



ASIC Design for Self-Learning Smart Electronic Nose

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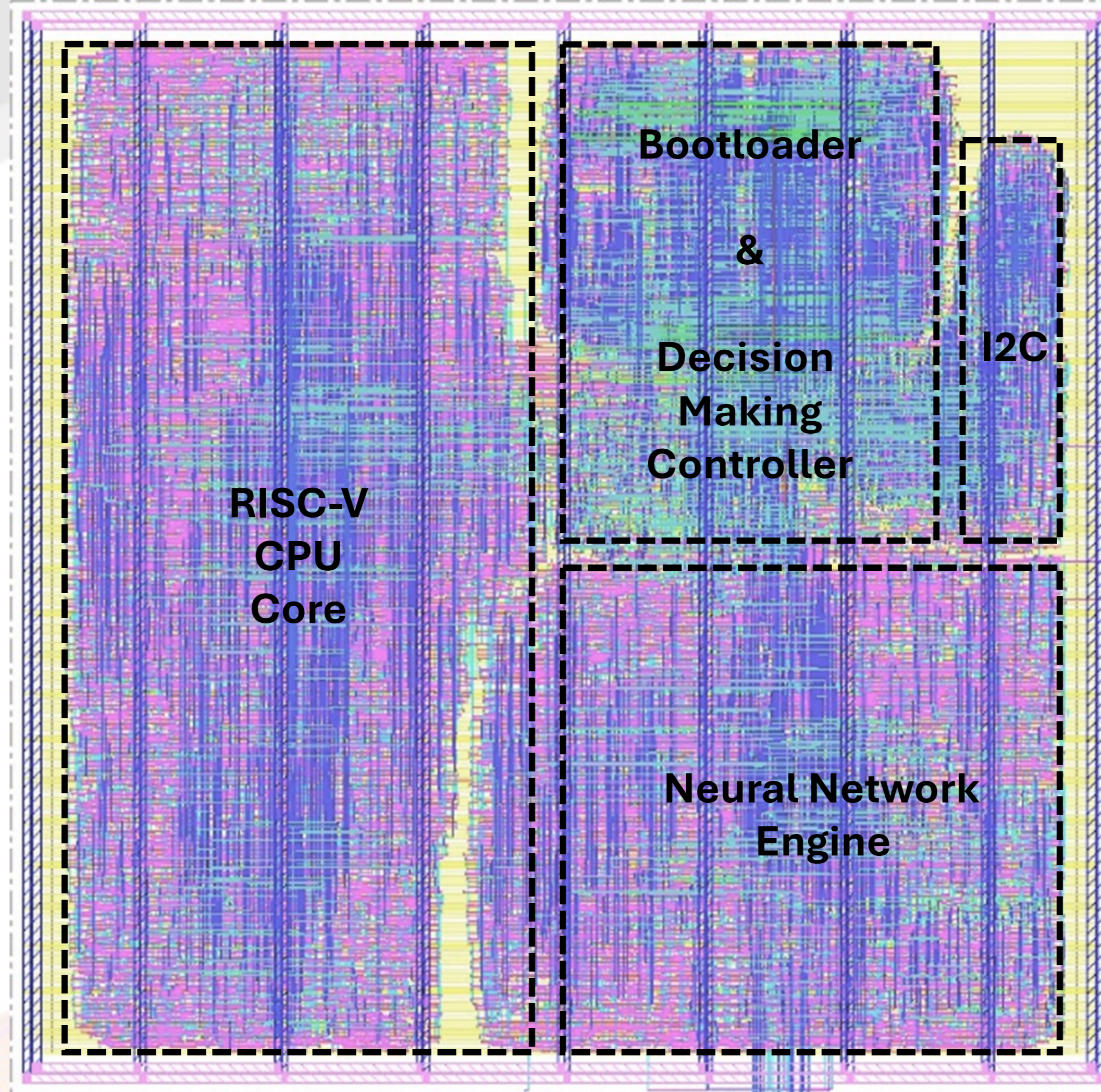
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INTRODUCTION

This project focuses on the design and development of application-specific integrated circuits (ASIC) for smart sensors. The goal is to create a versatile and intelligent sensor fusion system that can learn from and adapt to the environment, providing highly accurate and precise measurements. The project has concentrated on electronic noses using gas sensors.

In the scope of the project, a robust and efficient electronic nose platform has been realized by integrating disciplines of ASIC chip design, sensor technologies, sensor fusion, and machine learning-based data fusion algorithms.

The designed chip has successfully achieved sample odor detection by using machine learning algorithms trained with the odor data collected through sensors.



SYSTEM DESIGN

The electronic nose system consists of four main components: a sensor array, an ESP32 microcontroller, an ASIC with a RISC-V based neural network engine, and an LCD screen.

The ASIC forms the core processing unit for the system with the Neural Network Engine that analyzes sensor data.

The ESP32 microcontroller collects data from the sensors and stores it in Flash ROM.

The LCD screen displays the results from the Neural Network Engine.

The sensor array is critical for the functionality of the electronic nose by measuring various gases, including smoke, ethanol, and methane.

METODOLOGY

In our project, data on various odors with eight different gas sensors were collected.

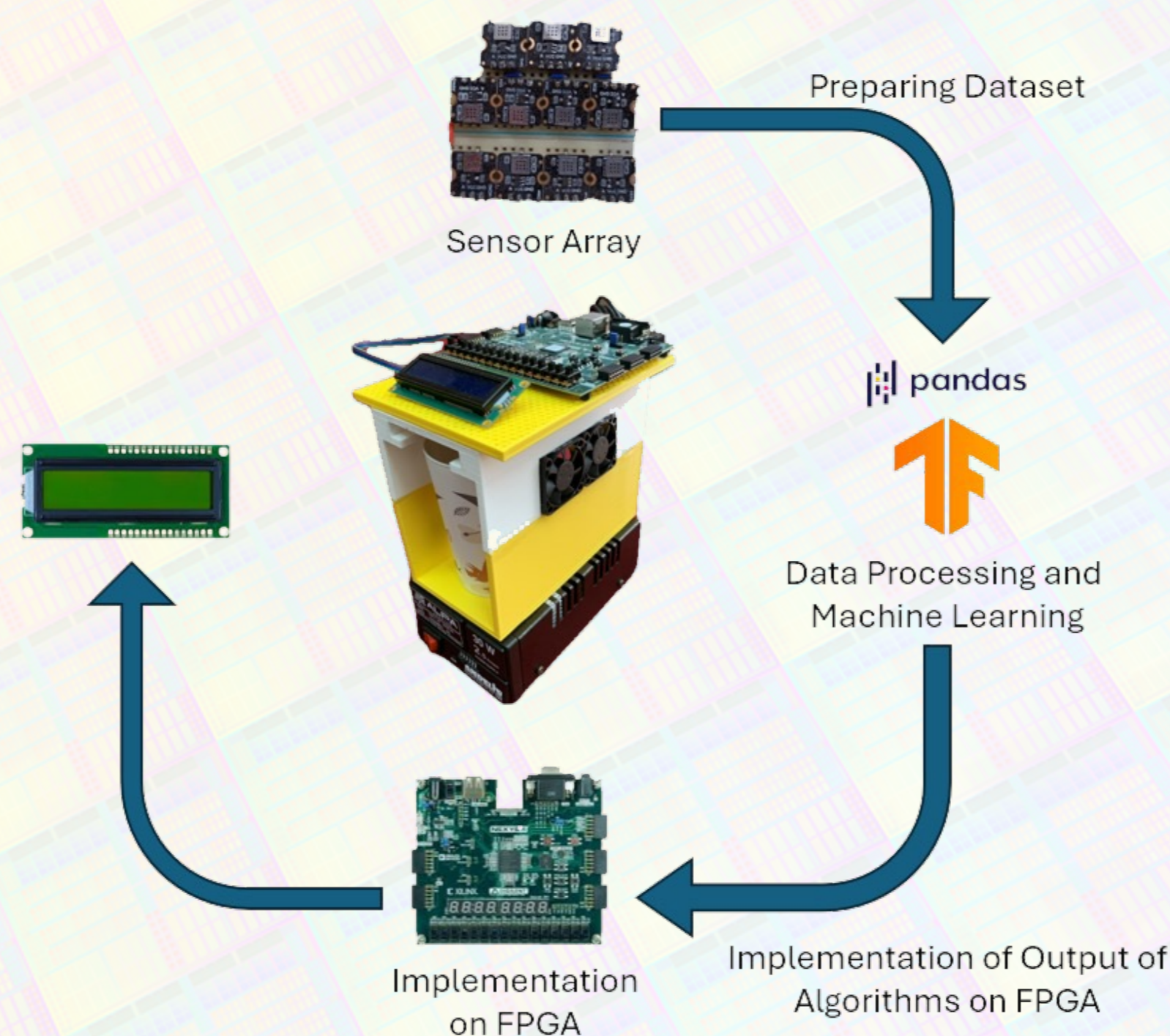
This data was classified with an artificial neural network TensorFlow.

The weights and coefficients obtained at the end of the training were stored digitally, stored on the chip.

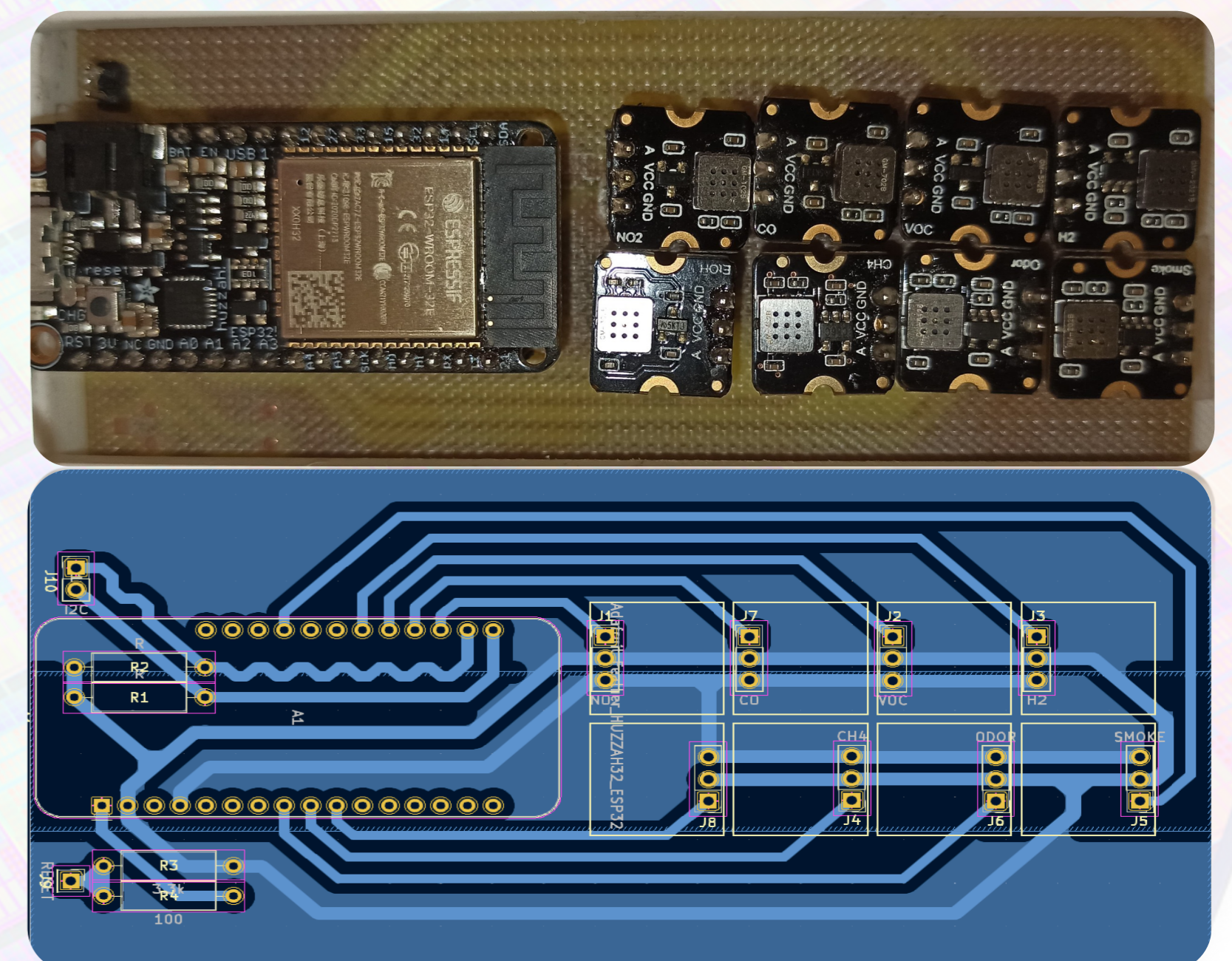
In this way, real-time odor data is processed and stored.

This algorithm enables fast and precise detection of odors.

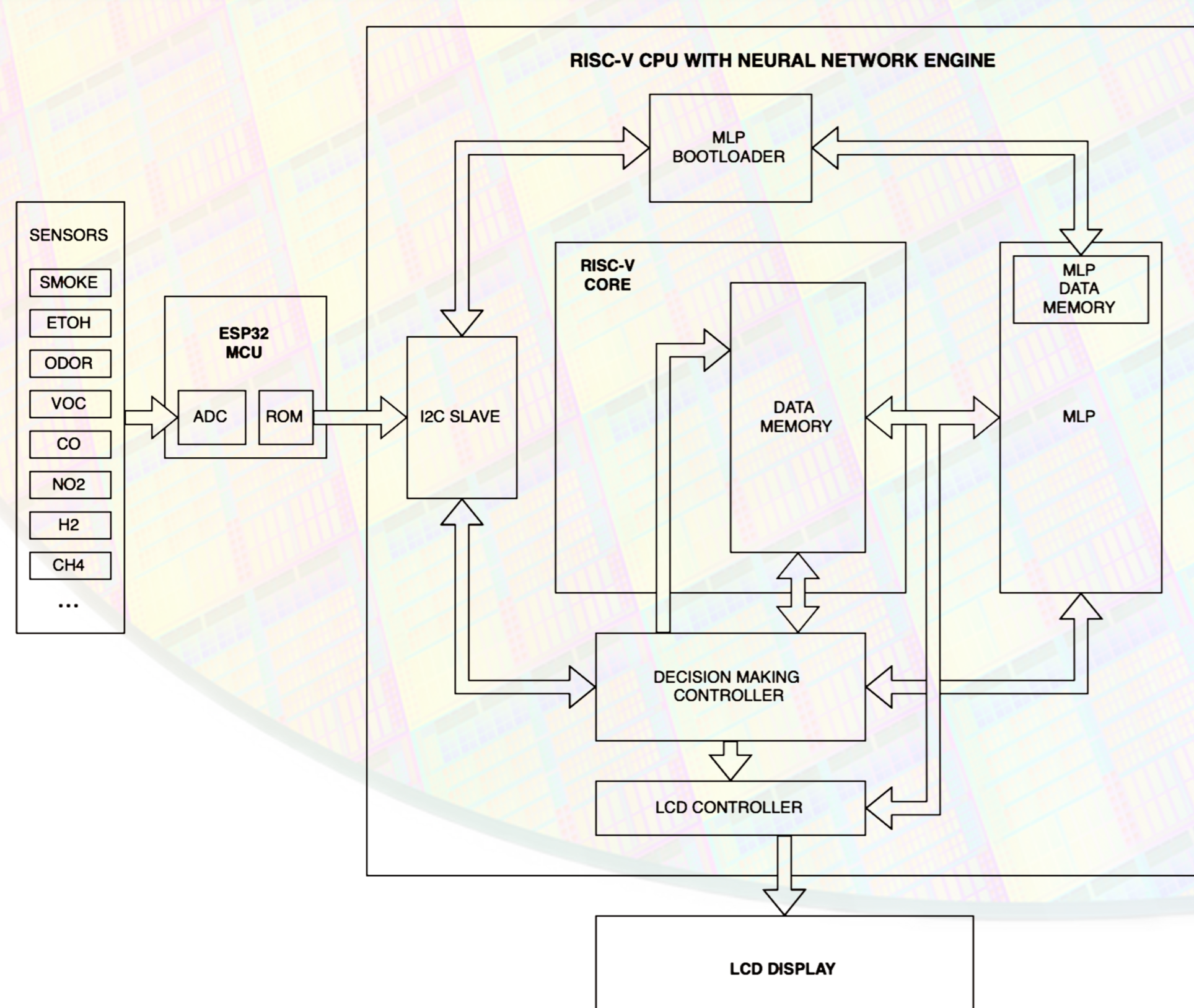
DESIGN PHASES



PCB DESIGN



SYSTEM ARCHITECTURE



DATA SET PATTERN

