Getting the Country Back to Work, Safely: A Digital Solution

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This article explains how businesses can use a widely available, low-cost technology to protect their employees from Covid-19 as they return to work. The proposed approach encompasses the need for better management of processes that can limit infection spread, including management of employee movements, physical distancing, segmentation of personnel into groups, and coordination of sanitization activities.

CCS Concepts: • **Computer systems organization** → **Embedded systems**; *Redundancy*; Robotics; • **Networks** → Network reliability;

Additional Key Words and Phrases: Track and trace, covid-19, pandemic management, IoT

ACM Reference format:

Mahsa Honary, Veronica Martinez, Theodore Wlazlowski, Sumi Helal, Hans-Henning von Oertzen, and Souroush Honary. 2020. Getting the Country Back to Work, Safely: A Digital Solution. *Digit. Gov.: Res. Pract.* 1, 4, Article 29 (September 2020), 5 pages.

<https://doi.org/10.1145/3416090>

1 INTRODUCTION

In the absence of a vaccine or effective treatments, governments around the world are looking for ways to get people safely back to work. “Lockdown” has proved successful in slowing the transmission of the virus, but its economic and social consequences are becoming increasingly catastrophic, having cost the worldwide economy around USD 40B to date [5], with estimated economic losses of USD 1–2.7T through 2020 [12]. Restarting the economy without triggering a new wave of infections is clearly a priority for governments and businesses alike [11]. But how do you reassure an anxious workforce that its employers will do everything in their power to protect them from infection? We are already seeing headline-grabbing examples of outbreaks in the workplace, such as the US food processing plant that saw nearly 40% of its 2,200 employees test positive in just under a

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2639-0175/2020/09-ART29 \$15.00

<https://doi.org/10.1145/3416090>

Digital Government: Research and Practice, Vol. 1, No. 4, Article 29. Publication date: September 2020.

Fig. 1. Real-time visibility of employees (Left - Green indicates safe staff location and red that social distance is breached; Right - Warning that four staff exceeds limit of three in that room).

week [7]. To avoid incidents of this kind, governments around the world are setting out operational guidance for businesses preparing for a new way of working [13]. While these recommendations are—rightly—informed by expert advice from clinicians, epidemiologists, infectious disease, and public health specialists, they have thus far ignored the critical role technology could play in making the workplace a safer place for employees [14]. We think that the conditional logic and rule-based systems of computer science coupled with IoT technology can provide organizations with a visualization and management tool that could help protect their workforces and provide them with much-needed reassurance. In this article, we consider the application of a simple, unobtrusive, and inexpensive digital device—the Bluetooth Low Energy (BLE) enterprise tag—which, when used in conjunction with site maps and context-based rules, could enable businesses to gradually return to pre-Covid operations under a “new normal” definition gradually and safely.

2 HOW IT WORKS: TEST, TAG, AND TRACE

- (1) **TEST.** First, each member of staff is tested for Covid-19. Initially, this could be done by taking their temperature, but laboratory testing could be introduced later as it becomes more widely available and turnaround times faster. If the test proves negative, the employee will be certified and their available-for-work status uploaded anonymously to a secure database. They are now safe to enter the controlled workspace.
- (2) **TAG.** Next, they will have a lightweight BLE tag, roughly the size of a stick of gum attached to their ID badge, swipe card, or pocket placement. These tags will be read by IoT hubs strategically placed at key points around the building or site and at entrances and exits.
- (3) **TRACE.** As they carry out their tasks and move around, each employee’s tag sends a signal to the encountered hubs that feed information to a database. Real-time data analytics match the employee’s locations with a role and context-based set of rules to check that they are in the right place at the right time and within the safe limit of number of people for that particular workspace (see Figure 1). In addition, the employee could also choose to have an app on their phone that warns them if rules have been breached nearby or if there are places they should avoid.

3 A DIGITAL INFRASTRUCTURE FOR A SAFE WORKING ENVIRONMENT

This digitally enabled test, tag, and trace approach will mean employees can get on with their work, confident that they will be alerted to any unsafe behaviors, either their own or their colleagues'. In fact, the presence of the digital infrastructure and its reinforcement of the required behaviors will help to minimize the number of infringements by ensuring that the rules are clear and properly explained.

4 WHY BLE TAGS?

Most of the national contact tracing apps [9] in use or in development rely on mobile phone location services to trace contacts with infected people. However, using mobile phones for a workplace management system would be problematic. First, there are the logistical issues: Every employee would need to have their phone with them at all times and make sure it is both charged up and switched on. And then there are the privacy issues. For the approach to work, employees will need to accept that it is for their protection and actively support its implementation rather than seeing it as an unwarranted intrusion into their privacy. If the mobile phone were to be used as the principal means of location tracing, employees could have legitimate concerns that they would be personally identifiable, that their individual movements could be tracked (both inside and outside work) and that their employer could access confidential information on their phones.

BLE tags, therefore, have a number of clear advantages. They are cheap, simple devices that do not need regular battery charging or a mobile signal to operate. They are always "on," continuously pinging their anonymous identifier to the reader and will stop tracking as soon as the tag is out of range. In other words, they will allow the organization to monitor the movements of its employees without identifying them individually throughout designated areas of the workplace. This solution provides both employee visibility and privacy, acting as a digital twin when they are at work but conferring invisibility on the employee the moment they leave the site. There is, however, one critical issue with BLE communications that needs to be addressed. Open BLE communication allows devices to pair, connect, and share information freely [3]. If a BLE tag uses a standard BLE protocol, these vulnerabilities can be exploited. We need the tag to operate with the efficiency of a BLE device but to do so without allowing pairing and connection with unauthorized third-party devices. This is possible by using BLE-discoverable signals that are broadcast from the tag rather than the full BLE stack implementation that allows for device pairing. This is the approach taken by a new generation of enterprise BLE tags such as Reference [10] that are being adopted for security-critical applications such as asset management and supply-chain logistics. The broadcast messages from these enterprise tags can still be read by a smartphone using its BLE capability, but the smartphone is unable to pair to the tag, rendering them extremely secure.

It also means that mobile phones can still have an important role to play. For example, iBeacon-enabled devices strategically placed throughout a building could provide location information to a phone app to provide additional functionality to employees, allowing them to read and transmit BLE tags so they can be kept informed of areas to avoid.

5 WHY IS STAFF LOCATION IMPORTANT?

One might argue that with temperature readings, hand-sanitizing stations, plexiglass partitions, masks, employee distancing of desks, in meetings, elevators as prioritized by state government rules and business practice to date is adequate and thus BLE based tracking is not needed. However, real-time determination of where and when staff move is essential for a comprehensive program [2].

Location of staff is a crucial element in protecting the individual, because, invariably, adherence to safety rules will be breached [1]. Whether by intent or accident, distance violations or other rule infractions need to be noted as to occurrence and assessed to the degree of severity relative to risk to all who may be impacted. A case in point is a casual movement through a hall from one assigned area to another may result in an innocent courteous exchange between colleagues [8]. If one or the other staff member is found to be infected and although they move

to assigned areas—the need for knowing who else has been potentially exposed is paramount in quelling an outbreak. This can only be done with continuous, real-time location, associations and historical records thereof.

This is further exacerbated when work rules are not able to be defined well, or at all, due to the nature of the business activities. Manufacturing, food processing, assembly businesses have high staff interactions that cannot be programmed as well as an insurance or banking office. Thus, the need for continuous location monitoring of interactions or associations will be integral to diagnosing a prospective risk trail by a historical contact trace of a suspected individual. Social distancing rules can be applied even in these unstructured environments but then the need for location monitoring is the only means to diagnose and remediate after an incident of infection is noted.

Another circumstance is that of segmentation of staff in high-density environments. For instance, it may not always be practical to maintain self-distancing between all individual employees. However, it may be more practical to have staff segmented into groups and rules enforced to ensure that different groups of staff do not mix. Location determination can ensure that individuals do not violate the staff segmentation requirements. This is particularly important when considering disinfection of communal areas prior to allowing access for different staff groups.

6 DIAGNOSTICS AND CONSEQUENCES

Continuous monitoring of staff location with BLE tags allows for a level of valuable diagnostic information and also sets the stage for addressing staff behavioral change to a new normal.

BLE tags, combined with hubs, allow for data accumulation of location. The supervision of rules compliance is then administered in a central management platform where logic and conditions are compared to accepted practice and then noted or alerted for action. The implementation of the rules and routines needs to be customized to the particular context of the organization. From the agency theory perspective [4], these rules and routines need to be carefully designed to build a safe space to operate. Rules and routines need to be reinforced by the top managers (the principals) through positive motivation and a firm set of established consequences communicated to the employees (the agents).

A direct result of any variances should be to advise staff of the violation and deal with consequences accordingly. The consequence of a rules breach would depend on the rule and its level of risk severity to personnel or to the business reputation. The most egregious would obviously be close, prolonged interaction of staff due to the possibility of transmission [1].

Combining iBeacon hub devices, tags, and mobile apps in an integrated design makes the most operational sense and provides the best continuous visibility. When deployed in conjunction with databases, maps, rules, and guidance to manage employee movements anonymously and securely, this digital infrastructure will help employers protect their staff and provide reassurance. Other than sensing and comparing location of staff to association and business process rules, there are other factors that can be considered:

- Time – whether it is at a location or as part of an association sequence with other staff, the amount of time spent could be a determinant in a risk situation assessment;
- Process sequence – should there be a protocol that stipulates that staff regularly wash one's hands, the travel to and dwell time at a cleansing station can be measured;
- Room sanitizing – appropriate notice and timing of cleaning following use of a meeting room can be easily determined.

Hubs that sense the BLE tags can be enabled to measure factors that relate to hygiene, such as indoor air quality and integrity of building fresh-air flush for comfort and safety [6]. Establishing the right rules for particular contexts will be critical to the scheme's success. It will also be important to put in place analytical tools that measure adherence so adjustments can be made in response to any challenges that arise.

We think that technology has an important—and so far overlooked—role in delivering a secure working environment that is consistent with government guidelines. The test, tag, trace approach—carefully implemented and properly communicated to employees—could allow businesses to re-open safely while Covid-19 remains among us. When the pandemic is over, the same infrastructure could continue to provide employees with a secure working environment that could be quickly adapted to new circumstances and help minimize future disruption. We are currently working with industry partners to scale the implementation of this methodology.

REFERENCES

- [1] Erin Bromage. 2020. The Risks—Know Them—Avoid Them. Retrieved from <https://www.erinbromage.com/post/the-risks-know-them-avoid-them>.
- [2] Derek K. Chu, Elie A. Akl, Stephanie Duda, Karla Solo, Sally Yaacoub, Holger J. Schünemann, Amena El-harakeh, Antonio Bognanni, Tamara Lotfi, Mark Loeb et al. 2020. Physical distancing, face masks, and eye protection to prevent person-to-person transmission of SARS-CoV-2 and COVID-19: A systematic review and meta-analysis. *The Lancet* 395, 10242 (2020), 1973–1987.
- [3] Cybersecurity and Infrastructure Security Agency 2020. SweenyTooth Vulnerabilities. Retrieved from <https://www.us-cert.gov/ics/alerts/ics-alert-20-063-01>.
- [4] Kathleen M. Eisenhardt. 1989. Agency theory: An assessment and review. *Acad. Manag. Rev.* 14, 1 (1989), 57–74.
- [5] Marcus Richard Keogh-Brown and Richard David Smith. 2008. The economic impact of SARS: How does the reality match the predictions? *Health Policy* 88, 1 (2008), 110–120.
- [6] Jianyun Lu, Jieni Gu, Kuibiao Li, Conghui Xu, Wenzhe Su, Zhisheng Lai, Deqian Zhou, Chao Yu, Bin Xu, and Zhicong Yang. 2020. COVID-19 outbreak associated with air conditioning in restaurant, Guangzhou, China, 2020. *Emerg. Infect. Dis.* 26, 7 (2020), 1628.
- [7] NBC News 2020. Nearly 900 workers at a Tyson Foods plant in Indiana test positive for coronavirus. Retrieved from <https://www.nbcnews.com/news/us-news/nearly-900-workers-tyson-foods-plant-indiana-test-positive-coronavirus-n1197776>.
- [8] Shin Young Park, Young-Man Kim, Seonju Yi, Sangeun Lee, Baeg-Ju Na, Chang Bo Kim, Jung-il Kim, Hea Sook Kim, Young Bok Kim, Yoojin Park et al. 2020. Early release-Coronavirus disease outbreak in call center, South Korea. Retrieved from https://wwwnc.cdc.gov/eid/article/26/8/20-1274_article.
- [9] Cyrus Shahabi. 2020. Why We Need More Than Bluetooth Data to Fight Covid-19. Retrieved from <https://medium.com/@csatusc/why-we-need-more-than-bluetooth-data-to-fight-covid-19-64da29b3164e>.
- [10] System Loco Ltd 2020. Loco Assets: Find anything, effortlessly. Retrieved from <https://www.systemloco.com/>.
- [11] The UK Government 2020. Our plan to rebuild: The UK Government's COVID-19 recovery strategy. Retrieved from <https://www.gov.uk/government/publications/our-plan-to-rebuild-the-uk-governments-covid-19-recovery-strategy/our-plan-to-rebuild-the-uk-governments-covid-19-recovery-strategy>.
- [12] United Nation News 2020. Coronavirus update: COVID-19 likely to cost economy \$1 trillion during 2020, says UN trade agency. Retrieved from <https://news.un.org/en/story/2020/03/1059011>.
- [13] United States Department of Labor 2020. Control and Prevention. Retrieved from <https://www.osha.gov/SLTC/covid-19/controlprevention.html>.
- [14] World Health Organization 2020. Getting your workplace ready for COVID-19: How COVID-19 spreads, 19 March 2020. Retrieved from <https://apps.who.int/iris/handle/10665/331584>.

Received May 2020; revised July 2020; accepted July 2020