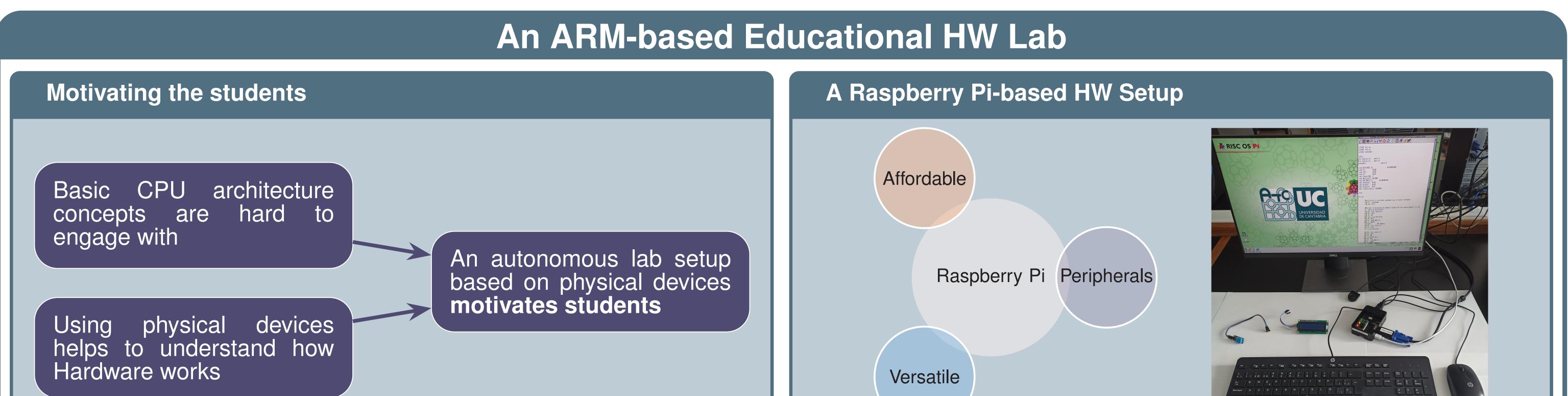
Towards a RISC-V Educational HW Lab

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RISC OS/UCDebug

GUI and simplified **peripheral** management is crucial for an initial approach to HW



RISC OS: ARM-developed OS with easy HW access



UCDebug: in-house developed
tool capable of debugging
interrupt handlers

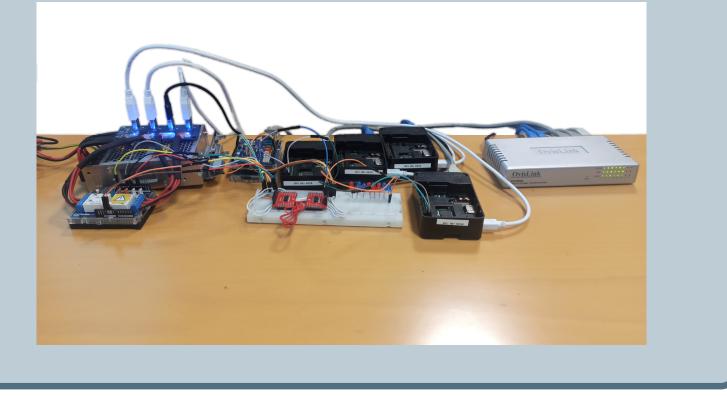
0x00019000	1200ECFE	BC6CC8F8	3 718138	7A	95016683				l.z8.q.f
0x00019010	4B0DB2D4	8B5312C7	AE0F80	AE0F80C0 36BB6908				K	si.e
0x00019020	7937A767	5BE6FF9F	EBDD1E	79	FAEC4365			g.7y	[yeC
0x00019030	33139E18	B486FF29	6EC407	BF	45292D0F			3)h)H
0x00019040	0E7CD095	8CF47CCF	E0692A	F5	6B0BAD8F				. *i}
0x00019050	6EA893C5	7018A7B0	D4341F	66	73FD622E			n	pf.4b.s
0x00019060	05F0D2F7	2EEF6CA1	429719	61	134D44A8				.laB.DM.
0x00019070	EFBBE080	0D076290	2 9D4126	9D4126C8 C79AA354					.b&A.T
0x00019080	A0286D9A	3C8F940E	E 38D4A8	F6	63857050				<8Pp.0
0x00019090	E01E66F1	0FE78002	2 E5510D	510D48 8080F447				.f	H.Q.G
0x000190A0	11A8ED8F	38A0ECFE	3 1A0C48	E2	E2 FBA07C98				8.H .
0x000190B0	4D23C66D	D8345DC8	B D129D8	EB	12511D6E			m.#M	.]4).n.Q.
×		Co	ode			-	×	CPU	Register
0x00018088	0x46F4A9AD	LDRMIBT R10,	[R4],R13,LSR	#19		<u> </u>	RO		0x2316FB1F
0x0001808C	0x7257ED9C	SUBVCS R14,	R7,#&9C,26				Rl		0x00012544
0x00018090	0xEEDCCF34	MRC CP15	5,6,R12,C12,C4	,1			R2		0x00020000
0x00018094	0x217E9447	Undefined in	nstruction				R3		0x0001FFFH
0x00018098	0x241A435A	LDRCS R4,	[R10],#-858				R4		0x00008C00
0x0001809C	0xD5AE56AF	STRLE R5,	[R14,#1711]!				R5		0x000123A8
0x000180A0	0xB0CEDF92	SMULLLT R13,	R14,R2,PC	;	*** Not R15		R6		0x00035814
0x000180A4	0x0E321DDC	MRCEQ CP13	3,1,R1,C2,C12,	6			R7		0x00036CE0
0x000180A8	0x1103DBCA	SMLABTNE R3,	R10,R11,R13	;	ARMv5TE or la		R8		0x0001234
0x000180AC	0xFA68F077	BLX &017	454290	;	ARMv5 or late		R9		0x04006F30
		SBCNES R3, H					R10		0x04006208
0x000180B4	0xA0916A7E	ADDGES R6, H	R1,R14,ROR R10			-	R11		0x04006F54
×		ARM D	EBUG			- 🗆			0x0000000
						-	A CONTRACTOR OF	(SP)	0x04006F30
							R14	(LR)	0x00008CC4
							R15	(PC)	0x000112C0
							CPSI	R	0x20000110
							FLAGS		C
							CPU	Mode	usr
Dbg>						-			

PiGARDEN: remote access to Raspberry Pi lab

Pi boards are currently difficult to acquire. PiGARDEN offers:

- Handling of GPIO pins
- Live stream of the peripherals
- Easy file sharing with boards
- Board allocation in time slots





Towards RISC-V

RISC-V Boards

SiFive VisionFive

SW environments

Operating Systems and development software

Main Specs:

- CPU: StarFive JH7110 (RV64GC)
- RAM: 4GB / 8GB LPDDR4
- Storage: FLASH + SD slot + MVNe
- Conectivity: 4xUSBs + HDMI + 2xRJ45
- GPIO: 40 pins
- Price: 65\$ 85\$

Board summary/Evaluation: easy to setup, complete CPU user manual, better performance, same GPIO pinout as Raspberry Pi

Sipeed Lichee RV

Main Specs:

- CPU: CPU: Allwinner D1 Alibaba Xuantie C906 (RV64GCV)
- RAM: 512MB / 1GB DDR3
- Storage: FLASH + SD slot
- Conectivity: USB + HDMI
- GPIO: 40 pins



Linux-based distros available for both boards: Debian & Ubuntu (official)

- Distro images with GUI, which enables an autonomous setup without an external PC
- Images of newer versions of Linux kernel without GUI \Rightarrow Board communication through ssh

GNU development tools available for both boards:

- gcc to generate executable files (compile/link phases)
- gdb to debug user-generated programs

Completed goals

- Driver to control GPIO as a kernel module
- Communication interface via IOCTL to make use of the GPIO from user space (adds overhead due to ioctl cost)
- Driver test programs with simple peripheral devices

Next steps

• Recompiling Linux kernel to add a system call to map physical addresses into user space \Rightarrow Manage peripheral controllers directly from user programs

• Price: 25\$ - 45\$



Board summary/Evaluation: easy to setup, complete and easy to read CPU manual, good quality-price ratio, accessible, small size

• Testing other OS's such as Haiku OS; currently testing ports to VisionFive2

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Conclusions

OS availability for RISC-V has risen as the ISA garners interest and adoption, although OS support varies between devices. The VisionFive and Lichee RV boards support general Linux distros, such as Debian or Fedora, and purpose-built platforms such as Tina7 or Waft8. Early results show promise: the boards are capable of running a modern OS autonomously and our tests on managing peripheral devices have been succesful. Our next step is to find the desired SW features in an OS that can be booted in a RISC-V board.