Bluetooth's Role in Modern-Day Teaching and Classrooms

The Hub: IoT in Education

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Introduction

This tech note explores the topics of Bluetooth, its role in the Internet of Things, and how these topics are integrated into modern-day teaching and classrooms. As the world continues to move in a very technological direction, its vital that students of younger and younger ages are exposed to learning these concepts and technologies. However, if these ideas are not well-understood or easily accessible to teach, the purpose can quickly be lost.

Bluetooth

The History of Bluetooth

Figure 1. the Bluetooth Logo [1]

Bluetooth, a technology that has been around since 1998 [1], is present in a wide variety of devices such as smartphones, cameras, speakers, and laptops just to name a few. In general terms, Bluetooth is a form of wireless communication made specifically for close range and lower power applications. Additionally, Bluetooth is meant for devices where battery life is more highly valued than high data transfer rates, which is what sets it apart from Wi-Fi communication. As is the case with Wi-Fi however, Bluetooth allows devices to communicate with one another. [2]

The first release of Bluetooth was to create wireless data systems that could carry data at speeds of up to 721 kbps with the addition of up to three voice channels. [3] Its original purpose was to enable the elimination of cables between devices such as printers, fax machines, and desktop computers. This technology was intended to be low-cost, and could easily be incorporated into all kinds of electronics. Bluetooth enables communication between devices up to a maximum distance of about 100 meters, however it is more typically used for shorter distances.

Bluetooth in Practice

Bluetooth radio interface utilizes several techniques and signal formats to allow for reliable operation. It uses frequencies in the 2.4 GHz Industrial, Scientific, and Medical (ISM) band, categorizing it as ultra-high frequency (UHF) radio waves. [4] Bluetooth uses a technique known as frequency hopping, where the signal moves from one frequency to the next at regular intervals of time. Since the ISM band is used by many other communication technologies such as Wi-Fi and microwaves, this frequency carrier hopping enables Bluetooth device interference to be avoided. The Bluetooth standard uses a "hopping rate" of 1600 hops per second, and the system hops over the entire span of available frequencies using a predetermined, pseudo-random hop sequence which is based upon the Bluetooth address of the master node in the network. This technique of frequency hopping was chosen to be used over a direct sequence spread spectrum approach because frequency hopping allows for operation over a greater dynamic range.

A given Bluetooth transmission only remains on a certain carrier frequency for a short period of time. A great advantage of Bluetooth is that if there is any interference present during a transmission, the data will be resent at another time when the signal has changed to a different channel, one that will be free of other interfering signals. [4] Bluetooth uses a modulation technique known as Gaussian

Frequency Shift Keying (GFSK), which is a form of modulation that is both spectrally efficient and enables the use of resourceful radio power amplifiers thus saving on battery life, a feature of Bluetooth that sets it apart from other wireless communications.

There are two types of Bluetooth technologies: Bluetooth Classic and Bluetooth Low Energy (BLE). Bluetooth Classic refers to the technology that is used in devices such as wireless speakers, car systems, and headsets – devices and systems that require higher power and/or greater amounts and frequencies of data transfers. On the other hand, Bluetooth Low Energy is more prominently used in applications where, as one would assume, power use is more critical, as well as smaller amounts of data are transferred more infrequently. [5] Most Internet of Things devices, which will be discussed further in the following section, utilize BLE technology, therefore this will be the type of Bluetooth technology most heavily discussed in this paper.

Current Technologies

This section will briefly explore two of the many technologies currently on the market that utilize Bluetooth technology and the idea of the Internet of Things in an educational context. The two technologies that will be discussed are the LEGO Education WeDo 2.0 Core Set and the Sphero SPRK+.

LEGO Education WeDo 2.0 Core Set

Figure 2. LEGO Education WeDo 2.0 Core Set [6]

"LEGO Education WeDo 2.0 Core Set is a hands-on STEM solution that combines the LEGO brick, classroom-friendly software, engaging standards-based projects and a discovery-based approach. Designed with collaboration in mind, each Core Set supports two students, introducing them to computational thinking and engineering principles in a fun and engaging way." [6]

This system utilizes Bluetooth Low Energy technology to wirelessly connect the LEGO brick (essentially the control unit of all things built from this robotics kit) to the tablet that the student is programming on. [7]

Sphero SPRK+

Figure 3. Sphero SPRK+ [8]

"Equipped with Bluetooth SMART and a scratch-resistant, durable shell, SPRK+ takes hands-on learning up a notch. Programmable sensors like motor encoders, LED lights, accelerometer, and a gyroscope allow for countless experiences and coding conditions. SPRK+ will foster a love of robotics, coding, and STEAM principles… all through play." [8]

In The Classroom

The world is moving in the direction of integrating technology wherever people go, especially in the era of the Internet of Things. Due to this surge in technological advancements, it is extremely important that people are educated in these concepts

since the world is becoming increasingly dependent on such practices. There is no better place to begin this necessary education than in school classrooms. In fact, it is estimated that 46 percent of K-12 and higher education IT managers foresee that such smart technologies will have a major impact on schools across the country in as little as two years. [9]

There are indeed avenues for exploring and teaching such technologies and ideas surrounding Bluetooth and the IoT, but how feasible is this? What do teachers themselves think about bringing these technologies into their classrooms and being able to teach it effectively? How are students responding to these devices – do they find them fun, or do they find them frustrating? All of these risks and questions must be addressed when considering the idea of bringing such technologies into a classroom setting.

Conclusion

Bluetooth is a very versatile technology that has and will continue to improve throughout the years. It is an effective form of wireless communication that allows for low-power consumption at exceptional data transfer rates. Bluetooth technology ties very naturally into the world's direction toward a network of everything being connected, widely known as the Internet of Things. Understanding both of these concepts is crucial to being able to thrive in today's society, therefore a need for teaching the idea of the Internet of Things, particularly through the use of Bluetooth technology, must be considered as a priority in schools. However, this is not as easily achievable as one may hope.

Some companies make it their goal to teach students these concepts, such as LEGO and Sphero, but it also requires these systems to be easily operational and teachers to be effective at educating their students. There is a lot of work to be done in these fields, and this paper serves as an attempt to shine a light on the large amount of potential surrounding Bluetooth technology and the Internet of Things and their integration in education.

References

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