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IP based Digital Clock for Academic Applications

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Abstract - *Time plays a vital role in our lives. In order to ensure that our pending work gets completed, clock helps us to keep a track of time. To reach to a particular destination or station and catch a train or an airplane, clock assist us to plan our timing. To ensure punctuality and accountability, clock helps us to plan our daily routine. At many places like schools, colleges, hospitals, railway stations and airports there are many implementations of digital clocks to show real time. These clocks are isolated and maintained on individual basis. These clocks are not synchronized and there may be the time gaps in such clocks. Our project aims at synchronization of all such distributed digital clocks with a server using communication technology specially for academic applications so that there is no dependency on human for reminders like ringing of a hooter. The technology used is Network Time Protocol (NTP). Using proposed model, it's possible to synchronize distributed digital clocks so that all the clocks will show the same time and they are also maintained centrally. We are installing our model at three different places like a classroom, a tutorial room and a laboratory. We generate clock timing at one place and distribute the timings of the clock at devices which will help the students and professors to work on synchronize times. Apart from schools and colleges, this system can be implemented anywhere like hospitals, factories, NGOs, etc. which will help every individual to meet the deadlines of any task.*

***Key Words*: Digital clock, Synchronization, server, NTP**

1. INTRODUCTION

Information and communication technologies have been increasingly experiencing significant growth in both software and hardware. For society at large digital clock is one of the important tools as a marker, or a reminder of the time. With the clock, different activities can be managed well, so no time is wasted. Developments of clock is increasing, in ancient times the timings were used as a sundial to determine the day and night and also a time of worship. Along with the development of technology, the timing clock went through a phase change of the sundial, hourglass, analog clock, and digital clock. Now, it is the era of digital clock including smart clocks and smart watches. When everything is smart, then why our digital clock is not better or smart enough to share timings? Better approach is designing a digital clock by sharing accurate time from a central facility. Running text should match with the list of references at the end of the paper.

1.1 OBJECTIVE OF PROJECT

Let us consider an example of the digital clocks or digital indicators for clocks at railway stations. It may happen that two clocks show different times, may be difference of one second or may be difference of one minute, as shown in fig. 1 and 2. In scenarios like examinations, tutorials or may be final exams, small time difference make big difference. So what is the way we can handle this type of discrepancy, or how can we handle the mismatch? One way to handle this mismatch is that if there are six digital clocks at six different places, then every digital clock has to be tuned individually. This will consume more time and more manpower as well. So it is not easy to go at each and every place and adjust clock manually. Hence, to overcome this problem, we proposed this project model if we can keep a centralized server to handle the clocks and distribute that time to various places so all digital clocks will be synchronized. Our proposed model synchronize our digital clock so that if a digital clock is taken in one classroom which is at 4th floor and another clock in another classroom which is at 5th floor, they will show same clock, same time. This will be useful in variety of applications. Normally, it's very common that digital indicators, digital clocks are visible, in fact, one way to improve the time tables of railway is that can we sync the indicator with the clock. The indicator system at railways for clocks and the actual clock system both are independent. They are not synchronized. So the time synchronization is possible from our solution.

Figure-1: Digital clock used at railway station (PlatformNo.1)

Figure-2: Digital clock used at railway station (PlatformNo.2)

1.2 RELATED WORK

Authors N. Vijaykrishnan, R. Y. Chen and M. J . Irwin [1] have discussed about issues in the power consumption of a clock in System-on-aChip (SoC) Designs. Clock must have very large fan-out and span the entire chip, so power consumption of a clock net distributes a significant amount of the total power. So authors came up with the solution of modelling clock power using distributed driver scheme. The model is then extended to account for multiple clocks required by SoC designs. Authors Dhimas Wahyu Pratama, Endro Ariyanto, Dr. Maman Abdurohman [2] have discussed about working with digital clock synchronization using Internet Protocol (IP) with Wi-Fi. Network Time Protocol (NTP) is the protocol required to synchronize the time between master like time server and slave or client like a digital clock. Authors Xu Jie, Xu Liang [3] have discussed about research on network timing system based on NTP, in which there are three modes of time synchronization such as hardware synchronization, navigation satellite time synchronization and software synchronization. NTP protocol is network clock synchronization protocol used by software synchronization, which deals with synchronizing time in different computers connected to the variable, packet switched data networks. Authors Xinhua Yang, Shike Zhang [4] have discussed about how IEEE1588 uses time synchronization packets and hardware timestamp technology to achieve accurate clock synchronization for Microgrid. IEEE 1588 was compared with other clock synchronization schemes such as GPS, BD System, NTP, IRIG-B on the basis of accuracy, lock time, cost, ethernet, reliability. Authors Kambhampati Sai, Maragatha Eswari, Geethu Remadevi [5] have discussed about how an alphanumeric keypad can be used to set an alarm time and give an input text. Customization is done on a RTC such that it is user-friendly. The input-text and alarm time can be given manually, using the alpha numeric keypad. Authors Leandro T. Brusato, Edison P. Freitas and Tales Heimfarth [6] have discussed about how the wireless communication protocols work for the sensor networks targeting applications on Internet of Things (IoT) and types of clock synchronization are shown. Global clock, Relative clock, Relative Notion of Time, Physical ordering are the main types of clock synchronization. Freescale MC13224V and ARM 7 core based Microcontroller unit are used for implementing clock synchronization. Authors Yanmei Wang, Kaijin Qiu and Qunchao Yu [7] have discussed about how an electronic alarm clock can be designed for the students in order to keep them focused and help them to complete the assigned tasks, exams on time. Mainly, SCM Microcontroller, loudspeakers, a microphone, power supplies, buttons, LCD display and an audio extraction unit are used for the system structure designing.

2. SCOPE OF THE PROJECT

Our proposed design can also interface a hooter or an alarm to give an indication or an alert that the session like examination, practical or tutorial is getting finished or the session is finished. Considering the case of the examinations, once the time of examination is complete, a centralized buzzer or an alarm will get activated. There is no human interaction involved. No physical human will go and he or she will activate the alarm for a particular system. The entire system is automatic system. This is s step towards smart examination. Nowadays someone goes to a particular alarming system and rings the bell once the session is finished. The session can be any particular lecture, seminar, exam, tutorial, conference, practicals. With our design prototype we are trying to minimize the human interaction as much as possible which will help the system to function automatically. This system will help every professor and student to complete their planned schedules, seminars, events, documentations, laboratory sessions on time. The clock will be continuously displayed and it will give two alerts, out of which one alert will be given few minutes before the session ends by giving sound and another alert will be the final alert given at the time session ends by giving sound. And since the timing will be displayed continuously, there is no possibility that anyone will lose his or her track and will be aware of the timings, and the people or the students, and the professors will have an exact idea about when and how any session will begin and end. Also, it will help to make decisions about how many agendas can be executed for the day or for the allocated time slot. We can also implement this project at hospitals, offices, or any kind of organization.

3. PROPOSED SYSTEM

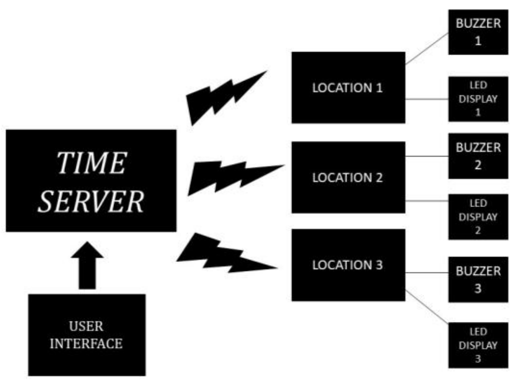

Figure-3: Basic diagram of a proposed system

TIME SERVER: NTP pool is acting as a Server. This server will continuously send the timings to the clients. This block helps in setting up the alert for any particular event by using the Graphical User Interface (GUI). Figure 3 shows block diagram of proposed model.

USER INTERFACE: User Interface or GUI will be acting as the input system used to interact with the end users for the time server which is NTP pool and Node MCUs so that the alert for a particular event can be saved. Software like MIT app inventor is used to design user interface.

WIRELESS LINKS: Wireless links are used to indicate the wireless communication between the server and the client. NTP is the wireless communication technique used over here which will help to maintain the time synchronization.

LOCATION 1, LOCATION 2, LOCATION 3: Indicates specific locations like a particular classroom , or a laboratory or a tutorial room. Also, Node MCU module works like a client, which will keep on receiving the signals communicated by the Server end which is NTP pool.

BUZZER 01, BUZZER 02, BUZZER 03: These Buzzers are interfaced to the Node MCU so that when any particular event or lecture is about to get finished and when the lecture is finished, Buzzer gives an audio indication indicating that event is finished or event is about to get finished.

LED DISPLAY 1, LED DISPLAY 2, LED DISPLAY 3: These LED displays are also connected to the Node MCU so that time is continuously received by the Node MCU from the Server and displayed on these.

4. METHODOLOGY

We have planned and implemented our project in three phases:

Phase – 1: Deciding the time server for the clock system

This phase is about deciding the time Server which is NTP pool for setting up the clock system. At the server end, we will be designing a GUI. The reason behind creation of GUI is that any particular user or event manager provide the timing information, give the alerts through buzzer when event is about to get finished or when event is finished.

Phase – 2: Designing the Client with Node MCU for the clock system

In this phase, Node MCU will be acting as a client which will continuously receive timings (from NTP server). Also, Node MCU will be getting interfaced with Buzzers and 8x8 LED matrix displays. We will be using the GPIO (General Purpose Input Output) pins of Node MCU. Wi-Fi standard used by Node MCU is IEEE 802.11.

Phase – 3: Communication between the Server and the Client

This is the phase where NTP pool acting as a server and Node MCU acting as a client will communicate with the help of Wi-Fi from Wi-Fi module using NTP. NTP is a networking protocol for clock synchronization between computer systems over packet-switched, variable-latency data networks. NTP will be implemented through programming the Node MCU with the help of the Arduino IDE.

5. HARDWARE & SOFTWARE TOOLS

A. Hardware Components:

Node MCU: Node MCU is used at the client side. The reason behind using Node MCU is that it has ESP 8266 Wi-Fi SoC, which helps to allow the devices to get connected to Wi-Fi. Maximum device connections a Node MCU can handle is upto 5.

Buzzers: Buzzers are used to give an indication or an alert that the event is about to end or the event is finished. Node MCU is interfaced with the Buzzer at the client side.

8x8 LED matrix displays: The 8x8 LED matrix displays are used to display the timings in hours, minutes and seconds (HH:MM:SS). These matrix displays are interfaced with the combinational circuitry of Node MCU and Buzzer.

RTC Modules: Real-Time Clock (RTC) is a computer clock that keeps track of the current time. This module is going to be used as a backup so that it can be used when there will be no internet connection or when internet connection between client and server is lost.

B. Software Tools:

Arduino IDE: Node MCU is programmed using Arduino IDE. The software comes with the option in the preferences of the Board Manager where we can enter the appropriate URL for Node MCU boards and then programming for the same is possible.

MIT App Inventor: We designed an android application which provides a simple user interface to control the setup for giving the alerts. The end user has to enter the appropriate IP addresses of Node MCUs to hit an alarm and this can be done either separately or simultaneously all three setups can be accessed wirelessly to hit alarm at the same time.

6. DESIGN

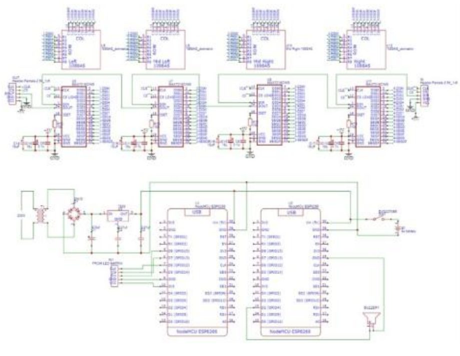

Figure-4: Circuit diagram of the project

Figure 4 shows the schematic diagram for our proposed model designed for the digital clock prototype. It includes 9V power supply, two Node MCUs are used. One is interfaced with 8x8 LED matrix display module to display the real clock timings using protocol like NTP. Other module is interfaced with buzzer to create an alert that the session is finished. Also, for backup purpose, we have connected the setup to 12V batteries and switch in such a manner that when we are getting power supply through mains, the switch will remain OFF and when the power supply from the mains is lost, the switch can be turned ON to provide the power supply to the entire setup. To create the alert in a specific time, we have created an application with the help of MIT app inventor. In that application, for three setups, three sections are made for entering the IP addresses of the Node MCUs which can be accessed either separately or simultaneously all the three at the same time and alerts can be provided with the help of options either to create an alert or not. The user needs to enter the IP addresses of the Node MCUs (the ones connected to the buzzers), provided that the Node MCUs and the end device used like mobile phones should be connected over the same network. And then, the user can give the alerts as per his or her need. Figure 5 shows GUI of providing the timing information.

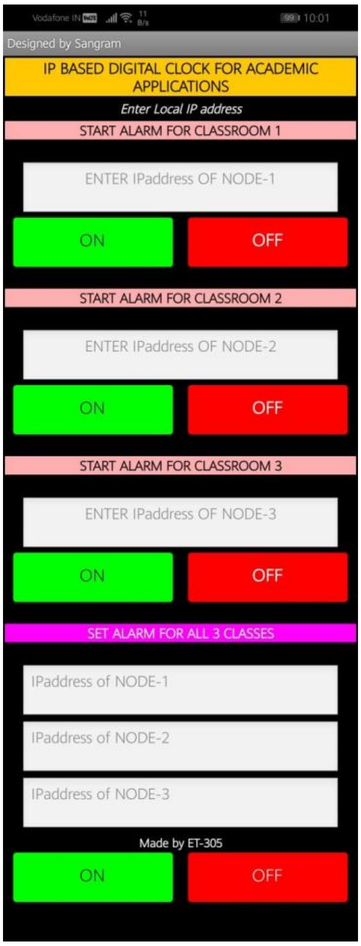

Figure-5: Screenshot of android application designed for creating alerts using MIT App Inventor

7. CONCLUSIONS

In our proposed model, the digital clocks can be time - synchronized using NTP. Main aim of the model is in the academic applications like conducting different activities like examination without manual inputs. All the digital clocks are synchronized so that after examination is complete or lecture session is complete or tutorial session is complete an automated buzzer can be sounded without any human interaction. This project can be further extended for keeping records of time logs of different activities. Even after the power is lost from the mains, the built-in power supply helps the setup to fetch the time again and display it on LED matrix displays. Figure 6 shows the internal wiring of the proposed model.

Figure-6: Internal Wiring of proposed model

Figure-7: Synchronized Proposed models at classroom, laboratory and tutorial room (top to bottom)

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