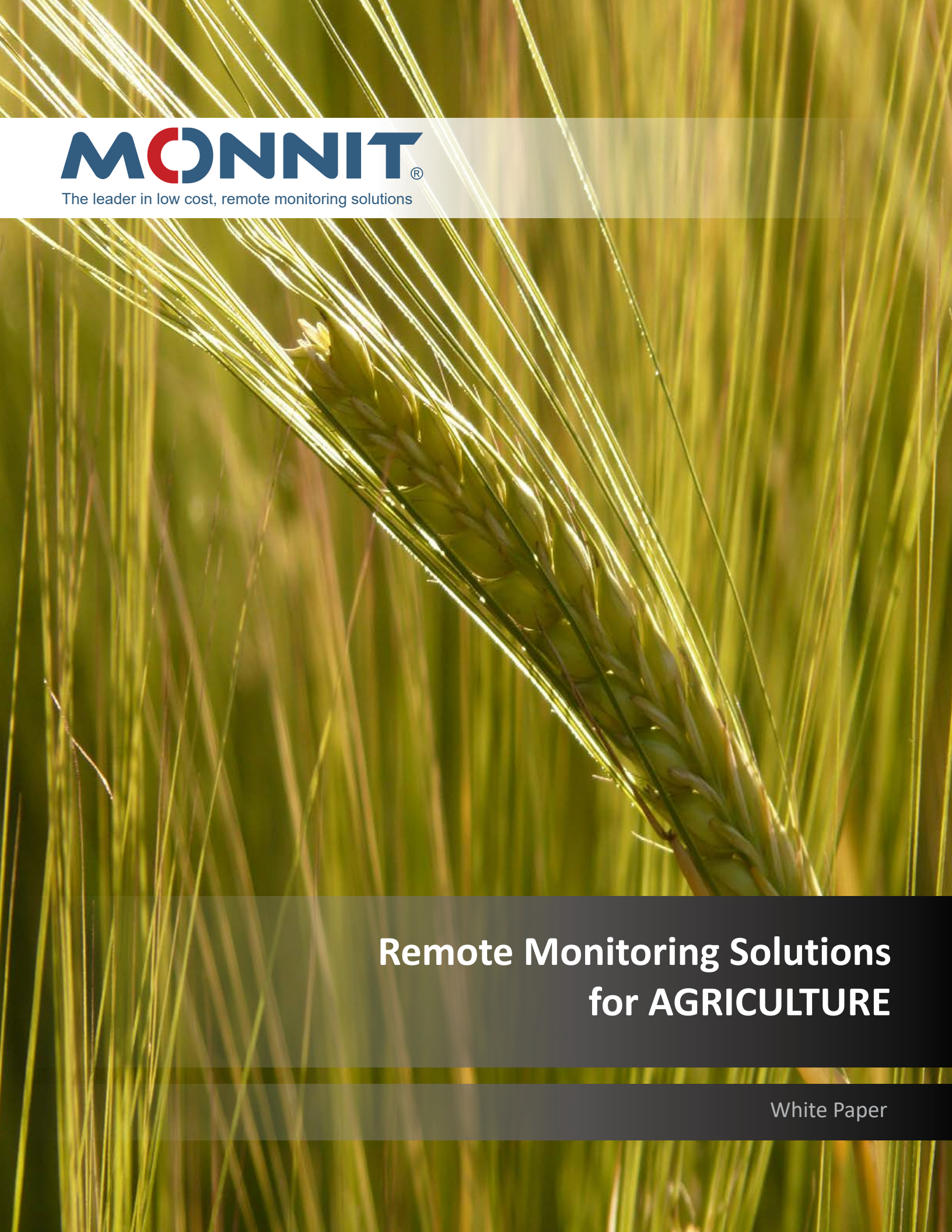


MONNIT®

The leader in low cost, remote monitoring solutions

Remote Monitoring Solutions for AGRICULTURE

White Paper

Remote Monitoring Solutions for Agriculture

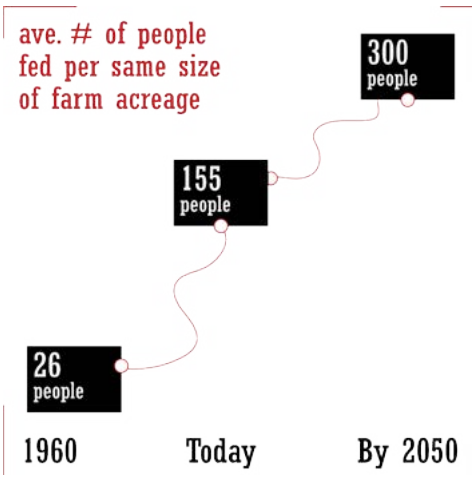
Implementing reliable, low-cost monitoring solutions to achieve smarter, safer and more efficient operations.

Introduction

The Internet of Things (IoT) has graduated from buzzword to reputable platform that saves money in agriculture. IoT sensors connect people with data that illuminates the vital signs of "things" that have a high impact on business operations. Sensors methodically communicate information that empowers farmers (information such as soil properties variances, machine behaviors, aquatics, climate conditions, atmospheric physics & more). With remote monitoring in place, stakeholders are notified the second when conditions are met that merit fast action. Notifications and alerts are communicated directly from "things" and sensors to select stakeholders via SMS text, voice mail, email and/or web portals.

Sensors help farmers realize ideals like those touted in "precision agriculture". In the context of this white paper - precision agriculture is defined as the optimization of farm land for maximum profitability and yield - while sustaining a stewardship to farm lands and public safety. Precision agriculture has re-shaped expectations regarding farm land output. For perspective: the same farm acreage that was expected to feed 26 people in 1960; will be expected to feed 300 people by the year 2050[1].

Figure 1. Precision Agriculture - "Digital Agriculture" and "Agribusinesses" making more efficient use of farm acres



The U.S. Department of Agriculture's 2016 Annual Performance Report[2] predicts the IoT will play an increasing role in realizing ideals in economic growth, sustainability, nutrition and safety. The report outlines a strategic plan for increasing prosperity in farming communities and estimates $775.8B in economic activity will surround the agriculture industry in 2020. IoT solutions will help maximize every drop of water and monetize every grain of dirt.

1 http://performance.ey.com/wp-content/uploads/downloads/2017/02/EY-Performance-digital-agriculture.pdf

2 https://www.obpa.usda.gov/perfrpt/2015usdaperfrpt2017plan.pdf

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Ag Sensing

The opportunities for wireless IoT sensing in agriculture are innumerable; regardless, this section attempts to list a few of the most attractive applications for wireless sensing. A report published by the Broadband Commission for Sustainable Development 2016[1] identifies a plethora of IoT sensor solutions that have track records of saving money in areas such as crop production, food storage, distribution, air monitoring and soil monitoring (temperature, salinity, PH and water levels). IoT solutions allow growers to leverage sensor data and increase yields and efficiency.

Examples of IoT Solutions for Agriculture

>> Click on sensor icons to view additional IoT product information.

Greenhouse Monitoring

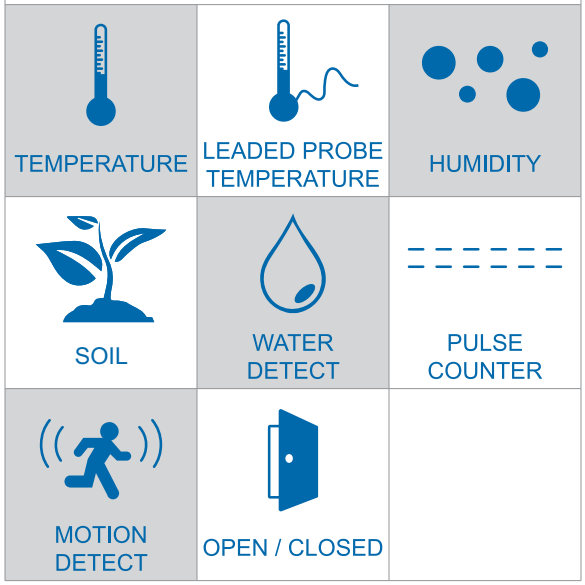
Air Quality
- Ambient Temperature Readings
- Relative Humidity Levels

Plant Health
- Soil Content Properties
- CO2 Levels

Occupancy Monitoring & Energy Savings
- Door and Window Open/Closed Status
- Access Control / Security
- HVAC Efficiency

Water Monitoring
- Under/Over Watering Prevention
- Flood Prevention
- Mold Prevention
- Plant Nourishment
- Water Flow Metering (using pulse counter sensor)

Applicable Wireless Sensor Types >>

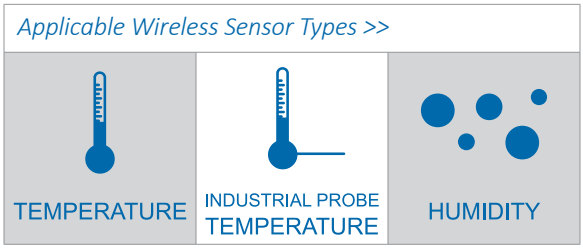


Hay Bales, Compost Piles, etc.

Probe temperature readings for:
- Hay Bales
- Forage Piles
- Compost Piles
- Mulch Piles
- Soil Properties

Ambient air temperature readings

Applicable Wireless Sensor Types >>



Did we miss one? Join the discussion!
Share the applications and areas where you'd like to see more IoT development - email: iot@monnit.com

Agriculture Sensing Applications (continued next page) >>>

1 http://broadbandcommission.org/Documents/reports/bb-annualreport2016.pdf

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Transportation / Distribution

Food Quality
- Prevent Food Spoilage
- Guaranteed Temperatures (High or Low)
- Traceability
- Unbroken Cold Chain

Access Control
- Theft Prevention

Energy Savings
- Refrigerator Door Monitoring

Regulations Compliance / Insurance
- Guarantee Transport Temperatures
- Best Practices / Quality Control / Quality Assurance

Applicable Wireless Sensor Types >>

TEMPERATURE	LEADED PROBE TEMPERATURE	OPEN / CLOSED

Storage (Dairy)

Quality Control
- Prevent Spoilage
- Guaranteed Temperatures (High or Low)
- Traceability
- Unbroken Cold Chain
- Refrigerator Door Monitoring

Energy Savings
- Refrigerator Door Monitoring

Regulations Compliance / Insurance
- Guarantee Transport Temperatures
- Best Practices / Quality Control / Quality Assurance

Applicable Wireless Sensor Types >>

TEMPERATURE	LEADED PROBE TEMPERATURE	OPEN / CLOSED
WATER ROPE		

Storage (Grains)

Food Quality
- Prevent Food Spoilage
- Guaranteed Temperatures (High or Low)
- Moisture Content
- Traceability
- Unbroken Cold Chain

Regulations Compliance / Insurance
- Guarantee Transport Temperatures
- Best Practices / Quality Control / Quality Assurance

Applicable Wireless Sensor Types >>

TEMPERATURE	LEADED PROBE TEMPERATURE	OPEN / CLOSED
WATER DETECT		

Storage (Gases)

Performance & Safety
- Connection Integrity
- Leak Monitoring
- Access Control
- Integrity of Seals / Connections

Applicable Wireless Sensor Types >>

PRESSURE METER	MOTION DETECT	OPEN / CLOSED

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Machinery

Equipment Life / Servicing & Maintenance

- Detect Operational Abnormalities
- Orbital Revolutions Monitoring
- Power Supply Monitoring
- 12V Battery Power Monitoring

Preemptive Maintenance

- Detect Issues Before They Snowball
- Alerts and Notifications Indicating Early Signs of Malfunction - Catch issues when their urgency level is in the “yellow” - not the “red”
- Engine Monitoring
- Connection Integrity

Applicable Wireless Sensor Types >>

PRESSURE METER	VIBRATION METER	AC CURRENT METER (0-150 AMP)
0-10 VDC 0-10V VOLT METER	0-50 VDC 0-50V VOLT METER	LEADED PROBE TEMPERATURE

Soil Monitoring

Monitor Levels

- Temperature
- Humidity
- PH Levels
- Salinity

Water Flow Metering

- (using pulse counter sensor)

Applicable Wireless Sensor Types >>

INDUSTRIAL PROBE TEMPERATURE	SOIL	PULSE COUNTER
HUMIDITY	WATER DETECT	

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What is the Internet of Things (IoT) and what does it mean for agriculture?

IoT represents an ever-growing network of physical objects ("things") connected to sensors capable of network connectivity. Sensor networks automate the collection and exchange of crucial operational data from the field. Using Monnit Remote Monitoring Solutions for Agriculture, growers can remotely monitor and manage crop, processing, and machinery systems from anywhere, anytime. This also means secure data recording and immediate alerts about issues before they become costly, time-consuming problems.

BusinessInsider.com reports that the agricultural industry is rapidly becoming more important than ever before. The report predicts a future population of more than 9 billion people by 2050[1]; which dictates world growers will need to produce about **70 percent** more food by that time.

This makes the Internet of Things an ag-industry growth factor, as recognized by Deloitte, a leading audit, consulting, advisory and tax services firm in the U.S. who predicts a "millennial shift from family operations to smart food factories." By employing automation technology and IoT solutions; operations can keep pace with "Agribusiness" trends and advantages.

Advantages Enabled by IoT Solutions

- Food Quality
- Operational Efficiencies
- Increase Machinery Life Cycle
- Food Safety / Regulatory Compliance
- Energy Savings

By the Year 2050 -

World Growers Expected to Produce

70% more Food -

Without Proportionally

Increasing Foot Print

In a USDA Sustainable Agriculture Research and Education (SARE) article, *Smart Water Use on Your Farm or Ranch*[2], it is estimated that **85 percent** of the nation's water consumption is attributed to agriculture - "a reality that contributes to declining ground and surface water quantity and quality." In addition to the financial pressures that come with farming; farmers also shoulder a responsibility to protect and preserve shared natural resources.

Pin-Pointing Inefficiencies

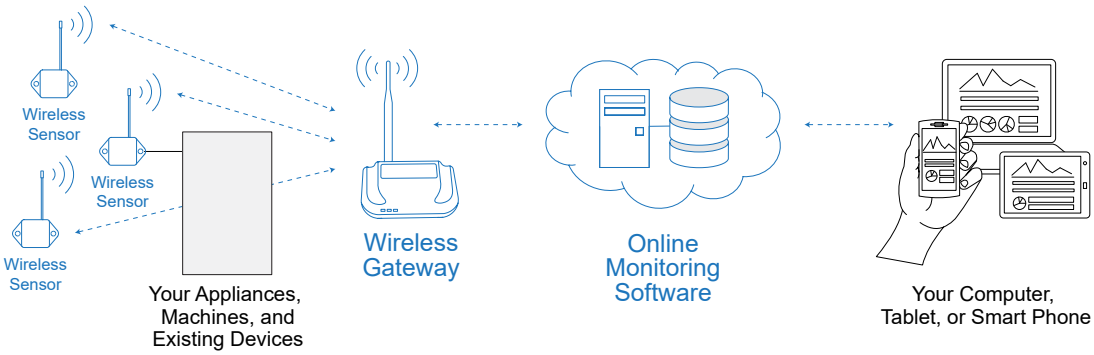
IoT sensing helps implement tighter standards in performance and accountability. The sensor data provides a heightened level of awareness for operations. For example, farmers can receive details over-the-phone that alert them of conditions that merit immediate attention. The key is to detect trouble before the trouble can escalate. Routine readings of humidity levels, water levels, temperatures, door positions or other variables translate to saved assets, protected resources and disasters averted.

1 http://www.un.org/en/development/desa/news/population/un-report-world-population-projected-to-reach-9-6-billion-by-2050.html

How the Monnit Wireless IoT Sensor Platform Works

The Monnit ALTA Platform is the only IoT solution that enables integrators to achieve over 1000' wireless range, 10-year battery life and bank-level security.

Figure 2. Monnit Wireless IoT Sensor System



Wireless sensors can be used to monitor various environmental aspects from the field. Monnit wireless gateways act as a communication bridge between wireless sensors and the iMonnit Online Monitoring Software, which allows integrators to view sensor information through a computer, tablet or smart-phone. iMonnit software also provides immediate text, e-mail or voice call alerts.

The Monnit Wireless Sensor Network (WSN) can is expandable from a single local area to a multi-site network. Monnit gateways transmit sensor data to a cloud-based software interface where users can configure, monitor and manage sensors on a network.

Monnit manufactures more than 55 different sensor types and delivers a variety of gateway options (Cellular, Ethernet, USB and serial MODBUS) for connecting devices with sensors and iMonnit software. Cellular, Ethernet and USB gateways from Monnit can connect with up to 100 wireless sensors per gateway. Serial MODBUS gateways can connect with up to 50 wireless sensors.

Features and Benefits of Wireless IoT

- Easy set-up and use
- Reliable, proven technology
- Low-cost
- Low battery life
- Exceptional wireless range
- 55+ sensor types
- Scalable / Expandable (100 sensors per gateway)
- Global RF Frequencies
- Cloud-based monitoring software
- SMS Text message, e-mail, or phone call alerts
- 24/7/365 Access from Anywhere

About Monnit Corporation

As government regulations tighten and competition grows, precision monitoring systems for agriculture offer a unique opportunity to operate farm lands with improved efficacy. IoT sensors are able to monitor, transmit and record critical operational data 24/7/365. Sensor data has become more accessible now than ever before and empowers users to receive communications from devices anywhere, anytime through online dashboards, mobile apps, SMS text messages and voice calls.

Get IoT Started

Leverage Sensor Data, Protect Resources & Save Money

For more information about Monnit products or to place an order, please contact our sales department at info@monnit.com or 801-561-5555.

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