Timers and interrupts are two vital features to embedded systems. According to Toulson, R. & Wilmshurst, T. (2016), "Embedded systems have to respond in a timely manner to events as they happen. Usually, this means they have to be able to: measure time durations; generate time-based events, which may be single or repetitive; and respond with appropriate speed to external events, which may occur at unpredictable times."

One of the most common embedded systems in our homes that uses timers and interrupts is a thermostat. A thermostat not only has to measure temperature, compute and implement heater and fan settings, and display the temperature, but it also has to respond to events that may occur at random, such as respond to user control or switch to battery backup in case of power loss.

For this discussion, think of an embedded system (other than a thermostat) that uses timers and interrupts. This may be an embedded system in your home or workplace. This may also be an example that you have read about or have seen on the Internet or TV; just be sure to provide an APA reference linking to the original source. Explain how the timers and interrupts work in the embedded system chosen.

In your responses to at least two peers, explain if you think the timers and interrupts are efficient in the embedded systems shared. Are there any ways to configure the timers and interrupts to make the system more efficient? Provide additional resources regarding the embedded systems, if applicable.

**Reference**

Toulson, R. & Wilmshurst, T. (2016). Fast and effective embedded systems design: Applying the ARM mbed (2nd ed.). Newnes.

A modern gun safe could be considered to be an embedded system that relies heavily on timers & interrupts to ensure security and the user’s accessibility. These type of safes include an electronic locking mechanism that is controlled by a microcontroller, which manages inputs such as keypad entries, fingerprint scans, or even RFID. Personally I use the keypad entry with a backup physical key. These systems need to operate in real time, sometimes instantaneously to valid access while preventing unauthorized attempts though timed lockouts & alarm triggers.

Timers and interrupts play a crucial role in the safe’s functionality. A timer ensures that the safe remains locked for a set duration after multiple incorrect access attempts, deterring brute-force attacks. Additionally, an auto-relock timer engages the locking mechanism if the safe door is left open for too long, preventing accidental exposure. Meanwhile, hardware interrupts handle critical events, such as an abrupt power loss, triggering a backup battery mode to maintain security. If a tamper sensor detects forced entry, an interrupt immediately activates an alarm, providing an additional layer of protection.

Though they do have problems Sometimes the system is not the most responsive in times of need. Other times, a simple battery dying after 2 years of inactivity could lead to the system being non-responsive. Even though the embedded system should be viewed as a simple machine, it still introduces another point of failure in the overall design. Overall, the users of timers & interrupts strike a balance of security & usage.

Toulson, R. & Wilmshurst, T. (2016). Fast and effective embedded systems design: Applying the ARM mbed (2nd ed.). Newnes.

Kubiniec, T. (2025, February 4). *Gun safes: Is technology putting you at risk?*. LinkedIn. https://www.linkedin.com/pulse/gun-safes-technology-putting-you-risk-tom-kubiniec-gur9e/

Evening Austin, glad to see someone else is excited to be halfway through the term. I know I am, challenging term it is!

Embedded systems like the air fryer you & I both use, needs timers & interrupts to work efficiently. The timer needed to keep track of cooking times accurately, while the interrupts can be simple as pressing pause/stop, or removing the the item via handle (mine does not turn off when I do this to “flip my food”. Granted these systems are probably for improved safety while not allowing energy to be wasted. Potentially only checking for changes reacting when needed instead of consistently checking for changes.

Can an air fryer be improved? Cook faster! In all serious, providing an interrupt for all functions for efficiency? Setting priority controls (lower temp after x minutes), overheating issues (had one recalled for that) to improve safety. Overall, air fryers show how timers & interrupts help embedded systems run smoothly, similar to many other devices in our kitchen.

I understand that as I get a little older, appliances are exciting. Anything that makes my life easier, or a task quicker. I also may have a bit of Samsung bias because many of my major appliances are Samsung.

Modern day washing machines rely heavily on embedded systems to function in such meticulous manners, allowing them to automate timing & optimize performance. More impressive are the machines that are able to do a full wash & dry cycle with nearly no interactions. They just know how to get it done. Features like delayed start, sensor based soaking, washing, rinsing & spinning demonstrate the precision of the timers. Unlike some older machines, the new digital ones are able to adjust water levels & spin speeds on the fly, improving their longevity in the process.

Interrupts are also equally important to handle unexpected events. Often popping the door open to the dryer stops the cycle, now it has 5 seconds, or a certain angle where if not passed, will resume the cycle. Other times it may pause the load or slow down if too much weight is detected, or if I have tossed a wet blanket that didn’t fully spin out in there (crappy old washer). Even user inputs, such as pressing start or stop, generate interrupts for instant processing. This digital approach distinguishes modern washers from older models, which relied on hardwired switches or analog timers. By integrating programmable timers and interrupt-driven sensors, the system achieves greater flexibility, efficiency, and safety—showcasing how embedded systems enhance everyday appliances.