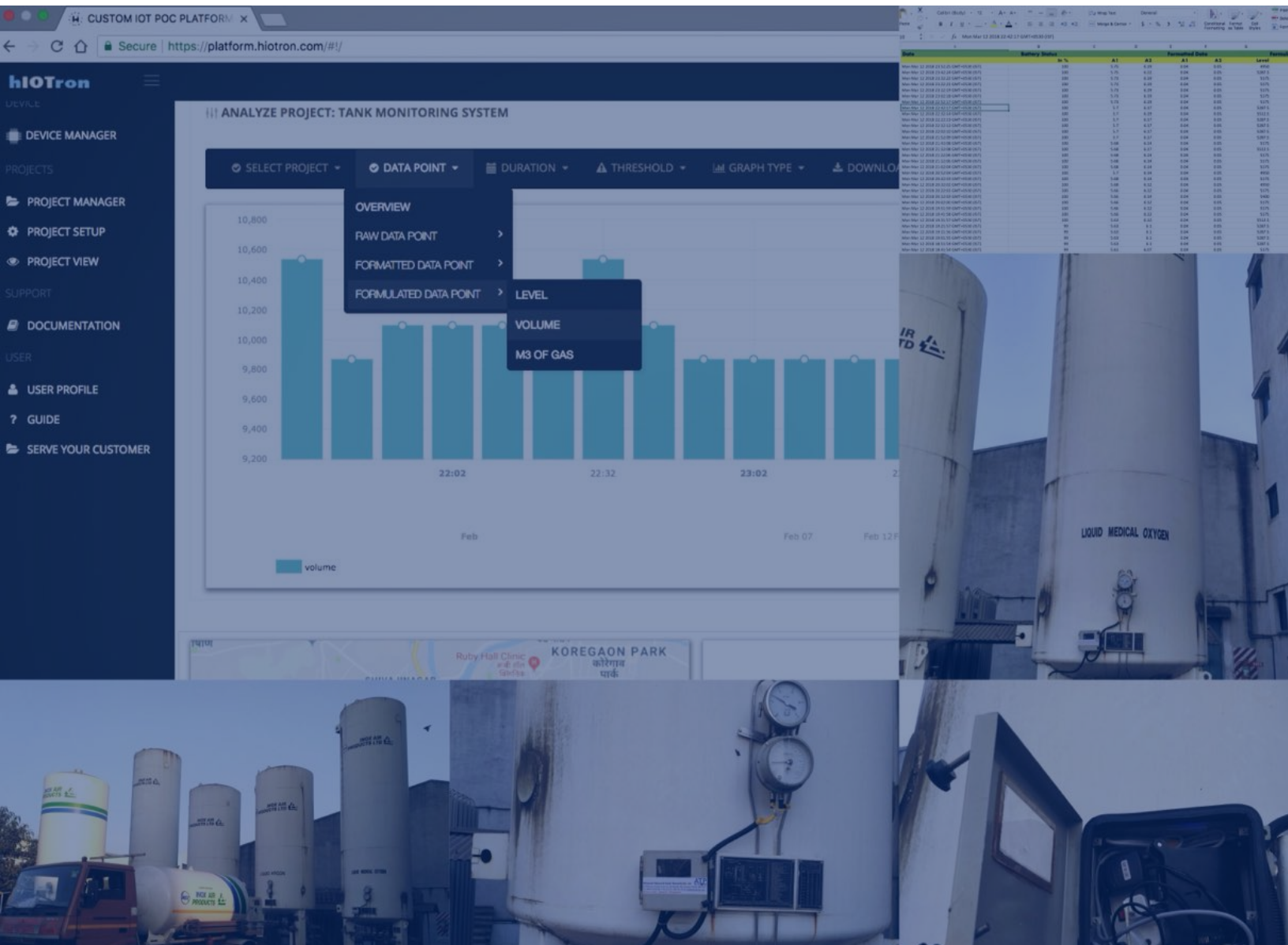


Remote Tank Monitoring System



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CLIENT PROFILE

Inox Air Products (NYSE:APD) is a world-leading Industrial Gases company in operation for over 75 years. The Company's core industrial gases business provides atmospheric and process gases and related equipment to manufacturing markets, including refining and petrochemical, metals, electronics, and food and beverage. Air Products is also the world's leading supplier of liquefied natural gas process technology and equipment.

The Company had fiscal 2017 sales of \$8.2 billion from continuing operations in 50 countries and has a current market capitalization of about \$35 billion. Approximately 15,000 passionate, talented and committed employees from a diversity of backgrounds are driven by Air Products' higher purpose to create innovative solutions that benefit the environment, enhance sustainability and address the challenges facing customers, communities and the world.

BUSINESS REQUIREMENTS

Medical gas systems in hospitals are, in a word, lifesaving. These assemblies supply piped oxygen, nitrous oxide, nitrogen, carbon dioxide, and medical air to hospital areas such as patient rooms, recovery areas, operating rooms, and more. It is of utmost important to keep medical gas systems up and running for the benefits of patients and those who are taking care of them.

There are main types of medical gas used in hospital environments.

- **Oxygen:** Oxygen is used when patients require supplemental oxygenation due to hypoxemia and hypoxia (insufficient oxygen in the blood).



- **Nitrous Oxide:** Nitrous Oxide, or laughing gas, is used as an analgesic, and as an anesthetic for pre-operative procedures. Nitrous oxide is delivered to the hospital in standard tanks and is supplied through the medical gas system at around 345 kPa, or 50 psi.
- **Nitrogen:** Nitrogen is often used to power up surgical equipment during various procedures and also used as a cryogen to freeze and preserve blood, tissue, and other biological specimens, and to freeze and destroy diseased tissue in dermatology and cryosurgery.
- **Carbon Dioxide:** Carbon dioxide is used to suspend or inflate various tissues and is used in laser surgeries. Most commonly, carbon dioxide is used in abdominal and thoracic surgeries, where the surgeon may need to move various organs to get to one particular area of the body.

There are many more like Medical Air, Helium/Heliox and Carbon Monoxide etc. it is necessary to establish a monitoring system to maintain a stable supply of medical gases. It should trace the gas flow from the source, through the piping, and to the various hospital outlets that use the gas. These systems should show the amount of gas remaining in the different tanks. It should also show the operating condition of the supply station, and the gas pressure applied to each area where the gas is in use.



“The Remote Tank Monitoring Solution (RTMS) of medical gases delivers complete tank transparency to health care providers. Utilizing end-to-end IoT hardware stack coupled with advanced pressure gauges and regulators, Remote Tank Monitoring Solution of medical gases solves the critical challenges of gases tank management.”

CHALLENGES

There were several challenges faced:

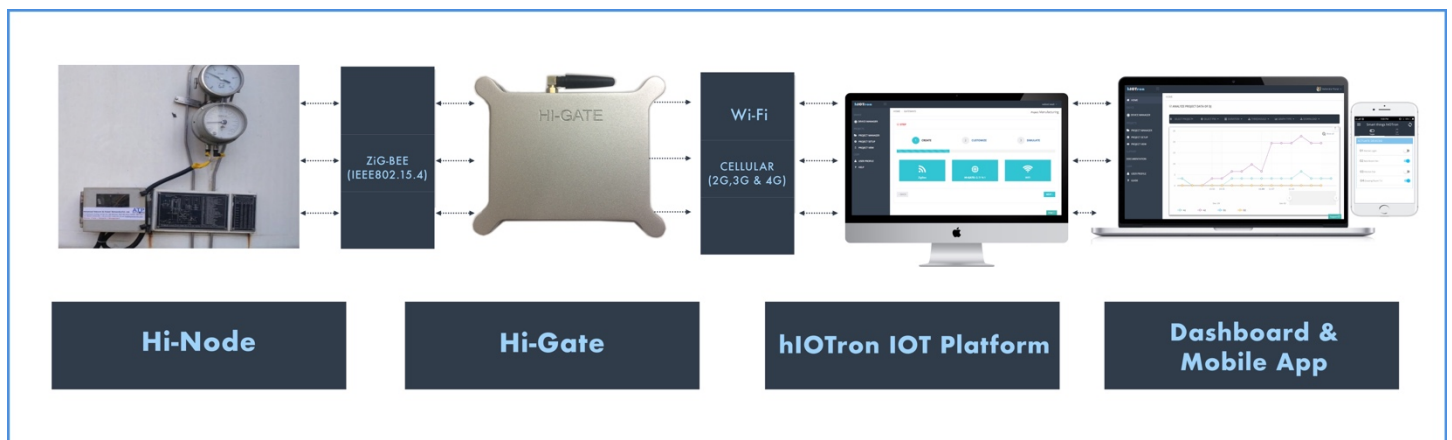
1. **Power Management & Data Collection:** On-site, no managed way for powering the [Sensors + Wireless Nodes + Gateways] available & data collection was also a challenge.
2. **Setup Local Wireless Network:** Due to Availability of multiple tanks (closely placed) on each site required to setup a local wireless network architecture instead allocating Data/Sim card-based Gateway to each in order to reduce the future operational & maintenance cost.
3. **Network Reliability:** Client having almost 85% sites on remote locations. Therefore, un-stability of Network was the biggest challenge.
4. **Security & 100% Data Delivery:** Being related to Healthcare and Medical gases are lifesaving element, the security & 100% data delivery or accuracy of solution is utmost importance.
5. **Minimum Operational & Maintenance Cost:** The biggest fear of any IoT solution is operational cost. Therefore, client was also having the same perception.



hIOTon provided complete End-To-End Remote Tank Monitoring Solution (RTMS) of medical gases by achieving all the challenges mentioned in association with hIOTron channel partner ATPN.



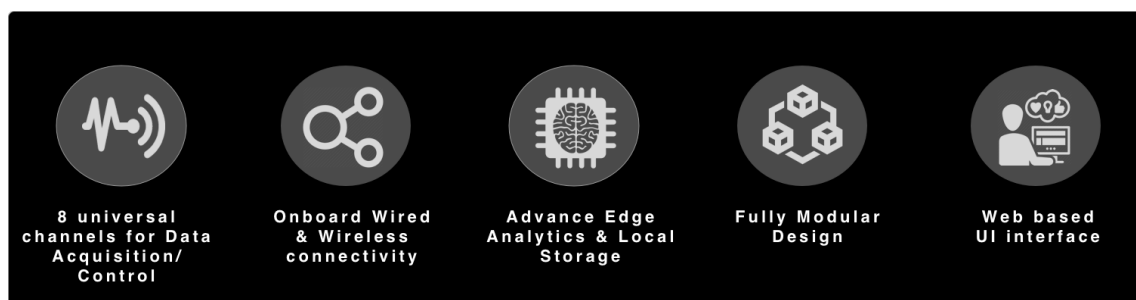
SOLUTION → ARCHITECTURE



SOLUTION → COMPONENTS

- **Hi-Node (Wire-less Node)** - Hi-Node is a battery (2700 mAh Li-ion) or 5volt USB (Optional) powered wireless node which comes with 4 output channels to control real world devices using 4 relays (Output 5A 230VAC) with 4 connectors and 4 universal (Analog/Digital) input channels to communicate with industrial sensors and transmit this information to IoT gateway (Hi-Gate) using wireless Zig-bee protocol. [Note: Modular shield provision available for Sub-1, Lo-Ra protocols].

Key Features:

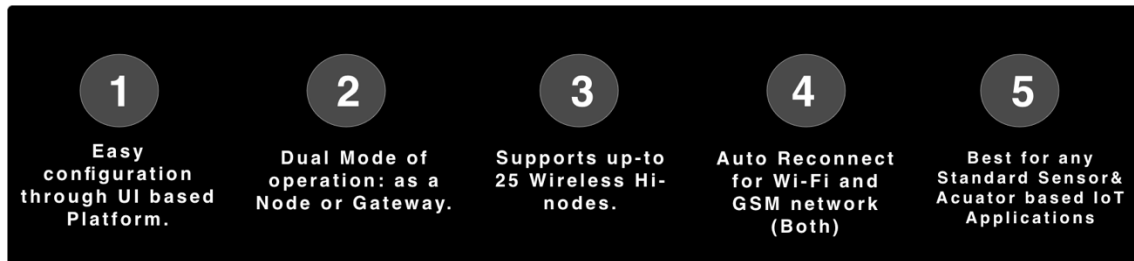


- **Hi-Gate (An Enterprise IoT Gateway)** - Hi-Gate is the brain of this kit which is fully Modular & Enterprise IoT gateway with TI-CC3200 at its heart, it offers better computational power to run advance IoT algorithms & communication because of easy & modular integration of Inbound & Outbound connectivity protocols.

The main feature of Hi-Gate is to Get wireless data from Inbound Connectivity Protocols and process/send to hIOTron IoT server in IP network via Wi-Fi/Ethernet/2G/3G/4G etc and similarly in a

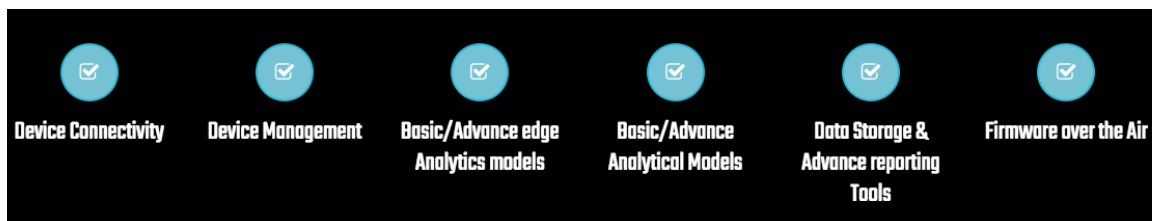
reverse way Get command from hIOTron IoT Server and send it back to local devices.

Key Features:



- **hIOTron IoT™ Platform & Dashboard & Mobile App** - hIOTron IoT™ platform which enables rapid designing, developing, deploying, and operation of enterprise IoT applications to accelerate the IoT innovations right from PoC to Production. A rich set of device connectivity (Wired/Wireless) models, device management, Edge Analytics/Anomaly detection models, end-to-end data security, data storage & machine learning into one platform. hIOTron IoT Platform turns any raw data from sensors and devices into actionable intelligence for your business.

- **Key Features:**



SOLUTION → DESCRIPTION

- **Power Management & Data Collection:** As it was priory clear by client, the managed distribution of power (230v) supply would be challenge on-site.

Therefore, by keeping the same constraint hIOTron team had designed a separate dual functionality power adaptor to provide (5v to Hi-Node & 12v to Integrated Sensors) which worked as a Data acquisition unit.

Power Adaptor	Sensors Used To collect Tank Data	Wireless Hi-Node Used
Power supply outputs both 5V and 12VDC	<ul style="list-style-type: none">• Pressure• Volume• Level• Temperature• Humidity• Location	Hi-Node [Zig-Bee Enabled Wireless Node]

- **Setup Local Wireless Network:** It was very easy & simple to collect the data via Hi-Gate and send it to cloud directly but due to heavy operational & maintenance cost, a 2nd approach (Data → Sensors → Hi-Node → Hi-Gate → hIOTron Platform → User Dashboard) was taken and benefited well.

Therefore, a zig-bee mesh network was established to collect all the data from Hi-Nodes to Hi-Gate having 4G-GSM card (Support Backward compatibility) & pushed to cloud whenever needed.



- **Network Reliability:** For remote sites, maintaining 24/7 device connectivity to cloud is always biggest challenge. Therefore, auto-connect & remote reset Hi-Gate feature made this issue to look very small means whenever Hi-Gate gets network back, it automatically connects to the internet without requiring any manual settings and also gives alerts before ending the data pack in sim card. Provision to add Wi-Fi & Ethernet is also available in case on any site if it is available.
- **Security & 100% Data Delivery:** Being related to Healthcare and Medical gases are lifesaving element, the security & 100% data delivery or accuracy of solution is utmost importance. Therefore, to maintain same
 - **Data Security:**
 - For data security within local (2.4Ghz) network: The encryption algorithm used is AES (Advanced Encryption Standard) with a 128b key length (16 Bytes) in each & every node firmware.
 - For data security from Hi-Gate to cloud based Platform: All the packets from Hi-Gate to hIOTron Platform exchanged over global network using SSL/TLS method which is an industry standard and is used by millions of websites in the protection of their online transactions with their customers.

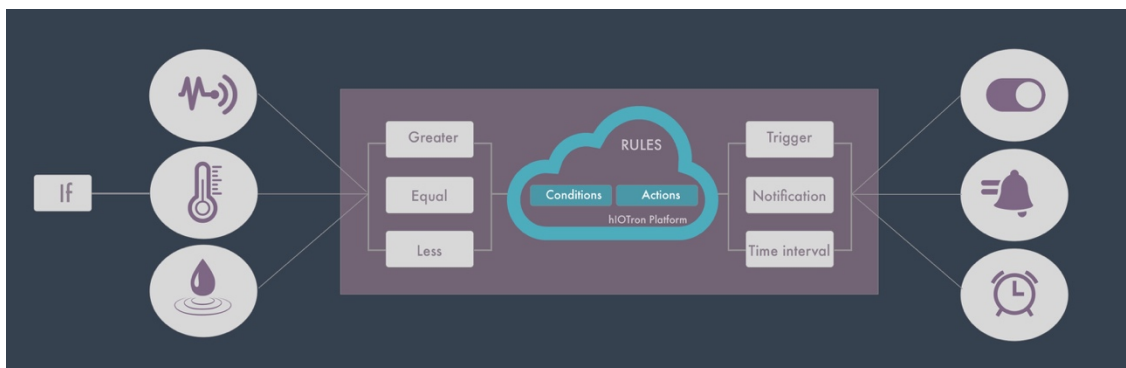


- **100% Data Delivery:**
 - A local EEPROM/SD card is used in the gateway to store the data in case of un-availability of the network and once it gets back then it pushes all the records with their respective time-log (RTC is inside) to store the same on cloud in order to apply various business logic to see the results.

- **Minimum Operational & Maintenance Cost:** For almost every client/Industry, buying a IoT Hardware or solution is not a challenge, to maintain them (Operation & Maintenance) is a big challenge/risk which directly involves monthly or yearly cost.

But truth is this cost can be ignored completely because every device talks to cloud will be having (Operational: Data Streaming/Bandwidth + Storage + Maintenance cost) & Even many IoT solution companies are taking it as a recurring revenue business opportunity by selling low cost IoT solutions or Hardware like a sim card (Free of Cost).

Therefore, to Reduce to this operational cost & unify hIOTron solutions from others, major (80%) tasks/ Edge computing done on the Hi-Node itself such as conversion & Display of RAW sensor to formulated data rather following round-trip through cloud, Advance anomaly detection (Alerts such mail/notifications/messages only when threshold crossed or local device decision making) and some basic Machine Learning Models before sending data to Hi-Gate or Hi-Gate to Cloud.



Whereas for rest 20% task (Which wasn't possible on devices) performed on hIOTron IoT Platform & Displayed on Dashboard with Mobile Application provision.

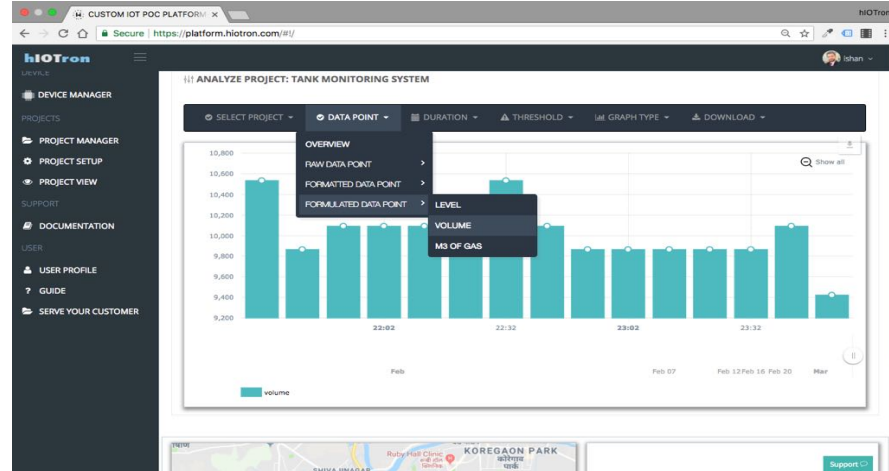
SOLUTION → BENEFITS

Tracking the location each & every tanks and their gases level, pressures, volumes time-based records benefited tank owners including improved tank filling, lower costs, lowered institutional risk, reduced inventory and re-allocation of work to the appropriate human resources. Some highlights include:

- **Process Improvement** - With instant notification (Mail or Message) threshold based or time based an oxygen tank is running low and the exact identification of that tank, healthcare operators can eliminate the risk associated with various procedures running on pipeline across hospital linked with that tank.
- **Inventory Right-sizing** - Because of inefficiencies in process and the wide array of individuals interacting with the medical oxygen inventory, hospitals and healthcare facilities often maintain substantially more medical oxygen inventory than they need. For many organizations electronic medical oxygen monitoring can result in a 30% or more reduction in inventory. Additionally, improved processes and electronic monitoring of pressure can result in a near elimination of unnecessary re-charges of full or mostly full tanks (a very common problem in healthcare).
- **Lower costs** - Elimination of unnecessary inventory and tank refills, the redistribution of responsibilities results in lower cost of maintenance, process improvements and procurement improvements can add up to big savings.
- **Improved Care** - Most importantly, remote medical oxygen monitoring leads to improved care by dramatically lowering the risk associated with unnecessary empty medical oxygen tanks.



SOLUTION → GALLERY



Date	Battery Status	In %	A1	A2	Formatted Data	Level	Volume	M3gas
Mon Mar 12 2018 23:52:25 GMT+05:30 (IST)	100	5.75	6.19	0.04	0.05	4990	9422.41	8163.13
Mon Mar 12 2018 23:42:24 GMT+05:30 (IST)	100	5.75	6.22	0.04	0.05	5287.5	10087.8925	8847.2025
Mon Mar 12 2018 23:32:22 GMT+05:30 (IST)	100	5.73	6.19	0.04	0.05	5175	9866.005	8652.645
Mon Mar 12 2018 23:22:21 GMT+05:30 (IST)	100	5.73	6.19	0.04	0.05	5175	9866.005	8652.645
Mon Mar 12 2018 23:12:19 GMT+05:30 (IST)	100	5.73	6.19	0.04	0.05	5175	9866.005	8652.645
Mon Mar 12 2018 23:02:18 GMT+05:30 (IST)	100	5.73	6.19	0.04	0.05	5175	9866.005	8652.645
Mon Mar 12 2018 22:52:17 GMT+05:30 (IST)	100	5.73	6.19	0.04	0.05	5175	9866.005	8652.645
Mon Mar 12 2018 22:42:15 GMT+05:30 (IST)	100	5.7	6.17	0.04	0.05	5287.5	10087.8925	8847.2025
Mon Mar 12 2018 22:32:14 GMT+05:30 (IST)	100	5.7	6.19	0.04	0.05	5532.5	10531.5475	9236.3175
Mon Mar 12 2018 22:22:13 GMT+05:30 (IST)	100	5.7	6.17	0.04	0.05	5287.5	10087.8925	8847.2025
Mon Mar 12 2018 22:12:12 GMT+05:30 (IST)	100	5.7	6.17	0.04	0.05	5287.5	10087.8925	8847.2025
Mon Mar 12 2018 22:02:10 GMT+05:30 (IST)	100	5.7	6.17	0.04	0.05	5287.5	10087.8925	8847.2025
Mon Mar 12 2018 21:52:09 GMT+05:30 (IST)	100	5.7	6.17	0.04	0.05	5287.5	10087.8925	8847.2025
Mon Mar 12 2018 21:42:08 GMT+05:30 (IST)	100	5.68	6.14	0.04	0.05	5175	9866.005	8652.645
Mon Mar 12 2018 21:32:06 GMT+05:30 (IST)	100	5.68	6.17	0.04	0.05	5532.5	10531.5475	9236.3175
Mon Mar 12 2018 21:22:06 GMT+05:30 (IST)	100	5.68	6.14	0.04	0.05	5175	9866.005	8652.645
Mon Mar 12 2018 21:12:06 GMT+05:30 (IST)	100	5.68	6.14	0.04	0.05	5175	9866.005	8652.645
Mon Mar 12 2018 21:02:04 GMT+05:30 (IST)	100	5.68	6.14	0.04	0.05	5175	9866.005	8652.645
Mon Mar 12 2018 20:52:04 GMT+05:30 (IST)	100	5.7	6.14	0.04	0.05	4990	9422.41	8163.13
Mon Mar 12 2018 20:42:03 GMT+05:30 (IST)	100	5.68	6.14	0.04	0.05	5175	9866.005	8652.645
Mon Mar 12 2018 20:32:02 GMT+05:30 (IST)	100	5.68	6.12	0.04	0.05	4990	9422.41	8163.13
Mon Mar 12 2018 20:22:01 GMT+05:30 (IST)	100	5.66	6.12	0.04	0.05	5175	9866.005	8652.645
Mon Mar 12 2018 20:12:00 GMT+05:30 (IST)	100	5.66	6.14	0.04	0.05	5400	10309.72	9041.76
Mon Mar 12 2018 20:02:00 GMT+05:30 (IST)	100	5.66	6.12	0.04	0.05	5175	9866.005	8652.645
Mon Mar 12 2018 19:51:59 GMT+05:30 (IST)	100	5.66	6.12	0.04	0.05	5175	9866.005	8652.645
Mon Mar 12 2018 19:41:58 GMT+05:30 (IST)	100	5.66	6.12	0.04	0.05	5175	9866.005	8652.645
Mon Mar 12 2018 19:31:57 GMT+05:30 (IST)	100	5.63	6.12	0.04	0.05	5532.5	10531.5475	9236.3175
Mon Mar 12 2018 19:21:57 GMT+05:30 (IST)	99	5.63	6.1	0.04	0.05	5287.5	10087.8925	8847.2025
Mon Mar 12 2018 19:11:56 GMT+05:30 (IST)	99	5.63	6.1	0.04	0.05	5287.5	10087.8925	8847.2025
Mon Mar 12 2018 19:01:55 GMT+05:30 (IST)	99	5.63	6.1	0.04	0.05	5287.5	10087.8925	8847.2025
Mon Mar 12 2018 18:51:54 GMT+05:30 (IST)	99	5.63	6.1	0.04	0.05	5287.5	10087.8925	8847.2025
Mon Mar 12 2018 18:41:54 GMT+05:30 (IST)	99	5.61	6.07	0.04	0.05	5175	9866.005	8652.645
Mon Mar 12 2018 18:31:53 GMT+05:30 (IST)	99	5.61	6.07	0.04	0.05	5175	9866.005	8652.645



SUMMARY

Deploying Remote Tank Monitoring Solutions save hospitals time and money, generate a rapid and significant return-on-investment, lowers risk and improves patient care. Designed to integrate into a new or existing installed tank system provide real-time insight into the location and state of your medical oxygen inventory.

ABOUT HIOTRON

Building a complete IoT solution can be a challenging task, as it requires technical expertise, a lot of time, resources and capital. On the other side, a ready-made IoT platform simplifies the development and deployment of IoT applications, as it connects devices and sensors easily, delivering more values in terms of cost and time optimization.

We are leading custom IoT solution provider in APAC [Asia-Pacific] region. Our full-fledged hIOTron cloud Platform enables us to provide cost-effective solutions to our customers in shortest period of time with 100 % satisfaction because this is what matter to us.

Our highly passionate in-house development team works in all major vertical of IoT technology. We are expert in such as custom PCB design/hardware development, embedded software development, device-cloud/network integration, communication/web protocols & IT experts, front-end/mobile app or Web-App development & big-data analytics.

With design thinking approach we provide uniquely designed custom solution that improve processes, differentiate products and services.



We are global in nature since our inception in 2013, we have served our customers in 8 different IoT business verticals and delivered almost 9700 connected devices and we feel proud in stating that 84% devices are live on our hIOTron IoT platform in 26 various cities across 4 countries.

REACH US

1. At **info@hiotron.com** for setting up quick demo.
2. At **partner@hiotron.com** to become channel/distributor/OEM (White labelling) partner of Smart Home Automation Solution to sell in your region.
3. At **sales@hiotron.com** to buy this solution for your smart home automation or live product demo.
4. Call at +91-9975551455/+91-7028438993.

