Human Detection and Tracking for Social Distancing Enforcement

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When the COVID-19 pandemic began in early 2020, it was considered a passing matter--one that would be here for a short time. A year later, this virus remains prevalent, almost normalized. Although leading scientists are working towards herd immunity, this virus shows resilience, adopting variants. The effects of COVID are irrefutable and widespread; hospitals running out of beds for the sick, businesses shutting down (many permanently), and many lives lost. To limit the spread of this virus, doctors recommend preventative measures. Some of which are; social distancing, vaccinations, and proper wearing of face masks. Although these measures prove to help flatten the curve, temptations, mistakes, and resistances tend to arise. Temptations arise to break social distancing protocols, and errors occur because humans are not perfect beings.

Since humans are prone to mistakes and revert to normalcy even amid a pandemic, many companies utilize technological innovations to track social distancing parameters. For instance, Amazon introduced its proprietary software, "Distance Assistant." A creative and AI-driven means to enforce social distancing in many workplaces, which works by providing live and immediate visual feedback to supervisors (Porter 2020). RightCrowd, another software company, provides a mechanism that works with wearing trackers (Anonymous). Like Amazon, RightCrowd's software is capable of social distancing monitoring and can perform contact tracing in case of a COVID outbreak among employees. Finally, CronJ's software can perform social distance measuring, personal protective equipment (PPE), crowd management, and thermal screening analytics, all of which are important in following the social distancing paradigms set by the World Health Organization (WHO) (Anonymous). These approaches, although innovative, have their limitations. Amazon's software is currently close-sourced software, used only at Amazon-specific workplaces. CronJ's and RightCrowd's software are business solutions with costs ranging on the higher end. To that avail, we present our application of human detection and tracking (HDT) to enforce social distancing paradigms.

In this study, we implement state-of-the-art HDT algorithms to provide an automated means of monitoring social distancing. For our application to be considered a success, there must be a successful implementation of live and dynamic HDT algorithms on a camera. It must also be capable of analyzing any environment (scene), with the ability to differentiate humans failing to distance and those properly doing so. Although we plan to incorporate other features, such as live and dynamic reporting, mask detection, scene scoring, and portability, the two first aforementioned are the initial outcomes. The basic premise of our system works by analyzing individual frames of videos. On each frame, we detect and track only humans; then, with each detected individual, we utilize applied math to discern individuals adhering to distancing protocols from those failing to do so.

To build this system, we use many tools. Python is our choice language for the entire process. We specifically focus on comparing SOA object detection algorithms, such as comparing which works best for particular scenes. One counterintuitive notion set forth by Hasan et al. is general object detection models perform better at detecting humans in uncontrolled settings than models specified on just humans (2020). Since it is imperative to reduce the detections of false positives, we direct significant resources on analyzing this topic. To adequately measure the distance between detected humans, we implement and compare SOA tracking algorithms. We pit these algorithms against each other, comparing which perform best and detailing why. After assembling the required pieces of this application, we utilize the software paradigm of transfer learning for portability. We employ either the Robotics Operating System (ROS) or a Raspberry Pi kit as our base architecture to get our software working on an installed camera. ROS is a flexible framework commonly used for robotics applications. It helps researchers and developers build and reuse code between robotics systems. Raspberry kits are low-cost miniature-sized computing platforms that allow the implementation of computer vision tasks on embedded systems. Both architectures work well for computer vision applications, but they both have their limitations. We compare which works best for our specific needs.

In this research, we utilize software development paradigms such as; computer vision, HDT, and transfer learning to perform deep analytics on environments to enforce social distancing while the world reverts to normality. We hope that the research and baseline we establish will provide future researchers with a foundation to build their research. Furthermore, even though Kean University's ecosystem is the main focus of this system, we hope to generalize this software, allowing for open sourcing. Our work here provides a valuable contribution to the scientific, economic, and health communities.

References

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