

**DISTRIBUTED PILL IDENTIFIED: A CROSS-DEVICE  
HORIZAONTAL FEDERATED LEARNING APPROACH  
WITH NON-IID DATA FOR PILL IDENTIFICATION**

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## **Abstract**

Mobile health (mHealth) applications are apps that offer personalized and convenient health related services such as diet trackers, fitness trackers, and pill identifiers. The growing market of mHealth applications is placing patient data at risk, in fact 19 out of 24 of the most popular mHealth applications were found to be sharing user data to various companies and service providers, some were even commercializing the data (Grundy, et al., 2019). Pill identifiers are a subset of mHealth apps that allows users to identify medication pills and tablets, they aim to tackle the problem of medication non-adherence. The cost of improper medication usage It is estimated that adults in developed nations only properly adhere to 50% of prescribed drugs for various chronic diseases, in developing nations, that figure is estimated to be even lower (Ahmed et al., 2018). Numerous pill identifiers have been implemented in order to tackle this issue and many research's creating new pill identification systems have also been conducted. The majority if not all these researches however failed to address the issue of user privacy concerns when it comes to having access to the user's raw medication data.

This research focuses on creating a pill identification system overcomes this gap in existing pill identification research. The proposed pill identification system uses deep learning coupled with Federated Learning to create a privacy preserving pill identifier. The identifier, more specifically, the image classification model, was trained using Cross-Device Horizontal Federated Learning. Federated Learning aims to preserve user privacy in machine learning tasks by allowing the training of data to be distributed among multiple parties such as the user's devices themselves. Thorough qualitative and quantitative testing proved the success of the proposed pill identification system. Overall impressions of the system from domain experts and industrial experts were quite positive as well. This research presents the first pill identifier to strongly address privacy related issues in pill identification by employing Federated Learning.

**Keywords:** Medication non-adherence, Deep Learning, Federated Learning, image classification, Cross-Device Horizontal Federated Learning