Mitsubishi Electric Research Laboratories (MERL)

Annual Report

July 1999 through June 2000

TR2000-00

Welcome to MERL – Mitsubishi Electric Research Laboratories, the North American corporate R&D arm of Mitsubishi Electric Corporation (MELCO). In this report you will find descriptions of MERL as a whole, and of our three laboratories, MERL Cambridge Research, MERL Cambridge Systems, and MERL Murray Hill . We also describe MERL Concord, which is in the process of moving into a separate business unit.

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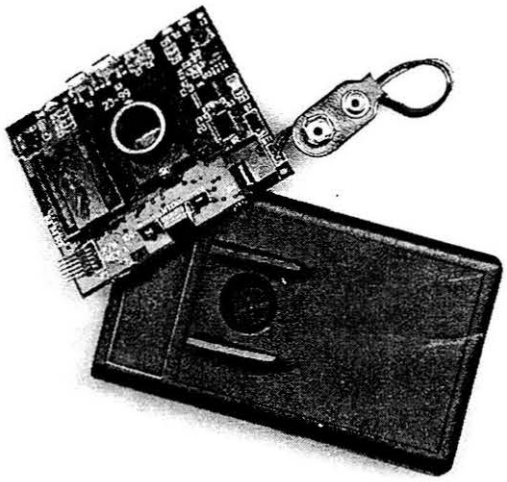
Personal Eyewitness CarCam – Vehicle Accident Video Recorder



The Personal EyeWitness Vehicle Accident Video Recorder provides a robust and tamper-resistant recording of vehicle accidents. The PEW continuously records video into semi-conductor memory, overwriting old video every thirty seconds, and stopping only after an accident triggers the vehicle crash sensor.

The PEW uses Mitsubishi's Artificial Retina chip as an inexpensive image sensor, and Mitsubishi's M32R/D integrated CPU plus DRAM chip to provide data compression and storage. The entire device will be able to sell for approximately US$100 retail.

PEW – Personal Eye Witness, AR: Mitsubishi's CMOS-based Artificial Retina imaging sensor.

Background and objectives: The Personal EyeWitness project goal is to produce a working prototype of a self-contained solid-state video recorder for vehicle accident data capture. The justification for this work is the large market in the US for any system that decreases liability or insurance costs for automobiles, taxicabs, trucks, and buses.

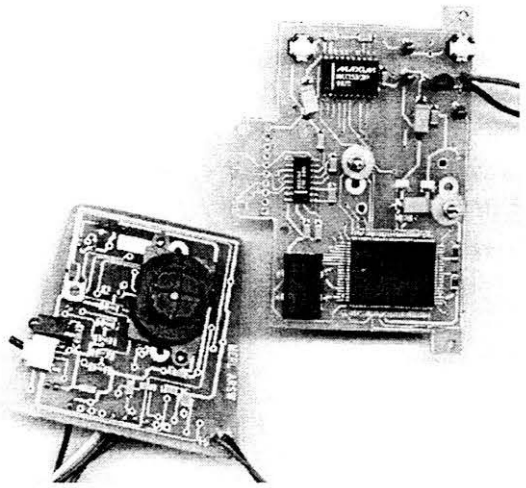
Technical discussion: We have constructed twelve prototype units of the CarCam using the M64283FP Artificial Retina image sensor, the M32R/D microprocessor with 2 MB of DRAM, a solid state accelerometer and 4 MB of FLASH memory. The units are each about the size of a pack of cards and are impact resistant. For demonstration purposes, the units can be attached to small radio-controlled trucks, which are then used to simulate crashes.

Customer focus: The prototype units have been demonstrated at two large shows that Mitsubishi Electric Automotive America put on for Daimler-Chrysler and General Motors. The hands-on nature of the demonstrations as well as the "fun" aspects of camera-equipped toy cars proved to be a very popular combination and the CarCam demo was regarded by many as the "hit" of the shows. The units will be demonstrated to Ford at another large show this September. We are also investigating security applications of the CarCam technology and have some interest from the manufacturer and distributor MCM.

Future Directions: Since most of the technical issues have been worked out, our goal is now to find a customer willing to license our IP and technology. In the mean time, because of the amount of processing power in them, the prototype units make an excellent test bed for portable "smart" camera applications.

Contacts: William Yerazunis, Darren Leigh June 22, 2000

PalmCam – Digital Camera for PDA



The PalmCam is an experiment in using Mitsubishi Electric artificial retina (AR) chips as an accessory for a Personal Digital Assistant (PDA).

The PalmCam experiment explores the use of a highly portable digital camera integrated into a personal digital assistant.

The PalmCam uses an M64283FP AR chip as an imaging sensor, with an M16C microcontroller to produce the control signals, perform A/D conversion, and interface with the PDA serial communications line.

We have developed PalmCam units in several form factors, to fit different PDA applications.

PDA: Personal Digital Assistant, AR: Artificial Retina

Background and objectives: Increasing use of digital imaging integrated into communications and messaging will provide an increasing market for Mitsubishi imaging chips.

Technical discussion: The PalmCam is a generalized design for an imaging accessory for PDAs and other consumer electronics. PalmCams can be implemented in different form factors (two are shown in the photo above). PalmCams use a Mitsubishi Electric AR chip to sense an image, and a Mitsubishi M16C microcontroller to generate control signals for the AR, to convert the sensed image from analog voltage to a digital form, and to interface to the PDA or other consumer electronic device. To decrease costs, the PalmCam uses the on-board A/D converter built into the M16C. Additionally, the M16C can perform image processing on the image or produce a "movie".

Collaboration: PalmCam was developed in cooperation with ARPro in Japan, and with cooperation of the DECWET applications group in the USA.

Future Directions: The PalmCam has been protected by four US patents, and we are actively exploring the profitable licensing of this intellectual property to PDA companies.

Contacts: William Yerazunis, Darren Leigh June 23, 2000

SCAR – Super Cheap Artificial Retina Evaluation Board

The design goal of the SCAR board is to produce and market an AR evaluation board that can be sold at a single-unit price of under $100 US. This goal is achieved by requiring only the absolute minimum hardware, by using the parallel port of a PC as the controlling interface, and by generating all control signals in software.

The SCAR software runs under both LINUX and Windows 98, is open source, and allows all operating modes of the M64283FP AR chip to be evaluated by a system designer, including the powerful image processing modes that are our strongest marketing differentiator.

SCAR : Super Cheap Artificial Retina AR: Artificial Retina (Mitsubishi's CMOS imaging sensor)

Background and objectives: The goal of the SCAR board project is to develop a hardware board and controlling software that can be used by MELCO's USA marketing to leverage the MELCO AR chips into US markets by generating design wins with a low-cost evaluation board. We have beta-tested fifty SCAR boards in the US market, with a strongly positive response, and have been negotiating the sale of SCAR boards through a quick-response distributor in the USA. We hope the SCAR board produces strong growth in the US market for Mitsubishi AR chips.

Technical discussion: In order to absolutely minimize the hardware cost of the SCAR board, only the minimum components are included, such as the AR itself, an inexpensive plastic lens, a pair of buffers, and an analog-to-digital converter. Power is supplied externally from a 9-volt battery. To minimize costs, no case is provided, and the circuit card is laid out without multi-layer techniques. The current design uses the M64283FP AR chip. All control signals for the AR are generated by running a program on a PC, under either LINUX or Windows 98. The PC program generates the timing waveforms in software, triggers the A/D converter, and captures the digitized image. The result is that software (which has zero per-unit cost and can be distributed by the Internet) replaces hardware devices that would increase per-unit price. In beta tests, we have achieved speeds of up to 7.5 frames/second with modern PCs. All of the image-processing modes of the AR chip are accessible, including edge detection, image enhancement, convolution, and baseline projection.

Collaboration: This work was done with the assistance of the ARPro group.

Future Directions: We are currently negotiating final distribution and sales details for SCAR boards.

Contacts: William Yerazunis June 1, 2000