ABSTRACT

In this research, a method is proposed to detect heartbeats using a thermal camera based on digital image processing, working in a non-contact or no direct contact manner with the object whose heartbeats are to be detected. The dataset used consists of thermal images of humans as the objects, captured using a Caterpillar S61 smartphone. Dataset collection involves pairing the object with an oximeter as a reference for the object's heartbeat. Subsequently, the object is recorded according to the required data. The recorded videos are then extracted into images with a frame rate of 5 fps to provide dataset diversity. Each image is labeled and trained to display corresponding results with the sought BPM (beats per minute).The process employs deep learning, a method used to teach a computer to learn data or patterns randomly and complexly. YOLOv5 is used in this context due to its ability to process images and detect objects. The utilization of deep learning in YOLOv5 allows the model to automatically learn from extensive training data and extract crucial features from images to achieve accurate object detection. From the results of this study, the F-1 score was 0.89 or 89%.

YOLOv5 utilizes a Convolutional Neural Network (CNN) architecture for object detection. This architecture consists of several convolutional layers that help extract essential features from the images. YOLOv5 is an improved version of YOLOv3, with enhancements like using 1x1 convolutions to reduce computational load. In the YOLOv5 context, a confusion matrix can be used to analyze the model's object detection and classification performance in an image. Moreover, YOLOv5 training data should encompass various images containing different object classes to be detected, as a larger and more diverse dataset leads to better detection.

Training is carried out with pre-labeled data divided into 8 classes based on classified heartbeats, i.e., 80–84 bpm, 85–89 bpm, 90–94 bpm, 95–99 bpm, 100–104 bpm, 105–109 bpm, 110–114 bpm, and 115–119 bpm. The output is displayed via YOLOv5 using the pre-trained model, showing bounding boxes around the detected objects. The results of testing indicate that the proposed method can successfully detect human heartbeats through the various stages of the method.

Keywords: Thermal, Heart rate, YOLOv5