Cold Chain Monitoring And Tracking Solutions

Ver1.0

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Revisions

Ver	Date	Descriptions
1.0	2016.09.08	The Initial version

1. General

1.1 Cold Chain Logistics

Logistics that requires temperature controlled transportation is called cold chain logistics. A cold chain is a series of storage and distribution activities which maintain a given temperature range. It is used to help extend and ensure the shelf life of products such as fresh agricultural produce, seafood, chemicals, and pharmaceutical drugs.

Unlike other goods or merchandise, cold chain products need to be prepared, stored, and monitored with great precision so that the products doesn't lose its integrity. Transportation includes use of refrigerated trucks and railcars, sometimes cargo ships and air cargo too.

A cold chain should be measured, documented, and validated by a quality management system. The system would monitor equipment status, product temperature history, and custody chain, etc. These help ensure that a food, pharmaceutical, or vaccine is safe and effective when reaching its intended consumer.

1.2 Our services

Our service is to provide temperature sensors and RFID tags, helping to monitor the temperature history of product containers like cargo, truck, warehouse or the products itself.

Temperature sensors are able to pass standards like ISOs and the others depending on the targets to be monitored. And the sensors are fully traceable.

We also provide hand-held terminals and scanners that facilitate data collections from large-scale sensor units, the data would in turn be submitted to the cloud database for storage.

Documentation is critical. A cloud database system is built so the data could be exposed to end-users, as well as third-part agencies like insurance companies, which could help verify and better ensure the integrity of the overall cold chain process.

2. Sensor Products

2.1 Sensor unit

The main purpose of a sensor unit is to record and track temperature data. Each sensor unit has its unique ID. The temperature data saved in the sensor would be transmitted to a logging device in a wireless method.

Precision is important in terms of measuring, the principle is to use thermally sensitive resistors whose prime function is to exhibit a scalable change in electrical resistance when subjected to a corresponding change in temperature. The target to be measured could be liquid, gas or solid surfaces.

Functionalities of a sensor unit are listed below:

- Measurement of temperature;
- Measurement of humidity;
- Recording of measurement results;
- Reporting measurement results to logging devices;
- Wireless support (2.4GHz Radio Frequency);
- Unique ID and QR code recognition;
- Detection of UV index, optional;
- Waterproof, optional;

Following is its appearance and main specifications.

[Please note this is preliminary design version, the actual device may be different.]

Major Parameters	
RF type	2.4GHz
RF distance	Bluetooth: 0.5m-15m;
Power	5V DC Power
Battery life	One year (typical)
Operating temperature	-55℃-+90℃
Sampling rate	One minute (typical)
Recording duration	Six months, loop around (typical)
Appearance	46*62*20mm
Installation	Bolting or sticking
UV detector	Optional
Waterproof	Optional
Temperature Sensor	
Temperature accuracy	± 0.5 °C,-50 to +50 °C
Humidity Sensor	
Humidity accuracy	± 4.5% rH, 20 to +80% rH

2.2 Hand-held Scanner

The hand-held scanner is a terminal that is able to fetch and collect data in sensor units. By supporting 4G and LTE mobile telecommunications technology, it in turn would transmit the data to cloud database.

Following is its appearance and main specifications.

[Please note this is preliminary design version, the actual device may be different.]

Major Parameters	
Chipset	Qualcomm, Quad-core 2.0GHz
Memory	1GB (2GB optional)
Storage	8GB (32GB optional)
Display	5.0 inch TFT-LCD WVGA
Panel	Capacitive touch screen
Camera	Supported
Audio	Supported
GPS	Supported
Connectivity	LTE, Wi-Fi a/ac/b/g/n, Bluetooth 4.0
RF distance	Bluetooth: 0.5m-15m
Power	3.8V, 4800mAh
OS	Android 4.4+
Operating temperature	-10℃ ~ +40℃
Operating humidity	80% @40℃

3. Work Flow

3.1 Deploying

a) Installation

The sensor unit could be attached to the target by sticking or bolting.

We can put several sensor units both inside and outside of a container.

Here, for example, we choose to stick them on the container's walls.

[Red icons indicate the placement of sensor units.]

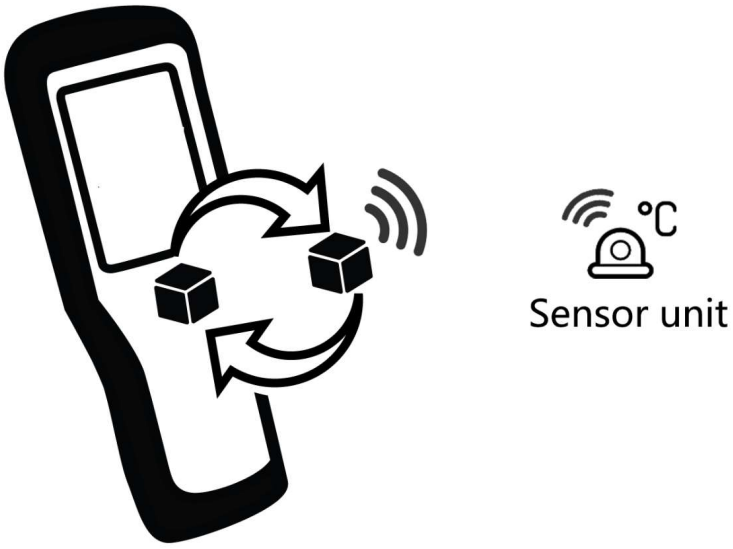
b) Power on

The power button is located on the back of the sensor unit, which is the side attached to the walls. By doing so, normal packing or unpacking works wouldn't be interfered.

Once powered, the sensor unit starts to work. Typically, it records temperature data once a minute. In this condition, its battery life could last for more than one year. The battery of a sensor unit could survive low temperature. Once the battery is used out, we need to replace it with a new one.

c) Configuration

After being powered on, the sensor unit also sends out RF signal to the surroundings. The hand-held scanner could detect a sensor unit and set up its working configurations.



Major things that can be configured including:

- IDs, names, positions, monitoring targets, comments, etc.;
- Sample rating of data monitoring;
- Advertising interval of RF signal;
- Alarm threshold values of temperature monitoring;
- Battery usage;
- (To be continued)

3.2 Shipping

The product is insulated with proper packaging, and be put into the container that is tracked by the sensor units. The entire operation is under temperature controlled environment.

After packaging, the product are under transportation and delivery to its destination. The means of transportation usually would be refrigerator trucks, refrigerator cars, reefer ships, reefer containers, and refrigerated warehouses, etc.

In the whole process, the sensor unit keeps sampling and recoding temperature data. The memory of a sensor unit for data recording is 4K Bytes, if the memory is used out, it will loop the recording around to its beginning.

3.3 Syncing

At the destination, we have arrived customer's warehouse, which should be a temperature controlled environment as well, and we shall start to unpack goods and collect senor units' data.

Here, we need the hand-held scanner again. We could put it in a place around the container, the scanner would use wireless technology to scan sensor units around it, and automatically connect sensor units each by each, then would receive and sync data from the sensor unit.

Meanwhile, the scanner would submit the synced data to the cloud database. We call the above processes as "Syncing".

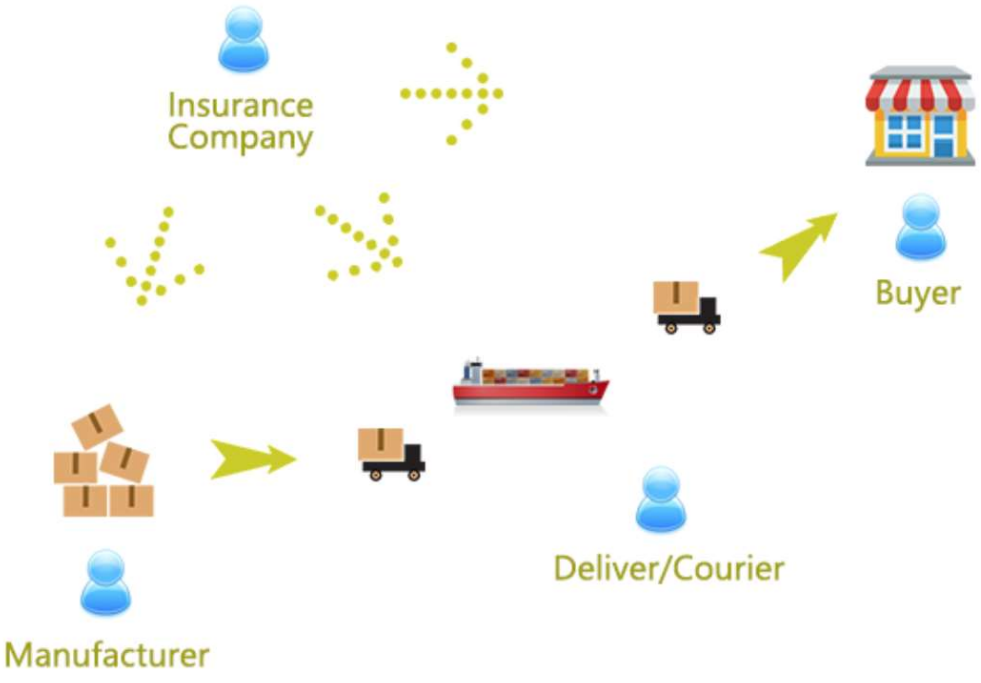
The sensor units are recyclable, after all data finishes syncing, they should be withdrawn. So we take all the sensor units off from the container.

3.4 Inspecting

After the syncing procedure, the temperature data should have been shifted to the cloud. A database system is provided so that people could verify or inspect the data history.

Manufacturer, delivers, traders, customers, and other third parts like insurance companies have the privilege to see the data. If issues found, certain measures should be taken to solve the problem, like customer rejecting the goods, someone paying for the damage cost or insurance company settling a claim.

4. Conclusion



The Cold Chain Business Model

Several roles are involved in the cold chain, we would like to corporate and provide modern monitoring and tracking solutions for the overall business.