Servo Project Proposal

Assignment Specifications

- Main goal is to provide a SCOMP peripheral for a servo and a user friendly API
- Base feature:
  - Controllable servo pulse generator that generates safe pulses between 0.5 and 2.5 ms.
- Advanced features:
  - Precision within 1 degree controlled by 90 kHz clock
  - Various speed modes
  - Practical Oscillating Tower fan application with angle and speed control

Goal of Project

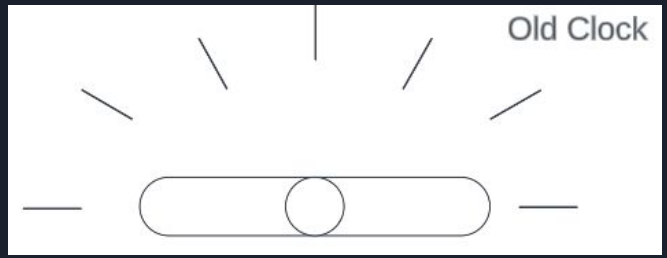
- 2 ways to interact with servo
  - Constant rotation (input speed)
  - Input degree/position
- Demonstration
  - Use a small fan (Oscillating Tower Fan)
  - Manipulate using DE10 switches and buttons to demonstrate modes and precision

Technical Approach

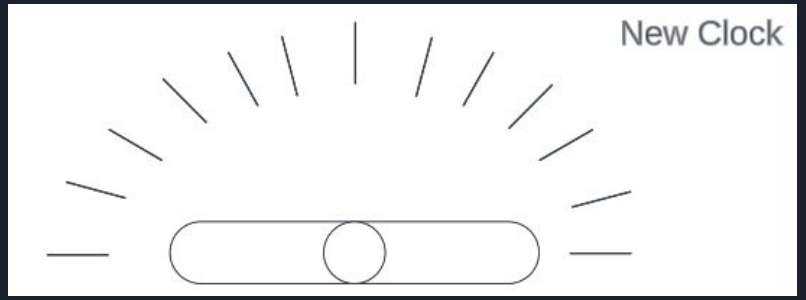
- We decided to go with 3 ways of interaction to give the user a variety of options
- Constant Rotation mode
  - There will be a constant rotation mode with configurable speed
  - This mode can show off the servos full range of motion to an unfamiliar user
- Degree Rotation Mode
  - Allow for degree precision input and rotation of servo
- Interaction through assembly code
  - This method allows the user to write more complex custom sequences of movement for the servo

Technical Approach - Hardware

- Use 90Khz to increase number of discrete positions
- Changes of 10 microseconds or fewer of high time are negligible
- Mode packed into the LSB



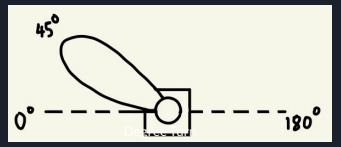
Old 10kHz clock had 20 possible positions

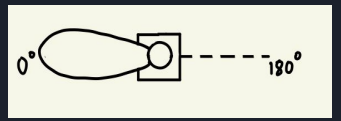


Implemented 90kHz clock has 180 possible positions

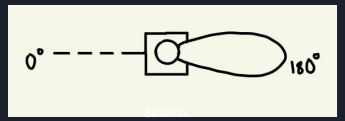
Technical Approach - API

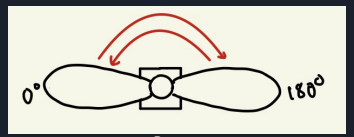
- Inputting a position as a degree through code is the only way to interact through code
  - This is because any additional functionality can easily be written as assembly routines
- For the demo we plan on having 5 functions
  - Degree Turn
    - Given a degree the servo will turn to that degree
  - Radian Turn
    - Given a angle in radians, servo will turn to that degree
  - SetZero
    - The servo will move to the 0 degree position
  - SetMax
    - The servo will move to the max (180) degree position
  - msTurn
    - The servo will turn to the pulse inputted
  - Bounce
    - The servo will go back and forth from min to max input degree position





SetZero

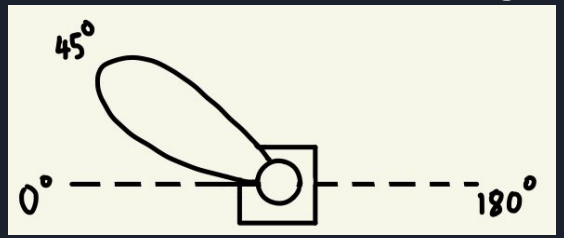




Bounce

Technical Approach - API cont.

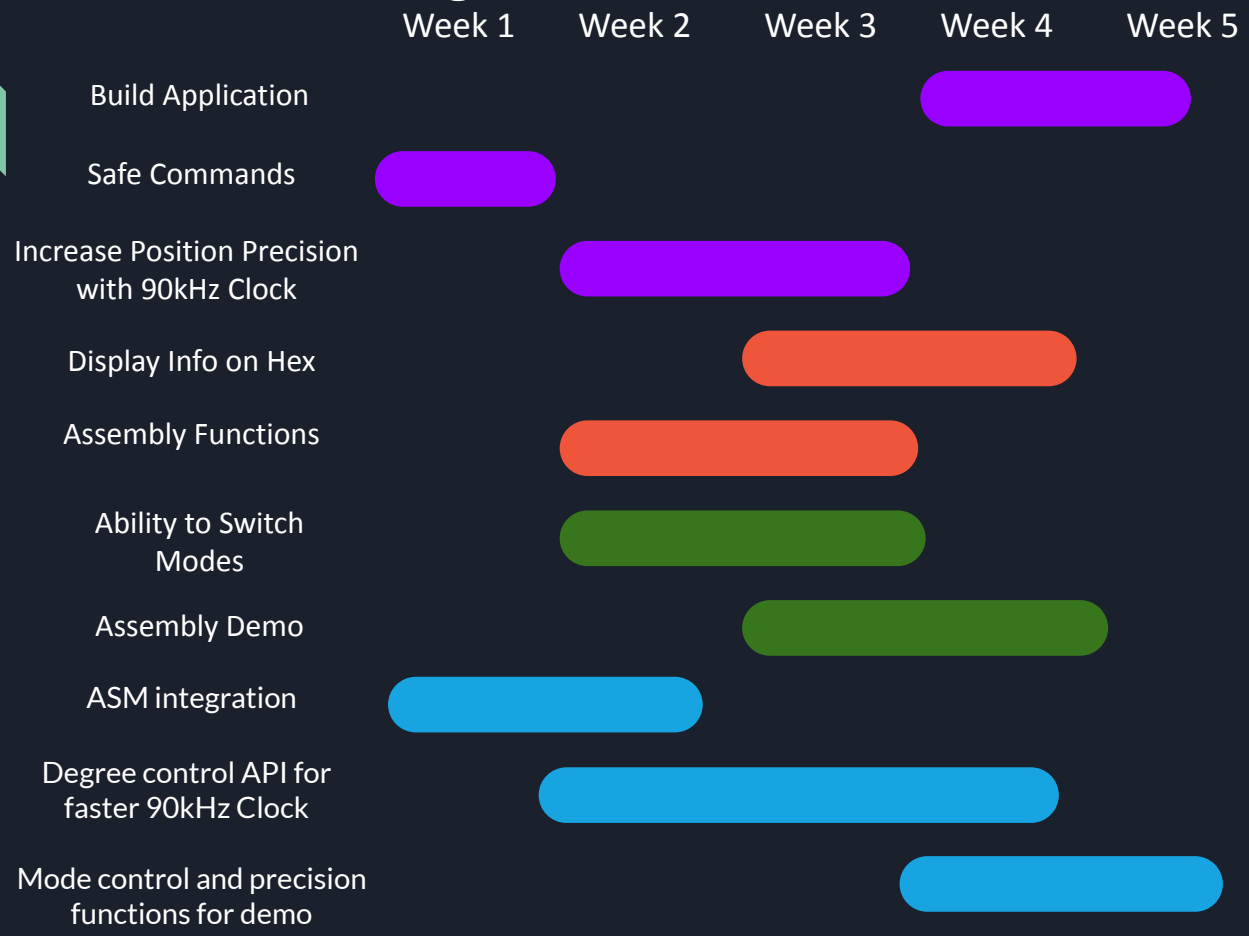
- When implementing degree turn using the 90kHz clock, we noticed that the servo specifications were off:
  - A 0.5ms pulse would generate 0 degrees, while a 2.5ms pulse would generate around 200 degrees instead of 180 degrees
- To solve this, we have implemented a scale factor within the ASM API to scale inputs by 8/9 to correct the overshoot.
- By doing so, the user can adjust the scale factor as need for their individual servo's discrepancies:
  - We have met the manufacturers specifications while also allowing for case by case user tuning



Technical Approach - Application

- Will rotate a small fan to different positions
  - DE10 switches control position in position mode and speed in constant rotation mode
  - Pushbutton will control state
- Fans need to be adjusted to cool their target
- Sometimes need constant motion to cool a large area
- Demonstrates precision movements and modes

Time management



Color Key
- Harsh
- Matthew
- Gabe
- Ariel

Conclusion

- We will present you, the customer, with an easy to program, versatile, and precise peripheral/API interface to control a PWM Servo Motor that could have the following applications:
  - Precision electronics:
    - Robotics applications
    - Pressure valve controller
  - Oscillation
    - Lawn sprinkler
    - Fan control