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AN ARDUINO DEVICE FOR FRAUD-FREE, AUTOMATIC CLASSROOM ATTENDANCE CONTROL

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Abstract. *In this work we present an Arduino device for classroom attendance control. The device offers a way in which classroom attendance can be recorded without the need of time-consuming rollcall from the teacher, or the use of fraud-prone lists of signatures. The device is built on an Arduino Uno SMD R3 board, an inexpensive, open-source microcontroller board. A prototype of the device has been built and thoroughly tested with an undergraduate engineering class. The article brings a blueprint for construction of the device, as well as the embedded code for its operation.*

Keywords: *Attendance control, Arduino*

1. INTRODUCTION

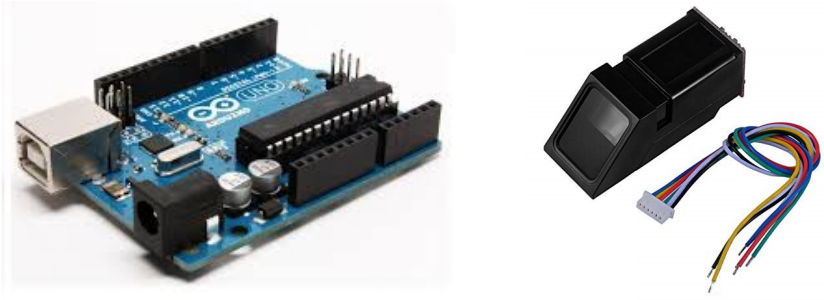
Classroom attendance has been repeatedly shown to have a positive and significant impact in student's performance (Van Blerkom, 1996; Chen and Lin, 2008; Devadoss and Foltz, 1996; Marburger, 2006). However, traditional rollcall forms of attendance-taking demand valuable classroom time and attention from the teacher, and lists of signatures are prone to fraud. Automatic attendance control systems that bypass both problems have been proposed in the literature with different technologies and media (Saparkhojayev and Guvercin, 2012; Kar et al. 2012; Kassim et al. 2012), including biometric signatures through fingerprints as identification medium (Mittal et al., 2015; Gupta, 2013; Li et al., 2010). Most of these systems, however, require sophisticated and/or expensive systems to be available or installed in the classrooms.

In this work we present an Arduino device for classroom attendance control. Arduino is a single-board microcontroller for user-end building digital devices (Monk, 2012). The board is famously cheaper than most of its competitors, due to its licensing under the GNU General Public License (Tsai, 2008). Arduino's low cost was the main motivator to build the present device on this platform.

2. ARDUINO SOLUTION

The proposed device offers a way in which classroom attendance can be recorded without the need of time-consuming rollcall from the teacher, or the use of fraud-prone lists of signatures. The device is built on an Arduino Uno SMD R3 board, an inexpensive, open-source microcontroller board (Fig. 1a).

Extra memory was added via an SMD memory card in order for the device to be able to record attendance for a larger number of students and classrooms. Attendance is taken by fingerprints collected by a specific biometric sensor (Fig. 1b). An LCD display is used to inform the user of success in recording their attendance, or appropriate error messages otherwise. A real-time clock (RTC) has been incorporated as well in order for attendance lists to be assigned to specific calendar dates.



(a) (b)

Figure 1. (a) Arduino Uno SMD R3 board and (b) biometric sensor.

Figure 2 shows the circuit assembly of the device with all of its components.

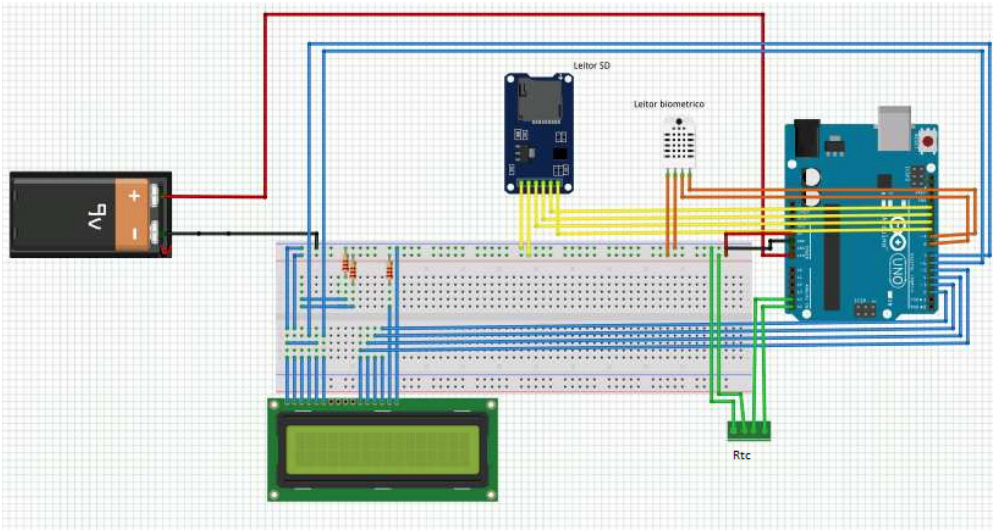
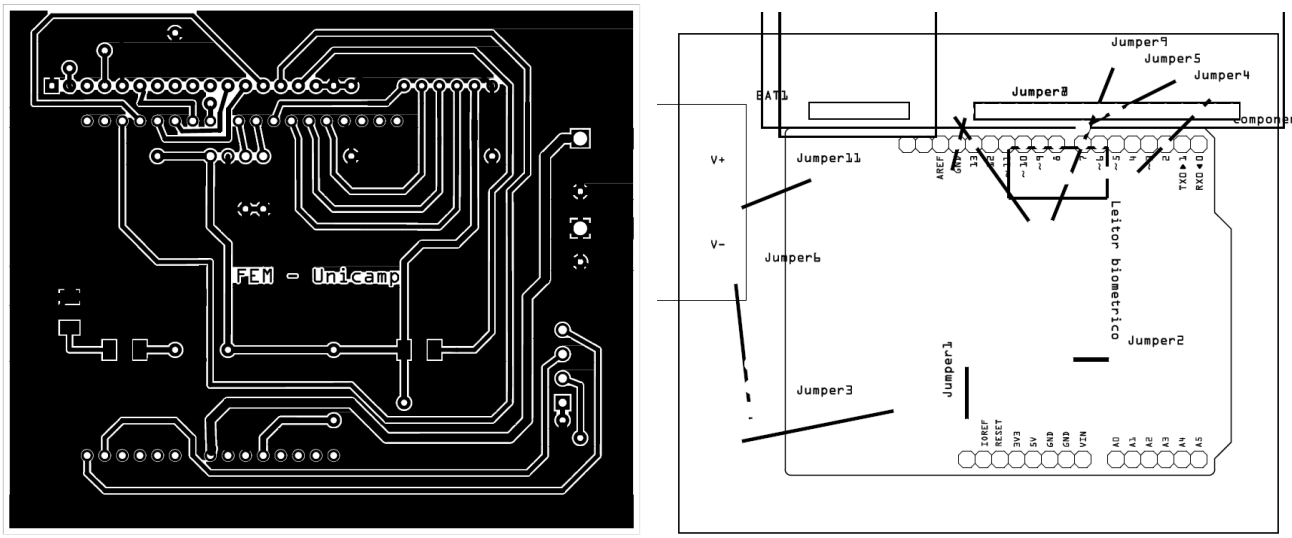


Figure 2. Circuit assembly of the device with its components.

Figure 3 shows the templates for printing the electronic circuit and the necessary jumpers. These are mere examples; the remaining necessary templates are available with the authors upon request.

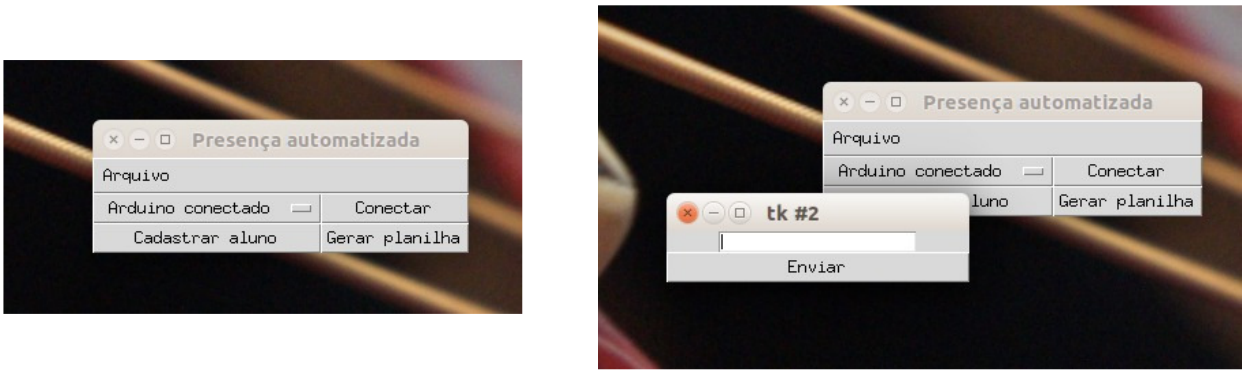


(a) (b)

Figure 3. Selected templates for printing circuit boards of the device.

3. OPERATION

The device has two operation modes. In the first, which is executed only once in the school semester, the teacher's and students' fingerprints are recorded and assigned to an identification number, such as students' IDs. This operation mode requires the device to be connected to a computer, in which student IDs are entered and teachers are registered. Figure 4a shows a graphic user interface (GUI) that has been written in Python Tkinter for this purpose. In the second operation mode, which is executed every day of class, students' fingerprints are compared to their previously stored records and attendance is registered. The teacher's fingerprint is used each day to start and close daily rollcalls. No additional device is needed for this operation mode. Summary of attendance can be taken at the end of the semester. Figure 4b shows the GUI written for this purpose.



(a) (b)

Figure 4. GUIs written for the operation of the device: (a) main screen with functions to register student and generate attendance records and (b) entry field shown to register student ID.

Source codes of the Arduino device, as well as for the GUIs, are too long to be shown in this article, but are available with the authors upon request.

Figure 5 shows a prototype of the device has been built and tested with an undergraduate engineering class.

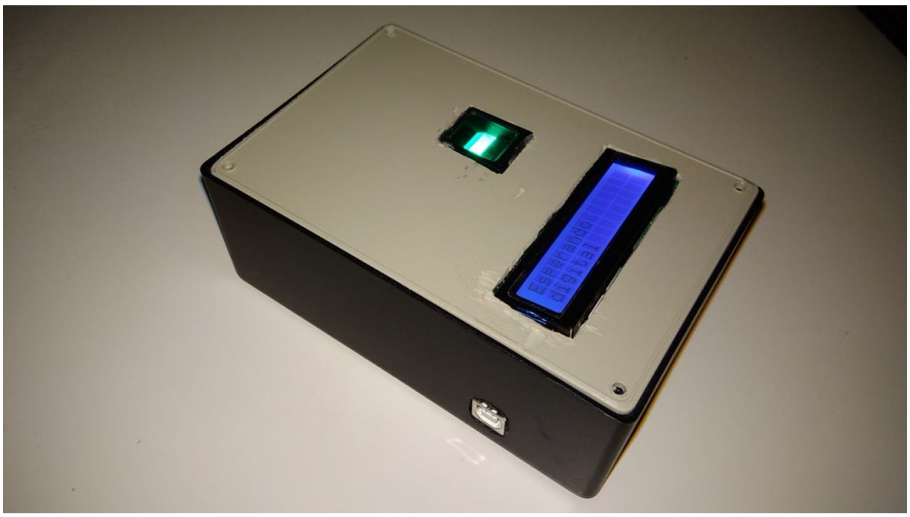


Figure 5. Prototype built and tested in this work.

The tests of the prototype were conducted in three different lecture days for a class of undergraduate mechanical engineering students from the University of Campinas. In the first day, 32 students were registered in the system, according to the procedure described above. The sensor failed to recognize two fingerprints at first try, but eventually all students had their attendance registered. The second day, one week from the previous test day, was initially meant for the prototype to run only its second setting – the attendance record setting. However, 11 students who were absent in the first test day were not registered into the system. This has prompted a modification into the procedures; it may be necessary to run the registration procedure in more than one lecture day. The 11 students were then registered correctly. In the attendance record procedure within the same class, the fingerprint sensor failed to recognize the fingerprint at first try in 7 instances. These were recognized eventually. Other 7 students did not have their fingerprints recognized at

all. The result of this second test was that of 25 previously-registered attendees, only 72% had their attendance in the second class correctly registered. Finally, in the third test day, 6 new students who had been absent in the previous two registration days had to go through the registration procedure. Their fingerprints were recognized at the first try. In the attendance record procedure, one student had his attendance registered in the second attempt. Five students did not have their fingerprints recognized at all. The result of this third test was that of 12 previously-registered attendees, only 58,3% had their attendance in the third class correctly registered. The tests showed that the main shortcoming of this prototype was the reliability of the biometric sensor, which failed to recognize some of the previously-registered students. In order to bypass this problem, it is recommended that more than one fingerprint be registered per student – of more than one finger.

4. CONCLUDING REMARKS

In this work we proposed an open-source, inexpensive Arduino device for fraud-free classroom attendance control. A prototype has been built and tested. Results of the tests prompted a recommendation on how to improve the reliability of the device. Prototype blueprints are available in this article, and the necessary source codes are available upon request.

5. ACKNOWLEDGEMENTS

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