Shiraz University	**Shiraz University** **Department of Computer Science & Engineering**
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	Course: Microprocessors **Semester:** Spring, 2023
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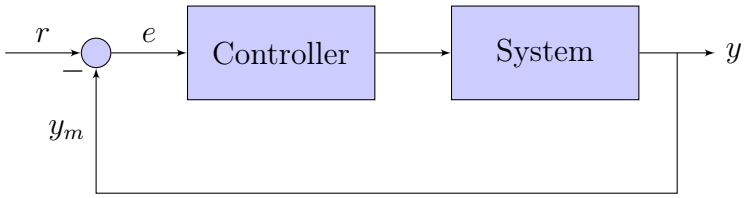
	Project

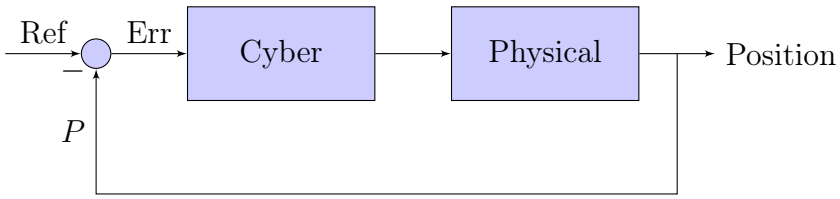
Introduction

Smart homes are the way of our future. They incorporate technologies like *internet of things (IoT)*, *embedded systems (ES)*, *cyber-physical systems (CPS)*, and much more.

Old control systems are being replaced by a new technology called *cyber-physical systems (CPS)*. We will not get into the details of this technology, but in short, they *sense* the environment they are in and take actions based on what they have sensed. Robots are the best example of the CPS. Consider a finder robot seeking to find a ball in an environment. The robot senses the surroundings using cameras, process the data using pattern recognition algorithms, and takes actions based on the outcome.



(A) Old control systems



(B) New cyber-physcial systems

FIGURE 1 – CPS and control systems compared

In this project, we will be implementing a simple system to be more introduced to ES and CPS world.

Description

We want to implement a simple smart home. This system has three main objectives:

1. Security
2. Temperature Control
3. Lightning Control

1 Security

A default password is hard coded and users can enter a password using a keypad. Every time they press a button a star symbol is displayed on the LCD. When they entered the desired password, they can submit the password by pressing * on the keypad. They can also edit the entered password by pressing # which deletes the last character on each press.

But what if the users want to check if they entered the correct password before submitting? This is where a push button comes into the action. The button acts as a toggle switch for showing the password. If the entered password is invisible and a user presses the button the LCD should be cleared, and the entered password must be printed on it. When the password is visible and the user presses the button, LCD should be cleared, and a star symbol should be printed for each entered number. If show password is active, newly entered characters should also be displayed.

After submitting the password two scenarios happen: the password is either correct or wrong.

1. If the password is correct, "Access is granted" should be displayed on the LCD. If and only if the password is correct, access to the other parts such as temperature and lighting control is granted.

2. If the password is wrong, "Wrong password" should be displayed. The message should disappear after one second and the system should receive a new password again. Other parts of the system MUST NOT work unless the correct password is entered.

2 Temperature Control

The goal of this part is to design a temperature monitoring system that controls and regulates the temperature of the house.

We have two motors: the cooler and the heater. For temperatures between 25 and 55 degrees, the cooler motor must be turned on, starting with a duty cycle of 50% plus 10% for every additional 5 degrees. (E.g., for a temperature of 37 degrees, the duty cycle is 70%). For temperatures between 0 and 20, the heater motor must be turned on, starting with a duty cycle of 100% minus 25% for every additional 5 degrees. Between 20 and 25 degrees, neither the cooler nor the heater is turned on.

We also have a red warning LED and a blue warning LED. The red LED must blink if the temperature is higher than 55 degrees (the cooler must stop working at this point). The blue LED must blink if the temperature is lower than 0 degrees (the heater must stop working at this point).

3 Lighting Control

The goal of this part is to design a lightning monitoring system that controls and regulates the lightning in the house.

The lighting control subsystem has one motor. Light is denoted by a number between 0 and 100. For light intensity between 0 and 25, the motor works with a duty cycle of 100%; for every 25% increase in light, the motor's duty cycle is reduced by a factor of 25%.

Light intensity	Duty cycle
$0 < x < 25$	100%
$25 < x < 50$	75%
$50 < x < 75$	50%
$75 < x < 100$	25%

Table 1 – Duty cycle of the lightning motor

Considerations

1. Your design must use ATMega32 microcontrollers. Your design must contain two ATMega32 chips: the master and the slave. The master only reads the data and sends it to the slave. The slave processes the data and takes actions based on the outcome. No processing, such as password checking, should happen on the master. The schema of your project must look like this:

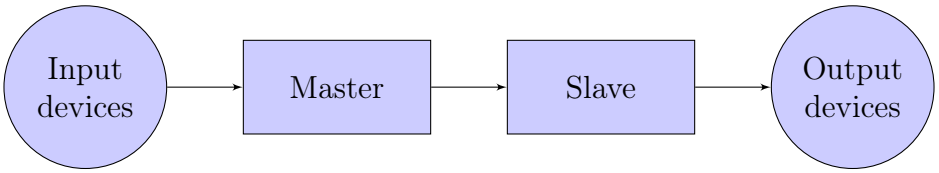


FIGURE 2 – The relation between different components of the house

2. The use of Arduino and other chips is prohibited.
3. Your implementation must be user-friendly.
4. Encrypting data and then transmitting it, is a bonus.
5. Having speakers is a bonus.
6. Implementing the system in Persian is a bonus.
7. Good documentation is a bonus.