COMPARATIVE STUDY OF ADVANCE PROCESSORS

A Technical Review on Node MCU

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Abstract: Nowadays we almost have a very good internet infrastructure in which world is strongly connected together and it was only because of continues growth in the field of communication. The field of communication is broadly depends on software as well as electronic hardware development. Inline to this in today's technological era different types of electronic controllers are available through which it is very easy to control multi electronic circuits. So many researchers are working on development in existing core controller to increase the function ability. The world is moving towards use of IoT from simple bit microcontroller. IoT try to establish advanced connectivity among device such as devices are MP3 players, MRI, traffic lights, microwave ovens, washing machines and dishwashers, GPS even heart monitoring implants or biochip and etc. or systems or services in order to little by little makes automation in all areas. Now in recent technology Node MCU is popular as an open source IoT platform. The Node MCU is a development kit that helps you to design prototype of your IoT product with Arduino IDE or in few Lau script lines. In this paper we are going to discuss in detail about the construction, operation and application of Node MCU along with is comparative study with other electronic controllers.

Keywords: IoT, GPS, Node MCU, Arduino, Raspberry Pi

I. INTRODUCTION

The ESP8266 is the name of a micro controller designed by Espressif Systems. The ESP8266 itself is a self-contained Wi-Fi networking solution offering as a bridge from existing micro controller to Wi-Fi and is also capable of running self contained applications. This module comes with a built in USB connector and a rich range of pin outs. With a micro USB cable, you can connect NodeMCU development kit to your laptop and flash it without any trouble, just like Arduino. It is also immediately breadboard friendly. [1]

Espressif's ESP8266EX delivers highly integrated Wi-Fi SoC solution to meet user's continuous demands for efficient power usage, compact design and reliable performance in the Internet of Things industry. With the complete and self-contained Wi-Fi networking capabilities, ESP8266EX can perform either as a standalone application or as the slave to a host MCU. When ESP8266EX hosts the application, it promptly boots up from the flash. The integrated high-speed cache helps to increase the system performance and optimize the system memory. Also, ESP8266EX can be applied to any microcontroller design as a Wi-Fi adaptor through SPI / SDIO or I2C / UART interfaces. ESP8266EX integrates antenna switches, RF balun, power amplifier, low noise receive amplifier, filters and power management modules. The compact design minimizes the PCB size and requires minimal external circuitries. Besides the Wi-Fi functionalities, ESP8266EX also integrates an enhanced version of Tensilica's L106 Diamond series 32-bit processor and on-chip SRAM. It can be interfaced with external sensors and other devices through the GPIOs. Software Development Kit (SDK) provides sample codes for various applications. [5]

II. RELATED STUDY

2.1 Arduino: The arduino board is a freely available open source development microcontroller capable to cope up with a variety of communication protocols that is a must to be usable for any kind of IoT device. This board is cheap and feature rich with availability of a variety of daughter boards that have an amazing stacking feature to the main mother board.[6]

2.2 Raspberry Pi: The Raspberry pi Development Board is small sized Broadcom BCM 2835 SoC based ARM11 power minicomputer. The raspberry pi can be easily plugged into monitor because of its inbuilt GPU and audio-visual capabilities. Also it uses standard mouse and keyboard. This is easily programmable by powerful languages like C, python etc, giving it a capability to store and analyze the data [2][3][4]. Raspberry Pi low power consumption and high performance device [9].

2.3 ARM7: LPC2148 (ARM7) is also a good processing unit. The 14 MHz crystal oscillator is used to provide the required clock signals to the ARM7. It takes input from power supply of 3.3V for its operation this generation introduced the thumb 16 bit Instruction set providing improved code density compared to previous design .It is versatile processor designed for mobile device and other low power electronics. In ARM7 they are combination of c and assembly language but in ARM7 architecture used more instruction set as compared PIC microcontroller but it has some of disadvantages as Cost is high, Complex instruction set and complicated to designs because number of pin is more [2] [3].

2.4 ESP-8266: The ESP-8266 module little beast is an extremely capable wireless programmable microcontroller board. The ESP8266 Wi-Fi board is a SOC with integrated TCP/IP protocol stack that can give any secondary microcontroller access to your Wi-Fi network.[9][4]

III. NODE MCU ARCHITECTURE:

The Architecture of Node MCU is as shown in below figure bellow

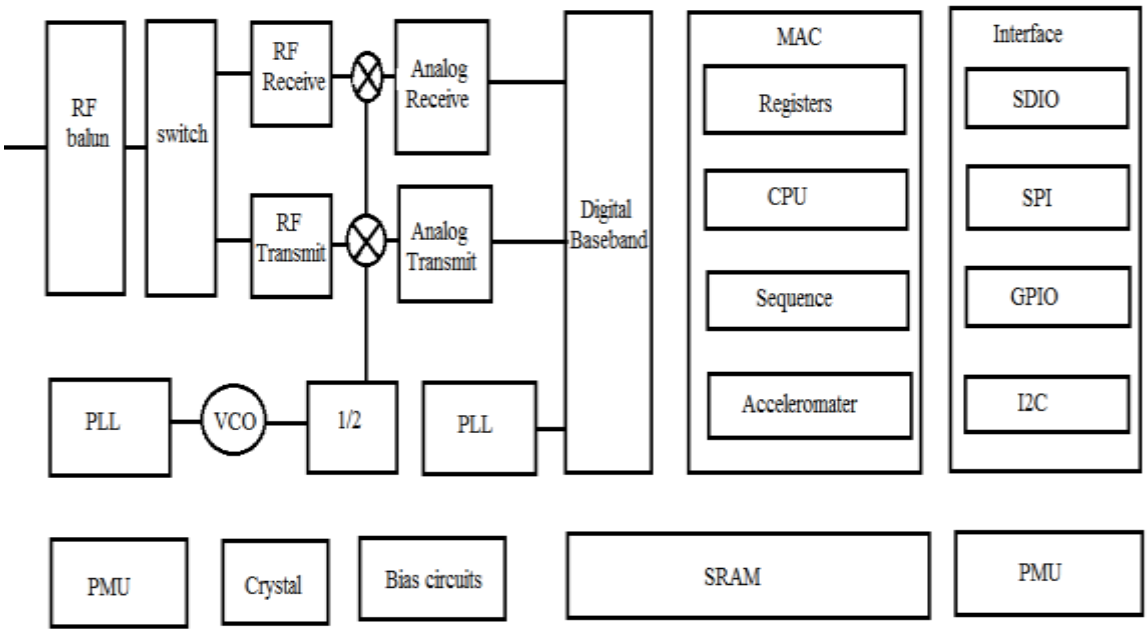

Figure1. Architecture of ESP8266EX

ESP8266EX offers a complete and self-contained Wi-Fi networking solution, it can be used to host the application or to offload Wi-Fi networking functions from another application processor. When ESP8266EX hosts the application, it boots up directly from an external flash. In has integrated cache to improve the performance of the system in such applications. Alternately, serving as a Wi-Fi adapter, wireless internet access can be added to any micro controller based design with simple connectivity (SPI/SDIO or I2C/UART interface)[7][8].

3.1. Pin Diagram of Node MCU:

Node MCU provides access to the GPIO (General Purpose Input/output) and for developing purposes below pin mapping table should be referenced.

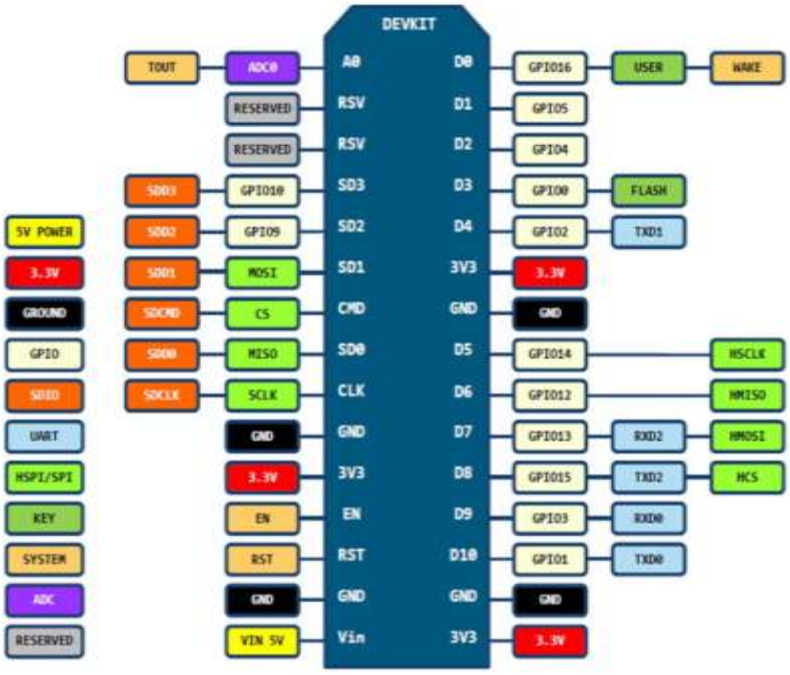

Figure 2.Pin diagram of Node MCU

Table 3.1 General pin attributes and the functions of each pin.

Pin	Name	Type	Function
1	VDDA	P	Analog Power 3.0 ~3.6V
2	LNA	I/O	RF Antenna Interface. Chip Output Impedance=50ΩRF No matching required but we recommend that the π-type matching network is retained.
3	VDD3P3	P	Amplifier Power 3.0~3.6V
4	VDD3P3	P	Amplifier Power 3.0~3.6V
5	VDD_RTC	P	NC (1.1V)

6	TOUT	I	ADC Pin (note: an internal pin of the chip) can be used to check the power voltage of VDD3P3 (Pin 3 and Pin4) or the input voltage of TOUT (Pin 6). These two functions cannot be used simultaneously.
7	CHIP_EN	I	Chip Enable. High: On, chip works properly; Low: Off, small current
8	XPD_DCDC	I/O	Deep-Sleep Wakeup； GPIO16
9	MTMS	I/O	GPIO14; HSPI_CLK
10	MTDI	I/O	GPIO12; HSPI_MISO
11	VDDPST	P	Digital/IO Power Supply (1.8V~3.3V)
12	MTCK	I/O	GPIO13; HSPI_MOSI; UART0_CTS
13	MTDO	I/O	GPIO15; HSPI_CS; UART0_RTS
14	GPIO2	I/O	UART Tx during flash programming; GPIO2
15	GPIO0	I/O	GPIO0; SPI_CS2
16	GPIO4	I/O	GPIO4
17	VDDPST	P	Digital/IO Power Supply (1.8V~3.3V)
18	SDIO_DATA_2	I/O	Connect to SD_D2 (Series R: 200Ω); SPIHD; HSPIHD; GPIO9
19	SDIO_DATA_3	I/O	Connect to SD_D3 (Series R: 200Ω); SPIWP; HSPIWP; GPIO10
20	SDIO_CMD	I/O	Connect to SD_CMD (Series R: 200Ω); SPI_CS0; GPIO11
21	SDIO_CLK	I/O	Connect to SD_CLK (Series R: 200Ω); SPI_CLK; GPIO6
22	SDIO_DATA_0	I/O	Connect to SD_D0 (Series R: 200Ω); SPI_MSIO; GPIO7
23	SDIO_DATA_1	I/O	Connect to SD_D1 (Series R: 200Ω); SPI_MOSI; GPIO8
24	GPIO5	I/O	GPIO5
25	U0RXD	I/O	UART Rx during flash programming; GPIO3
26	U0TXD	I/O	UART Tx during flash programming; GPIO1; SPI_CS1
27	XTAL_OUT	I/O	Connect to crystal oscillator output, can be used to provide BT clock input
28	XTAL_IN	I/O	Connect to crystal oscillator input
29	VDDD	P	Analog Power 3.0V~3.6V
30	VDDA	P	Analog Power 3.0V~3.6V
31	RES12K	I	Serial connection with a 12 kΩ resistor and connect to the ground

3.2. **Application:**

Major Fields of ESP8266EX applications to Internet-of-Things include:
Home Appliances
Home Automation
Smart Plug and lights
Mesh Network
Industrial Wireless Control
Baby Monitors
IP Cameras
Sensor Networks
Wearable Electronics
Wi-Fi Location-aware Devices
Security ID Tags
Wi-Fi Position System Beacons

IV. COMPARATIVE STUDY OF NODE MCU WITH OTHER CONTROLLERS:

Based on the availability of usable I/O interfaces for sensors, interfaces for Internet connectivity, memory and storage interfaces, and audio/video interfaces the following boards are evaluated. IoT devices can also be used to a variety of other purposes, for instance, wearable sensors, smart watches, LED lights, automobiles and industrial machines [4]. GSM modem such as Quad-band intelligent GSM/GPRS modem suitable for long duration data transmission [8] in interface with microcontroller but Node MCU has inbuilt wife for transmission of data.

Table 4.1. Comparison of Arduino, Raspberry Pi-3 and ESP 8266-01 Wi-Fi module

Parameters	Arduino Uno	Raspberry Pi B+	ESP-8266
Processor	ATMega328P	Quad-core ARM Cortex A53	-
GPU	-	Broadcom Video Core IV with 400Mhz	-
Operating voltage	5V	5V	3.3V
Clock speed	16 MHz	1.2GHz	26 MHz – 52 MHz
System memory	2kB	1 GB	<45kB
Flash memory	32 kB	-	up to 128MB
EEPROM	1 kB	-	-
Communication supported	IEEE 802.11 b/g/n IEEE 802.15.4 433RF BLE 4.0 via Shield	IEEE 802.11 b/g/n IEEE 802.15.4 433RF BLE 4.0Ethernet Serial	IEEE 802.11 b/g/n
Development environments	Arduino IDE	Any Linux compatible IDE	Arduino IDE, Lua Loader
Programming language	Wiring	Python C C++ Java Scratch Ruby	Wiring, C, C++
I/O Connectivity	SPI I2C UART GPIO	SPI DSI UART SDIOCSI GPIO	UART, GPIO

V. Conclusion

This paper gives the comparative study of Node MCU with other microcontroller. Raspberry Pi, Arduino Uno and Node MCU are taken into consideration for comparison. The detailed analysis show that higher end development boards such as Raspberry Pi-3 have higher performance in comparison with other boards like arduino and ESP8266 in terms of its storage and computing speeds but at the cost of higher price. Node MCU has flash memory is 128MB which is greater than other two controllers. Raspberry Pi equipped with inbuilt Wi-Fi and Bluetooth serves as an easy means to connect to internet and push the data to the cloud servers if required for further processing. Whereas it is clearly visible from the comparison that boards like Arduino being equipped with inbuilt analog to digital conversion has a better means of sensing the analog data readily when there is a need to sense some continuous analog signals coming out of analog sensors. Node MCU is better availability than other controllers for example cost wise it is cheap where raspberry pi is very costly. The node MCU operating power is 3.3v and other are operates on 5v. On the basis of development environment in Arduino Uno uses only Arduino IDE where as in Node MCU uses Arduino IDE and lua loader.

VI. Acknowledgment

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