v7.3.28

Rhonda Software

Company Profile

Company Highlights

Software & Hardware design house with a focus on Embedded solutions in the areas of Imaging, Multimedia and Connectivity domains.

- Established in 1995, decades of Engineering experience
- Camera Imaging experts since 2007
- History of over 200 camera products
- 100+ engineers (EE, ME, SW, QA, IQ, etc.)
- Close Ambarella design partner
- Experts in Still & Video processing, Connected devices, Computer Vision, Cloud based services and Mobile Applications
- Certified SEI SW-CMM Level 4 – high quality standards
- Excellent performance record with Motorola (customer since 1997), CSR, Ambarella and other partners

Clients and Partners

Motorola (USA) www.motorola.com

- E-mail client component ownership, Multimedia applications (audio/video player, picture viewer, voice recognition), OS drivers and services, Android QA (test automation/execution), i-Mode™ (NTT DoCoMo) integration

CSR/Zoran (USA, Japan, Korea, Israel) www.csr.com

- In 2007 – 2014, Rhonda has made a major contribution to COACH Camera SDK development, many cameras for major brands were taken to mass production

Ambarella Inc. (USA, Taiwan) www.ambarella.com

- Rhonda's Imaging platform of choice since 2014. Middleware & Application level development and support on new video / still image processing SoCs (A12, A9, H2, H22, S2L, S3L, S5L, CV-line)

Sony Image Sensors Group https://www.sony-semicon.co.jp/products_en/IS/sensor0/security

- Rhonda's hardware partner. Custom drivers development for new image sensor products (not originally supported by imaging platform)

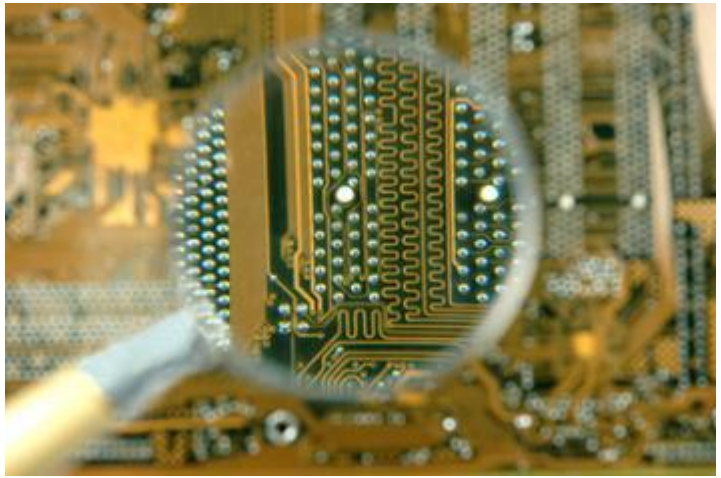
Cypress www.cypress.com

- Rhonda's hardware partner. WiFi/BT silicon for connected devices. Drivers support & high complexity connectivity scenarios implementation

Murata www.murata.com

- Rhonda's hardware partner. WiFi/BT modules based on Cypress chips. Used in many designs

Camera Development Cycle



Requirements, Architecture & Feasibility

- It all starts with project analysis, scope definition and customer requirements elicitation
- There are three main deliverables:
  - Project Evaluation Document – key components, major features, capturing modes
  - Product Requirements Description – use cases, behavior, functionality, architecture
  - Project Proposal – estimated efforts, cost and schedule

Optical System Selection

- Depending on defined features, the most appropriate image sensor and lens candidates are proposed based on the spec analysis and in-lab research

Hardware Design Definition

- As per customer request, the required level of responsibility is taken – from review and recommendations up to full EE design and ME recommendations

Camera Development Cycle

Project Management

- Skilled management assigned to control all necessary PM activities: resource and tasks planning, tracking, reporting, etc.

Quality Assurance

- Automated Camera testing is a must and as such it incorporate various levels of testing: sanity, regression, feature, integration, system, etc.

Image Quality Tuning

- Having Image Quality Lab and trained experts the best resulting picture possible is ensured by dedicated Ambarella SoC IQ Pipeline tuning

Camera Manufacturing Support

- Production line quality control (on different stages of camera assembly) is established to filter out malfunctioning hardware parts and poorly assembled units
- Additional per-unit Image Quality calibration of each individual Optical system is provided to fix defective pixels, enable correct color representation and mitigate lens shading effects

Technology Profile

Platforms

- Linux, ThreadX, MQX, VRTX, Android, Windows, NetBSD, FreeBSD, CentOS, Mac OS, iOS

Domains

- Camera imaging, computer vision, drivers, protocols, networking, connectivity, multimedia, security, cloud applications

Main Programming Languages

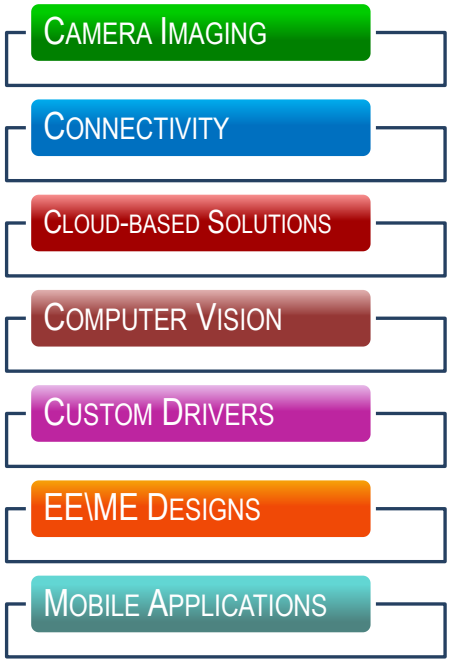
- C/C++, Assembler (ARM, MIPS, ARC, x86 and other), C#, Perl, PHP, Python, Java (including Enterprise Java), Ruby, JavaScript

Cloud

- AWS, Cassandra, MongoDB, MapReduce (Hadoop), HDFS, ZooKeeper, ElasticSearch

Process Tools

- Capistrano, TeamCity, Jenkins, Quickbuild, Git, SVN, Perforce, Redmine, Jira, Zabbix, Reviewboard, Nagios



Camera Imaging Highlights

Being a close Ambarella's design partner Rhonda Software covers many aspects of Camera Hardware and Software development.

- The most advanced Ambarella System on Chip (SoC) models are used for the camera projects: A12S, A12W, A9SE, H2, H22, S2L, S3L, S5L, CV1, CV2AQ, CV22
- Rhonda Camera SDK built on top of the low-level Ambarella System Support Package (SSP) allows to speed up development cycle of complex custom Cameras and hit the market faster

- Video and Still flows (multiple sensors, multiple streams)
- Wide range of peripherals drivers (including Image sensor drivers) designed in-house
- Variety of Connectivity features (BT on RTOS, Wi-Fi on RTOS, BT/Wi-Fi on Linux, MFi, LTE, etc.)
- Additional support for Linux features (v4l2, inter-process communication between RTOS and Linux over standard sockets, etc.)

Video & Still Capture

Video Recording & Still Image Capturing

- Recording from up to 8 sensors, storing/streaming of up to 4 video streams, playback of up to 2 video streams at the same time, modification of recorded footage
- Single / Burst image capturing

Image Processing & Performance Optimization

- Deep knowledge of Ambarella video pipeline, RAW → IQ filters → YUV → compression, streaming
- H.264 / H.265 encoding, JPEG encoding
- Image stabilization, temporal filtering, audio processing
- DRAM/CPU consumption optimization, bandwidth consumption profiling, tight system load balancing
- Battery consumption optimization

Formats, Protocols & Codecs

- File formats: MOV/MP4, AVI 1.0/2.0, MPEG2 TS, MP3, AAC, JPEG, EXIF, Multi-Picture format, DNG
- Streaming: UVC/UAC, RTP/RTSP
- Video codecs: H.264, H.265, MJPEG
- Audio codecs: AAC, uLaw, ADPCM, various PCMs

Image Quality

Rhonda's Image Quality experts armed with all required equipment and Know-How are able to tune the entire Ambarella SoC IQ Pipeline and deliver the best Camera IQ possible.

- Product specific Lens & Image sensor selection
- Image Quality Lab for thorough Optical system analysis
- Baseline IQ tuning of selected Lens & Image sensor and Factory IQ calibration:
  - Noise reduction, tone mapping, color fidelity
  - Aberrations, shading, distortion correction
  - Sharpening, local contrast enhancement
- In-house 3A algorithms implementation (Autofocus, Auto exposure, Auto white balance) with additional capabilities for multi-sensor Cameras (e.g. for Virtual Reality cams)

Camera Production Support

At the production line there are two main quality-related aspects covered: Manufacturing Quality control and Factory IQ calibration.

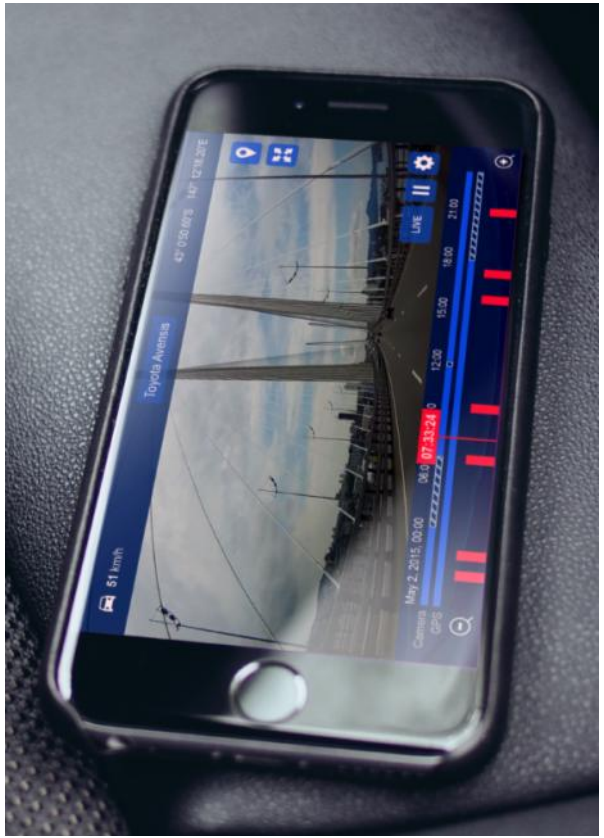
Manufacturing Quality Control

- Well-defined pass/fail criteria to filter out those hardware components that cannot be accommodated for manufacturing and assembling variations
- Automated testing software to find malfunctioning parts (e.g. connectivity modules, audio components, GPS), dirty image sensors, poor lens alignment, focusing issues...

Factory IQ Calibration SW

- Per-unit calibration of each individual Optical system at the production line:
  - Defective pixels correction
  - White balancing
  - Lens shading compensation, etc.
- Quantitative success criteria
- Computer vision based validation algorithms

Video Cloud Solution



Celesta

In-house Video Cloud Platform.

- Cloud-connected Car-DVR functionality support
- Remote video storage and instant video access both to archived footage and re-routed real-time stream from connected devices
- High definition video with triple storage replication
- Playback through web-browser & mobile devices
- Live Geo-tracking with Google maps integration to monitor current / last known location
- Video timeline with events markup & playback
- Event notifications on mobile devices (iPhone / Android): Email, Push, SMS
- MP4/JPEG support with video to the cloud upload resumed in case of instable network interruptions

Android & iOS Applications

Remote Camera Control

- WiFi, BT, BLE, LTE protocols
- Optimized low-latency video preview from camera over network
- Remotely triggered camera actions (start/stop recording, take snapshot, zoom +/-, etc.), seamless device pairing and camera file system operations by customizable protocol
- (Re)Stream video/audio to the cloud: YouTube, Celesta, Custom configuration
- Mobile device based solutions to be provided as standalone Apps or camera control / video-stream SDK for integration with customer's own Mobile App with branded UI
- Apple device connection with MFi chip authentication support
- Camera Firmware update over Mobile App
- Multi-camera control by a single connected device working in a WiFi Access point mode

Computer Vision (CV)

Over 10 years of researches in the Computer Vision domain with experience in both PC-based CV algorithms development and Embedded platforms porting.

- FPGA, DSP and GPU CV methods acceleration skill set
- Production-grade Audience Measurement video-analytics that includes: bidirectional people counting, face detection & tracking, facial features classification (gender, age group, pose)

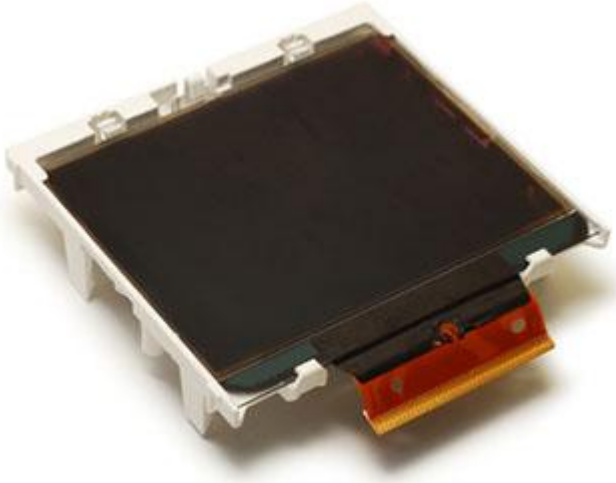
- CV-powered Factory Image Quality calibration and Optical systems inspection procedures:
  - Automated IQ calibration results validation
  - Image sensor dust particle contamination detection
  - Sensor to lens alignment check
  - Optical resolution calculation powered by automatic chart detection
  - etc.

Data Storages and File Systems

- Various types of NAND chips: C/Asm-based drivers, speed optimization, support for specific vendors' features, ECC, Translation Layer (between File System and NAND), etc.
- Support for SD and MS-Pro cards: C/Asm-based drivers, support for various card subtypes (SD-ROM, SD-WORM, EyeFi card, etc.), speed optimization, etc.
- File Systems: Experience with all the types of FAT, including exFAT: FileX-based FS layer support and optimization for customer's needs. Interaction between File System and low-level NAND and SD drivers
- DCF: Experience with DCF (Design rule for Camera File system), a specialized upper level for file-management, using a low-level FS API to maintain a standardized set of folders and predefined rules for files/folders naming, storing, association, filtering and many more
- Boot-timing optimization: FW loading from ROM (NAND) timing, SD-card mount timing, timing of various HW/SW modules' initialization, etc.

External Devices and Peripherals

- UART, SPI, I2C, GPIO, USB, and other types of I/O interfaces: Driver-level and HW-level development, support, debug and analysis
- PWM and ADC: Driver-level and HW-level development and support
- Implementation of various protocols: SPI-based I2S serial audio protocol (C driver + Asm driver), SPI-based UART, SPI-based full-duplex data transfer, using GPIO for controlling various embedded hardware, etc.



- Large experience with CCD and CMOS image sensors (both parallel and LVDS interfaces)
- Driver development and support for Sony, Panasonic, ON Semi (Aptina), OmniVision, Samsung image sensor models
- Serializer/Deserializer for image sensors
- Experience with various displays: Drivers for various LCD types, for HDMI, PAL and NTSC, upper-level display management (API for image layers, drawing primitives, fonts, color management, etc.)

Device Drivers

- Audio: driver for ADC, DAC, I2S (bring up of external codecs); Audio Filters (HW and SW ALC, AGR, Notch, BP, LP, HP, Equalizer) implemented on MIPS and Arc + Desktop designer; PCM, Intel ADPCM (IMA), AAC (support only); Audio Quality (noise reduction); Validation with oscilloscope
- Sophisticated driver for Digital Image Processing filters implemented in HW (up to 40 filters: Scalers, WBC, BLC, CSH, LSC, LDC etc); Formats: Bayer8/12/16, Y-only, YUV444, YUV422, YUV420, GBR420, RGB24, RGB48; Alpha blending, geometrical calculation, IQ pipeline, motion estimation, memory optimization and speed optimization

- JPEG Driver (encode, decode, estimation, DCT, qt, hufman)
- RTOS support: two MIPS CPU, ThreadX; abstraction layer (Threadx, MQX, Windows); work with HW in batches (hw command buffer pattern); watchdog; inter-processors communication, context switch profiler, ISR latency profiling, logging framework
- Driver for Clock generation unit (clocks 15+ different clocks, dividers, reset); Power optimization; work without DRAM; code optimization to fit ROM size restriction, validation with oscilloscope
- Driver for Memory Management unit (DDR broker); bandwidth allocation and optimization

Connectivity

Running various connectivity features on Linux (MIPS, ARM CPUs)

- Wi-Fi Direct™ Soft AP Coexistence with Bluetooth and station modes
- Bluetooth stack and applications, camera control over Bluetooth, UART over Bluetooth, HID profile, RFCOMM protocol
- BLE/Bluetooth Smart

- LTE networking
- NFC pairing
- Ethernet

Providing remote access and control of a camera

- Live video streaming from the camera (HLS and RTSP/RTP protocols, MJPEG and H.264 formats)
- Remote camera control and settings management
- Access camera memory card and file transfer
- Rhio Streamer (RTMP, HLS, MPEG-DASH),
- Cypress WICED BT/WiFi on RTOS stack

Embedded Linux

Linux User Level Experience

- GUI applications (based on Qt, Gtk Embedded, DirectFB)
- Custom boot process for aggressive boot time optimization
- Various System-specific daemons and services (includes multi-threaded/multi process applications)
- Various network applications/services (Video/Audio streaming, Webserver's/CGI's)

Kernel Mode

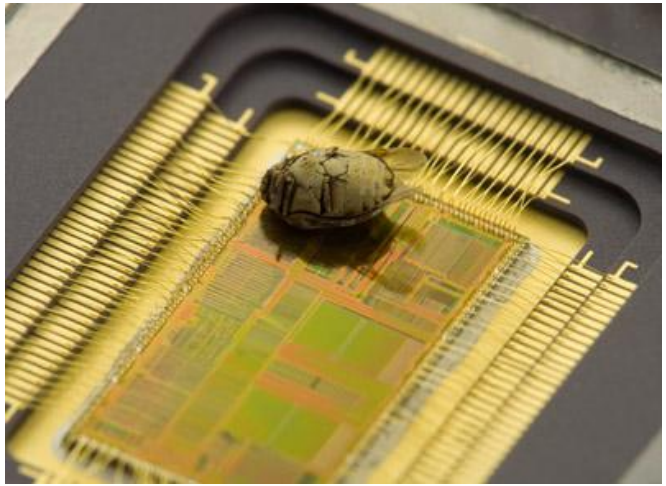
Porting Linux to various SoC (MIPS & ARM based), including development and support of platform drivers

- USB Host & Device, Ethernet
- SDIO(for WiFi chips connection)
- Frame buffer / NAND controllers
- GPIO/UART's/Timers/I2C/SPI/Power-management/CPU frequency scaling drivers for RTOS/Linux communication (Ipc/Rpc)

Embedded Debugging

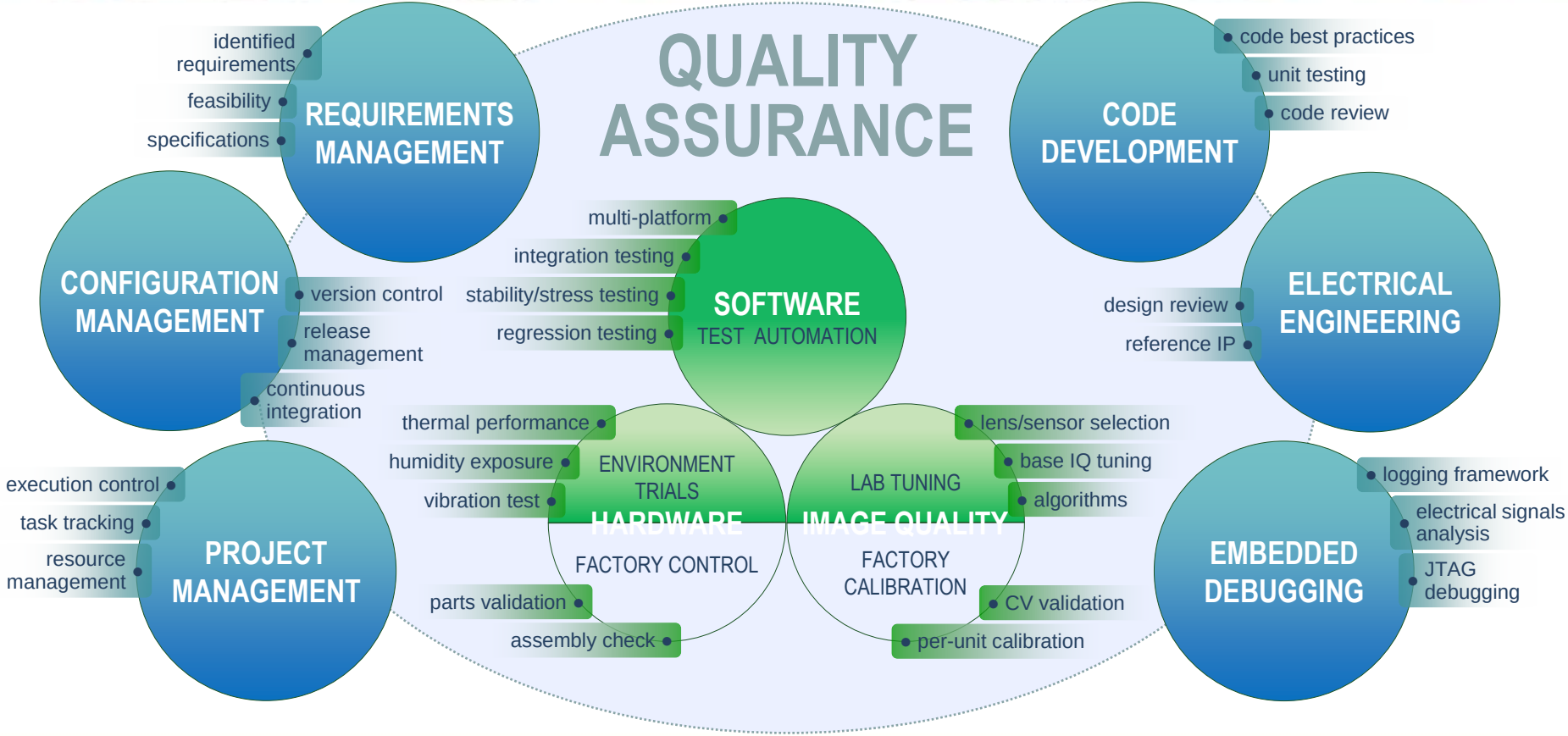
Extensive experience with debugging of embedded solutions

- Image/video corruptions debugging
- Audio quality issues debugging
- Custom debug tools development
- Cross-platform logging infrastructure



- Large experience in debugging issues “on remote”, i.e. when issue is reproduced only at specific customer environment and not at developer local environment
- User Level applications with JTAG & gdb / gdbserver
- Kernel mode debug with KGDB, JTAG
- Post-mortem debugging by crash/memory dump analysis
- Debugging of very timing critical issues with logic analyzers, oscilloscope and custom HW

Integrated QA Process



QA Automation

Fully Automated Regression Testing of Imaging platform

- Proofbuild system controls entire process – get code from SVN, compile for different platforms / configurations, burn, execute tests, store test results
- The Auto-test lab has 80+ test platforms installed
- In-house test result management database was developed to store test results, generate test execution reports, provide some analytics
- Regression test cycle was reduced from ~5 weeks to 5-6 hours

In-house Application Test Framework (ATF)

- The main goal of developed framework is to automatically emulate camera's end-user actions
- Framework provides the set of APIs that allow testing of Customer Application and SoC firmware stack end-to-end. ATF includes:
  - Solution for unit-testing
  - Unified testing interface that provides portability of tests between projects across multiple customers

Security and IP Protection

Security

- Premises secured 24/7 by 3rd party security guards, video monitoring
- Internet & Intranet intrusion protection: firewalls, VPNs, DMZ, traffic monitoring, up-to-date antivirus software, user rights management, security policy
- Backup power supply, several Internet providers, regular data backups

IP Protection

- Customer & Rhonda NDA
- Optional individual NDA with each Rhonda team member
- Customer & Rhonda contract terms
- Clean-room environment with security access
- No cross sharing of engineers on competitive projects
- Regular internal audits and customer audits

Camera Project Options

Camera SoM

- Board-level Camera System on a Module (SoM)
- Out-of-the-box feature set
- Stable HW design
- Pre-calibrated Image Quality
- Can be easily integrated with a customer's application processor
- Low-volume friendly

SoM customization

- Customized SoM Firmware
- Re-designed SoM Hardware
- Additional HW accessories (e.g. new image sensor & lens)
- New SoM platform tailored to your requirements and needs
- Applicable to low volumes as well

Custom Camera

- Unique camera HW: your design or Rhonda's EE services
- Optimal SoC & key HW components
- New Software features & feature interaction scenarios
- System Performance balancing
- Full camera functionality on a single HW platform

Service Projects

- Required level of support:
  - Selected on-project activities
  - Dedicated team of experts
  - Unique features implementation
- Agile project planning and project management
- Highly skilled engineers in critical areas of expertise

Discovery Process (SOW1)

Statement Of Work 1 (SOW1)

- Standalone project
- Requirements, Architecture & Feasibility:
  - Select the best applicable SoC model & part-number along with other key HW components
  - Create detailed Project Requirements Document
  - Confirm feasibility of requested camera features
  - Propose suitable image sensor model
  - Estimate Project Duration and Project Cost
- One month period (typical duration)
  Actual dates may vary depending on project scope and feature-set complexity
- Scope-driven price
- Allows to secure project scope & support with Ambarella

Camera Development Project (SOW2)

With a Discovery project (SOW1) completed the Camera development project (SOW2) can be started right away. We are open for discussion and dedicated to propose the help you are looking for with the collaboration options best for your project needs.

Camera Project Areas

- Software: SoC Middleware, User interaction, Mobile application, Cloud solutions
- Hardware: HW design, Reference boards, Schematics & Layout reviews, HW bring-up
- Image Quality: Optical components profiling & selection, SoC IQ pipeline tuning
- Factory Support SW: Production line QA & IQ calibration

Time and Material Collaboration

- Adjustable project scope
- Fixed per-hour cost

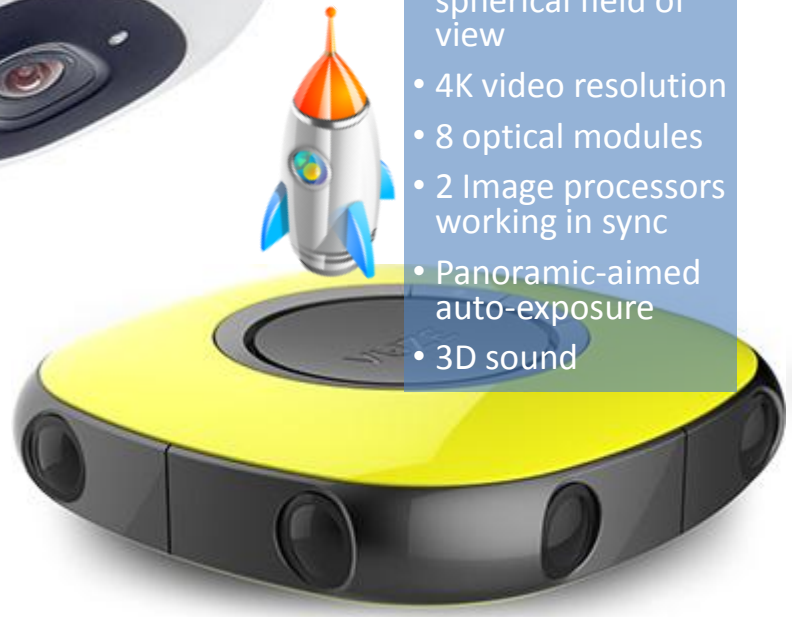
Licenses & Royalty

- License for Rhonda Camera SDK & IP use
- HW designs manufacturing license
- Flexible models of volume-driven decreasing royalty fee

Few Camera Products

Baby monitor

- Real-time HD video stream
- Day/Night mode
- BT pairing
- Wi-Fi connection
- Mobile App
- Sleep analytics
- Surveillance capabilities



3D VR Camera

- 360° x 180° spherical field of view
- 4K video resolution
- 8 optical modules
- 2 Image processors working in sync
- Panoramic-aimed auto-exposure
- 3D sound

Robotic cam

- Automatic filming - pan, tilt & zoom by worn Tag tracking
- Two camera options:
  - 4K, 30 fps video, x65 optical zoom
  - 1080p, 60 fps video, 25x zoom
- Instant focus

Few Camera Products

Time-lapse cam

- 2 optical modules
- 220° combined panoramic field of view
- Solar-powered
- Weather proof
- Wi-Fi connected
- 4G LTE (external module)

Flying camera

- 4K, 30fps video
- Live video stream
- Smooth-lock gimbal
- Still photos / photo bursts
- Modular design
- Smart battery
- Auto tracking capabilities

Sport camera

- Build-in physical stabilizer
- Electronic image stabilization
- 4K, 30fps video
- Still photos / photo bursts
- Activity tracking sensors
- Mobile App

Thank You!

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