

Development of an IoT-Enabled Coffee Harvest Management Tool for Mechanized Farming

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Introduction

The efficiency of mechanized coffee harvesting depends on several factors, such as fruit ripeness, harvester speed, rod vibration, and brake belt tension (SILVA, 2006). Traditionally, adjustments to these parameters have been made empirically (SILVA ET AL., 2010). To improve decision-making, the original **Coffee Harvest Manager (CHM)** equipment was developed, based on fruit detachment force, which aimed to inform the coffee grower about the ideal time to start harvesting, the recommended type of harvest (full or selective), and the suitable adjustments for the harvester (SILVA; SILVA; AVELAR, 2015). This study presents the **digital transformation** of the CHM aligned with **Agriculture 4.0**, introducing internet connectivity, a mobile app interface, enhanced ripeness assessment methods, and additional harvester adjustment recommendations.

Materials/Methods

The updated CHM uses a redesigned ergonomic structure, digital interface, and a new experimental protocol (MARQUES ET AL., 2024):

- **Hardware redesign** with 3D printing and improved electronics (including internet-capable microcontroller);
- **Software development** included firmware (C++) and a mobile app (Java/Android Studio), with communication via User Datagram Protocol;
- A new method for evaluating fruit maturity: manual counting of green and ripe fruits from 10 selected plants;
- Field tests were conducted using a **randomized block design** with three replications in the same crop at UFLA to compare the new and old CHM versions.

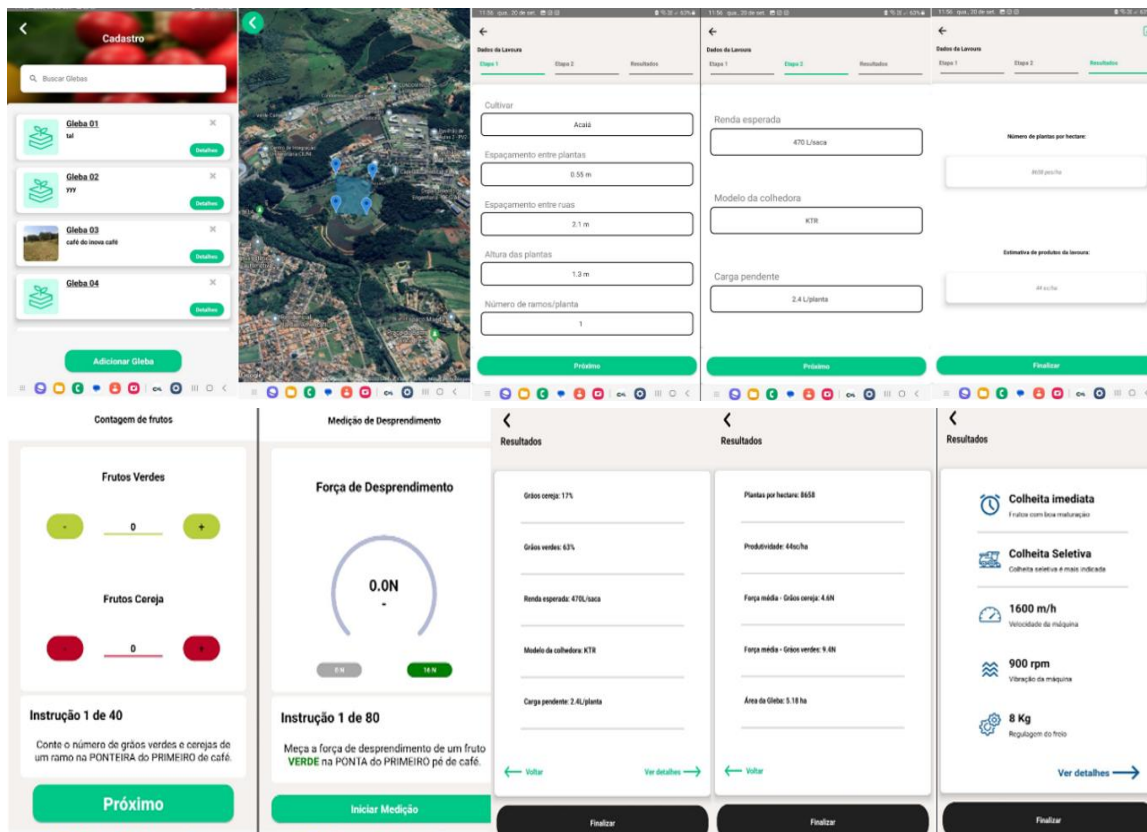


Figure 1: Updated CHM screens

Results/Discussion

- The new CHM version maintained the diagnostic consistency of the original in all tested crop replications for parameters like harvest timing and harvester settings (except brake tension, which is new);
- The mobile app provides features such as **plot registration, crop data entry, productivity estimation, and recommendation generation**;
- The updated system improves usability, memory capacity, ergonomics, and update flexibility;
- Validation tests confirmed the reliability and superiority of the new system in real-world scenarios.

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Conclusion/Perspectives

The digitized CHM proves to be a **modern, efficient, and user-friendly tool** for managing mechanized coffee harvesting in the context of Agriculture 4.0. By combining internet connectivity (IoT), improved design, enhanced data acquisition, and expanded functionality (notably brake tension recommendations), the system supports **greater productivity, precision, and sustainability** in coffee farming. Future perspectives may include expanding compatibility with other harvest equipment.

References:

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