

PROFESSIONAL TRAINING – REPORT

*Submitted in partial fulfilment of the requirement for the award
of Bachelor of Electrical degree in Electrical and Electronic Engineering*

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1. INTRODUCTION TO INTERNET OF THINGS

IoT

Many of us say that Internet has changed the society which is right but, at the same time, the greatest transformation actually still lies ahead of us. Several new technologies are now converging in a way that means the Internet is on the brink of a substantial expansion as objects large and small get connected and assume their own web identity.

Following from Internet of computers, where our servers and personal computers were connected to global network, to Internet of mobile phones then the next phase of development is the Internet of things, when more or less anything will be connected and managed in the virtual world. The most indispensable part of IoT is that it covers smart connectivity across existing networks and context aware computation with network resources. WIFI and 4G-LTE wireless Internet access are growing immensely, towards the evolution of information and communication networks is already evident. For the vision of Internet of Things, a computer paradigm will go beyond traditional mobile smart phones scenarios and connects everyday existing objects and embedding intelligence into our environment.

Demands which involves in Internet of Things: a shared understanding of the situation of its users and their appliances, software architectures and pervasive communication networks to process and convey the contextual information to where it is relevant, and the analytic tools in the Internet of Things that aim for autonomous and smart behavior. By this we can accomplish smart connectivity and context-aware computation.

The advancement of current Internet to Network of interconnected objects which not only gives senses information from environment and

interacts with the physical world (actuation/ command/control), but also uses existing Internet standards to provide services for information transfer, analytics, applications, and communications. IoT is transforming the current static internet to fully integrated Future Internet.



Fig 1. Internet of Things IoT

2. HISTORY OF INTERNET OF THINGS (IoT)

The main concept of a network of smart devices was discussed early in 1982, in Coca Cola vending machine. This coke machine is modified at “Carnegie Mellon University” and becoming the first Internet-connected appliance. This machine was able to report its inventory and whether newly loaded drinks were cold.

Mark Weiser's paper on "The Computer of the 21st Century", as well as academic venues such as Ubicomp and PerCom produced the contemporary vision of the IoT. In 1994, Reza Raji explained the idea of IoT as "small packets of data to a large set of nodes, so as to integrate and automate everything from home appliances to entire factories". After that many companies proposed various solutions like Microsoft's at Work or Novell's Nest. Bill Joy proposed Device to Device (D2D) communication as a part of his "Six Webs" frameworks at the World Economic Forum at Davos in 1999.

The Internet of Things was independently coined by Kevin Ashton of Procter & Gamble later MIT's Auto ID Center, in 1999. Besides that, near field communication, barcode scanners, QR code scanners and digital

watermarking are the various devices which are working on IoT in the present scenario.

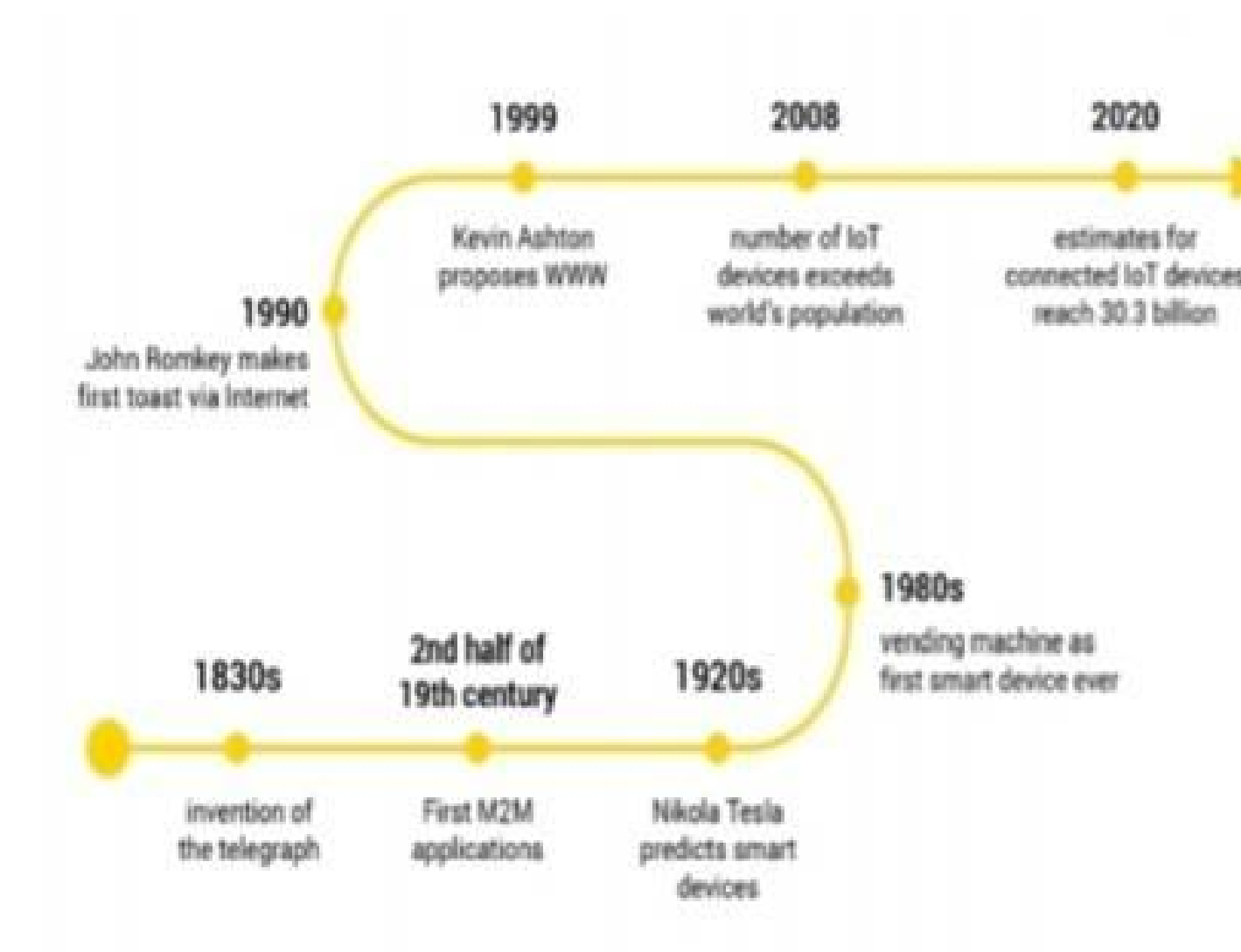


Fig 2. History of IoT

3. DEFINITION

The Internet of Things (IoT) describes physical objects (or groups of such objects), that are embedded with sensors, processing ability, software, and other technologies, and that connect and exchange data with other devices and systems over the Internet or other communications networks. It has evolved due to concurrence of multiple technologies, including ubiquitous computing, commodity sensors, increasingly powerful embedded systems, and machine learning. Traditional fields of embedded systems, wireless sensor networks, control systems, automation (including home and building automation), independently and collectively enable the Internet of Things.

Moreover, if we have computers that knew everything there was to know about things using data, they gathered without any help from us we would be able to track and count everything, and greatly reduce waste, loss and cost. We would know when things needed replacing, repairing or recalling, and whether they were fresh or past their best. The Internet of Things has the potential to change the world, just as the Internet did or even more.



Fig 3. Definition - IoT

4. ARCHITECTURE OF INTERNET OF THINGS

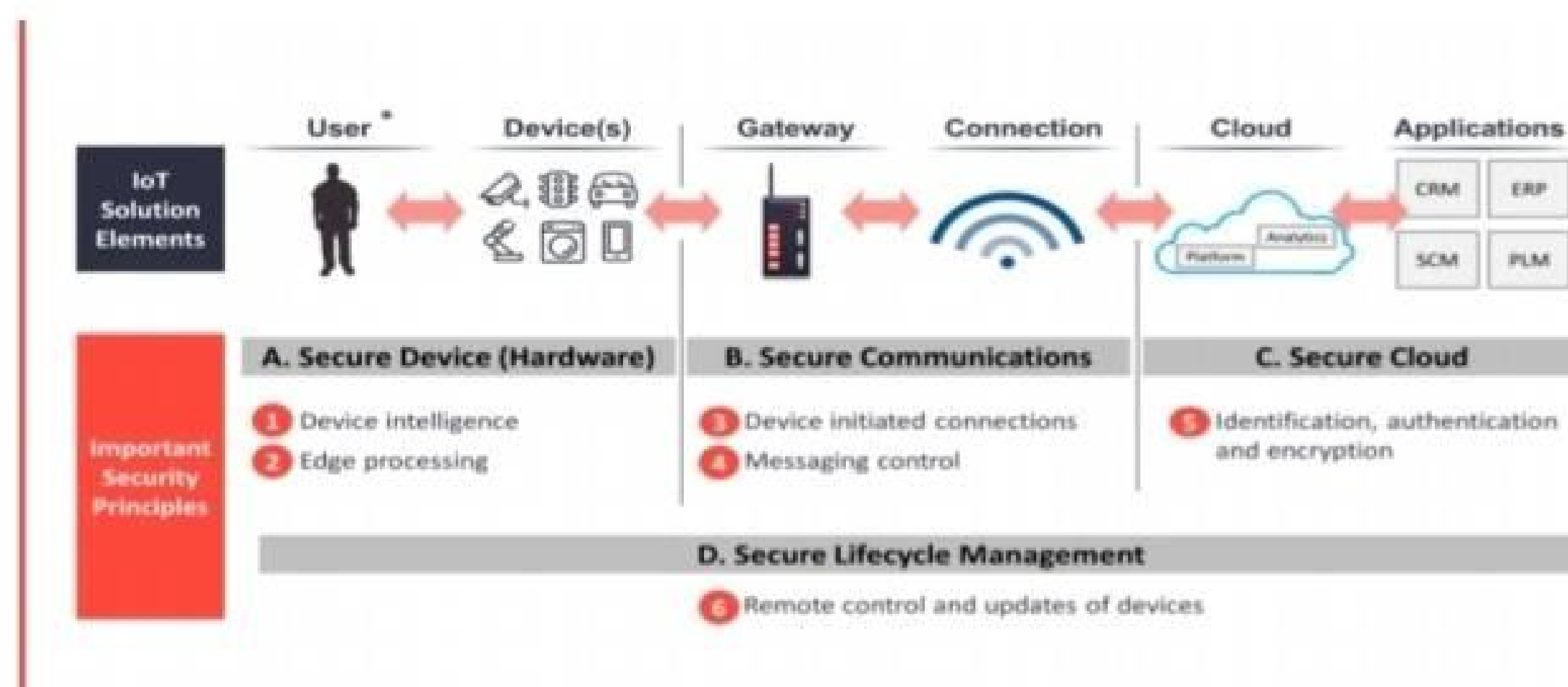


Fig 4. Architecture of IoT

IoT architecture is the system of numerous elements: sensors, protocols, actuators, cloud services, and layers. Given its complexity, there exist 4 stages of IoT architecture. Internet of Things architecture layers are distinguished in order to track the consistency of the system. IoT architecture include functionality, scalability, availability and maintainability.

1. Sensors and Actuators.
2. Internet Gateways and Data Acquisition Systems.
3. Edge IT.
4. Data Center and Cloud.

4.1. Sensors and Actuators

- The ability of sensors is to convert the information obtained in the outer world into data for analysis.
- It connects the digital and physical world thereby, providing information for further processing.
- Actuators are used to intervene the physical reality like switching off lights and adjusting temperature in a room.
- It is the lowest abstraction layer giving necessary insights for processing.

4.2. Internet Gateways and Data Acquisition Systems

- The vital importance of this stage is to process enormous amount of information collected on previous stage and squeeze it to optimal size of further analysis.
- It is the robust and high performing network infrastructure.
- Allows multiple organizations to use same network independently and supports communication requirements.
- Mainly this stage makes data digitized and aggregated.

4.3. Edge IT

- The prepared is transferred to the IT world, particularly the edge IT systems performs enhanced analytics and pre processing here. For example, machine learning, visualization and additional processing before entering in next stage.
- Captures periodic sensory data with security and privacy.
- This stage is closely linked previous stages i.e., sensors and actuators, creating wiring closet and residing in remote offices is also possible.

4.4. Data Center and Cloud

- The main process in the last stage is the in-depth processing and follow up revision for feedback.
- This phase includes the analytical skills of highest rank, both in digital and human worlds. Therefore, data from the other sources included here to ensure in depth analysis.
- After the processing all the quality standards and requirements, they are brought back to the physical world but in a processed and precisely analyzed appearance.

In simple words, The IoT can be viewed as a gigantic network consisting of networks of devices and computers through a series of intermediate technologies where numerous RF-IDs (radio frequency identification) tags, wireless connections may act as enablers of this connectivity.

- Tagging things: Real-time item traceability and address-ability using RF-IDs.
- Feeling things: Sensors act as primary devices to collect data from environment.
- Shrinking things: Miniaturization and Nanotechnology has provoked the ability of smaller things to interact and connect within “things” or “smart devices”.
- Thinking things: Embedded in devices through sensors has formed the network connection through Internet. It can make the “things” realizing the intelligent control.

5. APPLICATIONS OF IoT

There are several application domains which will be impacted by the emerging Internet of Things. The applications can be classified based on the type of network availability, coverage, scale, heterogeneity, repeatability, user involvement and impact.

Nowadays, many companies from different sectors or sectors are adopting this technology to simplify, improve, automate and control different processes.

5.1. Wearable Devices

- Wearable devices are small and energy efficient, which are equipped with sensors, with the necessary hardware for measurements and readings, and with software to collect and organize data and information about users.
- Virtual glasses, fitness bands to monitor for example calorie expenditure and heart beats, or GPS tracking belts.

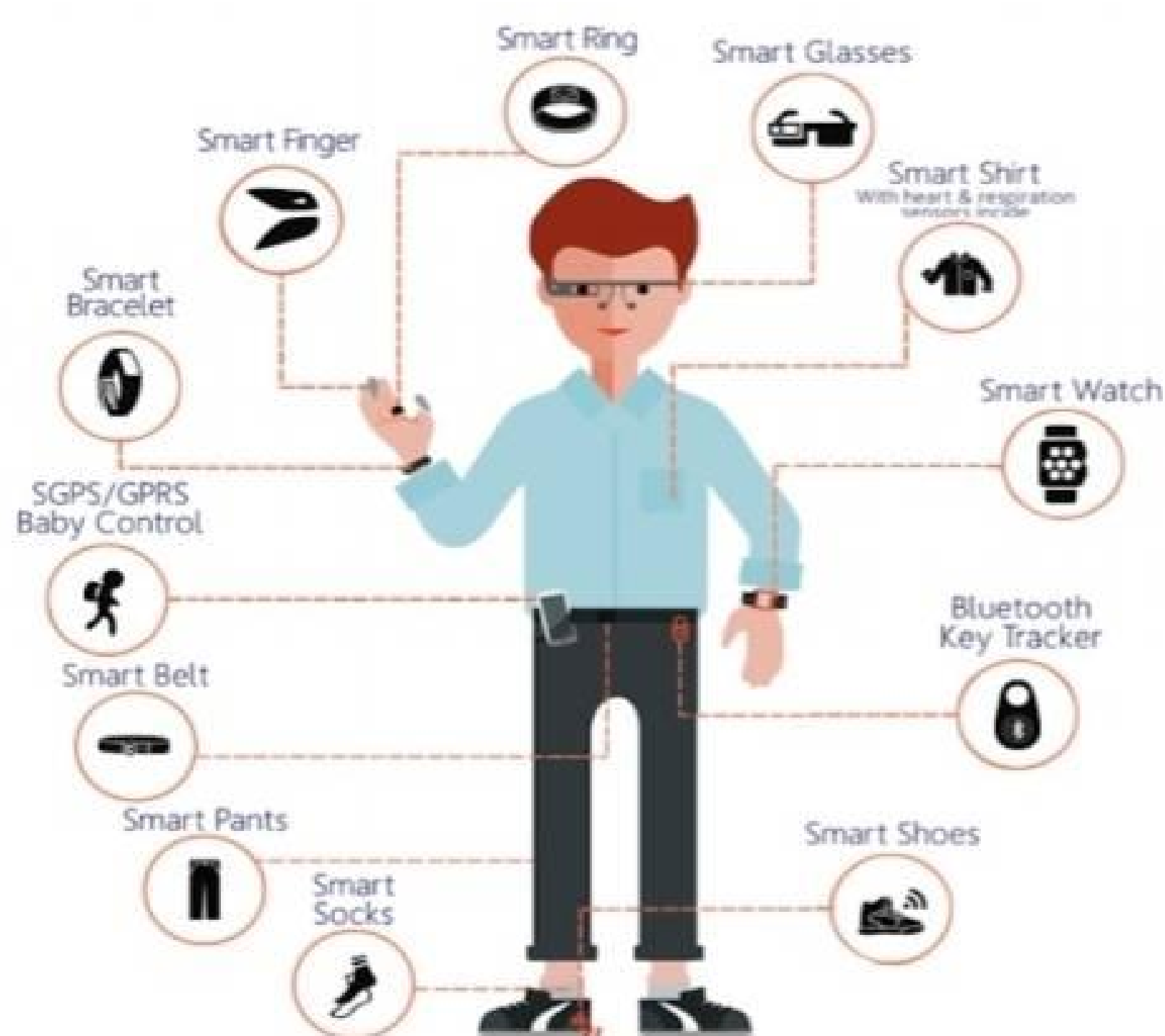


Fig 5.1. Wearables

5.2. Health

- The wearables or sensors are connected to patients in hospitals, which allows doctor to monitor patients' health condition. The Internet of Things helps to improve the care for patients and the prevention of lethal events in high-risk patients.

- Another use is the integration of IoT technology into hospital beds, giving way to smart beds, equipped with special sensors to observe vital signs, blood pressure and body temperature, among others.



Fig 5.2. Health

5.3. Agriculture

- Internet of Things offers farmers the possibility to access detailed knowledge and valuable information of their soil condition i.e., Smart farms. These IoT sensors provide the data based on the state and stages of soil.
- Information such as soil moisture, level of acidity, the presence of certain nutrients, temperature and many other chemical characteristics, helps farmers control irrigation, etc.



Fig 5.3. Agriculture

5.4. Smart Grid and Energy Saving

- The progressive use of intelligent energy meters, or meters equipped with sensors, and the installation of sensors in different strategic points that go from the production plants to the different distribution points, allows better monitoring and control of the electrical network.
- By establishing a bidirectional communication between the service provider company and the end user, information of enormous value can be obtained for the detection of faults, decision making and repair thereof.
- It also allows offering valuable information to the end user about their consumption patterns and about the best ways to reduce or adjust their energy expenditure.



Fig 5.4. Smart Grid

Many more applications are processed and worked using Internet of things platform.



Fig 5. Applications - IoT

6. CLOUD IN IoT

The data gathered by the sensors and devices interpret into meaningful information and pave the way for the advancement of IoT. Cloud services facilitate instantaneous databases, on-demand delivery of computing infrastructure, storage. It also facilitates applications needed

for the analysis and processing of data points generated through hundreds of IoT devices.

Cloud is basically used for memory storage. Generally, cloud computing is a virtualization technology. It is placed in a server or remote location which stores data using Internet. Cloud computing is the combination of hardware and software resources to access the data through the cloud.

It acts as a data storage element and configures the devices i.e., it stores bulk amount of data or information through online networking. Cloud doesn't require separate software and we access data through web browser. For example, Google photos, Google drives, etc.

6.1. Types of Cloud

- Public Cloud
- Private Cloud
- Community Cloud
- Hybrid Cloud

6.1.1. Public Cloud

A public cloud is a type of computing in which a service provider makes resources available to the public via the internet. Here, public users or people can use the data. For example, Google Cloud, Microsoft Azure, etc. But it provides less security as general public can access the cloud.

6.1.2. Private Cloud

Private cloud is also known as an internal cloud or corporate cloud. Private cloud provides computing services to a private internal network (within the organization) and selected users instead of the general public. For example, Oracle, Cisco, etc. It provides good security.

6.1.3. Community Cloud

Community cloud is a cloud infrastructure that allows systems and services to be accessible by a group of several organizations to share the

information. Example: Our government organization within India may share computing infrastructure in the cloud to manage data.

6.1.4. Hybrid Cloud

Hybrid cloud refers to a mixed computing, storage, and services environment made up of on-premises infrastructure, private cloud services, and a public cloud. Here critical information is stored in private such as username & passwords while others stored in public cloud.

6.2. Cloud Services

Cloud services has 3 types,

6.2.1. Infrastructure-as-a-Service (IaaS) This is the most common service model of cloud computing as it offers the fundamental infrastructure of virtual servers, network, operating systems and data storage drives. It allows for the flexibility, reliability and scalability that many businesses seek with the cloud, and removes the need for hardware in the office.

6.2.2. Platforms-as-a-Service (PaaS) It is basically programming, where cloud computing providers deploy the infrastructure and software framework, but businesses can develop and run their own applications. Web applications can be created quickly and easily via PaaS, and the service is flexible and robust enough to support them.

6.2.3. Software-as-a-Service (SaaS) This cloud computing solution involves the deployment of software over the internet to various businesses who pay via subscription or a pay-per-use model. It is a valuable tool for CRM and for applications that need a lot of web or mobile access – such as mobile sales management software.

6.3. Cloud Analyst

Cloud Analysts are responsible for the planning and engineering of an organization's cloud computing applications and services. Cloud Analysts implements and designs hardware and software that runs

entirely in the cloud. Thus, information in one data center in a remote location can be accessed and shared using cloud.

6.4. Cloud in IoT Benefits

- Anything with an internet connection can become “smart”.
- High system scalability and availability.
- Ability to aggregate large amounts of data, etc.



Fig 6. Cloud Services & IoT

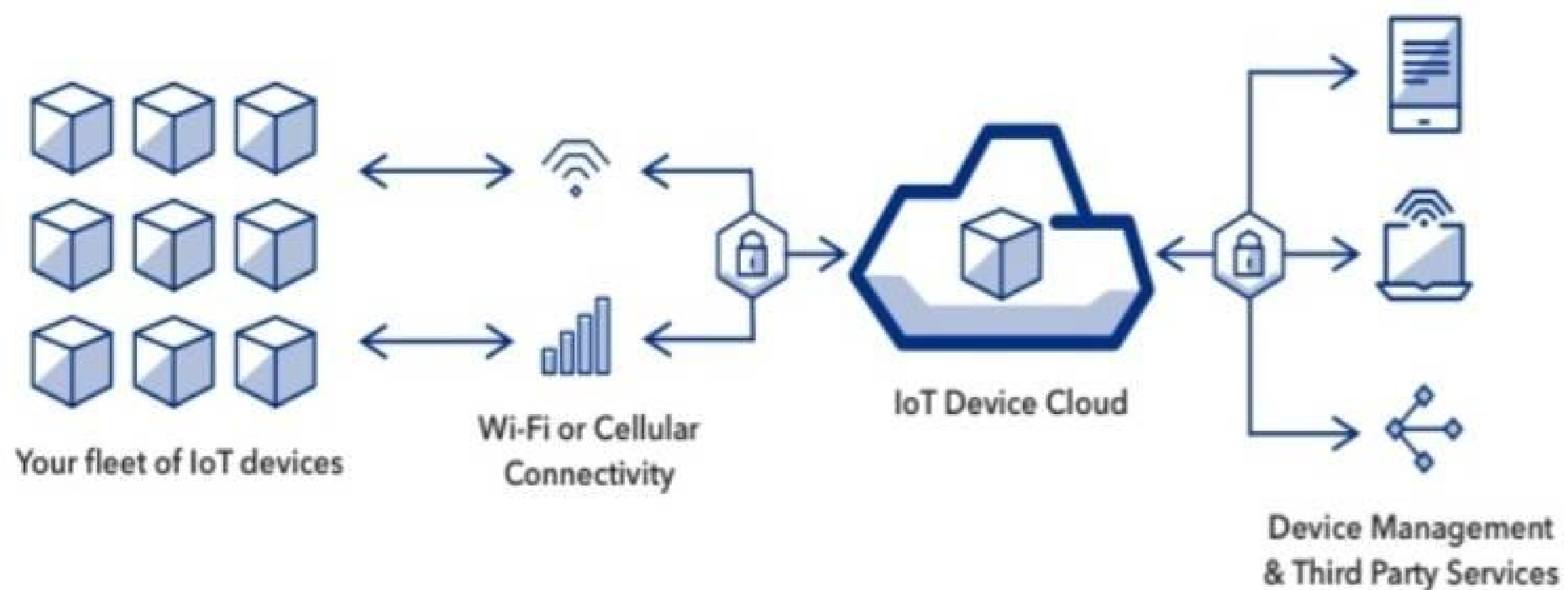


Fig 6.2. Stages of Cloud Services

7. MICRO-CONTROLLER

- It contains the circuitry of microprocessor, with built in ROM, I/O devices, timer and counters.
- Has one or more instruction to move data between CPU & memory using many bit level operations, as they are used for control purposes and data.
- Used for single purpose, inexpensive, low processing power and power consumption.
- Embedded systems (DVD players, GPS, etc.).

8. MICROPROCESSOR

- It contains ALU, general purpose register, stack pointer, program counter, clock timing and interrupt circuit.
- Has too many instructions to move data between CPU and memory with intensive or one- or two-level bit operations.
- Expensive, complicated, huge set of instructions as RAM, ROM, etc. uses external bus.
- Smartphones, satellite communication, microwave oven, etc.

9. COMPONENTS USED

9.1. Arduino UNO

A micro-controller board, contains on-board power supply, USB port to communicate with PC, and micro-controller chip.

Arduino is an open source, PC and programming organization, endeavor, and client group that plans and produce micro-controller packs for

constructing programmed devices and intelligent object that can detect and control questions in the real world.

Greater tool for developing interactive objects, taking inputs from variety of switches or sensors and controlling a variety of lights, motors and other outputs.

Connected to computer using USB, no external programmer or power supply needed.

- USB - serial communication to program micro-controller, board requires 5V.
- Power jack – power (7V-20V) DC.
- Voltage Regulator – regulates supply of 3.3V on the board.
- Reset Button – for resetting using program.
- Digital I/O pins – 0-13 pins (with 6 PWM pins).
- Analog pins – has 6 analog pins (A0-A5), when some sensor is connected to analog pins the built in ADC converts it and gives as digital O/P.
- TXD and RXD – used to transmit and receive data respectively.
- GND – ground of the Arduino board.



Fig 9.1. Arduino Board

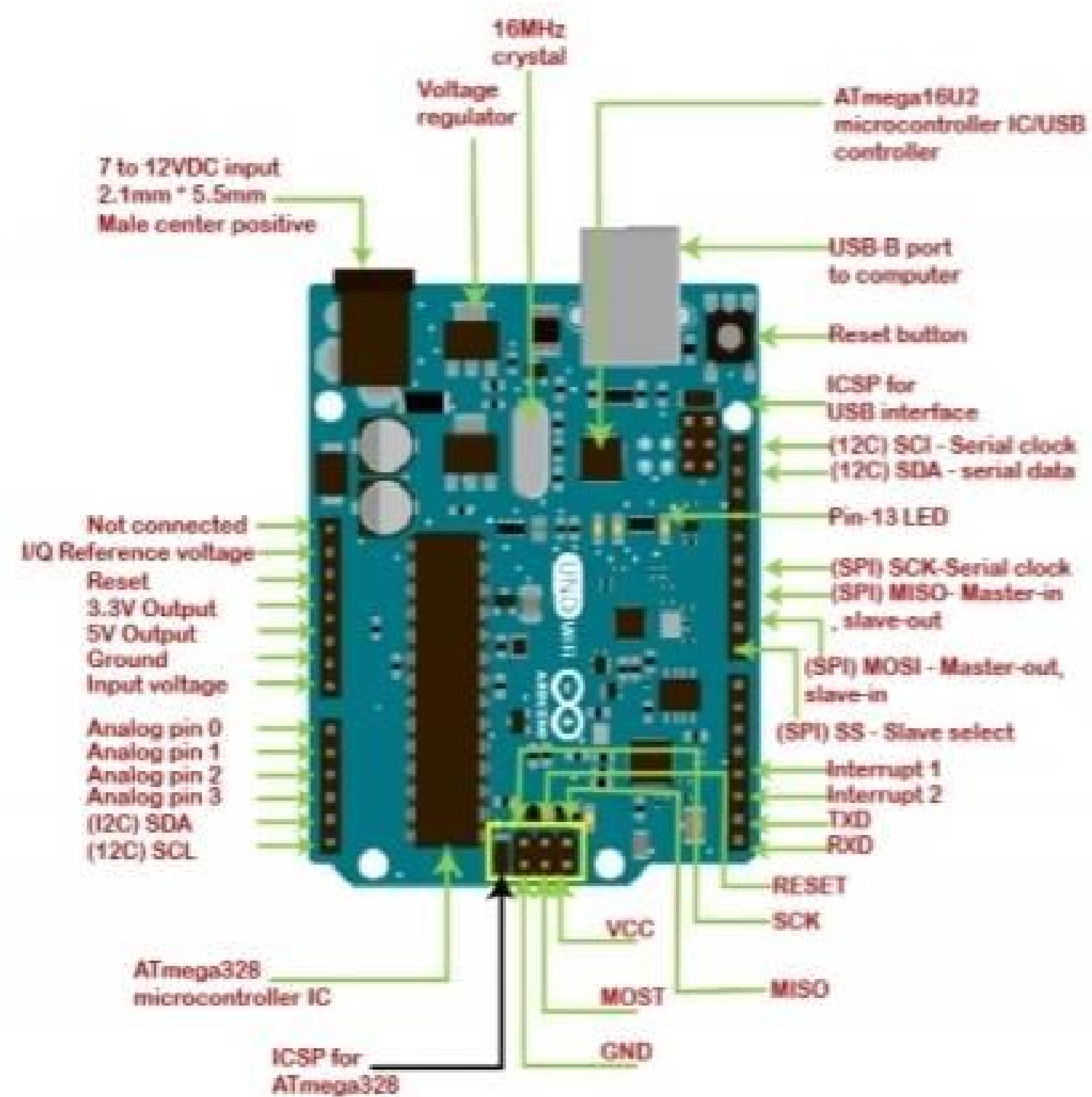


Fig 9.1.1. Arduino UNO Board - Pin Diagram

9.2. Nodemcu ESP8266



Fig 9.2. Nodemcu - ESP8266

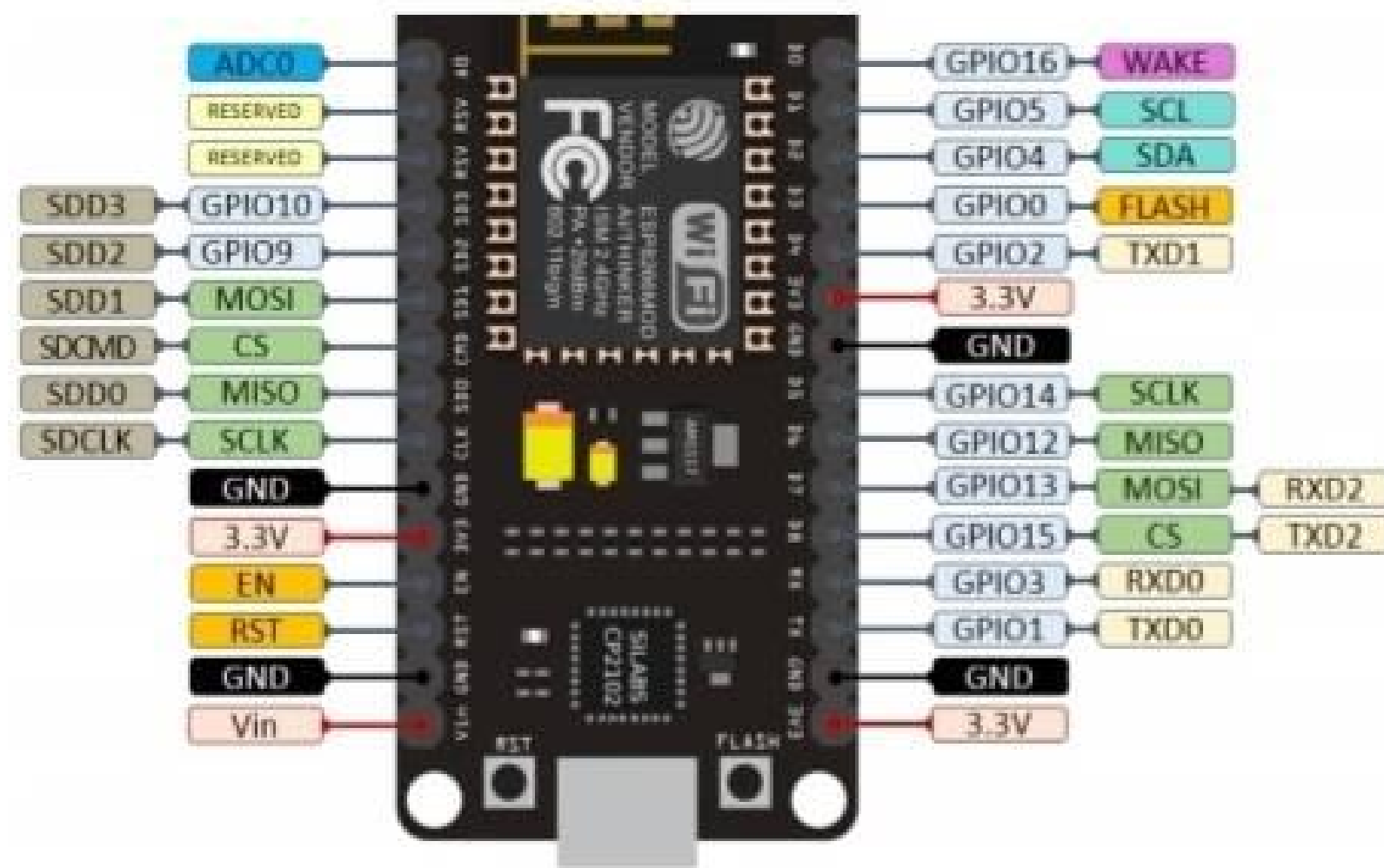


Fig 9.2.1. Nodemcu - Pin Diagram

NodeMCU is an open-source firmware and development board specially targeted for IoT based Applications. It includes firmware that runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware.

- Power - 3.3V, GND, Vin
 1. NodeMCU can be powered through the USB port.
 2. 3.3V: Regulated 3.3V can be supplied to this pin to power the board.
 3. GND: Ground pins.
- Vin: External Power Supply.
- Control Pins - EN, RST pin and the button resets the micro-controller.
- Analog Pin A0 - Used to measure analog voltage in the range of 0-3.3V.
- GPIO Pins GPIO1 to GPIO16 - NodeMCU has 16 general purpose input-output pins on its board.
- UART Pins TXD0, RXD0, TXD2, RXD2 - NodeMCU has two UART interfaces, UART0 (RXD0 & TXD0) and UART1 (RXD1 & TXD1). UART1 is to upload the firmware/program.

The NodeMCU Development Board can be easily programmed with Arduino IDE since it is easy to use. Programming NodeMCU with the

Arduino IDE will hardly take 5-10 minutes. All you need is the Arduino IDE, a USB cable and the NodeMCU board itself.

9.3. Bread board and Jump wires

- A breadboard is utilized to build and test circuits expeditiously afore finalizing any circuit design. The breadboard has many apertures into which route components like ICs and resistors can be connected.
- A typical breadboard that includes top and bottom power distribution rails. Jump wires are generally used to establish connectivity with bread board.

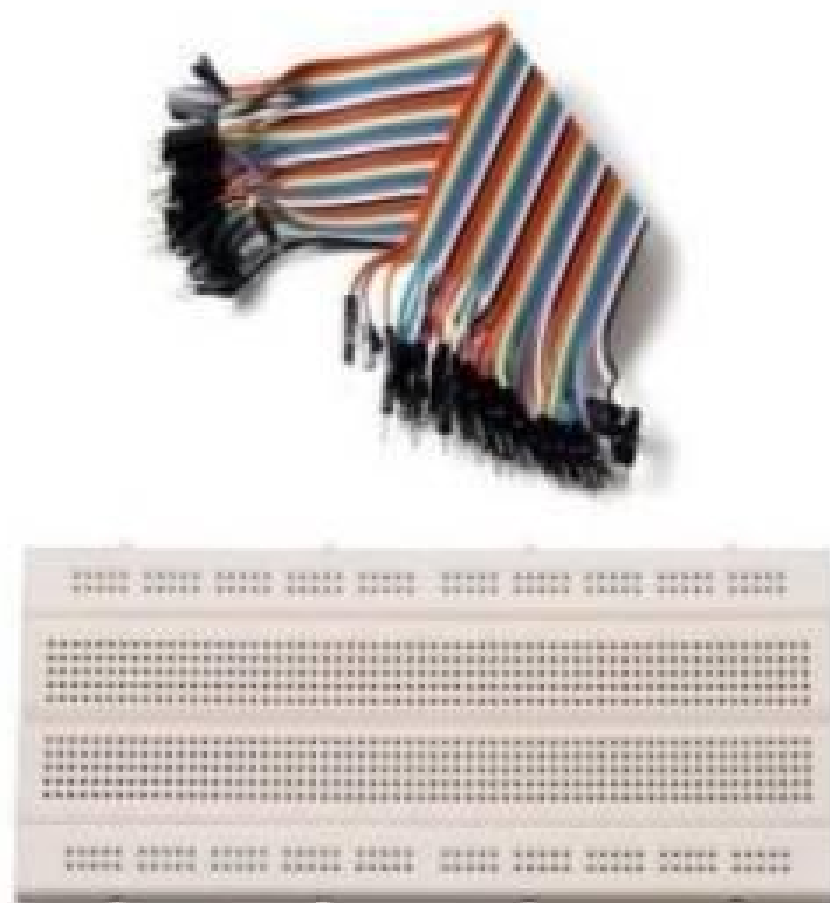


Fig 9.3. Bread board and Jump wires

10. BLYNK

Blynk is an Internet-of-Thing's platform designed to make development and implementation of smart IoT devices quick and easy. It can be used to read, store, and visualize sensor data and control hardware remotely. The main focus of the Blynk platform is to make it super-easy to develop the mobile phone application. Blynk is free to use for personal use and prototyping.

With Blynk, we can control an LED or a motor from your mobile phone with literally zero programming. Blynk is a robust and scalable tool that is used by hobbyists and the industry alike. We can use it

We can also use it to control smart furniture that can learn from your

routines, or embed IoT and AI to traditional industrial products such as a boiler, or for improving the integrity and safety of oilfields.

10.1. Blynk Server

- It provides essentially unlimited energy units, so that you can build any Blynk application you can think of.
- Minimal latency, which is useful when your application is used in a limited geographic area and responsiveness is important.
- Total control of your data. You can keep your own backups of your Private server, migrate your server to a new host, implement whichever security mechanisms you wish, and finely control your users.
- Blynk offers a secure, responsive and centralized cloud service through its server which allows all of this communication between the devices.

10.2. Blynk Library

- This makes the blynk library scalable and outstanding. As it connects our hardware, get it up and running in a blink.
- The library supports multiple hardware devices including Arduino, ESP8266 and Raspberry Pi and also connects different ways of communication like Wi-Fi, Bluetooth, USB, etc.
- Blynk Library is an extension that runs on top of your hardware application. It handles all the connection routines and data exchange between your hardware, Blynk Cloud, and your app project.
- Once you download the app you will be able to generate Auth Token for every device.

11. CONFIGURATION OF BLYNK

- After installing Blynk app on the smartphones, an account should be created to access its services.
- When the app is opened, it asks whether sign in or create account. Create an account and add a new project to get started.
- Each project has its own authentication code which is used by the code to communicate with that particular model.
- To interface with our components, we need to add widgets to our model. To add widgets press „+” to add to the model. The app provides a neat interface to add all the required widgets and setting them up according to the code.
- The Blynk needs to be running in the background for the user to get real time notifications. After downloading the Blynk app, you can create a project dashboard and arrange buttons, sliders, graphs, and other widgets onto the screen.
- Thus, in short Blynk allows you to quickly build interfaces for controlling and monitoring your hardware projects from your iOS and Android device.

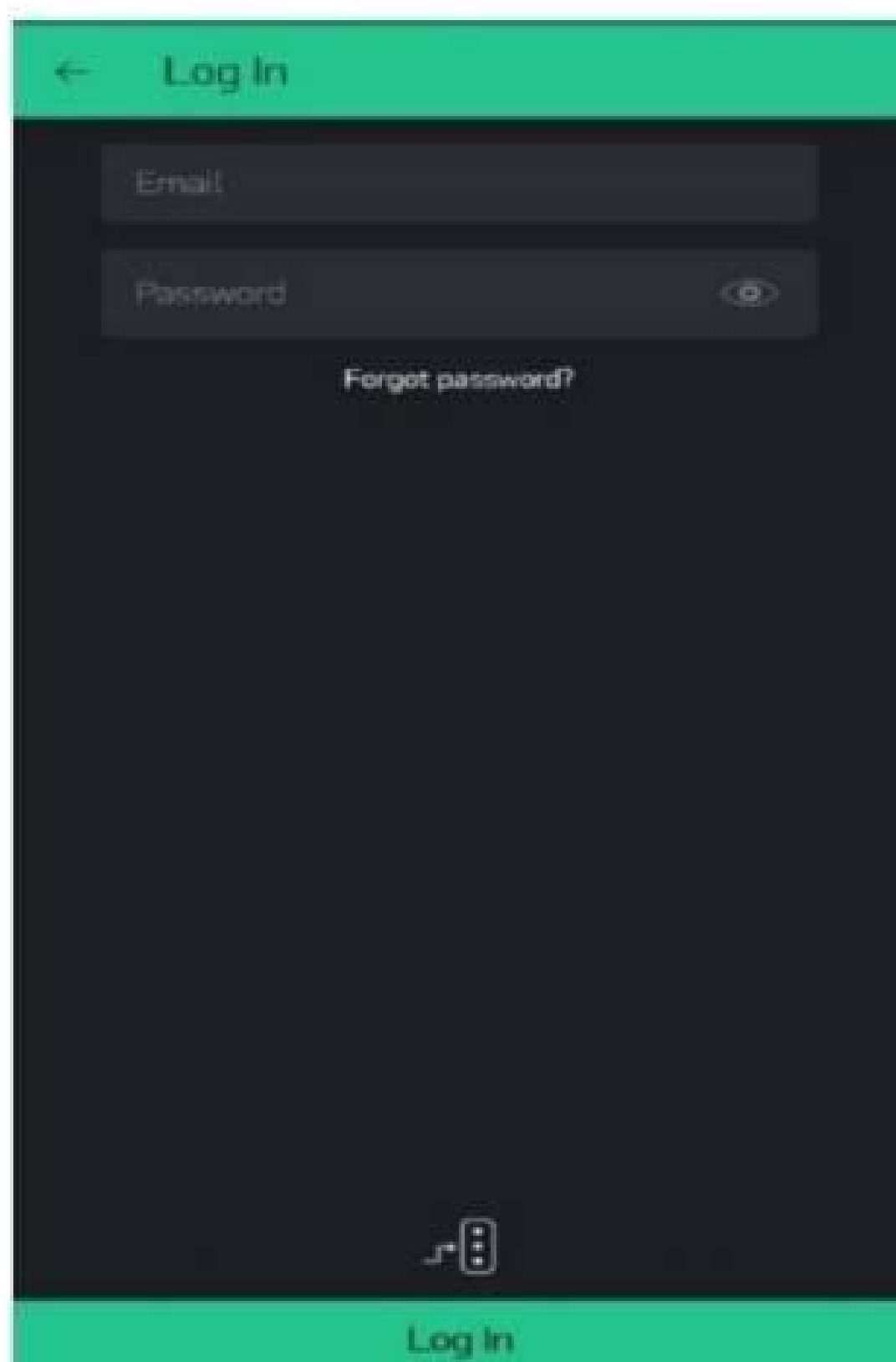


Fig 10. Blynk

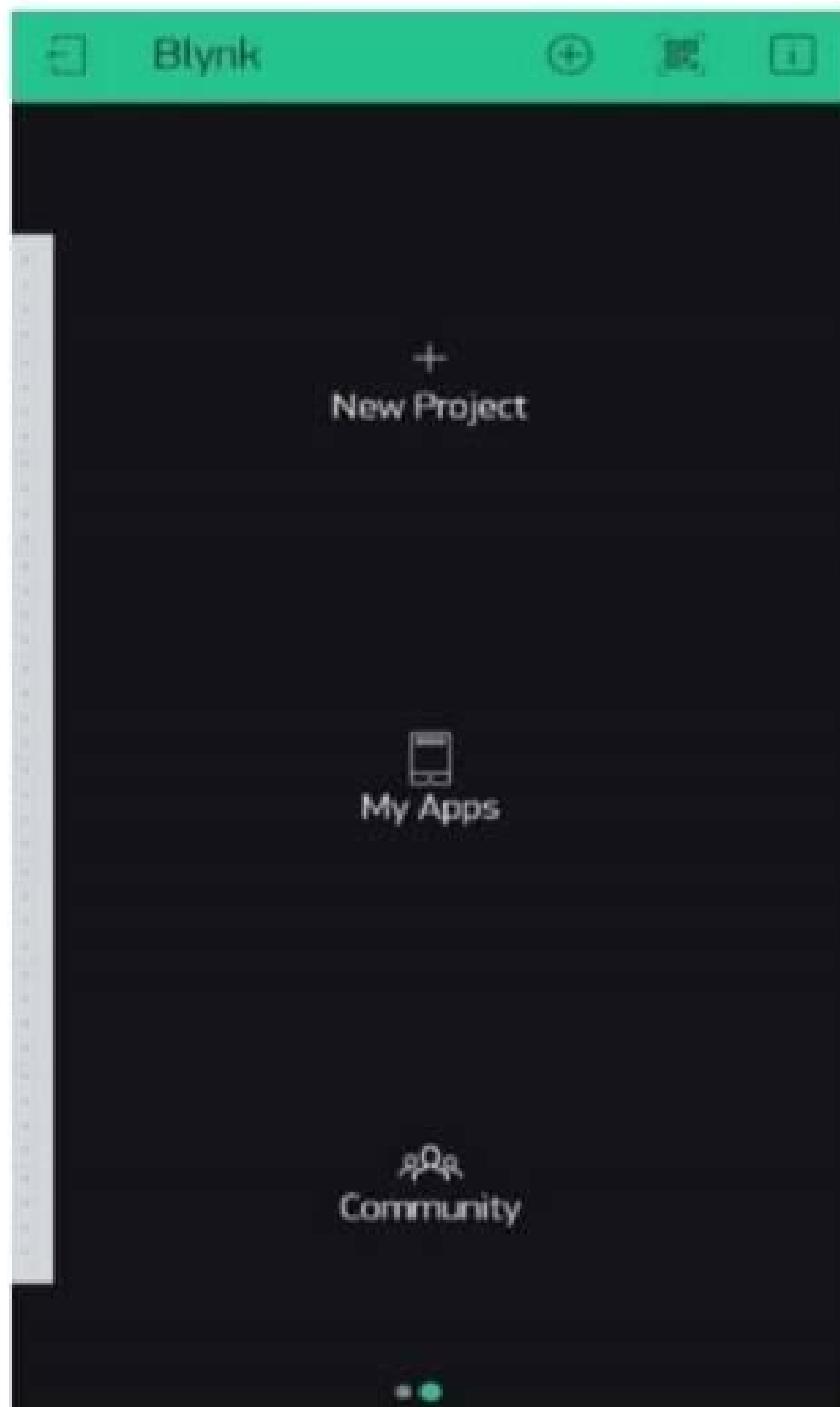


Fig 11. Configuration of Blynk

12. ADVANTAGES

- The IoT allows you to automate and control the tasks that are done on a daily basis, avoiding human intervention.
- The machine-to-machine interaction provides better efficiency, hence; accurate results can be obtained fast. This results in saving valuable time.
- The main advantage of “Home Automation through Android mobile” is that the “physically challenged and disabled people”.
- Can control home appliances from anywhere from the world. Helps for safety purpose.

- Saves natural resources and trees Helps in creating a smart, greener and sustainable planet.
- IoT can be used in every vertical for improving the efficiency Creates new businesses, and new and better jobs.
- All the applications of this technology culminate in increased comfort, convenience, and better management, thereby improving the quality of life.

13. DISADVANTAGES

- **Complexity:** The designing, developing, and maintaining and enabling the large technology to IoT system is quite complicated.
- **Technology Takes Control of Life:** Our lives will be increasingly controlled by technology, and will be dependent on it.
- **Lesser Employment of Menial Staff:** The unskilled workers and helpers may end up losing their jobs in the effect of automation of daily activities.
- **Privacy/Security:** With all of this IoT data being transmitted, the risk of losing privacy increases.
- **Compatibility:** As devices from different manufacturers will be interconnected, the issue of compatibility in tagging and monitoring crops up.

14. REQUIREMENTS

14.1. Software Requirements And References

- Arduino IDE - We need Arduino IDE software to write and upload the programming logic onto the Arduino UNO board.

<https://www.arduino.cc/>

- Blynk App - Here, we need to create an account in the Blynk app IoT to integrate the working of the system physically on the Blynk app.

14.2. Hardware Requirements

- Node MCU (ESP8266)
- Arduino UNO
- Bread Board
- Jump wires
- Power

15. IMPLEMENTED PROGRAMS

- Arduino UNO used to blink Led related applications and detecting various sensors.
- An application is installed in the mobile (Blynk), where ESP8266 Wi-Fi module used for communication between the application and system.
- By using this we can switch on or off the lights automatically when we are outside. Also, the notification gets triggered in Blynk app whenever a motion is detected.

16. SOURCE CODE

16.1. TO BLINK AN LED

Turn an LED on for one second, off for one second, and repeat forever.

```
void setup () {  
  
    pinMode(13, OUTPUT);  
  
}  
  
void loop () {  
  
    digitalWrite(13, HIGH);  
    delay (1000);  
    digitalWrite(13, LOW);  
    delay (1000);  
  
}
```

16.2. LIQUID CRYSTAL DISPLAY

```
LiquidCrystal lcd (12,11,5,4,3,2);  
void setup ()  
  
{  
    lcd.begin(16, 2);  
  
    lcd.clear();  
  
    lcd.print("hello, world!");  
  
}  
  
void loop ()
```

```
{  
  
    lcd.setCursor(0,1);  
  
    lcd.print(millis()/1000);  
  
}
```

16.2. BLYNK NOTIFICATION

```
#include <ESP8266WiFi.h>  
  
#define BLYNK_PRINT Serial  
  
#include <BlynkSimpleEsp8266.h>  
  
char auth[] = "eg_80LgRrpPLNa1l6t2rGn_RI-WiFJYS";  
  
char ssid[] = "CodeBind Hathway";  
  
char pass[] = "9789617617";  
  
#define ledPin D7  
  
#define pirPin D1  
  
int pirValue;  
  
void setup()  
{  
  
    Serial.begin(115200);  
  
    delay(10);  
  
    Blynk.begin(auth, ssid, pass);  
  
    pinMode(ledPin, OUTPUT);  
  
    pinMode(pirPin, INPUT);  
  
}
```

```
    digitalWrite(ledPin, LOW);  
}  
  
void loop()  
{  
    getPirValue();  
    Blynk.run();  
}  
  
void getPirValue(void)  
{  
    pirValue = digitalRead(pirPin);  
    if (pirValue)  
    {  
        Serial.println("==> Motion detected");  
        Blynk.notify("T==> Motion detected");  
    }  
    digitalWrite(ledPin, pirValue);  
}
```

17. CIRCUIT CONNECTIONS AND OUTPUT

17.1. TO BLINK A LED

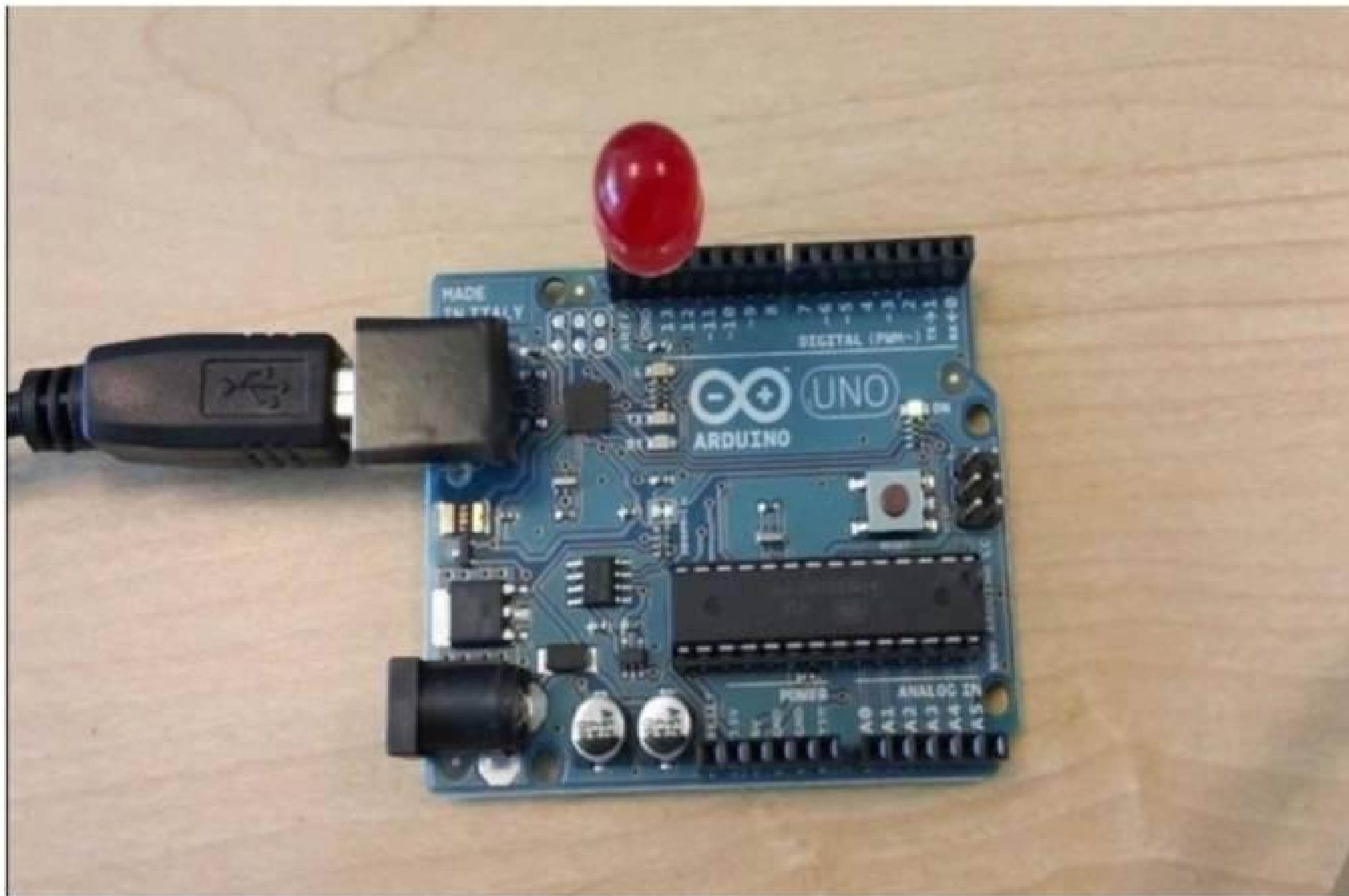


Fig 17.1. Circuit Apparatus - To blink a LED



Fig 17.1.1. Output of LED blinking

17.2. LIQUID CRYSTAL DISPLAY

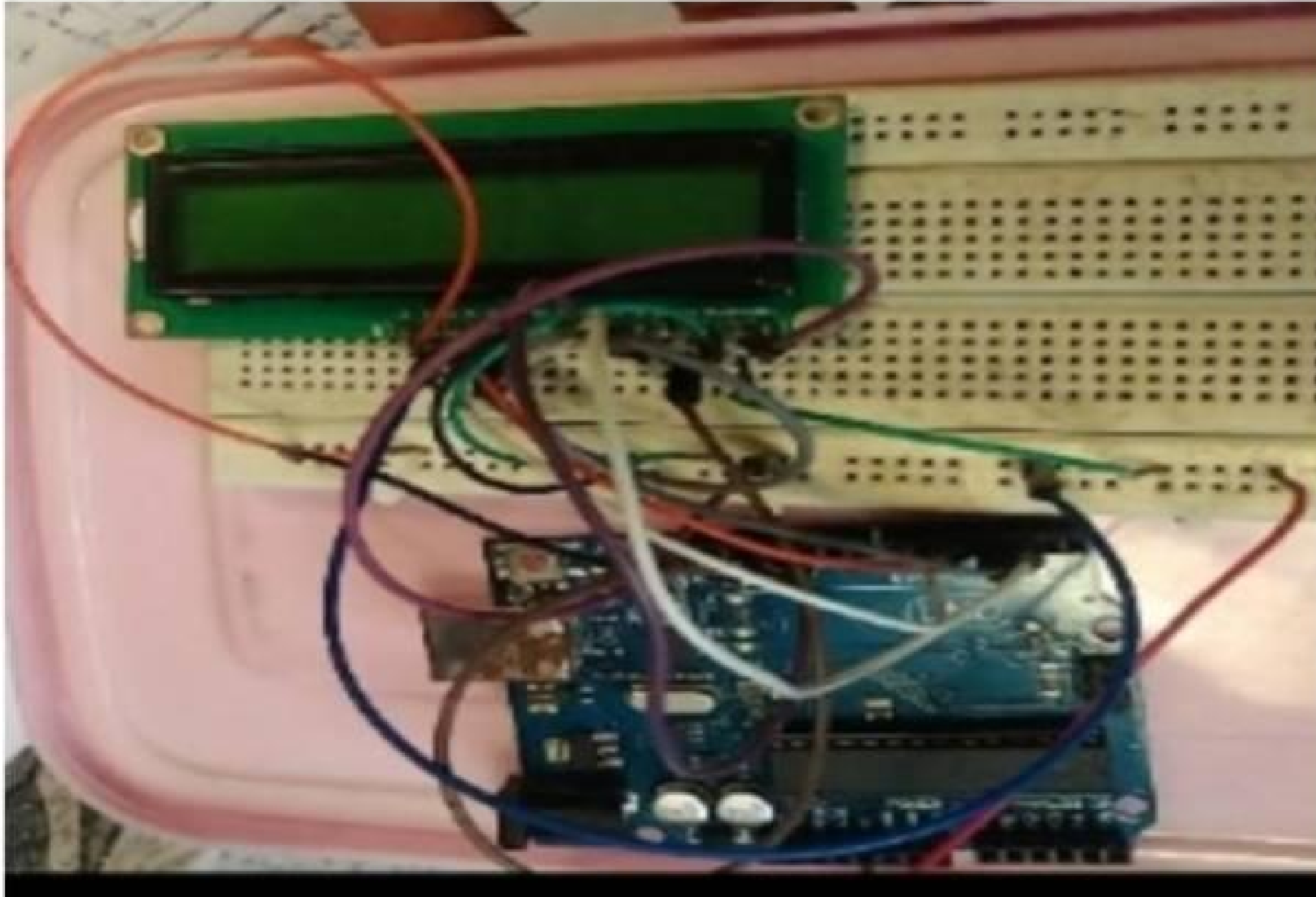


Fig 17.2. Circuit Apparatus - LCD Display

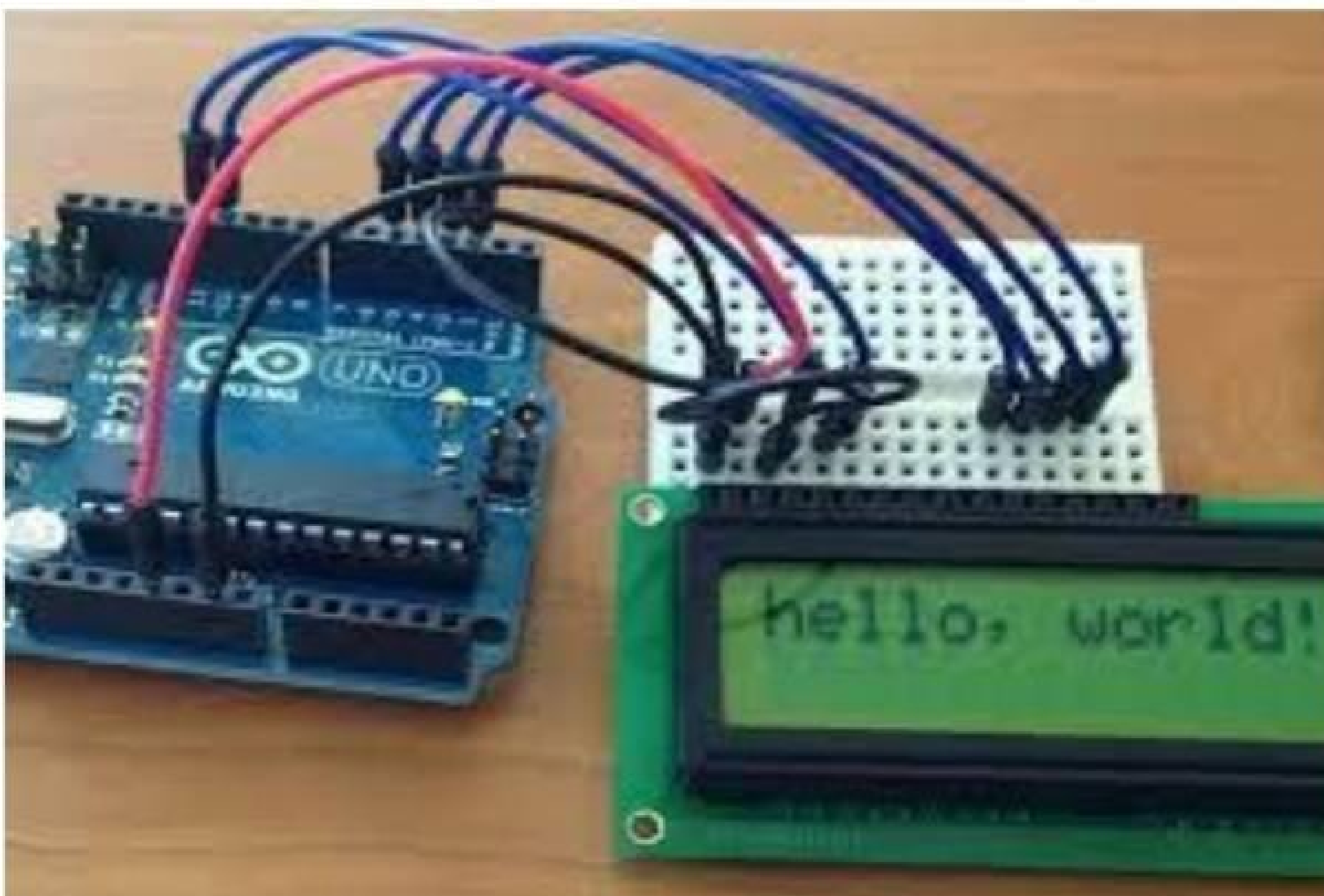


Fig 17.2.1. Output of "helloworld" on LCD Display

17.3. BLYNK NOTIFICATION



Fig 17.3. Blynk Notification - ON



Fig17.3.1. Blynk Notification - OFF



Fig 17.3.2. Blynk Notification - ON



Fig 17.3.3. Blynk Notification - OFF

18. CONCLUSION

Internet of Things is the next stage of information revolution and referenced the internet connectivity of everything from urban transport to medical devices to household appliances.

Integrating features of all the hardware components used have developed it. Presence of every module has been reasoned out and placed carefully thus contributing to the best working of the unit. Embedded systems are emerging as a technology with high potential. In the past decades microprocessor based embedded system ruled the market. The last decade witnessed the revolution of Micro-controller based embedded systems.

With regards to the requirements gathered the manual work and the complexity in counting can be achieved with the help of electronic devices. Thus, IoT related program implementations are executed and explained with required components.



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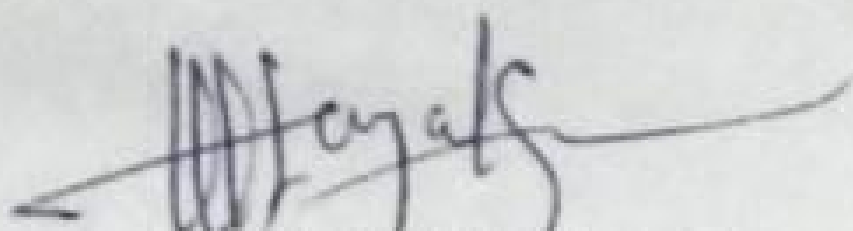
Thurs day, 25 November 2021

CERTIFICATE

This is to certify that **Ms. PARKAVI. V**, 3rd year, **B.E.(Electrical And Electronic Engineering)** student of **SATHYABAMA INSTITUTE OF SCIENCE AND TECHNOLOGY, CHENNAI**. has undergone her project work in **LORDS ENGINEERING, Chennai** from **5th November 2021 to 20th November 2021**.

Her project work on **"Internet Of Things"** was completed successfully.

We wish her success in all her future endeavors.


M. JAYAKUMAR.

(Manager Personnel)

