International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 04 | April - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

AutoDry : Automation in Food Drying

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Abstract — Traditional food dehydration methods are often inefficient, labor-intensive, and inconsistent in preserving food quality. This research introduces AutoDry, a smart food drying system that utilizes artificial intelligence and Internet of Things (IoT) to automate food dehydration processes. The system detects food type using a camera, automatically sets the drying parameters, and allows remote monitoring via a mobile application. Developed using Raspberry Pi, temperature sensors, and Java-based software, AutoDry aims to reduce energy consumption, labor requirements, and post-harvest food wastage. The system is scalable for both domestic and industrial use, empowering small-scale farmers to preserve and sell surplus produce efficiently. Experimental results indicate improved drying precision and usability, making AutoDry a sustainable and market-ready solution.

Keywords — Food Dehydration, IoT, Artificial Intelligence, Raspberry Pi, Automation, Smart Agriculture

A. Introduction

Post-harvest losses and food spoilage are significant challenges in the agricultural sector, especially for small- scale farmers. One of the most effective food preservation techniques is drying, but traditional methods like sun drying and manual electric dryers suffer from limitations such as weather dependency, contamination risk, and the need for constant human supervision. To address these issues, we designed AutoDry, an automated food dehydrator that simplifies and optimizes the drying process using AI and IoT. This paper presents our solution, its implementation, and its advantages over existing methods.

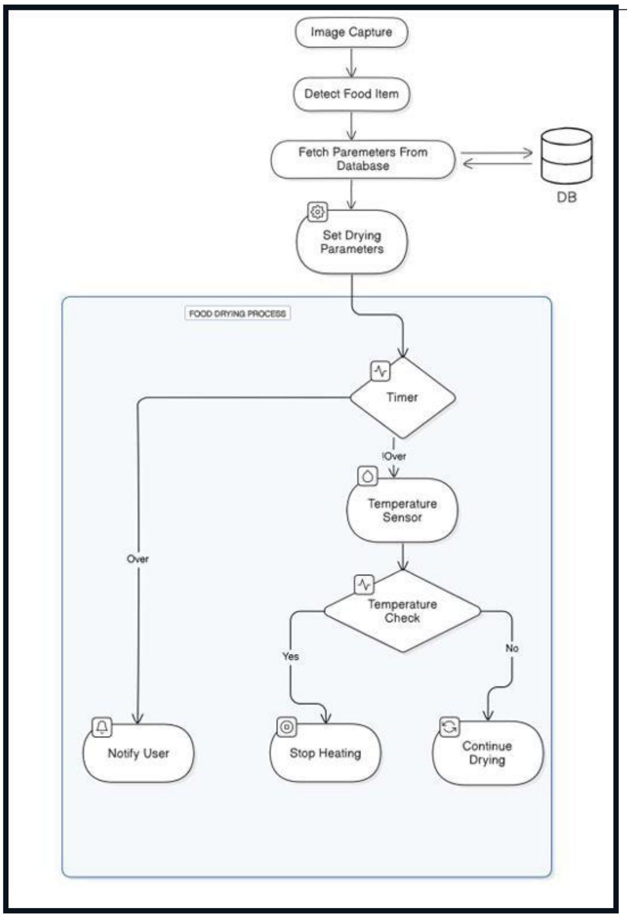
B. Literature Review

A detailed review of existing drying methods-such as sun drying, freeze drying, heat pump drying, and microwave drying-revealed the need for smart automation. Researchers have explored modern techniques like infrared drying, dielectric heating, and vacuum microwave drying, but these methods often involve expensive equipment or are unsuitable for small-scale users. The integration of sensors, AI, and automation in food dryers has been suggested in recent studies as a way to enhance drying efficiency, reduce spoilage, and ensure consistent product quality. However, current solutions lack end-to-end automation and affordability for rural or domestic users.

C. System Architecture / Methodology

The AutoDry system consists of several core components:

1. A camera captures the image of the food.
2. An AI model identifies the food type and retrieves optimal drying parameters.
3. A Raspberry Pi-based controller receives AI output, activates the heating coil and fan.
4. Sensors monitor real time temperature.
5. A mobile IoT app allows real-time monitoring.
6. The dried food is output with minimal user intervention.



Credits: AutoDry

The hardware includes Raspberry Pi (5-8GB), camera, heating coil, sensors, breadboard, and relay circuits. Software components include Java, XML, and Android Studio. The AI model was built using Llama 3.2 Vision.

D. Implementation

A working prototype of AutoDry was developed using Raspberry Pi integrated with sensors and actuators. The Llama 3.2 Vision model helps in detecting the food type, automatically selecting appropriate drying parameters. Temperature and humidity sensors feed data to the controller, which adjusts the heating coil and fan. An Android-based mobile app allows real-time monitoring and control over the Internet.

Credits: AutoDry

Credits : AutoDry

Key modules implemented:

1. AI food detection and classification
2. Sensor-based heat control
3. Mobile IoT dashboard
4. Real-time feedback loop

The biggest challenges involved stabilizing temperature control and accurate food detection, both of which were resolved after multiple iterations of testing and model refinement.

E. **Components**

Component	Description
Temperature Sensor	Digital Temperature Sensor. DS18B20. Senses and helps display the real-time temperature inside the dryer.
Raspberry Pi 5 8Gb RAM	Controls and automates drying parameters, including temperature and fan, based on sensor data.
Heating Coil & Circulating Fan	Maintains the temperature in the dryer.
Camera	Captures the image of the food item.
7-inch touch screen display	Displays Graphical User Interface

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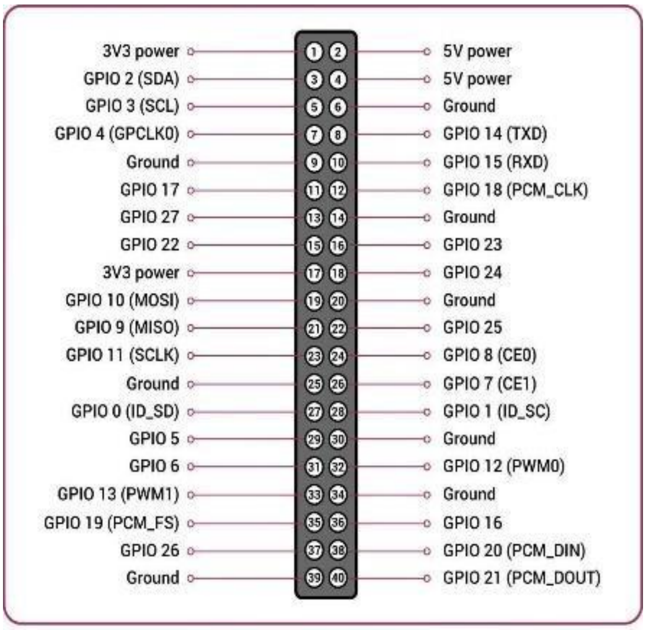
Component	Description
Data Logging Systems	Track performance and drying conditions for analysis and optimization.

Data Processing & Storage: Processes drying data locally and stores it temporarily before syncing to the cloud.



40 GPIO Pins Description of Raspberry Pi 5

Credits: Hackatronic

Credits: Amazon

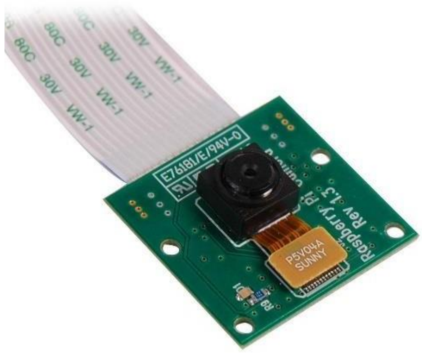
Credits: ThinkBits India

Raspberry Pi 5 (8GB) serves as the central processing hub of the AutoDry system. It handles:

1. Sensor Integration: Collects real-time data from temperature and humidity sensors.
2. Hardware Control: Controls fans, heaters, and other actuators using GPIO pins.
3. IoT Connectivity: Connects to the cloud or mobile app via Wi-Fi or Ethernet for remote monitoring and control.
4. User Interface Support: Powers a touchscreen display (if attached) for local access to settings and real-time status.

5. Automation Logic: Runs Python scripts or AI models to automate drying cycles based on food type, weight, and sensor feedback.

6. The DS18B20 digital temperature sensor in AutoDry provides accurate, real-time temperature data to the Raspberry Pi, helping maintain ideal drying conditions.
Its durable, waterproof design makes it suitable for the dehydrator environment, and its readings are used to control the heating system for consistent and efficient food drying.



Credits: Amazon

The Camera Module 3.1 (5MP) is mounted outside the AutoDry unit to capture images of the food item before it's placed inside. These images help the Raspberry Pi identify the type of food, enabling the system to automatically select the optimal drying settings based on the detected category.

F. **Results and Discussion**

1. Accuracy of food type detection using the AI model: 90%+
2. Reduction in drying time compared to manual dryers: ~30%
3. Energy efficiency improved by ~25% due to sensor-driven control
4. Minimal manual intervention required, enhancing usability

The system proved highly effective in maintaining food quality and consistency while reducing user workload and operational costs. It works well in both domestic and semi- industrial settings.

G. **Conclusion and Future Scope**

AutoDry showcases how automation can revolutionize food preservation, especially for rural and small-scale farmers. It delivers consistent results, minimizes food spoilage, and saves time and energy. With its scalable design, AutoDry is suitable for both home users and agricultural cooperatives.

Future upgrades include:

1. Expanding the AI model to identify more food types
2. Integrating solar power for off-grid operation
3. Developing automatic packaging and sealing add- ons
4. Linking the system to an e-commerce marketplace for dried goods

H. **Acknowledgment**

We would like to express our sincere gratitude to our mentor Mr. U. S. Shirshetti for his invaluable guidance throughout this project. We also extend our thanks to the staff and management of the Information Technology Department at Sou. Venutai Chavan Polytechnic for their support.

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