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Bluetooth IoT education platforms: Enabling Adaptive Learning Environments

for the Digital Generation

by Brad Canham

From MOOCs to Adaptive Education enabled by Bluetooth IoT

If you've ever enrolled in a massive open online course (MOOC) the odds are high you've experienced, first hand, the promise – and disruptive nature - of the "future of education." (Also, the odds are very high, over 90%, you never completed the MOOC course.) With MOOC attrition rates at high level, it's clear the future of education took a different direction.

For today's current "digital generation," one of the new directions is happening at Harvard University's HarvardX adaptive learning system (Driessen, 2017). It merges academically rich environments, unique and robust content, and personalized education adapted to a student's individualized needs using "big data." Moreover, while disruption in education will continue, it's a good bet digitized data and student choice will play a significant role going forward.

At HarvardX and in schools around the world, instead of sitting behind rows of desks, digital students increasingly take their educational environment with them.

Student-centered smart schools: China gets Adaptive

Since a 2014 pilot, an increasing number of schools in China are designed along a Western model where students walk to teachers' classrooms, instead of remaining in a single classroom visited by different teachers (Nylander, 2016).

In these student-centered adaptive learning environments, students in China are encouraged to manage their own educational calendars. The students register for different teachers in a variety of classrooms, shifting to classes and teachers based on their academic interest. As a result, an additional style of "adaptive" teaching is developing, including outdoor classes.

On the one hand, this new education trend accommodates an innovative approach to education. On the other hand, managing the location and behavior of this mobile and self-motivated group of students comes with new challenges. In China, meeting the challenge of this mobile digitization of adaptive education means using light weight, low power Bluetooth technology.

Using Long-range Bluetooth to align educational resources with student goals

Due to its low-cost, low battery consumption, ultra-light weight, and worldwide standardization, Bluetooth technology is an ideal for creating an IoT education platform used to align a student's individualized educational achievement goals with technological tools used to

achieve those goals, such as: teachers, multimedia classrooms, pad devices, classroom chairs, etc… In China, a Bluetooth IoT campus is a key component of this new adaptive education model.

Liberating Bluetooth low energy networks, big data

However, given the traditional short-range and one-to-one nature of traditional Bluetooth, creating the physical network required to create a seamless coverage of a student environment was a challenge.

Linking a Bluetooth IoT education platform to multiple students in an adaptive learning environment requires a Cassia Networks long-range Bluetooth router delivering one-to-many data on students, locationing, as well as bi-directional communications pushed to the students.

Moreover, only Bluetooth low energy (LE) provided the low-cost, ultra-light weight, low-power capability for reducing power expense and battery maintenance. In this regard, Bluetooth LE enabled a wearable bracelet with signaling capabilities. Further, for administrators of the adaptive learning data system, Bluetooth LE enabled an understanding of student movement patterns, positioning, reverse notifications, and helped solve teaching management issues as they arose.

Cassia Networks long-range Bluetooth IoT

Linking the students' adaptive educational goals to a digitized network system involved a Cassia Networks campus intelligence awareness solution:

- Smart Bluetooth low energy bracelet,
- Long-range Bluetooth router,
- Cassia Access Controller (AC)

Hardware: Long-range Bluetooth router and a smart Bluetooth bracelet

The entire campus intelligence solution is seamlessly covered by multiple Cassia long-range Bluetooth routers (up to 1000 feet of range). Each student wears a smart Bluetooth bracelet, which the long-range Bluetooth router connects to for data collection. The data from hundreds, and even thousands, of Bluetooth bracelets is fed to the Cassia AC and passed to an application used to manage educational resources in real-time. Additionally, the Cassia AC manages the set-up and management of the long-range Bluetooth routers.

Linking adaptive education to Bluetooth IoT capabilities

Five broad characteristics of an adaptive, connected education experience include:

● In physical education classes, adaptive learning means adapting activity goals to an individual student's unique needs, including safety concerns.

During physical education classes, real-time monitoring of student's heart rate, exercise, calories, rest, to improve health outcomes also includes setting enabling a "dangerous data, critical value" alarm. This critical value data provides a unique precautionary measure to protect students' personal safety. Also, historical data on each student and for classes is used in vertical and horizontal comparisons to facilitate individual and group-based health improvements.

● Quantitative accuracy and Qualitative interactions: Real-time data, teachers exploring student interests one-on-one

In these Bluetooth IoT adaptive learning environments, students explore their educational environment based on personal interests. The amount of time a student stays in each subject-focused classroom is digitally recorded. Over time, teachers better understand student interests. As a result, teachers spend less time guessing about student interests, and "tracking" students with old-fashioned check marks on a piece of paper.

Instead, teachers spend more time "one-on-one" connecting with students and enriching the educational experience. Moreover, with a combination of accurate long-term quantitative data accumulation and more time for qualitative one-on-one interactions, the school is better able to facilitate student interests, outcomes, and achievements.

● Bluetooth IoT platform: ease of use, data interface, and simple development

The Cassia Bluetooth IoT education platform includes a simple developer-friendly API interface to ease set up of an adaptive education environment. As Bluetooth LE is a worldwide standard it is quickly and easily integrated via the Bluetooth low energy bracelet, long-range Bluetooth router, and AC system into an educational environment.

 ● Connectivity at the center of IoT: Simple installation using Bluetooth

As Bluetooth is a worldwide, common standard, the connectivity between the Bluetooth bracelet and the long-range Bluetooth router is simple to set up and easy operate. Unlike many other low power wireless protocols, the Bluetooth LE enables bi-directional notifications, such as: reminders to students about class times etc., emergency warnings, danger zone warnings

etc. * (Note: the Bluetooth bracelet also includes near field communication (NFC), a short-range wireless communication technology) function, which may be enabled as needed for digitizing additional applications, such as a student campus ID card, food line card, bus card etc.

● Easy-to-use Internet application management

The Cassia Access Controller (AC) eases the management of hundreds of Cassia Networks long-range Bluetooth routers connecting to thousands of Bluetooth devices seamlessly connected across a wide educational campus. The Cassia AC also eases management with real-time status monitoring, AC auto discovery, firmware management, device tracking and security policy integration. The Cassia AC background dashboard displays real-time data in the current state, including throughput, system, connected Bluetooth routers, connected clients, and events. Also, network downtime is reduced with included network error detection and alerts, for administrators.

The Cassia AC pulls the data and management interface into a single, easy-to-use interface via an Internet application. As a result, real-time and effective feedback involving a dynamic, free-roaming student environment of classrooms, playgrounds, and an entire campus occurs. The Cassia Bluetooth IoT education platform also involves managing many Bluetooth connected education devices within the Cassia AC interface.

Bluetooth IoT education platform for adaptive learning

The Cassia Access Controller (AC) is a powerful cloud-based Bluetooth IoT education platform and network management solution. The Cassia AC enables deployment of many Bluetooth routers and Bluetooth terminal devices in a campus environment, via the Cassia AC centralized management control, positioning, roaming and other functions.

 1. Centralized management and control

The Cassia AC solution seamlessly deploys and manages thousands of Bluetooth routers in the campus environment and tens of thousands of Bluetooth devices connected to it through a centralized management interface (aka, the Cassia dashboard).

2. Seamless Bluetooth cover using existing network infrastructure

The Cassia AC and long-range Bluetooth router combination, achieves indoor and outdoor seamless cover without changing the networking environment. The Bluetooth data is fed via Ethernet or Wi-Fi from the long-range Bluetooth router to the Internet and Cassia AC application.

3. Understanding locations for educational resource allocation

A Cassia AC, along with multiple Bluetooth routers, tracks and reports the location of Bluetooth devices within its coverage, providing real-time tracking of people and educational equipment and assets. Cassia AC uses the classic RSSI (signal strength) measurement, unique fingerprint algorithm and intelligent signal filtering algorithm for triangulation. Real-time tracking location accuracy of 5-10 meters, is used to understand student locations and Bluetooth device tracking for resource allocation.

 Cassia Internet Access Controller Map Management

4. Unlimited scalability

Smart schools build large and small long-range Bluetooth wireless networks as needed. Larger venues include areas like sports venues, or school campus environments, where multiple long-range Bluetooth routers indoors and outdoors maintain seamless coverage and are managed via a single management interface.

5. Fast-roaming

Cassia AC supports the roaming of Bluetooth devices. The fast-roaming capability auto-detects and reconnects between Cassia Bluetooth routers to ensure continuity of access.

6. External interface via standard HTTP/HTTPS

HTTP / HTTPS provides the data output API to the application server.

7. Security

End-to-end security practices and encryption from the client Bluetooth device to the Cassia long-range Bluetooth router, Cassia AC, and application server, includes:

• Cloud API supports OAuth for user authentication (open validation)

• Support for the Docker architecture, which isolates applications from each other and isolates them from the underlying infrastructure, providing additional protection for applications.

• Use of a whitelist to manage the routers and client devices that enter the network.

• Strategies to limit the use of routers and devices, minimizing the likelihood that they will be attacked, include:

- Setting a policy to restrict roaming in a Bluetooth router (for example, to "Building 1").

- You can also set a strategy to track the locations of student personal safety sensors (PSS).

- User Management - Create and manage user accounts with different access control levels.

Worldwide Adaptive learning Bluetooth IoT educational platforms

Disruption in education continues throughout the world. Aided by big data and robust and personalized learning environments, adaptive learning models are taking place at schools from Beijing to HarvardX.

New long-range Bluetooth low energy capabilities have enabled digitalized education and new adaptive smart school environments in China where educational assets and students are aligned to achieve improved student outcomes.

For example, Cassia Networks long-range Bluetooth IoT educational platform and campus intelligence solution is deployed in schools throughout China, including: Beijing, Shanghai, Chengdu, Qingdao and several other areas.

By aligning a Bluetooth IoT education platform with student-centered adaptive learning, Cassia Networks is enabling the digital generation to use technology to place the student at center of education.

<div align="center">References:</div>

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