ECE 362 Embedded Microcontroller Mini-Project – Spring 2018

Team 14 – Face Follower

V3M

"Directing our attention on your awareness..."

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Background

Inspired by the Peloton iOS application, users who used ipad to workout in their preferred local gym would rely on a tablet holder while watching virtual indoor-cycling class. Users tend to do a sitting or standing motion while in virtual class. However, users had limited view range while using the application because the tablet would be oriented statically in one direction and was not able to adapt to its users location state.

Product Motivation

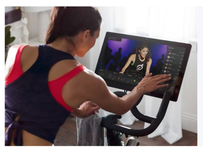
Providing users the comfort of automated orientation smartphone/tablet holder while working out on an upright bike equipment. The Microcontroller design can be adjusted to a diverse application in the real-world scenarios.

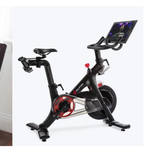
Product Future Improvement

The flexibility of the product system gave itself a room for major improvement. One improvement could be made on the software side by implementing a microcontroller response based on a certain facial expression (Microsoft Kinect, etc).

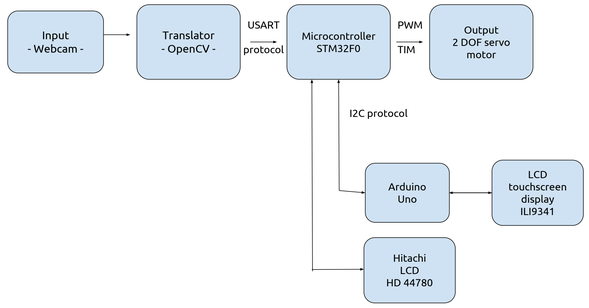
Another improvement on the hardware side could be done by improving the servo motor capability and LCD with better communication protocols

Commercial Application

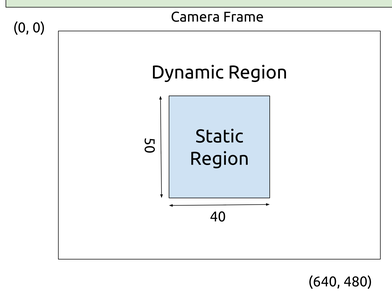




Microcontroller-Centered System Design



Facial Location Grid



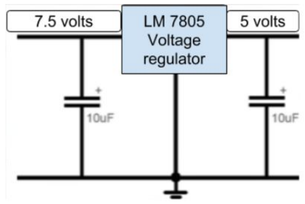
Static Region dimension was established based on the stability of the Communication System. the communication system was using a baud rate of 115200 and the performance was significantly affected by the speed of processing the location of the user's face from OpenCV interface and by the speed of the information transmission to the Microcontroller. The controller was programmed to move holder orientation away from dynamic region and into static region.

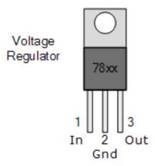
Hardware /softwareLimitation

- Servo Motor maximum torque was limited
- Servo Motor produced underdamped oscillation when moving to its designated orientation.
- OpenCV was not compatible to cortex M0+/M0
- OpenCV interfacing did not utilized most libraries for maximum performance.
- OpenCV exception still occurred

Power Regulation

The power regulation circuit was designed to provide the stm32F0 discovery board with 5 volts from a 7.5 volts adapter. A 7.5 volts power adapter was used maximized the input voltage applied on the Servo motor so that the motor would be able to perform its maximum capability. Another set of voltage regulator circuit was used to power the arduino board that interfaced the Display touch panel ILI9341.

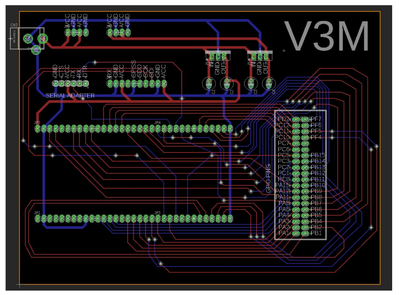




Type	Min Input Voltage	Output Voltage
7805	7V	+5V
7806	8V	+6V
7808	10V	+8V
7809	11V	+9V
7812	15V	+12V
7815	18V	+15V
7818	22V	+18V
7824	30V	+24V

Voltage regulator circuit with LM7805

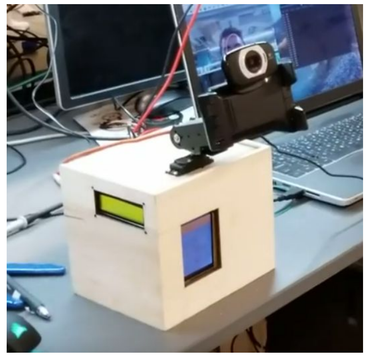
PCB Design



Design Considerations:

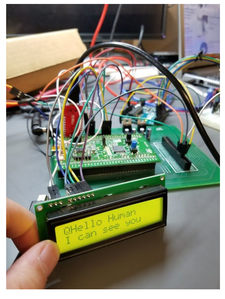
- Minimized parallel traces on top of each other on 2 different layers to reduce electromagnetic interference
- Power traces: 40 mil pin connection traces: 12 mil
- avoided traces passing between two drill holes to minimize faulty current shortage

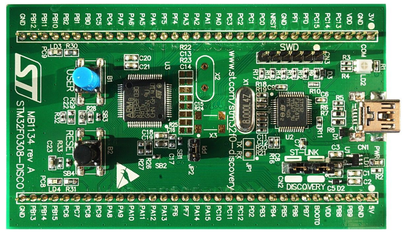
Product Specification



Microcontroller Board: STM32F0 Discovery
Communication Protocols:
USART, SPI, I2C
On board-peripherals: PWM
Sensors interface:
OpenCV, ILI9341, Arduino Uno
Additional hardware:
LCD Hitachi HD 44780, logitech webcam C615, MG995 Servo motors mount, Universal Power Adapter

STM32F0 Discovery Board and Peripherals





STM32F0 Discovery with ARM Cortex M0
USART Operating Baud Rate: 115200 bit/s
SPI operating Baud Rate: 46875 bit/s
I2C Operating Frequency: 100 kHz

Functionality

USART : communication with OpenCV through a PC
I2C : communicationwith Touch display ILI9341 through Arduino Uno
SPI : communication with Hitachi HD 44780
PWM : control Servo Motors MG995