Android Controlled Based Interface

Objective

- Fix Foba
- Build Rofi (Fifth Generation Robot)
- Develop, Build, and Implement a Dynamic Balanced Biped Robot

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Embedded Systems

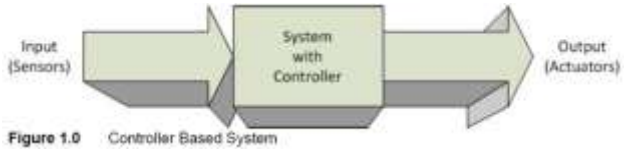


Figure 1.0 Controller Based System

Engineers design systems. A system can be characterized by a box with an input and output. Typically the engineer is tasked to design the box with a given set of inputs and a desired output.

- When a controller "the brain" is part of the design solution, the design is known as an Embedded System.
- The controller may be implemented using an ASIC (Application Integrated Circuit), FPGA (Field Programmable Gate Array) or in most cases a Microcontroller.
- For a microcontroller based design, the input device is by definition a Sensor, while the output device is known as an Actuator.

In this document we look at the Android based system design used by our rovers. It is hoped that by looking at this specific example you will be able to apply the lessons learned to the design of the Andriod based systems.

Biped Android Based System Design

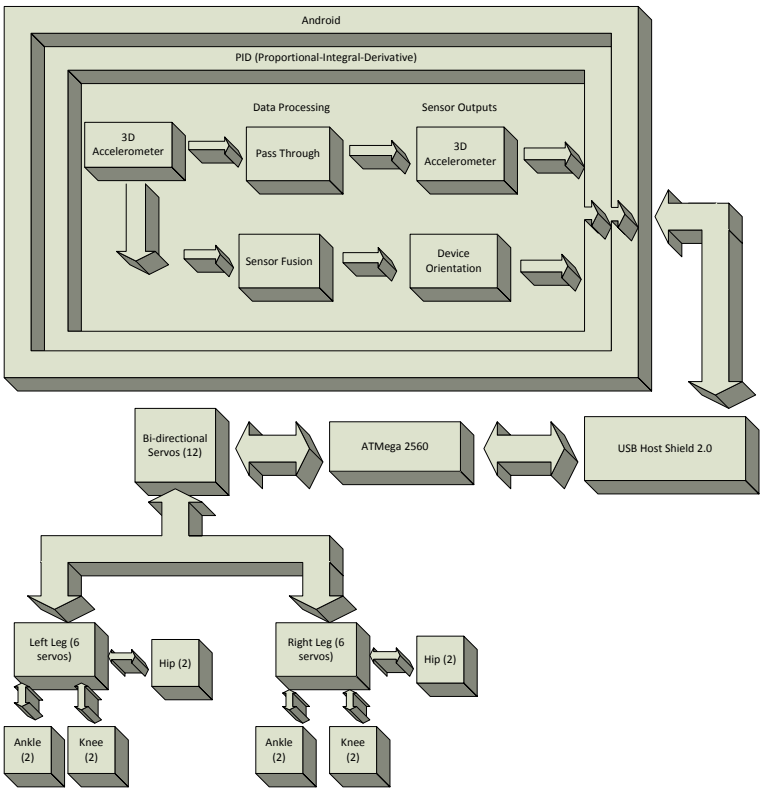


Figure 1.1 Biped Android Based System

The figure above illustrates our biped robot design from a generic capabilities perspective. At the heart of our Android we have the Android Sensor Manager.

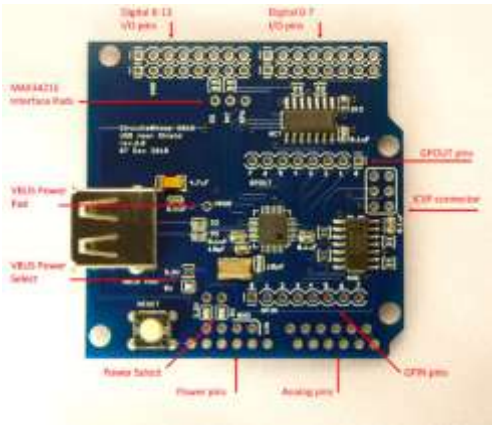
The ATMega2560 is built into an Arduino motherboard

The Arduino Mega 2560 is a microcontroller board based on the ATmega2560 (datasheet). It has 54 digital input/output pins (of which 14 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Mega is compatible with most shields designed for the Arduino Duemilanove or Diecimila.

Important Characteristics

- Microcontroller ATmega2560
- Operating Voltage 5V
- Input Voltage (recommended) 7-12V
- Input Voltage (limits) 6-20V
- Digital I/O Pins 54 (of which 14 provide PWM output)
- Analog Input Pins 16
- DC Current per I/O Pin 40 mA
- DC Current for 3.3V Pin 50 mA
- Flash Memory 256 KB of which 8 KB used by bootloader
- SRAM 8 KB
- EEPROM 4 KB
- Clock Speed 16 MHz

USB Host Shield 2.0 for Arduino



The figure above shows the USB Host Shield 2.0 for the Arduino. This host shield is compatible with a greater range of Arduinos, such as the Arduino UNO, Arduino Duemilanove, the big Mega and Mega 2560. SPI re-wiring and code modifications are not necessary, all you do is just solder included stackable connectors (2×3 ICSP connector's female side should be facing down). This shield will work with standard (dual 5/3.3V) and 3.3V-only (for example, Arduino Pro) boards. Arduino clones with standard connector layout, including ICSP connector, should work, however only BlackWidow has been tested so far.

Devices that support the shield

- HID devices, such as keyboards, mice, joysticks, etc.
- USB to serial converters – FTDI, PL-2303, ACM, as well as certain cell phones and GPS receivers
- ADK-capable Android phones and tables
- Digital cameras – Canon EOS, Powershot, Nikon DSLRs and P&S, as well as generic PTP

Interface Capabilities of our Integrated System

Analog

Arduino	ATMega2560		To Call Pin		USB Host Shield		Servos	IR Sensors
PIN 0	PIN 97		PF0 (ADC0)					
PIN 1	PIN 96		PF1 (ADC1)					
PIN 2	PIN 95		PF2 (ADC2)					
PIN 3	PIN 94		PF3 (ADC3)					
PIN 4	PIN 93		PF4 (ADC4/TCK)					
PIN 5	PIN 92		PF5 (ADC5/TMS)					Data Signal
PIN 6	PIN 91		PF6 (ADC6/TD0)					
PIN 7	PIN 90		PF7 (ADC7/TDI)					
PIN 8	PIN 89		PK0 (ADC8/PCINT16)					
PIN 9	PIN 88		PK1 (ADC9/PCINT17)		INT			

PIN 10	PIN 87		PK2 (ADC10/PCINT18)		SS			
PIN 11	PIN 86		PK3 (ADC11/PCINT19)					
PIN 12	PIN 85		PK4 (ADC12/PCINT20)					
PIN 13	PIN 84		PK5 (ADC13/PCINT21)					
PIN 14	PIN 83		PK6 (ADC14/PCINT22)					
PIN 15	PIN 82		PK7 (ADC15/PCINT23)					

Digital

Arduino	*ATMega2560*		*To Call Pin*		*USB Host Shield*		*Servos*	*IR Sensors*
PIN 13	PIN 26		PB7 (OC0A/OC1C/PCINT7)					
PIN 12	PIN 25		PB6 (OC1B/PCINT6)					
PIN 11	PIN 24		PB5 (OC1A/PCINT5)					
PIN 10	PIN 23		PB4 (OC2A/PCINT4)					
PIN 9	PIN 18		PH6 (OC2B)					
PIN 8	PIN 17		PH5 (OC4C)					
PIN 7	PIN 16		PH4 (OC4B)					
PIN 6	PIN 15		PH3 (OC4A)					
PIN 5	PIN 5		PE3 (OC3A/AIN1)					
PIN 4	PIN 1		PG5 (OC0B)					
PIN 3	PIN 7		PE5 (OC3C/INT5)					
PIN 2	PIN 6		PE4 (OC3B/INT4)					

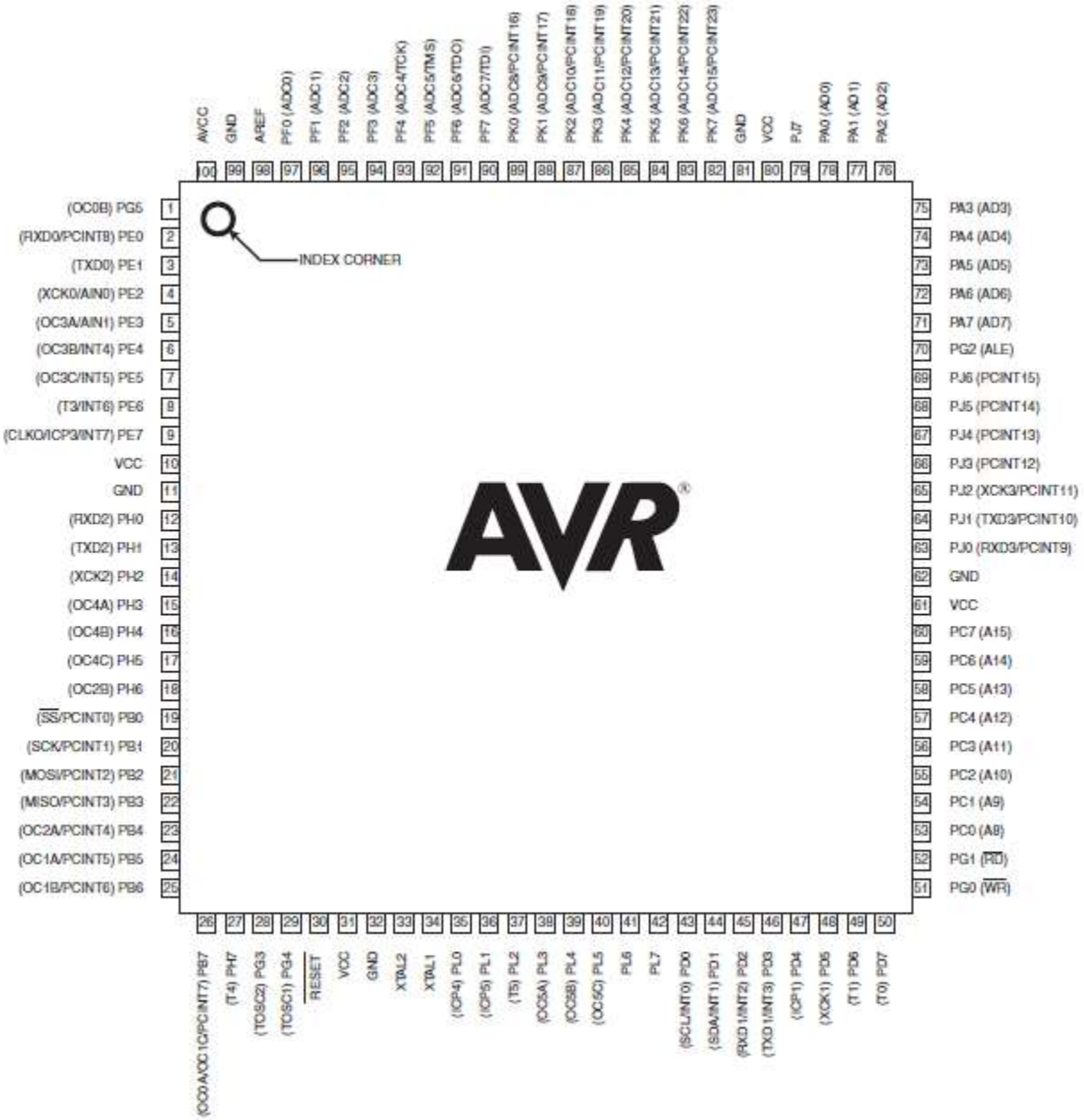
Communications

Arduino	*ATMega2560*		*To Call Pin*		*USB Host Shield*		*Servos*	*IR Sensors*
PIN 1	PIN 3		PE1 (TXD0)					
PIN 0	PIN 2		PE0 (RXD0/PCINT8)					
PIN 14	PIN 64		PJ1 (TXD3/PCINT10)					
PIN 15	PIN 63		PJ0 (RXD3/PCINT9)					
PIN 16	PIN 13		PH1 (TXD2)					
PIN 17	PIN 12		PH0 (RXD2)					
PIN 18	PIN 46		PDE (TXD1/INT3)					
PIN 19	PIN 45		PD2 (RXD1/INT2)					
PIN 20	PIN 44		PD1 (SDA/INT1)					
PIN 21	PIN 43		PD0 (SCL/INT0)					

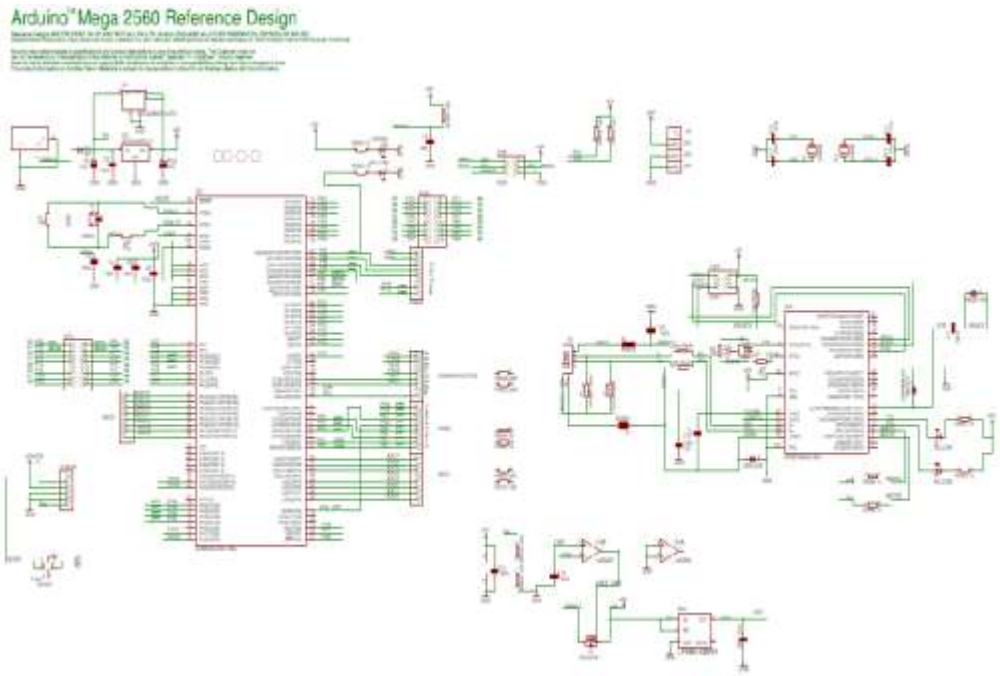
Digital

Digital					
Arduino	***ATMega2560***	***To Call Pin***	***USB Host Shield***	***Servos***	***IR sensors***
PIN 22	PIN 78	PA0 (AD0)		Control Signal (Ankle)	
PIN 23	PIN 77	PA1 (AD1)			
PIN 24	PIN 76	PA2 (AD2)		Control Signal (Lower Leg)	
PIN 25	PIN 75	PA3 (AD3)			
PIN 26	PIN 74	PA4 (AD4)		Control Signal (Knee)	
PIN 27	PIN 73	PA5 (AD5)			
PIN 28	PIN 72	PA6 (AD6)		Control Signal (Middle Leg)	
PIN 29	PIN 71	PA7 (AD7)			
PIN 30	PIN 60	PC7 (A15)		Control Signal (Upper Leg)	
PIN 31	PIN 59	PC6 (A14)			
PIN 32	PIN 58	PC5 (A13)		Control Signal (Hip)	
PIN 33	PIN 57	PC4 (A12)			
PIN 34	PIN 56	PC3 (A11)			
PIN 35	PIN 55	PC2 (A10)			
PIN 36	PIN 54	PC1 (A9)			
PIN 37	PIN 53	PC0 (A8)			
PIN 38	PIN 50	PD7 (T0)			
PIN 39	PIN 70	PG2 (ALE)			
PIN 40	PIN 52	PG1 (/RD)		Control Signal (Ankle)	
PIN 41	PIN 51	PG0 (/WR)			
PIN 42	PIN 42	PL7		Control Signal (Lower Leg)	
PIN 43	PIN 41	PL6			
PIN 44	PIN 40	PL5 (OC5C)		Control Signal (Knee)	
PIN 45	PIN 39	PL4 (OC5B)			
PIN 46	PIN 38	PL3 (OC5A)		Control Signal (Middle Leg)	
PIN 47	PIN 37	PL2 (T5)			
PIN 48	PIN 36	PL1 (ICP5)		Control Signal (Upper Leg)	
PIN 49	PIN 35	PL0 (ICP4)			
PIN 50	PIN 22	PB3 (MISO/PCINT3)	Connected via ICSP (MISO)	Control Signal (Hip)	
PIN 51	PIN 21	PB2 (MOSI/PCINT2)	Connected via ICSP (MOSI)		
PIN 52	PIN 20	PB1 (SCK/PCINT1)	Connected via ICSP (SCK)		
PIN 53	PIN 19	PB0 (/SS/PCINT0)			
GND			GND	GND	GND
AREF					
5V PIN			PWR	PWR	PWR
RESET			RST		

ATmega2560 Pin Configuration(TQFP –pinout)

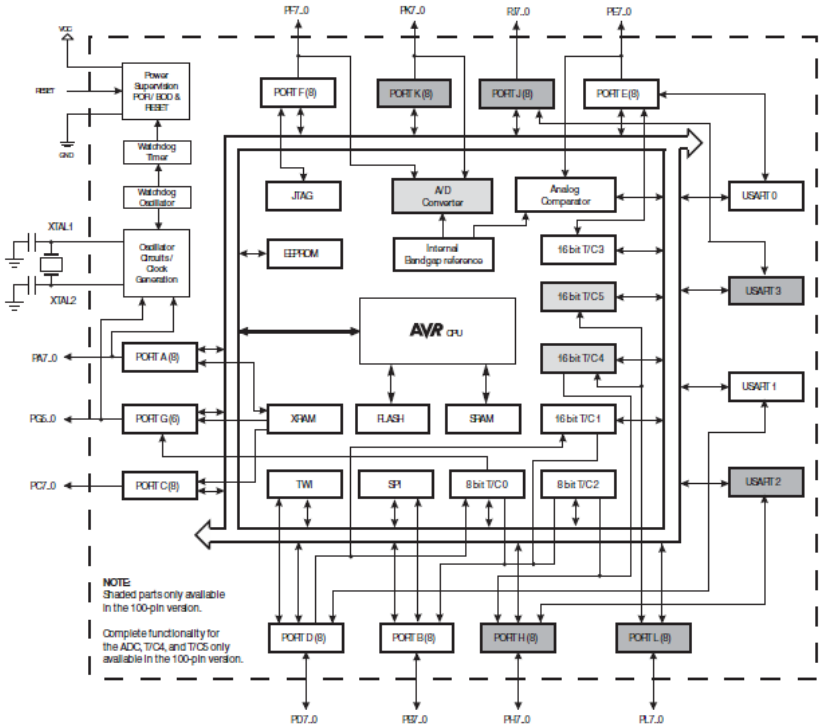


ATmega2560 Schematic



Block Diagram for the ATmega2560

The ATMega2560 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATMega2560 achieves throughputs approaching 1 MIPS per MHz allowing the system designer to optimize power consumption versus processing speed.

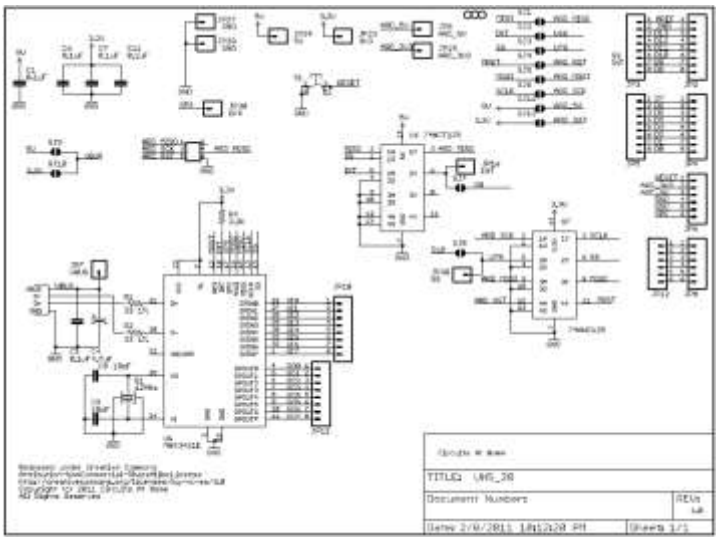


Breakdown of Rofi parts

The table below shows the parts needed to build the Rofi frame. It also shows what parts still need to be printed along with their printed dates.

	A	B	C	D	E	F
1	ROFI Parts					
2						
3	Part	Quantity	Color	PLA/ABS	Print Date	Notes (etc)
4	Foot	2	Black	ABS	sirac and steve	
5	Servo Band	4	Yellow	PLA	10/9/12 PF	
6	Servo Wrap Lower Right	1	Yellow	PLA	10/14/12 PF REDONE	
7	Servo Wrap Lower Left	1	Yellow	PLA	10/14/2012 PF REDONE	
8	Servo Wrap Upper Right	1	Yellow	PLA	10/14/12 PF	
9	Servo Wrap Upper Left	1	Yellow	PLA	10/14/12 PF	
10	Knee Frame	2	Yellow	PLA	10/10/12 PF	
11	Heel	2	Yellow	PLA	10/15/12 PF	1 done might have to modify stl file for better part PF
12	Bearing Bar	4	Black	PLA	10/15/12 PF	2 out of 4
13	Bearing Frame	1	Black	PLA	10/15/12 PF	
14	Side Knee Fram	4	Black	PLA		
15	Center Bracket	1	Black	PLA	10/15/12 PF	
16	Body Riser	1	Black	PLA	10/17/12 PF	
17						
18	Body Panel RIGHT	1	Black	ABS		
19	Body Panel BACK	1	Black	ABS		
20	Body Panel FRONT	1	Black	ABS		
21	Body Panel LEFT	1	Black	ABS		
22	Body Strut	1	Black	ABS		
23	Servo Bracket - Left	2	Black	ABS		
24	Servo Bracket - Right	2	Black	ABS		

USB Host Shield 2.0 Pin Configuration



http://www.pjrc.com/teensy/td_libs_USBHostShield.html