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SMART SHOPPING CART

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ABSTRACT

1. The Shopping Centre is a place where people go to purchase their daily goods.
There has been a growing market for quick and easy bill paying in shopping malls.
2. Shoppers are occasionally disappointed with their ability to locate products on their shopping list while shopping in a store, and no assistance is required.
3. To address these challenges, we created a smart trolley with a smartphone app.
This paper provides a user interface to assist customers in locating the product. Using Node MCU's barcode scanner, it also provides a centralized and automatic billing system.
4. Each shopping center merchandise will be labelled with a barcode to differentiate it from the others. For each shopping cart, a Product Identification System (PID) with Node MCU, the barcode reader, is employed.

Keywords: Internet Of Things (IOT), Security, Cloud Computing, barcode , Smart Shopping

INTRODUCTION

This report explores and demonstrates how the TEC algorithm model was used in evaluation of a business opportunity from a generated technology idea proposed for commercialisation purposes [1]. The idea generation was conducted using the double diamond method in guiding the team towards identifying a technological idea for this project. There are four fundamental techniques within the double diamond method known as Ideation, Requirements, Iterative Design and Idea Implementation [2]. These techniques were utilised by the team to implement a great technology concept which will be targeted towards all the big UK retail stores. The double diamond method aided the team in developing many ideas to narrow it down to the Smart Trolley idea based on a feedback from a focused group within the team. A precise idea came up from the ideas generation list which was chosen for this project. This document discussed the selection of the Smart Trolley idea through the process of using an algorithm to evaluate the unique business advantages compared to its disadvantages. To come out with creative and innovative ideas, the team was split into two sub teams to generate ideas. Each sub team was responsible to produce ideas which was later managed by verifying with the requirements set for this

project. As a team, all ideas were exploited and explored carefully to fit the scope of implementing a technology that is useful in the world of business. The Smart Trolley idea stood out from many ideas presented by the team based on how the idea would be developed into an interesting technology product which is convenient, easy to use and efficient, including it being an add-on service for the existing self-checkout system. As the concept was based on technology, it was important to get the insight of consumers for which the idea was designed. The purpose for this was to analyse the role of assumptions, perceptions and expectations from the stores and its daily customers towards the proposed Smart Trolley idea for UK supermarket outlets and perhaps to other European countries. The team had a great response from a targeted major retail stores such as Tesco, Asda and Sainsbury after a focused group from the team had made contact. The Smart Trolley idea is based on the most popular automated self-checkout system in most of UK retail stores. The concept is designed into a smaller version of the automated self-checkout system on a shopping trolley with a user interface screen which allows customers to make payment for items scanned and placed in the trolley before leaving the entrance of the store. This is to release pressure at the tills during peak hours. The Smart Trolley comes with all the traditional services including scanning an item to check for price and details, also there are other additional features that will be included in the design such as locating an item in the store by typing in the item's name in the search field on the user interface screen which will automatically show the item's location in the store. The Smart Trolley is designed with security measures to prevent it being wheeled out from the store's premises and also to protect customer's card details as it is designed to accept only card payment for items bought in the store.

LITRETURE SURVEY

The below research papers have given information about finalizing and implementing the project.

1. Saurabh Singh, Harjeet Matharu and Dr. Sangeet Mishra, "Internet Of Things Based Home Automation System", November, 2017, DOI:10.5281/zenodo.1049436.

This paper purposes the study of Internet of Things (IOT) based home automation system. Internet of things(IOT) based home automation system can be controlled over mobile devices. This system can perform varied functions to be performed at home. This allows accessibility over internet from any corner in the world. The main focus of this project is to minimize the usage of electricity and reduce human efforts.

2. Purushottam, and Chandan Kumar Dubey,"Automation by Voice Commands", Volume 8, IssueV, MAY 2018.

Automation is one of the most growing things now days. It increases the productivity & decreases the time, it is also very useful thing for special able people or those we needs to control machinery, electricity or many things from a single system. This paper attempts to describe how we can improve our automation systems

3. **Aayush Agarwal, Anshul Sharma, Asim Saket Samad and S Babeetha, "UJALA- Home Automation System Using Google Assistant", Vol-4 Issue-2 2018.**

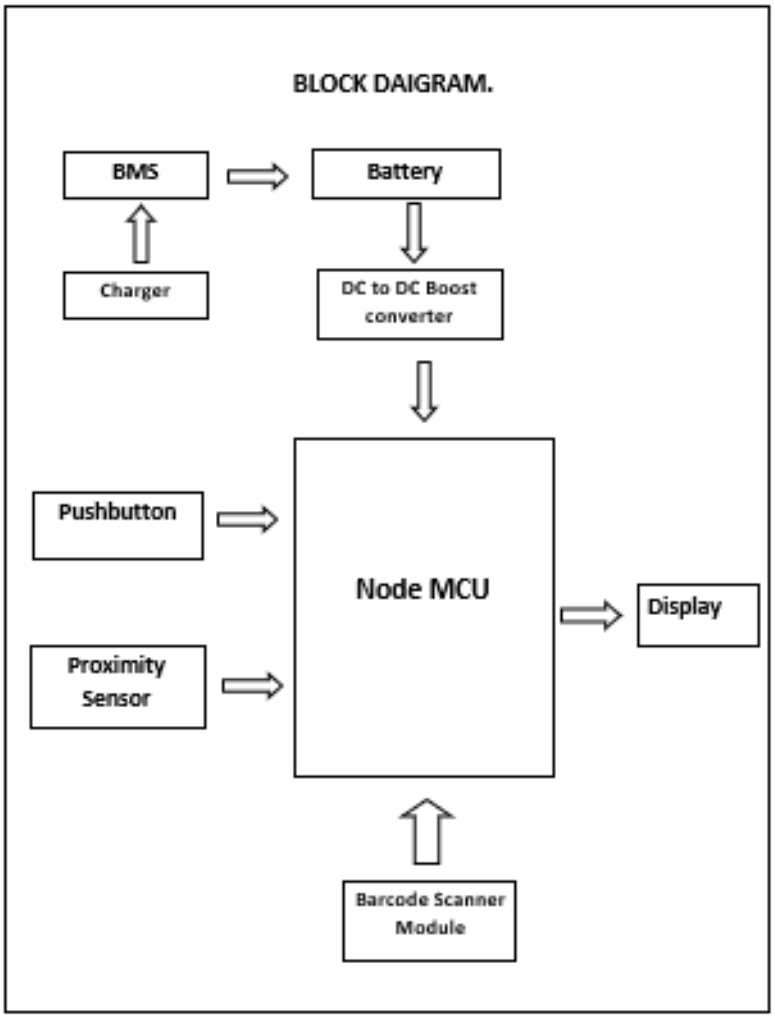
World's demand for electricity had grown 85% between 2010 and 2017 this increase is more than today's total use of electricity in India, USA, Japan, Australia combined.We can't decrease the electricity growth rate but we can lessen the amount of electricity wasted each year by turning off our home appliances when not in use.

4. **Manish Prakash Gupta, "Google Assistant Controlled Home Automation",Volume: 05 Issue: 05 May-2018.**

This paper presents a proposal for home automation using voice via Google Assistant. Home automation or domotics a term for home automation coined by Jim Hill has been evolving drastically. We saw many home automation technologies introduced over these years from Zigbee automation to Amazon Echo, Google Home and Home from Apple. It has become acraze these days.

5. **Sandeep Chintha, K. Ramya Prathima-'Google Assistant Voice Activated Automatic Control Of Home Appliances Using Iot And Node MCU' Publisher :International Journal of Advanced Research in Engineering and Te.**

The paper presented here deals with the Home Automation scenario in the world today, It reviewed many aspects of home automation technologies like web based technologies, App based technologies, Remote technologies etc. The review is helpful for the researchers and will be instrumental for further work and advancements to be carried out in the said field of Home Automation.



COMPONENT SELECTION

A.BARCODE SCANNER

A Barcode represents the **line of numbers** printed underneath it with a pattern of **black** and **white bars**. Barcodes are designed for computers to read quickly by **scanning red LED** or laser light across them.

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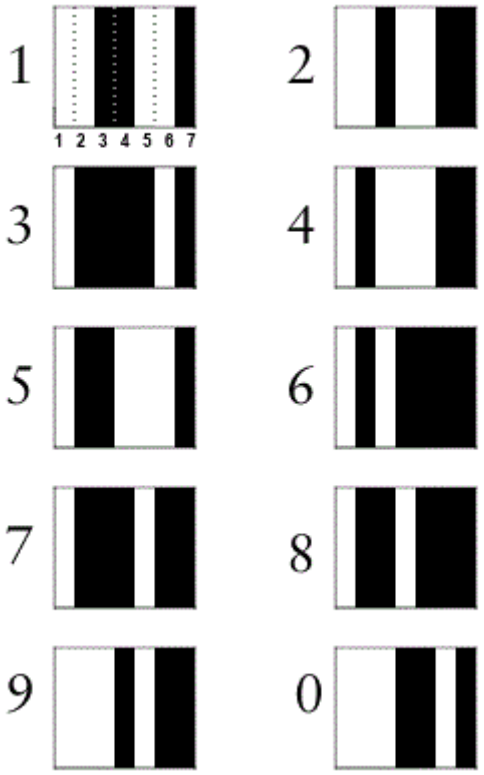
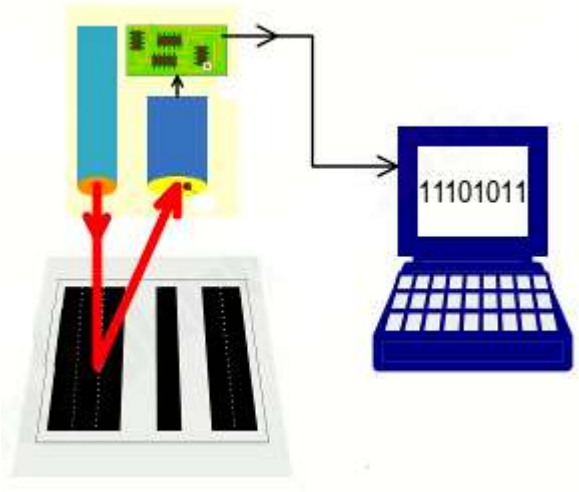
Each digit in a Barcode is represented by **seven equal-sized vertical blocks**. These are colored in either black or white to represent the decimal numbers **0–9**. Every number ultimately consists of four fat or thin black and white stripes and its pattern is designed so that, even if you turn it upside down, it can't be confused with any other number.



How does a Barcode scanner work?

A **Barcode scanner** scans digitally convert printed Barcodes. It then **decodes** the data and sends the data to a computer. It consists of a lens, a source of light, and a light sensor that can translate optical impulses into electrical signals. A Barcode scanner contains a decoder that analyses the **image data** provided by the sensor and sends it to the output port. After scanning an image, it links to a host computer to pass along the captured **information**.

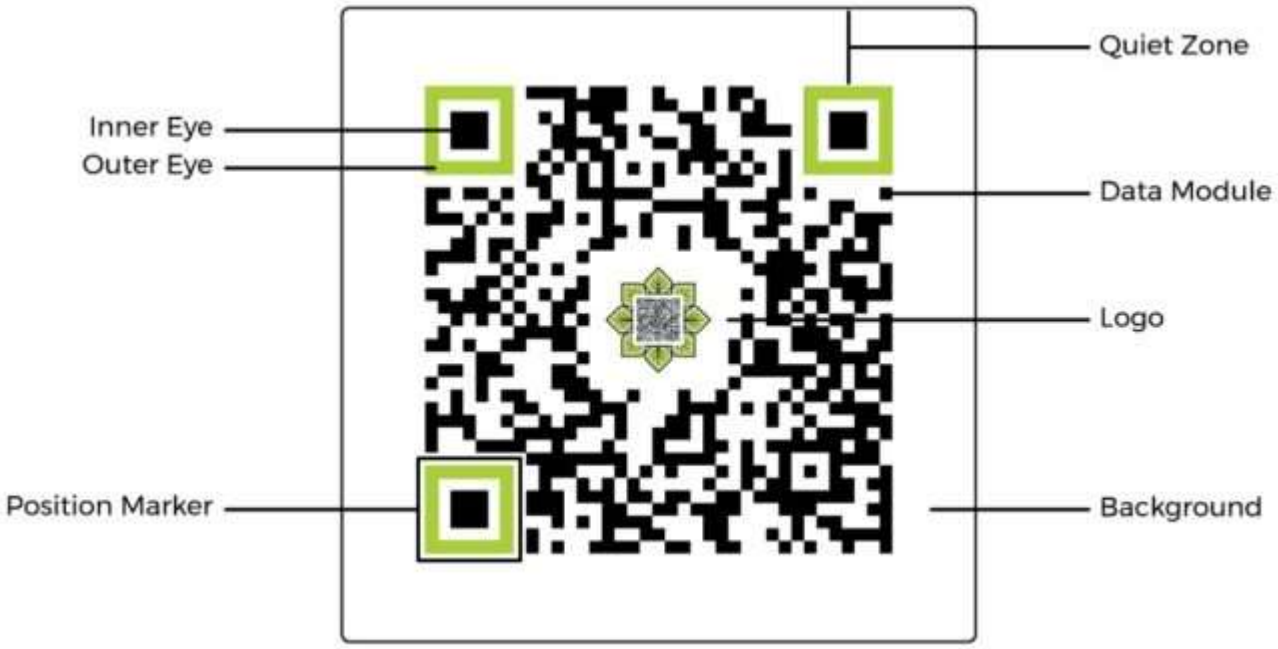


The **decoder** recognizes the **Barcode symbols**, translates the bar and space content, and transmits the data to a computer in such a format that we can read.

What is QR Code & how it works?

A **QR code** is a **scannable Barcode encoded** with data. Encoded means converted into a particular form. In the case of QR codes, numeric and alphanumeric characters, bytes, and kanji convert into a unique **two-dimensional arrangement of squares**. When an optical scanner passes over those squares, it translates their arrangement back into that data's original form.

The most important parts of a QR code are the **Data module**, **Position marker** & **Quiet zone**.



The **data module** is the standard unit of the QR code. It's typically a black square set against a white background. There are three **position markers** on every QR code. Consisting of an inner and outer eye, they allow scanners and cameras to quickly and accurately locate the data modules and the scanning direction. The **quiet zone** is the blank area on all sides of the data module matrix that contains all the data modules and position markers. It allows scanners and readers to optically place where the QR code begins and ends.

.

How QR Code Scanner work?

The patterns within QR codes represent **binary codes** that can be interpreted to reveal the code's data.

A QR reader can identify a standard QR code based on the three large squares outside the QR code. Once it has identified these three shapes, it knows that everything contained inside the square is a QR code.

The QR reader then analyzes the QR code by breaking the whole thing down to a **grid**. It looks at the individual grid squares and assigns each one a value based on whether it is **black or white**. It then groups grid squares to create larger patterns.

Description of major Component used with features and specification

Barcode Scanner(GM73)

Description

GM73 Bar code reader module is a high integration and high performance scanner, mainly used to read payment codes. The bar code and QR code formats that can be recognized are QR Code, Data Matrix, PDF417,maxicode,Aztec,hanxin,EAN,UPC,Code 39,Code 93,Code 128,UCC/EAN 128, Code 11,Codabar, Interleaved 2 of 5, Standard 25, MSI-Plessey,GS1 Databar, Industrial 25, Matrix 2 of 5.

Description:

This is a small sized Barcode and QR Code reader module that can detect codes and output the data throught a serial UART interface. The output can be read by any microcontroller(Ardunino/Raspberry Pi) through the serial port. You can also connect it to a computer through USB and get the code details through a serial terminal program. It can also connet to a computer as an HID Device.

It offers medium scan speeds, easy wiring and interface, panel mount mountings and inbuilt light for illuminating the QR Code.

Just point the scanner to a code and the data in the code will be sent out through the serial interface. USB HID interface lets the scanner output the code directly through USB. It detects as a keyboard and code data will be entered directly to any software that takes input from keyboard - Excel, Word, Browser, Billing Software, etc

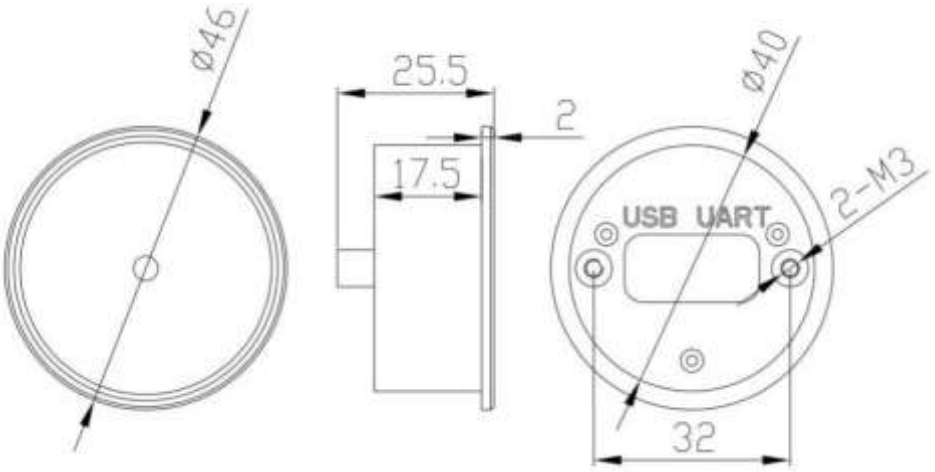
Technical Specification

Scanning Performance	Scan Mode		640*480 CMOS
	Read Code Type	2D	QR Code, Data Matrix, PDF417,maxicode,Aztec,hanxin
		1D	EAN,UPC,Code 39,Code 93,Code 128,UCC/EAN 128,
			Codabar, Interleaved 2 of 5, Standard 25，MSI-Plessey
			GS1 Databar, Industrial 25, Matrix 2 of 5
	Accuracy of reading		One Dimensional Code:6mil
	Working Mode		Continuous Mode, Induction Mode, Manual Mode
	Depth of Field	Alipay	30-150mm
		Bus	50-120mm
	Contrast		≥25%
	Scanning angle		Intersection angle 360°, Elevation ± 55°, Deflection angle ± 55°
	Viewing Angle		Inclination 60°, Elevation 46°
Mechanical/ Electrical Parameters	Interface		TTL-232、USB
	Dimension		Diameter 46mm
	Operating Current		≤100mA
Environmental Parameters	Operating Temperature		-20℃~+50℃
	Storage Temperature		-40℃~+70℃
	Operating Humidity		5%~95% (Non-Condensing)
	Environmental Light		0~100000LUX

Specifications

Model	GM73
Type	Barcode Scanner
Interface	USB 2.0 UART
Resolution	10mil
Operating Current	90mA
Weight	15g
Size	46mm(Diameter)
Light	White/Blue
Scanning Angle	46°C
Inclination Angle	36°C
Reading Distance	40-100mm
Light Levels	0-85000LUX

Dimension (mm)



1.1 Circuit Board Interface

1.2 Interface definition

UART interface definition:

Pin	Name	Definition	Description
1	5V	Power Input	Power Input
2	TX	Data Output	TTL3.3V logical level
3	RX	Data Input	TTL 3.3V logical level
4	GND	Power Input	Signal ground. Connected to power Ground

Interface note:

a) Baud rate 9600bps; 8 bit data; 1 bit stop bit; No check.

b) If the upper computer is MCU (3.3v), it is directly connected to TX and RX. If the upper computeris PC, the RS232 level conversion chip needs to be hooked up.

USB interface definition:

Pin	Name	Definition	Description
1	5V	Power Input	Power Input DC5V
2	D+	Data Output	USB
3	D-	Data Input	USB
4	GND	Power Input	Signal ground. Connected to power Ground

Features

- Multiple output modes - Serial UART TTL, USB COM Port, USB HID Output
- **Serial UART** outputs scanned data as ASCII Text to a microcontroller
- **USB COM Port** outputs scanned data as ASCII Text overa USB COM Port (Data can be accessed through the COM Port in MATLAB, Python, etc)
- When plugged in as a USD HID Device, it emulates a keyboard and types the scanned code as characters on the computer. Can be used to enter data directly to softwares like - Excel, Word, Browser,Calculators, Billing & Accounting Softwares, etc
- High resolution camera can scan code on multiple devices such as labels, paper, mobile phones or computers
- The scanner supports wide viewing Angle. Upto Inclination 60°, Elevation 46°
- Ring Illumination & Inbuilt buzzer for status inducation
- Macro support replaces a string in the bar code with another
- High-precision small code reading upto 1D: 3mil, 2D: 5mil
- The bar code and QR code formats that can be recognized are QRCode, DataMatrix,PDF417, maxicode, Aztec, hanxin, EAN, UPC, Code 39, Code 93, Code 128, UCC/EAN 128, Code 11, Codabar, Interleaved 2 of 5, Standard 25, MSI-Plessey,GS1 Databar,
  Industrial 25 and Matrix 2 of 5

Node MCU

The Node MCU (Node Micro Controller Unit) is an open-source software and hardware development environment built around an inexpensive System-on-a-Chip (SoC) called the ESP8266. The ESP8266, designed and manufactured by Espressif Systems, contains the crucial elements of a computer: CPU, RAM, networking (WiFi), and even a modern operating system and SDK. That makes it an excellent choice for Internet of Things (IoT) projects of all kinds.

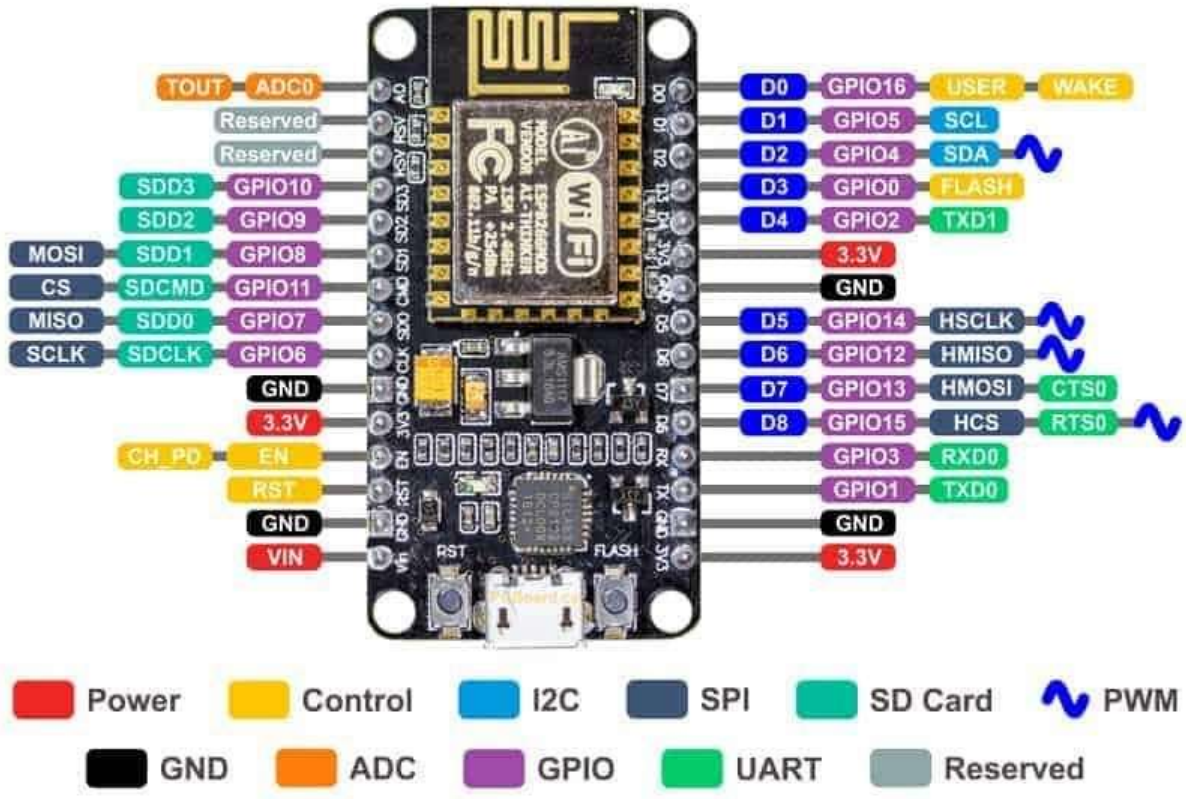
However, as a chip, the ESP8266 is also hard to access and use. You must solder wires, with the appropriate analog voltage, to its pins for the simplest tasks such as powering it on or sending a keystroke to the "computer" on the chip. You also have to program it in low-level machine instructions that can be interpreted by the chip hardware. This level of integration is not a problem using the ESP8266 as an embedded controller chip in mass-produced electronics. It is a huge burden for hobbyists, hackers, or students who want to experiment with it in their own IoT projects.

But, what about Arduino? The Arduino project created an open-source hardware design and software SDK for their versatile IoT controller. Similar to Node MCU, the Arduino hardware is a microcontroller board with a USB connector, LED lights, and standard data pins. It also defines standard interfaces to interact with sensors or other boards. But unlike Node MCU, the Arduino board can have different types of CPU chips (typically an ARM or Intel x86 chip) with memory chips, and a variety of programming environments. There is an Arduino reference design for the ESP8266 chip as well. However, the flexibility of Arduino also means significant variations across different vendors. For example, most Arduino boards do not have WiFi capabilities, and some even have a serial data port instead of a USB port.

Node MCU Specifications

The Node MCU is available in various package styles. Common to all the designs is the base ESP8266 core. Designs based on the architecture have maintained the standard 30-pin layout. Some designs use the more common narrow (0.9″) footprint, while others use a wide (1.1″) footprint – an important consideration to be aware of.

The most common models of the Node MCU are the Amica (based on the standard narrow pin-spacing) and the Lo Lin which has the wider pin spacing and larger board. The open-source design of the base ESP8266 enables the market to design new variants of the Node MCU continually.



3.3.1 Node MCU

Power Pins There are four power pins. VIN pin and three 3.3V pins.

VIN can be used to directly supply the Node MCU/ESP8266 and its peripherals. Power delivered on VIN is regulated through the onboard regulator on the Node MCU module you can also supply 5V regulated to the VIN pin 3.3V pins are the output of the onboard voltage regulator and can be used to supply power to external components.

GND are the ground pins of Node MCU/ESP8266

I2C Pins are used to connect I2C sensors and peripherals. Both I2C Master and I2C Slave are supported. I2C interface functionality can be realized programmatically, and the clock frequency is 100 kHz at a maximum. It should be noted that I2C clock frequency should be higher than the slowest clock frequency of the slave device.

GPIO Pins Node MCU/ESP8266 has 17 GPIO pins which can be assigned to functions such as I2C, I2S, UART, PWM, IR Remote Control, LED Light and Button programmatically. Each digital enabled GPIO can be configured to internal pull-up or pull-down, or set to high impedance. When configured as an input, it can also be set to edge-trigger or level-trigger to generate CPU interrupts.

ADC Channel The Node MCU is embedded with a 10-bit precision SAR ADC. The two functions can be implemented using ADC. Testing power supply voltage of VDD3P3 pin and testing input voltage of TOUT pin. However, they cannot be implemented at the same time

UART Pins Node MCU/ESP8266 has 2 UART interfaces (UART0 and UART1) which provide asynchronous communication (RS232 and RS485), and can communicate at up to 4.5 Mbps. UART0 (TXD0, RXD0, RST0 & CTS0 pins) can be used for communication. However, UART1 (TXD1 pin) features only data transmit signal so, it is usually used for printing log.

SPI Pins Node MCU/ESP8266 features two SPIs (SPI and HSPI) in slave and master modes. These SPIs also support the following general-purpose SPI features:

- timing modes of the SPI format transfer
- Up to 80 MHz and the divided clocks of 80 MHz
- Up to 64-Byte FIFO

SDIO Pins Node MCU/ESP8266 features Secure Digital Input/Output Interface (SDIO) which is used to directly interface SD cards. 4-bit 25 MHz SDIO v1.1 and 4-bit 50 MHz SDIO v2.0 are supported.

PWM Pins The board has 4 channels of Pulse Width Modulation (PWM). The PWM output can be implemented programmatically and used for driving digital motors and LEDs. PWM frequency range is adjustable from 1000 µs to 10000 µs (100 Hz and 1 kHz).

Control Pins are used to control the Node MCU/ESP8266. These pins include Chip Enable pin (EN), Reset pin (RST) and WAKE pin.

EN: The ESP8266 chip is enabled when EN pin is pulled HIGH. When pulled LOW the chip works at minimum power.

RST: RST pin is used to reset the ESP8266 chip.

WAKE: Wake pin is used to wake the chip from deep-sleep

Microcontroller	Tensilica 32-bit RISC CPU Xtensa LX106
Operating Voltage	3.3V
Input Voltage	7-12V
Microcontroller	Tensilica 32-bit RISC CPU Xtensa LX106
Operating Voltage	3.3V
Input Voltage	7-12V
Digital I/O Pins (DIO)	16
Analog Input Pins (ADC)	1
UARTs	1
SPIs	1
I2Cs	1

Fig. 3.2.1 Node MCU specification

LCD display:

A LCD display is provided to see the real time data from the sensors; it is set to show the body temperature and heartbeat in BPM. A 10K potentiometer is provided using which you can adjust LCD contrast for optimum legibility.

- Pin1 (Ground/Source Pin): This is a GND pin of display, used to connect the GND terminal of the microcontroller unit or power source.
- Pin2 (VCC/Source Pin): This is the voltage supply pin of the display, used to connect the supply pin of the power source.
- Pin3 (V0/VEE/Control Pin): This pin regulates the difference of the display, used to connect a changeable POT that can supply 0 to 5V.
- Pin4 (Register Select/Control Pin): This pin toggles among command or data register, used to connect a microcontroller unit pin and obtains either 0 or 1(0 = data mode, and 1 = command mode).
- Pin5 (Read/Write/Control Pin): This pin toggles the display among the read or writes operation, and it is connected to a microcontroller unit pin to get either 0 or 1 (0 = Write Operation, and 1 = Read Operation).
- Pin 6 (Enable/Control Pin): This pin should be held high to execute Read/Write process, and it is connected to the microcontroller unit & constantly held high.
- Pins 7-14 (Data Pins): These pins are used to send data to the display. These pins are connected in two-wire modes like 4-wire mode and 8-wire mode. In 4-wire mode, only four

pins are connected to the microcontroller unit like 0 to 3, whereas in 8-wire mode, 8-pins are connected to microcontroller unit like 0 to 7.

- Pin15 (+ve pin of the LED): This pin is connected to +5V
- Pin 16 (-ve pin of the LED): This pin is connected to GND.

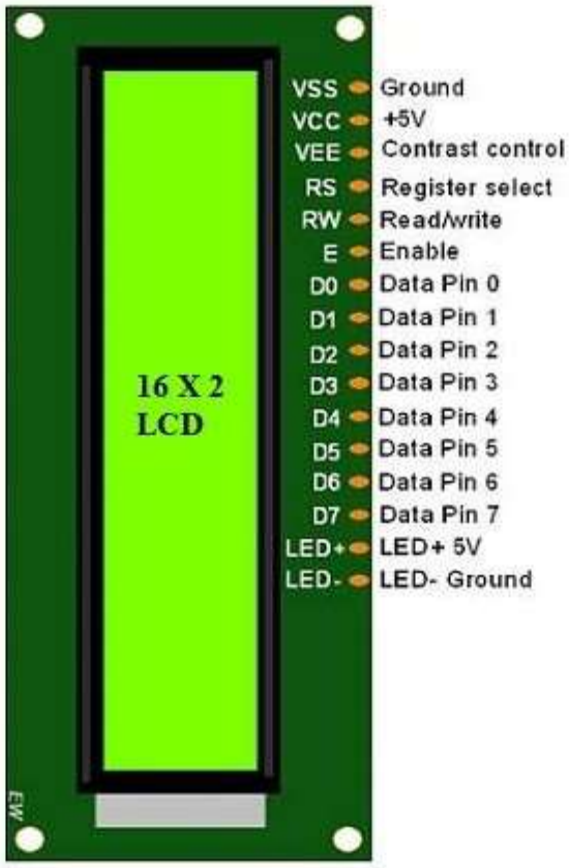


Fig 3.2.2 LCD Display

Features of LCD16x2

The features of this LCD mainly include the following.

- The operating voltage of this LCD is 4.7V-5.3V
- It includes two rows where each row can produce 16-characters.
- The utilization of current is 1mA with no backlight
- Every character can be built with a 5×8 pixel box
- The alphanumeric LCDs alphabets & numbers
- Is display can work on two modes like 4-bit & 8-bit
- These are obtainable in Blue & Green Backlight
- It displays a few custom generated characters

Lithium ion battery 3.7V2.5Ah

Standard charge method

At 25 ± 2 ℃the cell is charged to 4.2 V at constant current of 0.5 C (1250 mA), then charged at constant voltage of 4.2 V until the current tapers to ≤ 0.01C (25 mA) followed by resting for 5min.

2.2 Standard discharge method

Under 25 ± 2 oC, the cell is discharged to 2.75V at a constant current of 0.2C (500 mA).

2.3 Nominal capacity

Nominal capacity, signed as capacity and using mAh as unit, is obtained by discharging a cell via standard discharge method after it is standard charged.

3 Cell model and dimensions

3.1 Description and model

Description: Cylindrical Li-ion rechargeable cell

Model: H18650CQ

型号：H18650CQ

3.2 Cell dimensions

Cell physical dimensions listed in Figure 1 (unit: mm), with tube.

Cell characteristics

Unless otherwise specified, the cell is fresh cell and tested by standard charge and standard discharge.

ITEM		SPECIFICATION
Capacity	Nominal capacity	2550mAh by standard charge and discharge
	Minimum Capacity	2500mAh by standard charge and discharge
Nominal Voltage		3.60v
Charge cut-off voltage		4.20v
Discharge cut-off voltage		2.75v
Max charge current		1C
Max discharge current		2C
Storage temperature		
Humidity range		
Internal resistance		≤30 mΩ(AC Impedance, 1000 Hz)
Weight		48g