

- **Title of the project**

AI-Driven Retail Automation with Real-Time Object Recognition Using PolarFire SoC Icicle Kit

- **Hardware Platform Selected for the implementation**

PolarFire SoC Icicle Kit

- **Abstract:**

This project presents an AI-enabled smart automation system using the PolarFire SoC Icicle Kit, designed for automated shopping environments. The system captures images of vegetables or fruits placed on the scale, with weighing sensors connected to the kit to measure the weight. Using FPGA-accelerated neural networks, the system identifies the items, calculates their price based on the weight, and generates a QR code for seamless checkout. The solution eliminates the need for manual barcode entry, improving customer convenience and speeding up the shopping process.

- **Explanation of the idea**

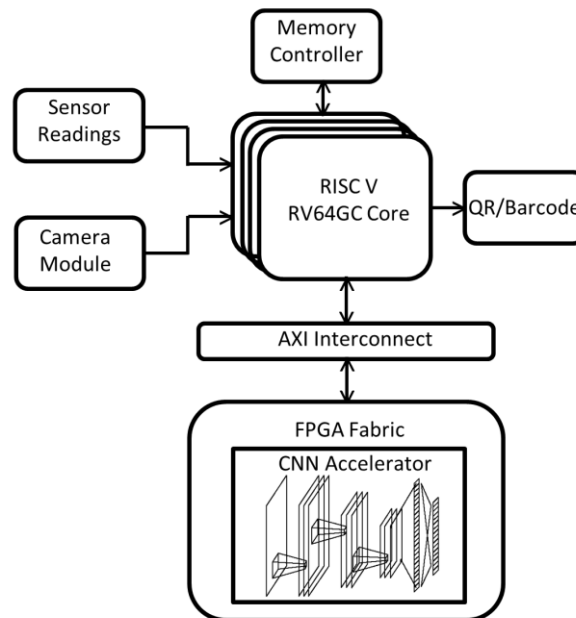


Figure: Block Diagram of the implementation

The AI-enabled smart weighing machine utilizes the PolarFire SoC Icicle Kit to perform item recognition and generate billing information based on weight. The system operates as follows:

Object Recognition: The system captures images of the items (vegetables or fruits) placed on the weighing scale. The PolarFire FPGA accelerates the neural network that processes the image data to identify the item. Convolutional neural networks (CNNs) are employed to classify the items accurately.

Weighing and Price Calculation: The weight of the item is measured using integrated sensors. The PolarFire SoC processes the data in real-time, correlating the weight with the item's identification to calculate the price. This process is quick and energy-efficient, benefiting from the low-power yet powerful capabilities of the PolarFire FPGA.

QR Code Generation: Once the price is calculated, the system generates a QR code that contains

the details of the purchase. This QR code can be scanned at checkout for a fast and automated billing process. The QR code generation is handled by the RISC-V CPU within the PolarFire SoC, ensuring a smooth operation.

Data Security and Management: The system ensures secure processing of the data, with the PolarFire SoC handling all operations efficiently without the need for cloud-based services. This ensures customer privacy and fast processing times.

Key components include:

Image Capture and Processing: Connected to the PolarFire SoC, the system captures images of the items placed on the weighing scale.

Neural Network Acceleration: Performed on the PolarFire FPGA, allowing real-time and accurate object identification.

RISC-V CPU: Manages the system's operations, including weight-to-price calculations and QR code generation.

- **Example of its application**

Automated Weighing in Shopping Environments: In a supermarket or grocery store, this smart automation system can significantly streamline the checkout process for items like fruits and vegetables. When a customer places an item on the scale, the system captures an image of the item, and the weighing sensors measure its weight. The PolarFire SoC identifies the item using neural networks and calculates the price based on the weight. A QR code is then generated, which the customer can scan at the checkout to complete their purchase quickly and efficiently. This system reduces the need for manual barcode entry, allowing for a more automated and customer-friendly shopping experience.

- **Benefits and Value addition**

The key benefits of this system include:

Real-Time Object Recognition: The PolarFire SoC's FPGA fabric provides high-speed object recognition, ensuring that the system can quickly and accurately identify items placed on the weighing scale.

Efficient Processing with Low Power Consumption: The PolarFire SoC is designed for energy efficiency, making it ideal for environments that require constant use with minimal power consumption.

Simplified Shopping Experience: By automating the weighing and billing process, the system eliminates the need for manual barcode entry, allowing customers to experience a faster and more convenient checkout.

Secure and Private: The system operates without the need for cloud-based processing, ensuring that all data is handled locally and securely.

Market Potential: With the increasing demand for autonomous retail solutions, this system is highly adaptable to various retail environments, offering a scalable solution for supermarkets, grocery stores, and other retail outlets.



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