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A review of use of Nodemcu ESP8266 in IoT products

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Abstract : The prototype is the first, step in building an Internet of Things(IoT) product. An IoT prototype consists of user interface, hardware devices including sensors, actuators and processors, backend software and connectivity. IoT microcontroller unit (MCU) or development board is used for prototyping. IoT microcontroller unit (MCU) or development board contain low-power processors which support various programming environments and may collect data from the sensor by using the firmware and transfer raw or processed data to an local or cloud-based server. NodeMCU is an open source and LUA programming language based firmware developed for ESP8266 wifi chip. Espruino , Mongoose OS, software development kit (SDK) provided by Espressif, ESP8266 add-on for Arduino are a few of development platforms that may program the ESP8266. ESP8266 may be used to either host the application or to offload all Wi-Fi networking functions from another application processor through its self contained Wi-Fi networking solution. ESP8266 has powerful on-board processing capabilities and sufficient storage that allow it to be integrated with minimal development up-front and minimal loading during runtime through its GPIOs(General Purpose input/output) with the sensors specific devices. ESP8266 has very low cost and high features which makes it an ideal module for Internet Of Things (IoT). It can be used in any application that require it to connect a device to local network or internet.

IndexTerms **- Actuators, Connectivity, Development board, ESP8266, GPIO, Internet of things, IoT, MCU, NodeMCU, Prototype, Processors, Sensors, Wi-Fi.**

I. INTRODUCTION

I

NTERNET OF THINGS (IOT) is a system of interrelated computing devices, machines or objects with unique identifiers and the ability to communicate the data over a network or Internet without requiring human intervention. Internet of Things offers many applications today that help in making life easier. Making IoT product is the act of connecting any physical object to the Internet or local network to collect and share data and performing some physical act according to available data. Peparing the prototype is first step in building an Internet of Things(IoT) product. An IoT prototype consists of user interface, hardware devices including sensors, actuators and processors, backend software and connectivity. An smartphone app or web frontend may work as a user interface. A sensor is may measure a physical phenomenon and transform it into an electric signal. An actuator takes an electrical input and turns it into physical action. The processor unit of IoT systems is generally a microcontroller (MCU) which is responsible for processing data and run software stacks interfaced to a wireless device for connectivity. Through connectivity the hardware is connected with the backend, and the backend with the user interface. Backend software implements the business logic and data storage. IoT microcontroller unit (MCU) or development board is a prototyping solution that features low-power processors which support various programming environments, collect sensor data using firmware and transfer it to an local or cloud-based server. IoT Prototyping Hardware or Development kits are breadboard friendly and optimized for expandability, modularity, and ease-of-use. Main Featuresof IoT Development kits are USB connectivity, ecosystem of hardware accessories, breadboard-able headers, RGB status LED, on-board antenna and affordable costs. NodeMCU is an open source LUA based firmware developed for Espressif's ESP8266 wifi chip. NodeMCU firmware comes with ESP8266 Development board/kit. A large number of research done using NodeNCU,a few works are listed below.

Environment Dynamic Monitoring and Remote Control of Greenhouse designed with ESP8266 NodeMCU.[1]
NodeMCU Choreography Automation by CoAP designed with NodeMCU.[2]
An IoT based Smart Garbage Alert System designed using NodeMCU.[3]
A Smart Power Meter to Recharge Electric Vehicles in Communal Parking Areas using NodeMCU.[4]
A Geo tagged internet of things (iot) device for radiation monitoring designed using NodeMCU.[5]
Implementation of a System for the Evaluation of Environmental Factors that Use the Internet of Things with the help of NodeMCU had been designed.[6]
A Very Low Cost, Open, Wireless, Internet of Things (IoT) Air Quality Monitoring Platform has been designed using NodeMCU.[7]
An Mongoose RTOS based IoT Implementation of Surveillance System had been designed using NodeMCU.[8]
Design and Fabrication of Smart Home With Internet of Things Enabled Automation System is suggested using NodeMCU.[9]
Waste Monitoring System based on Internet-of-Thing (IoT) created with the help of NodeMCU.[10]
Smart Crop Cultivation Monitoring System by Using IoT suggested using NodeMCU.[11]

II. OVERVIEW OF NODEMCU

NodeMCU is open source platform, it's hardware design is open for edit/modify/build. NodeMCU Dev Kit/board consist of ESP8266 wifi enabled chip.The ESP8266 is a low-cost Wi-Fi chip developed by Espressif Systems with TCP/IP protocol.[12] More details can be found on ESP8266 Documentation.

NodeMCU uses an on-module flash-based SPIFFS(Serial Peripheral Interface Flash File System) file system. NodeMCU is

implemented in C and is layered on the Espressif NON-OS SDK. The firmware was initially developed as is a companion project to the popular ESP8266-based NodeMCU development modules, but the project is now community-supported, and the firmware can now be run on any ESP module.[13]

Generally, we can find NodeMCU Dev boards of make Amica,DOIT,Lolin & D1 mini /Wemos etc. in market. Amica produces NodeMCU ESP8266 Development Boards v1.0(Version2) with designed hardware specifications.

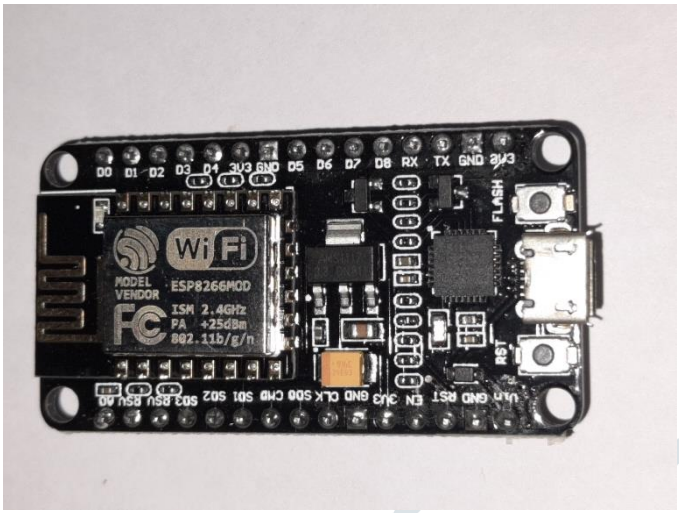

Fig. 1. NodeMCU Development Board/kit v1.0 (Version2)

NodeMCU is an Arduino like device. It's main component is ESP8266. It has Programmable pins. It has built in WiFi. It can get power through micro-usb port. It's cost is low. It can be programmed through multiple programming environments.

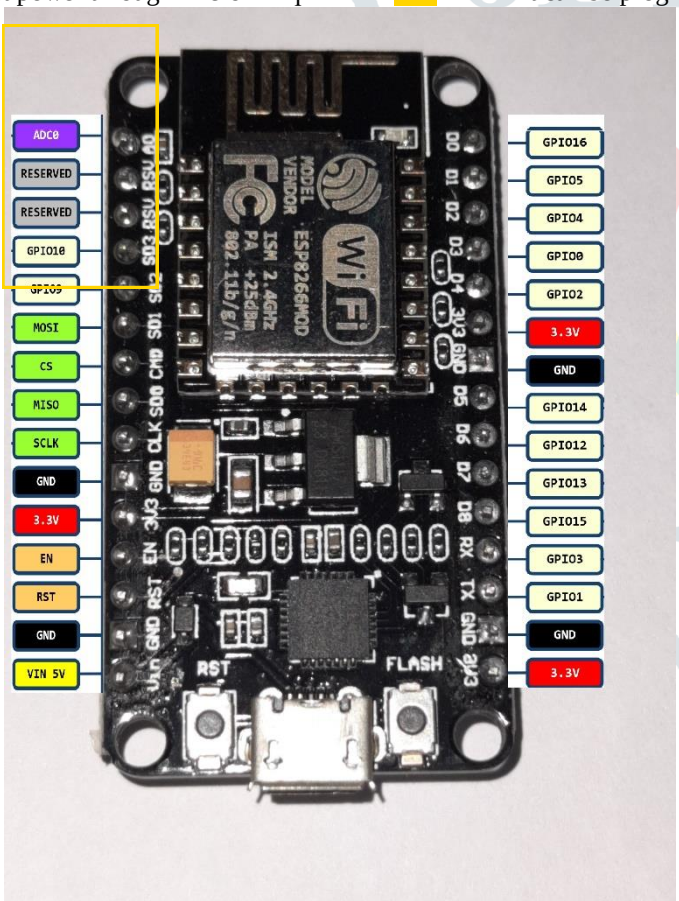

Fig. 2. Pin Definitions or layout of 1st generation ESP8266 NodeMCU development board.

ESP8266 NodeMCU require 2.5V to 3.6V Operating Voltage, On-board 3.3V- 600mA regulator, 80mA Operating Current, 20 µA Current during Sleep Mode. Power to the ESP8266 NodeMCU is supplied via the on-board Micro USB connector. ESP8266 NodeMCU is equipped with 32 Kb RAM, 80 Kb DRAM and 200 Kb Flash Memory. ESP8266 NodeMCU has Pin D0 to Pin D10 Digital Pins, 12 PWM Pins, A0 Analog Pin. It has 5 Ground Pins, 3 number of 3.3 V Pins, 1 Vin Pin for adding 1 external supply of +5V which is not connected to USB. The ESP8266 NodeMCU has total 17 GPIO pins. These pins can be assigned to all sorts of peripheral duties, including one 10-bit ADC channel,Two No. of UART interface which are used to load code serially, four PWM pins for dimming LEDs or controlling motors, SPI and I2C interface to hook up all sorts of sensors and peripherals, I2S interface for adding sound to project. ESP8266 has pin multiplexing feature (Multiple peripherals multiplexed on a single GPIO pin). Meaning a single GPIO pin can act as PWM/UART/SPI. NodeMCU has a RST button to Reset the ESP8266 chip, one FLASH

button to Download new programs and one Blue LED that is user programmable. More details of NodeMCU may found on NodeMCU documentation webpage.[14]

III. THE NODEMCU ESP8266 DEVELOPMENT PLATFORMS

The ESP8266 NodeMCU can be programmed using a variety of development platforms. A few such platforms are listed below-

Espruino

Espruino is an open-source JavaScript interpreter for microcontrollers. JavaScript SDK and firmware closely emulating Node.js. Espruino can be loaded into the esp8266 using any of the flashing techniques applicable to the esp8266 itself. A variety of tools are available to assist with this.[15]

Mongoose OS

An operating system for IoT devices (recommended platform by Espressif Systems and Google Cloud IoT). It is IoT Firmware Development Framework available under Apache License Version 2.0. [16]

Software development kit (SDK) provided by Espressif

The Espressif SDK is a bundle of utilities and device-level APIs for ESP8266 and ESP32 series of wireless chipsets. Optimized precompiled libraries and ready-to-compile driver libraries reduce time to market, while ensuring freedom of customization. [17]

ESP8266 add-on for Arduino

The Arduino IDE is a cross-platform application that is used to write and upload programs to Arduino compatible boards, but also, with the help of 3rd party cores, other vendor development boards.[18] The ESP8266 community created an add-on for the Arduino IDE that can be used to program the ESP8266 using the Arduino IDE and its programming language.

There are many other platform suitable for programming ESP8266 NodeMCU.

IV. CONCLUSION

NodeMCU is equipped with ESP8266 which is highly integrated chip designed for the needs of new connected world. It offers a complete and self-contained Wi-Fi networking solution, allowing it to either host the application or to offload all Wi-Fi networking functions from another application processor. ESP8266 NodeMCU has powerful on-board processing and storage capabilities that allow it to be integrated with the sensors specific devices through its GPIOs with minimal development up-front and minimal loading during runtime. elaborate on the importance of the work or suggest applications and extensions.

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