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A Low-Cost Prototype for Edge-Computing Powered Smart Display Board

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ABSTRACTS

This study examines how Edge Computing technology, through the creation and use of smart notice boards, has changed the way that organizations communicate. Notice boards have historically relied on manually operated or wired electronic devices, which provide drawbacks like slowness, security flaws, and a lack of adaptability. But a new way of looking at notice board systems has developed with the advent of Edge Computing, which is driven by hardware like the ESP8266 server and communication protocols like MQTT (Message Queuing Telemetry Transport). We explore the advantages of Edge Computing in the context of smart notice boards in this study, emphasizing its capacity to support real-time data processing, improve security via local data management, login credentials, and provide users with user-friendly interfaces for content management. Smart notice boards can outperform traditional systems in terms of efficiency, security, and adaptability by utilizing the concepts of Edge Computing.

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1. INTRODUCTION

Smart Web-based notice boards can be used in a variety of settings, including schools, institutions, banking, medical facilities, and railway stations (Chinnasamy et.al, 2022). Noticeboards are widely employed in the modern world, including train stations, schools, universities, and companies. However, they have not been innovated since their creation (Rangani et.al, 2017). In the area of corporate communication, the modest notice board has long functioned as an important instrument for conveying information, sharing news, and encouraging community involvement. However, traditional paper-based and wired electronic notice boards have disadvantages, ranging from inefficiency to security flaws. In response to these issues, the introduction of Edge Computing technology has ushered in a new era of smart notice boards, transforming how information is managed and conveyed inside enterprises.

Cutting-edge technology, such as microcontroller-based servers like the ESP8266, come together in an Edge Computing-powered smart notice board. By utilizing the concepts of Edge Computing, this novel strategy minimizes dependency on centralized servers and allows real-time data processing and secure communication by moving computational processes closer to the data source. This system lays the groundwork for investigating how Edge Computing can revolutionize notice board systems. Through an analysis of the benefits of local data processing, improved security protocols, and intuitive user interfaces, we may acquire a deeper understanding of how Edge Computing is transforming organizational communication strategies and promoting efficiency, security, and agility in the digital era. A smart notice board powered by Edge Computing is an example of the application of edge computing approach for such system development "it shows from figure 1".

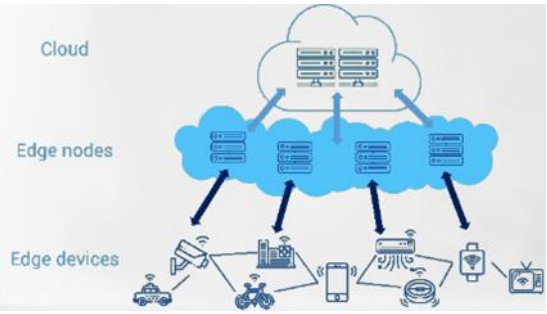

Fig. 1. Edge Computing Illustration

1.1. Objectives

- To create a wireless display notice board that can interact with an Android device or browser via Wi-Fi networking.
- To allow users to send messages from any remote place using a Wi-Fi module attached to an Android handset or PC browser.
- To assist users in issuing notifications using an Edge Computing Approach

1.2. Applications

- This system minimizes the need for human labor to maintain the notice board.

- The use of Wi-Fi technology ensures good performance and cost-effectiveness due to its fast internet speed.

- Saves paper and printing costs to bring out digital revolution in information delivering.

2. LITERATURE REVIEW

Within the year 2012, Abhishek Gupta together with few analysts (Nivetha, et al.,2013) have created the GSM based remote take note board. GSM innovation, Raspberry Pi innovation and LCD screen are utilized in this project. The mode of exchanging data is through GSM innovation. But the GSM innovation isn't solid in exchanging data. Within the year 2016, progressed form of take note board was created. Meenachi and other analysts (Dalwadi, 2012), by utilizing the state-of-the-art advances like Bluetooth Innovation. They have utilized an Arduino microcontroller. The mode of exchanging information is through Bluetooth. In this the data can be passed as it were when the versatile is connected to the Bluetooth. In other words, the data can as it were pass when the client is close the take note board. In the paper (Vishnu, et al., 2021) GSM technology is utilized for exchanging the message but there emerges a downside of deferred transmission of message. Driven show is utilized for showing the message. Within the year 2012, Darshan Kumar C, Dalwadi, Yash Teckchandani.et al has created an Expansive Screen Remote Take Note Show Framework. Raspberry Pi is utilized to show the message which is exorbitant. The messages were passed on utilized SMS. In this strategy they did not give any verification so it can be abused by anybody. GSM arrange is broadly utilized nowadays whether it is for calling or SMS. Too, a few of the places needs critical takes note like in college, railroad stations share-market, and this take note ought to be in real-time, so we require a real-time notice (Kumar, et al., 2014). This venture is the experiment to deliver a begin to the time of real-time taking note. This extend is almost composing the message which is to be shown in portable and send it as SMS to other side. This gotten message is gotten into Microcontroller and after verification it is shown on LCD screen. Moreover, by meddle a voice information recording IC with Microcontroller able to moreover do announcements in real-time. In the year 2014 (Ketkar, et al., 2014), utilizing the Bluetooth and ZigBee innovation, compact and short-range remote take note board has been created and it was an episode for the routine take note board. The ATmega32 microcontroller is the heart of this system. The LCD shows is utilized to show the gotten message. Within the year 2015 (Mujumdar, et al., 2015), Jaiswal Rohit et.al. Has created a progressed advanced Take note Board utilizing GSM innovation that can control the show board and plays crucial part to handover the data from verified client by utilizing the mobile innovation. The heart of that plot was the Atmel AT89S52. The study presented a new method of communicating messages to individuals via a wireless electronic display board synced with GSM technology. This proposed solution had the potential to improve security and raise awareness of emergency situations in public spaces, malls, and large buildings, reducing risks (Reddy and

Venkareshwarlum,2017). This research focuses on the core concept of an IoT-based digital display utilizing a Raspberry Pi. The goal of this suggested project is to ensure that data is updated and output is displaced in all internet-connected devices. Notice boards are quite significant in our daily life. Information dissemination in a paperless era can be greatly eased by replacing the classic analogue type notice board with a digital notice board (Singaram, et al., 2022).

Numerous research projects have focused on developing a cost-effective solution (Nivetha, et al., 2013; Dalwadi,2012; Vishnu, et al., 2021; Kumar, et al., 2014; Ketkar, et al., 2014; Mujumdar, et al., 2015; Reddy and Venkareshwarlu, 2017) for the creation of digital notice boards. This concentrated effort seeks to democratize access to such technology, making it available to organizations and institutions with modest resources. By harnessing these advances, institutions can improve communication channels, convey information more efficiently, and encourage stakeholder participation. The cornerstone of these advancements is their devotion to cost without sacrificing functionality. Researchers have created digital notice board systems that are not only cost-effective, but also extremely configurable and scalable, by employing their own secure HTTP-based access, easily available hardware components, and streamlined design techniques.

3. METHODOLOGY

Edge Computing-based wireless notice boards show the notice continually till the user does not send another message. This system's function is to show and proclaim the text message that was sent by the user from the browser and received by the ESP8266. The message is then sent to the LED matrix display via the IP address page that the ESP8266 installed. The system creates an IP address from the linked wireless network in order to connect the ESP8266 to the LED display. The Matrix display and the ESP8266 node MCU are connected via the GPIO pins. An LED display and an ESP8266 node MCU make up the suggested setup “it show from figure 2”.

Basic block diagram

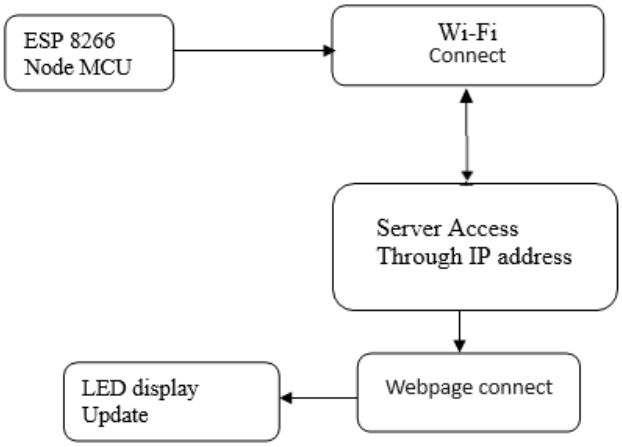

Fig 2. Block Diagram

3.1. Edge Computing

Processing data closer to the point of generation, as opposed to depending on a centralized data center or cloud server, is known as edge computing. This results in computational operations being carried out nearer to the data generation location, which can lower latency, boost productivity, and enhance security and privacy for specific applications. Web pages are processed, saved, and delivered to web clients via a web server. Simply explained, a web client is a web browser that we use on our phones and PCs. The Hypertext Transfer Protocol (HTTP) is a unique protocol that web clients and servers use to interact with one another. A client initiates a discussion using this protocol by submitting an HTTP request for a certain web page. The web page's content is then returned by the server, or if it cannot find it, an error message is displayed (such as the well-known 404 Error) "it shows from figure 3".

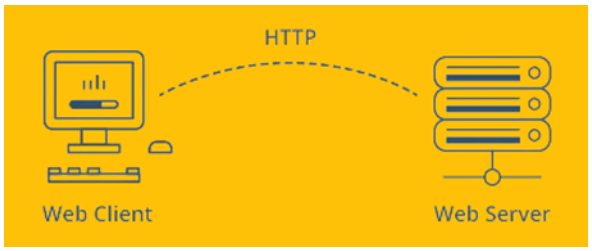

Fig. 3. Web client-server connection

3.2. HTML

The common markup language for building and organizing web pages on the Internet is called HTML (Hypertext Markup Language). It is made up of a collection of markup tags that specify the organization and content of a webpage, including lists, headings, paragraphs, links, multimedia components, and images. Web browsers translate HTML texts to create interactive, aesthetically pleasing web pages that users can view and interact with. Web developers can utilize HTML to construct responsive, dynamic websites that meet the needs

and tastes of a wide range of users. The HTML-based webpage is designed here to login via authorized credentials and update the system remotely.

3.4. HTTP protocol

The fundamental mechanism that facilitates communication between web clients—like web browsers—and web servers on the Internet is called HTTP (Hypertext Transfer mechanism). It lays out a set of guidelines and customs for sending and receiving data via the internet. By sending an HTTP request message, a client in the HTTP protocol asks a server for a certain resource, like a web page. After processing the request, the server replies with an HTTP response message that either contains the resource that was requested or, in the event that the request cannot be completed, an error code. Web material may be retrieved and displayed in a standardized, cross-platform manner thanks to HTTP, which enables smooth and effective communication between clients and servers.

3.5. Algorithm

i. *Start*
ii. *Properly connect the LED Display with ESP8266 node MCU*
iii. *Code the program and logic*
iv. *Develop server system connecting and setting local Wi-fi system in Esp8266 board*
v. *Test the IP address allocated by Esp8266*
vi. *Connect to IP address and login page remotely via authorized ID*
vii. *Update the Display board as desired*

Table 1. Hardware Requirement

Hardware	Function
ESP 8266 board	Main microcontroller
5v adapter	Powering system
LED matrix board	Display for output

Table 2. Software Requirement

Hardware	Function
Arduino IDE	System Programming

Flow Chart of System

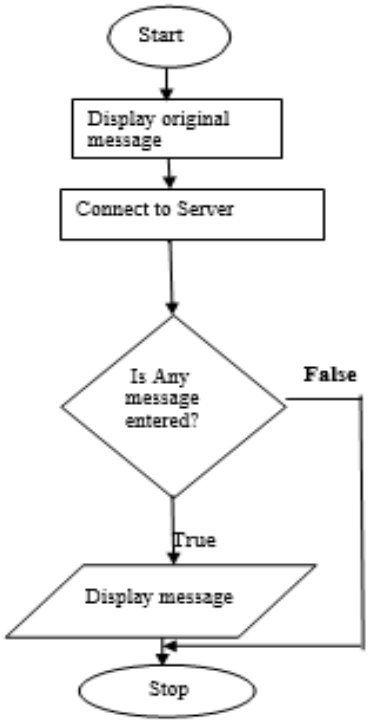

Fig 4. System Flowchart

In this paper, we present a thorough methodology for designing and implementing a smart notice board system driven by Edge Computing. Our approach consists of multiple crucial stages, each intended to tackle particular facets of the project and guarantee its effective implementation.
In order to obtain a good understanding of Edge Computing principles, smart notice board systems, ESP8266 server technology, and associated topics, the first part entails performing a thorough literature review. This phase creates the foundation for the project's later phases by combining current information and defining best practices. After defining the requirements, we proceed to the hardware setup stage, where we obtain and set up the required hardware parts in accordance with project criteria. This entails configuring the networking gear, ESP8266 server, display modules, and sensors (if any) to build a workable hardware infrastructure for the smart

notice board system.

At the same time, we start the software development stage, during which we create and put into use the software elements required to run the smart notice board system. This entails implementing backend server applications for data processing and storage, integrating the IP protocol for device connection, producing firmware for the ESP8266 server, and designing a web-based user interface for content management. Following the development of the hardware and software components, the various parts are integrated to produce a working prototype of the smart notice board system during the integration and testing phase. Thorough testing is done to make sure the system satisfies predetermined requirements and use cases by assessing its security, performance, and dependability. We implement the smart notice board system in a real-world organizational setting after successful integration and testing, and users and stakeholders assess it there. In addition to collecting feedback on usability, efficacy, and satisfaction, important metrics like reaction speed, dependability, and security are used to assess the system's performance "it shows from figure 5".

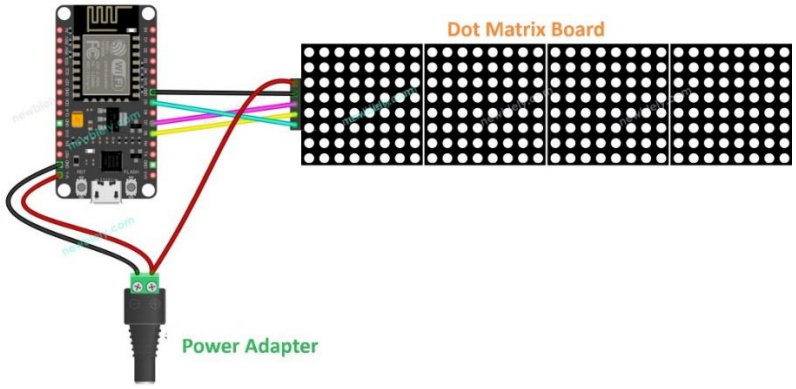

Fig. 5. Proposed Circuit Diagram of System

The IoT-based Notice Board's circuit schematic is shown above. The circuit diagram is not that complex, as we can see. The input clock pin of the second 8x8 LED display module is linked to the output clock pin of the first 8x8 LED module. In a similar manner, the DOUT pin was connected to the Din pin of the second 8x8 LED module, the output CS pin of the first 8x8 LED module was connected to the input CS pin of the second 8x8 LED module, and the GND and VCC pins of the first 8x8 LED module were connected to the GND and VCC pins of the second 8x8 LED module. Thsubsequent 8x8 Matrix LED display module is connected using the same procedure.

The first 8x8 Matrix LED module's Clock, CS, and DIN pins are connected to the Nodemcu ESP8266 digital pins D5, D7, and D8. On the other hand, the LM7805 voltage regulator-based 3.3 or 5 Volt regulated power supply is often connected to the GND and VCC pins. This power source can be used to power up the 8x8 Matrix LED display modules and the Nodemcu Module in a similar

manner. The female power jack, or J1, is where an adaptor, a 12-volt battery, or a solar panel are connected.

4. RESULTS AND DISCUSSION

Promising outcomes were obtained from the deployment of the Edge Computing-powered smart notice board system, indicating its efficacy in delivering real-time updates and facilitating user-controlled content management. Through the use of an ESP8266 server and edge computing principles, the system effectively demonstrated its capacity to display dynamically updated material based on user inputs "it shows from figure 6".

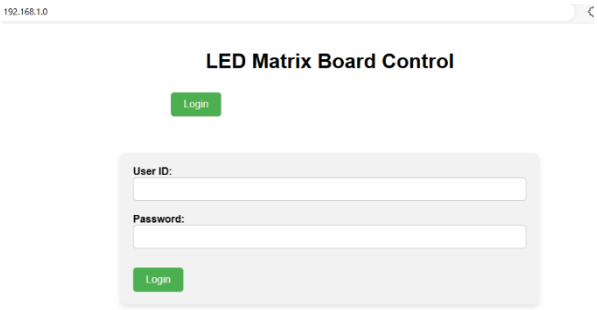

Fig. 6. LED update console

Through the HTML page through ESP system user can remotely access the ESP8266 system and login and then update the display board wirelessly without physical contact and is very feasible than approaches used in (Nivetha, et al., 2013; Dalwadi,2012; Kumar, et al., 2014) and also it minimizes the limitations of such systems efficiently. The IP address-based access can be done and IP can be seen in the address bar of the mobile device as shown in fig 7.

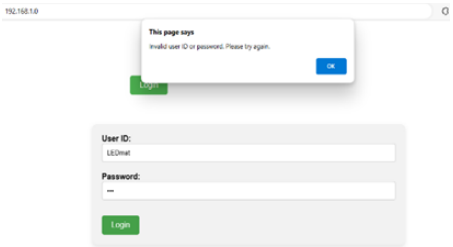

Fig. 7. Unauthorized login attempt result

One important aspect of this research work is finding a secured system for not depending on external parties for updating the LED display board. The login system developed in HTML supports this procedure so that user can securely login and update the LED matrix board remotely. Thus, this approach enhances the system server security and prevents threats like misuse of notice board system as well as inappropriate threats can be prevented providing secured system access to the dedicated users "it shows from figure 8".

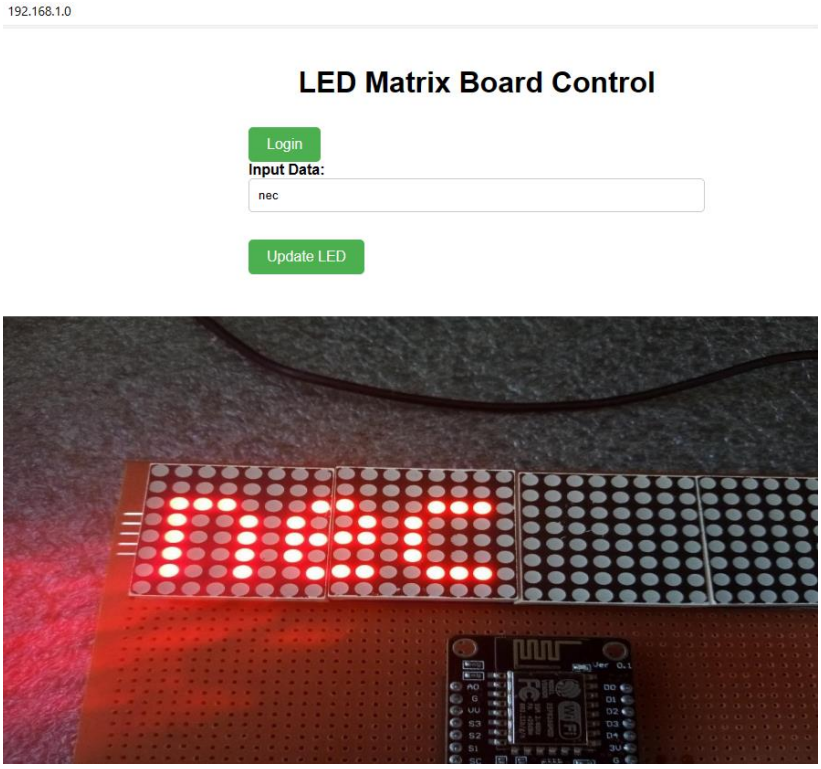

Fig. 8. Output Display

The ESP8266 microcontroller was utilized by the smart notice board system to host web pages and handle HTTP requests from web clients by deploying a web server. Users are able to remotely update the content displayed in real-time thanks to this architecture, which supported seamless communication between the notice board and the user interface. The ESP8266 server contained a web-based interface that users could use to enter and upload fresh notice board material. The server parsed the input data and modified the notice board display in accordance with the HTTP request it received. This two-way communication feature increased the adaptability and usefulness of the smart notice board system by allowing users to modify the content that is displayed at any moment. Moreover, users may quickly update the notice board information from any location with internet connectivity, demonstrating the system's dependability and simplicity of use. This simplified the content management process and increased overall efficiency by doing away with the need for complicated procedures or manual intervention. The smart notice board system driven by edge computing was effective in demonstrating the technology's potential for real-time content management and data processing. The technology provided a flexible, affordable, and easy-to-use way to update and manage the content that was presented by utilizing an ESP8266 server and the HTTP protocol. This allowed users to update and control content remotely “it shows from figure 9”.

Simulation results

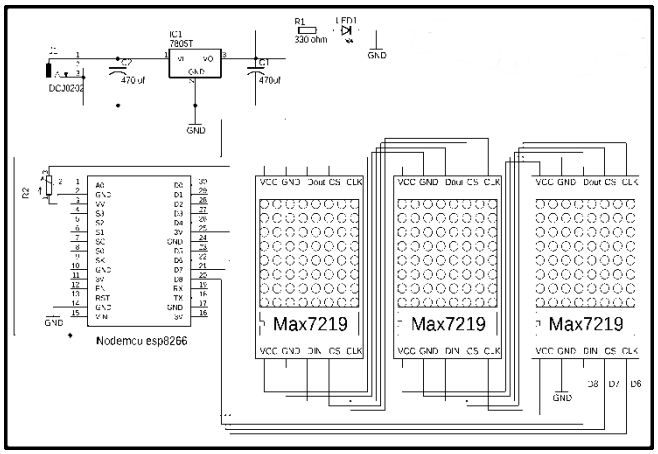

Fig. 9. Simulation of wireless information displayboard

5. CONCLUSION

The creation and deployment of a smart notice board system driven by edge computing has shown how edge computing technologies can revolutionize corporate communication methods. The system demonstrated its capacity to give real-time updates and user-controlled content management by utilizing the capabilities of an ESP8266 server and the HTTP protocol, thereby overcoming the drawbacks of conventional notice board systems. The smart notice board system accomplished multiple important goals by integrating edge computing principles and secured password based authorized login system. Instead of requiring complicated processes and manual involvement like traditional notice boards, it offered an affordable, adaptable, and user-friendly way to distribute information within businesses. Enhancing efficiency and accessibility, users could update and control the displayed content remotely from any location with internet connectivity. The system also proved to be scalable and dependable, providing a strong foundation for future growth and integration of new features and functionalities. Edge computing technology reduced dependency on centralized servers and reduced security threats by decentralizing data processing and storage, protecting the privacy and integrity of data.

In summary, the Edge Computing-powered smart notice board system offers a modernized method of content management and information distribution, marking a significant leap in organizational communication. Adoption of edge computing technology holds promise for transforming communication methods and improving operational efficiency across a range of sectors as enterprises continue to embrace digital transformation.

Low-cost approach

There is a lot of room for cost savings when an Edge Computing-powered smart notice board is used in different organizational settings. Organizations can cut expenses related to paper

procurement, printing, and upkeep of physical notice boards by switching from traditional paper-based or wired electronic notice boards to a digital, edge-based solution. Furthermore, the smart notice board's real-time updating feature removes the need for manual intervention, saving labor expenses and valuable staff time. Additionally, by minimizing reliance on centralized servers, Edge Computing technology lowers infrastructure costs and operational expenses related to server infrastructure management and upkeep. All things considered, using an Edge Computing-powered smart notice board can help businesses save a significant amount of money while improving the efficacy and efficiency of their communications. The purpose and type of applications used in (Nivetha, et al., 2013; Dalwadi,2012; Vishnu, et al., 2021, 2013; Kumar, et al., 2014; Ketkar, et al., 2014; Mujumdar, et al., 2015; Reddy and Venkareshwarlu, 2017) are the hint of external application requirement and dependency and hence, this system solves the requirement of a slow-cost solution with depending on own server network for updating the notice board along with a secured login system.

Future Scopes

The installation of a smart notice board with Edge Computing capabilities sets the stage for several expansions and improvements in the future. The addition of sophisticated sensors and data analytics tools, which would allow the smart notice board to gather and evaluate environmental data in real time, including temperature, humidity, and air quality, is one possible direction for future development. The relevance and usefulness of the notice board can then be increased by using this data to give users personalized and context-aware alerts and notifications. To further improve user engagement and happiness, machine learning algorithms can also be integrated into the smart notice board to allow it to automatically generate and prioritize information based on user preferences and past usage trends.

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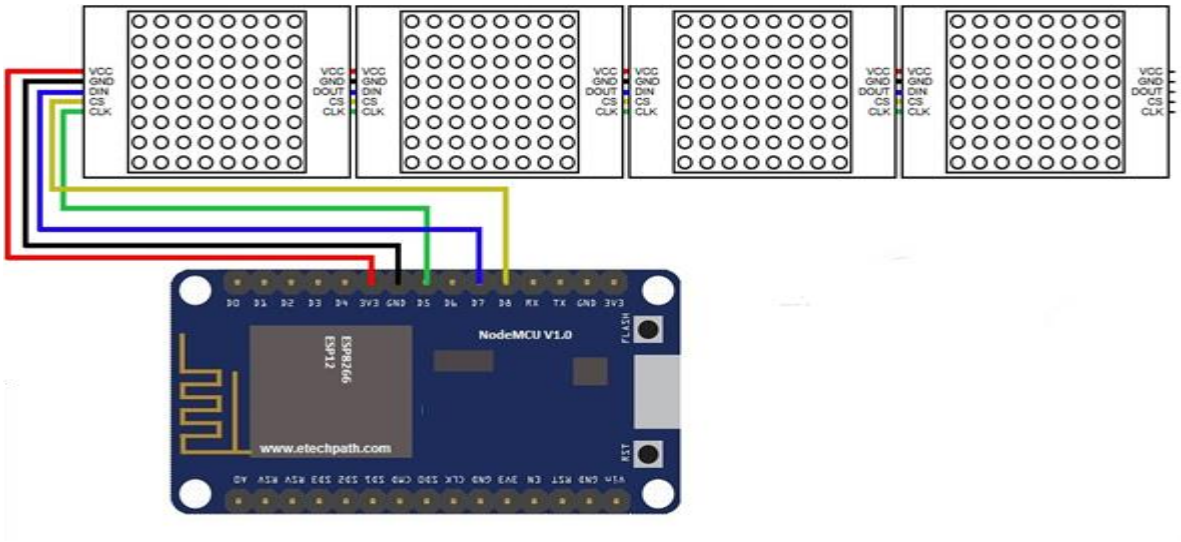
Appendices

Appendex1: Complete Circuit Diagram



Appendex2: Pin Configuration

Fig: Pin functions

ESP8266nodeMCU	LED
3V	VCC
G	GND
D5	CLK
D7	DIN
D8	CS