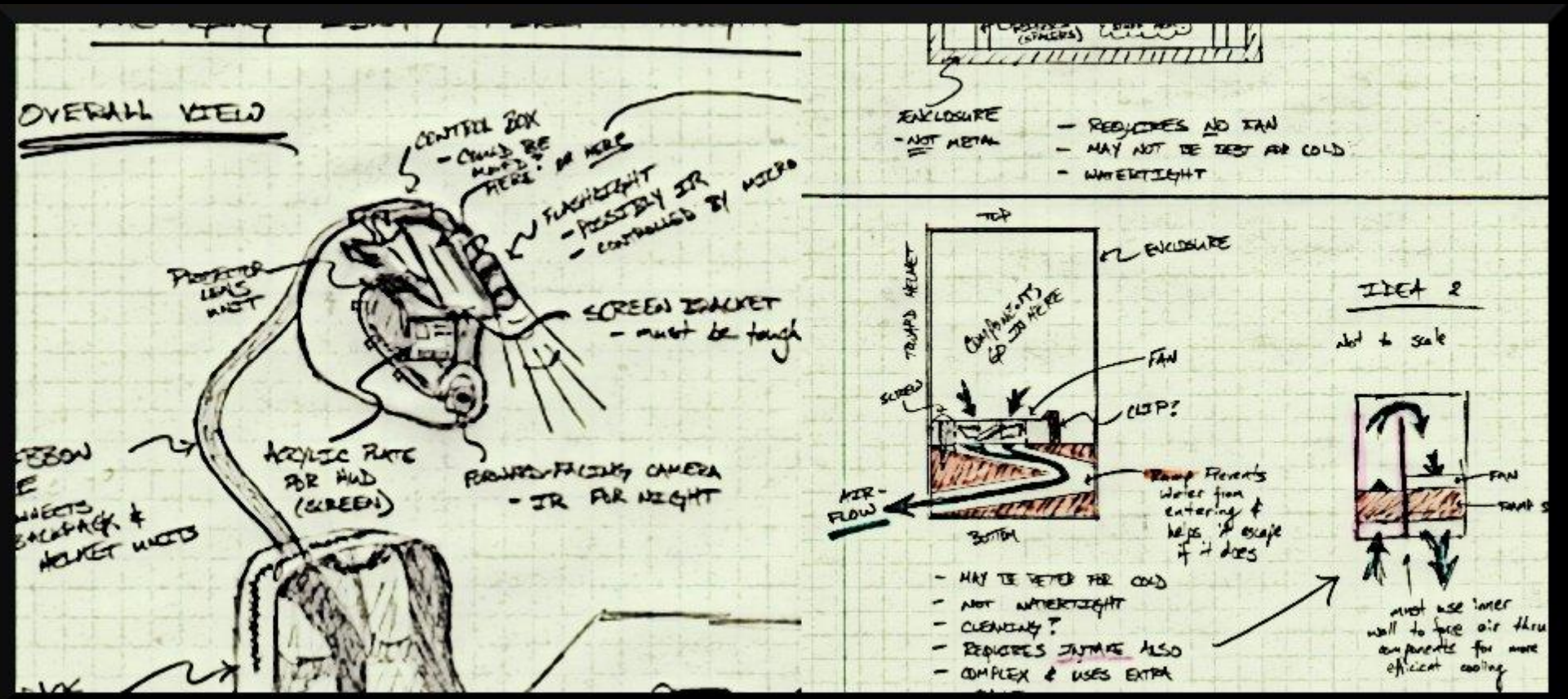
THE INCREDIBLE HUD



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UPDATED PSSCs

- An ability to display critical system information via a heads-up-display (HUD)
- An ability to measure telemetry information (speed, acceleration, temperature, humidity and GPS) and store it to flash memory.
- An ability to maintain portability through the use of a rechargeable battery system
- An ability to enable/disable important features within the display (full information, minimal, on/off).
- An ability to plot recorded GPS data on a map while overlaying telemetry information on a computer.

MAJOR DESIGN CONSTRAINTS

- Electrical specifications:
  - Microcontroller responsible for fusing sensor and GPS data into meaningful packets to be delivered to Intel Atom motherboard
  - Intel Atom board responsible for processing rear-view camera feed, generating GUI elements and outputting VGA signal to HUD
- Optical performance:
  - Collimated light & combiner glass
- Packaging:
  - Majority of components must fit onto helmet
  - Design must be robust enough to be water/dust/impact resistant

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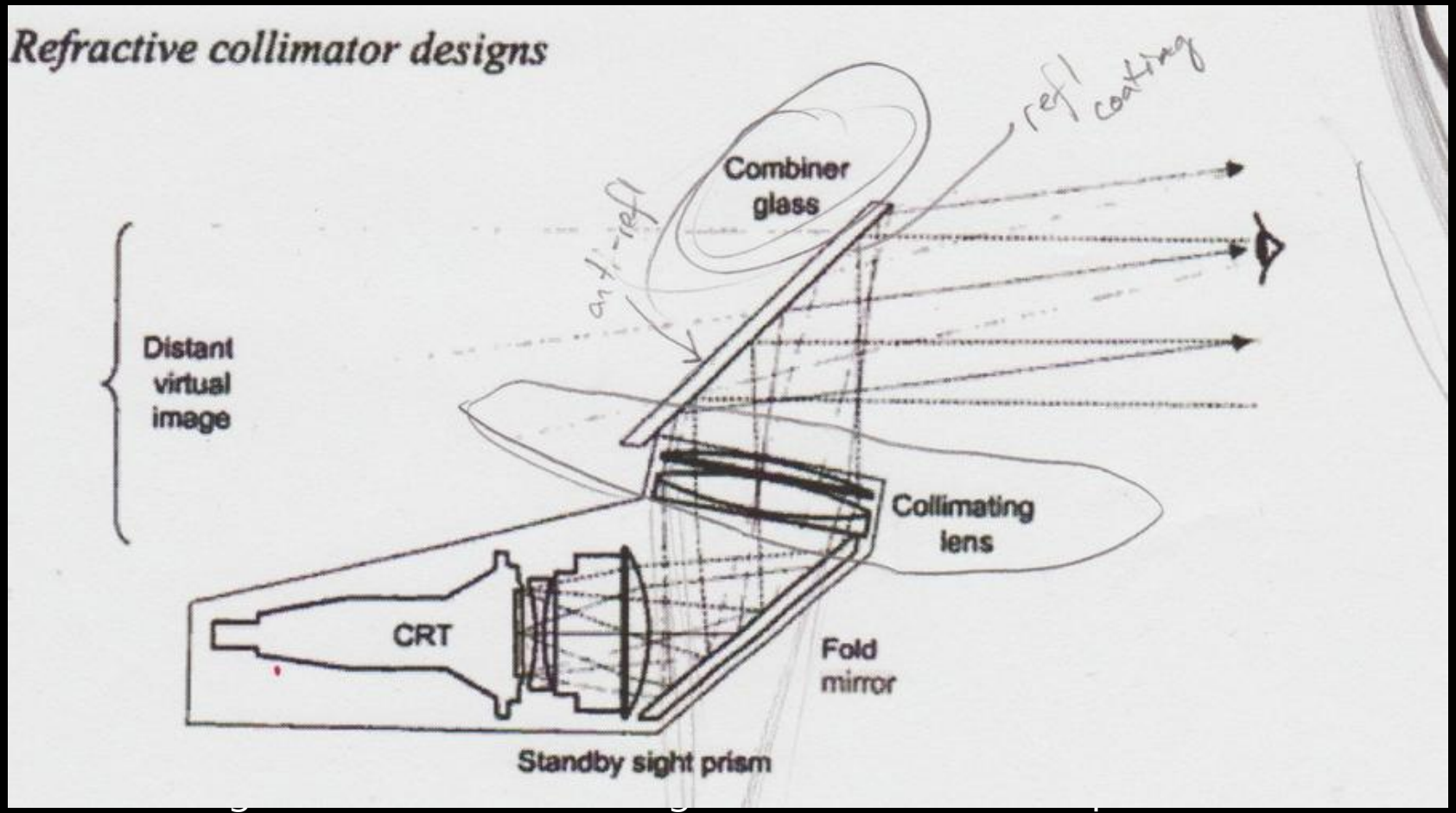

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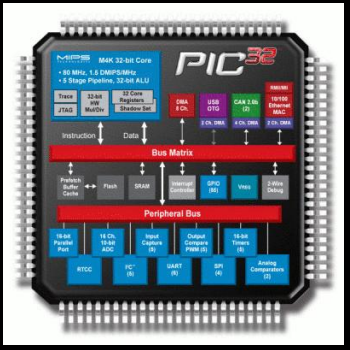
COMPUTATIONAL REQUIREMENTS

- Intel Atom motherboard:
  - Handles all video processing – rear-view camera feed control, generate VGA signal for output to projector
  - Will render GUI elements with telemetry information
- PIC32 microcontroller:
  - Sampling information from GPS module, temperature sensor & accelerometer @10Hz
  - Process raw accelerometer data into meaningful "G-force" value, GPS data into meaningful location and heading data
  - Perform signal conditioning on raw GPS data
  - Parse and transmit aggregated sensor data to Intel Atom board in a custom packet format via RS-232 connection
  - Sample and process control device inputs

eBox510-820-FL



ON-CHIP PERIPHERAL REQUIREMENTS

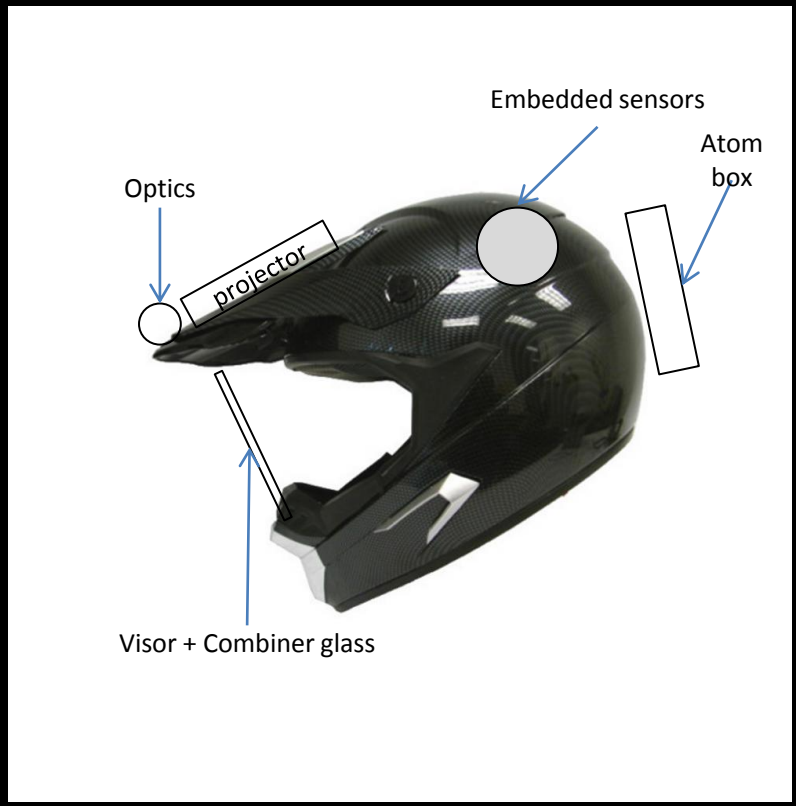
Peripheral(s)	Type	Number of channels
Thermometer (*TI TMP102 Breakout*)	ATD	1
Accelerometer (*Freescale MMA7361 Breakout*)	ATD	3
GPS Module (*Trimble Copernicus 12-Channel Module*)	SCI	1
Microcontroller→ Atom board connection	RS-232 or USB	1/1
Rotary encoder	GPIO	2
Select/Back buttons	GPIO	2
Rear-view insta-select/Kill-switch buttons	GPIO	2
Data collection algorithms & rotary encoder input decoding	TIM	2
Audio feedback to helmet (tentative)	PWM/ Atom	1/1

POWER CONSTRAINTS

- Intel Atom motherboard (Board = 5V, Die = 1.1V)
  - Supports advance power saving features such as SpeedStep
  - Consumes approximately 2W, current draw of processor expected to be ~1.8A
- PIC32 microcontroller & sensors
  - All components function in the 2.7~3.3V range
  - Collectively expected to draw <50mA
  - GPS module is comparatively power hungry, with 35mA continuous current draw when tracking
- Total current consumption ≈1.9A
  - Desired runtime ≥ 2.5hrs
  - Battery capacity requirement ≥ 4800mAh

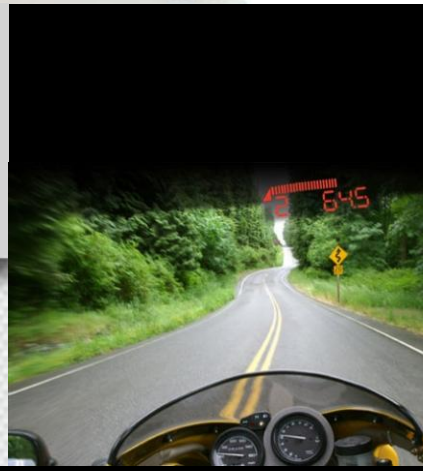
PACKAGING CONSTRAINTS

- Contain as much of the hardware as possible on the helmet itself
- Allow for sufficient heat dissipation by the projector, Atom processor, and GPS mod.
- Optimize device for hostile and extreme environments by ‘ruggedizing’ it.
  - Water, dust and impact-resistant
- Battery may have to be relocated off-helmet due to size required – possibly integrated into a neck-brace or backpack



COST CONSTRAINTS

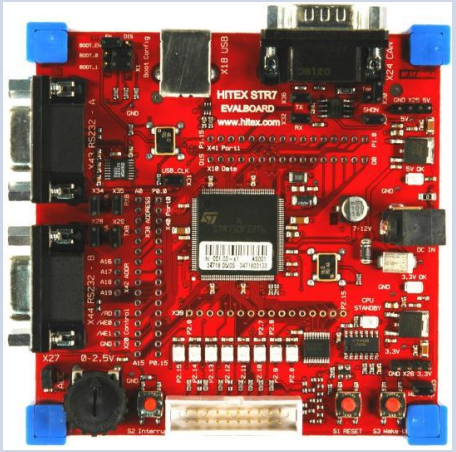
- Closest competitors are diopter based:
  - ‘Smart’ ski-goggles ($631)
  - Retro-fit helmet HUD ($N/A)
- The Incredible HUD is a novel device in both feature-set and display technology
- Target cost is ≤ $1000
  - Display alone = $300
- Costs could be significantly reduced in mass production - heavy prototyping costs%



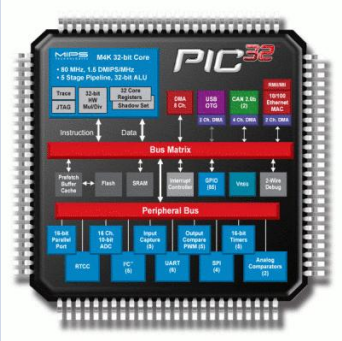
COMPONENT SELECTION: Projector

Optoma PK201 Pico Pocket Projector	SHOWWX+TM laser pico projector.
	
20 lumens, WVGA resolution, LED projection technology	15 lumens, WVGA resolution, Laser projection technology
159g, 17x61x118mm	122g, 14x60x90mm
$250	$249
Virtually non-existent documentation	Excellent documentation, tear-down information available
Mechanical optics	Solid-state optics – more rugged
Unnecessary media oriented features	Limited but well-developed feature set

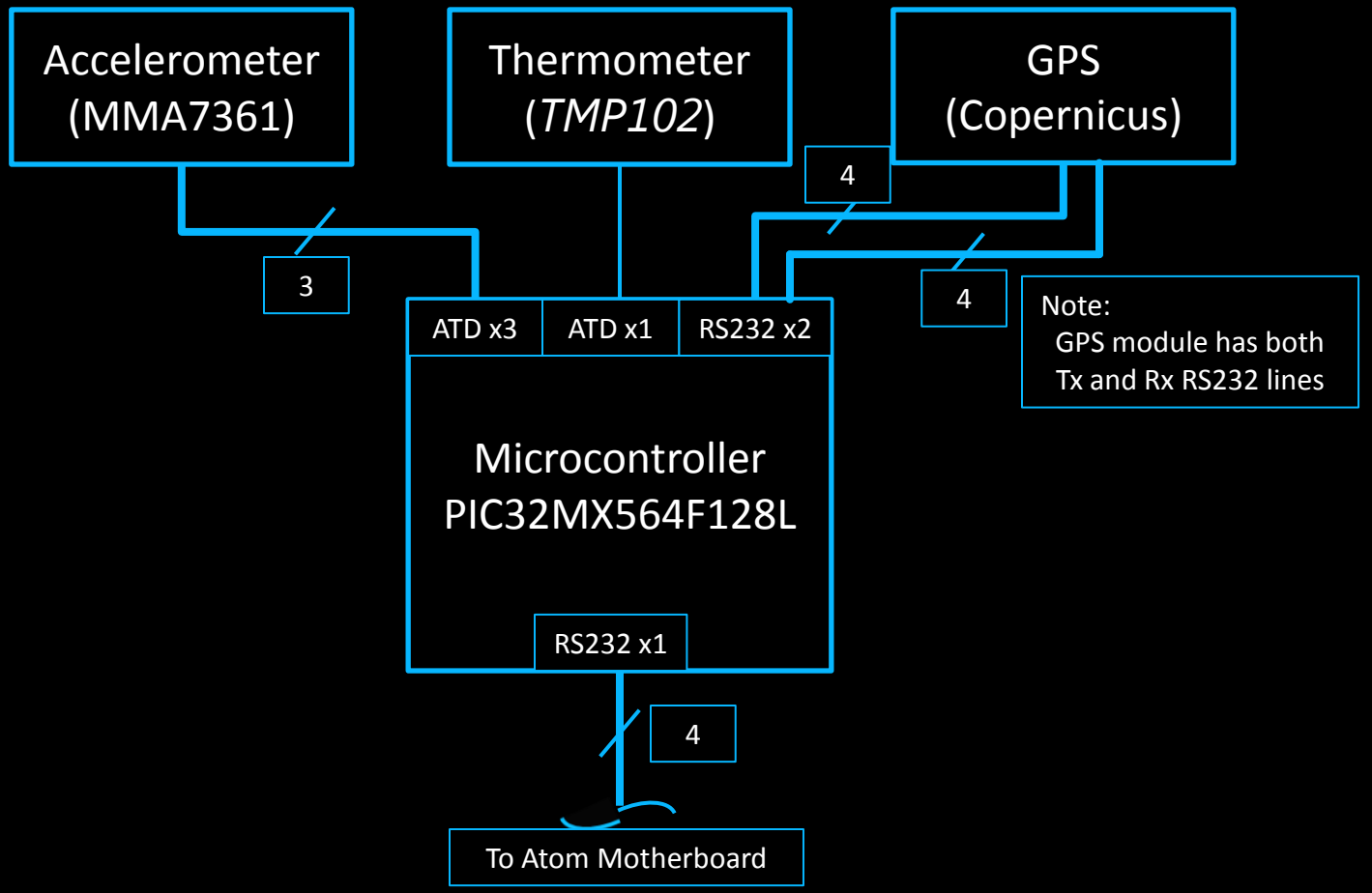
COMPONENT SELECTION: Motherboard

ARMv7 based motherboard	Intel Atom based motherboard
	
Only UNIX OSes supported	UNIX and Windows Embedded 7 support
No packaging solutions readily available – would have to be custom fabricated	Rugged case available
Sponsorship not available ~ $150-$200	Free!

COMPONENT SELECTION: Microcontroller

PIC32 Microcontroller

Low power consumption
Abundance of on-chip-peripherals
Native USB support
Previous experience with PIC32s
Easily and quickly sampled from Microchip

Block Diagram: Microcontroller



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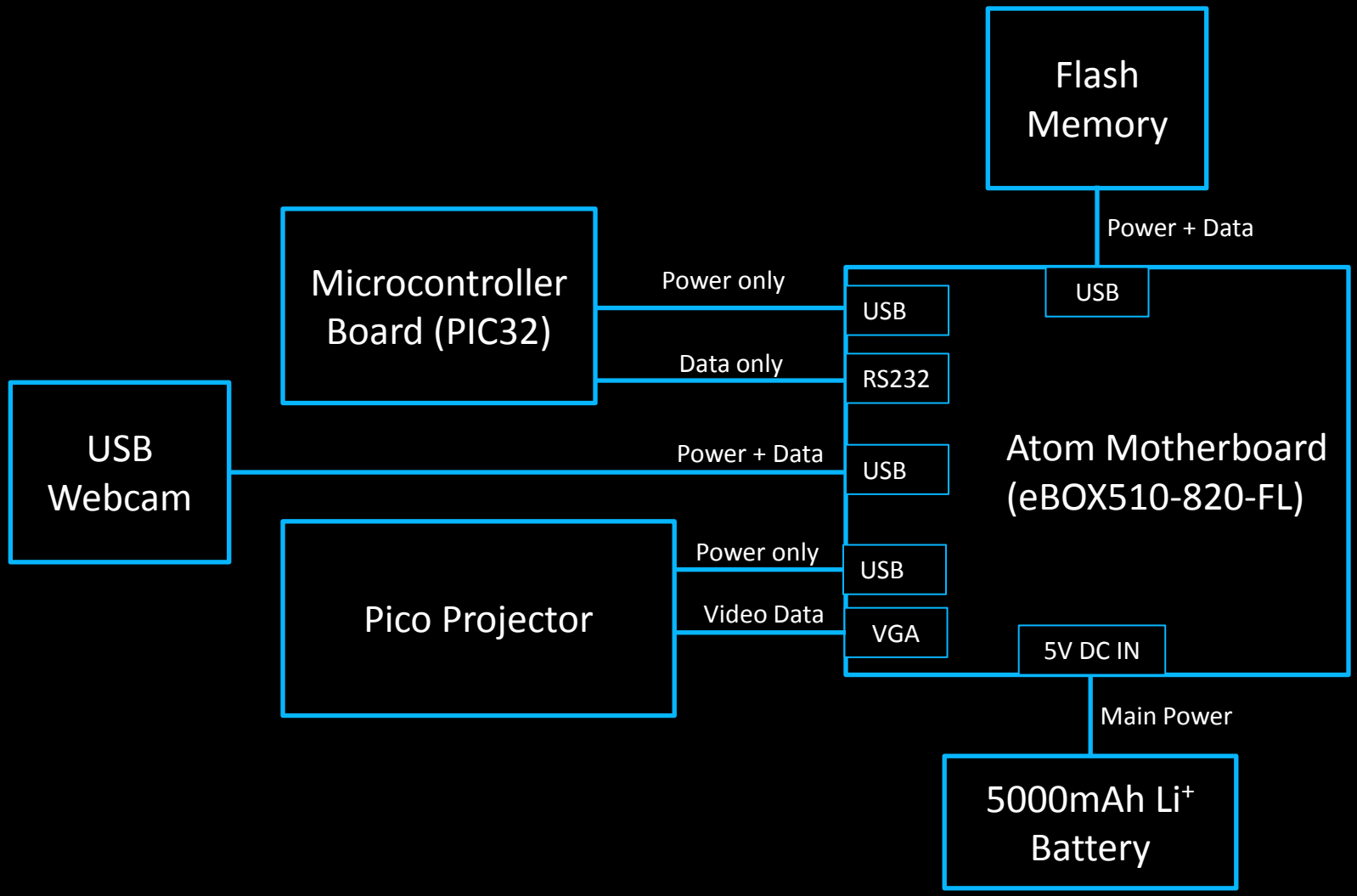

Questions or Comments?

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