

"Predictive Maintenance Feature development on Connected Car"

Subject of the call:

Create solutions by applying data analytics and machine learning algorithms on the data collected with the connectivity device from the vehicles and stored on the server, to predict the malfunctions / problems that may occur in the vehicle and to establish the necessary systematic.

Explanation:

After buying a car, it is one of the important demands in their lives for many of our customers and even their relatives to have an seamless travel experience without any problems or if there is a problem. Therefore, this has become an important feature for the customer, after it has become easier to be informed in advance about the vehicle's health status and possible problems and to reach this through digital channels.

However, we observe that our customers want all problems with their vehicle to be solved at once, especially from being on the road while traveling and when it comes to the service. We want to predict the parts that are likely to break down before the problem occurs and share this situation with our customers via the Fiat Companion application by commenting on the data generated in the vehicle without any malfunction, and we want to prevent the unplanned interruption of their travels by directing the customer about critical problems on time.

At this stage, we have launched the "Critical Failure Notification and Customer Care Center Referral" application, which we developed in order to facilitate the lives of our customers and services and to be a reliable guide in the process, in all our dealers and Customer Care Center as of June 13. Thanks to this application, when a critical malfunction occurs, our customers are called and informed by the Customer Care Center and if the vehicle is suitable to continue, they are directed to the service.

The number of uses of the Fiat Yol Arkadaşım application has been increasing continuously since its launch. Although we have met many expectations with the failure notification feature in the application, it seems that there is an important way for us to be informed by our customers before any malfunction occurs and to take precautions.

To achieve this goal, we need your views and opinions. If you want to contribute to this process, we are waiting for your applications until October 30

You can access more info about what we are looking for as HW & SW combination from the link below;

<https://yolarkadasim.fiat.com.tr/>

Hardware Requirements

1.1 Power Supply Requirements

Operational Voltage Range:

- Input voltage range: 9V to 16V;
- Must have protection against short circuit to Vbatt and GND.

→TCU shall not be effected by voltage drops during Stop&Start ignitions.

Over Voltage Protection:

- Load dump: 70Vpk @ 400ms;
- Fast transients: ± 200 Vpk.

Current consumption:

Normal mode: max 2A @ 12V

Sleep mode: max 1mA @ 12V

1.2 Microcontroller

A microcontroller of automotive family must have the following minimum requirements, in order to store, run and manipulate firmware, variables and all peripheral hardware.

The minimum requirements are:

- 32 bit architecture
- Sufficient memory for available and new APPs (preferably Flash memory)
- Sufficient memory for future firmware updates (preferably %20 more then current firmware size)

1.3 Cellular Modem

At least a dual-band GSM/GPRS modem must be used to provide bi directional wireless data transfer between TCU and a Service Provider.

GSM Modem requirements:

- Frequency bands: 900/1800 MHz
- GPRS Connectivity;

Antenna interface: 50 Ohms micro strip (for internal antenna).

The TCU must include support to a SIM Solution (SIM Card based) where subscriber's identification (ID) and security (PIN) numbers are stored. The SIM Card solution shall also include a SIM Card Holder Connector. This solution must ensure normal operation in case of high temperature (special concern due to the SIM Card material)

1.4 GSM Internal Antenna

An internal DUAL GSM antenna must be used to allow GSM modem data transmission / reception.

This antenna will be soldered at the PCB and connected to the GSM modem through a 50 Ohms strip line.

Antenna requirements:

Operates frequency bands: 824 _ 960MHz, 1720 – 1990MHz

Input impedance: 50 Ohms;

1.5 GNSS Receiver

A GPS module and an internal antenna must be used to collect data frames of the vehicle latitude, longitude, altitude, speed and official global time provided by GPS satellite constellation.

GPS Module requirements:

- a) Internal antenna
- b) Frequency: L1 (1575MHz);
- c) Number of channels: ≥ 16 ;
- d) Sensitivity: -159dBm (in tracking);
- e) Standalone horizontal position accuracy: $\leq 5\text{m}$;
- f) SMT assembling technology;

1.6 Accelerometer/Gyro

An accelerometer device shall be available for detecting movements in the X, Y, Z axis. It makes possible to know if the vehicle is being moved from its rest position as result of an attempt of theft, towing or any unauthorized intervention.

Accelerometer shall be used for both driver characteristics analysis and crash detection. Thus it shall be suitable for both use cases.

Accelerometer shall have output to wake up TCU when a movement is detected (even if the TCU is in sleep mode)

The Accelerometer should have low G detection characteristics.

1.7 Internal BackUp Battery

TCU must be equipped with an internal Battery to guarantee that the device will remain operational in case of loss of power.

The battery must be able to keep TCU operational for at least 15 minutes.

Battery life must be at least 3 years under normal conditions of use.

1.8 CAN Bus Interface

TCU shall have 3 CAN interface for reading data from vehicle CAN bus. TCU shall support 11bit and 29bit CAN ID's at 50kbps,125kbps and 500kbps bus speeds.

Basic functions required

- CAN Scanning: Reading selected CAN messages from bus. (Listen-Only mode)
- CAN UDS Diagnostics: TCU shall support UDS 0x22 and 0x19 services. (Read Data by Identifier)

1.9 Digital Output

Digital Output will be a low side driver to drive upto 50mA. It will be used to drive below circuit on vehicle.

All inputs must be protected against short circuit to Vbat and ground (GND).

All inputs shall have protection against Electrostatic Discharge and Transients Voltages.

1.10 Bluetooth Connection

TCU shall support Bluetooth 4.x or upper versions with Generic Attribute Profile (GATT) for direct communication with phone.

1.11 LED indicator

Device shall have a LED indicator to indicate operational status.

Status of Signal Indicator		
GSM Indicator (Blue)	The power is working	Always lighted: searching for GSM network
		Flash once in every 3 seconds: the network is normal
	The power is cutoff	Flash twice, in every 3 seconds: the network is normal
		Flash twice, light for 3 seconds: searching for GSM network

1.12 Input/Output Interface and Connector

TCU shall have wires on it. Connector is not mandatory. Input/Output list is given in below table.

- All inputs must be protected against short circuit to Vbat and ground (GND).
- All inputs shall have protection against Electrostatic Discharge and Transients Voltages.
- Power input must have protection against reverse battery connection.
- CAN Bus cables shall be twisted in pairs. (e.g. CAN1-H and CAN1-L shall be twisted.)
- All cables except OUTPUT1 shall be taped together as a unique branch with NZ tape (coroplast880) or alternative.
- OUTPUT1 cable shall be covered w/ corrugated tube as a separated branch.

Table 1. Input/Output List

	PIN Name	Type
1	GND	Power
2	Vbatt	Power
3	CAN1-H	CAN bus
4	CAN1-L	CAN bus
5	CAN2-H	CAN bus
6	CAN2-L	CAN bus
7	CAN3-H	CAN bus
8	CAN3-L	CAN bus
9	OUTPUT1	OUTPUT
10	Reserved	Reserved

Additional Input/Output is preferable.

1.13 AES256 Preperation

TCU shall be ready for AES256 encryption method in terms of HW and SW. In case of need, we will require to assemble chipset PCB, it shall be plug and play.

1.14 CAN Interface

CAN Interface	Specification
CAN 1 CAN 2	High Speed Transceiver Recomennded Transceivers: TJA 1043 TJA 1145/FD TJA 1145 SN 65HVDA541-Q1 TJA 1041A TLE 6251-2G TLE 6251-3G TLE 6251G UJA 1161 UJA 1162 NCV 7341 / AMIS 42668 Comply with ISO 11898-2
CAN 3	Low Speed Transceiver Recomennded Transceivers: TJA1054 TJA1055 Comply with ISO11898-3

1.15 CAN microcontroller

CAN / Microcontroller Type	CAN controller products <u>not allowed</u> : 1. Intel 82526 enhanced protocol not supported (e.g. replace with 82527) 2. Philips PCA82C200 enhanced protocol not supported (e.g. replace with SJA1000) 3. Old Fujitsu CAN controllers without ISO 16845 compliance (SJW settings not supported) 4. ST7F521 microcontroller because it doesn't support 2.0B Active protocol 5. National Semiconductor COP6 & COP8 microcontrollers because they don't support 2.0B Active protocol 6. All FPGA based controllers
Presence of ASIC (IC) used in the node concept	Yes
CAN controller compliant with 2.0 B Active requirement	Yes
Matching between Message ID and Rx mail boxes	One to One
Rx mail boxes empty rule	each 1 ms
Minimum separation time between two messages that you are able to manage in Rx	1 ms
Matching between Message ID and Tx mail boxes	One to One

1.16 Temperature classification

TN1L(-30 °C) / TCA1 (+65 °C) (operational)

Note: Below -20°C, battery capacity drop of %40 is acceptable.

1.17 Device Type E3, MS IL2

1.18 Vibrations classification V2

1.19 Dust & Water Intrusion ISO 20653

1.20 Immunity to handling electrostatic discharges

Test will be carried out according to ISO 10605: 2008.

1.21 Immunity to electrostatic discharges in operation

Test will be carried out according to ISO 10605: 2008.

1.22 Electromagnetic Compatibility

The TCU shall comply with UN-ECE regulation N.10 "Uniform Provisions Concerning the Approval of Vehicles With Regard To Electromagnetic Compatibility" (14 Aug 2008).