A9 - Legal and Regulatory Analysis

Year: 2023 Semester: Fall Team: 8 Project: Smart Seat System

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1.0 Regulatory Analysis

1.1 FCC

Devices that either emit or receive radio frequencies typically necessitate approval from the Federal Communications Commission (FCC). Particularly, any equipment categorized as an ‘intentional emitter’—defined as a device deliberately emitting radiation, such as those using WIFI/BLE technology—must undergo FCC approval and licensing. The regulatory standards for intentional emitters are outlined in CFR Section 15 Subpart C, accessible in the official FCC documentation (CFR-2010-title47-vol1-part15.pdf). While the FCC conducts testing and certification for a fee of $10,000, private entities can perform verification but not certification; the final certification must be acquired from the FCC. For initial development and prototyping, the FCC permits individuals to use up to 5 intentional emitters without mandatory testing. A significant advantage is that the ESP32, the primary intentional emitter within our product, is already FCC certified. As a result, the certification process becomes considerably simplified, requiring testing primarily to confirm that the overall properties and specifications of the ESP32 remain unaltered. Successful completion of this verification process ensures FCC certification for our product.

1.2 NIST

The National Institute of Standards and Technology (NIST) serves as a federal agency setting essential standards and guidelines across various technological domains, encompassing the Internet of Things (IoT), which is integral to our product's functioning, facilitating remote data transfer among devices. NIST's guidelines, like NISTIR 8259 along with associated subdocuments A and B, present best practices rather than legally binding regulations. They establish essential protocols for IoT cybersecurity, emphasizing practices such as network isolation and data randomization. These standards cover the entirety of the product life cycle, including architectural design, development, testing, release, and ongoing support.

Presently, cybersecurity isn't a primary concern for our product due to its limited data transfer and the anonymous nature of the transmitted data. However, considering potential future enhancements that might involve features connecting with users' devices and involving the exchange of private data within our system, adhering to NIST guidelines would become crucial. This shift would mandate strict compliance with NIST protocols to ensure robust security measures, protecting the confidentiality and integrity of sensitive user information within our system. As such, incorporating and aligning with these guidelines becomes imperative to fortify our product against potential security vulnerabilities and to uphold the integrity of user data in scenarios involving personal information exchange.

1.3 Wifi Alliance / Bluetooth SIG

The Wifi Alliance is a private organization that creates and certifies WIFI standards. The WIFI Alliance's certification process ensures that WIFI Certified products meet essential criteria for interoperability, emphasizing three key principles: interoperability, backward compatibility, and integration of new technology. Certification tests focus on three main areas: Compatibility testing checks the connectivity between different certified devices, while Conformance testing ensures adherence to critical IEEE 802.11 standard elements, such as protection against network attacks. Performance testing validates if products meet minimum performance requirements but does not compare performance among products. The process aims to demonstrate satisfactory performance in typical network settings and support both established and emerging applications.

The ESP32 is in fact certified by the WIFI alliance, and with it being our only WIFI-enabled device we are utilizing, we can say that our device is certified by the WIFI alliance

The Bluetooth Special Interest Group (Bluetooth SIG) is the standards organization that oversees the development of Bluetooth standards and the licensing of the Bluetooth technologies and trademarks to manufacturers. The Bluetooth SIG certification is a crucial process that ensures Bluetooth devices meet industry standards, interoperability, and quality benchmarks. Products that employ Bluetooth technology must undergo rigorous testing and validation to receive the official Bluetooth SIG certification. This certification confirms that the devices comply with Bluetooth standards, guaranteeing seamless compatibility and performance across a wide range of Bluetooth-enabled products. The certification process evaluates various aspects, including functionality, security, power efficiency, and interoperability, ensuring that Bluetooth devices meet the stringent criteria set by the Bluetooth SIG. Obtaining this certification demonstrates a product's adherence to high-quality standards and its ability to seamlessly integrate and operate within the broader ecosystem of Bluetooth-enabled devices. The ESP32 has in fact acquired the SIG Bluetooth LE 5.0 certification, making our device certified for Bluetooth communication.

2.0 Legal Liability Analysis

**2.1 Analysis of Patent 1,** US Patent Application **US2018/0143601 A1**:

**Patent Title:** BUILDING MANAGEMENT SYSTEM WITH OCCUPANCY TRACKING USING WIRELESS COMMUNICATION

**Patent Holder: Avinash Chavan , Navi Mumbai, Abhai Dhatavk**

**Patent Filing Date:** November 14, 2017

The patent holders describe an occupancy tracking system that utilizes signal strengths between routers and user devices within a building to determine the locations and number of occupants. The system can also control building equipment based on this occupancy information. Additionally, the system can record and predict the number of occupants, generate interfaces for display on user devices, and receive environmental configuration settings for different building zones, such as heating, air conditioning, airflow, and lighting settings. As stated, the occupancy tracking system is centered on wireless signals transmitted via routers. It determines location and occupancy based on signal strength from electronic devices.

However, our approach differs significantly. We intend to utilize a central control system coupled with sensor modules, diverging from the wireless signal-based tracking emphasized in the patent. In their system, the building routers gather information and transmit it to a Building Management System (BMS) for trilateration calculations. A web-based application server feeds any users access to building occupancy information and allows adjustments to the BMS controls based on the displayed occupancy[1]. The BMS can enable energy-efficient control of the building, such as zone-specific heating, conditioning, and lighting adjustments based on occupancy[1].

Although not stated directly, one can assume possible infringement avoidances generated by this patent include the use of wireless communication for occupancy tracking, controlling building equipment based on occupancy information, and generating interfaces for display on user devices with indications of occupancy locations.

Inferred from above, our project will utilize sensor data instead of utilizing routing network communication protocols to determine occupancy. Our selection of sensors revolve around radio frequency (ESP), sound frequency, force analog readings, and infrared technology. These protocols do not relate to any sort of wireless tracking, and in an even broader sense, it does not infringe upon any sort of personal space.

Next, our system does not control any sort of equipment around the occupancy system. While we plan on utilizing a web server to display our logged information, it is merely a static system that does not provide any further details besides occupancy based on the floor layout. Their display system also seems to be configurable based on zone density, temperature/airflow setpoints based on occupancy, and pinpoint accuracy of live locations of occupants[1]. Since our tracking system is often for immovable tables and chairs, we would merely just use a simple stream feed of data to determine a current occupancy status.

2.2 Analysis of Patent 2**,** US Patent Application:US1071968B2

**Patent Title:** “System, Method, and Apparatus for Occupancy Detection”

**Patent Holder: Stuart Andrew Holliday**

**Patent Filing Date:** April, 30th 2016

This patent consists of a detection system that has multiple sensors, including an entry sensor that detects objects entering a specific area and an exit sensor that detects objects leaving a different area. Moreover, this system has an approach sensor that detects objects approaching the entry area and a retreat sensor that detects objects moving away from the exit area[2]. The patent was created for many reasons, one reason is that managers and farmers, as well as control systems like building management and HVAC systems, want to know how many living things (e.g., people or animals) are in a specific area at different times and for various reasons. Detecting occupancy accurately over time can also help track the movement of subjects within a monitored space. Current systems for counting people in rooms have drawbacks. Direct methods use video analytics or automatic counters which are inaccurate and may raise privacy concerns. Indirect methods, which involve counting correction may not always be precise and require manual adjustments. These limitations make the results inconsistent and less accurate.

Compared to our system ( smart seat sensor ) the only commonality is that both systems are occupancy detection, however they both use very different methods. This patent also tracks subjects which we do not do. The patent uses a thermal sensor, a PIR security type sensor which is activated by motion, a magnetic door sensor and finally a subject tracker system[2]. Compared to this, our system uses a thermal sensor, a pressure sensor and ultrasonic sensor. We will achieve occupancy detection using cloud data which is transferred from our ESP32. Just like the above patent, potential ways to avoid infringement based on this patent may involve employing wireless communication for tracking occupancy, adjusting building equipment according to occupancy data, and creating interfaces displayed on user devices that indicate occupancy locations.

2.3 Analysis of Patent 3, US Patent Application US 2015/0 192471 A1:

**Patent Title:** “Occupancy Sensor”

**Patent Holder: Dale Reed**

**Patent Filing Date:** January, 7th 2014

Occupancy Sensor" (U.S. Patent Application US 2015/0 192471 A1) filed on July 9, 2015, presents an occupancy sensor designed for automated occupancy monitoring, particularly in office spaces. It involves the utilization of a passive infrared sensor (PIR sensor) and an infrared sensor (IR sensor) to confirm occupancy or non-occupancy based on the signals detected by both sensors. Additionally, it mentions the inclusion of an ambient temperature sensor to compensate for temperature variations and ensure the accurate detection of warm bodies. The patent also discusses the application of this sensor beneath a desk surface, with the sensors facing the user sitting at the desk. An automated occupancy monitoring system incorporating these sensors and data gathering units is presented, enabling wireless communication between sensors and remote data gathering units [3].

The patent combines PIR and IR sensors for accurate detection, and it compensates for temperature changes using an ambient temperature sensor [3]. Our project only uses a thermal sensor which is a different sensor to compensate for environmental factors. That being said, there’s no overlap with the patent’s claim since we don’t employ a similar combination of sensors to compensate for environmental factors.

The patent primarily targets desk occupancy monitoring, while our project centers on seat occupancy detection utilizing sensor technology [3]. This application differs substantially from the desk occupancy system outlined in the patent, thereby minimizing concerns of potential patent infringement. Notably, our system integrates detection technology directly into seats, offering enhanced mobility and modularity—features that are absent in the patented system.

Moreover, the patent highlights the use of wireless communication to send data to a remote device [3]. While our project also uses wireless communication for sharing occupancy information, this similarity pertains only to this specific aspect. The overall system design varies significantly from the patent's description, guaranteeing that our implementation remains different from the patented technology.

3.0 Sources Cited:

[1] A. Chavan, A. Dhatavkar, and A. Sridharan, “Building management system with occupancy tracking using wireless communication.” https://patents.google.com/patent/US20180143601A1/en?q=(live+occupancy)&oq=live+occupancy (accessed May 12, 2023).

[2]S. A. Holliday and N. Johnson, “System, method and apparatus for occupancy detection.” https://patents.google.com/patent/US10719698B2/en?q=(live+occupancy)&oq=live+occupancy (accessed May 12, 2023).

[3] “US20150192471A1 - occupancy sensor,” Google Patents, https://patents.google.com/patent/US20150192471A1/en (accessed Oct. 28, 2023).