MCU Based Solutions for Face Recognition

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SECURE CONNECTIONS FOR A SMARTER WORLD

I.MX RT106F – MCU BASED SOLUTION FOR SECURE FACE RECOGNITION – NEW FEATURES


i.MX RT106F

- i.MX RT106F – 600 MHz Arm® Cortex™-M7 based MCU
  - Integrates 1 MB SRAM & bundles secure face & expression recognition SW

- Low Cost – Uses inexpensive IR + RGB camera instead of 3D camera
  - MCU based BOM cost ~50% lower than MPU implementations
    - Eliminates SDRAM, eMMC Flash, PMIC, 6+ layer board

- Liveness detection protects against spoofing with photographs or phone/tablet displays

- Low-light capabilities, good for nighttime applications

- Supports databases of up to 3000 faces (RGB only)

- Operates entirely offline – eliminates cloud privacy issues (perhaps cost of Wi-Fi/BLE)
  - Adds support for Wi-Fi/BLE module
  - Available remote face registration capability for PCs & mobile devices (Android)

- Short MCU boot time enables face recognition from standby in less than 800 ms

- Familiar MCU/RTOS platform avoids MPU/Linux learning curve for IoT developers

- NXP EdgeReady solutions slash time-to-market
  - Full reference design, software source, schematics, BOM & layout
  - Customers have gone from concept to production in only four months

i.MX RT106F FACIAL RECOGNITION SOLUTION PERFORMANCE

Metric	Performance
Accuracy / False Acceptance Rate (FAR)	99.6% / 0.000001
Anti-spoofing Accuracy	96.5%[*]
Minimum face size (pixels @VGA or QVA resolution)	80 (IR) 100 (RGB)
Face detection and recognition distance	0.2 – 1.0 m
Power on to 1st frame	<300ms
Maximum number of faces ("heavy" model)	100 (IR), 3000 (RGB)
Total face recognition time (detection + quality check + liveness + recognition)	<500ms (light model <1k faces) <1000ms (heavy model <3k faces)

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i.MX RT106F EMOTION RECOGNITION PERFORMANCE EXAMPLE
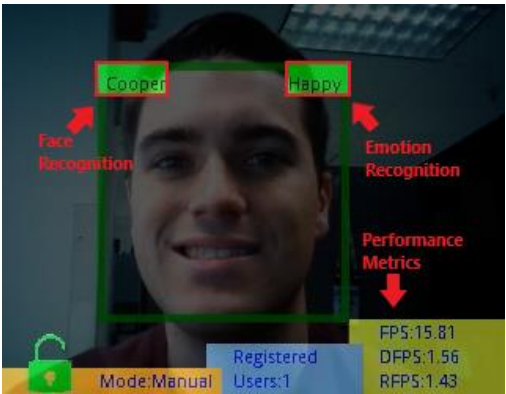
	Not Recommended	Recommended	
	7 Emotion Classifiers	**4 Emotion Classifiers**	**2 Emotion Classifiers**
Model Size	60 kB	60 kB	50 kB
Emotion Classifiers	Angry, Disgust, Fear, Smile, Sad, Surprise, Neutral	E.g. Angry, Smile, Surprise, Neutral	Smile, non-smile
Recognition Accuracy	62%	81%	92%
Max Runtime Memory	149 kB	149 kB	149 kB
Inference Time	100 ms	100 ms	100 ms

RT106F MCU POWER & PERFORMANCE

Core clock	Detection (mS) QVGA	Recognition (mS)	Total (mS)	SoC Power (mW)	Remarks
600Mhz	50	200/670	250/720	214mW	Can support to VGA, total power consumption need a system level test include camera and other components
528Mhz	70	275	345	174mW	Can choose to get better power consumption.
Suspend	N/A	N/A	N/A	0.82	Wake up by GPIO or RTC
SNVS(Off mode)	N/A	N/A	N/A	0.05	Wake up by WAKEUP PIN or RTC

5.1 Run mode

Table 7. Run mode on RAM

RT1060-EVK		Overdrive (600 MHz)		Full-speed run (528 MHz)		Low-speed run (132 MHz)		Low power run (24 MHz)	
Power Rail	Voltage (V)	Current (mA)	Power (mW)	Current (mA)	Power (mW)	Current (mA)	Power (mW)	Current (mA)	Power (mW)
DCDC_IN	3.3	53.1432	175.3726	38.2423	126.1996	12.9733	42.8119	2.7634	9.1192
HIGH_IN	3.3	20.4431	67.4622	20.4244	67.4005	5.2617	17.3636	0.2682	0.8851
SNVS_IN	3.3	0.0250	0.0824	0.0234	0.0771	0.0137	0.0452	0.0173	0.0571

Table 8. Run mode XIP on Flash

RT1060-EVK		Overdrive (600 MHz)		Full-speed run (528 MHz)		Low-speed run (132 MHz)		Low power run (24 MHz)	
Power Rail	Voltage (V)	Current (mA)	Power (mW)	Current (mA)	Power (mW)	Current (mA)	Power (mW)	Current (mA)	Power (mW)
DCDC_IN	3.3	44.5526	147.0236	32.4731	107.1612	11.8486	39.1004	2.4326	8.0276
HIGH_IN	3.3	20.4381	67.4457	20.4542	67.4989	5.2729	17.4006	0.2827	0.9329
SNVS_IN	3.3	0.0257	0.0847	0.0241	0.0796	0.0140	0.0461	0.0178	0.0586

HARDWARE DESIGN PROPOSAL

i.MX RT106F FACE RECOGNITION BLOCK DIAGRAM
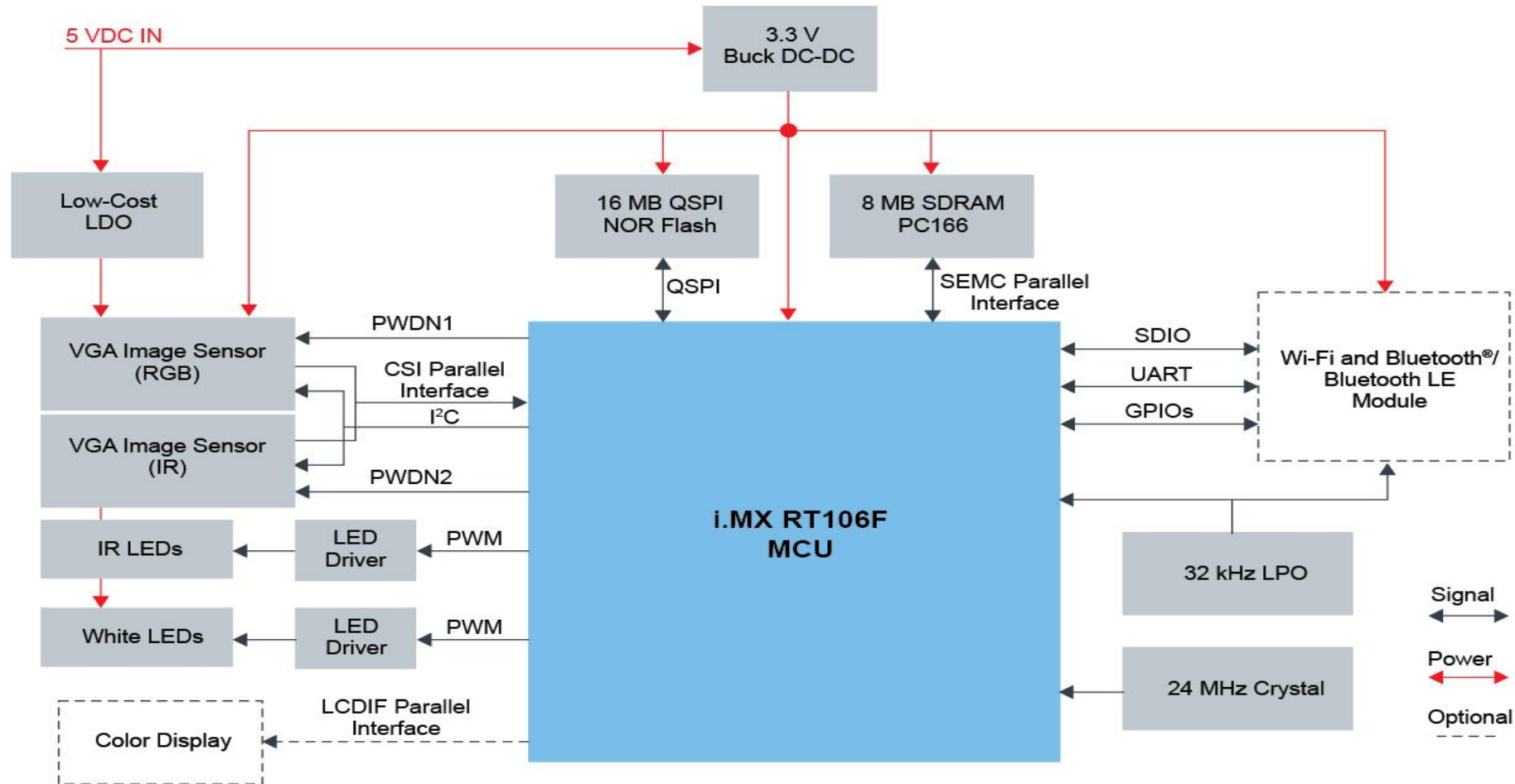
- LCD support parallel LCDIF is recommended.

- We support two types of Camera sensor in our reference design:

  – ONSEMI MT9M114 and GC0308.

  – Two sperate IIC interface should be reserved for dual camera case.

- Both IR and White LED should be enabled for dual camera case and better user experience.

- SDRAM size recommend 8 MB for dual camera case.

SOFTWARE BLOCK DIAGRAM

i.MX RT106F MCU SOLUTION FOR FACE RECOGNITION – OASIS SW
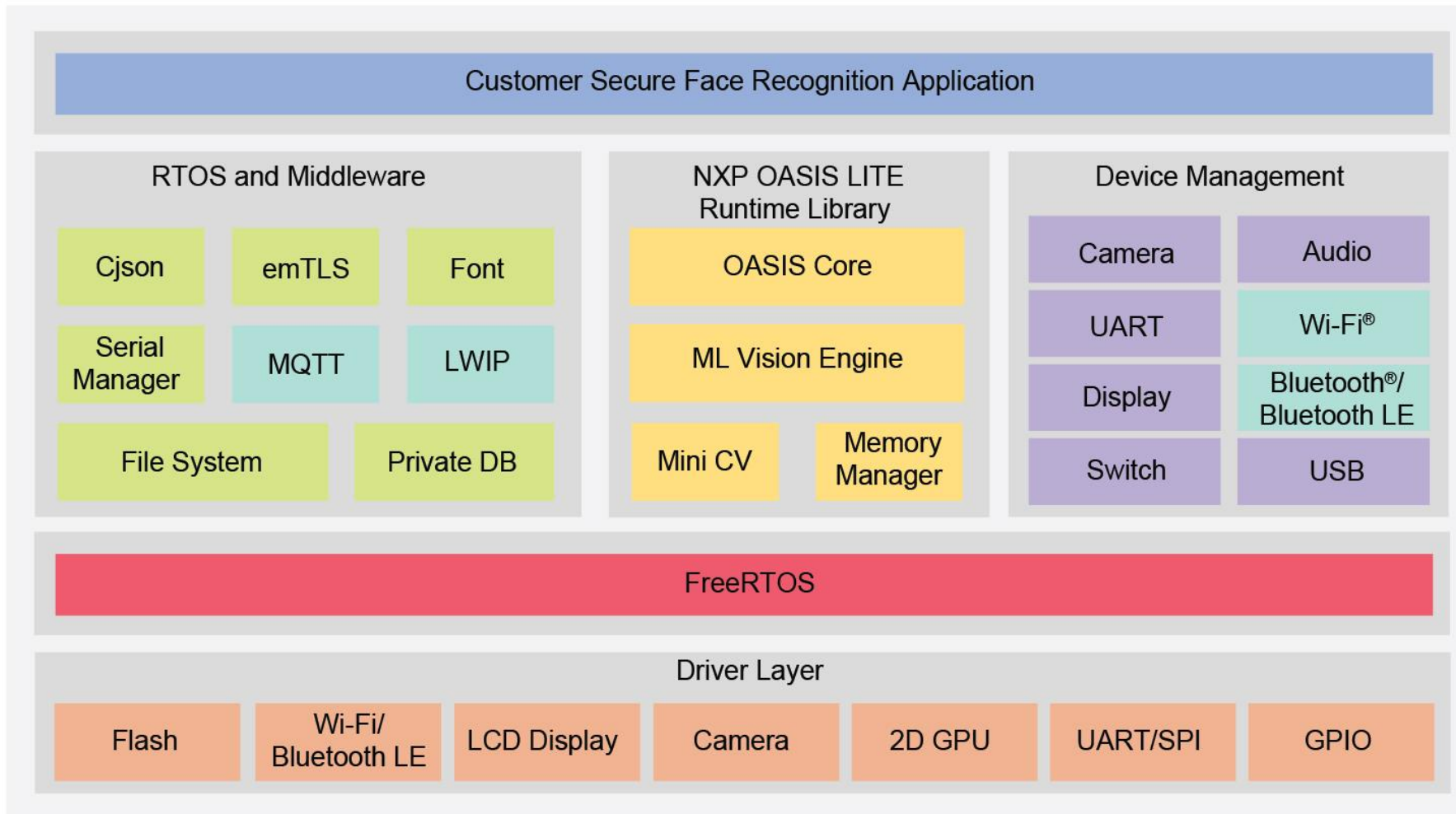
- Pre-integrated software minimizes product development time

- Out of the box automatic registration & recognition

- MCU optimized face recognition pipeline

- Choice of model types to support up to 3000 faces
  - Light – Fastest inference times
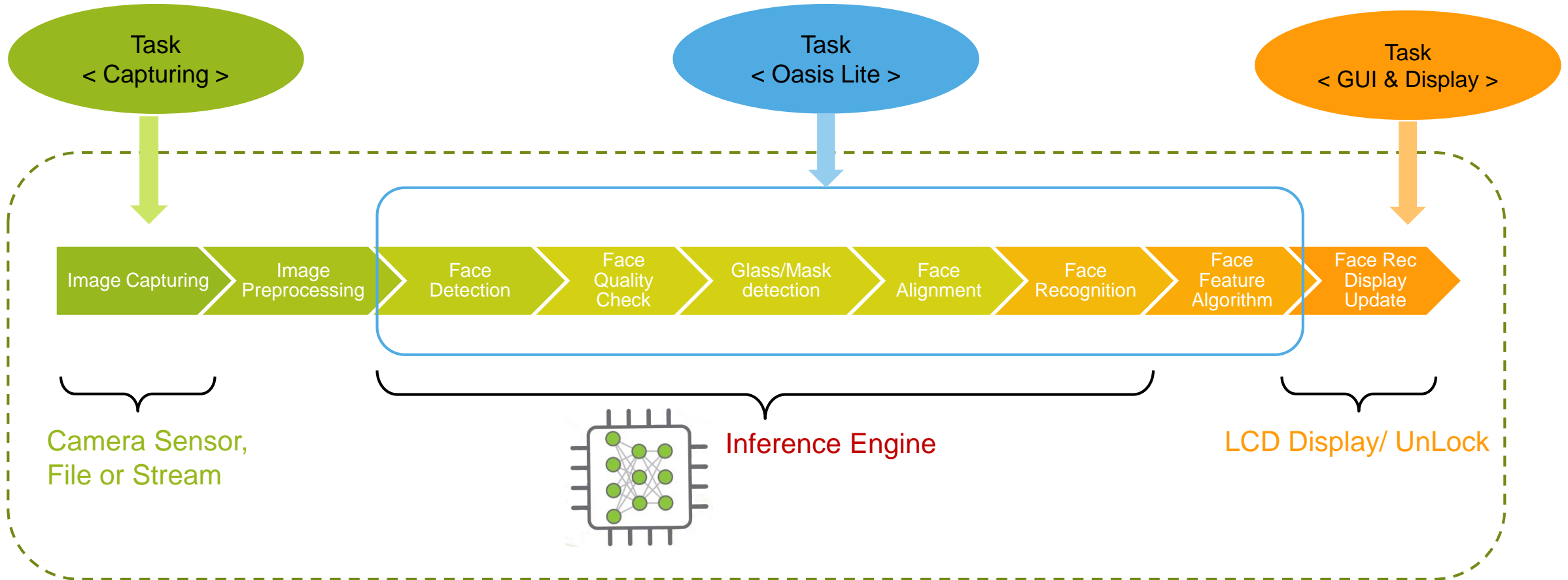 - Heavy – Bigger face database

Model	Light	Heavy
Max # faces (RGB)	1000	3000
Max # faces (IR)	50	100
Total face rec time	<500 ms	<1000 ms

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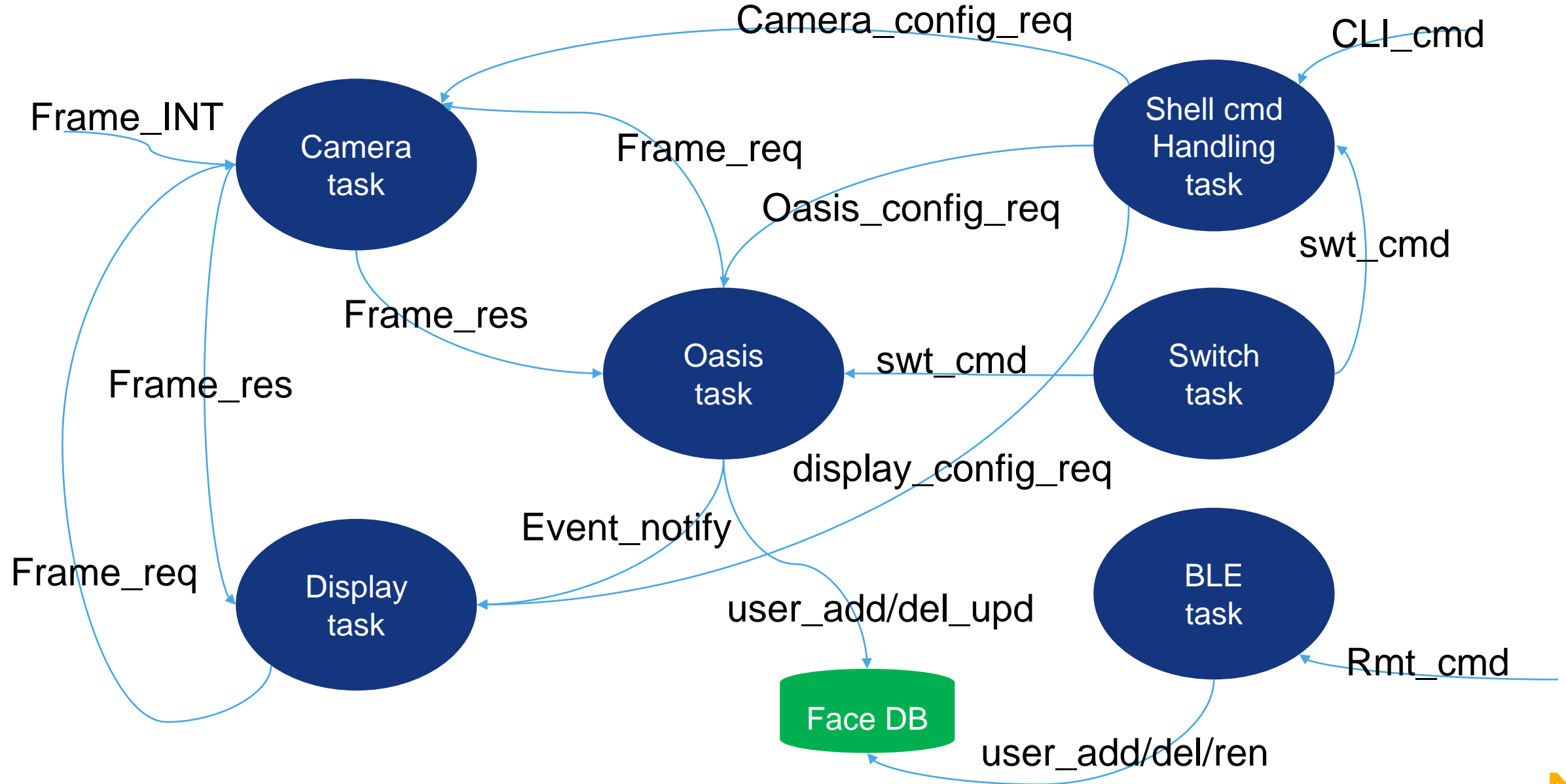
NXP MCU Face Recognition Framework (For Reference Only)

REMOTE REGISTRATION

REMOTE REGISTRATION CAPABILITY

Phone App

Oasis Lite
ARM A-Core

Reception Desk

Oasis Lite
X86

Face Feature
Data

BT or Wi-Fi
Gateway

Oasis Lite
ARM M-Core

Door Access

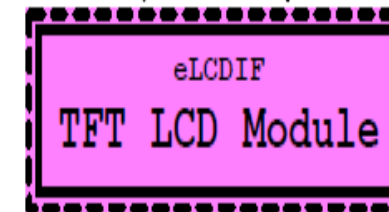Smart eLock
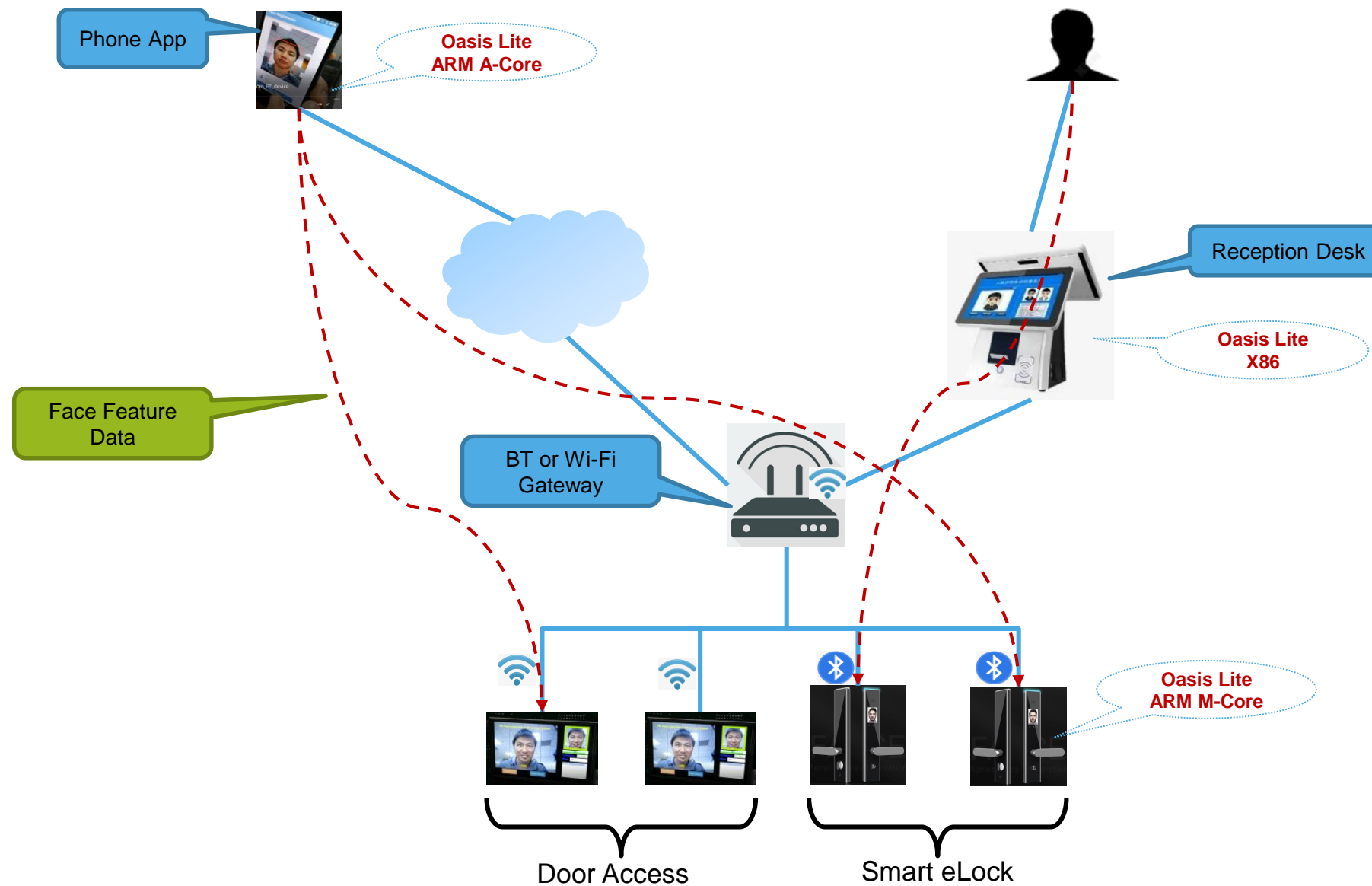
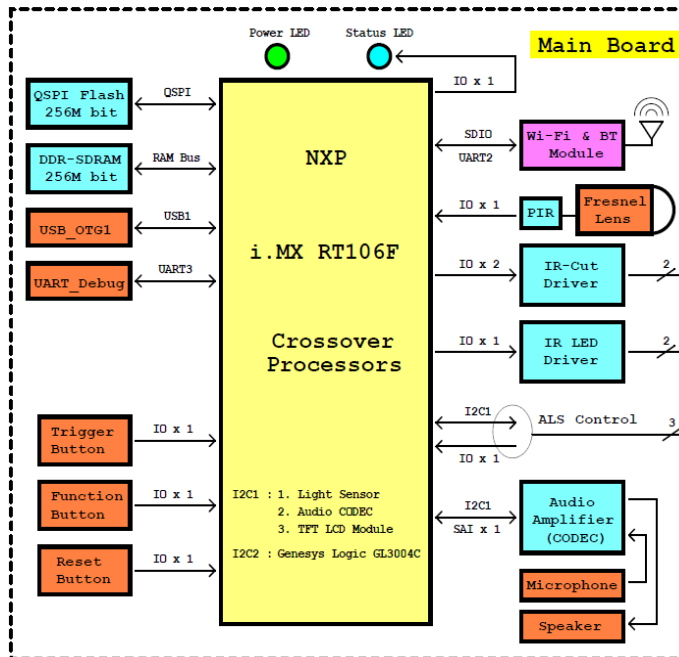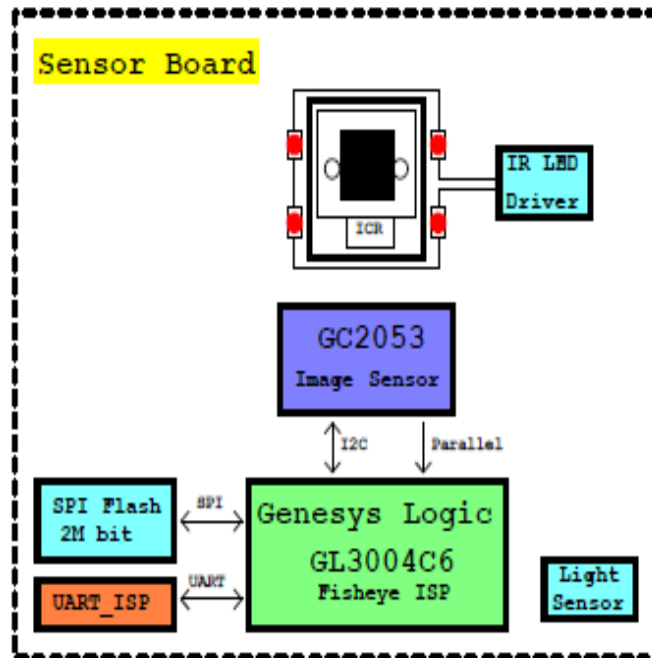# REMOTE REGISTRATION & GUI OPERATION (APK)
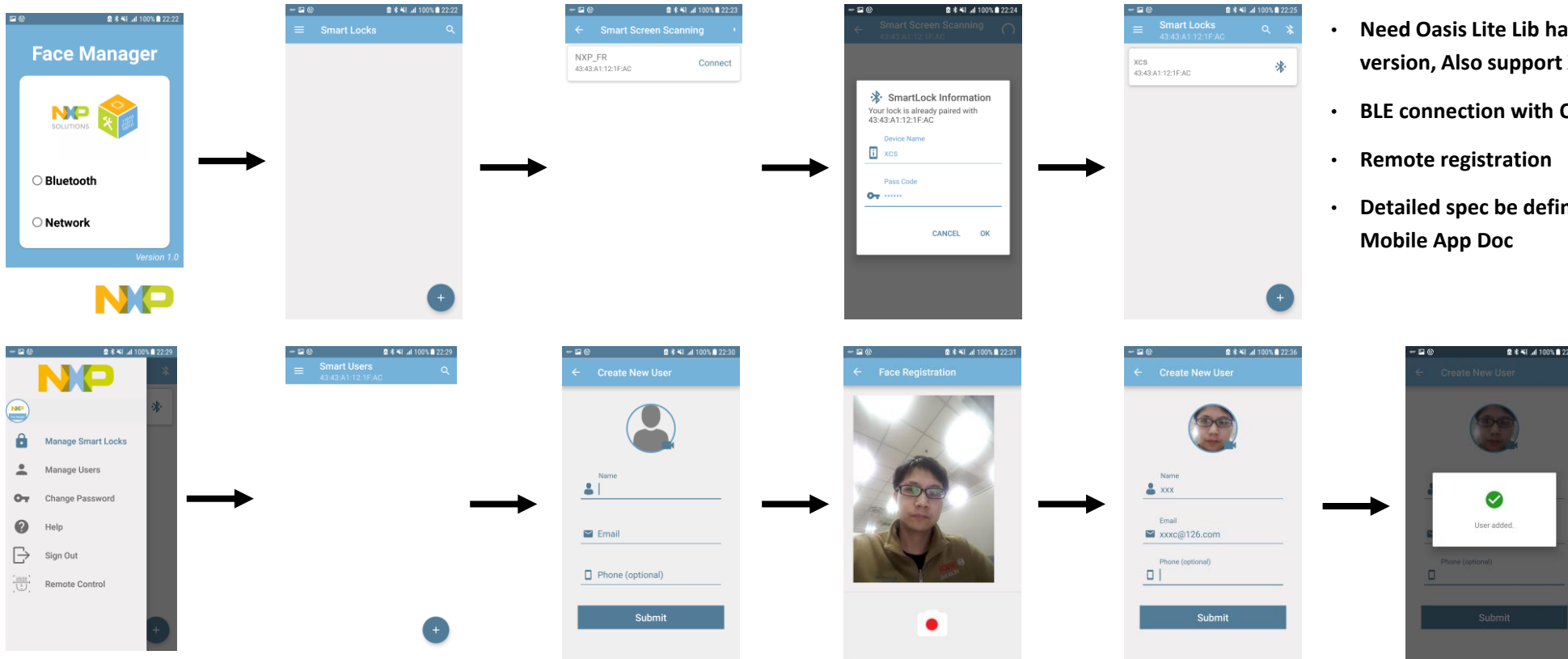
- • **Need Oasis Lite Lib have ARM M7 and ARM A-core version, Also support X86 version. (Bit match)**
- • **BLE connection with OOB**
- • **Remote registration**
- • **Detailed spec be defined in the separate dedicated Mobile App Doc**

FISHEYE DOORBELL SOLUTION

MXRT106F+FISHEYE GL3004

FISHEYE DOORBELL SOLUTION

- Real large field of view

  - FOV >= 160°

  - Auto rewrapping and focusing.

- Both day/night modes support

  - Day/night mode switch automatically based on ambient light condition.

  - IR LED and IR camera enabled automatically in night mode.

- Auto focusing, zoom in/out and face tracking based on face position.