Design and implementation of a microcontroller based printed circuit scrolling message notification board

Frank Kulor\textsuperscript{1*}, Elisha D. Markus\textsuperscript{2}, Michael W. Apprey\textsuperscript{3}, Kafui T. Agbevanu\textsuperscript{1}, Gabriel Gasper\textsuperscript{1}

\textsuperscript{1}Ho Technical University, Post Office Box HP 217 – Ho, Ghana
\textsuperscript{2}Central University of Technology, Private Bag X20539, Bloemfontein 9300, South Africa.
\textsuperscript{3}Power Factor Limited, Post Office Box BT 651 - Tema, Ghana.

*fkulor@htu.edu.gh

Abstract. The noticeboard is an essential thing in any establishment or association to convey data among the partners. In the occupied and quick-moving present reality, the traditional paper notice framework is tedious and not reasonable for brisk sharing of data. This exploration work aimed at designing an electronic scrolling display board on a specially designed Printed Circuit Board (PCB). The thought behind this undertaking is to furnish its clients with a basic, quick what's more, dependable approach to set up a significant notification in a LED where the client can display messages to be shown directly on the LED unit from a computer to the microcontroller and also to give notification about anything at a particular moment to the targeted group or audience. This will significantly provide improved measures to the limitations and restrictions of conventional notice boards. The system is created with an ATmega 328P microcontroller from Atmel. The microcontroller showed all the usefulness of the showcase notifications required. The Display is acquired on a 2X (16X72) dot matrix display board, orchestrated on a cascaded specialized PCB designed with a Ki-cad schematic/design software suite for a wider view. An ideal instant message from a computer is sent utilizing Arduino IDE and HT1632 driver IC to drive these tremendous LEDs. The framework was tried to work as per the test message. This brilliant notification board can make the notification arrangement of an association much basic, quick and financially savvy and provide a limitation to an accident that can occur when sticking paper-based notification sheets.

1. Introduction

Noticeboard plays a significant part in a portion of the spots like instructive organization, transport or railroad station, bank, emergency clinics, client care focus, share advertising, shopping centers and so forth to share data among the worker and customers [1]. The goal of this exploration was to build up an electronic presentation board to improve the past restrictions of traditional notice boards to make the seeing framework simple, quick, secure and financially savvy.

As data innovation is developing at an unbelievable pace, different instruments and strategies could be applied to accomplish the target of conveying data in time, exact and powerful [2]. Most urban areas are getting brilliant, and display boards and LEDs are put at each square for promotion and numerous
purposes. Yet at the same time, these advances are not adjusted in numerous organizations in the larger part of urban communities that need these remote electronic boards the most. Sending the messages with a remote electronic presentation board to the individuals and students which is synchronized utilizing current advances will help to pass the message immediately with more dependability as opposed to conventional methods for sticking messages on the old notification board. Likewise, the significant notification will be shown and will get a look at the schedule [3].

In this research, an Arduino Nano and HT1632 memory IC were used and two lines of text messages were shown simultaneously on a 2X (16X72) dot matrix LED display board. A framework proposed by [4] actualized a GSM GSM-based looking over message framework in which they used AT89c51 smaller scale controller which gives all the usefulness to remote correspondence. It utilizes a GSM modem to which an SMS is send sent from an approved client it confirms the secret phrase first and afterward show the message on the board in the wake of checking the secret key. The framework likewise shows the strategy for showing the letter set on the LED spot grid.

This undertaking in [5] bargains about a propelled Hi-Tech Remote Notice Board. This framework is upgraded to show the most recent data through an Android utilization of PDAs or tablet. While the client sends the message from the Android application gadget, it is gotten and recovered by the Bluetooth gadget at the showcase unit. The Bluetooth gets a secret password which that is known to the client, it is then sent to the microcontroller that further shows the notification sent from the client on the electronic notification notice board which is outfitted with an LCD Monitor unit. Reference [6] proposed a framework in which they presented an idea of the double choice of changing the message; one by utilizing GSM and second by utilizing PC or Laptop. It additionally concocted an idea of double force supply; one through AC force and second through sun-based force. Such cooperative forces and strategy for changing messages had not been created in a solitary gadget, and this paper denotes the start of the innovation of consolidating two separate advancements under one rooftop.

Work done by [7] had proposed to remotely send notice to Digital Monitor from approved PC on Raspberry pi card. Wi-Fi is used for utilizing Data transmission. Whenever they can include or evacuate or adjust the content as per their prerequisite. A transmitter approved PC is utilized for sending a take note. At accepting end Wi-Fi is associated with raspberry pi. At the point when an approved client sends a notification from his framework, it is gotten by the recipient. The information is gotten from a validated client. In [8], this undertaking manages notification ahead of time load up. It introduces an SMS based notification board fusing the broadly utilized GSM to encourage the correspondence of showing the message on notice board by means of client's cell phone. Its activity depends on microcontroller AT89c52 customized in low low-level computing constructs. A SIM300 GSM modem with a SIM card is interfaced with the ports of the microcontroller with the assistance of AT directions. At the point when the client sends an SMS through an enlisted number from his cell phone, it is gotten by the SIM300 GSM modem at the beneficiaries' end. The information is therefore brought into the microcontroller. It is additionally shown on an electronic notification notice board which that outfitted with an LCD unit interfaced with microchip fueled by a directed force supply from mains.

Additionally, in [9], this paper speaks to a shrewd electronic remote noticing framework where an approved responsible individual can share data in the notice load up whenever from his office room or any spots in the world having the cell organized. In the proposed framework, notice can be sent in two different ways. The client can refresh notice from his office room either by voice or instant message by means of employing a cell phone utilizing Bluetooth and RF correspondence inside 1-kilometer separation. Right now, the client sent notification utilizing his nearby remote system and ought not to pay cash to an administrator. Another approach to refresh notice by sending SMS utilizing versatile arrangements when the client remains outside of his office room. The client needs to pay an SMS charge to a versatile administrator. The notice sent by the client are observed and scrolled on a 32X8 LED framework show. The framework can show current notification with two lines of text messages. It likewise gives notice by a buzzer when another notification is gotten.
2. Methodology
The methodology adopted is grouped into circuit diagram design using the KiCAD schematics, PCB design using KiCAD, the printing of PCB design, component mounting on the PCB designed and programming of the smart system.

2.1 Model of the system
The framework model is shown in Figure 1. This will be a moving message show, which can be utilized as the computerized notice board, which is the most recent innovation utilized for correspondence between the PC and the embedded system.

The computer communicates with the microcontroller through its serial ports where written programs are uploaded onto the controller. The LED spot framework that we are going to utilize, is made by four 8x8 LED mono shading networks situated near the structure of a 2X (16X72) column. In the engine, we discovered that the HT1632 IC is proficient to drive this tremendous amount of LEDs. The HT1632 is both a controller and a LED driver since it has an onboard RAM for the mapping LED show and in light of the fact that it gives enough capacity to the LEDs. The gadget permits to change the brilliance of the LEDs incorporating a 16 stages PWM control.

The matrix offers to communicate with the host controller through a sequential interface that acts like an SPI-like convention. The Arduino side was furnished with wiring the LED grid and included the library that contains the committed correspondence convention and the utilities for simple composition on the network. The buzzer which serves as an output device sounds anytime a new message is uploaded and displayed for the attention of the audience was connected to the digital output pin of the controller.

Figure 1. Model of the system.

The circuit diagram for the project as illustrated in Figure 2 below was designed with the Ki-cad schematic capture software. The circuit diagram was drawn with the Eeschema Schematic Editor in the Ki-cad software.

Figure 2. Circuit diagram design of the system with Ki-cad.
2.2 **PCB design**

Ki-Cad schematic/design software was utilized in planning the schematics of the circuit and afterward converted into PCB structure, then sent for printing. The schematic rule check was used to check for blunder after the structuring of the circuit. On the off chance that there is a mistake in the schematic plan, a little green arrow will show up in the area of the blunder. After error checks the netlist checker permits you to link footprints to components. PCB design took about 3 weeks to a month for completion and a month more to receive final hardware.

![Figure 3. PCB Design with Ki-cad.](image)

![Figure 4. Final PCB Design.](image)

2.3 **Component mounting and system programming**

The circuit development begins by mounting the SMDs on the PCB as shown in Figure 5, followed by the controller/driver IC which is likewise surface mounted. From that point, different parts such as resistors, capacitors, a buzzer, and transistors were bound onto the printed circuit board (PCB). Attachments were additionally mounted on the PCB for the (28 pins) Arduino Nano microcontroller, and so on, then at long last comes to the 8x8 Dot Matrix LED mounted and patched on the PCB as the last segment of the task. An adapter of the 5V DC output force supply unit was associated with the circuit to supply capacity to the entire showcase board just as the microcontroller and the 8x8 Dot network LED.

2.4 **System programming**

Programming code improvement is one of the significant parts in building the calculation of the framework. It incorporates the C-program for the AVR microcontroller, assertions of the ADC esteems for HT1632 driver IC, buzzer and programming for the coordination of the cascaded PCB link up. The
framework program was composed utilizing the Arduino in C and customized through the ICSP interface.

Figure 5. Complete components mounted on PCB.

3. Results
A Dot-Matrix Display board is a presentation gadget which contains light transmitting diodes adjusted as a grid. There are three methodologies called push examine, section output and dab by-spot to light character design in LED lattice show [10]. The line filter approach was utilized in this research work. A 2X (16X72) presentation was built. Each showcase is driven by an HT1632 LED driver. The driver IC can control a selected number of ROW and COLUMNS as shown in Figure 6.

Figure 6. Final system design.

3.1 Testing for scrolling messages
Another program code was uploaded to check the scrolling of messages on the design as displayed in Figure 7. It should be noted that by default when the display board is switched on for the very first time, a default meaningless characters scroll across the board until a programmed code is uploaded. This message continues to scroll except it is changed by uploading another message from the remote source (personal computer) through the HT1632 driver IC which has already been connected to the display board. The test proved successful as the uploaded message swept across the mounted LEDs.
3.2 Testing for scrolling messages

The various signals required at each level for the mounted components on the designed PCB were checked with a digital dual channel oscilloscope and multimeter due to the manual process of mounting these components on the PCB. The blinker for the LED function also checked to see the correct timing characteristics diagrams as shown in Figure 8. The various graphs displayed the exact timing signal as expected from the HT1632 driver IC driving these LEDs. The LED OFF command was able to turn the LED display “off” by disabling the LED duty cycle generator. The LED ON command, on the other hand, was also able to turn the LED display “on” by enabling the LED duty cycle generator respectively. The voltage required at each point recorded the expected values.

4. Discussion

After all the modules of the undertaking (which incorporates the force framework, the control unit, and the 2X(16X72) grid LED course of action) has been developed and tried independently, where each module is associated fittingly to shape the total microcontroller-based presentation board framework as shown in Figure 6.

The effective usage of this work demonstrated that the microcontroller-based scrolling message display board framework functioned admirably as wanted. The speed of preparing and showing off new messages was quicker as shown in Figure 7 than those in past research works done due to the six (6) HT1632 driver IC that was utilized. The PCB designed was accurate with no defects. Component
mounting was very easy due to the component spot designed on the PCB. The messages were able to refresh when the computer is connected and new information is transmitted. The signal testing with the digital oscilloscope as shown in Figure 8 proved positive as all expected signals at each respective point were observed correctly.

This work has additionally demonstrated to be unmistakably more financially savvy and has numerous focal points when contrasted with customary paper-based notification sheets or notices. These points of interest include: Moment data refresh in light of the fact that there is no compelling reason to put posters. It is likewise ecologically benevolent; when the framework is mounted the wellbeing and security of the user is guaranteed. There is no compelling reason to remain at a stature and glue papers which can be hazardous when slip happens. It additionally diminishes papers and printer toner use and expenses. Its usability is friendly and remarkable as compared to some existing systems. The user just requires a personal computer with Arduino software for uploading and updating information at any point in time as no data, airtime, or specific mobile networks are needed. The microcontroller is mounted on a socket which is easily replaceable by an expert in case of any defect as compared to others with their controllers mounted directly on the board.

In future designs, multiple means of inputting information on the display board can be employed with more cascaded PCBs and the HT1632 driver ICs to display larger information.

5. Conclusion

In all, the display board was developed, modified, tried agreeably and was discovered deserving of large-scale manufacturing. It was structured from cheap parts. It has highlights that made it extraordinary from other presentation designs in the market. The set destinations inside this undertaking have been accomplished, demonstrating the attainability of the presentation. Through this kind of development, alterations could be effortlessly made before going into the advancement of bigger scales. Also, it offers a dependable showcase which makes it reasonable for applications in any situation except unsafe and harsh climate conditions. Low force request of the gadget with higher effectiveness is another in addition to this undertaking.

This exploration model can be utilized effectively for prompt data move in films, eateries, schools, open vehicles, railroads, air terminals, banks, etc., with less mistake and support.

References

[1] Khera, N., Shukla, D., & Awasthi, S., (2016). Development of Simple and Low-Cost Android Based Wireless Notice Board, 5th Int. Conf. on Reliability, Infocom Technologies and Optimization (Trends and Future Directions) (ICRITO), Noida, India.

[2] Display Technology, (2019). History of display technology. https://en.wikipedia.org/wiki/History_of_display_technology, accessed on 4th October, 2019.

[3] Morey, D., Taikar, M., Waghmare, R., & Ghumde, V., (2018). Review on Electronic Notice Board, Int. Res. J. of Eng. and Tech. (IRJET), Vol. 05.

[4] Mujumdar, A., Niranjane, V., & Sagne, D., (2014). Scrolling LED Display Using Wireless Transmission, Int. J. of Eng. Dev. and Res. (IJEDR) Vol. 2, Issue 1.

[5] Kadam, S., Saxena, A., & Gaurav, T., (2015). Android Based Wireless Notice Board and Printer, Int. J. of Inn. Res. in Comp. and Comm. Eng. Vol.3, Issue 12.

[6] Thit San, H. H., New, C. M., & Tun, H. M., (2014). Implementation of PIC Based LED Displays, Int. J. of Elect. and Comp. Sci. Eng. (IJESCE). Vol.3. No 3.

[7] Jadhav, V. B., Nagwanshi, T. S., Patil, Y. P., & Patil, D. R., (2016). Digital Notice Board Using Raspberry Pi, Int. J. of Res. in Eng. and Tech. (IJRET), Vol. 3.

[8] Merai, B., Jain, R., & Mishra, R., (2015). Smart Notice Board, Int. J. of Adv. Res. in Comp. and Comm. Eng. (IJARCE).

[9] Alam, E., Kader, M. A., Proma, S. A., & Sharma, S., (2018). Development of a Voice and SMS Controlled Dot Matrix Display Based Smart Noticing System with RF Transceiver and GSM Modem, 21st Int. Conf. of Computer and Information Technology (ICCIT).
[10]  Huang, W., (2013). Three Approaches to Light an 8X8 LED Dot Matrix Display, *IEEE 2nd International Symposium on Next-Generation Electronics (ISNE)*.