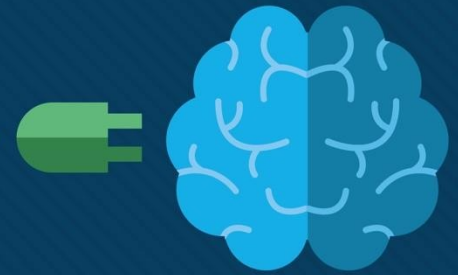

Edge Computing: Embedded Machine Learning

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Professor EE Department NAMAL University

February 27, 2018

- Front-End User Interface
- Data Architecture
- Software Architecture
- Hardware Architecture

Front-end Interface (UI)

- Front-end interface architecture involves defining the visual and interactive elements of the user interface, such as buttons, menus, forms, icons, and other graphical elements. It also involves defining the layout and navigation of the user interface, including the organization of content, the flow of information, and the overall user experience.

Parameters

- User requirements: UI design begins with identifying the needs and preferences of the target audience, including their knowledge and experience, and designing the interface to meet their expectations.
- Visual design: UI design involves creating a visually appealing interface that is easy to read, navigate, and understand. This includes selecting appropriate colors, fonts, and images, and designing a layout that organizes the content effectively.
- Navigation: UI design includes designing an intuitive navigation system that enables users to find the information they need quickly and easily. This includes creating clear and concise menus, buttons, and links that guide users through the application.
- Interaction design: UI design involves creating an interaction design that enables users to interact with the application easily and efficiently. This includes designing forms, buttons, and other interactive elements that respond to user input and provide feedback.
- Accessibility: UI design includes designing an accessible interface that can be used by people with disabilities. This involves complying with accessibility guidelines and standards, such as WCAG (Web Content Accessibility Guidelines), and designing the interface to be compatible with assistive technologies.
- Performance: UI design includes designing the interface to perform efficiently and effectively. This involves optimizing the interface for speed, responsiveness, and scalability, and minimizing the impact on system resources.

About Us

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Get started

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Software development

Option 2

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Get started

Portfolio

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Option 3

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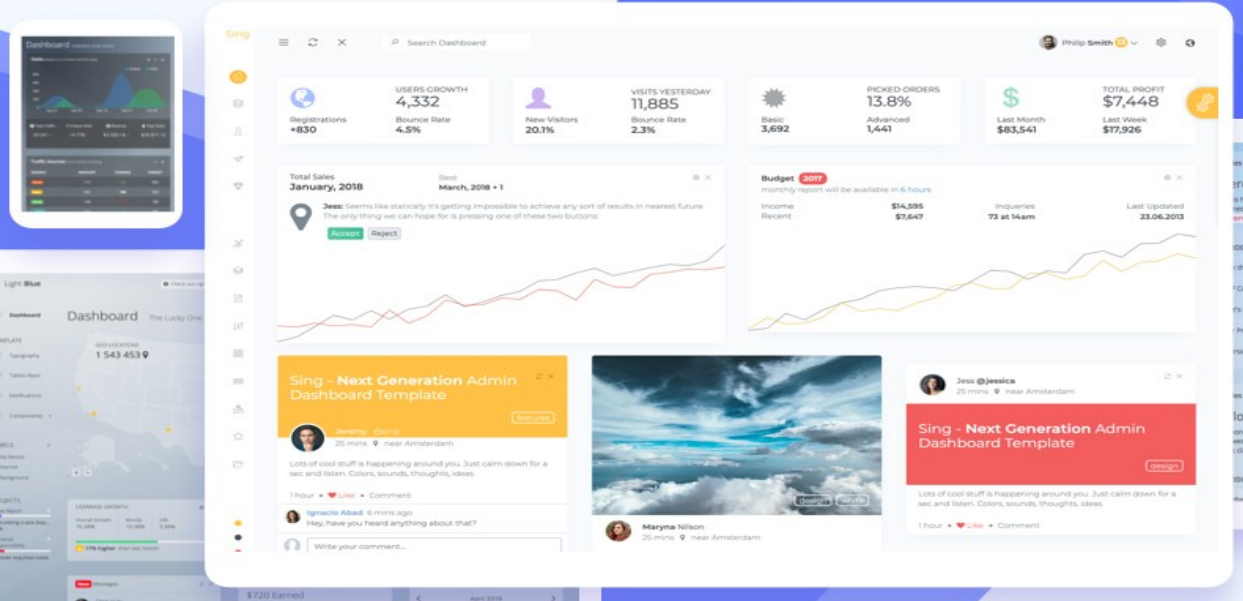
Get started

IOT
Dashboard



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Infographic chart
Infographic chart
Infographic chart
Pie chart
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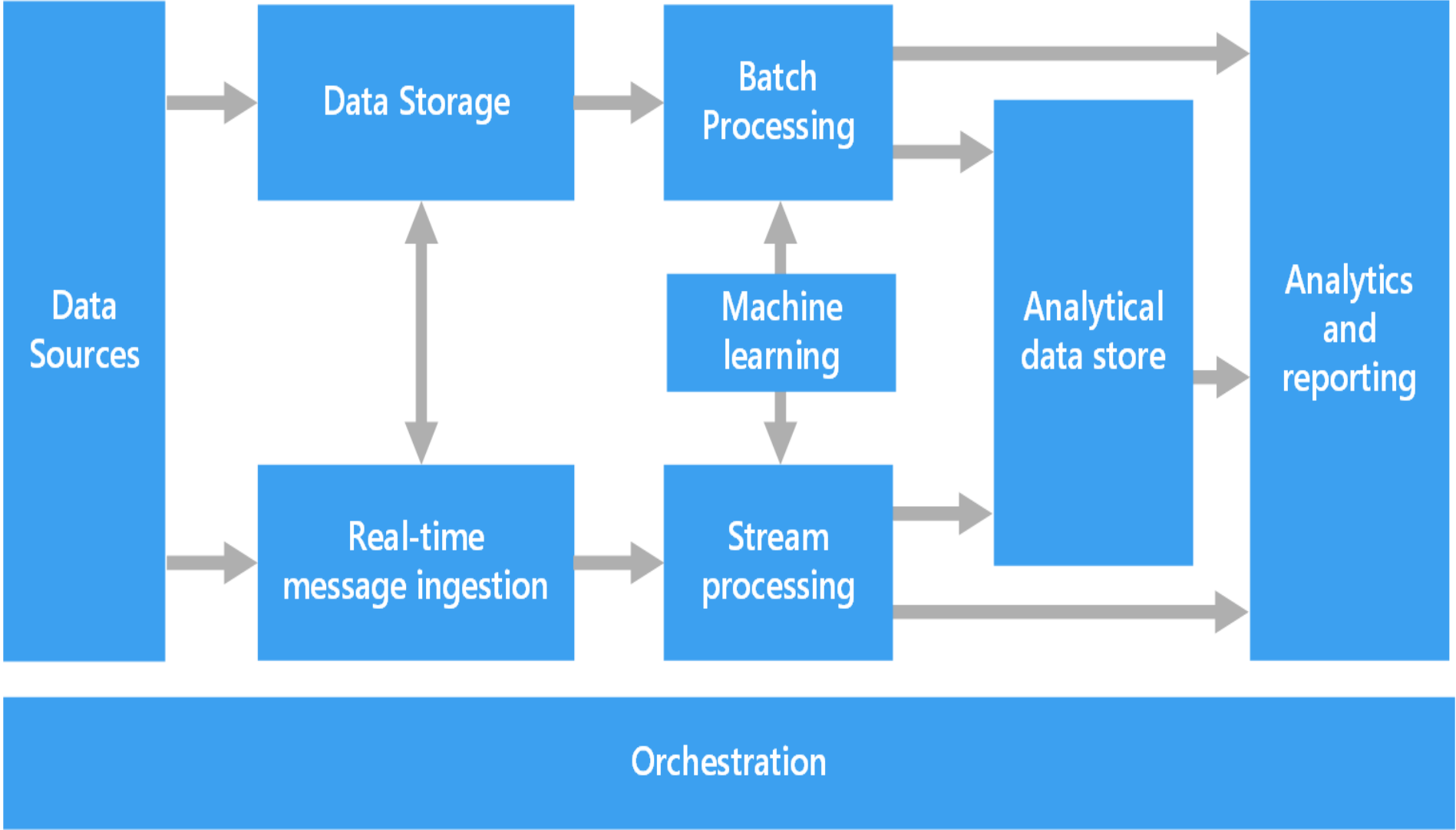
Data Architecture

- Data architecture is a set of principles, policies, standards, and models that govern how data is organized, stored, processed, and accessed by the IoT system.
- DA key component of IoT application architecture and plays a critical role in supporting complex operations and decision-making.

Data Architecture Parameters

- Data requirements: Data architecture begins with identifying the data requirements of the application program, including the types of data needed, their sources, and their intended use. Data requirements should be aligned with the application objectives and strategies.
- Data models: Data architecture involves creating data models that describe the structure and relationships of the data. Data models can be conceptual, logical, or physical, and they should be designed to support the applicatoin data requirements.
- Data storage and retrieval: Data architecture also involves defining how data will be stored and retrieved in the system. This includes selecting appropriate data storage technologies, defining data access methods, and establishing data management policies.
- Data integration: Data architecture includes designing and implementing data integration solutions to ensure that data from different sources can be combined and analyzed effectively. This involves defining data integration architectures and selecting appropriate tools and technologies for data integration.
- Data security: Data architecture includes defining data security policies and procedures to ensure that data is protected from unauthorized access, use, or disclosure. This involves establishing data security controls, such as access controls, encryption, and authentication, and implementing security best practices.
- Data governance: Data architecture includes defining data governance policies and procedures to ensure that data is managed effectively and efficiently. This involves establishing data quality standards, data management processes, and data stewardship roles and responsibilities.


Data Sources
Data Storage
Batch Processing
Machine learning
Analytical data store
Analytics and reporting
Real-time message ingestion
Stream processing
Orchestration

Software Architecture

Software architecture involves the design and organization of software systems. Key parameters involved in software architecture include:

Functionality: This refers to the software's ability to perform the intended tasks and meet the needs of its users.

Scalability: This parameter is about the software's ability to handle increased workload or larger amounts of data without losing performance.

Reliability: The software should be dependable and able to consistently perform its functions correctly, even under unexpected circumstances.

Maintainability: The software should be easy to modify or maintain over time, without requiring significant effort or causing downtime.

Performance: The software's speed and efficiency should be optimized to provide the best possible user experience.

Security: The software should be designed with appropriate security measures to protect against unauthorized access, data breaches, and other threats.

Interoperability: The software should be able to work with other systems and software programs, using standard protocols and interfaces.

Usability: The software should be designed with a user-friendly interface and intuitive user experience, to make it easy for users to interact with and achieve their goals.

Architecture style: There are several architecture styles such as Client-Server, Microservices, Monolithic, Event-driven, etc., and choosing the right style is an important parameter in software architecture.

Technology stack: The technology stack includes the programming languages, frameworks, and tools used to develop the software. Choosing the right technology stack can affect the software's performance, scalability, and maintainability.

Software Structure

Libraries

Global variables

Control Signals

Initialization (Peripherals etc.)

Data Structure (Read/Write)

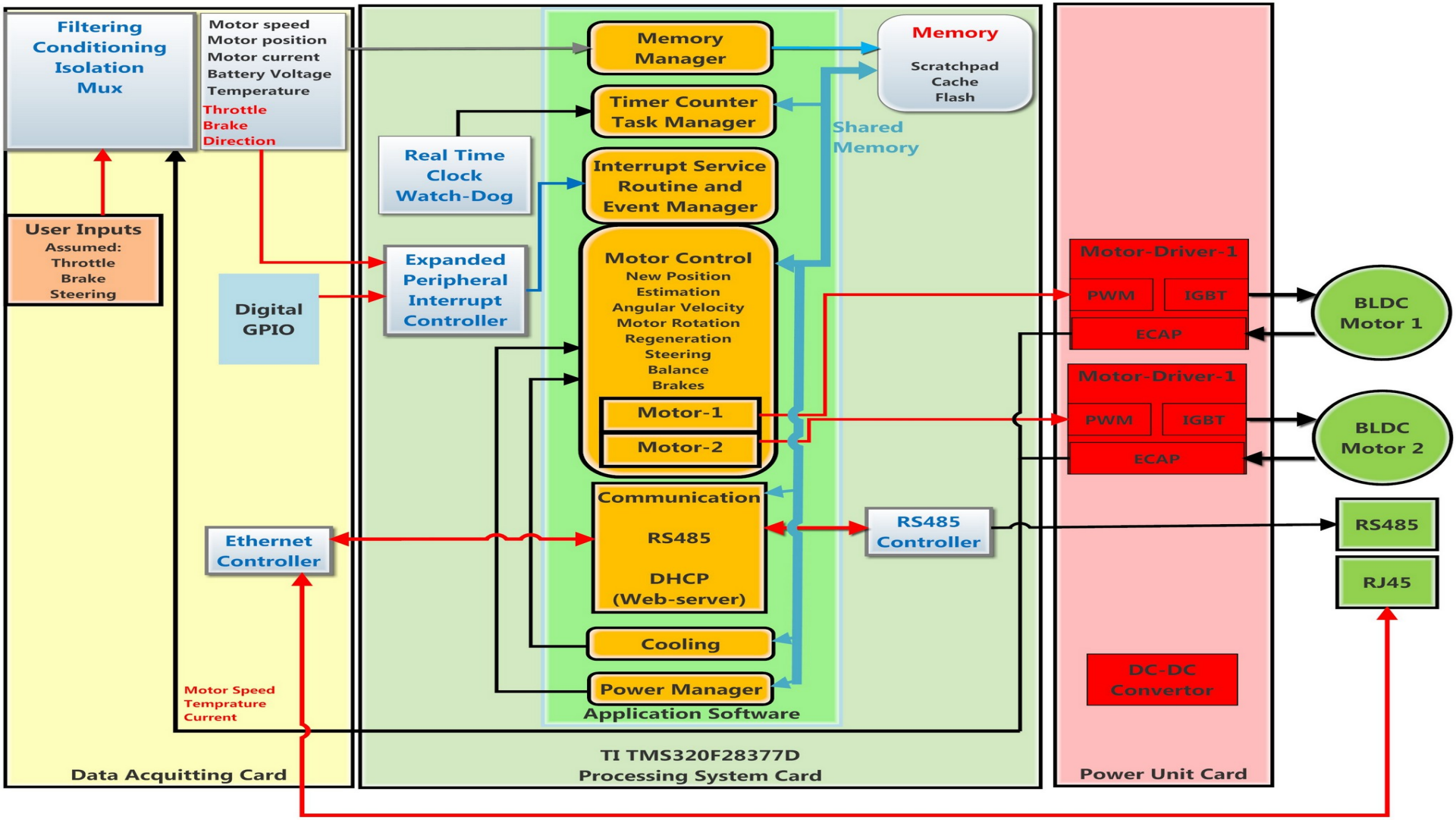
Processing

#Function Calls (Read/Write, Pre-Process, Filter, Computation, etc.)

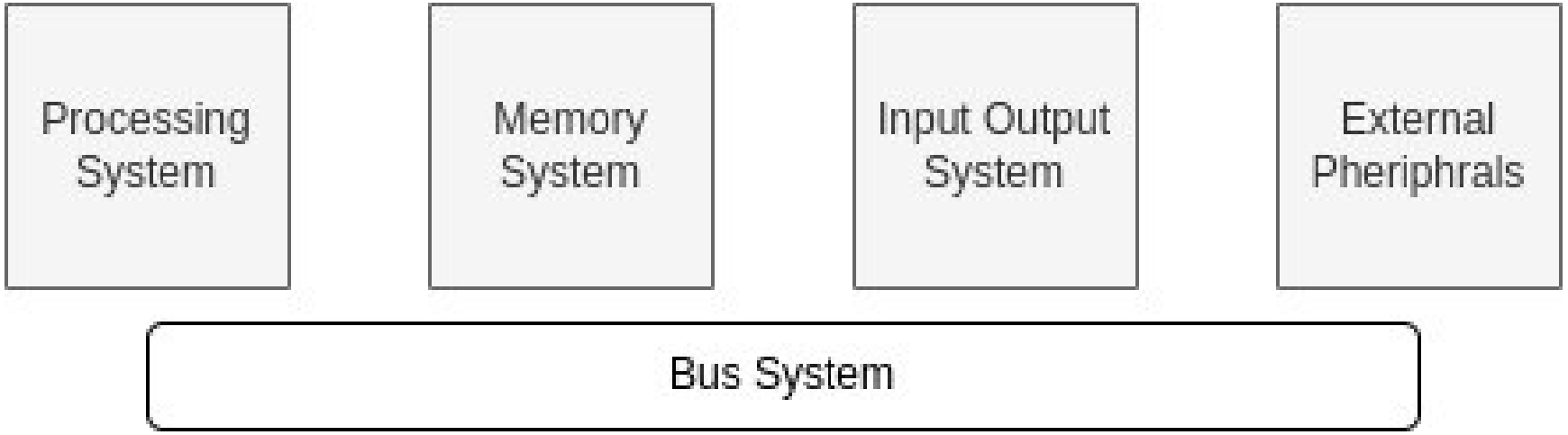
Transfer / Store / Display

Software Architecture Representation

- Flow Diagram: It is used to describe the flow of control or data between different components or subsystems within the software system. They can help to illustrate how the different components interact with each other and how the data flows between them.
- Block diagrams: Block diagrams are used to illustrate the high-level structure of a system or software architecture. They use blocks to represent different components or subsystems and arrows to show the relationships and interactions between them.
- State diagrams: State diagrams are used to represent the behavior of a system or software architecture. They show the different states that a system can be in and the events that trigger transitions between these states.
- Entity-relationship diagrams: Entity-relationship diagrams are used to represent the relationships between different entities in a system. They are commonly used in database design to illustrate the relationships between tables.

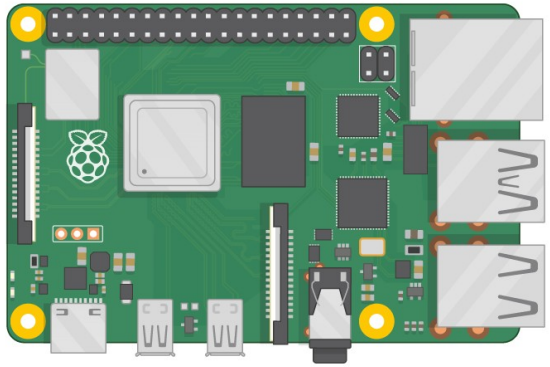

Filtering
Conditioning
Isolation
Mux
Motor speed
Motor position
Motor current
Battery Voltage
Temperature
Throttle
Brake
Direction
User Inputs
Assumed:
Throttle
Brake
Steering
Digital
GPIO
Ethernet
Controller
Motor Speed
Temprature
Current
Data Acquitting Card
Memory
Manager
Timer Counter
Task Manager
Real Time
Clock
Watch-Dog
Interrupt Service
Routine and
Event Manager
Expanded
Peripheral
Interrupt
Controller
Motor Control
New Position
Estimation
Angular Velocity
Motor Rotation
Regeneration
Steering
Balance
Brakes
Motor-1
Motor-2
Communication
RS485
DHCP
(Web-server)
Cooling
Power Manager
Application Software
Memory
Scratchpad
Cache
Flash
Shared
Memory
TI TMS320F28377D
Processing System Card
Motor-Driver-1
PWM
IGBT
ECAP
Motor-Driver-1
PWM
IGBT
ECAP
RS485
Controller
DC-DC
Convertor
Power Unit Card
BLDC
Motor 1
BLDC
Motor 2
RS485
RJ45

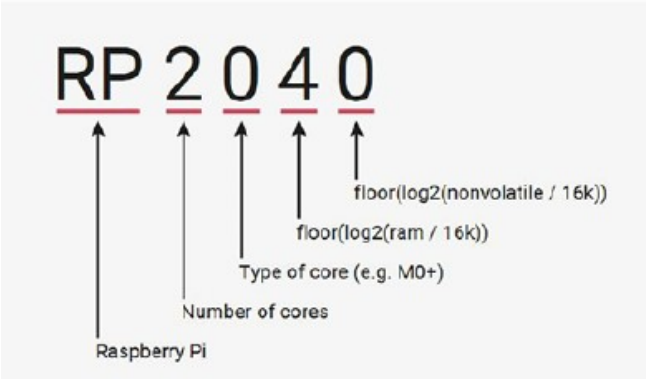
Hardware Architecture

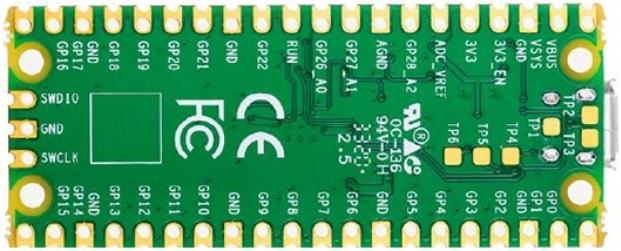


Hardware Architecture

- Single Board Computer
  - RasppberyPi
  - RasppberyPi Pico



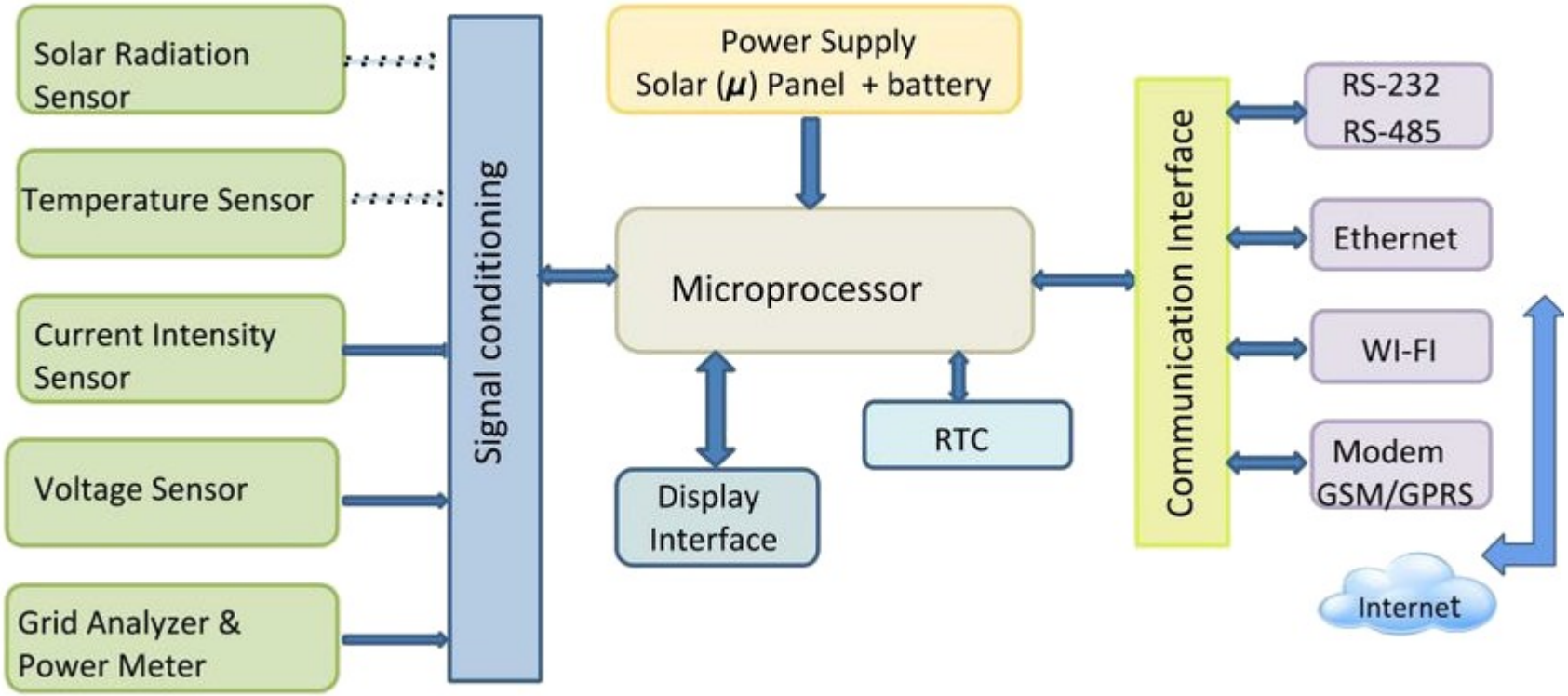




The Raspberry Pi Pico – bottom view (courtesy of raspberrypi.org)

Hardware Specifications

- Processor Architecture
  - Number of Cores (ALU) and Operating Frequency
- Processor Local Bus
  - Instruction and Data Bus
  - Program and Data Memory
  - Local Memory (Cache and ScratchPad)
- Processor External Bus (Peripheral Bus)
  - Main Memory
  - DMA, PWM, ADC, DAC
  - I/O Interfaces


Solar Radiation Sensor
Temperature Sensor
Current Intensity Sensor
Voltage Sensor
Grid Analyzer & Power Meter
Signal conditioning
Power Supply
Solar (μ) Panel + battery
Microprocessor
Display Interface
RTC
Communication Interface
RS-232
RS-485
Ethernet
WI-FI
Modem GSM/GPRS
Internet