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Smart Bus Seat Occupancy Detection System

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Techno-Commercial Proposal

hIOTron® is leading custom IOT solution enabler in APAC [Asia-Pacific] region which provides ready to market IoT enabled products in shortest period of time with 100% customer satisfaction.

We are IoT experts providing End-To-End IoT solutions that improve processes, differentiate products and services, and create new revenue streams.

Currently, Very Few companies have the in-house skills and tools to build IOT solutions quickly and costeffectively whereas our in-house development team is very much expertise in all the major vertical of IOT technology such as custom PCB design/hardware development, embedded software development, devicecloud/network integration, communication/web protocols & IT experts, front- end/mobile app or Web-App development & big-data analyst.

Starting from 2013, We have covered 8 different IOT business verticals and delivered almost 18500 internet connected devices out of which 84% devices are live on hIOTron IOT Platform in 26 various cities across 4 countries.

- Connectivity: Wi-Fi, ZigBee (Star/Mesh), LoRa (868 or 915 MHz), Z-wave, Sub-1, Bluetooth, BLE4.0, IR, NFC etc.
- Semiconductor: Freescale, Marvell, Atmel, TI, Microchip & Many more.
- **Communication Channel:** Wi-Fi, Ethernet, GSM/GPRS, GNSS, LTE.
- **Cloud Platforms:** AWS, IBM Blue-mix Watson, Xively, Thing-Worx, hIOTron & Private.
- > Communication & Queuing Protocols: MQTT, REST, Web-sockets, COAP, XMPP, AMQP.
- ➢ Databases: Cassandra, MongoDB, Raven DB, MySQL, Oracle, MS-SQL.
- ➤ Mobile: Android, iOS, Windows.
- > Standards: OPENIoT, HomeKit, Thread, Nest, Alljoyn, Brillo & Weave.

Introduction \rightarrow Clientele



Conceptual Details \rightarrow Introduction

It is very difficult for the bus owners to track and identify the unofficial pickups done by their bus drivers or conductors without their knowledge and record which mainly leads to the inconvenience for the bus existing passengers and sometimes this activity delays their journey as well. Therefore, to overcome this problem Bus owners can use smart seat occupancy detection system in their buses through which they won't only get the occupancy details of the bus seats remotely real time or historical basis but also the exact bus location, total number of pickup/drops, bus stop points, number of passengers entered/left throughout entire bus journey.



If the boarding/dropping points of every passengers are known to the system or all the booking done online (No offline booking) then it would have been very easy for the system to detect unofficial stops/pickups done by drivers or conductors but offline passengers booking done at conductor end creates lot of complications or challenges for the System to identify & understand whether bus stopped because of valid drop of passengers or invalid entry of passengers.

Conceptual Details \rightarrow Standard Solution

Therefore, to ensure the validity of stoppage of bus, certain inputs needs to be given to system via the cloud based centralized dashboard once or before starting the trip of the bus by the bus owners or travelling managers such as

Bus Source & Destination Point

Bus Total Number of Seats

Bus Total Number of Halts with their time.

Source, Destination & In between Cities First & Last Stop Points

Once this information remotely feed into the system then system will lock the exact count of occupied seats right after passing of last stop point of any city till First stop point of other consecutive city and keeps the passenger counts within the cities in local/cloud-based database which can be monitored real time or known later in the form report, charts or graphs remotely.



Let's take an example to deep dive into this, Suppose Bus has to travel from City A (Source) to D (Destination) which takes around 10 hours for journey. Therefore, when bus starts from the source city A then it has multiple stop (For Boarding/Dropping) points within the city but when it reaches to city A last stop point (A_{LSP}) then system locks the exact count of the passenger inside the bus till city B First stop point (B_{FSP}) arrive and re-count & Locks again after city B Last stop point (B_{LSP}) passes. This process will have repeated continuously till bus reaches to the destination city D First Stop point (D_{FSP}) to ensure the unofficial pickups in the bus.

Conceptual Details \rightarrow More Challenges

Locking the exact seat count after last stop point of city A & before First stop point city B gives the details about the occupancy of seats or number of passengers travelling in the bus but there are some other physical challenges due to which system may give wrong results for valid & invalid entries or create hurdles to drive the entire process smoothly such as,

1. Passenger inside the bus but not sitting – There may be a chance passenger may not sit on their seat for some-time or for long or till the next bus stop or even after which makes difficult for system identify whether same passenger left the bus or in it.

A. System Will Predict Accurately

Case-1: If bus Not Stopped & Passenger seats back again – System Will predict accurately if standing passenger seats back again if bus not stopped.

B. System Wil not Predict Accurately

Case-2: If bus stopped & started now previously standing passenger seat back again – System may fail to predict whether same passenger seating again or unofficial pick up done.

2. Bus may stop between 2 consecutive cities for unknown reason – Bus may stop in between two consecutive cities for any unknown reason such as fuel, washroom, traffic, dropping (Valid), Pickup (In-Valid) etc. & At the same time

A. System Will Predict Accurately

Case-1: Same Number of Seats occupied (No Fault) - Few passengers go out of bus and come back again then system may predict them same passengers again.

Case-2: More Number of Seats occupied (Fault) – Few passengers go out of bus but while coming back number increased then system may predict unofficial pick-up done.

B. System Will not Predict Accurately

Case-3: Same Number of Seats occupied (Fault) – Any passenger left the bus genuinely and un-official pickup done.

Conceptual Details \rightarrow Solution Robustness

For above cases where system won't **predict accurately** there would be any financial loss but still there may be a chance of inconvenience for the travelling passenger.

Therefore, to encounter such cases an array of IR sensor can be used on the entry/exit of door of the bus for passenger in/out (+/-) track along with the existing system which helps system work more robust and predict accurately in those failure cases.

Technical Details → End-To-End Solution Architecture



over GSM

Technical Details \rightarrow Solution End-To-End Flow

A seat occupancy sensor detects the occupancy of passenger on the seat of bus. If anyone sitting on the seat, it simply gives one else zero and this information along with IR detection will be passed (Wired) to the Battery (CR2032) enabled wireless Beacons circuit.

1. SEAT OCCUPANCY DETECTION SENSOR





Once Beacons receive the real time data from sensor then it will be passed to the Gateway (Wireless Scanner) which further process & Analyze the data locally to make the intelligence decisions. Now, Gateway work as tracker, having inbuilt GNSS, forwards the GNSS & sensor data to the hIOTron Middleware IoT Platform via cellular N/W such as 2G,3G or 4G.





Finally, data arrives on Dashboard or Mobile Application having multiple user level such as Owner/Drive/Travel Managers access through which data be can visualized on a historical or real time basis with multiple feature like graphs, charts, map & other widgets or filters.

Technical Details → Solution Components Technical Details

1. Beacon with Seat Occupancy & IR (Infrared) sensor – HI-5580FN is specially designed for the detection of seat occupancy, operating Temperature Range: -20°C to +60, Humidity detection range: ±0.4°C and battery life is 1 year & replaceable.

Technology Overview	
1. Signal transmission frequency	2.400 - 2.4835GHz
2. Protocol standard	Bluetooth 4.0
3. Controller	Cortex-M0 Kernel, 16MHz
4. Memory	256K FLASH ,16K RAM
5. Modulation mode	GFSK
6. Send interval	500mS, adjustable
7. Built in battery	600mAh /3V
8. Communication rate	1Mbps
9. Receiving sensitivity	1Mbps@-85dbm
10. Maximum distance	50 meters, adjustable
11. Service life	1year (can replace battery)
12. Outline size	67mm*51mm*15mm



2. Hi-Gate (HI-1210FG) – HI-1210FG is smart tracker act as a main central unit which is perfectly suitable for smarter cold chain application powered through mains, having majorly blue-tooth for local and GSM for cloud connectivity with in-built GNSS module to precisely track the vehicle position. It is also equipped Li-ion for battery in case of power failure for 15-20days & EEPROM & RTC to store the records in case of network failure.



Technical Overivew	
1. Modular Bluetooth	Work as a BLE scanner to communicate with Seat occupancy sensor equipped Beacons.
2. Modular GSM	Provision for 2G, 3G & 4G network.
3. Internal GNSS	Global positioning system/Global Navigation Satellite System.
Hardware Overview	
4. RTC	Real time clock to store data with time logs.
5. EEPROM (256MB)	Memory to store 15-20 days records in case power or network failure.
6. Li-ion battery	2700MAH battery backup in case of power failure
7. Internal GNSS antenna	An antenna used for GPS connectivity. Integrated into FM device PCB. Does not have external connector.
8. External GPRS antenna	An antenna used for GSM connectivity having external SMA connector.
9. Charging/Discharging circuit	Charge & discharge internal battery through mains automatically.
10. Over voltage protection	Protect device through over voltage from mains.

* GSM	* BLUETOOTH
Quad-band 900/1800 MHz; 850/1900 MHz GPRS Multi-Slot Class 12 (up to 240 kbps) GPRS Mobile Station Class B SMS (text/data)	Bluetooth [®] specification V4.0 Bluetooth [®] transceiver fully compliant with Bluetooth [®] specification V4.0 for external peripherals: Configuration via Bluetooth [®]
* GNSS	
Tracking: 33/ 99 acquisition channels -165 dBM sensitivity Hot start <1s Warm Start < 25s Cold start < 35s NMEA-183 protocol GPS, GLONASS, GALILEO, BEIDOU, SBAS, QZSS, DGPS, AGPS Accuracy < 3m CASING & OTHER IP54 Enclosed (Limited protection against dust ingress & fully against splash water from any direction.) Ambient Temperature Range: -40°C to 85°C. 5% to 95% (non-condensing)	 1 Digital Input 1 Analog Input 2 Digital Open-collector Output (connecting external relays) Bluetooth® specification V4.0 Power supply (+5) V DC with overvoltage protection Internal high gain GSM antenna Internal high gain GNSS antenna external 2700 mAh Li-ion back-up battery Dimensions: L(130mm) x W(115mm) x H(36,5mm) 6 Status LEDs Micro Sim Card Port Micro USB Port

3. **hIOTron IoT™ Platform** – An IoT (Middleware) Platform delivers a comprehensive platform as a service (PaaS) for rapidly designing, developing, deploying, and operation of CNC machine from monitoring to tracking with proactive fault/problem detection and resolution to shop floor engineer.



Technical Features

- Device Connectivity Web based Platform manages seamless device connectivity & configuration from platform to gateway (Out-Bound Connectivity Protocols: Wi-Fi, Ethernet & 2G/3G/4G/LTE modem) & gateway to wireless/wired end node [In-Bound Connectivity Protocols (Wired Serial, I2C, SPI, RS232/485, Mod-Bus & CAN) & (Wireless BLE4.0, ZigBee, Z-Wave, Lo-Ra, Sub-1, RF)] & Vice versa.
- Device Management Platform IoT Device Management makes it easy for you to manage your connected devices at any scale with right authentication & authorization process. Organize & Manage your Hub (gateway) & Nodes in hierarchical structure based on its category which help to search/edit/remove devices in bulk.
- Basic/Advance Edge Analytics Models Platform supports multiple Anomaly Detection Models to filter data based on event or time & perform some actions (if assigned any) at edge before it reaches to cloud to eliminate the round-trip latency of an actionable insight. In a production environment, same filtered events can be mapped with notifications/switching models to make the process automatic through cloud.
- Basic/Advance Analytical Models Platform provides a spectrum of analytics that enable you to start quickly and realize value immediately and visualize your device real time or historical Raw, Formatted & Formulated (Application category based) data in charts/graphs/bars in well-organized way with multiple filters like project/data/ time/threshold/download options
- Data Storage Platform stores last 90 days device generated data for any application which is directly in-sync with heart-beat interval (data update period from device to platform) period (default 10 minutes). For example- if Heart-beat interval kept 5 minutes then storage duration will also become half 45 days. For any customization in storage please contact.
- Reporting Tools Platform allows user to visualize real time & historical data along with time/event-based mail reporting feature for overall (combined) or each & every pattern of data in PDF format. [excel format reporting also available with data filtering option]
- FOTA (Firmware over the air) Platform maintains the record of every version (Newly or Previous) of firmware of devices associated to it which allows you to update gateways & its associated nodes new firmware one by one or all in one in single click.

Enterprise Features

- Open APIs for Custom UI Models & Business Logics Access of REST APIs in JSON/string format allows you to embed raw data anywhere in the form custom visualizing model as per business logics or branding requirement.
- **Logo/Theme Branding** Partners can serve hIOTron IOT platform as their own IoT platform to their clients with logo & theme branding features.
- White Label Custom URL Branding Partners can also serve hIOTron IOT platform as their own IoT platform with completely white label branding option right from their custom logo to URL.
- 4. Dashboard & Mobile application Multiple user role level mobile Application & Dynamic Dashboard/Web-app access fully sync with each other.



Real-Time Tracking - Track the location of your buses online in real-time. Choose from the following maps: Google, Satellite, OSM etc. View additional information about the tracking objects: seats vacant or occupied, travel history etc.

Notifications – Get instant if unofficial pick up done by driver or conductor: know when the object enters or exits geo-zone, know if it is speeding and stopovers. Get SOS alarms if it has been stolen as well as turn on/off the engine easily. Get notifications to your iPhone, Android or Windows devices, via e-mail, mobile App or SMS.

History and Reports – Download and review reports in different formats: XLS, PDF, CSV, TXT. Reports include various information by date and GPS tracker name including: driving hours, stopovers, distance traveled, fuel consumption, temperature history and many more. Detailed and group reports are also available.

Fuel Savings – Easily check tank fuel level and fuel consumption along the route in real time. Aggressive driving: rapid acceleration, speeding and braking, directly influencing fuel consumption. It is a fact, that improving driving behavior can cut your fuel costs significantly (by 5% to 15%). Moreover, fuel consumption control is a great preventive measure against fraud.

Geofencing – Geofence feature allows to set up geographic boundaries around areas that have specific interest for you. Receive automated alerts when the object enters or leaves marked boundaries

POI & Tools – With Points of Interest (POI) tool you can add markers at the locations, such as: gas station, a hotel, a restaurant, etc. Also, you can name the place and add description. You can also use tools for calculating distances between places on the map.

Mobile app – Download one of our mobile GPS tracking apps. Transform your mobile (iPhone, Android, Windows) into GPS tracker and track it online in real time. Or choose hIOTron mobile client app and access all software features on your smartphone.

Solution Benefits

24x7 Real Time seat & Bus Monitoring Full Visibility of drivers & related staff activity of the bus. Complete bus travel History No unofficial passenger entry Improved passengers travelling experience Basic & Advance level analytics for critical routes Fully Customizable for any bus, any seat ISO 27001 information security certified

hIOTron N/W Coverage for Installation & Service



Refer this link -

https://drive.google.com/open?id=1mC6sVViVt yyEdqNXqtQw2OYLnAEhRF4E&usp=sharing Go-To Market – Total 9 Weeks Phase-2 Customization Timeline – 3 Weeks

02

Phase-1 Proof of Concept (POC) Timeline – 2 Weeks

01

Phase-3 Production Timeline – 4 Weeks

03