Iterative Development: A Design Process

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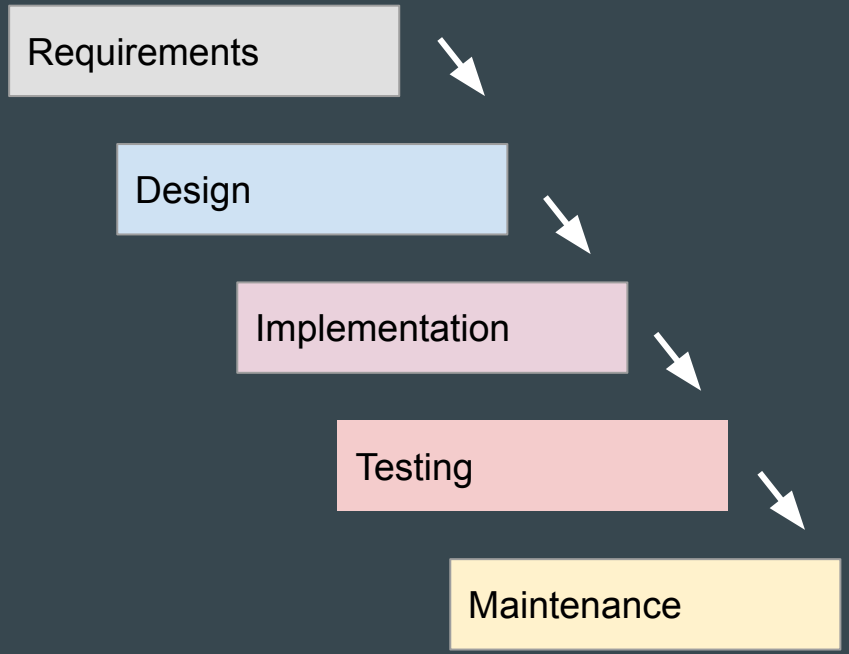
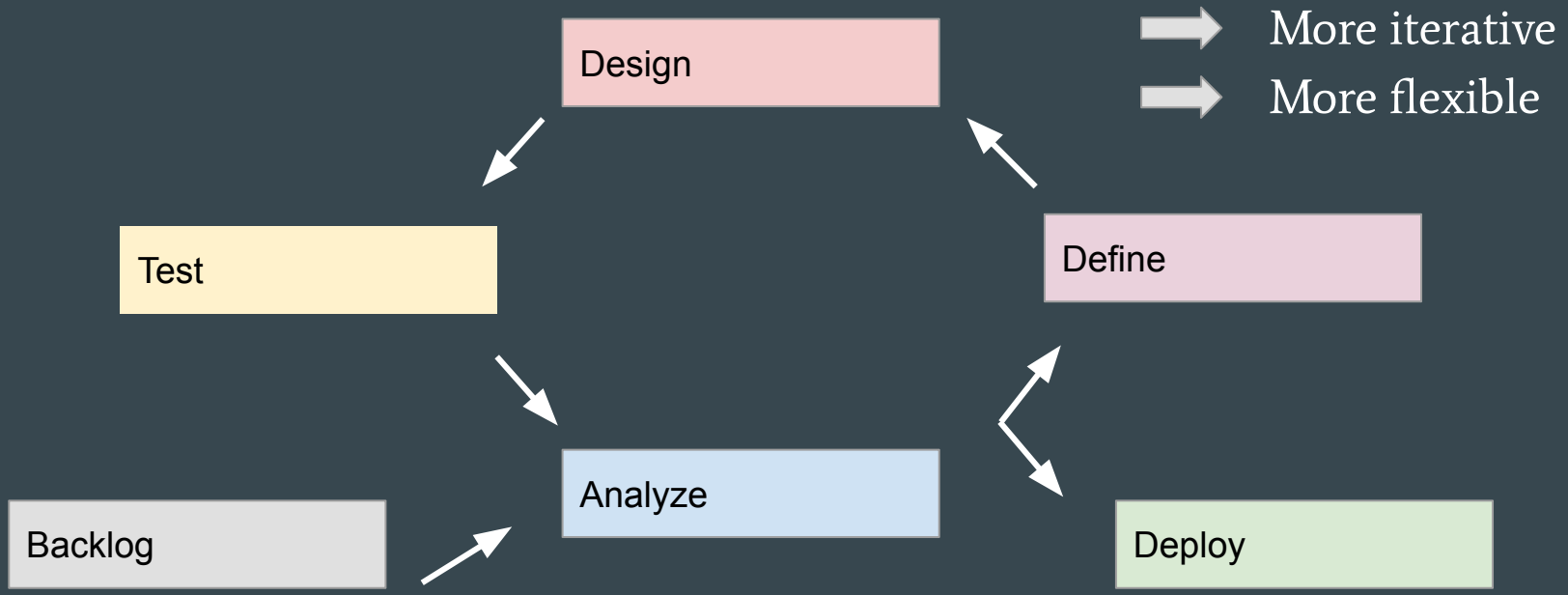
Background in Development Techniques: WATERFALL



- Less iterative
- Less flexible

Background in Development Techniques: AGILE



Benefits of Iterative Development

- Higher Quality Product
  - May take more time, but each step in the process is highly tested and the overall deployment is typically more stable
- More Control
  - If a key design flaw is noticed, it can be taken care of much easier and with less effect to other parts of the project.
- Increased Visibility and Reduced Risks
  - Testing small parts of the whole product at a time increases the visibility of each segment of the product and also makes it easier to safeguard against major issues

Case Study: Liquid Dispenser

Looking into a sample design process

- Defining the goal
- Designing the framework
- Rigorous testing
- Continual improvement

1. DEFINE

Requirements

- Budget under $200
- More than 1 tank
- LCD screen large enough to be useful
- Powered by arduino
- Being able to be powered externally
- Be protected against general wear and tear

2. DESIGN: Make a parts list

- Arduino board
- LCD Screen
- Relay Switches
- Motors
- Bottles for tanks
- Tubing

Hardware

Arduino Mega

Arduino Mega 2560 REV3

This device was chosen due to the ample amount of inputs and outputs as the LCD screen takes up a significant portion of the board. It is also easily able to obtain on amazon as indicated by the link above.

5 inch LCD Touch Screen + Expansion Shield

This product was chosen due to its size and compatability with the arduino mega board. It is not too overpowered and the resolution is just enough for its purpose.

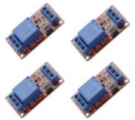
5 Inch LCD Touch Screen

In order for the LCD screen to work with arduino, it needs a shield expansion board to be placed directly in between the screen and the arduino itself. The purpose of the board is to streamline connections which also reduces the chance of shorting the screen due to poor connections.

Shield Expansion Board

Relay Switches

These are basic relay switches which have power and signal inputs that are used to control the motors. When the signal line is turned on, the respective motor is turned on.



Relay Switches

Pumps

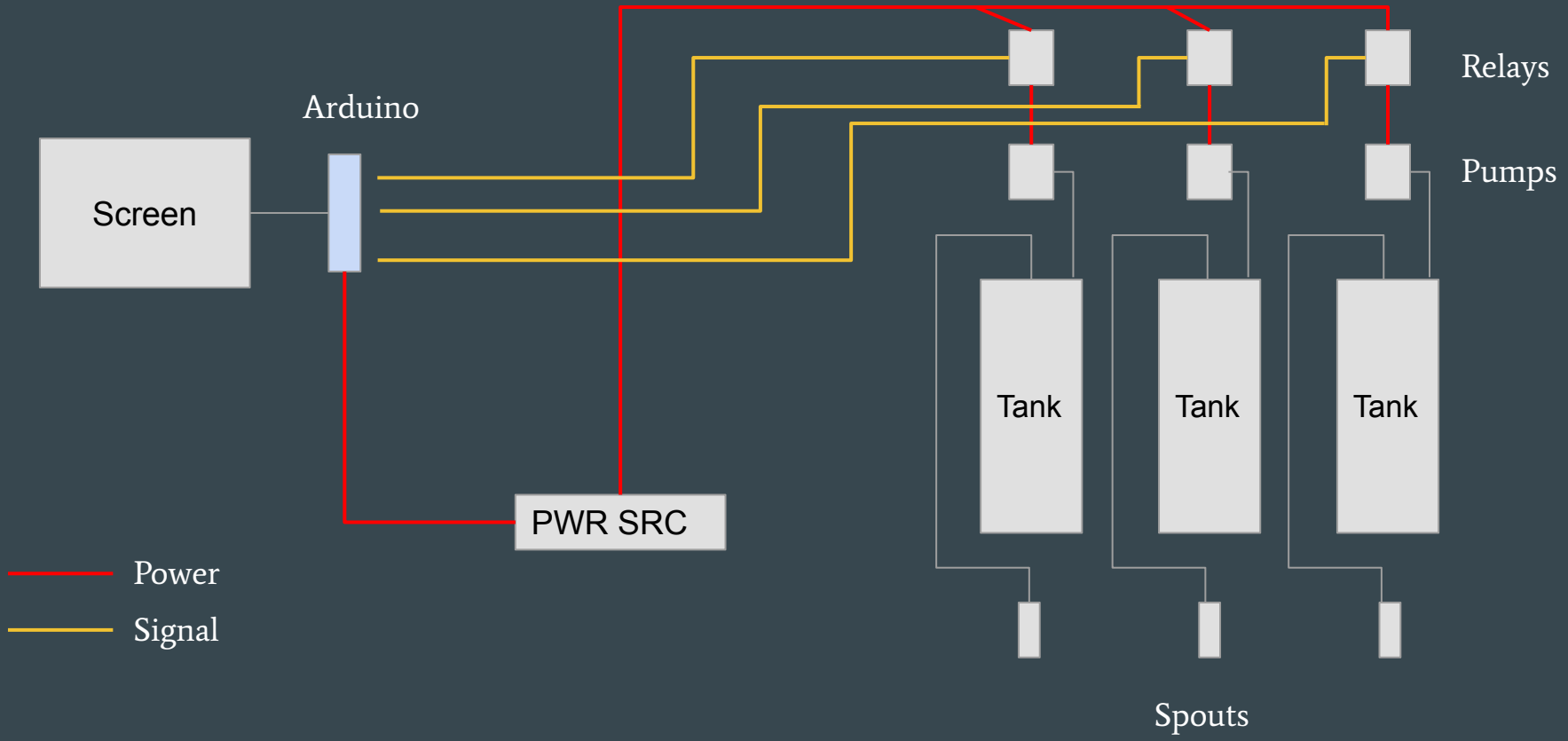
The pumps used in the design are technical air pumps. When turned on, it pushes air into the tank which moves the liquid out another hose and through the spout. This design was chosen due to its simplicity and low cost.

Pumps

Power Supply Materials

Simple 9v converter for arduino

2. DESIGN: Starting with the hardware



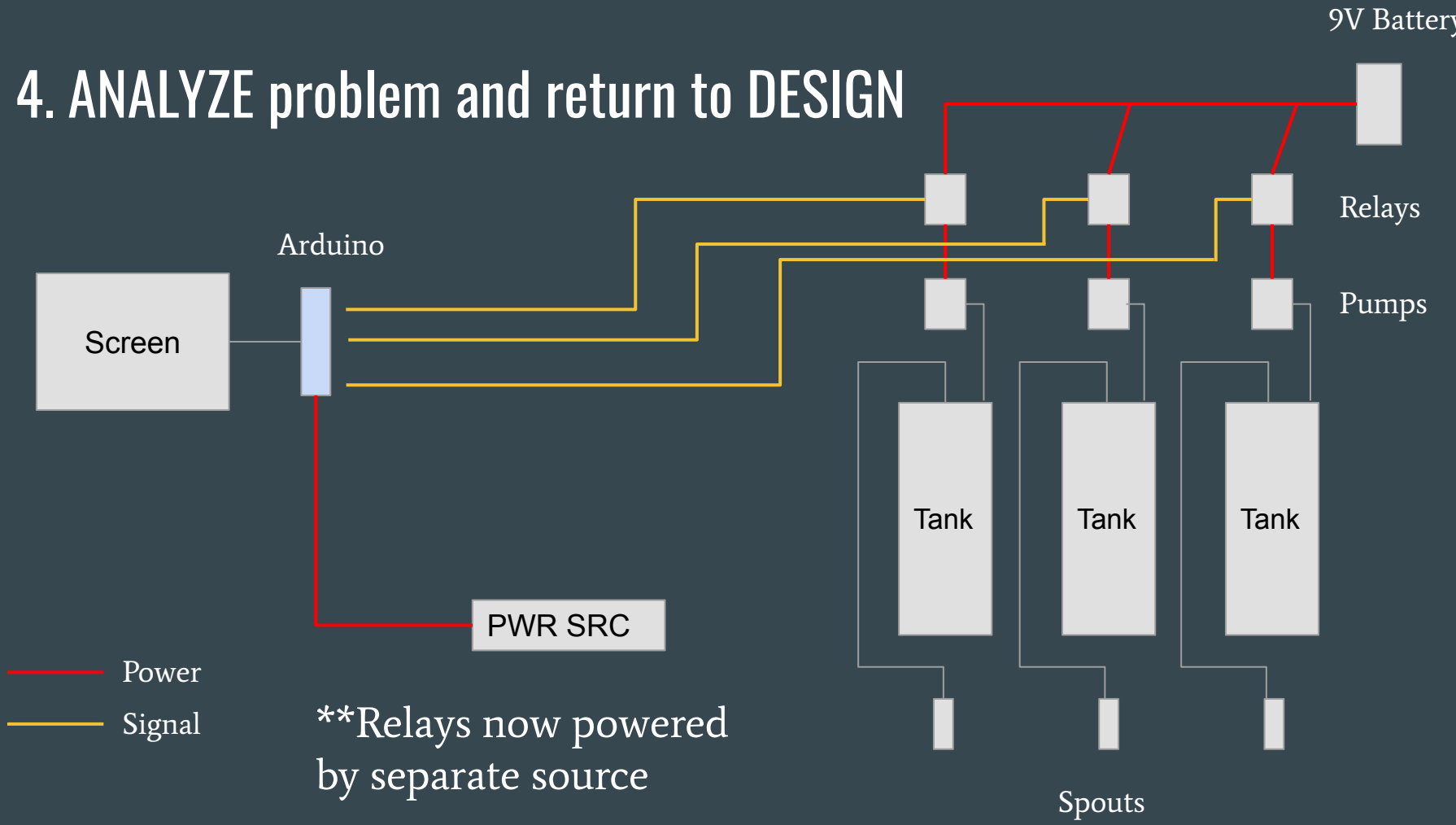
2. DESIGN: Moving on to software

```
1.  Initialize all constants
2.  Initialize hardware and digital outs
3.  Set hardware specs to desired settings
4.  Begin infinite loop
5.      If there is a response from LCD Screen
6.          Map the response to the button that corresponds to
    it
7.          While button is being pressed
8.             Send HIGH output to relay
9.          End while
10.         Set LOW output to relay
11.     End If
12. End infinite loop
```

3. TESTING

- Hooked up power to everything to make sure it would work
- Wrote basic code to just fire the motors and do nothing else
- Noticed an issue:
  - LCD screen would crash when motors turned on
  - Narrowed down issue to too much power draw from only one 9v power supply.
- Waterfall development would have caught this much later and would have been much more of a pain to fix

4. ANALYZE problem and return to DESIGN



5. Continue TESTING

- Writing one code function at a time, testing it, and making improvements
- Once stable version is deployed, start adding improvements
  - Including login screen for protection
  - Having a screen shut off timer to not waste too much power
  - Adding pre determined timers to fill measured amounts of liquid
- Because the design remained stable, it is much easier to improve on

6. Deploy

Github: https://github.com/KyleWengryn/liquidDispenser

- Once hardware and software are stable, I was able to put the time into building the wooden case around it.
- Iterative development left me confident that I could put time and effort into aesthetics without having to worry about major issues in functionality