Automated Student Attendance System using the ESP8266

Saqibur Rahman
Computer Science and Engineering
AIUB
Dhaka, Bangladesh
saqibur.rahman98@gmail.com

Ahmed Ali Fahim
Computer Science and Engineering
AIUB
Dhaka, Bangladesh
fahimali103@gmail.com

Sahil Aziz
Computer Science and Engineering
AIUB
Dhaka, Bangladesh
1234sahil5678aziz@gmail.com

Nazmul Hasan Tanmoy
Computer Science and Engineering
AIUB
Dhaka, Bangladesh
ntanmoy79@gmail.com

Sachi Datta
Computer Science and Engineering
AIUB
Dhaka, Bangladesh
sachi.likhon@gmail.com

Tasnim Ahmed
Computer Engineering
AIUB
Dhaka, Bangladesh
tasnimahmedfahim@gmail.com

Mirza Nowshin Nazim
Computer Science and Engineering
AIUB
Dhaka, Bangladesh
sarahnazim98@gmail.com

Priya Roy
Computer Science and Engineering
AIUB
Dhaka, Bangladesh
momo.roy23@gmail.com

***Abstract*—Currently, there are numerous systems which automate the task of giving attendance, be it in an academic or professional scenario. However, many of these systems require complex hardware, complicated algorithms or expensive systems to be put in place. In this paper, we propose an attendance system that uses a Wi-Fi hotspot, and MAC addresses of the devices of students to give attendance correctly via QR code scanning. Moreover, existing systems, along with their advantages and drawbacks are looked at in detail. In addition to this, device implementations, hardware implications, drawbacks and future scopes of this project are also discussed. Finally, the societal and environmental impact of the system is judged against the context of existing and past systems.**

***Index Terms*—Internet of Things (IoT), Attendance System, NodeMCU, ESP8266, Arduino.**

I. Introduction

With advances in technology, several everyday tasks are optimized through the use of newer devices or software. Attendance systems are once such activity which has been dealt with different systems and architectures in order to optimize the task of taking attendance.

Facial recognition systems, RFID tagging systems and other resource intensive systems have been discussed previously. In particular, the use of QR codes to automate student attendance systems have proven to be effective in the past. However, a complete automated system does not exist wherein the QR code is used as the main crux.

Therefore, after exploring several approaches, taking into consideration the implementation budget, societal impact and interactive experience of the system, we have concluded that such a system can be designed by harnessing the Wi-Fi modulation capabilities of the NodeMCU and using a standard Arduino Uno to generate the necessary connectivity QR code.

The many advantages of IoT come into play when desiging such as system as there is potential to use device specific MAC addresses to uniquely identify students instead of limiting them to their ID cards or other additional peripherals instead of one their main devices, their smartphones.

II. Literature Review

Like all other institutes, every educational institutes has certain rules and regulations and having certain percentage of attendance is mandatory. But as taking attendance manually can be rather time consuming [2] developed an automatic attendance system using bio-metrics. A portable wireless system and a web application to complement that system was developed where attendance can be taken by using fingerprint sensor and NodeMCU micro-controller and students can not only give their attendance but also check their attendance percentage for each courses they registered for in that particular semester/year.

Carrying University identity card is mandatory for students to enter the university premises. Thus [5] developed a system where Radio Frequency Identification (RFID) is used to take attendance. In this paper, RFID tags embedded in the student identity card was used to take data and validate against the data stored in database. To avoid for proxies, images of students

were taken while entering and exiting the class and verified against the image stored in the database.

[1] implemented an attendance management system with RFID and Raspberry Pi 3. Attendance was taken with RFID and two passive infrared sensors were used to tackle proxies. The Raspberry Pi receives the RFID data and validates and updates the particular teachers database accordingly.

[4] proposed a framework which uses RFID for taking attendance and uploads the data in Google Spreadsheet. They also implemented automated SMS feature using a cloud communications platform Twilio. The system implemented by [4] takes RFID data and updates the attendance. But no precautions were taken to avoid proxies like [1] [5] did in their papers.

[6] proposed a bio-metric based attendance system where students can give their attendance with the help of a fingerprint sensor. Fingerprints are taken through the fingerprint sensor and matched with the stored fingerprint to give attendance and update database if matched.

[3] implemented an event driven system where Passive Infrared sensors, Raspberry Pi, Webcam are used together to record the attendance of individuals in an organization. The two PIR acts as switch starting and ending the event, and Raspberry Pi acted as bridge between the PIR, webcam and smart phone application.

III. Block diagram

IV. Hardware information

A. Arduino Uno R3

The Arduino platform simplifies the process of creating micro-controller-based projects with the inclusion of a programmable micro-controller as well as the software required to program the micro-controller to achieve specific tasks. It is an easy to use and flexible medium for creating both complex and simple projects. The micro-controller used in the Arduino Board is the ATmega328P. It does not require a hardware circuit burner/programmer to load new code into the board. The Arduino Uno R3 is our choice because it is easy to use, and fits the needs of our project perfectly, that is, to display a generated QR code onto an LCD panel.

Overview of the Arduino Uno R3 -

- 14 Digital Input/Output Pins
- 6 Analog Pins
- A USB Connection Port for PC configuration.
- A Power Jack

Fig. 1. Arduino Uno R3

B. MCUFriend TFT LCD 2.4" Display

The MCUFriend TFT LCD 2.4" Display is a shield which sits on top of the Arduino to make it easy to program and display any necessary information onto a small screen from the Arduino itself. The hardware specifications of the display are as follows:

- Screen Size : 2.4 inch
- Resolution : 240 x 320
- LCD Color : 65k
- Interface : 8 data bit with 4 control bits
- Touchscreen : 4 Wire Resistive Touchscreen
- SD Card Support

Fig. 2. MCUFriend TFT LCD 2.4" Display Front

For our purposes, we intend to use this display to show a generated QR code onto the display of the LCD so that it can be scanned by students in order to give their attendance. Additionally, the device is fully compatible with the Adafruit Graphics library and comes with its library built on top of

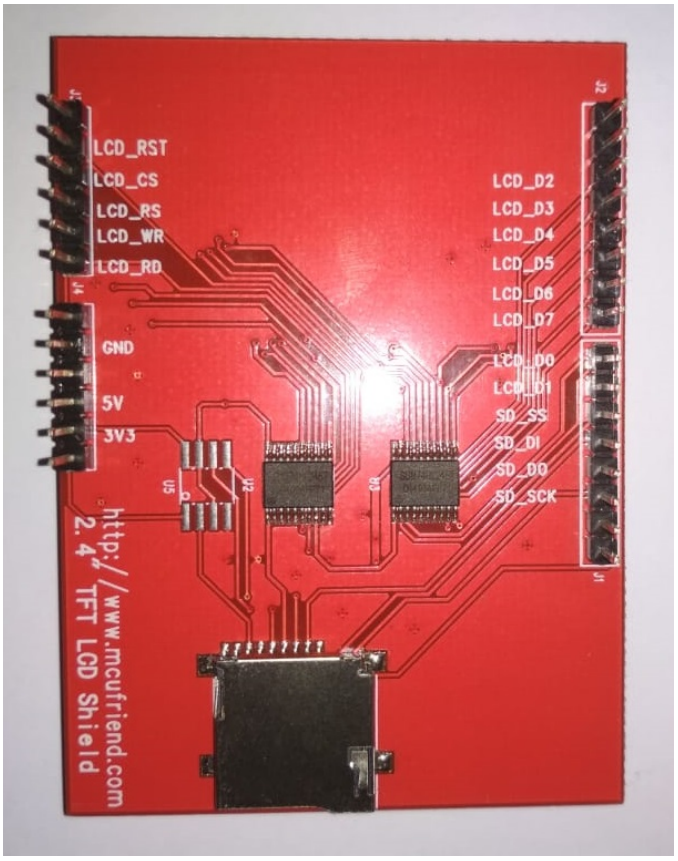

Fig. 3. MCUFriend TFT LCD 2.4" Display Back

the Adafruit_GFX suite. We will only be using the display features of the device and not the touchscreen features.

C. NodeMCU v2

The NodeMCU is an open-source IoT platform which, includes all the necessary hardware and software components to build both complex and simple IoT projects and applications. The NodeMCU itself is just the firmware and consists of the ESP8266 Wi-Fi enabled chip, which is a low-cost Wi-Fi chip developed by Espressif Systems with TCP/IP protocol. The specifications of the NodeMCU are as follows:

- 17 GPIO Pins
- Micro-USB for Programming and Power
- Flash and Reset Buttons
- CPU : ESP8266
- Memory : 128kBytes
- Storage : 4MBytes

Moreover, the NodeMCU is easily programmed through the Arduino IDE and plenty of open-source libraries make it an easy device to build IoT projects with. Version 2.0 of the NodeMCU is our device choice as it perfectly allows us to create a local soft access point which will then interface with a server to communicate the MAC addresses connected to the NodeMCU network.

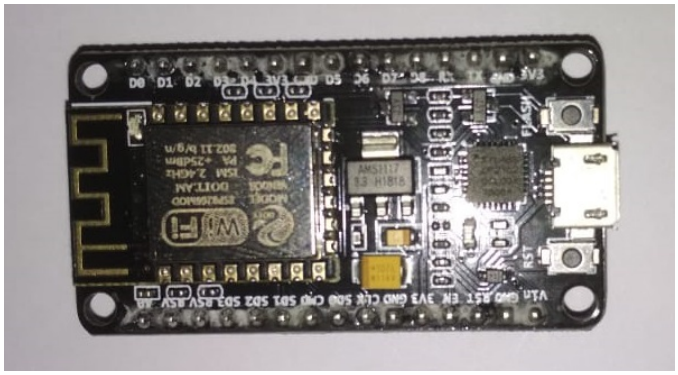

Fig. 4. NodeMCU

V. Results and Discussion

After configuring the device and setting up the Arduino and NodeMCU for their tasks, we have observed positive results in our findings, and that the system was working as expected.

First off, the QR Code was generated correctly by the Arduino Uno and displayed correctly and clearly on the LCD panel, which allowed us to clearly scan it, and connect to the Wi-Fi network of the NodeMCU.

Fig. 5. QR Code the student will scan

Once connected, the MAC address of the connected device is recorded and stored in the file system of the NodeMCU through SPIFFS. From there, the file containing the list of MAC addresses is available upon request.

Next, a local server was setup, so that the attendance of the student can be recorded and stored in the student list. Here,

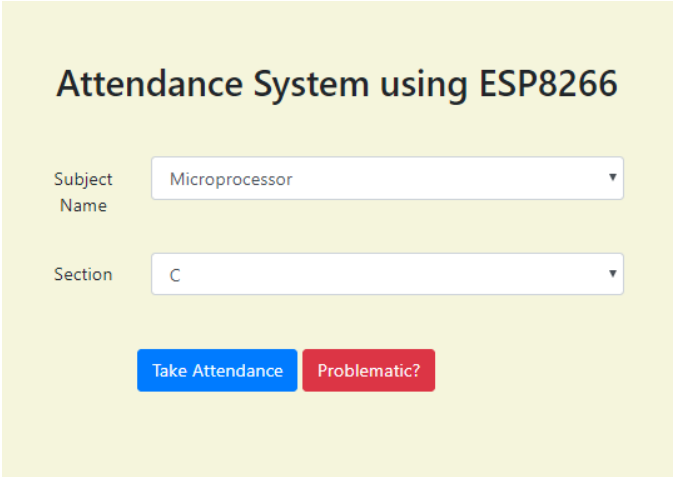

Fig. 6. Faculty Homepage for Course and Section Selection

once the instructor has filled in the required details in regards to the course name and section, attendance is recorded against a list of registered MAC addresses according to the students.

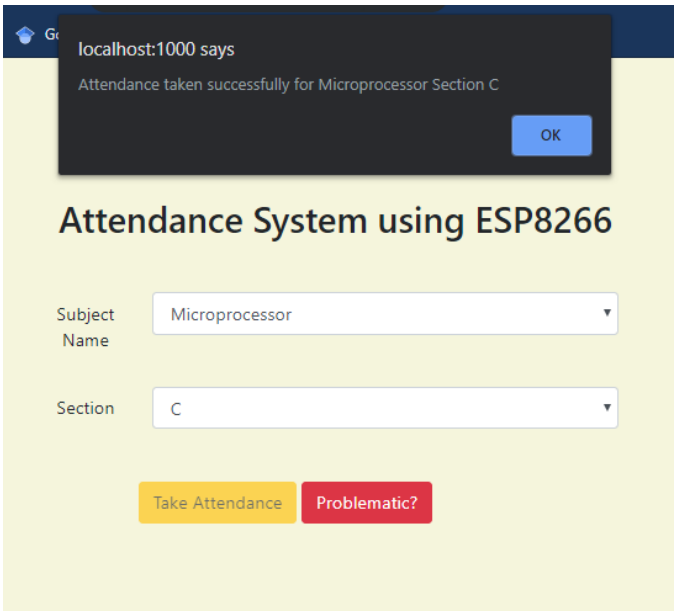

Fig. 7. Successful attendance

During our tests, it was seen that, given the nature of the system, it was successful in accurately marking the students absent or present according to their MAC addresses without too many complications.

VI. Limitations

The hotspot credentials of NodeMCU used for this project is fixed and cannot be changed dynamically according to the user's requirements. This is because transferring the hotspot credentials to the Arduino from the web page is difficult. The QR code generated in the LCD is affected by lighting conditions, which hampers QR code scanning for connecting to the

D	E	F	G
MAC	12/4/2019	12/5/2019	12/6/2019
[illegible]	1	1	1
[illegible]	0	1	1
[illegible]	1	0	1
[illegible]	1	0	1
[illegible]	0	0	1
[illegible]	1	0	1
[illegible]	0	1	1
[illegible]	1	1	1

Fig. 8. Student List with Attendances in excel file

hotspot. MAC addresses containing leading zeros are stored without the leading zero in NodeMCU internal memory. This needs to be addressed in the server side to properly compare the macs. The NodeMCU handles at most 8 connections at a time. So it is difficult to take attendance of more than 8 students at a time.

VII. Future Work

The web application does not contain any login functionality and verification which needs to be addressed. We also want to add the functionality of setting the SSID and Password of hotspot dynamically and limit access to different URLs without authorization. We also want to generate subjects and section according to login credentials and login time of the faculty dynamically and also keep functionality for the faculty to see all the registered subjects and section under him/her as well. We also need to find a better medium to send hotspot credentials to the Arduino for QR Code generation without using serial communication.

VIII. Impact on Society and Environment

From our studies and various other sources, we have been able to determine that even though taking attendance, be it student, or employee, is a necessary task, and there are several existing systems that allow for this task to be completed, as discussed in II.

We have proposed yet another system which aims to significantly reduce the manual labor and time consumed during class time by taking attendance automatically and transferring the responsibility to the student, instead of the instructor. In regards to the societal impact of the project, there are time-saving benefits as well as feedback cues. As feedback cues play an important role in system interaction and design, by allowing a student to scan a code and give attendance, the system gives a psychological reward.

Upon exploring the environmental impacts of our project, it was determined that a lot of paper-based attendance systems can be replaced with this system. Therefore, the project contributes towards moving away from paper-based systems and onto paper-less systems. Consequently, less paper is wasted and used, thereby making a direct impact on our environment, especially our tree population.

Additionally, because the devices used in this project are low-power devices, they can be powered through solar panels while maintaining their performance. Thereby, the project is also self-sustaining, thereby minimizing its associated energy costs and impact on the environment.

Through these findings, we can conclude that our system can have a positive psychological impact on society, save time spent on repetitious, menial tasks while leaving a minimal impact on the environment and our planet.

IX. Conclusion

In this paper we proposed a system for taking attendance easily and faster without the need of carrying papers by the faculty. The proposed system itself has limitations because of hardware implications as discussed in VI and the software side also needs more work to be done which was addressed in section VII.

References

[1] Devansh B.M Sri Madhu, Kavya Kanagotagi. IoT based Automatic Attendance Management System. *2017 International Conference on Current Trends in Computer, Electrical, Electronics and Communication (CTCEEC)*, 2017.

[2] Mahbubur Rahman Abdullah Zowad Khan Mohammad Shah Alamgir Md. Abdul Kaium Khan, Towqir Ahmed Shaem. A Portable and Less Time Consuming Wireless Biometric Attendance System for Academic Purpose Using NodeMCU Microcontroller. *2018 21st International Conference of Computer and Information Technology (ICCIT)*, 2018.

[3] Abdulhamit Subasi R. F. Kurdi Rana Johar, Saeed Mian Qaisar. An Event Driven Attendance Tracker. *2018 21st Saudi Computer Society National Computer Conference (NCC)*, 2018.

[4] Abdelshakour Abuzneid Soumil Nitin Shah. IoT Based Smart Attendance System (SAS) Using RFID. *2019 IEEE Long Island Systems, Applications and Technology Conference (LISAT)*, 2019.

[5] S. L. Aarthy Tarun Sharma. An automatic attendance monitoring system using RFID and IOT using Cloud. *2016 Online International Conference on Green Engineering and Technologies (IC-GET)*, 2016.

[6] G. P. Bhole Vikas Yadav. Cloud Based Smart Attendance System for Educational Institutions. *2019 International Conference on Machine Learning, Big Data, Cloud and Parallel Computing (COMITCon)*, 2019.