Embedded System Characteristics in Multiple Domains

Presented by,

Team OutBreak

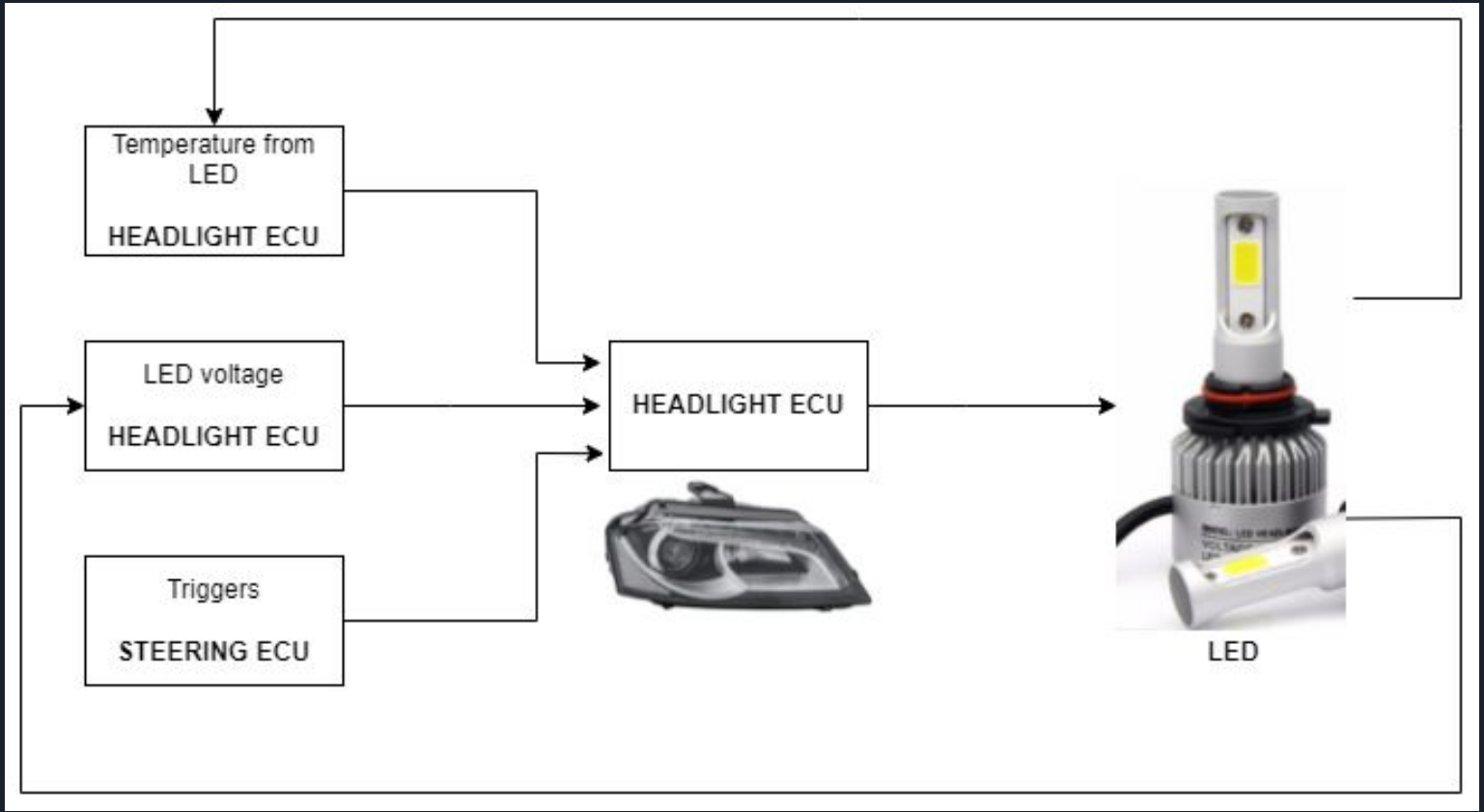
- Namık Mert Tunçbilek - 7213712
- Nijat Dashdamirov - 7213892
- Mirudhubashini Ramasamy Sridharan - 7213893
- Veli Ateş - 7213717
- Vignesh Arumugam - 7213710

AUTOMOTIVE

Embedded System in Car's Headlight

- A Car have multiple Embedded systems which are termed as ECU [Electronic Control Unit].
- This section mainly deals with HEADLIGHT ECU.
- Requirements of Headlight ECUs are,
  - Protect LED from Open circuit & Short circuit failures.
  - Protect LED from Over temperature failures.
  - Faster response to functionality changes.
  - In Premium & Future cars,
    - Adaptive headlight turn with Steering movement.
    - Adaptive lighting with speed.
    - Lightings for pedestrians

High Level Architecture



Characteristics of Headlight ECU

Is this a Reactive System?

Yes, it is.

This ECU continuously check with the voltage data for output failures [open & short circuit] triggered by external environment and temperature readings for LED burnt failures.

Characteristics continuation...

Is this a Real-time System?

Yes, it is.

This ECU comes under Hard-real time.

All the functionality Triggers(i.e., Low beam, High Beam, Turn Indicator & Parking light) need to be responded within DEADLINE.

The Turn Indicator output should be a periodic task.

Characteristics continuation...

Is this a Continuous/discrete/hybrid systems?

Yes, this ECU has Discrete character in time.

Values of output voltage & temperature readings are acquired in a discrete manner in a pre-defined time [Example - Periodicity of Temperature reading is 10ms].

Characteristics continuation...

Is this a Dependable System?

Yes, this ECU address **Reliability** attribute by having certain number of life cycles or Warranty periods.

Availability is required, since this ECU need to ensure its functions availability as soon as BCM[Body Control Module] gets powered up. And need to exists till the power gets down.

Also this ECU have **Safety** standard ASIL ; “Automotive Safety Integrity Level”. Which highly tells the safety functions like Low Beam & Turn Indicator should be ensured even during failures.[Hazard avoidance]

Security in this system is ensured by having checksum & ID checks for updating ROM parameters.[Confidentiality]

Characteristics continuation...

Failure Example - Memory Failure

RAM block write & read fault → RAM Error → Memory Failure

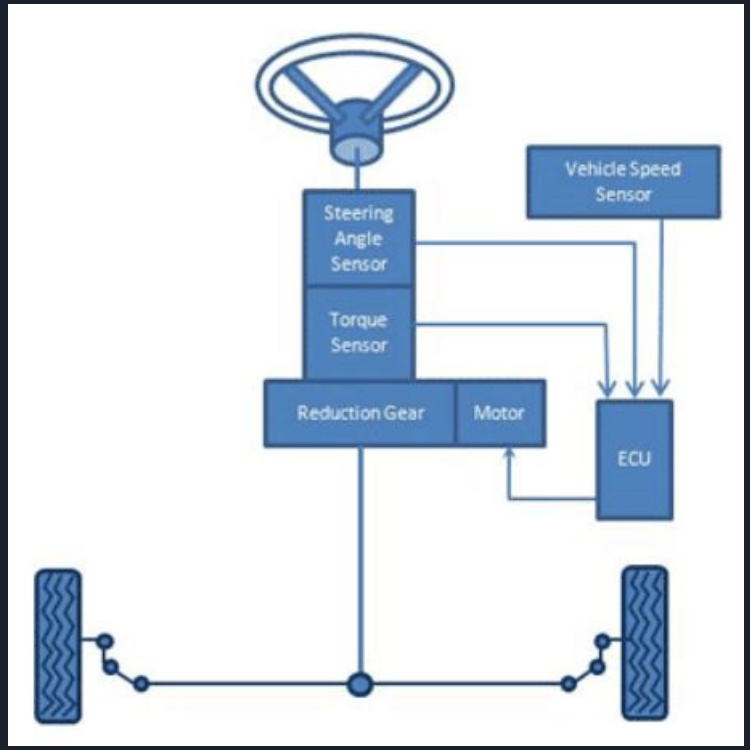
It is a Persistent fault and in Bathtub curve it is at Infant mortality .

Characteristics continuation...

Is this a Distributed System?

In the current ECUs the Distributed system character is missing.

But in the Premium & Future cars, the Headlight ECUs will have Distributed system characteristics, for example - the Headlight ECU will interact with Steering ECU for “Adaptive headlight turn with Steering movement”



MEDICAL

EMBEDDED SYSTEMS IN MEDICAL FIELD

Medical devices nowadays lean greatly on sensors as they provide aid in monitoring, diagnosing and treating the medical health of the patient.

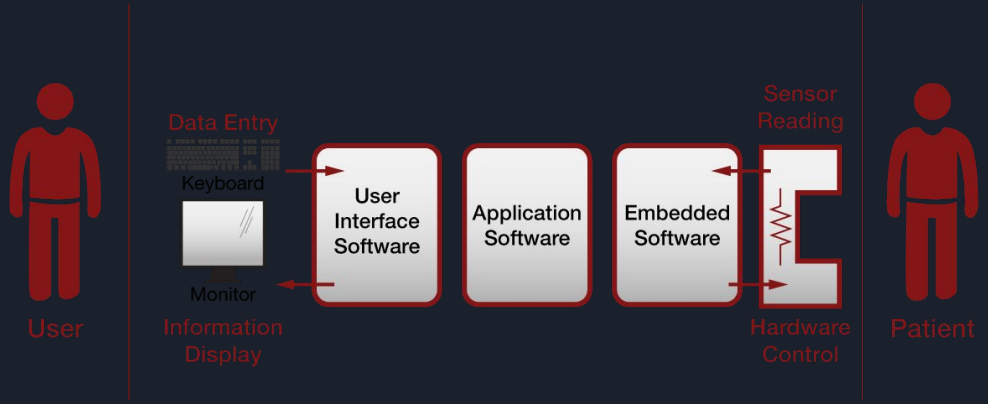
Embedded systems in biomedical applications allow doctors to remotely monitor patients' health and make diagnoses and treatment decisions through telemedicine and other remote systems.

Low-power and high-performance portable embedded systems offer many diagnostic functions, save time, aim to reduce overall diagnostic costs.

Main Features of the Use of Embedded Systems in the Medical Field

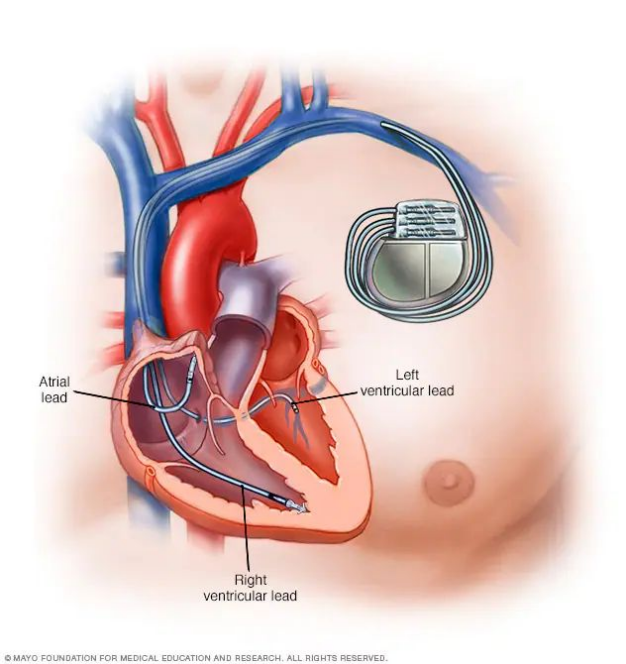
- Reliability
  - Device operations depends on embedded processor
  - Device must work continuously without user reset

- Performance
  - Real time systems
  - Scheduling
  - Optimized I/O



- Cost
  - Minimize manufacturing cost for consumer market
  - Fast time to market

Pacemaker



Main Characteristics of Pacemaker in Medical Field

Reactive systems: (+) Embedded System checks the sensor data and interact according to data.

Real-time systems: (+) Embedded system is real-time system because they gives exact output in time and timely response.

Dependable systems: (+) Device must work 24/7/365(continuously) without user reset.

Distributed systems: (-) It is not distributed system, also difficulties in failure handling and security, in this field distributed embedded systems are not common.

Frequently Used Architectures in Embedded Systems in Medical Field

Architecture in Pacemaker -> This system has a interrupt-control systems, all data which measured from heart has own priority. System react according to data and their priority in certain cases.

Frequently Used Architectures in Embedded Systems in Medical Field

1 - **Simple Control Loop**
2 - **Interrupt-controlled System**
3 - **Cooperative Multitasking**
4 - **Multi-threading**

HOME AUTOMATION

EMBEDDED SYSTEMS IN HOME AUTOMATION

Automation or automatic control, is the control mechanism used for operating various devices with the minimal human intervention.

Home Automation allows the user to take complete control of their home through the remotely controllable aspects with the aid of the electronic gadgets.

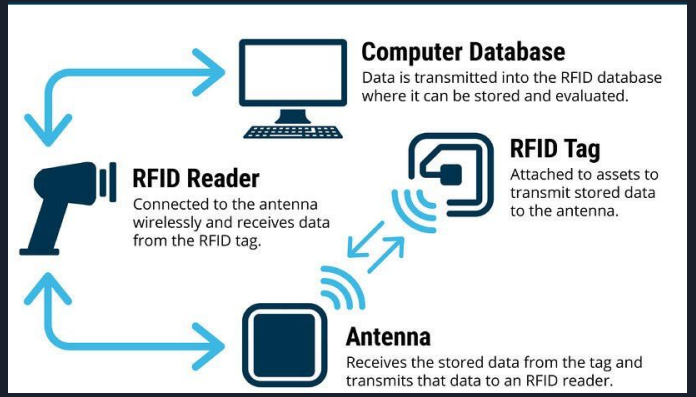
The automation system can be controlled from central host PC, the internet, and also through the mobile phones which is the combination of the computer and information technology.

Systems can range from simple remote control of lighting to complex computer / micro-controller based networks with varying degrees of intelligence and automation.

Key Factors of Embedded Systems in Home Automation

Reactive system - Door lock with RFID reader

- RFID Locking System is driven by stepper motor. The stepper motor acts as a actuator, which helps the door to open and close in real time.
- The RFID Reader detects the tag in real-time and opens the door automatically and closes it again after a specific time interval.



Key Factors of Embedded Systems in Home Automation

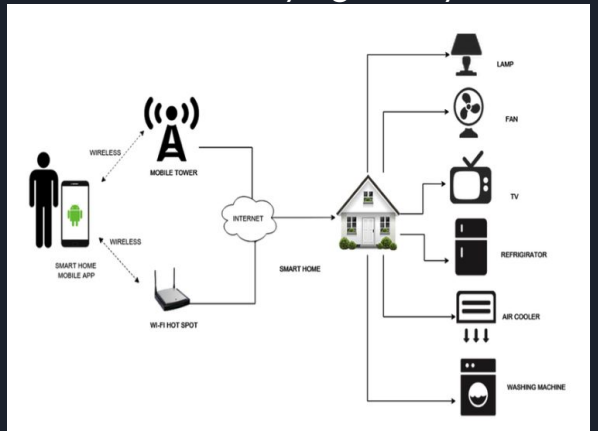
Real time system - Water level control

- The water level controller works on the actuality that the water conducts electricity.
- When water level rises or fall the sensing probes and circuits of the controller detect the same.
- These signals are used to switch ON or switch OFF the pump motor as per the need.
- The water level indicators in the tank also help to indicate the water levels in the storage tank.

Key Factors of Embedded Systems in Home Automation

Distributed system - IoT based home automation

- The Internet of Things refers to the ever growing network of physical objects like appliances, sensor data etc., embedded with network connectivity. It enables these objects to collect and exchange data.
- The IoT based home automation consist of several smart devices for different applications of lighting, security, home entertainment, as these devices are integrated over a common network established by a gateway and connected in a mesh network.



IoT Parking Machine

Parking IoT machines

Easy-to-use ticket machines allow customers to obtain their tickets and find their spot.

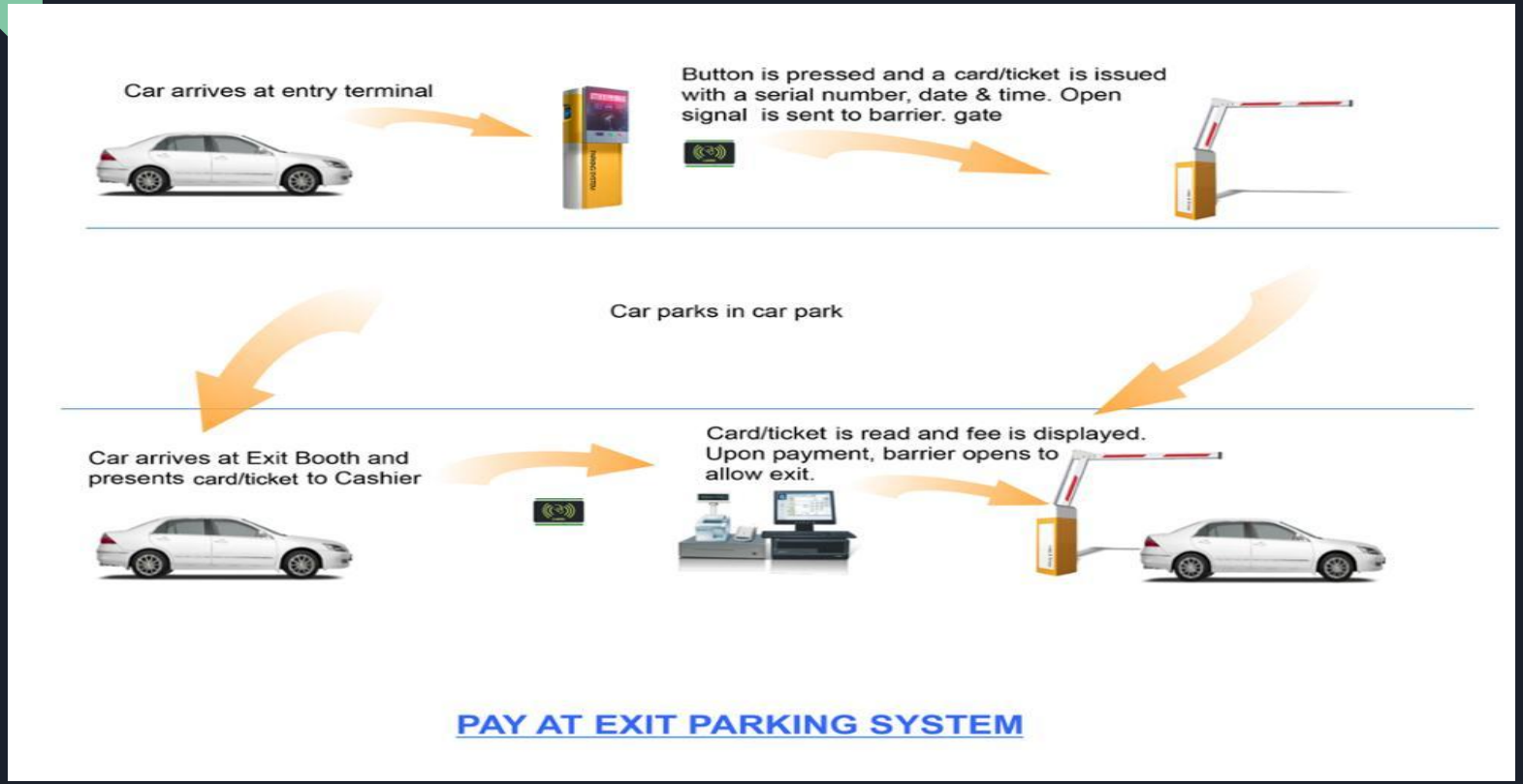
Requirements of the system

- Intelligent ticket with text, barcode date and time, ticket number, line number.
- Gate system for opening and closing the entrance.
- Printer and scanner to write and read the data from the ticket.
- Online data about the spare places in the parking area.

Future improvement

- Sensing serial number and automatically creating the tickets while entrance.
- Sensing serial number and detecting according payment while leaving the parking area.

Basic demonstration of workflow



Characteristics

Is it reactive systems?

- Yes, it is reactive.
- Because all parking areas have predefined number of places. The system should get the data from the environment regularly and print the according tickets

Characteristics

Is it real-time system?

- Yes they are real-time systems.
- While the client pressed the button the printer should machine should print and open the gates within given time frame

Characteristics

Is it dependable system?

- Yes, it is dependable system.
- Ticket printing, gate opening, payment and etc. work stuff should be done programmatically. That is why in order to have good operating system, well-programmed and performed software should be installed on the computers

Characteristics

Is it discrete system?

- No it is not distributable system.
- The cars that on the parking area is the totally independent of each other and they are not interacting via any channel. Only available numbers of the places are taken as a data, which can not be considered as distributed system