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SIBIONICS

SiSensing CGM In-Hospital Blood Glucose Management

Introduction

According to the World Health Organization, about 422 million people with 1.5 million of deaths directly attributed to diabetes. What is more concerning is that the number of cases and the prevalence of diabetes have been steadily increasing over the past few decades. According to the National Library of Medicine, glucose monitoring of diabetic patients should be done continuously for better outcomes. The benefits of continuous vital sign monitoring (CGM) are numerous, CGM can play a role in both alerting and educating people with diabetes and is particularly critical in monitoring chronic types of diabetes. Yet, the adoption of CGM is still lacking due to the lack of resources, policy limitations, and inadequate medical staff education. It is imperative that the

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CGM technology is reliable, secure, and easy to use for medical staff and hospital management to accept and adopt this technology.

  In this article, we focus on the particularly dire situation in China and how the companies SiSensing and Cassia Networks are helping in managing continuous glucose monitoring and reducing the negative impact of diabetes.

Project Background.

   Diabetes prevalence in China is a serious issue with a high management cost associated with it. The rates of diabetes for adults aged 20 – 79 years are projected to increase 8.2% - 9.7% during 2020 – 2030. This translates into an increased economic burden of diabetes from $231 - $414. The areas that are particularly impacted with high diabetes rates are Northeast and North China. (Lancet 2023). Yet, the blood glucose management methods in China are inadequate, partially because advanced technology and management concepts have not been widely and timely applied clinically. In most hospitals, whether it is internal medicine, surgery, or other departments with patients with abnormal blood glucose, the overall blood glucose management rate is generally lacking as the participation of endocrinologists in non-endocrinology blood-glucose management is relatively low.

   In response to the skyrocketing diabetes rates, a standardized management protocol for diabetic patients' treatment is projected to reach 70% and above by 2030. The Chinese Expert Consensus on Blood Glucose Management of Inpatients recommends the use of an Internet-based blood glucose management system for an effective blood glucose information management.

   Another consideration is routine glucose-level screenings. Regardless of whether they have diabetes or not, during the treatment of other diseases, inpatients may experience abnormal blood glucose metabolism. If the medical staff cannot detect and control the patient's blood glucose in time, the abnormal blood glucose will adversely affect the treatment results of the primary disease. Patients may experience additional burdens and risks. Therefore, it is crucial to establish a standardized blood glucose management solution in hospitals.

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Project Requirements

CGM Smart Ward Blood Glucose Information Management Solution

Shenzhen SiSensing Bionics Technology Co., Ltd. strives to create a digital hospital-wide blood glucose management solution for hospital scenarios and builds a digital hospital-wide blood glucose management solution around the Continuous Glucose Monitoring System (CGM) to achieve a unified CGM management of patients in multiple departments as well as establish blood glucose data display and storage. The whole process of transmission provides good conditions for endocrine remote consultation. Doctors can fully understand the changes in patients' conditions, assess the degree of metabolic disorders in patients, formulate reasonable hypoglycemic programs, improve the work efficiency of medical staff, and improve the compliance of inpatients and the rate of blood glucose compliance.

The operating principle of SiSensing CGM is to monitor the glucose concentration in the subcutaneous interstitial fluid through a sensor to indirectly reflect the blood glucose level. This can be done without a need for blood collection or capillary sampling. Another advantage is that users can see comprehensive, real-time blood glucose fluctuations on smart terminal devices such as mobile phones. Relevant data supports remote sharing with relatives, friends or doctors. In the hospital, patients wear CGM sensor and send out their
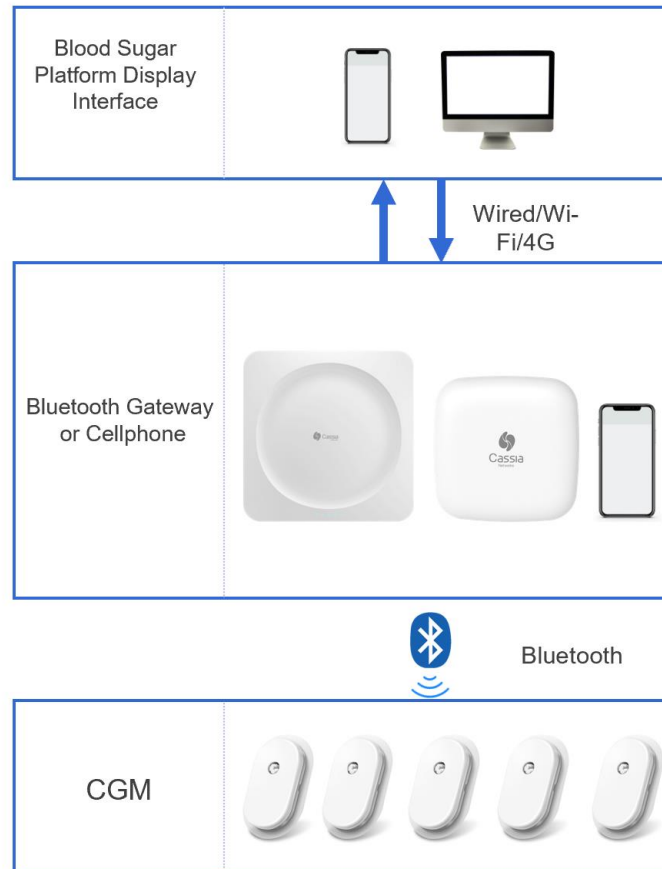
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blood glucose data in real-time. It will help the doctors/nurses to complete blood glucose management in the hospital, and the patients can receive dynamic glucose assessment reports when they leave the hospital. So, the doctors, nurses and patients can quickly and accurately obtain blood glucose information and provide efficient blood glucose management for medical staff. In order to support this solution SiSensing relies on the Cassia Networks' Bluetooth Internet of Things network supports to realize data interconnection in the hospital.

In-hospital Data Interconnection Scheme – Cassia Networks Bluetooth Internet of Things

SiSensing CGM uses Bluetooth for data communication and has selected Cassia Networks Bluetooth' Internet of Things network to enable data communication in the hospital. By deploying Cassia Networks Bluetooth Internet of Things gateway, CGM sensors, the automatic and batch collection and management of blood glucose data of patients can be realized allowing for a simpler, and more accurate solution benefitting hospitals, outpatient clinics, endocrinology departments, and other departments that require blood glucose monitoring.

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Blood glucose monitoring

Hospitals use two models of Cassia Networks gateways S2000 and M1000, and coordinate with the Cassia Networks IoT Access Controller to complete the work**.**

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Cassia Networks Bluetooth Gateway S2000

1. Up to 20 CGM sensors can be connected at the same time
2. Can transmit CGM data after penetrating two walls of the ward
3. In line-of-sight scenario, the gateway can communicate with the CGM up to 50 meters
4. Supports advanced functions such as roaming, data filtering, gateway auto-selection, etc.
5. Support Ethernet, Wi-Fi and 4G backhaul

Cassia Networks Gateway M1000

1. M1000 is a compact, easy to install and use Cellular Bluetooth gateway that provides superior Bluetooth performance. It can be powered by a DC 5V 2A power adapter or portable charger.
2. Can connect to up to 5 CGM sensors at the same time (will expand to 10 in the future)
3. In line-of-sight scenario, the gateway can communicate with the CGM up to 25 meters
4. Supports advanced functions such as roaming, data filtering, gateway auto-selection, etc.
5. Support 4G and Wi-Fi backhaul

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6. Suitable for a small number of CGM, mobility, and quick deployment scenarios

Cassia Networks Internet of Things Controller (AC)
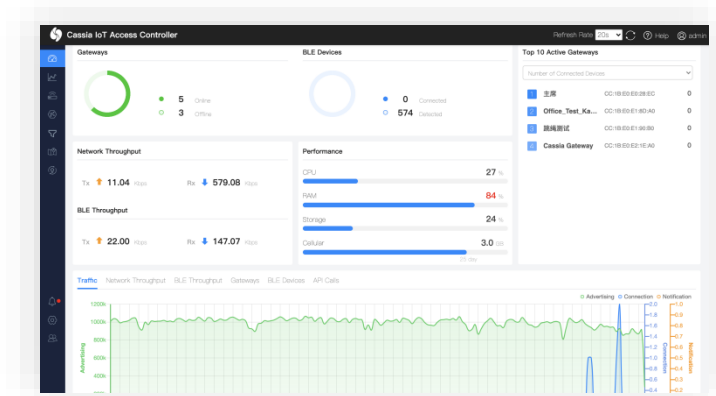
Flexible and Convenient Management Channels

1. Batch management of Bluetooth gateways: batch deployment, configuration, upgrade, maintenance, etc.
2. Advanced DI (Device Integrator) function: a batch of Bluetooth medical devices integrated, supports whitelist, data filtering, data parsing, customizable interface. Convenient interface based on HTTP/HTTPS
3. Bluetooth roaming: support Bluetooth roaming, support gateway auto-selection based on the best RSSI signal

This type of advanced and stable Bluetooth IoT network allows CGM sensors to work in multiple wards within a hospital without a manual intervention, automation, and it can process large sets of data. The blood glucose data of admitted patients wearing CGM sensors can be monitored every five minutes, and then automatically transmitted in real time to the medical management platform. For abnormal situations such as high and low blood glucose, it can be detected early and dealt with in a timely manner. At the same time, the use of

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intelligent centralized monitoring maximizes the work efficiency of medical staff. The solution comes with roaming capabilities. While a patient moves freely in the area covered by the Bluetooth IoT network, the blood glucose data remains continuous.
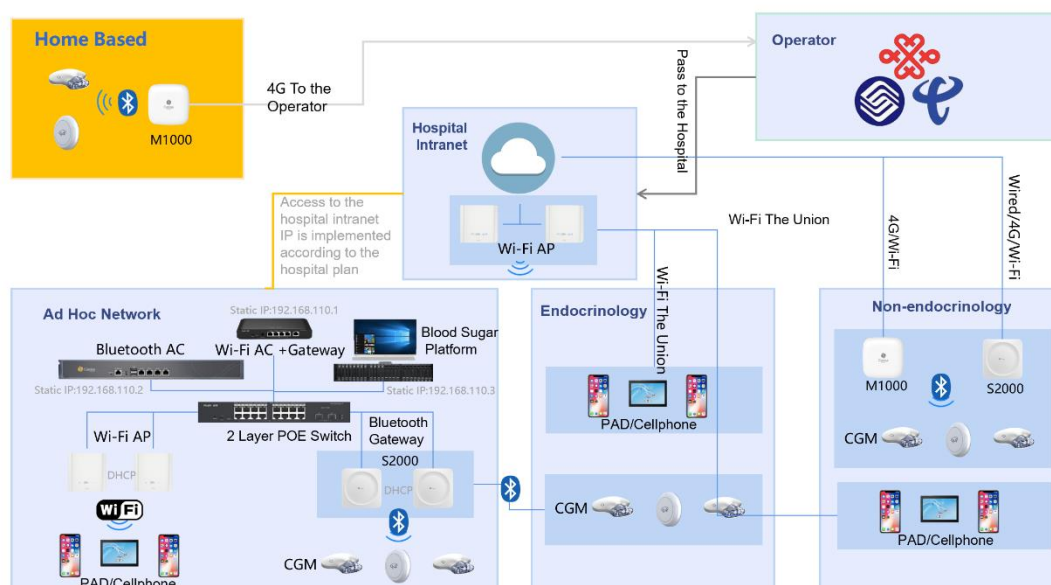
Advantages of Cassia Networks Bluetooth IoT technology

Cassia Networks has provided Bluetooth IoT network to SiSensing for CGM for more than three years, and this partnership has resulted in many advantages:

1. Long range seamless Bluetooth coverage - with the patented smart antenna and radio management technology, Cassia Bluetooth gateways can transmit Bluetooth data across multiple walls indoors, providing stable and seamless Bluetooth coverage for complex indoor scenes.
2. Roaming for Bluetooth devices - when patients move in wards, corridors, nurse stations, doctors' offices, etc., the Bluetooth devices, can quickly and safely switch between different Bluetooth gateways, maintaining stable and continuous data transmission without manual intervention.

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3. High-speed multi-connection mode - In the scenario of connecting with multiple Bluetooth devices simultaneously the Bluetooth connection performance is optimized, and the stability of the Bluetooth connections and the balance of data transmission are secured.

4. End-to-end data security - provides a secure channel for data transmission by using AES128-bit encryption, https transmission, etc.

Cassia Networks Deployment Advantages

Cassia Networks has so far assisted nearly 200 hospitals with a complete CGM deployment, and has helped establish multiple Standard Operations Procedures (SOP) involving the whole process from a site survey to planning, implementation, and acceptance testing. Cassia has a trained engineering partner covering the whole China, which can support the deployment across the country.

Because of the vast experience with the deployment in many hospitals, our team is highly skilled at troubleshooting the network, interference and communication problems in the hospitals. Cassia Networks has been a trusted partner in all matters regarding customer support.

Application Results from the CGM Smart Ward

The results accomplished at the CGM smart ward were multiple:

1. It provided dynamic blood glucose monitoring and management services for hospitalized patients with abnormal blood glucose. Moreover, It helped medical staff to understand the blood glucose fluctuations of patients in a timely and comprehensive manner.

2. It provided centralized monitoring and information management of blood glucose at hospitals, improved the work efficiency of medical staff, reduced the workload, facilitated data collection and scientific research, and improved the professional ability and scientific research level of medical staff.

3. It improved the refined management level of diabetes in the hospital. This resulted in higher blood glucose compliance rates in hospitalized patients,   a

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reduction in hypoglycemia incidents in hospitalized patients, and allowed the patients with abnormal blood glucose to obtain direct and immediate benefits.

4. It improved the hospital's informatization construction and established a hospital-wide dynamic blood glucose management informatization system. The systems communicates throughout different, integrates the dynamic blood glucose data of the whole hospital, and realize the intercommunication of dynamic blood glucose data of each department, which allows for a complete information management of dynamic blood glucose in the whole hospital.

5. Promotes the establishment of a more standardized blood glucose management model in hospitals. Standardizes the blood glucose monitoring processes and blood glucose consultation processes resulting in the reductions of medical errors. Moreover, it enables multidisciplinary personnel in various departments to collaborate efficiently, and shortens the length of hospitalization for patients with abnormal blood glucose, improves the bed turnover rate, and increase the number of inpatients in the hospital per unit time. This system has proven to be of great value to the endocrinology departments for blood glucose management.

About SiSensing

Shenzhen SiSensing Technology Co., Ltd. was established in 2016. It is an innovative company that provides accurate glucose data collection and related professional medical services to customers through technological innovation. SiSensing is committed to continuously develop continuous glucose monitoring system (CGM), diabetes management software, and artificial intelligence algorithm for diabetes screening, combined with chronic disease management and medical screening innovative service models. It strives to continually provide customers with accurate, easy-to-use, and comfortable glucose monitoring devices and a comprehensive blood glucose assessment and management program. Its parent company is Shenzhen Siji Bionic Technology Co., Ltd.

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