edge AI Systems by TARSENS



1st demo of YieldEstimator Blog; <https://tarsens.wordpress.com/tarsens-yield-estimator-demonstration/>

First field demo held on walnuts for tree counting as well



1st demo of YieldEstimator Blog; <https://tarsens.wordpress.com/tarsens-yield-estimator-demonstration/>

A system deployed in Spain with Edge AI



<https://www.youtube.com/shorts/xvJeiNOBFhE>

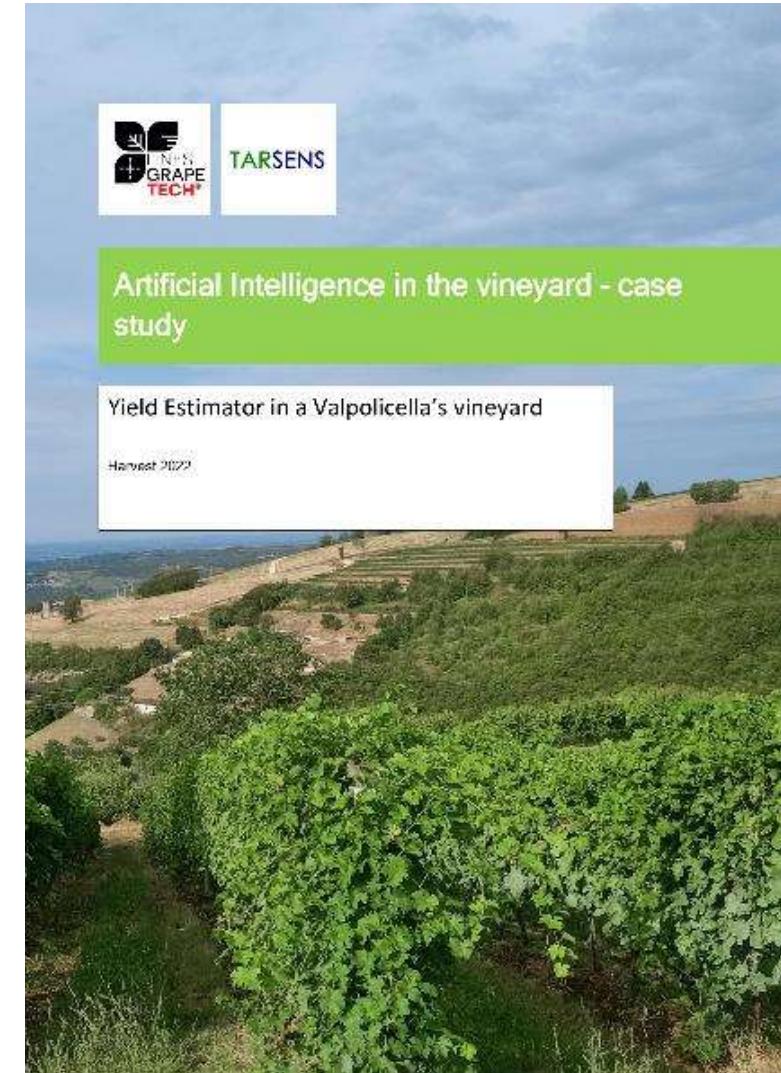
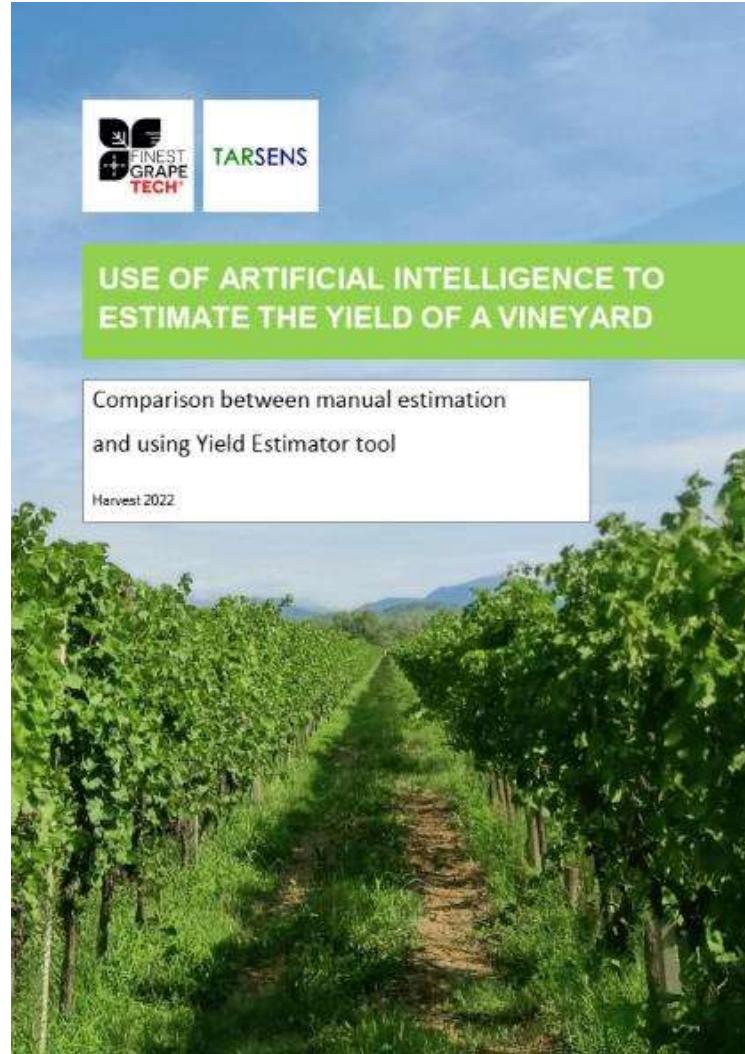


<https://www.youtube.com/shorts/5tKRC1OVx7E>



Independent results published by Finest Grape Tech, Italy

yieldEstimator



Tested on various vineyard settings and grape types



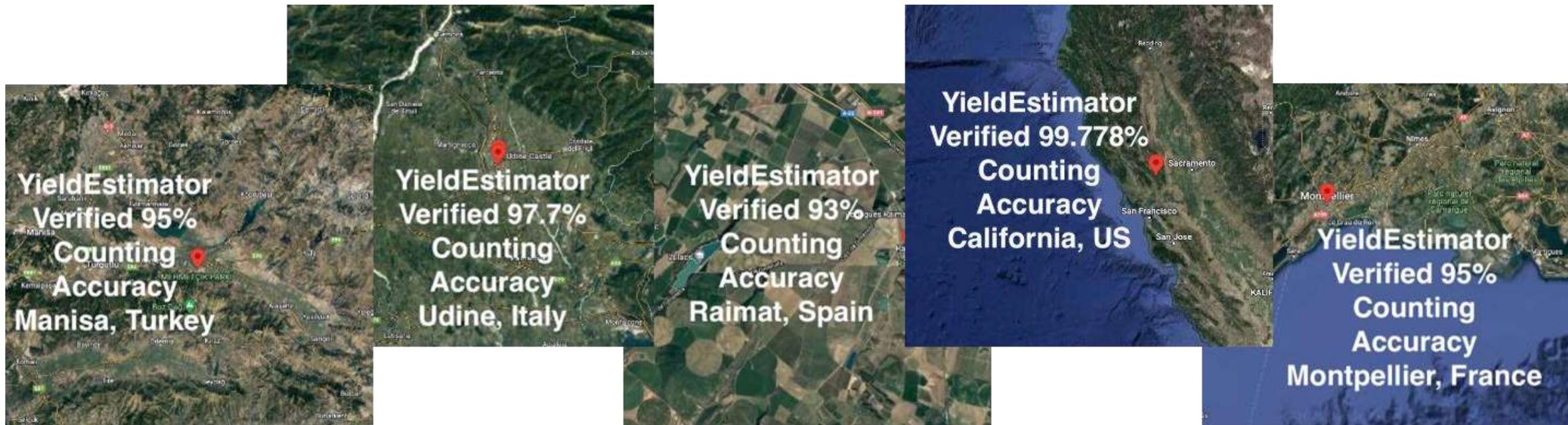
<https://www.youtube.com/watch?v=2tnLMaYKxtU>

Tested on various vineyard settings and grape types



<https://www.youtube.com/watch?v=2tnLMaYKxtU>

In field accuracy proven worldwide.



<https://www.youtube.com/@TARSENS/shorts>

Scaled to citrus

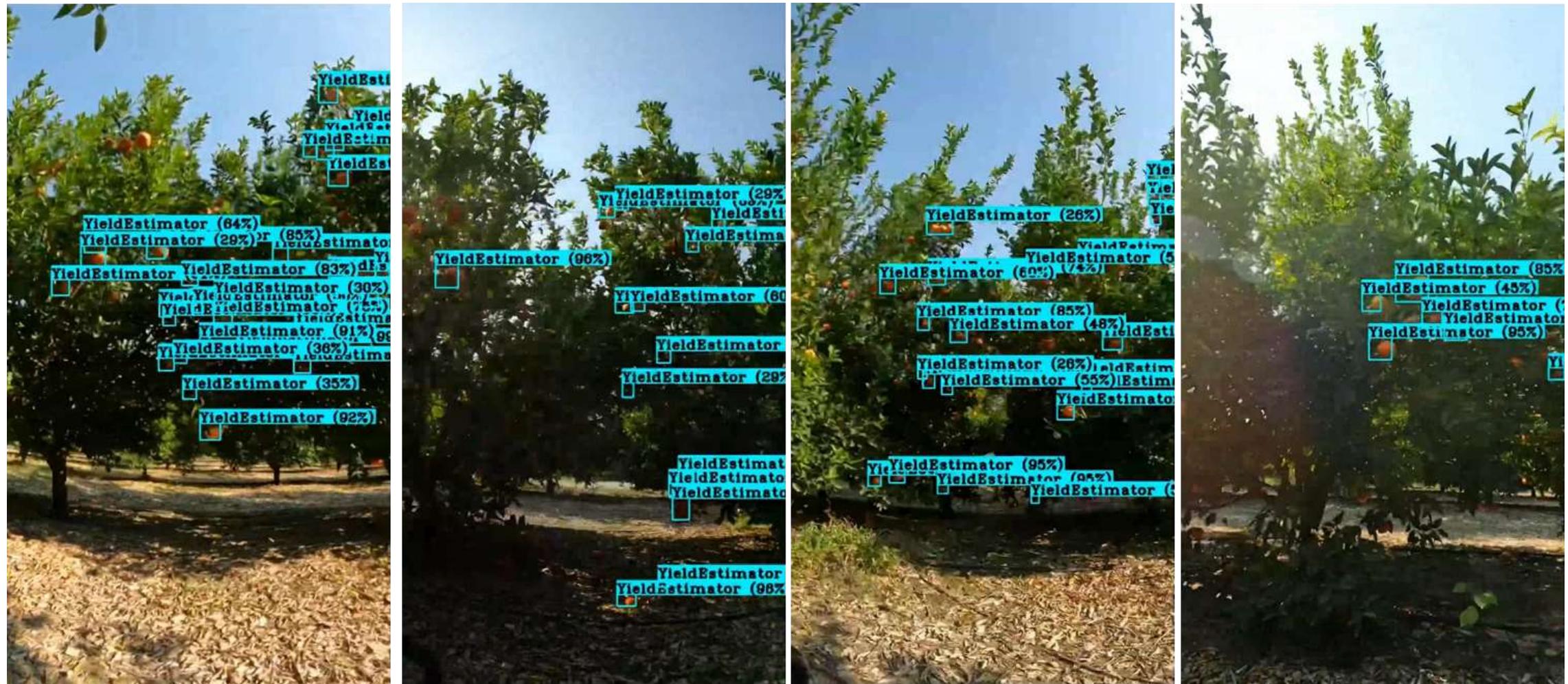


<https://www.youtube.com/shorts/UuKtXYxY6ns>

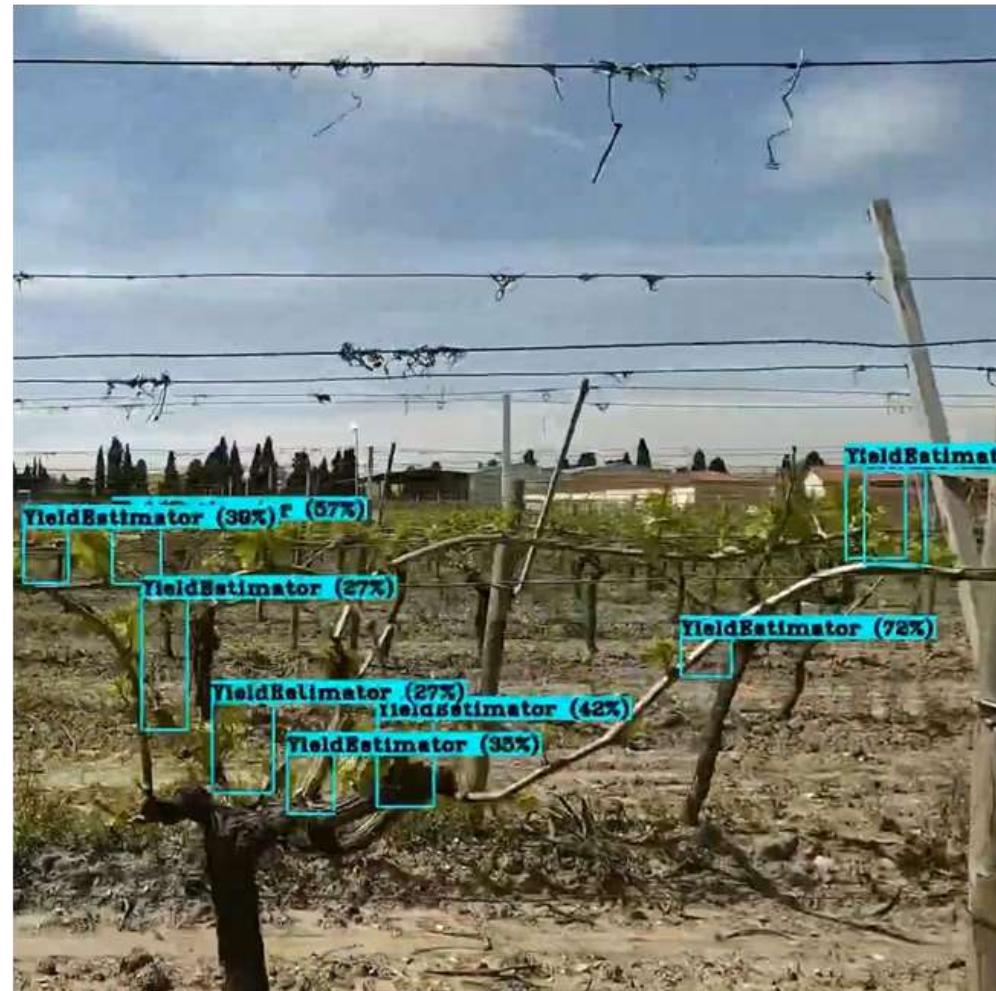
Proven to work with vertical camera mount



Had excellent detection on citrus



Tested on detecting & counting buds, early shoots



<https://www.youtube.com/watch?v=Z9UTf8NhYBU>

R&D Order: Almond blooming level mapping

• Customer Problem

- Challenge: They requested a system for predicting yield from blooming level.

• Our Solution

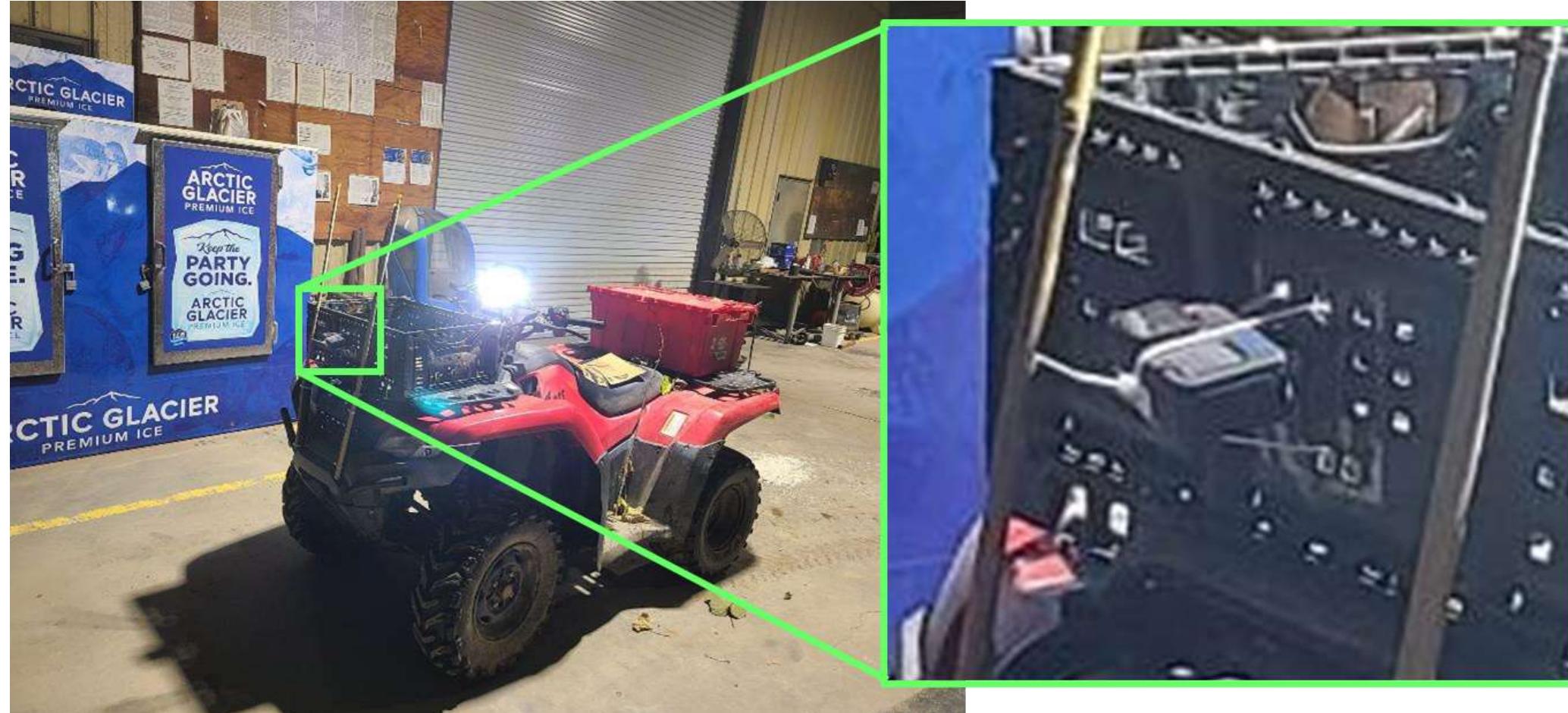
- Innovation: Classified trees based on blooming level.

• Proven Results

- Impact: Delivered successful results.



R&D Order: YieldEstimator for Kiwifruit



<https://www.youtube.com/shorts/fGZNt9yWIqg>

Excellent results were obtained

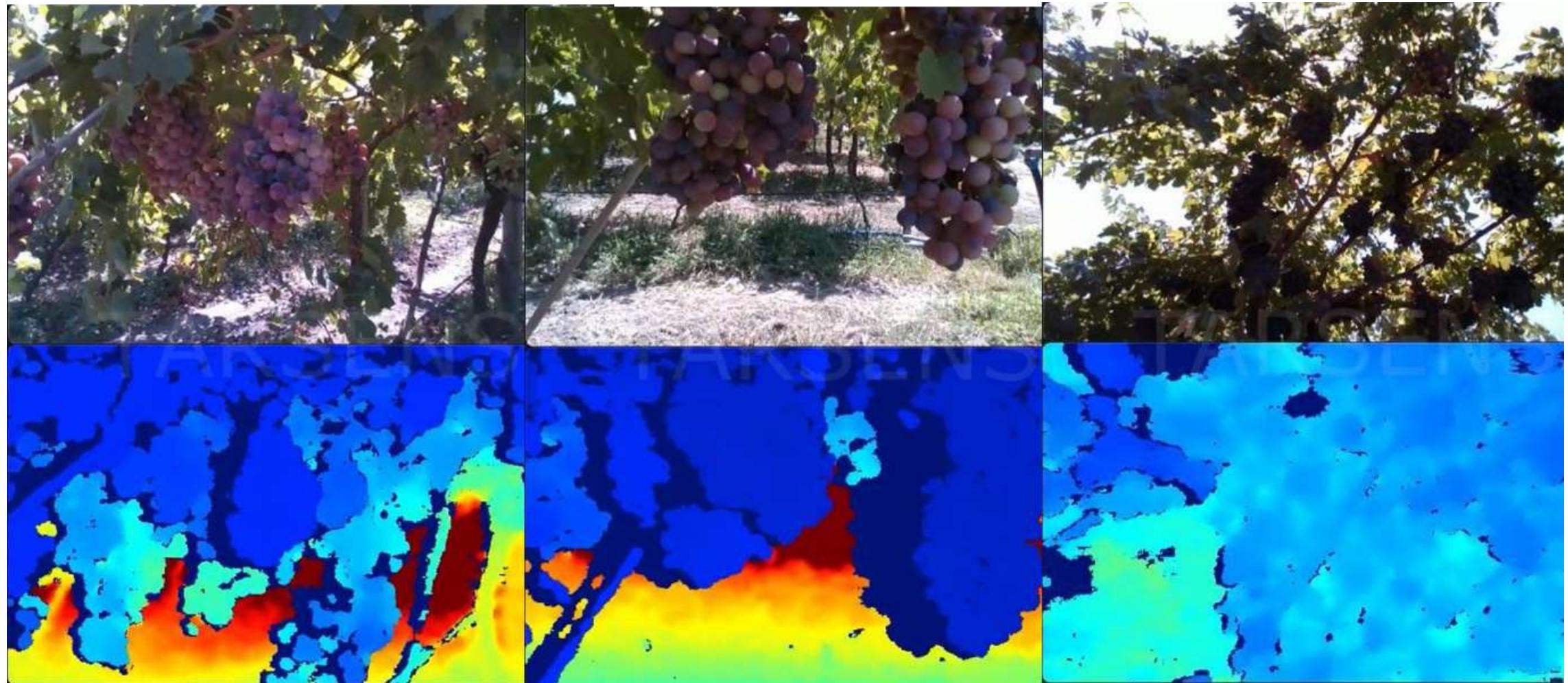


<https://www.youtube.com/watch?v=reNDRDNr1Cw>

Scaled it down to CAR DVR cameras and up to iPhones

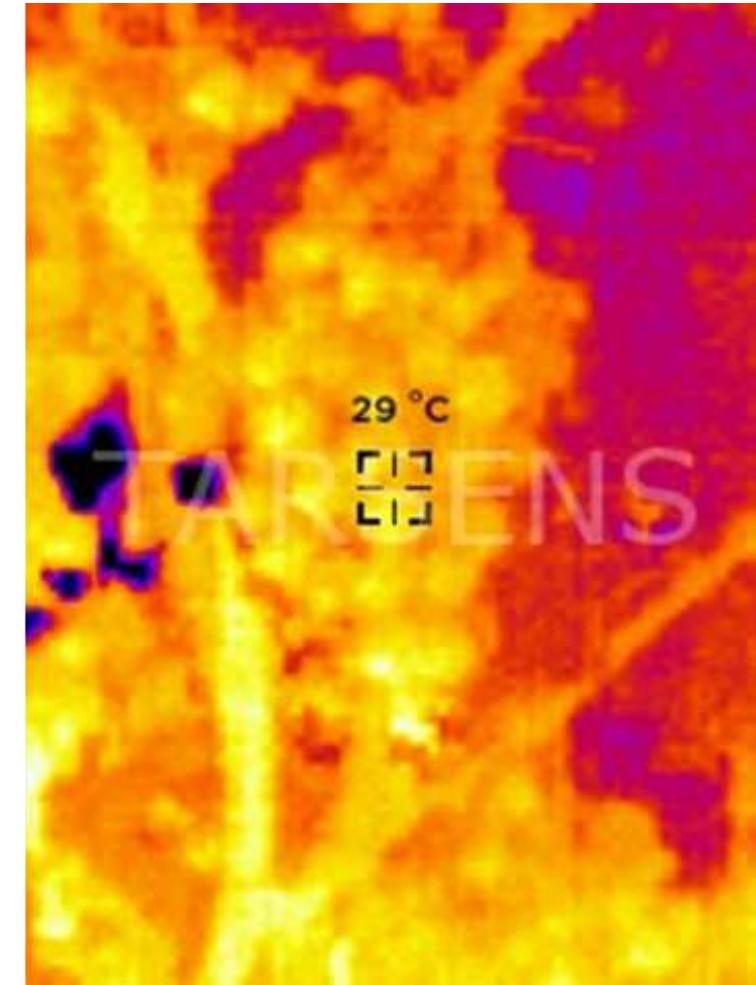
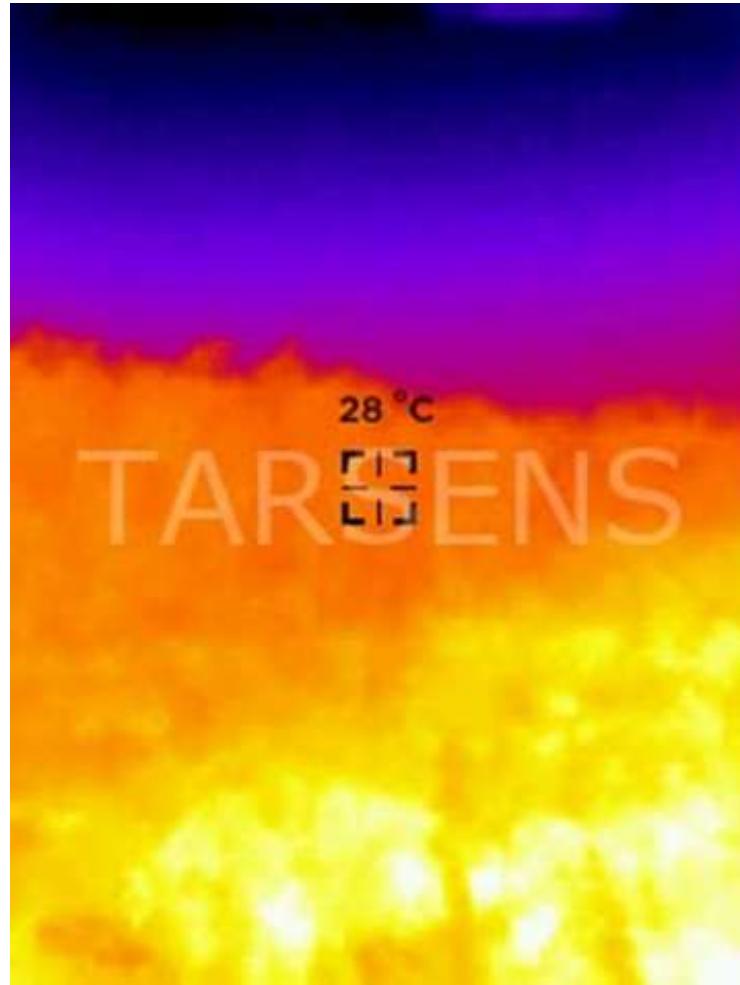


Worked with Stereo Cameras for Size information



https://www.youtube.com/watch?v=LRnhOngTL_4

Had thermal add-on



Developed Disease Spotter

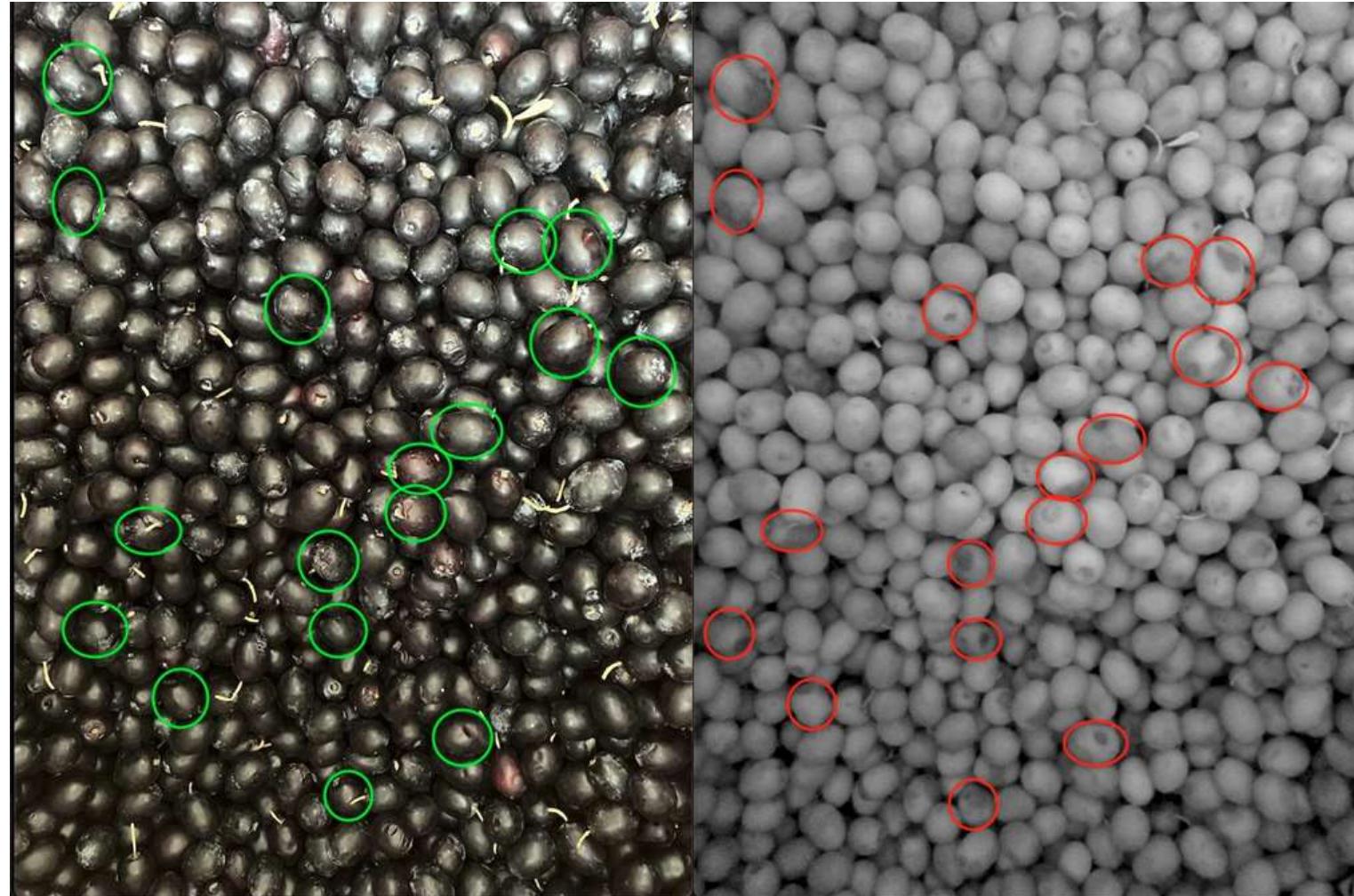


Disease Spotter with our Italian partner, Finest Grape Tech

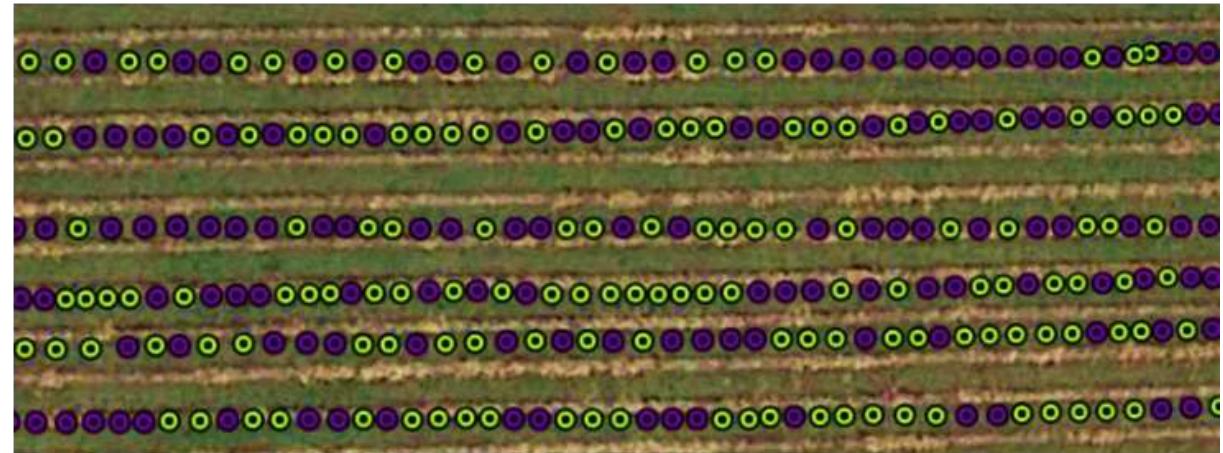
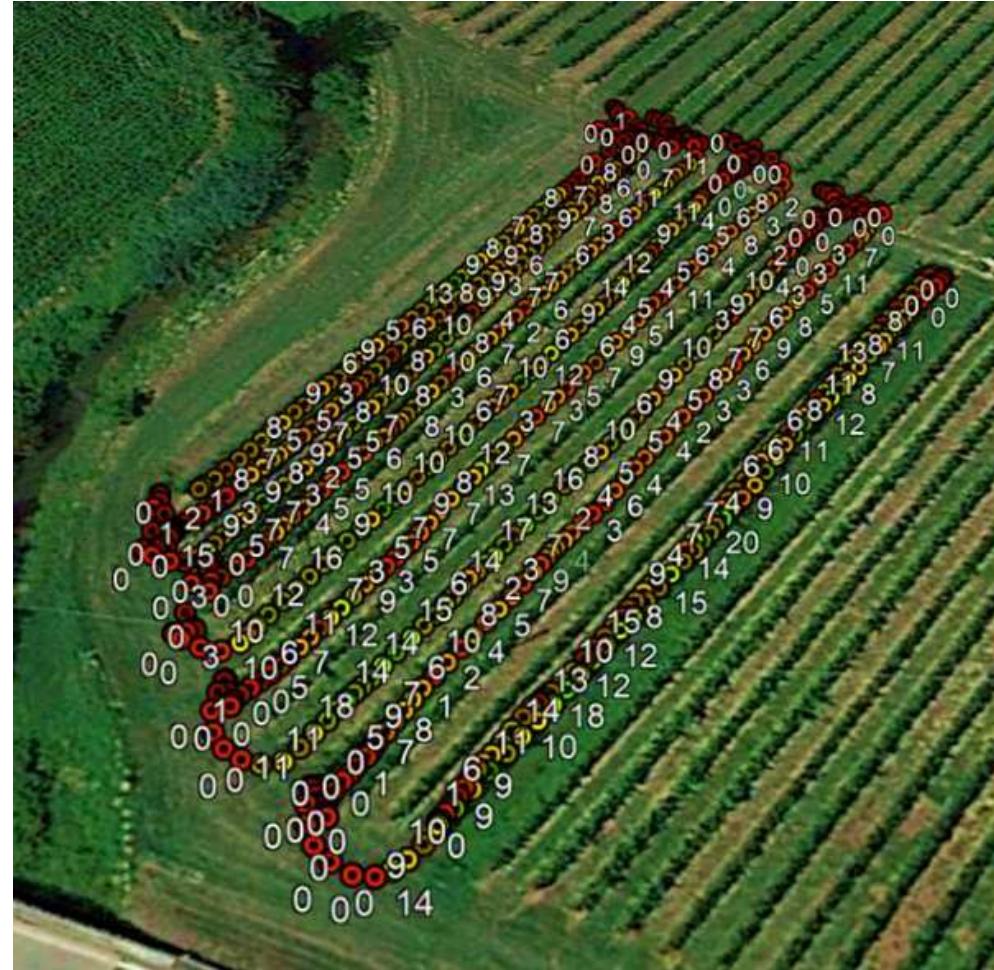


<https://www.youtube.com/watch?v=VSVIwjFDOtw>

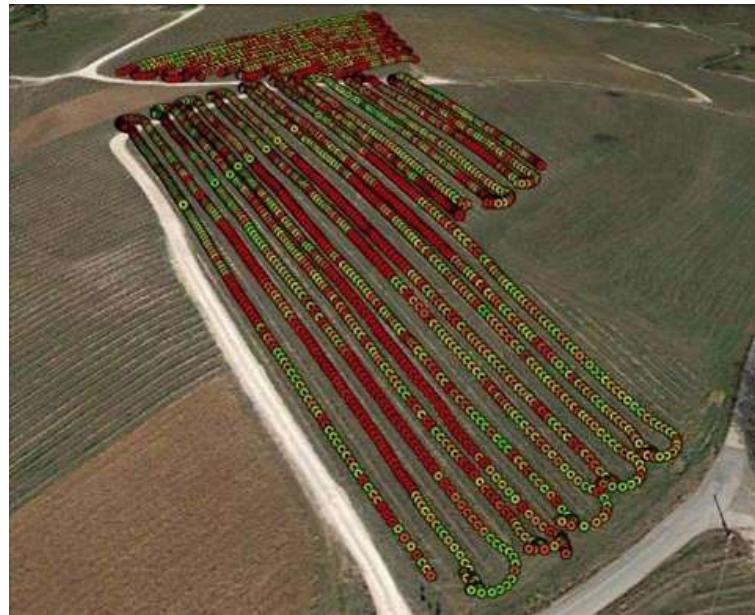
Optical sorting system, TR:2023/015217, patent pending



ViTiMAP for geolocating grape bunches



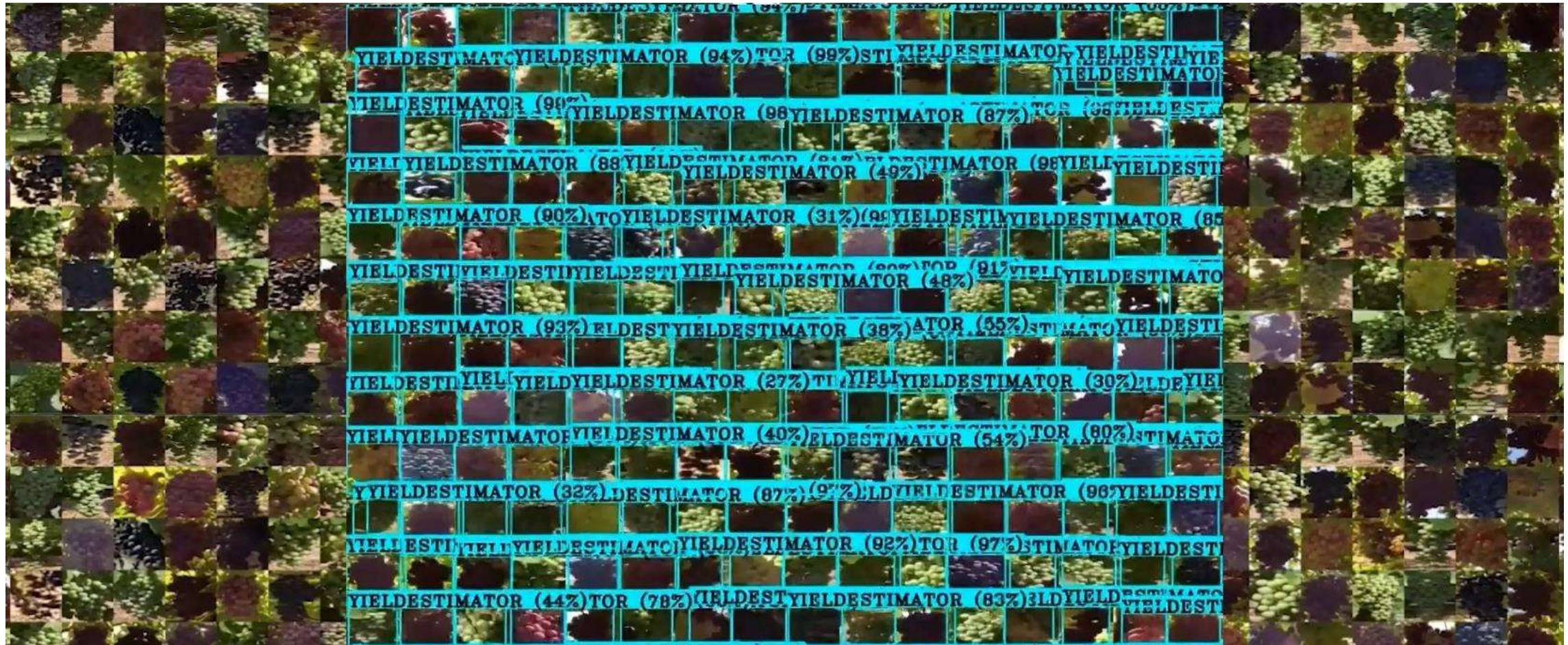
Added frequency, elevation, speed options to ViTiMAP



Generative Models for Generating even more grape bunches

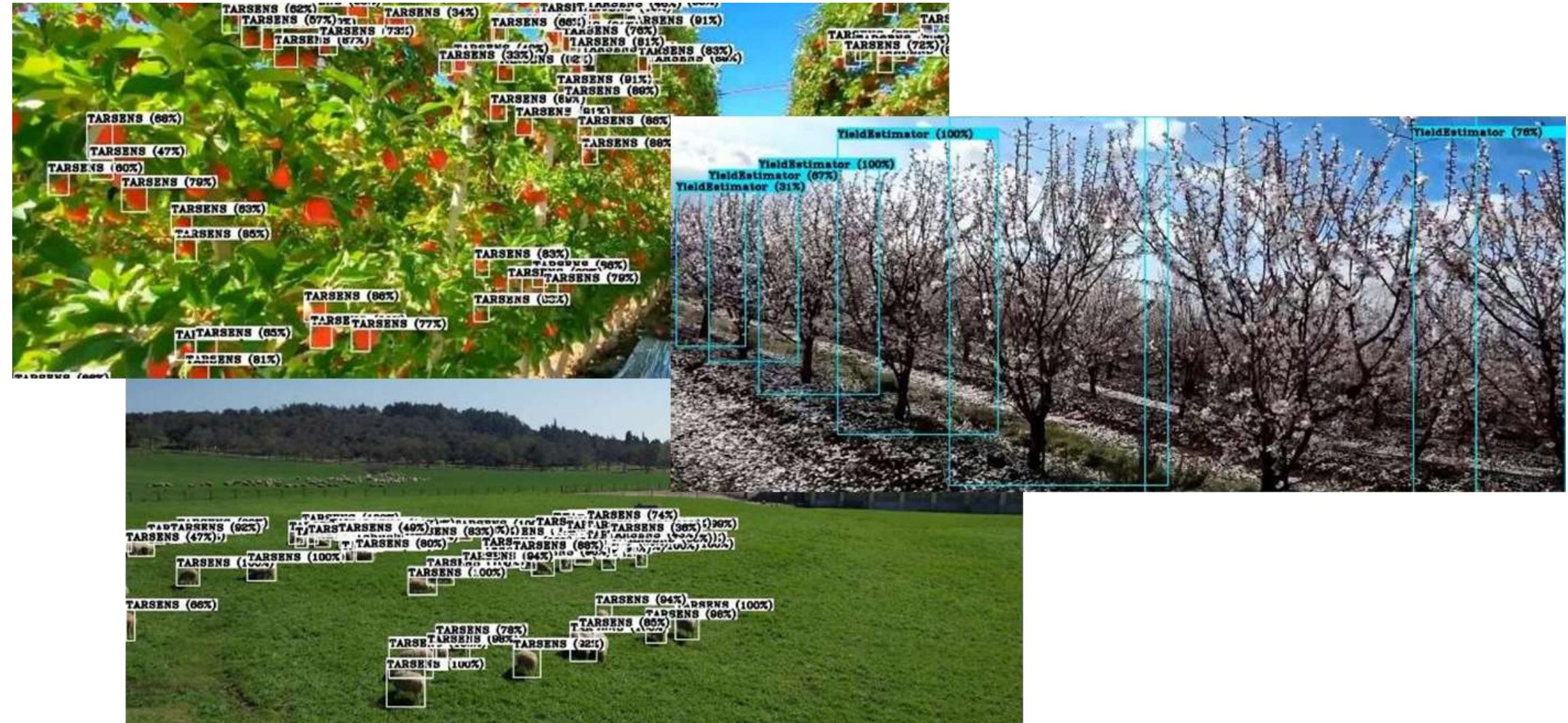


Deployed them within YieldEstimator backend



<https://www.youtube.com/watch?v=qg155amVGng>

Still working on creating new models for special applications



Remote and Proximal Sensing

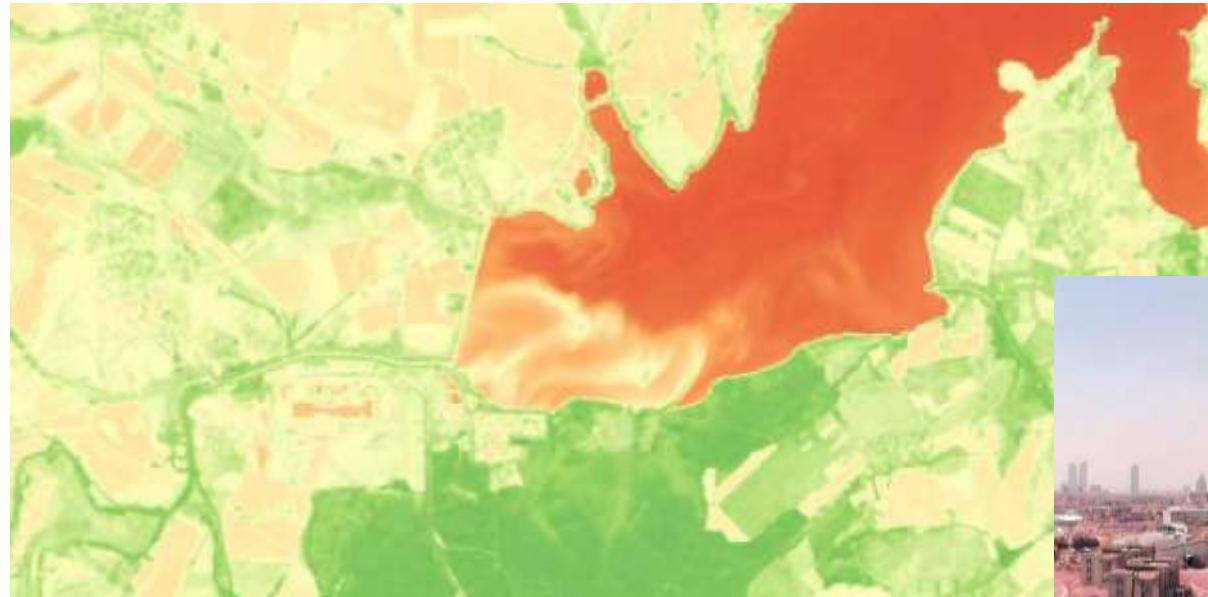
Remote and Proximal Sensing

- Remote sensing involves capturing data from a distance, such as using satellites or UAVs, while proximal sensing uses sensors close to the target, like handheld devices or mounted sensors.
- OpenCV is an open-source computer vision library used for processing and analyzing images and video, crucial for interpreting data from these sensing methods.
- Image processing helps in extracting valuable insights from visual data, enabling automation and detailed analysis in agriculture.
- Information extracted includes crop health, soil conditions, pest detection, and yield estimation, which guide precise and timely interventions.
- Applications such as identifying plant diseases, assessing growth stages, and mapping field variability are enhanced by advanced image processing techniques.

Vegetation health calculation basics



Various image sources can be implemented

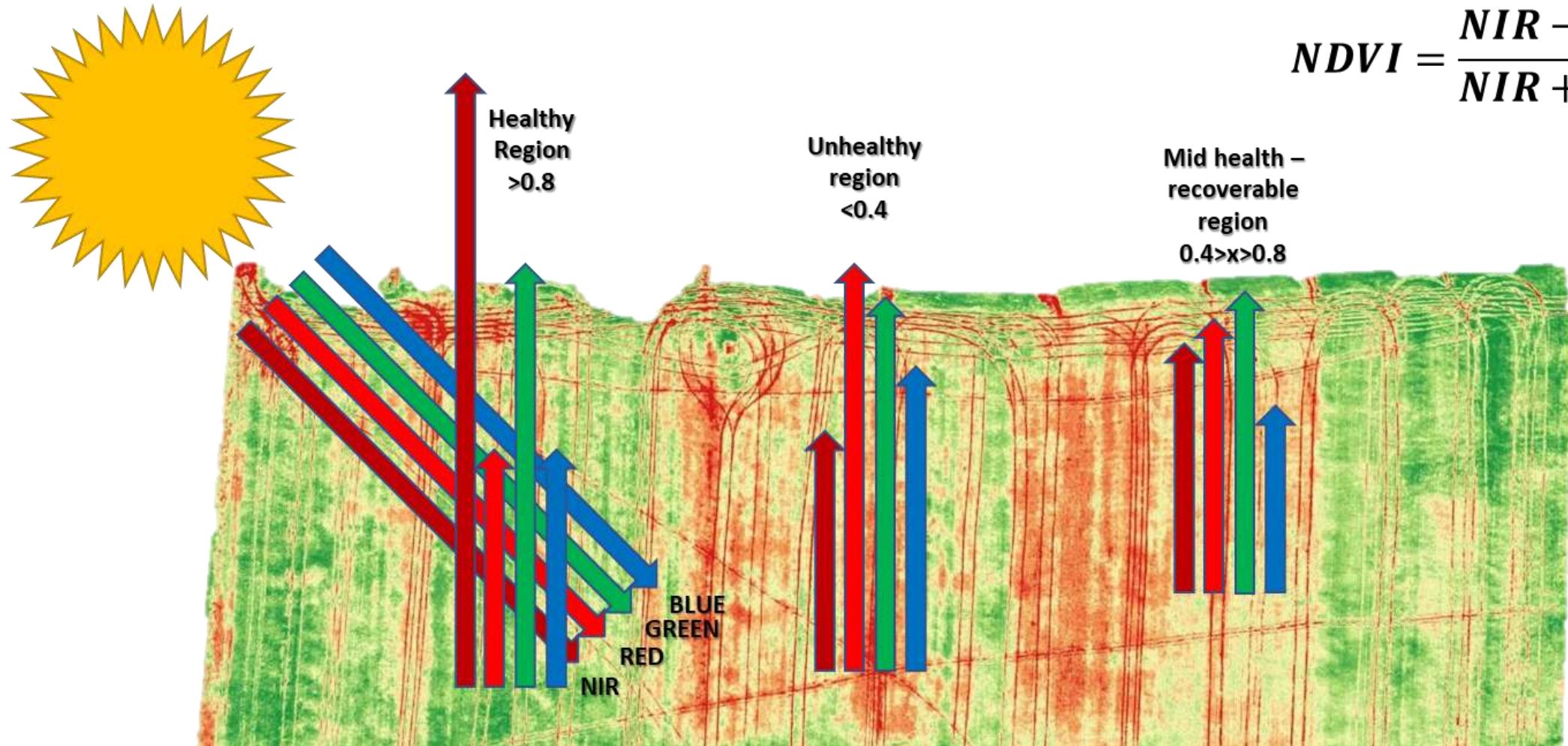


Landsat



Modified DJI

Agricultural remote sensing is based on NDVI formula

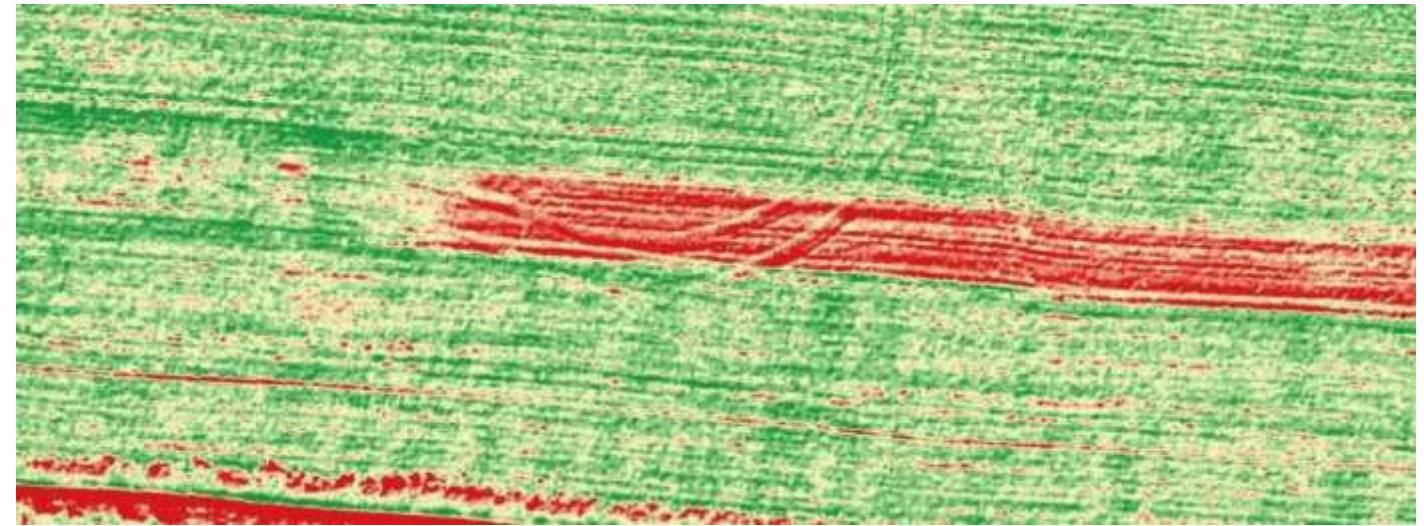


How NDVI Works? Plants reflect visible and invisible bands, we calculate their difference to figure out their health

Same formula can be used both satellite and UAV imagery



Free-Satellite Imagery Resolution



DJI Drone resolution

Collecting and processing of this data takes too much time



Able to accelerate data processing speed by 1000x

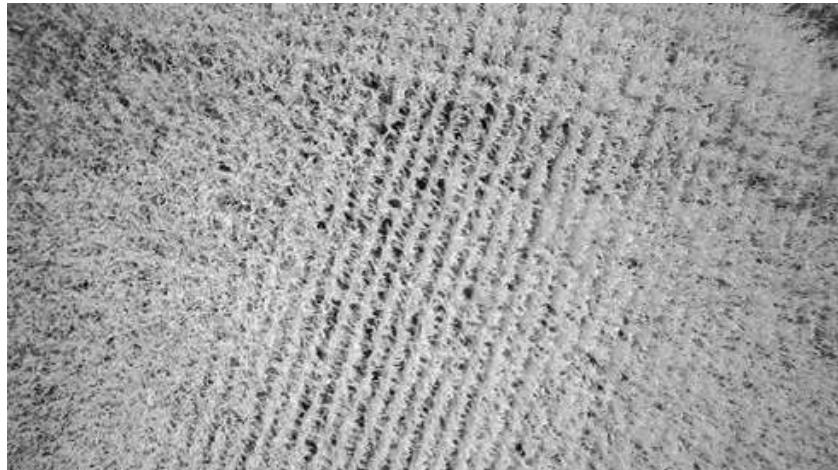


Different camera config testing

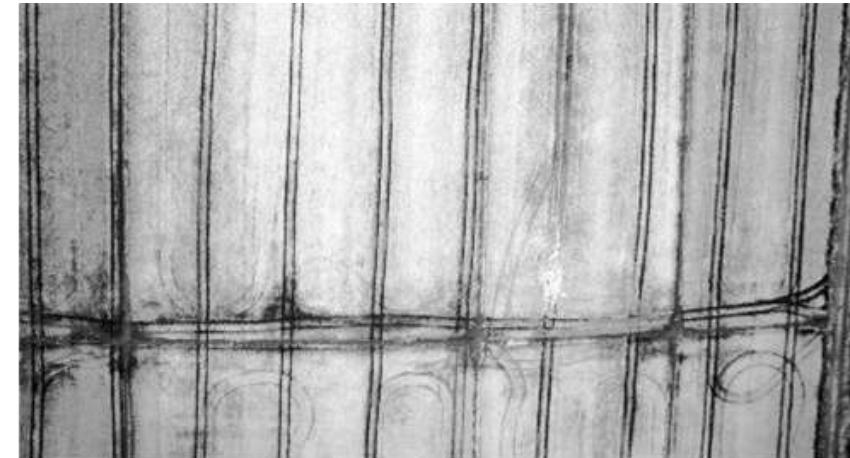


Different camera config testing

Collected data and trained AI models on field crops



Corn



Rice



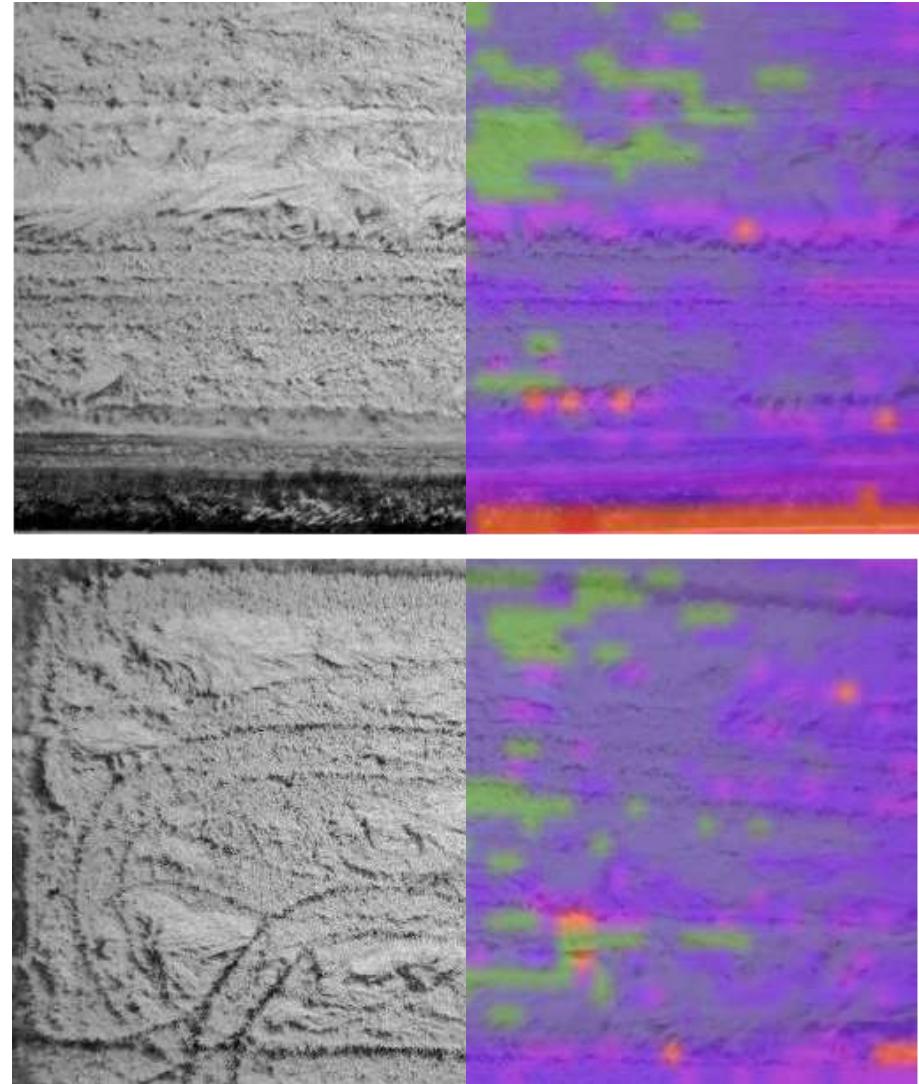
Wheat



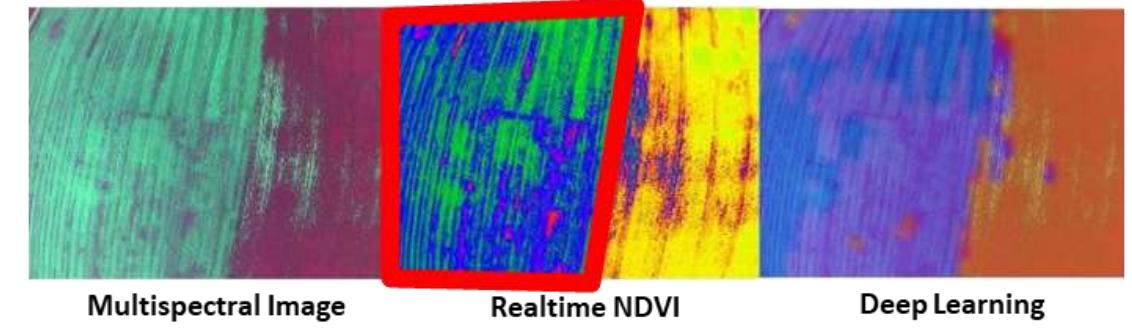
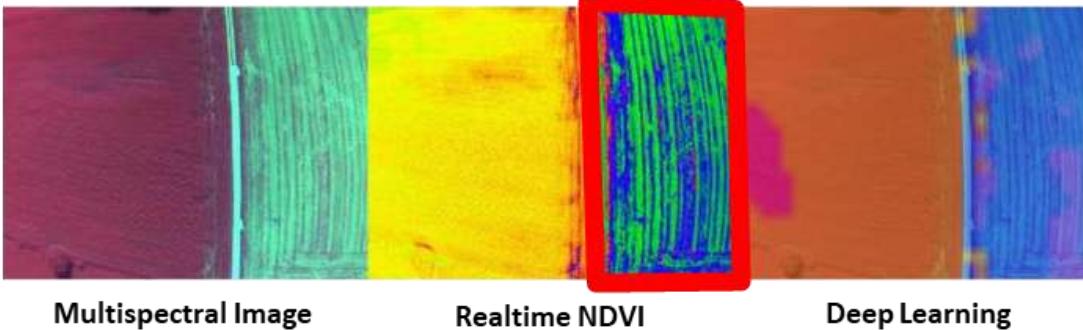
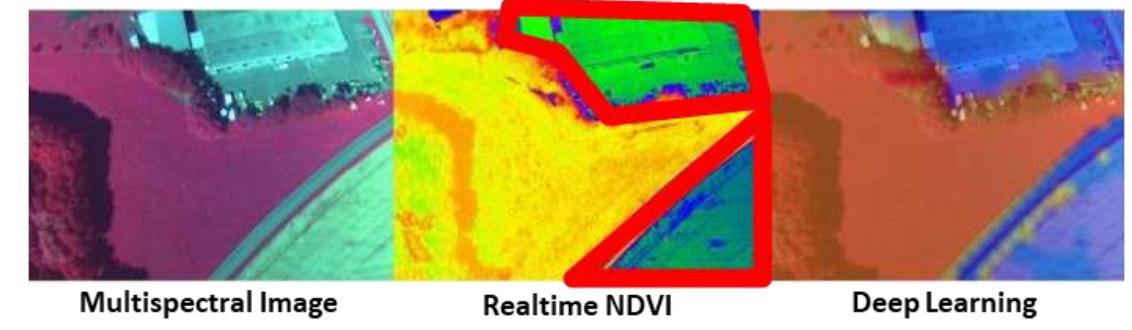
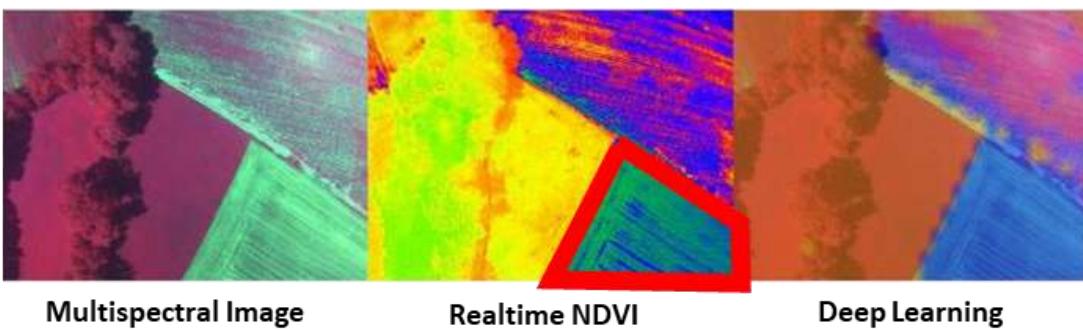
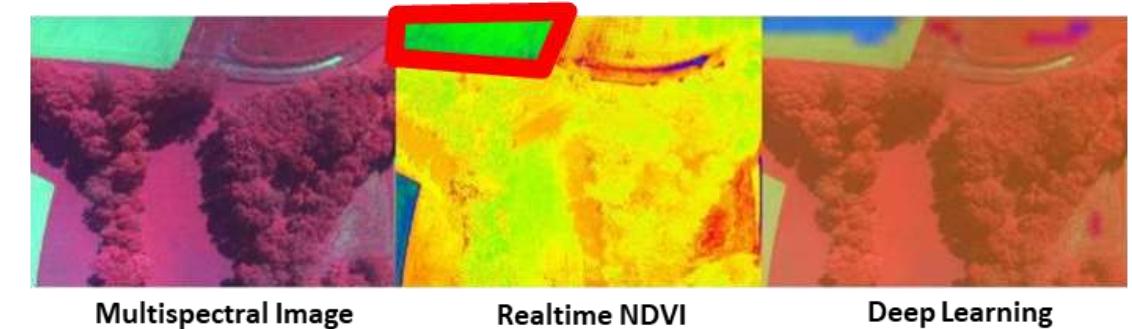
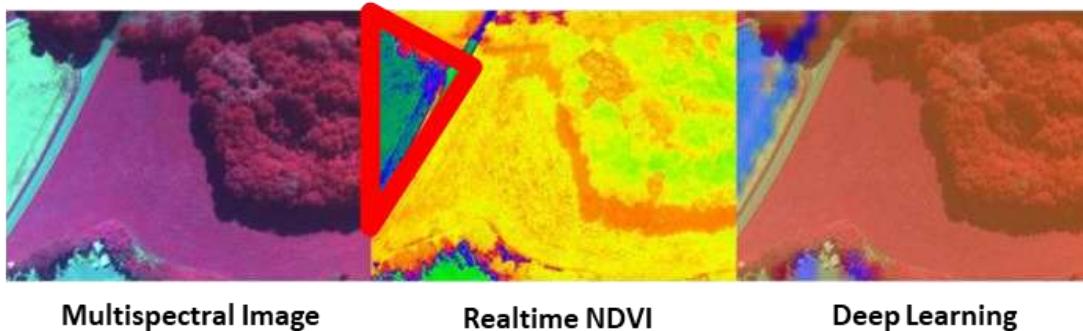
Tomatoes

R&D Order: Spectralix Live NDVI Camera

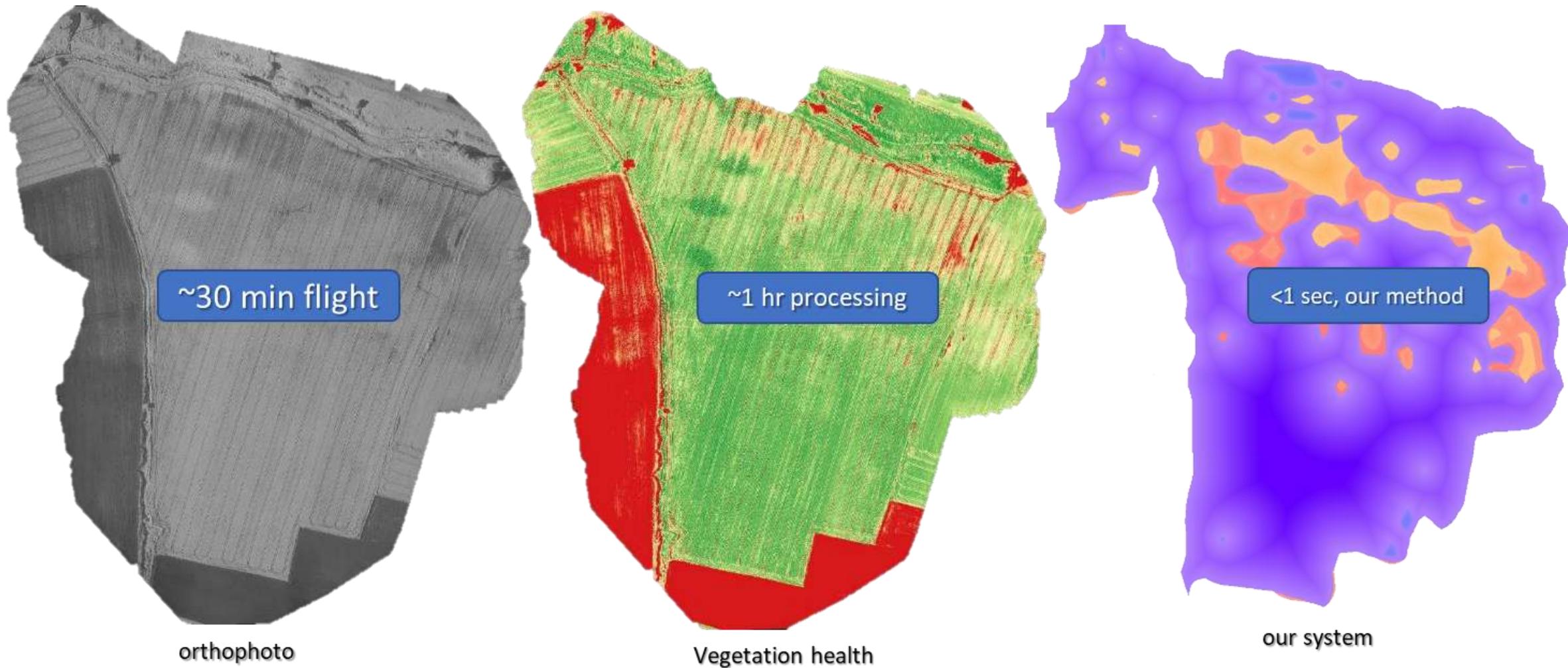
- **Customer Problem**
 - Challenge: Faster and more accurate data processing technique for vegetation health calculation.
- **Our Solution**
 - Innovation: Using deep learning we have achieved faster-than-real-time, more accurate, calibration free processing.
- **Proven Results**
 - Impact: Tested on NRG, NIR, Multispectral imagery and achieved more accuracy than classical processing methodologies.



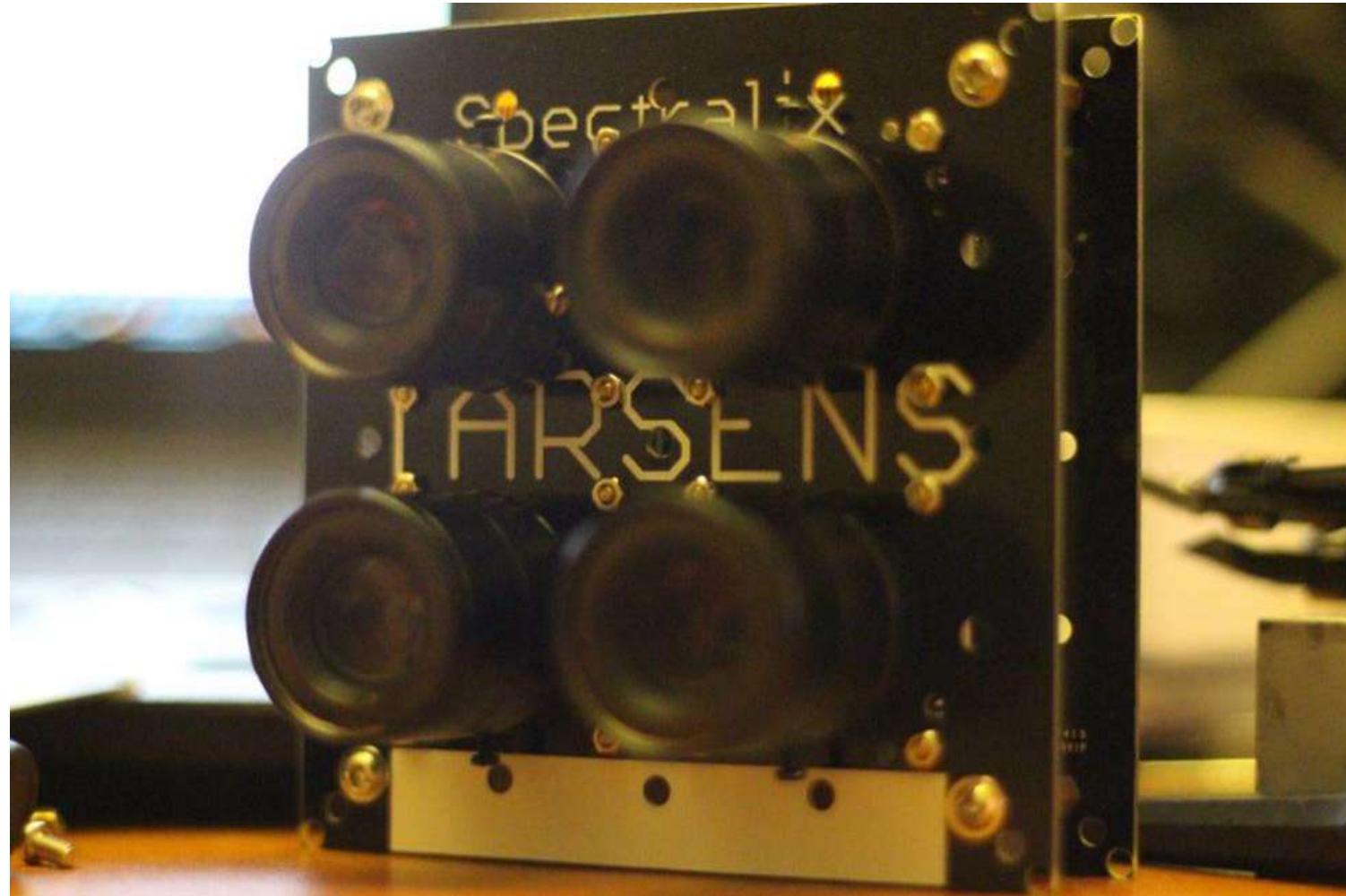
Deep Learning models for perfect accuracy



With perfect accuracy, came speed increase up to 3600x.



Multispectral camera with onboard EDGE AI Processor



TR2016/17566 Patented device

Developed field tablet for remote data processing



Development progress

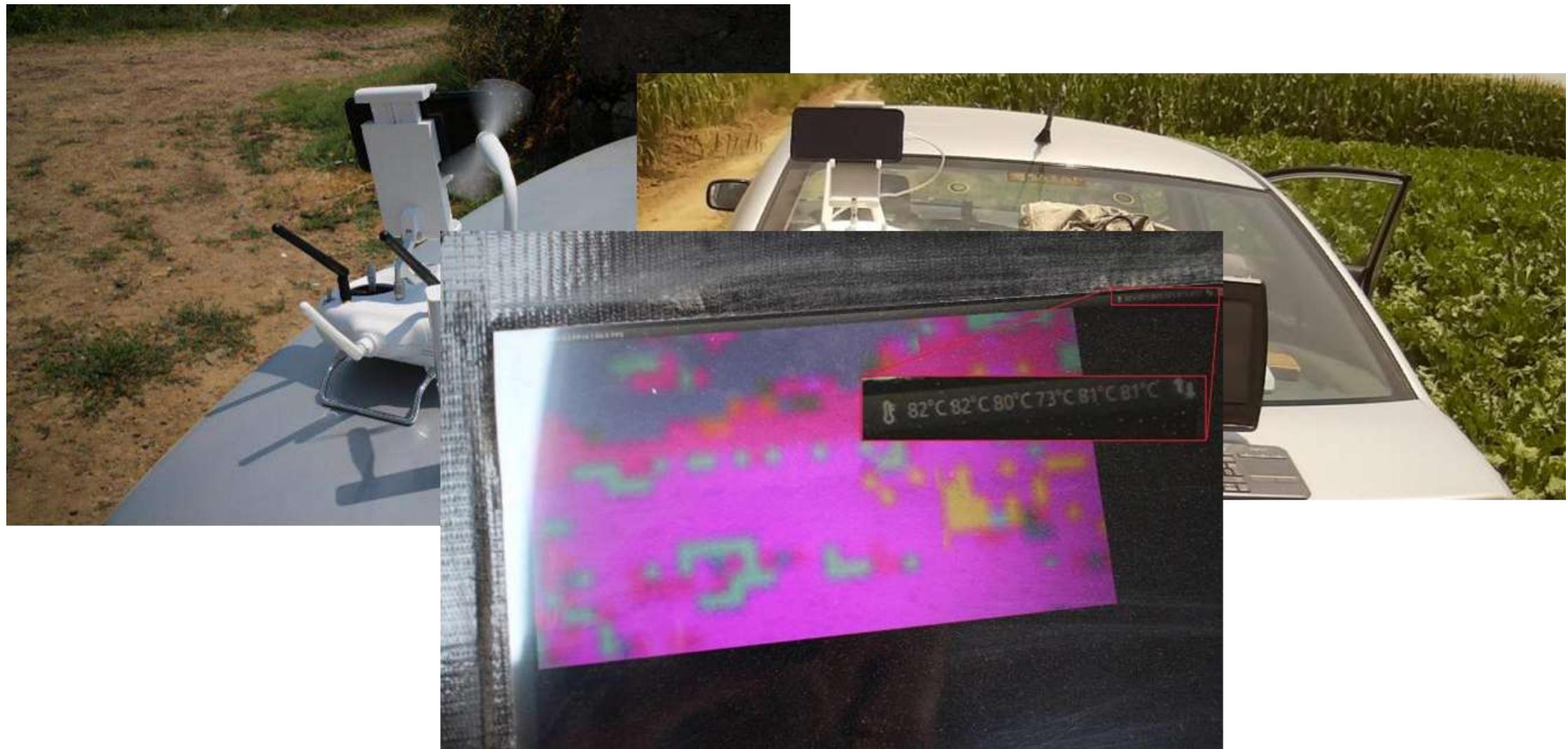


Field testing



Demonstration

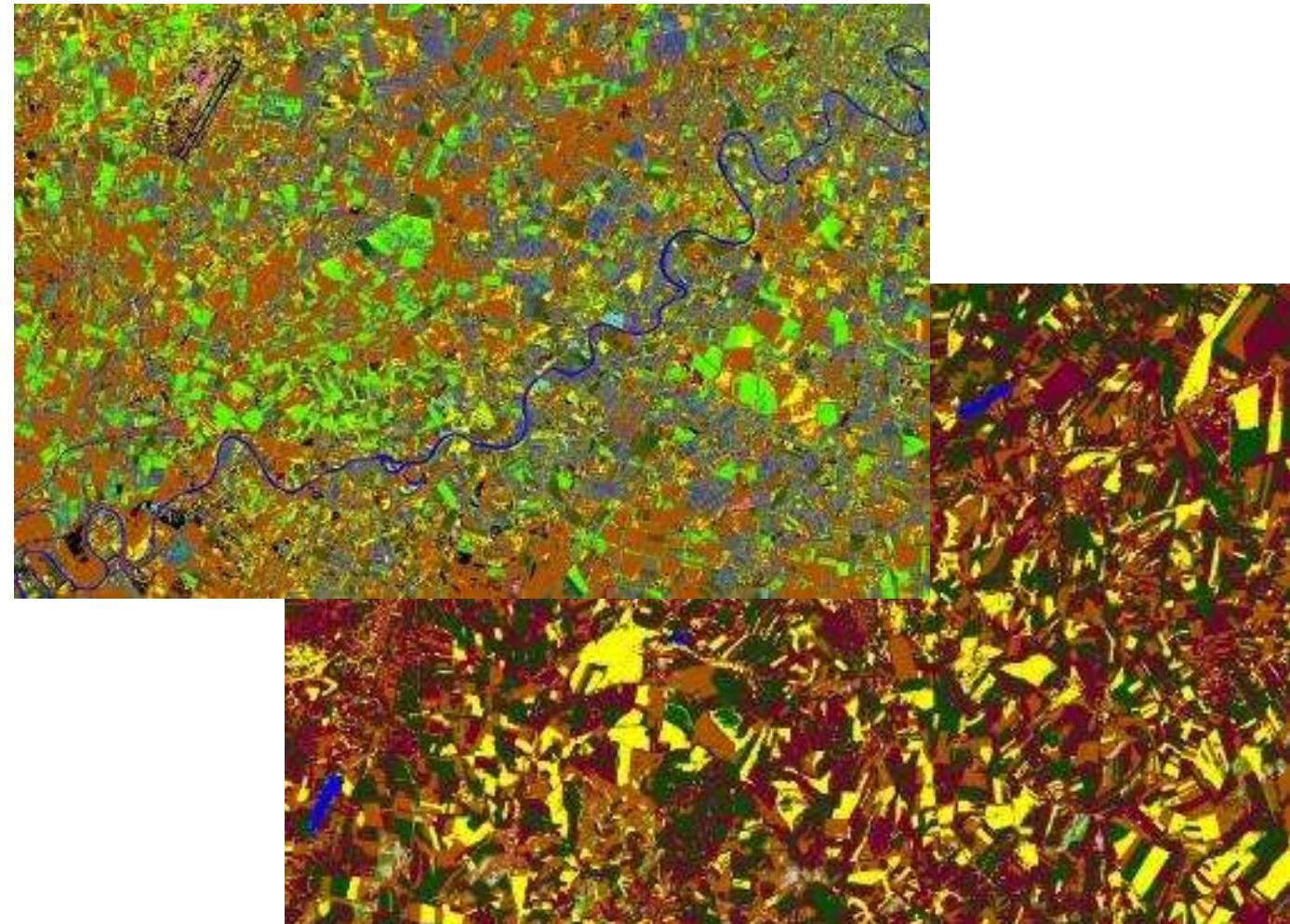
Developed field tablet for remote data processing



In-field system development

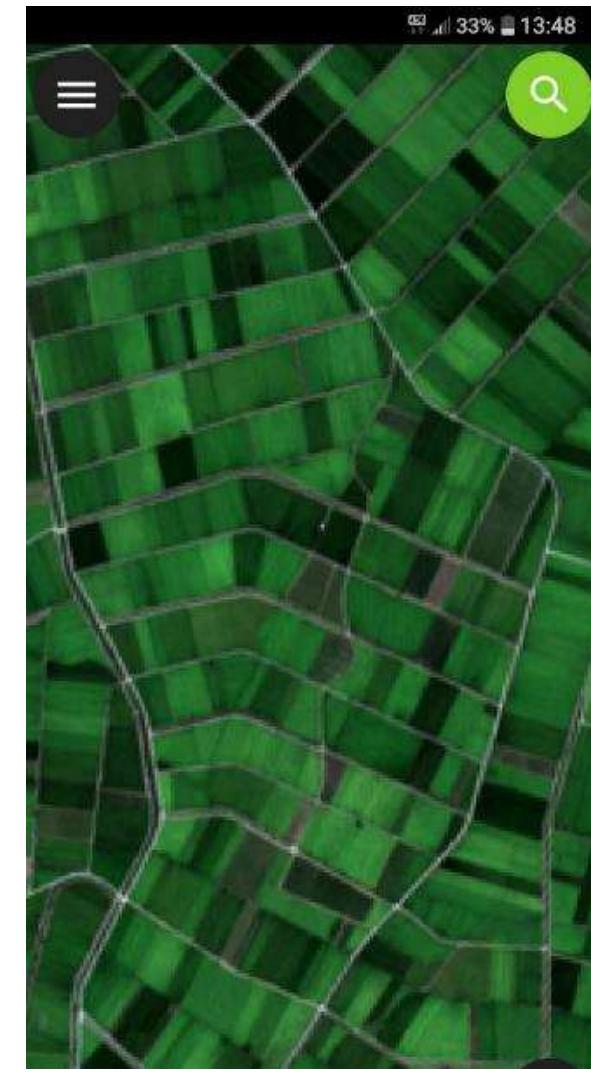
R&D Order: Crop mapping from Satellite Imagery

- **Customer Problem**
 - Challenge: Mapping crop types on hectare basis for different crop types.
- **Our Solution**
 - Innovation: Satellite image processing system.
- **Proven Results**
 - Impact: System was able to provide results of different crops up to 98% accuracy and mapped the Ordered crops efficiently, with geolocation.



Field – crop type monitoring

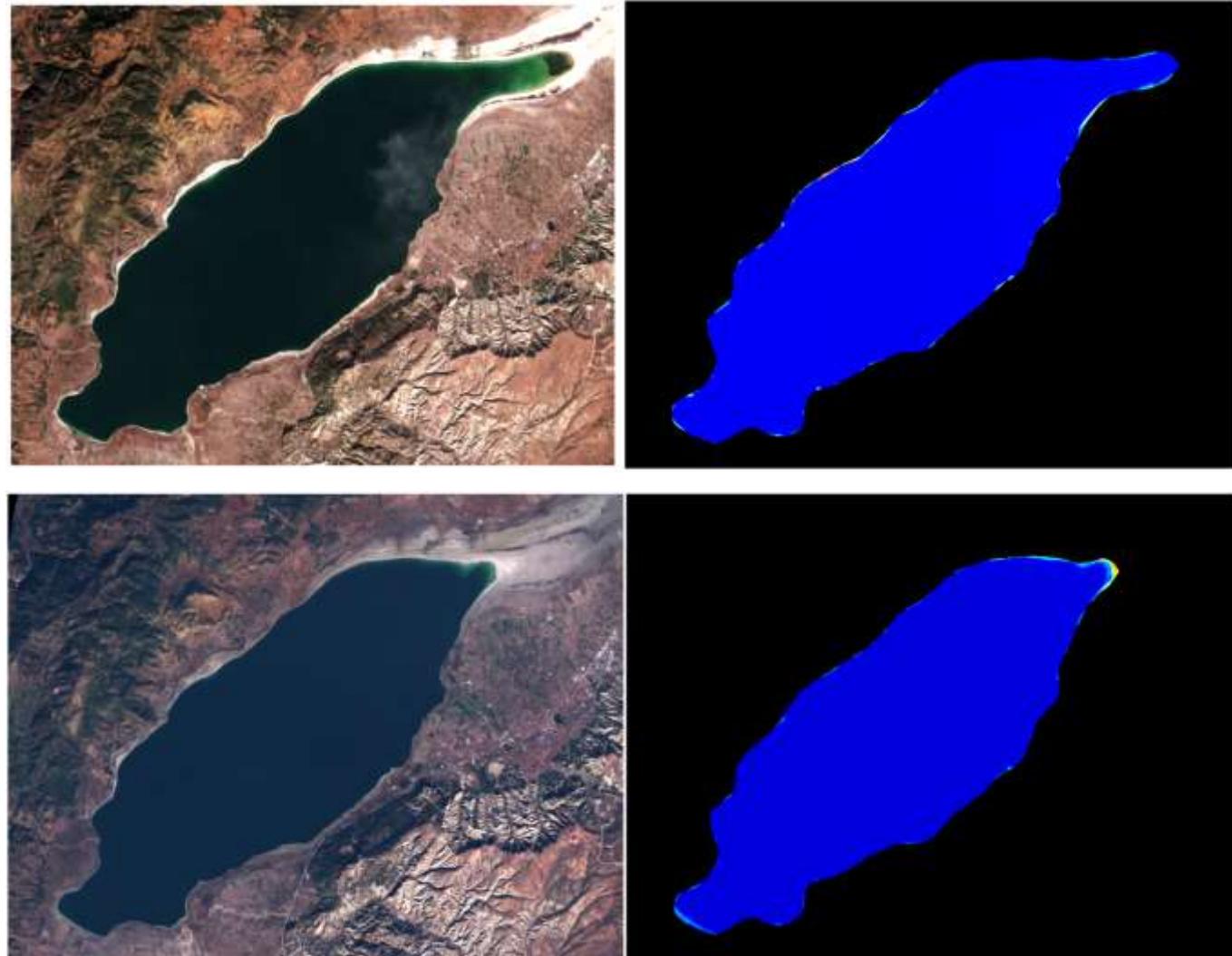
Provided in field recon service for customers



Mobile app support for field monitoring

R&D Order: Lake surface area monitoring

- **Customer Problem**
 - Challenge: A social responsibility project to monitor fresh water sources.
- **Our Solution**
 - Innovation: Image acquisition, object detection, automatic cropping and measuring water body surface size system.
- **Proven Results**
 - Impact: We were able to monitor the lake sizes up to 99.6% accuracy.



Surface size change of Burdur Lake

Lake surface area monitoring

- Started as a social-responsibility Project, later turned into an academic Research.
- In this study, we have collected satellite imagery of 10 major lakes in Türkiye and processed them using classical-image-processing methodologies as well as modern techniques.
- Developed systems were able to detect lakes from satellite imagery, automatically crop them and calculate the surface size up to 99.6% accuracy.

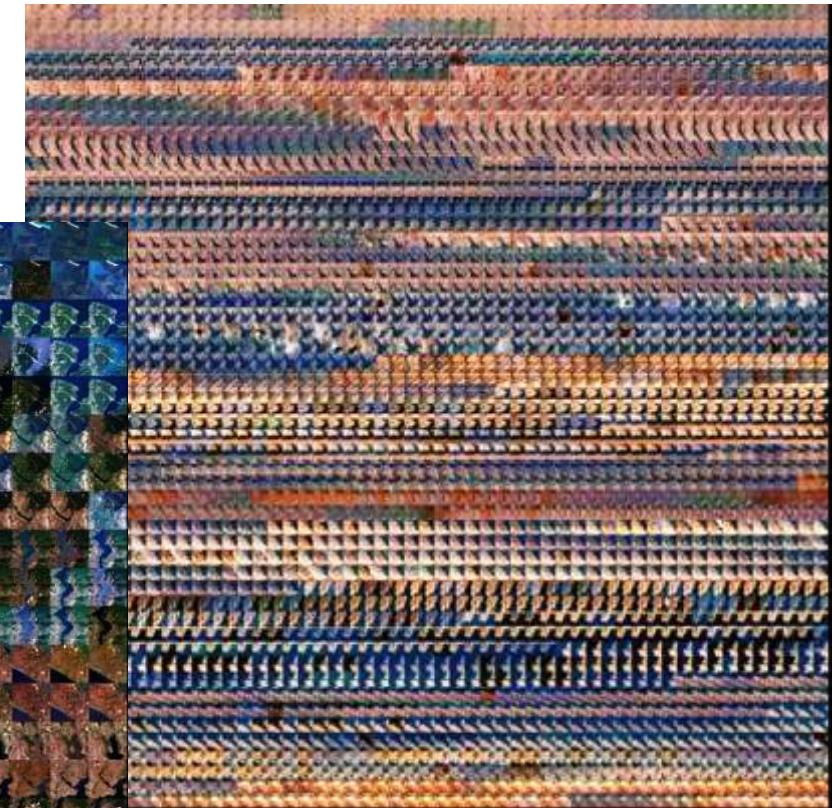
Lake surface area monitoring



Hundreds of natural lake imagery



Hundreds of river and canal imagery



Thousands of dam lake imagery

Lake surface area monitoring



Burdur Lake, Türkiye

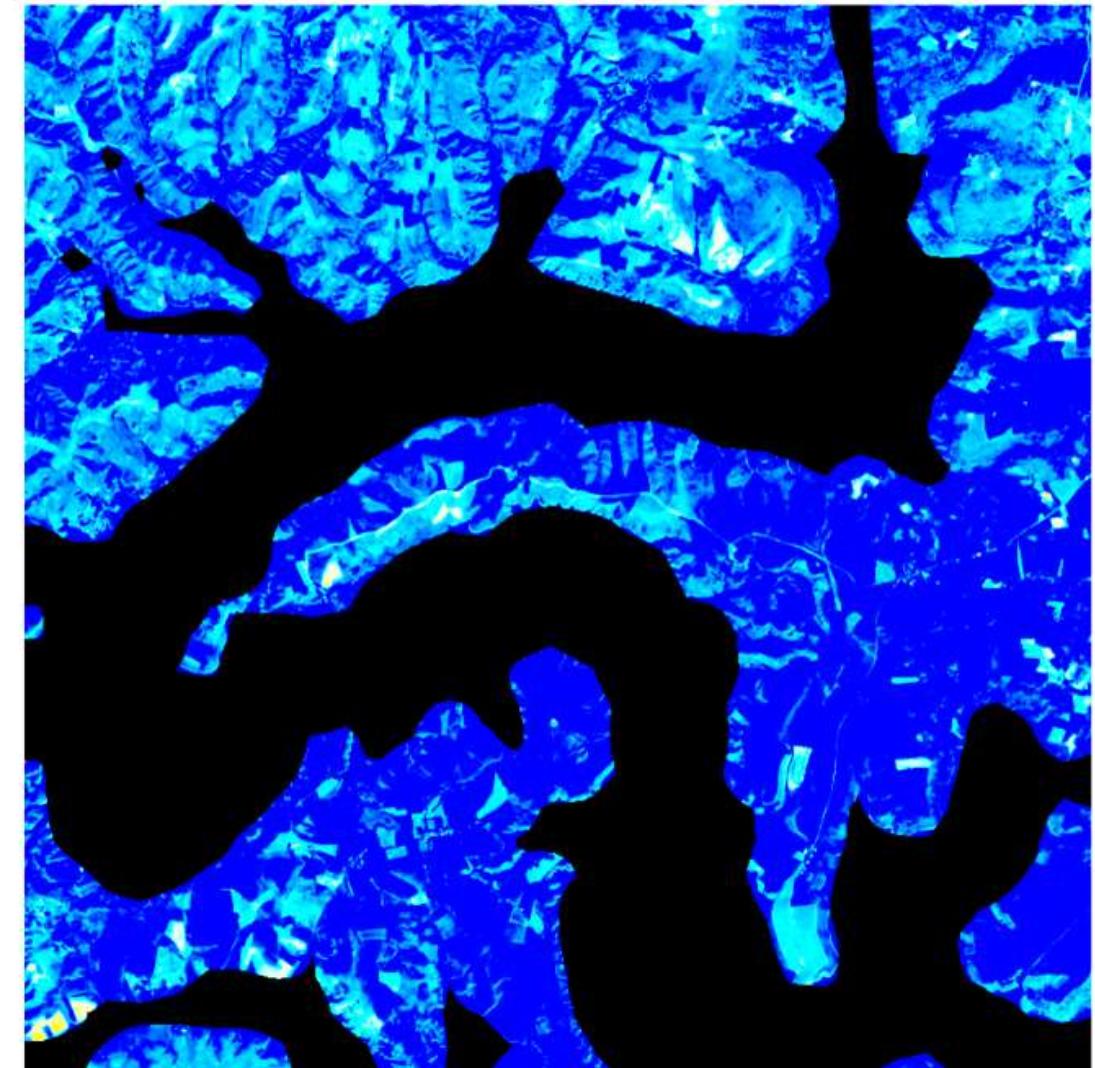
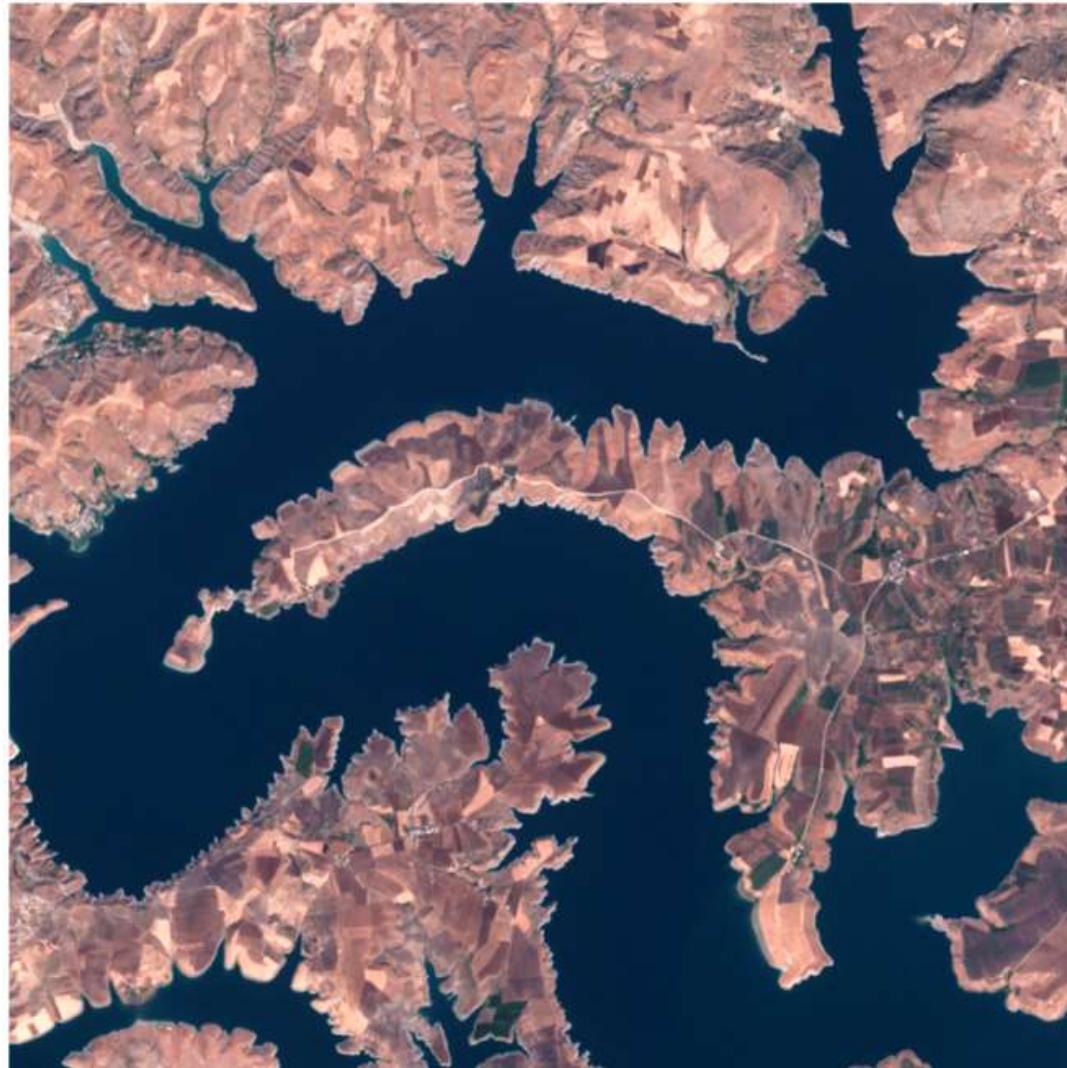


Lake Hennessey, United States



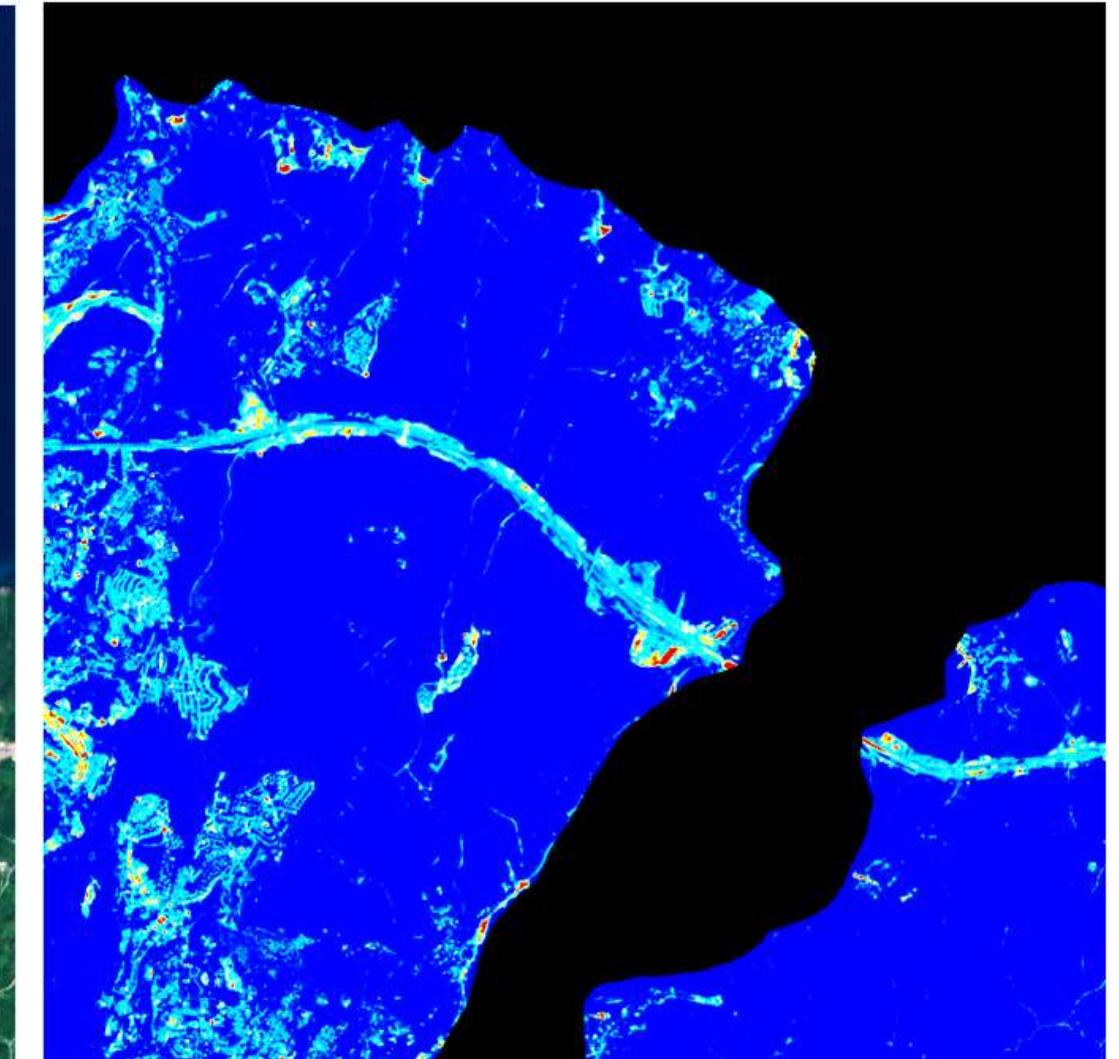
Lake Marmara, Türkiye

Lake surface area monitoring



Atatürk dam lake inspection with AI system

Lake surface area monitoring



Istanbul Bosphorus inspection with AI

Lake surface area monitoring

A	B	C	D	F	G	H	I	K	L	M	N	P	Q	R	S	U	V	W	X	Z	AA	AB	AC	AE	AF	AG	AH	AK	AL	AM	AN	AP	AQ	AR	AS	AU	AV	AW
1	bafı 355NB	20150812	61768000	beysehir	36SUG	20150826	546869700	burdur	355QB	20150730	137085000	egirdir	36SUH	20150730	446208000	ercek	38SLH	20150814	107163000	hazer	37SEC	20150708	78645600	iznik	35TQE	20150730	284371200	marmara	355NC	20150730	45676800	sakarya	35TQF	20150730	34544000	ulubat	35TPE	201507
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Lake surface area monitoring



2018



2020



2022



2019



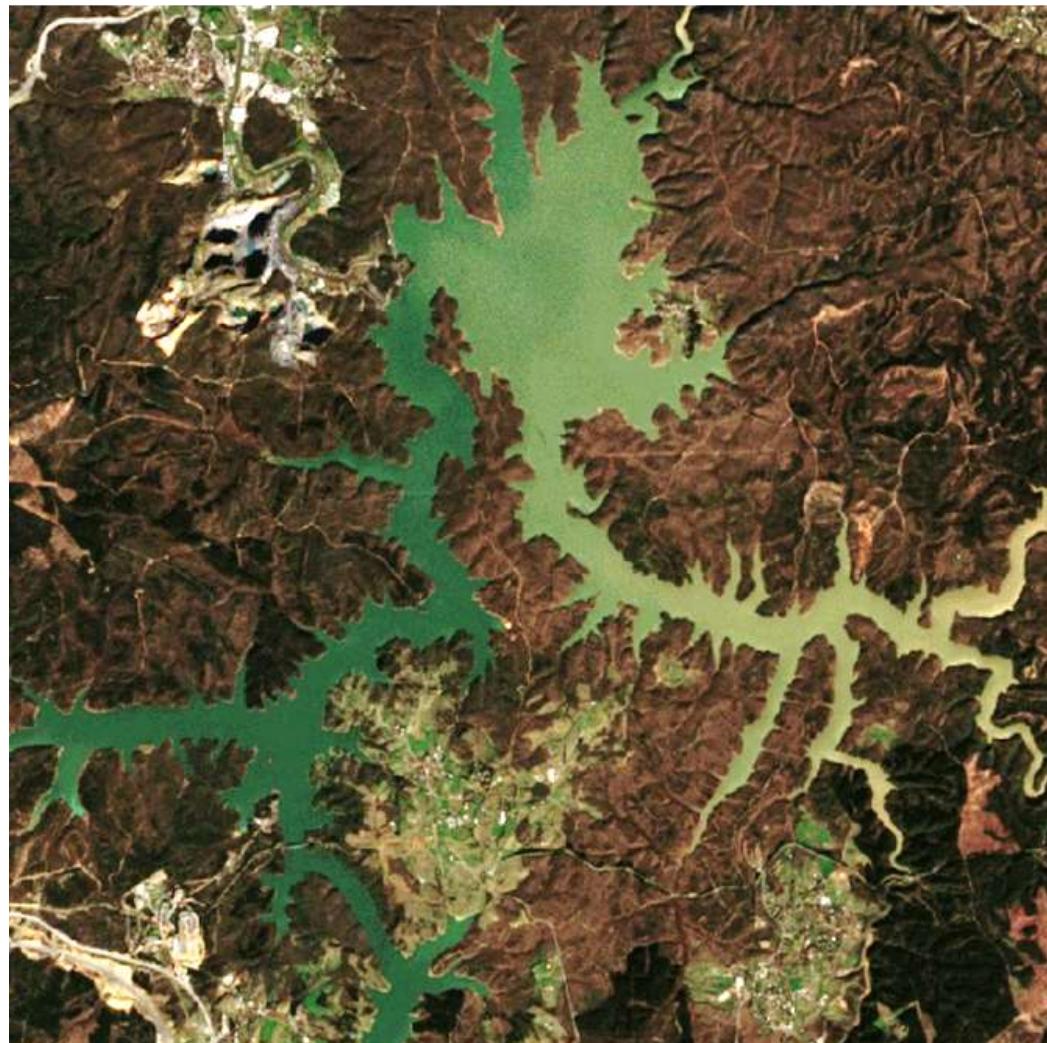
2021



2023

Temporal inspection of Lake Marmara

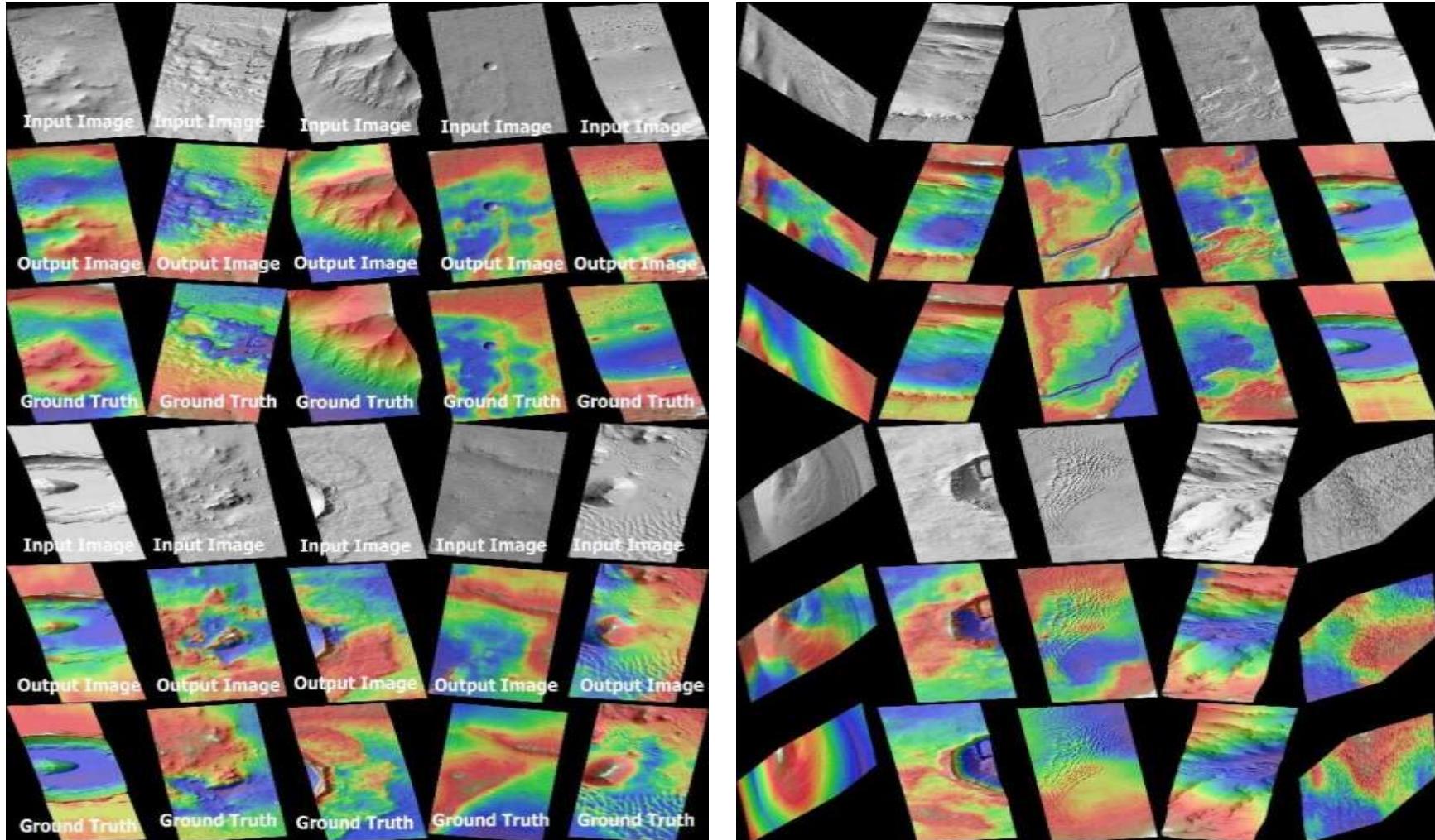
Lake surface area monitoring



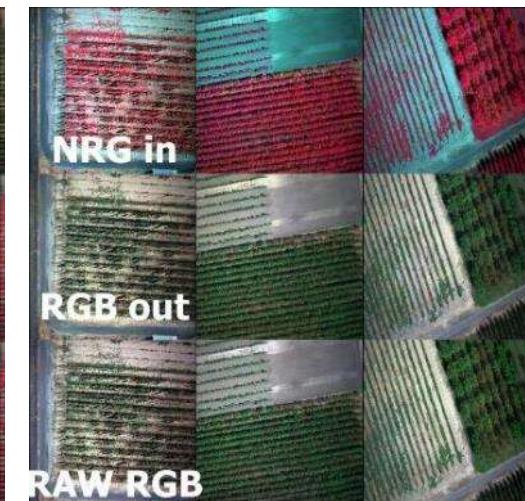
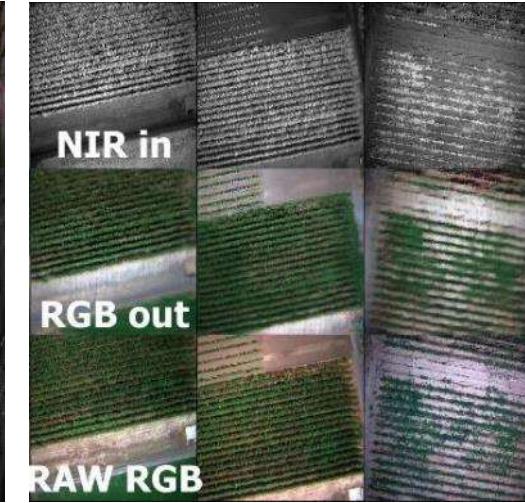
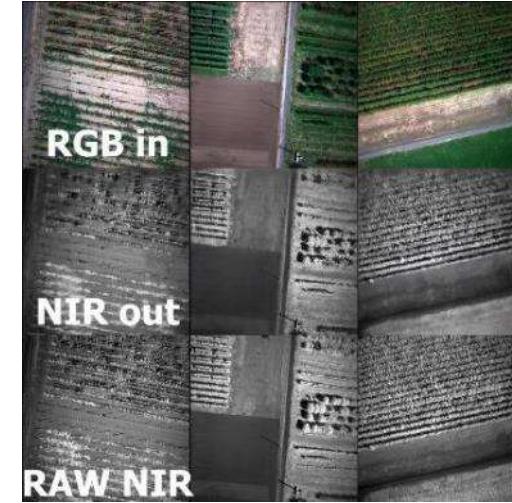
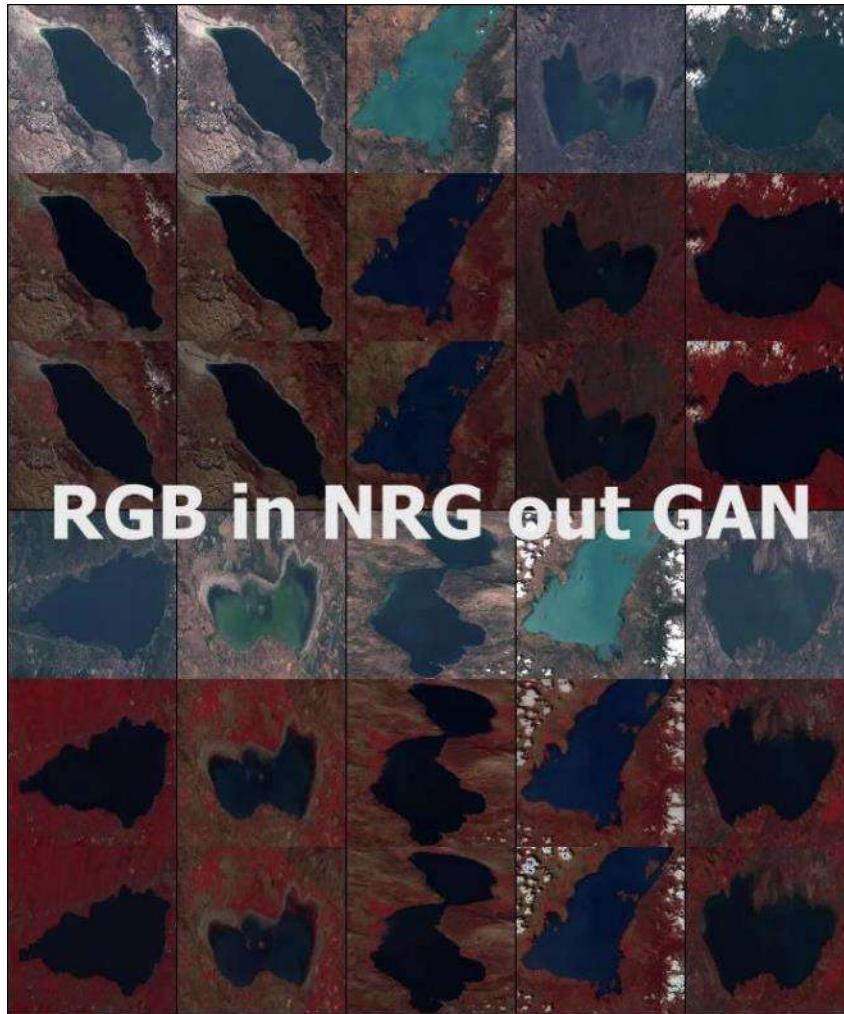
Istanbul dam lake monitoring

Generative AI Works for Different Applications

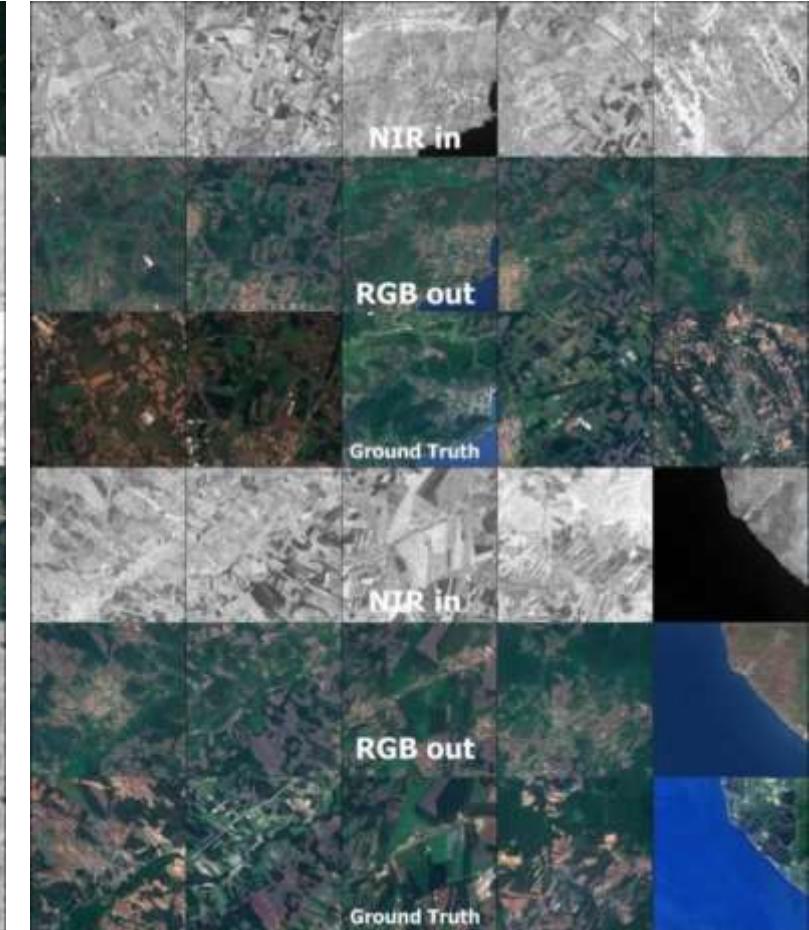
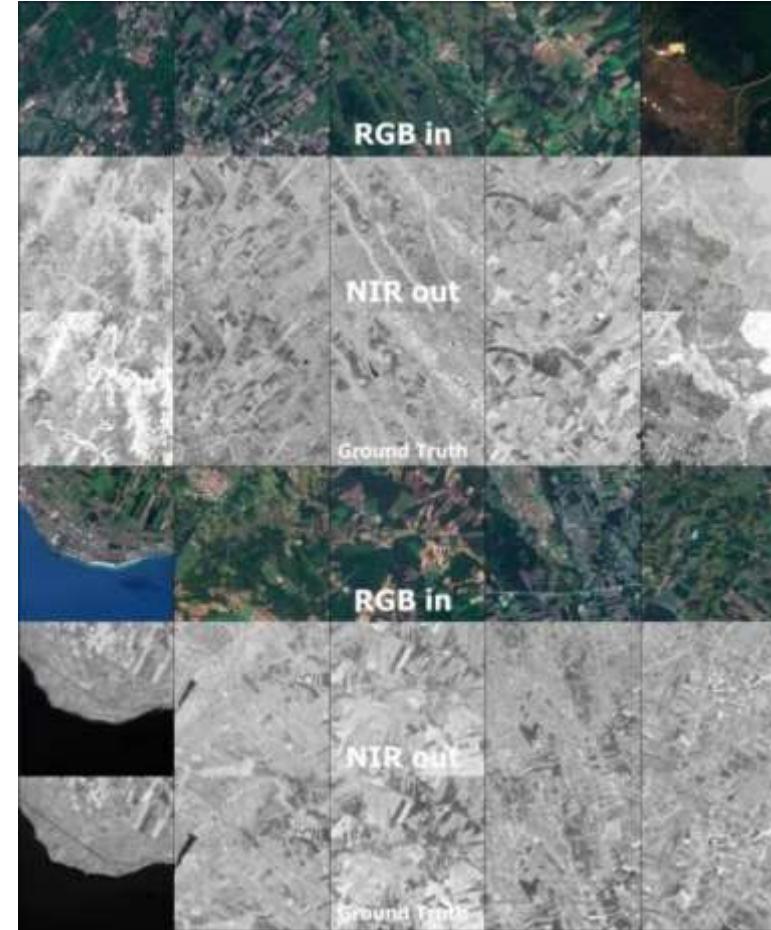
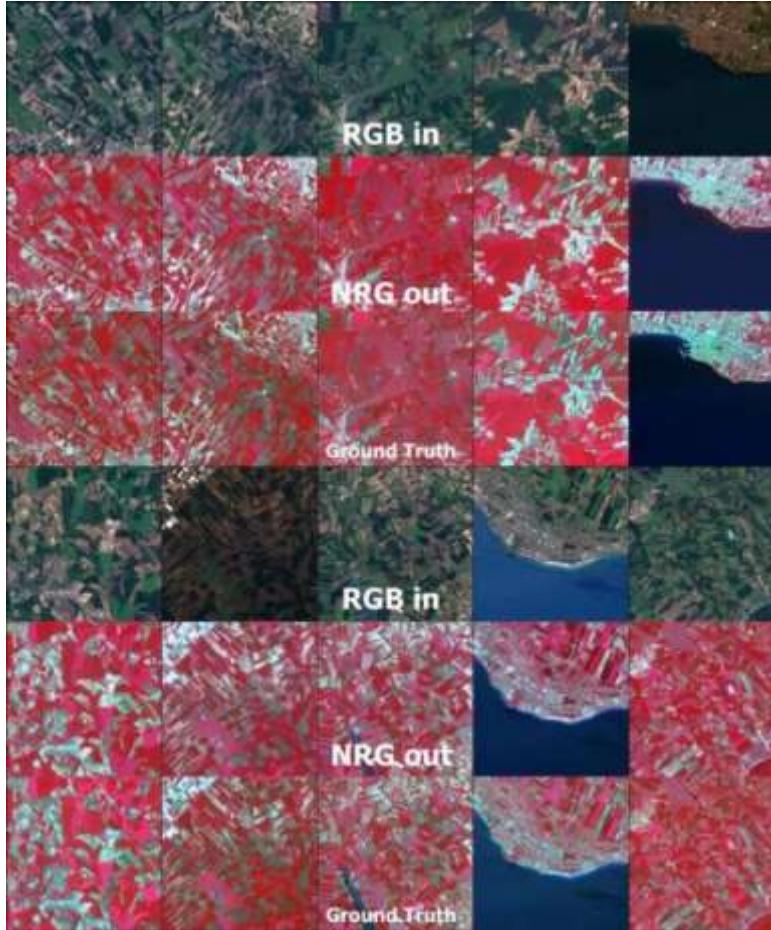
NASA HiRISE Imagery for MARS mapping



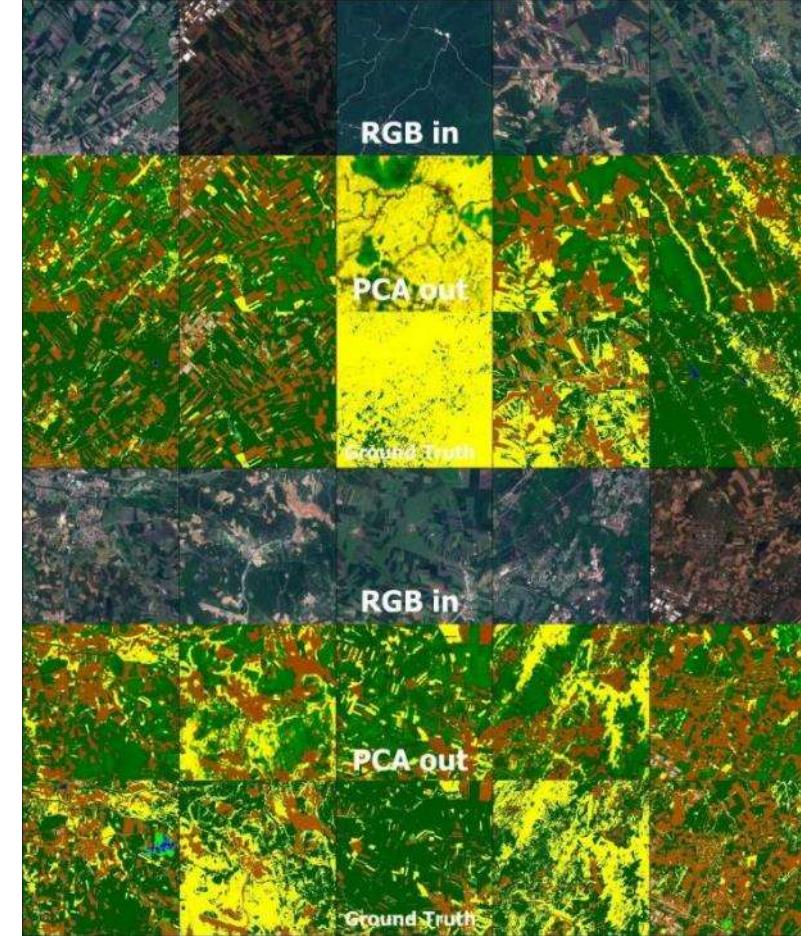
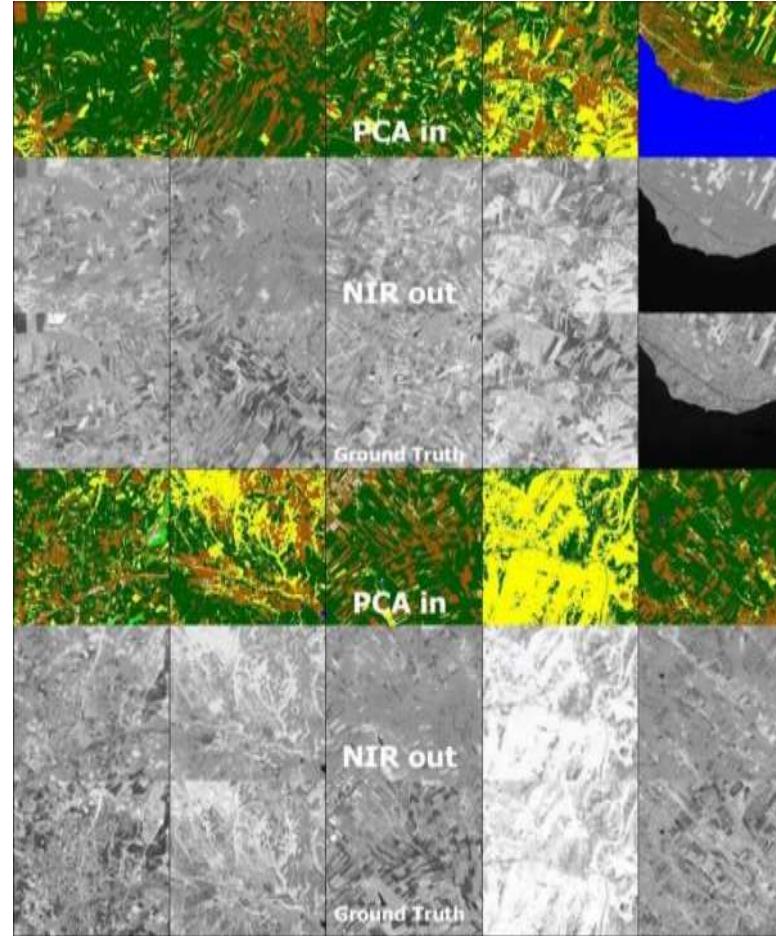
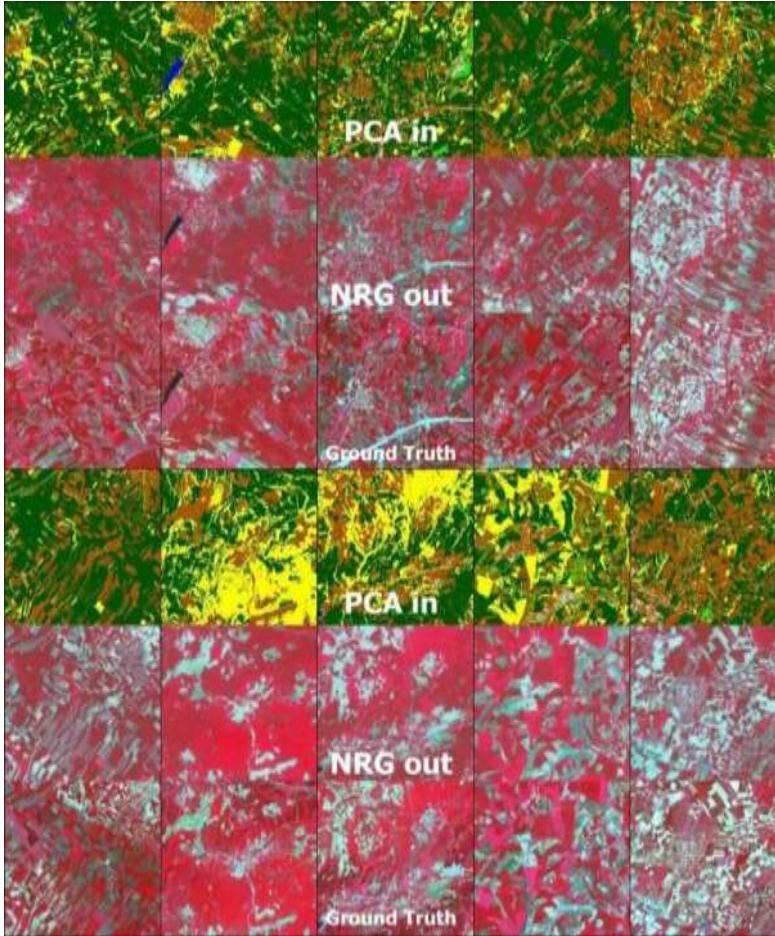
RGB/NRG Spectral Expansion with GAN



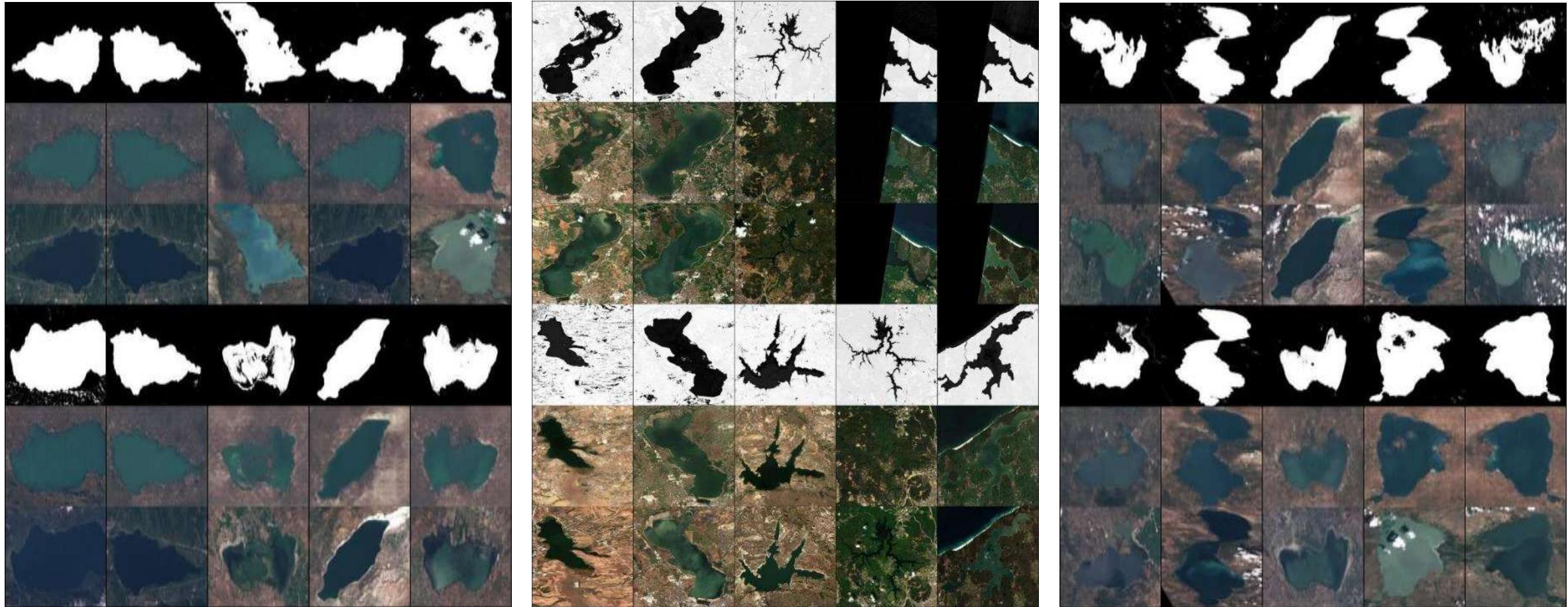
RGB/NRG Spectral Expansion with GAN



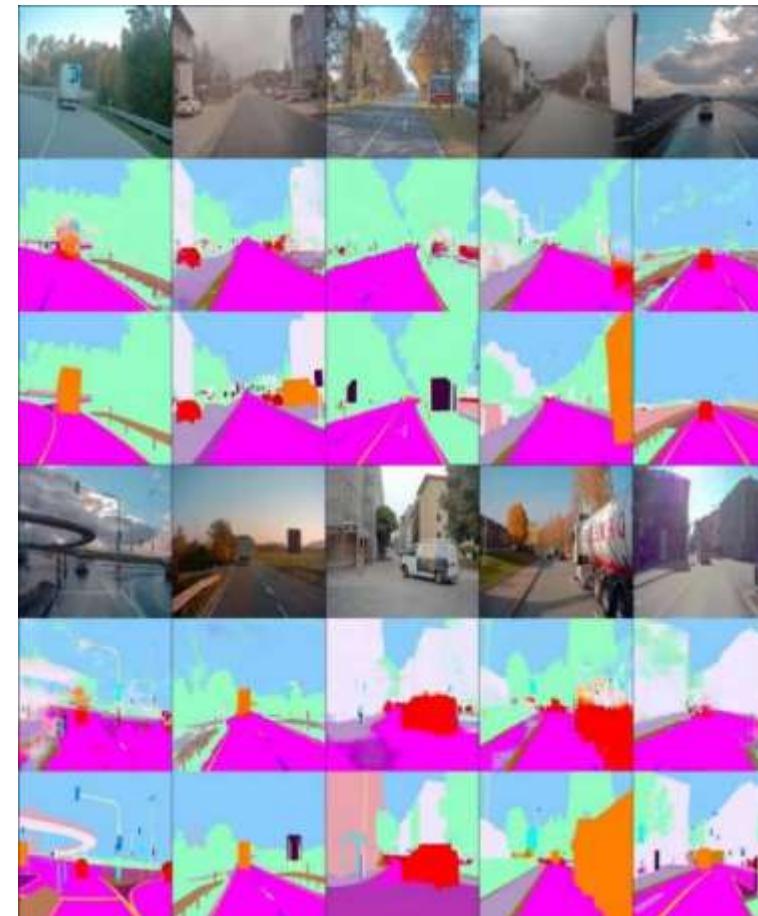
RGB/NRG Spectral Expansion with GAN



Lake surface area calculation enhancement



R&D Order: Labeling for Autonomous Vehicle Development



Life-like GenAI imagery for Remote Sensing



Occupational safety and health

R&D Order: Occupational safety and health

- **Customer Problem**
 - Challenge: Measuring vibration level of shaking system, distance of shaking robot arm to the tree and monitoring environment for human presence.
- **Our Solution**
 - Innovation: Combined distance measurement, vibration monitor and human presence detection and wirelessly sending both signals to operator tablet.
- **Proven Results**
 - Impact: First in class monitoring system for tree-shaker system in the world.



Human presence detection AI system and tree distance measurement live feed comes directly to the operator screen

Occupational safety and health

With widely available remote controlled tree shakers, occupational health and safety concerns also increased, with Kemal Aksezgin agricultural machinery, we have developed several solutions to address those and demonstrate them on AgroExpo'24.

- 1. Ergonomic Risks and Operator Health:** Examine how the ergonomic demands of remotely controlling olive tree shakers can lead to posture-related injuries and repetitive strain.
- 2. Hydraulic System Maintenance and Safety:** Focus on the hazards of hydraulic system failures, including leaks and high-pressure issues, and the importance of regular maintenance.
- 3. Remote Control Technology and Operator Safety:** Assess the impact of remote control technology on safety, including potential risks from reduced situational awareness and safety feature effectiveness.
- 4. Noise and Vibration Exposure:** Explore the health risks from prolonged noise and vibration exposure in hydraulic olive tree shakers and strategies to reduce these risks.
- 5. Emergency Procedures and Response Training:** Highlight the need for clear emergency procedures and effective training to handle hydraulic failures and other equipment malfunctions safely.

Occupational safety and health



Different attachments for different applications

Tree distance measurement & camera monitoring for live feed

<https://youtube.com/shorts/gwJ3vGiEQWo>

Occupational safety and health



AI Powered human presence warning system



Completely wireless data transmission of all information with encryption

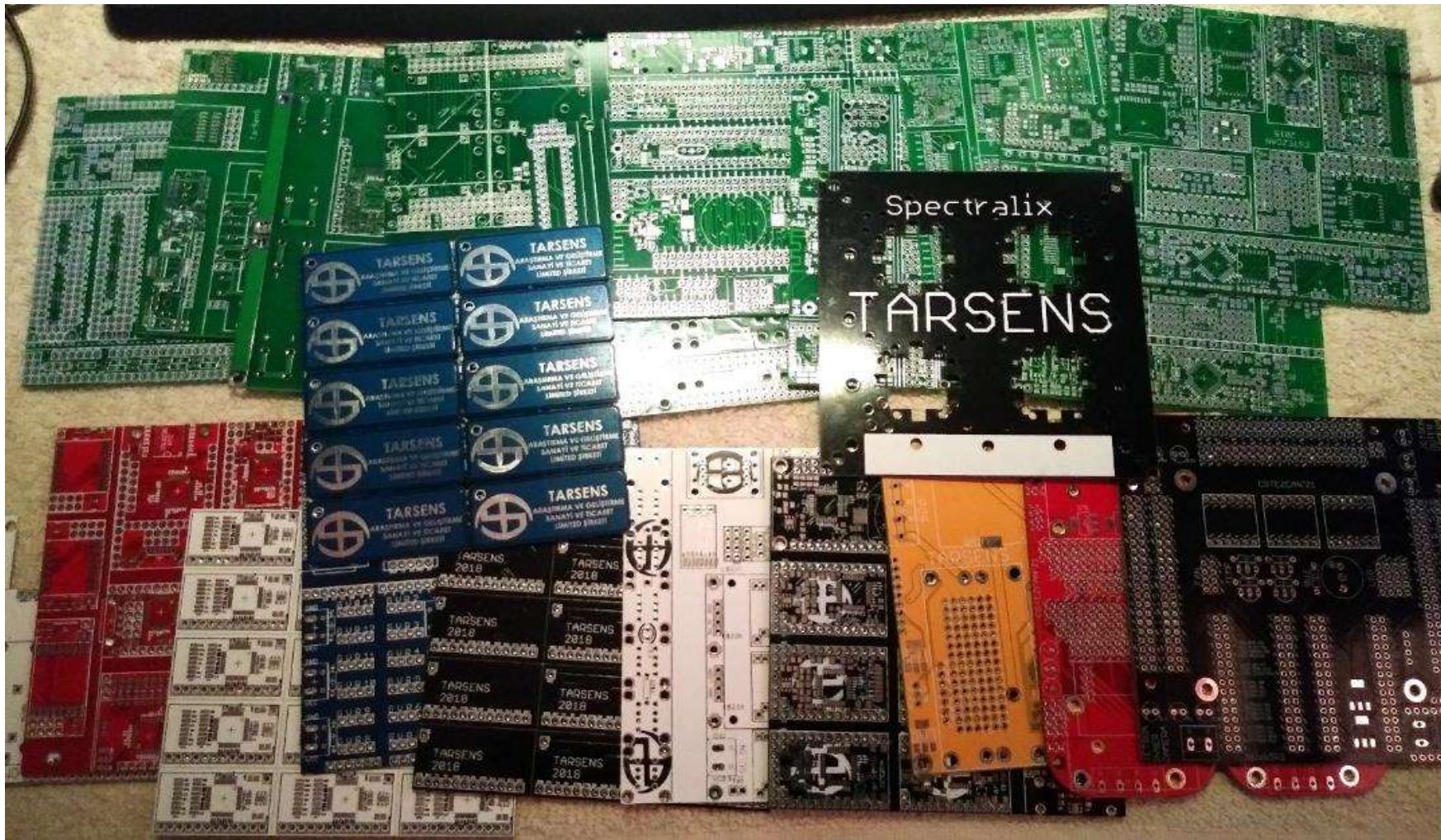
<https://youtube.com/shorts/gwJ3vGiEQWo>

Other projects, products, applications, services, consultancies

Projects, products, applications, services and others

- Over the years, we have done many other projects as well, those ranging from industrial inspection to generative works.
- Here are a few examples on them;
 - Solar Panel inspection using near-infrared cameras (not to be confused with thermal cameras), Chip solderpad inspection, Machine part inspection, Bottle inspection.
 - Infrastructure inspection using mobile cameras mounted to vehicles for road cracks, bridge cracks, other infrastructure monitoring

We design more than half of our PCBs



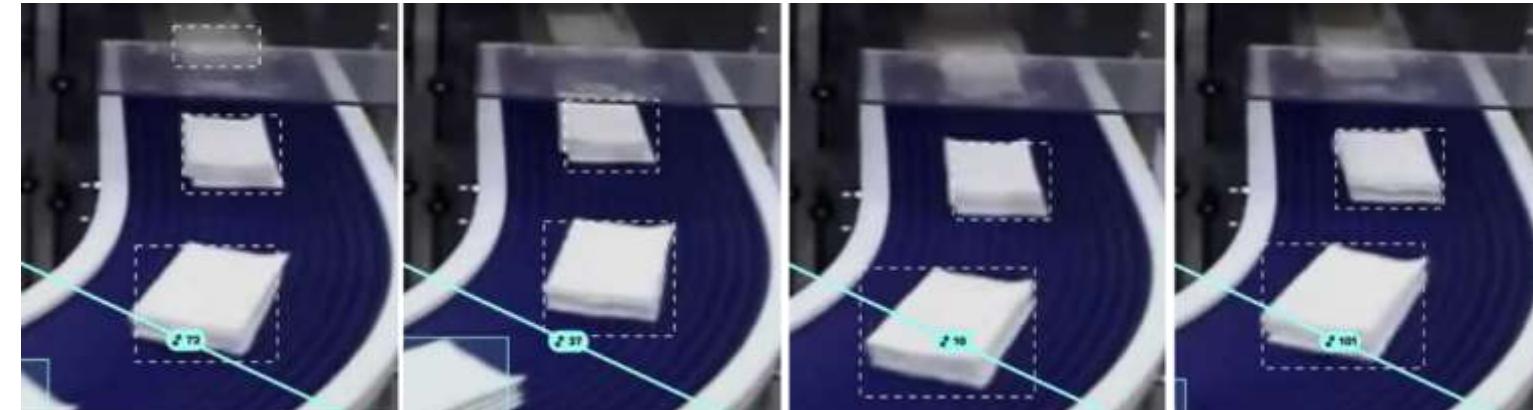
R&D Order: Infrastructure Monitoring

- **Customer Problem**
 - Challenge: From Canada, monitoring climate change impact on road surface, cracks etc. with GPS.
- **Our Solution**
 - Innovation: Using either a GoPro for offline data collection or Edge AI for detection.
- **Proven Results**
 - Impact: Able to geolocate to pinpoint problems with ease.



R&D Order: Counting sugar bags

- **Customer Problem**
 - Challenge: Sugar factory operators can't figure out how many bags out of the factory.
- **Our Solution**
 - Innovation: Bag counting system.
- **Proven Results**
 - Impact: Successful deployment of AI models.

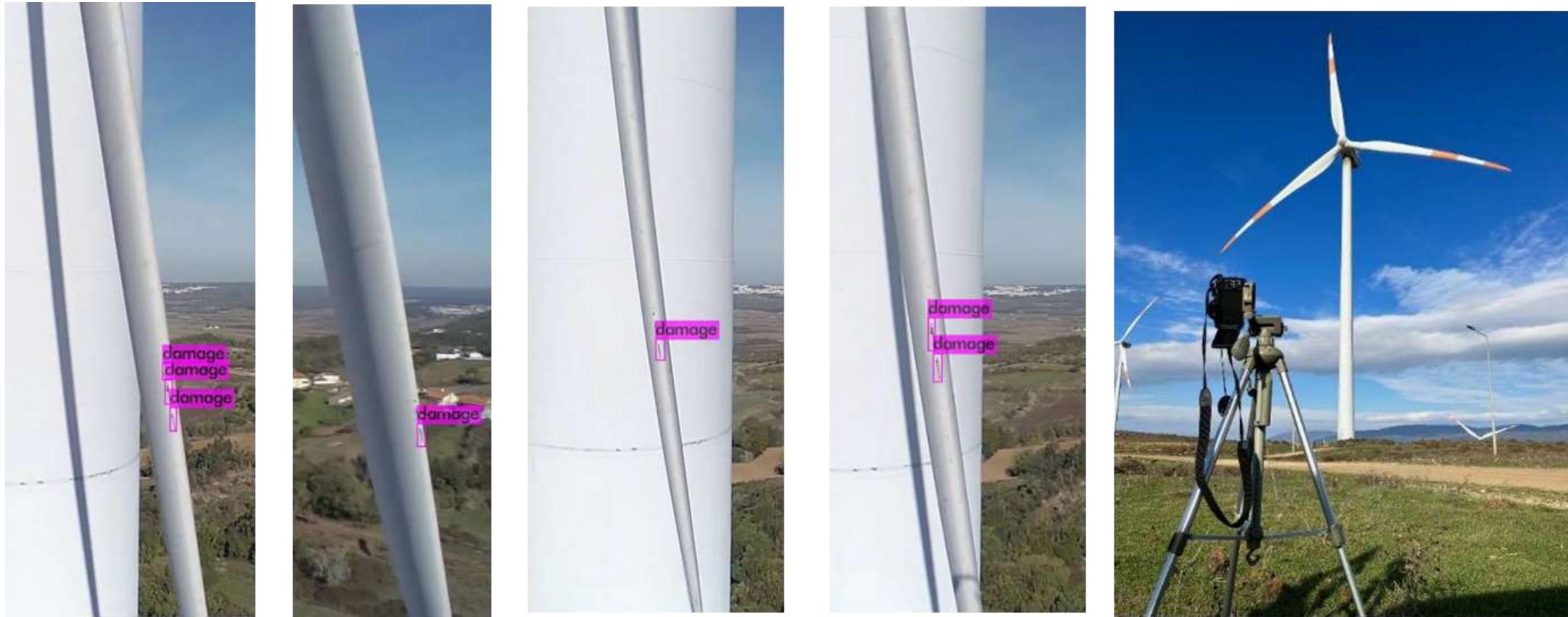


R&D Order: BEE hive health monitoring

- **Customer Problem**
 - Challenge: Varroa detection on bees, bee enter & exit frequency, anomaly detection.
- **Our Solution**
 - Innovation: Cameras deployed with Edge AI systems to monitor hives.
- **Proven Results**
 - Impact: Successful deployment of AI models.



Wind Turbine Blade Damage Detection System



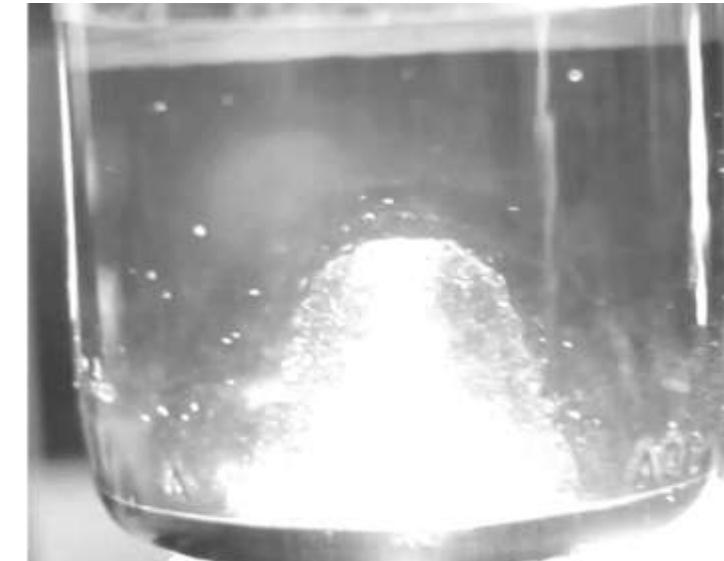
R&D Order: Machine part inspection system

- **Customer Problem**
 - Challenge: Finding production related problems on crucial machinery parts.
- **Our Solution**
 - Innovation: Multi-angle camera setup with simultaneous tracking.
- **Proven Results**
 - Impact: Successful deployment of AI models.

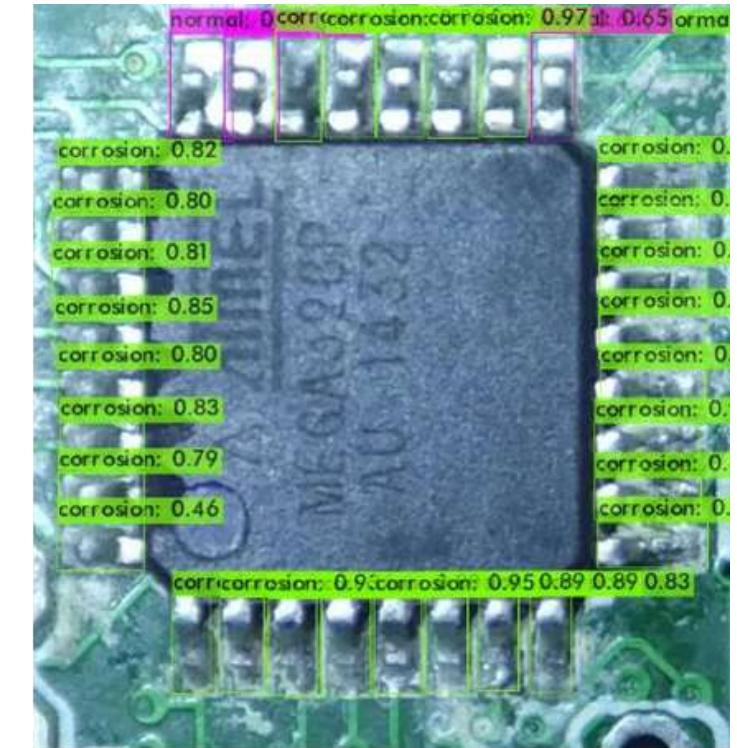
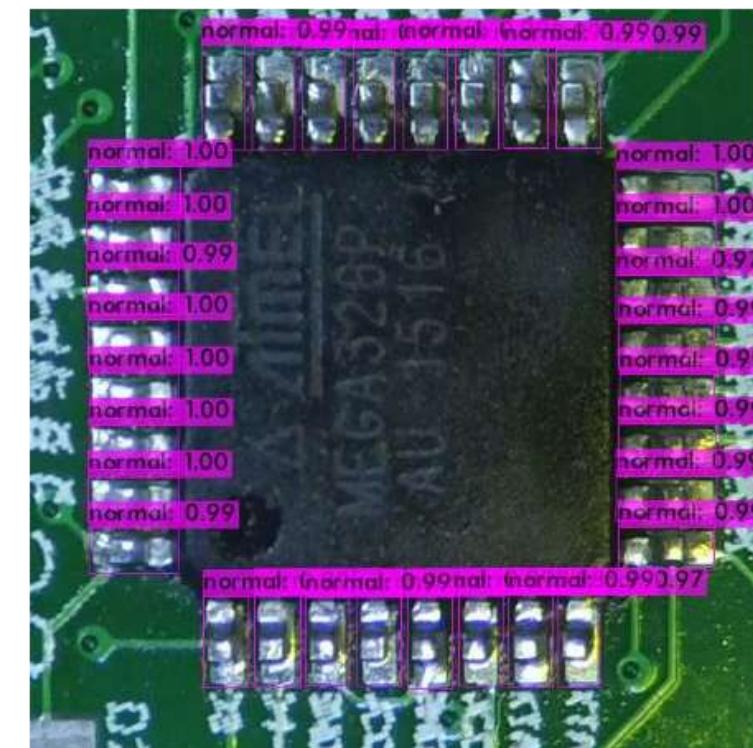
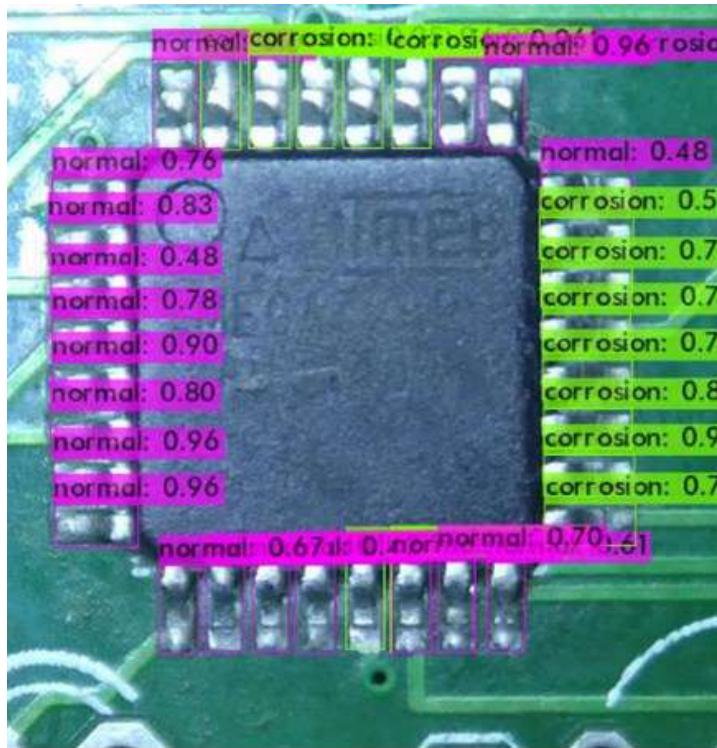


R&D Order: Wine bottle inspection system

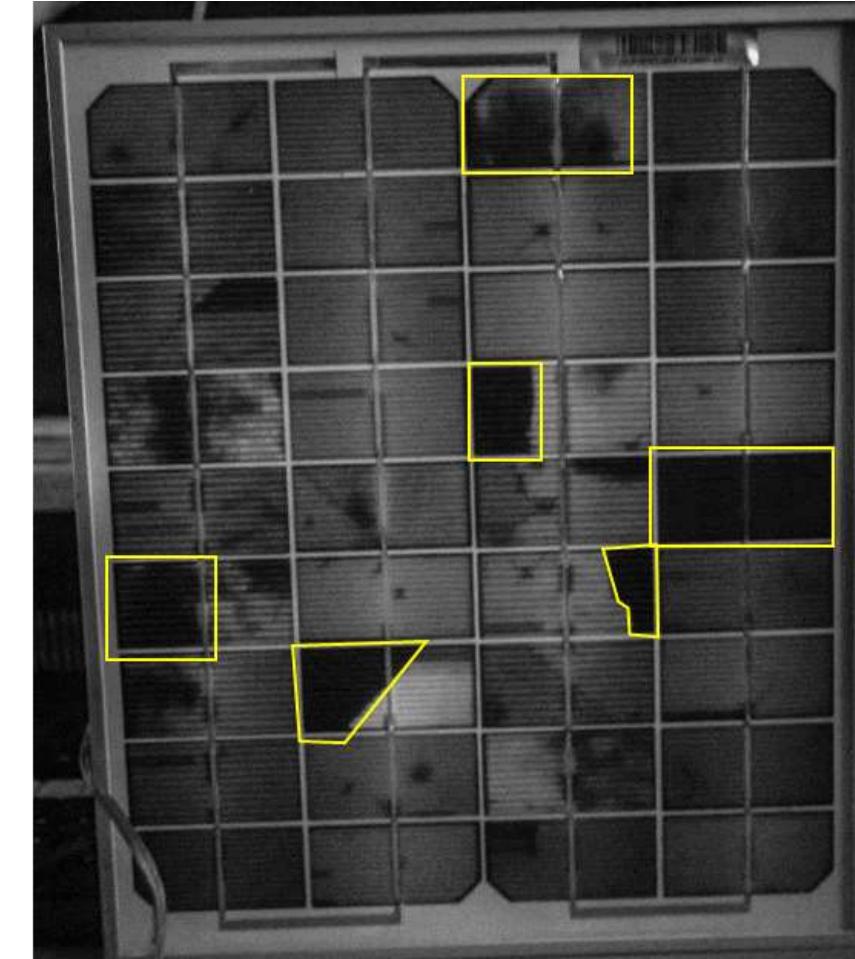
- **Customer Problem**
 - Challenge: Finding unwanted particulate in dark colored wine bottles.
- **Our Solution**
 - Innovation: Specialized camera with lighting setup and object recognition methodologies.
- **Proven Results**
 - Impact: More than hundred times better perception than a human operator.



SMD Part solder quality checking system



Solar panel inspection system



Consultancies for giants in Türkiye

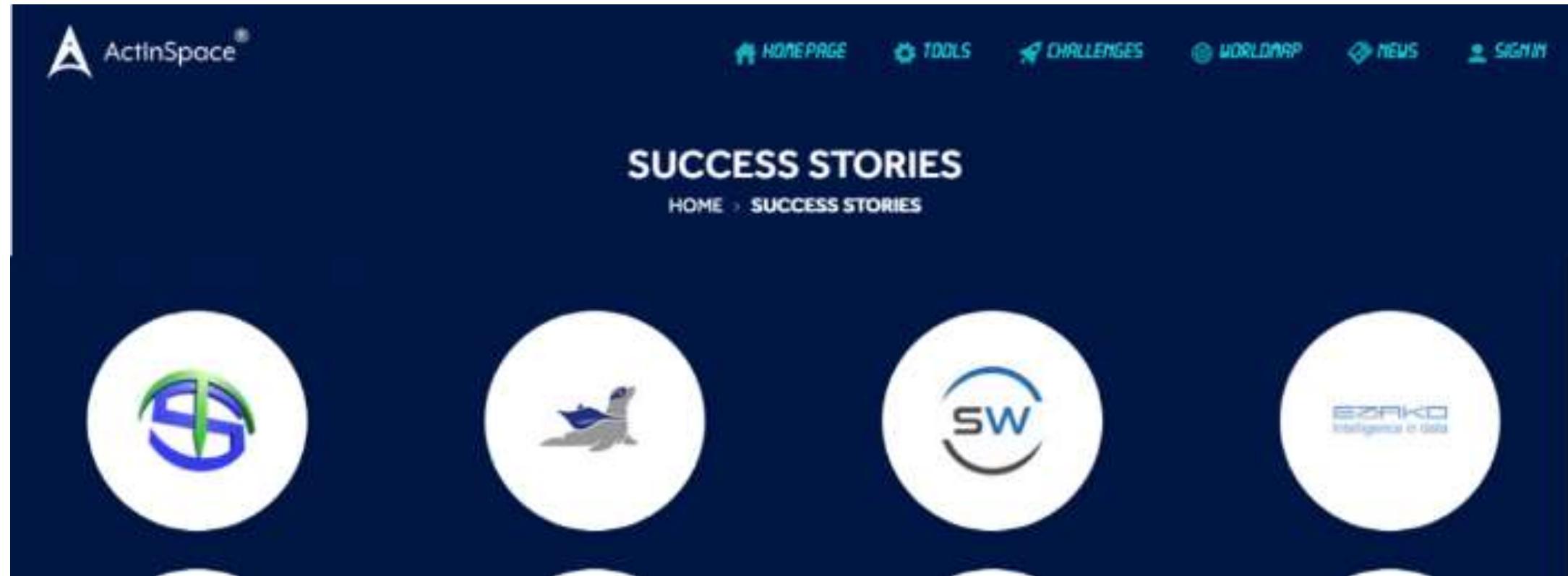


Presentations for Rotary



<https://www.youtube.com/@TARSENS/videos>

Listed under success stories of ESA & AIRBUS



Listed on UAE Food Safety Authority Page



A screenshot of a computer screen displaying a news article from the Abu Dhabi Agriculture and Food Safety Authority website. The URL in the address bar is 'www.adafsa.gov.ae/English/Innovations/Pages/U-Spectralix.aspx'. The page header includes the authority's name in English and Arabic, along with its logo. The main content area features a section titled 'HOT NEWS' with a link to the article. The article title is 'SPECTRALIX: ARTIFICIAL INTELLIGENCE USE IN PRECISION AGRICULTURE DATA ACQUISITION AND PROCESSING'. Below the title, there is a brief description of the technology and its application in precision agriculture.

Recent
Innovation List

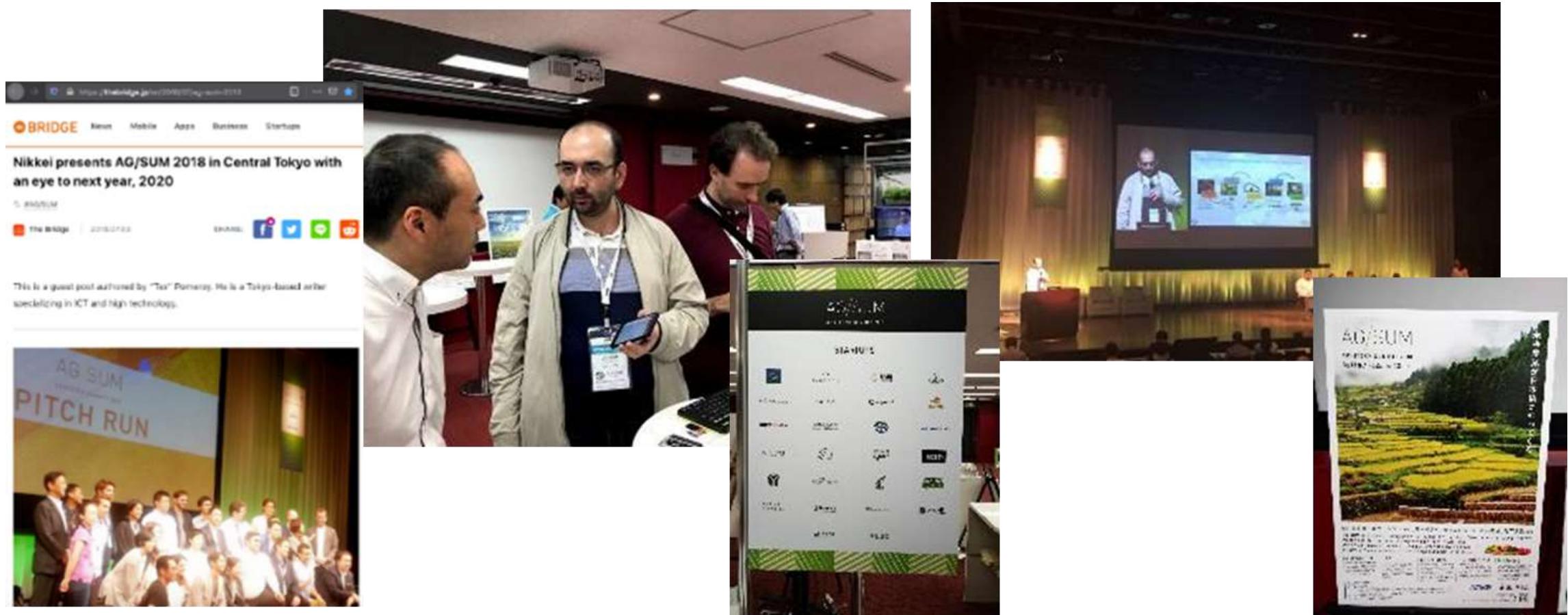
Spectralix: Artificial Intelligence Use in Precision Agriculture Data Acquisition and Processing

The precision agriculture business has several offers on the image gathering and recognition. Today, farmers mostly use UAVs and multispectral cameras to gather data, process using whether high-end computers or cloud computing with Pix4D like software. But in EMEA area, due to lack of knowledge for using UAV, processing data and describing it, they created a camera with AI to capture, process data real-time.

SPEAKER

Celil Serhan Tezcan, Founder & CEO, Tarsens

Invited to Tokyo by Nikkei for AgSUM



Invited to TRAI Summit, 2019

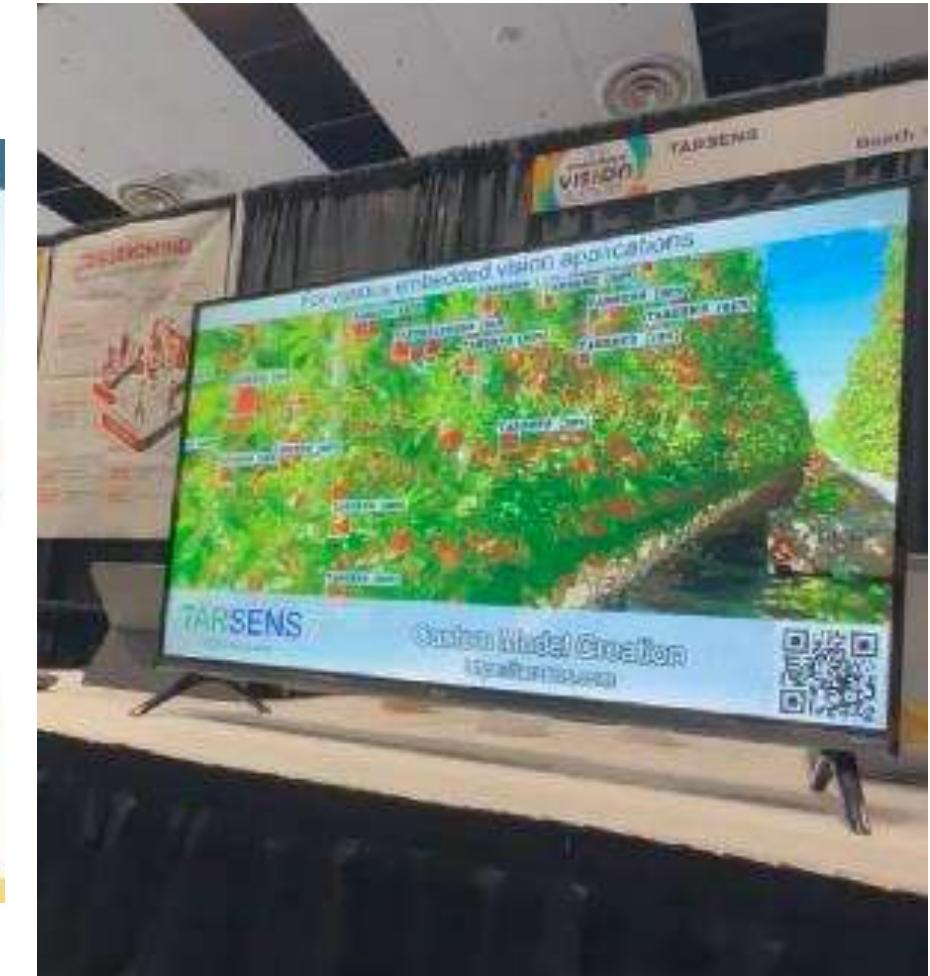


Demonstrated 3 projects simultaneously



<https://www.youtube.com/@TARSENS/videos>

Invited to Embedded Vision Summit, Santa Clara, 2023



<https://www.youtube.com/@TARSENS/videos>

Had TV programs, Awards and so on



<https://www.youtube.com/@TARSENS/videos>

TOBB presentation agritech companies in Türkiye to ASEAN



TARSENS Agricultural R&D Projects and AgriTech Companies in Türkiye

Presenter: Celil Serhan TEZCAN, Founder of TARSENS R&D LTD.
<https://tarsens.com>

To Sum Up

- TARSENS R&D – AgriTech R&D Company / Manufacturer
- Actimoo – Herd Monitoring / Manufacturer
- Afara – Agricultural Robots / Manufacturer
- Agrovech – Remote Sensing / Service Provider
- Agrovisio – Field Intelligence / Service Provider
- Bridgesoft – See & Spray / Manufacturer
- Cowealthy – Herd Monitoring / Manufacturer
- Doktar – Remote Sensing & Sensor Networks / Manufacturer
- Esular – Smart Irrigation Technologies / Manufacturer
- Farmingo – Sustainable Agriculture Solutions / Manufacturer
- FarmLabs – Field Monitoring / Manufacturer
- MoveOn – See & Spray / Manufacturer
- Naras – Precision Agriculture Hardware / Manufacturer
- Önallar – Precision Agriculture Machinery / Manufacturer
- Seracell – Greenhouse Automation / Manufacturer
- Smart Soil – Soil Moisture Sensors / Importer
- Wicow – Herd Monitoring Hardware / Manufacturer
- Uptechlabs – Vertical Farming Hardware / Manufacturer
- Agricultural Technology - Tarimsal Teknoloji / News Hub



<https://www.youtube.com/@TARSENS/videos>

News coverage of YieldEstimator/MeyveSayar

- <https://www.haberler.com/yapay-zekayla-baglardaki-rekolte-olculdu-14311175-haberi/>
- <https://www.posta.com.tr/yapay-zekayla-baglardaki-rekolte-olculdu-2359468>
- <https://www.milliyet.com.tr/yerel-haberler/balikesir/bandirma/yapay-zekayla-baglardaki-rekolte-olculdu-6567602>
- <https://www.cnnturk.com/yerel-haberler/balikesir/bandirma/yapay-zekayla-baglardaki-rekolte-olculdu-1685527>
- <https://www.oha.com.tr/balikesir-haberleri/uzum-rekoltesi-suni-zeka-ile-olculuyor-3143604/>
- <https://www.sabah.com.tr/balikesir/2021/08/05/uzum-rekoltesi-suni-zeka-ile-olculuyor>
- <https://www.haberturk.com/balikesir-haberleri/89571871-uzum-rekoltesi-suni-zeka-ile-olculuyorinsan-gucu-ile-2-ayda-yapilacak-isi-2-dakikada>
- <https://beyazgazete.com/haber/2021/8/5/uzum-rekoltesi-sun-i-zek-ile-olculuyor-6171892.html>
- <https://www.hurriyet.com.tr/yerel-haberler/balikesir/bandirma/yapay-zekayla-baglardaki-rekolte-olculdu-41866776>
- <https://balikesirkenthaberleri.com/2021/08/05/uzum-rekoltesi-yapay-zeka-ile-olculuyor/>
- <https://www.koydenhaber.com/2021/08/05/uzum-rekolte-olcumunu-bu-kez-farkli-bir-yontemle-yaptilar/uzum-rekoltesi-suni-zeka-ile-olculuyor-insan-gucu-ile-2-ayda-yapilacak-isi-2-dakikada-yapiyor-3/>
- <https://www.youtube.com/watch?v=84ncXY5Mu8U>



Australia NSW DPI a presentation of YieldEstimator

1



YieldEstimator



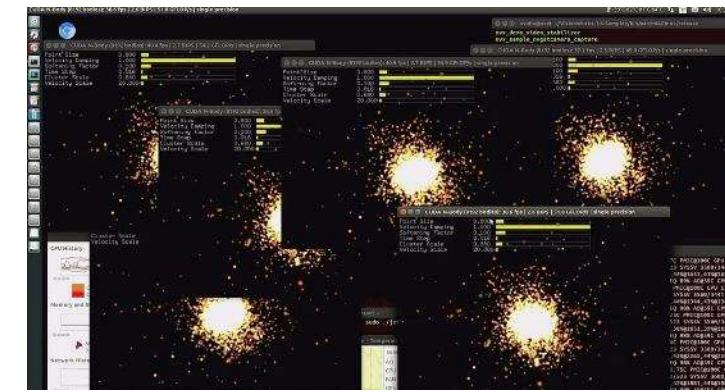
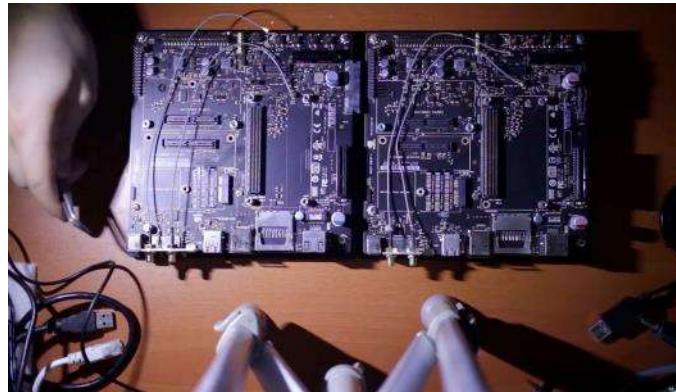
Viticulture Edition

“we are removing guesswork from yield estimation”

Presenter: Celil Serhan TEZCAN, Founder of TARSENS R&D, ai@tarsens.com

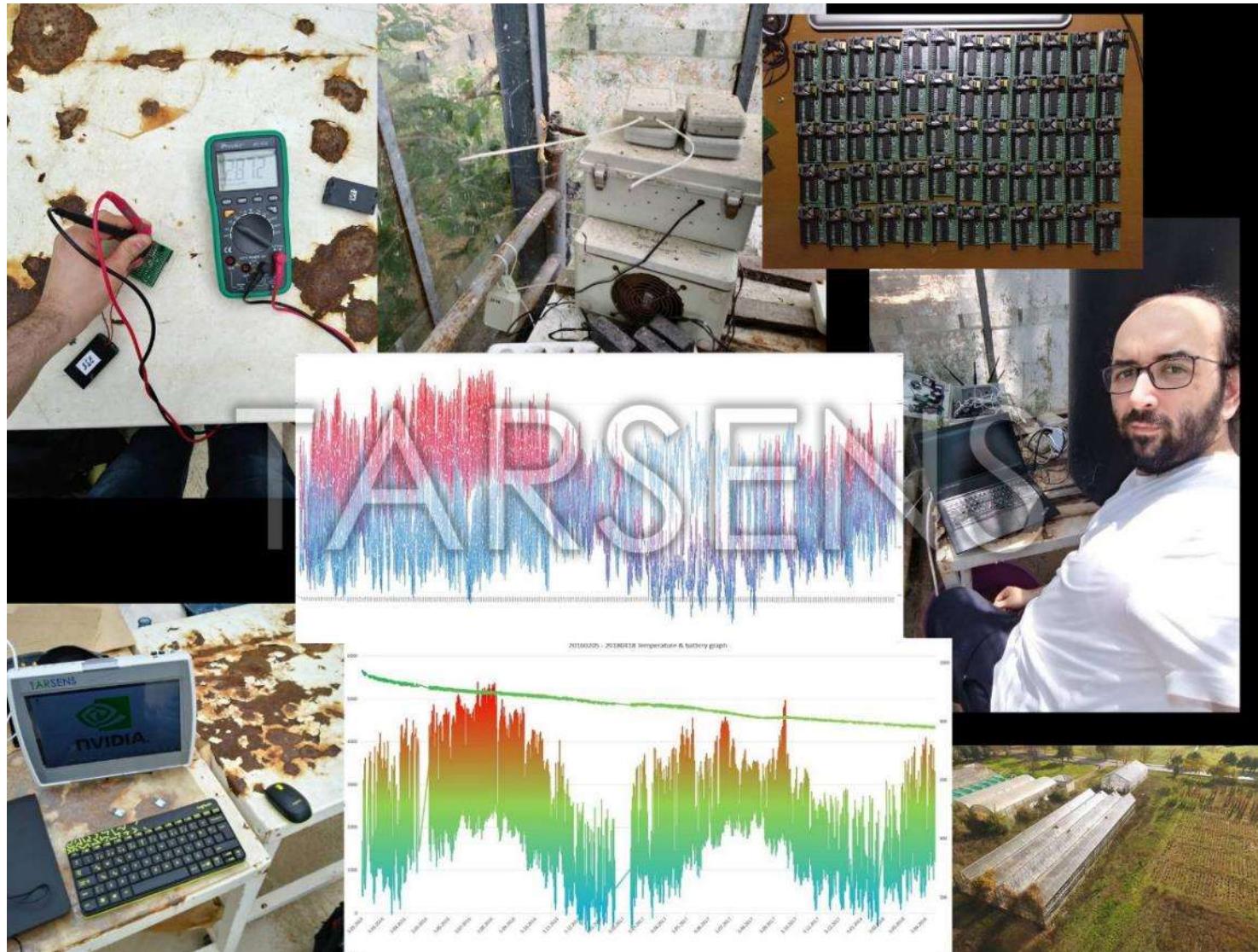
[Australia, NSW DPI link](#)

Consultancies on Embedded – EDGE AI development



summary

Wireless Sensor Networks



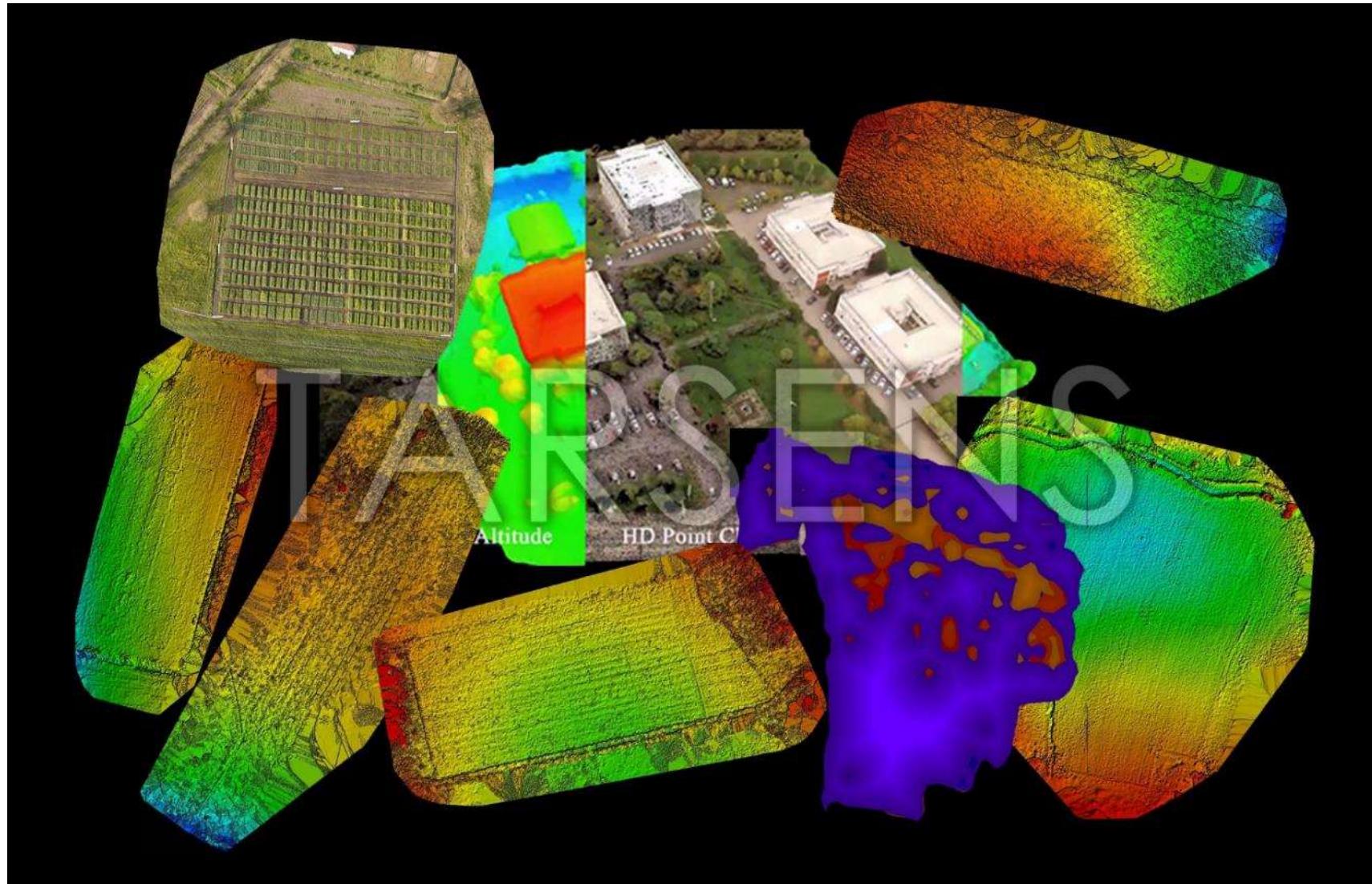
Embedded Systems



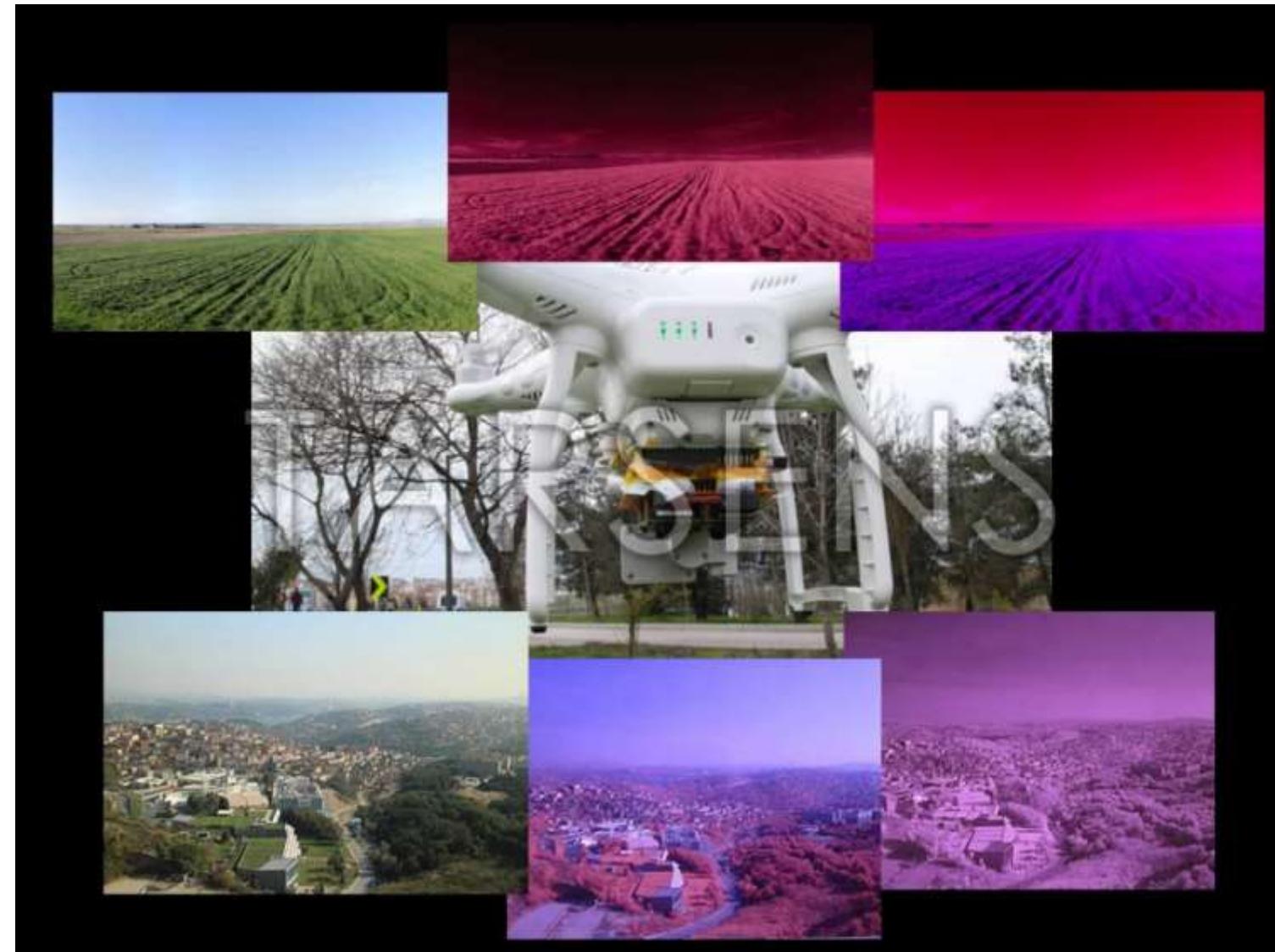
UAV Technology Development



UAV Mapping & Modelling



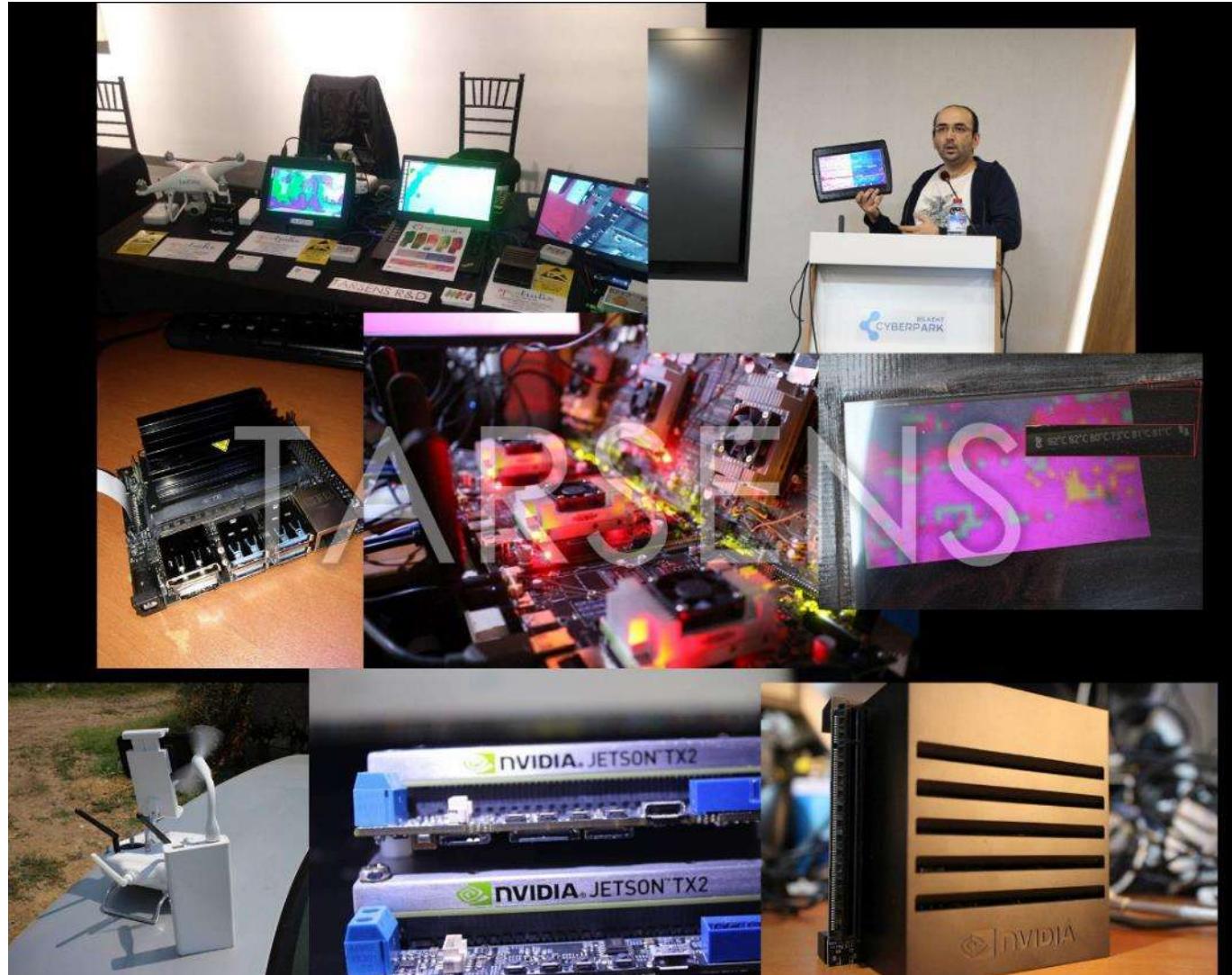
Multispectral Imaging



Realtime Image Processing



Edge AI Systems



Summary

UGVs



YieldEstimator



Completed R&D Projects

- Wireless Sensor Networks (WSN)
- Unmanned Aerial Vehicles (UAVs)
- Unmanned Ground Vehicles (UGVs)
- YieldEstimator for Vineyards
- YieldEstimator for Kiwifruit
- Almond blooming level mapping
- Spectralix Live NDVI Camera
- Crop mapping from Satellite Imagery
- Lake surface area monitoring
- Occupational safety and health
- Labeling for Autonomous Vehicle Development
- Occupational safety and health
- Infrastructure Monitoring
- Counting sugar bags
- Bee hive health monitoring
- Machine part inspection system
- Wine bottle inspection system

Useful Links

- TARSENS; <https://tarsens.com>
- YieldEstimator; <https://yieldestimator.com>
- Early prototyping Youtube channel; <https://www.youtube.com/@canonest>
- Edge AI Development Youtube channel; <https://www.youtube.com/@SelfAwareDevices>
- TARSENS Youtube channel; <https://www.youtube.com/@TARSENS>
- TR: 1st demo of YieldEstimator Blog; <https://tarsens.wordpress.com/bir-demo/>
- EN: 1st demo of YieldEstimator Blog; <https://tarsens.wordpress.com/tarsens-yield-estimator-demonstration/>
- Wireless Sensor Networks Blog; <https://tarsens.wordpress.com/anatomy-of-a-wireless-sensor-network-project/>
- TR: Lake Monitoring Blog; <https://tarsens.wordpress.com/gole-bakan>
- EN: Lake Monitoring Blog; <https://tarsens.wordpress.com/water-surface-mapper/>
- GAN 4 Remote Sensing Blog; <https://tarsens.wordpress.com/gan-for-remote-sensing/>
- TR Agricultural Projects Blog; <https://tarsens.wordpress.com/dur-bir-dakika/>
- TARSENS Instagram; https://www.instagram.com/tarsens_rd/
- EN: YieldEstimator Instagram; <https://www.instagram.com/yieldestimatorcom/>
- TR: MeyveSayar Instagram; <https://www.instagram.com/meyvesayar/>



Thank you!