

Arduino-Powered SmartSchools

9-12

Written Report

Group leader: Lim Kai Yang, Hayden (3A316)

Group members: Neo Kuang Yi Jayden (3A318)

Phua Jun Kai (3A320)

Jerome Queck (3P111)

1. Introduction

While technology is advancing in many aspects of life, schools seem to be lagging behind as they continue using old and inefficient methods to operate. In Hwa Chong, without automation, security personnel have to do extra work, such as going to each classroom to switch off electrical appliances. Many of them are also getting on in age, and if this process could be automated, it would reduce their workload significantly. Through Arduino prototypes, this project can introduce ideas to make schools “smarter”.

2. Objectives & Rationale

This project focuses on four main aspects, which are efficiency, security, energy conservation, and data collection, all tied to automation. These aspects have been discussed in a meeting with the security head, Mr. Tay, where he highlighted the areas of improvement. This project aims to introduce manual control of appliances with a longer range. Prototypes with sensors can also be made to detect human presence and count the number of people in a classroom by keeping track of people entering and exiting. The system can automatically switch off the lights and fans and lock the door when there is no one in the room, saving electricity and reducing the workload of the management team. The data for each classroom can be gathered through Internet of Things (IoT) and consolidated in an app for the convenience of the management team. Security is improved as the security head will know the number of students in the school at any time, which is helpful in case of emergencies.

3. Literature Review

The idea of a smart school is certainly not new. Many existing projects improve the pedagogy in schools through technology. For instance, some schools have electronic notice boards controlled by an app. This project instead focuses more on the administrative aspect

which other projects have considered too. A team of students automated an attendance system through a fingerprint sensor. The Fingerprint ID of each student is saved in a database, and the data is transmitted to a computer via a scanner. This project deviates from this approach, as a fingerprint sensor can be impractical for many schools. Other projects use a Passive Infrared Sensors around the classroom to detect human presence and switch of the fans accordingly. However, this approach cannot keep track of the number of people in the room, and is thus inefficient. Photoresistors have also been used to adjust the light level based on the illumination in the room. This project aims to integrate these systems and use more effective prototypes to solve the issue.

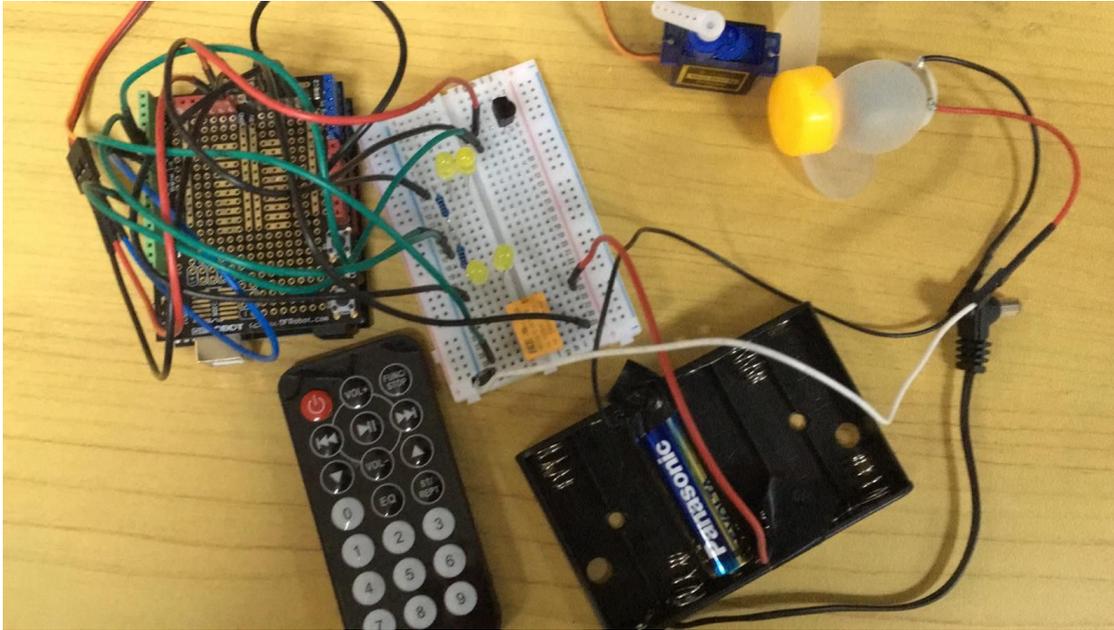
4. Study & Methodology

This project was done by considering many different approaches to a problem, their pros and cons, as well as potential problems that might occur. Arduino components are used to simulate electrical appliances. Inspiration is taken from existing solutions and they are modified to be improved. Cardboard models are made for the prototypes to enhance the overall aesthetics of them.

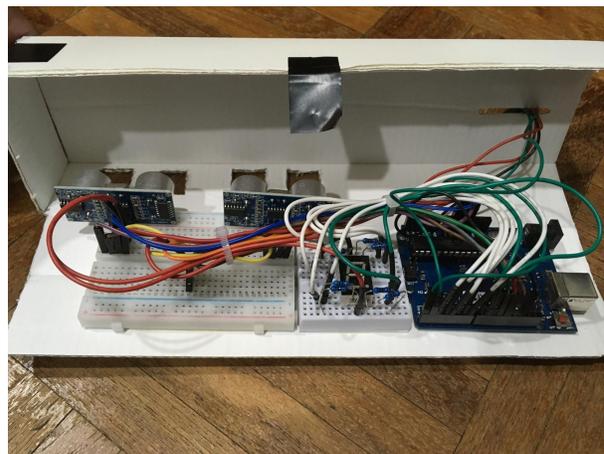
5. Prototypes

In total, there are three prototypes that have been designed:

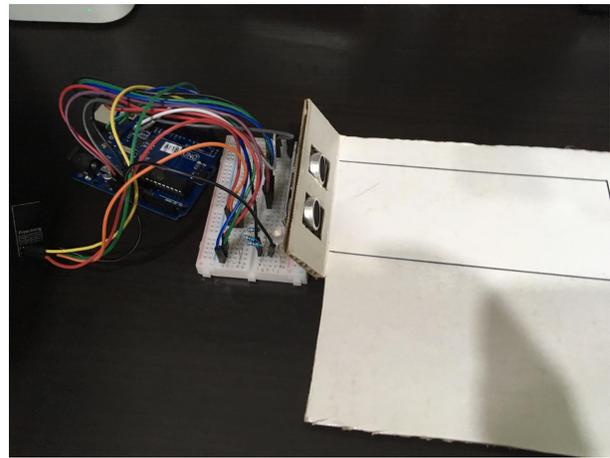
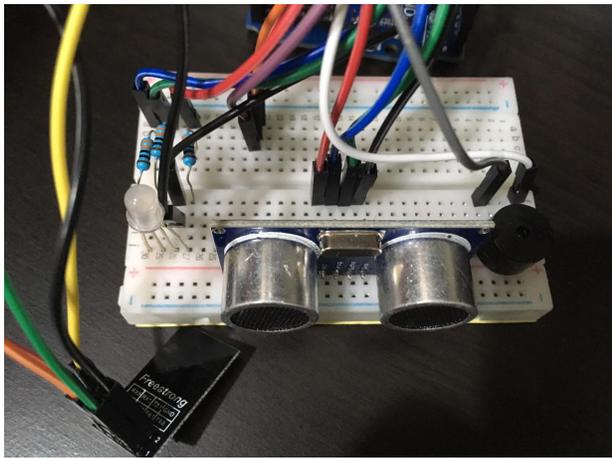
The first prototype is the manual control of classroom appliances. Through an infrared (IR) remote and an IR receiver, the appliances in the classroom can be individually turned on and off, and the door can be locked and unlocked. The appliances include LEDs to simulate lights and a DC motor to simulate a fan. A relay controls the components and the circuit is powered by an external battery holder.



The second prototype is a counter that keeps track of the number of people in a room. Using 2 ultrasonic sensors and the Blynk IoT device, the direction of motion in front of the 2 sensors can be detected, and depending on the direction, the count is increased or decreased. The number of people in the room can be viewed through the Blynk app. There were a few other options on how to implement this, such as using a PIR or lasers with photoresistors, or infrared sensor. Through experimentation, it has been determined that using ultrasonic sensors was still the optimal solution.



The third prototype is an automated parking sensor. It utilises IoT and an ultrasonic sensor to detect when a car is reversing into the lot. Based on the distance between the car and the wall, the buzzer beeps faster and slower accordingly. An RGB LED indicates the availability of the lot. The data of the cars is collected in an app to allow parents to check the availability of parking lots in the school so that they can plan better.



6. Conclusion

In conclusion, three prototypes have been made that work separately. However, given more pins on the Arduino, models can be seen as a whole system that is integrated together. For example, the first prototype can work seamlessly with the second one. When the counter is 0, the electrical appliances are automatically switched off. This cannot be implemented currently simply due to the limitation of the Arduino microcontroller. In addition, the reliability of prototypes can be improved if more powerful sensors are used, as well as IoT with more stable connections. The counter could be more accurate if a laser rangefinder is used.

7. Further Extensions

In the future, the prototypes could be implemented into an actual classroom, and the designs of the models could be further improved. Additionally, measures could be taken to make the IoT connections more stable, improving the user-friendliness of the IoT system.

8. Bibliography

- Harikrishnan, V., Roy, P., Yasodharan, R., Karthick, S., & Bennaiah, D. (January 19, 2018). IoT based Classroom Automation using Arduino. Retrieved from <http://www.ijtsrd.com/engineering/electronics-and-communication-engineering/9404/iot-based-classroom-automation-using-arduino/yasodharan-r>
- Batin, A., & Filatov, A. (2017, February 16). SMART SCHOOL SYSTEM. IoE unit REMIC, intellectual-control. Retrieved from <https://www.hackster.io/itea-school/smart-school-system-ioe-unit-remic-intellectual-control-404d55>
- 21 education Projects - Arduino Project Hub. (2019). Retrieved from <https://create.arduino.cc/projecthub/projects/tags/education>