



**DesignNews**

PLC-HMI Automation Applications

# DAY 4 : HMI Fundamentals Part 1: Automation Control and Firmata

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## Webinar Logistics

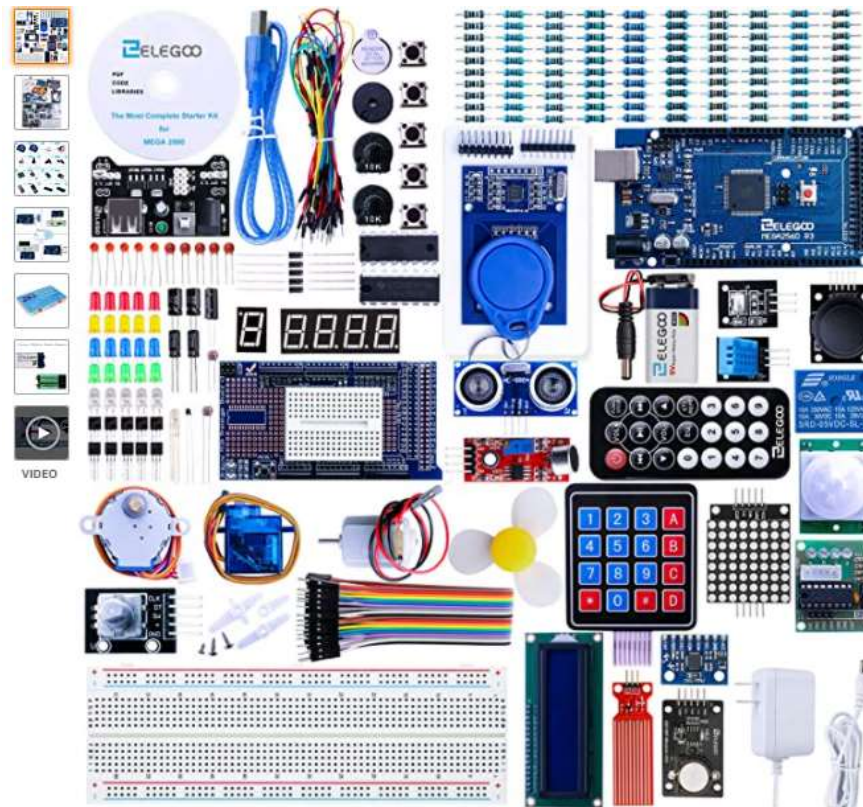
- Turn on your system sound to hear the streaming presentation.
- If you have technical problems, click “Help” or submit a question asking for assistance.
- Participate in ‘Group Chat’ by maximizing the chat widget in your dock.



## Don Wilcher

Visit 'Lecturer Profile' in your console for more details.

Course Kit:  
The ELEGOO Mega 2560 Project: The Most Complete Starter Kit w/Tutorial



## Course Components:

**ELEGOO UNO R3 2.8 Inches TFT Touch  
Screen with SD Card Socket w/All  
Technical Data in CD for Arduino UNO R3**

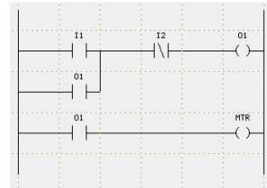


**TWTADE SSR-40 DD 40A DC  
3-32V to DC 5-60V SSR Solid  
State Relay + Heat Sink**



## Agenda:

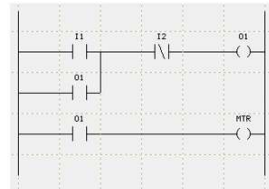
- HMI Basics
- HMI Applications
- Firmata
- Lab Project: Firmata – HMI Controller



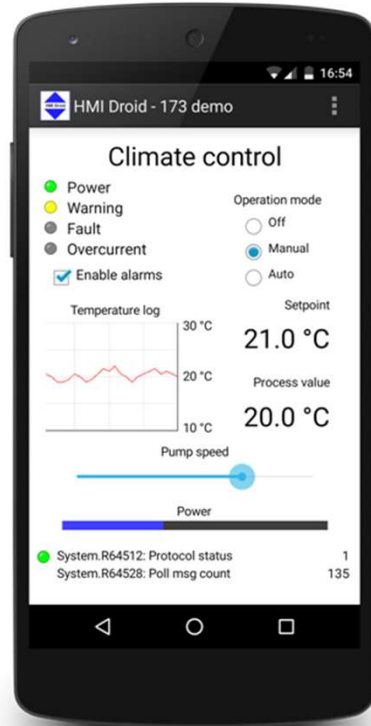
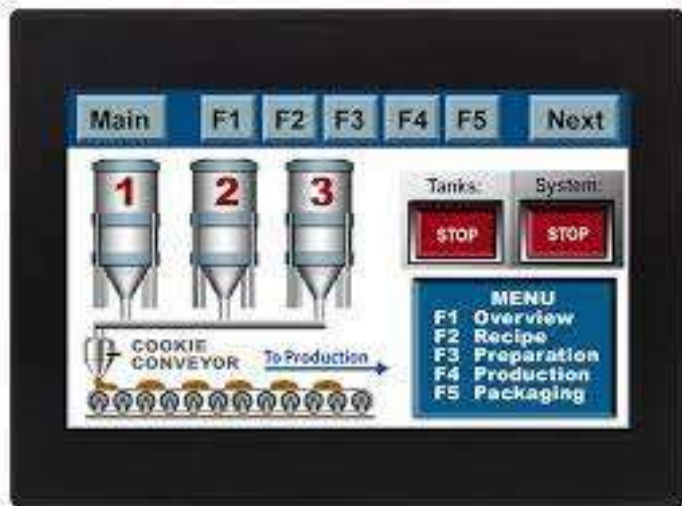
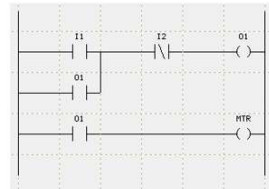
## HMI Basics

The Human Machine Interface (HMI) is:

- the interface between the processor machine and the operator.
- an operator's dashboard.
- the primary tool operators and line supervisors use to coordinate and control industrial and manufacturing processes and machines.
- used to display easily-understandable, real-time operational information.
- to help managers and supervisors improve the process by providing historical and trending data on machine efficiency or product quality.



# HMI Basics. . .





## Question 1

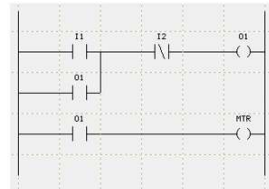
**The Human Machine Interface (HMI) is the primary tool managers and line supervisors use to coordinate industrial and manufacturing processes and machines.**

- a) True**
- b) False**



# Create Your HMI Layouts!

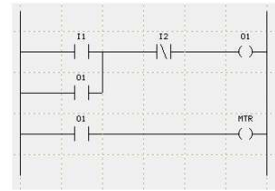
## HMI Basics . . .

| Lay... | Object Type | Object Name | Width | Height | Top | Left |
| --- | --- | --- | --- | --- | --- | --- |
| 1 | Volume Control | VolumeControl1 | 120 | 80 | 350 | 460 |
| 2 | Pushbutton | Pushbutton1 | 50 | 50 | 360 | 280 |
| 3 | Indicator Light | IndicatorLight1 | 50 | 50 | 360 | 370 |
| 4 | Analog Meter | AnalogMeter1 | 410 | 260 | 60 | 200 |

Source: Automation Direct [https://www.automationdirect.com/c-more/software/project\\_simulator](https://www.automationdirect.com/c-more/software/project_simulator)

# Create Your HMI Layouts!

## HMI Basics. . .



Simulation

Screen List

1 - Screen 1

Tag List

Tag Name	PLC Address	Data Type	Value
SYS COUNTMAX		Signed int 32	0
SYS USER LED ...		Discrete	OFF

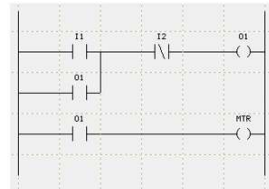
C-more Simulation

# HMI Design/Simulation Software

## HMI Basics. . .

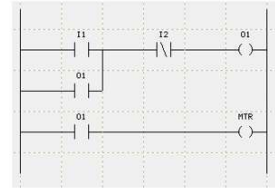
The Human Machine Interface (HMI) :

- is connected to an individual PLC.
- Is connected to an industrial controls network communication fieldbus.
- Screen can have just a few pushbuttons and a couple of text lines
- is used to change the operating modes:
  - a) can monitor data
  - b) can collect data



# Create Your HMI Layouts!

## HMI Basics. . .



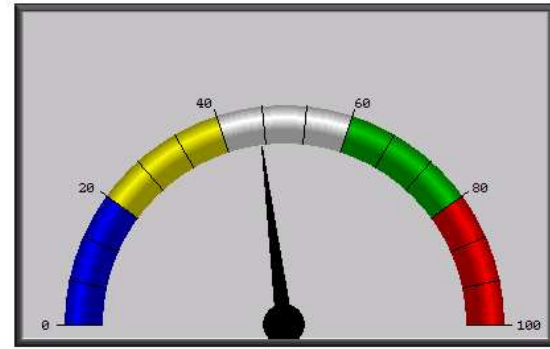
Simulation

Screen List

1 - Screen 1

Tag List

Tag Name	PLC Address	Data Type	Value
SYS COUNTMAX		Signed int 32	46
SYS TIME MM		Unsigned int 16	34
SYS USER LED ...		Discrete	OFF



Displayed Text



## Question 2

**The Human Machine Interface (HMI) is connected to several computers.**

- a) False**
- b) True**

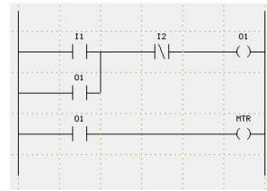
## HMI Applications

**HMIs can be found in multiple locations.**

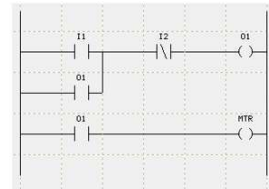
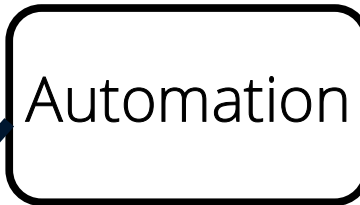
- a) portable handheld devices,
- b) on machines
- c) centralized control rooms
- d) factory floor machine and process control.

**Applications include:**

- a) industrial
- b) building automation
- c) medical
- d) automotive
- e) appliances



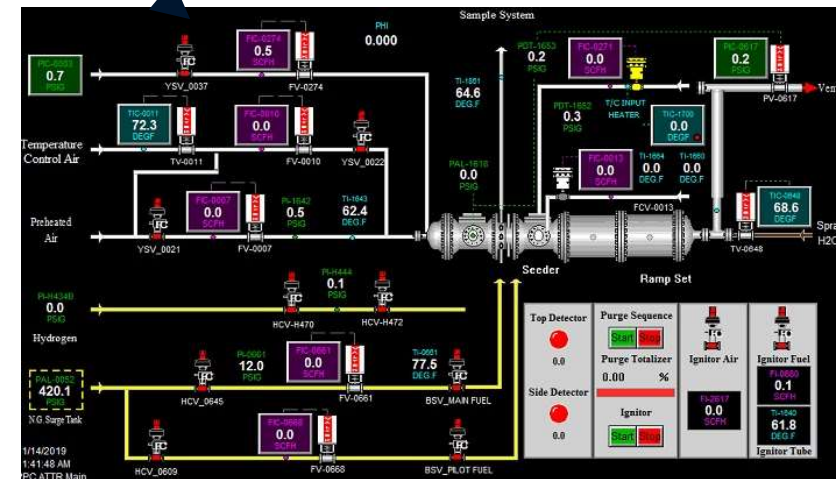
# HMI Applications. . .



Operations



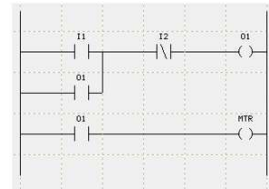
Processes





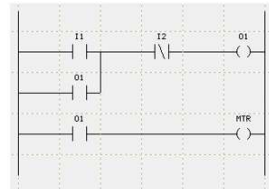
## HMI Applications. . .

HMI - Automation Use Case:  
How can an HMI be use with a PLC?

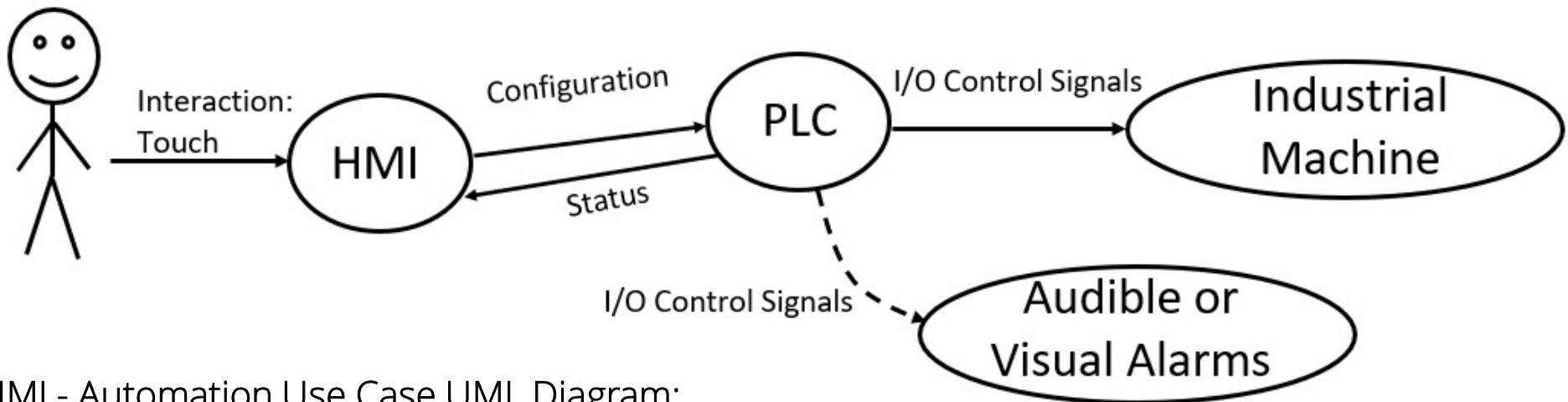


## HMI Applications. . .

HMI - Automation Use Case:  
How can an HMI be use with a PLC?



Actor: Operator



HMI - Automation Use Case UML Diagram:  
UML=Unified Modeling Language



## Question 3

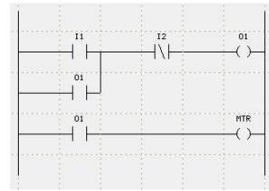
**The reviewing slide 18 which device is extended from the PLC.**

- a) The Actor**
- b) PLC**
- c) Industrial Machine**
- d) Audible or Visual Alarms**

## Firmata

### What is Firmata?

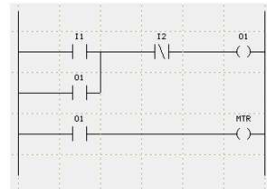
- A generic protocol for communicating with microcontrollers.
  - a) uses host computer
  - b) software installed on host computer
- Allows controlling an Arduino from a host computer.
- Based on Musical Instrument Digital Interface (MIDI)
  - a) command bytes are 8bits
  - b) data bytes are 7bit



## Firmata

### MIDI Message Types and format

type	command	MIDI channel	first byte	second byte
analog I/O message	0xE0	pin #	LSB(bits 0-6)	MSB(bits 7-13)
digital I/O message	0x90	port	LSB(bits 0-6)	MSB(bits 7-13)
report analog pin	0xC0	pin #	disable/enable(0/1)	- n/a -
report digital port	0xD0	port	disable/enable(0/1)	- n/a -
start sysex	0xF0			
set pin mode(I/O)	0xF4		pin # (0-127)	pin mode
set digital pin value	0xF5		pin # (0-127)	pin value(0/1)
sysex end	0xF7			
protocol version	0xF9		major version	minor version
system reset	0xFF			



## Firmata . . .

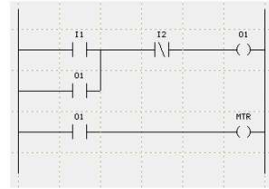
MIDI Message Types and format:

Control Expansion: Set pin mode

```
0 set digital pin mode (0xF4) (MIDI Undefined)
1 set pin number (0-127)
2 mode (INPUT/OUTPUT/ANALOG/PWM/SERVO/I2C/ONEWIRE/STEPPER/ENCODER/SERIAL/PULLUP, 0/1/2/3/4/6/7/8/9/10/11)
```

Control Expansion: Set digital pin value

```
0 set digital pin value (0xF5) (MIDI Undefined)
1 set pin number (0-127)
2 value (LOW/HIGH, 0/1)
```





## Question 4

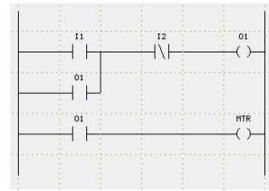
**Firmata is based on Musical Instrumentation Digital Interaction.**

- a) True**
- b) False**

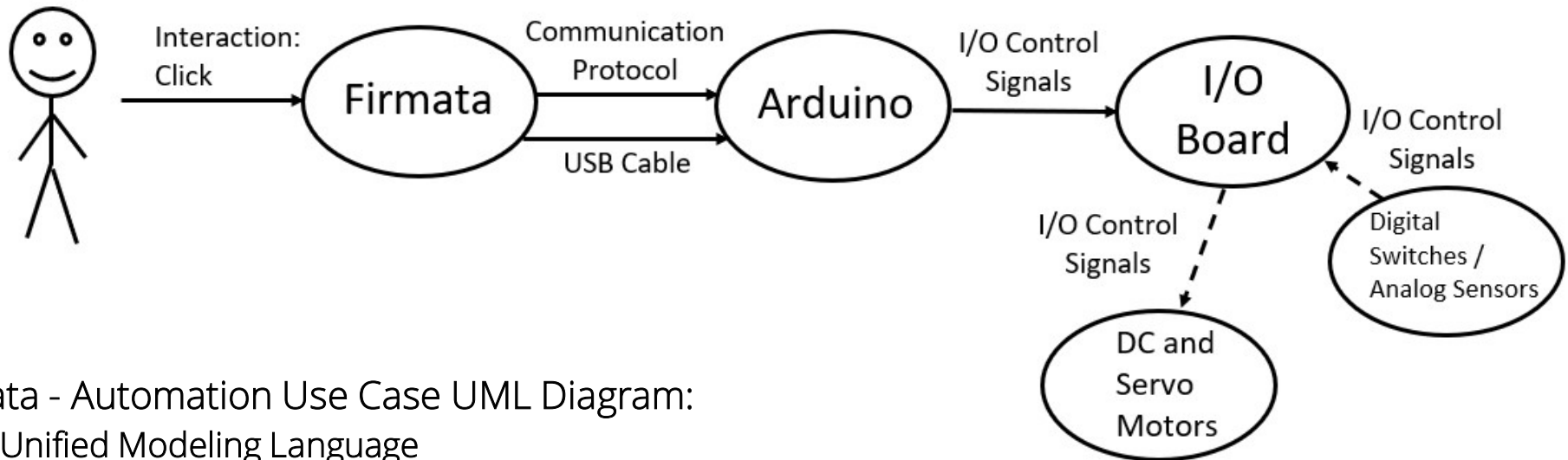
# Lab Project: Firmata – HMI Controller

## Firmata-HMI Controller Use Case

How can Firmata work as an HMI?



Actor: Operator

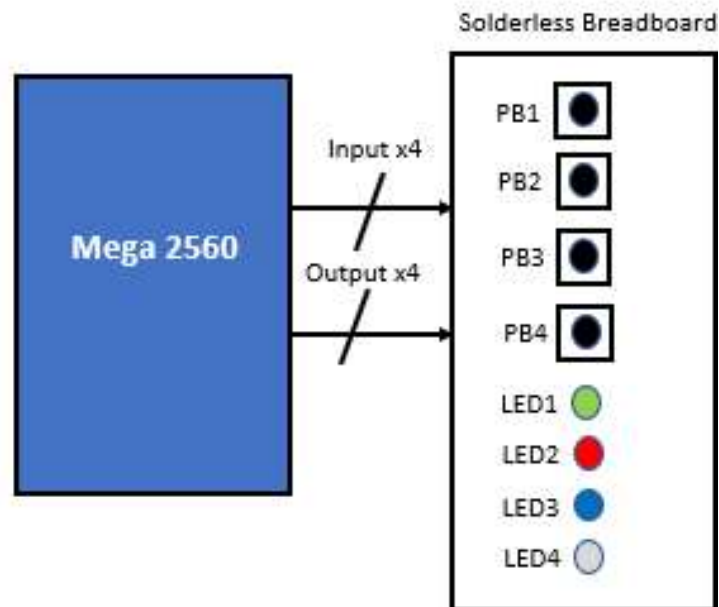
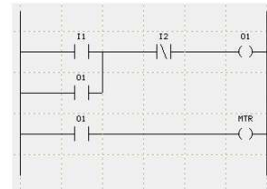


Firmata - Automation Use Case UML Diagram:  
UML=Unified Modeling Language



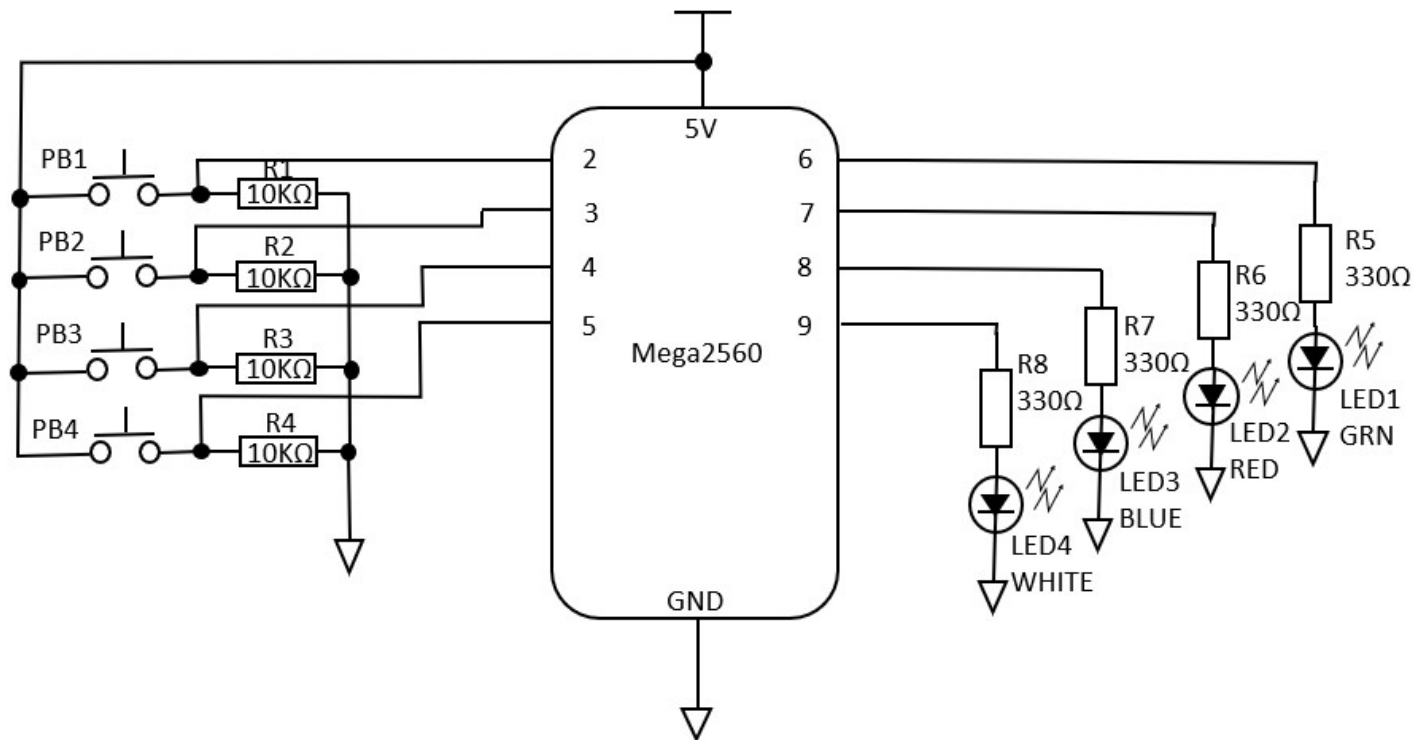
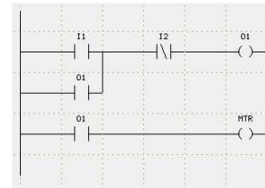
## Lab Project: Firmata – HMI Controller. . .

### Lab Project: Firmata – HMI Controller Functional Block Diagram



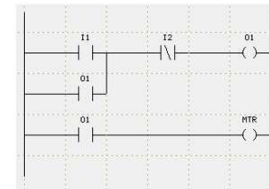
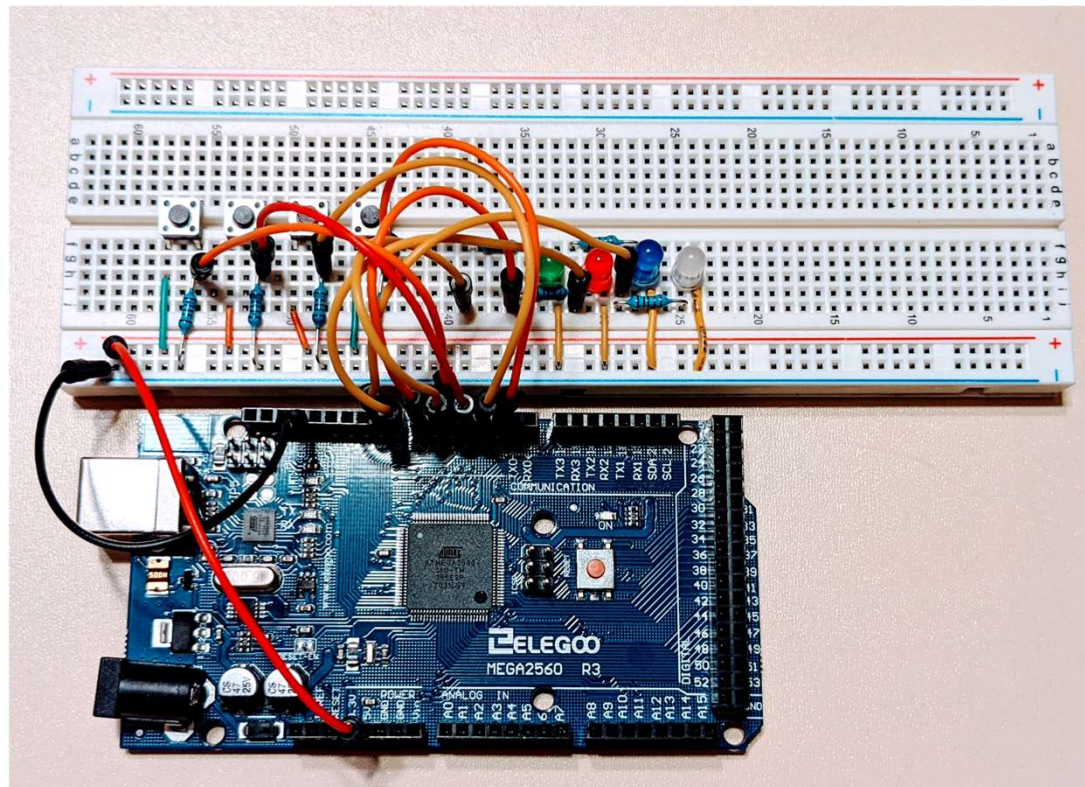
# Lab Project: Firmata – HMI Controller. . .

## Circuit Schematic Diagram



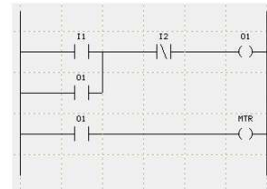
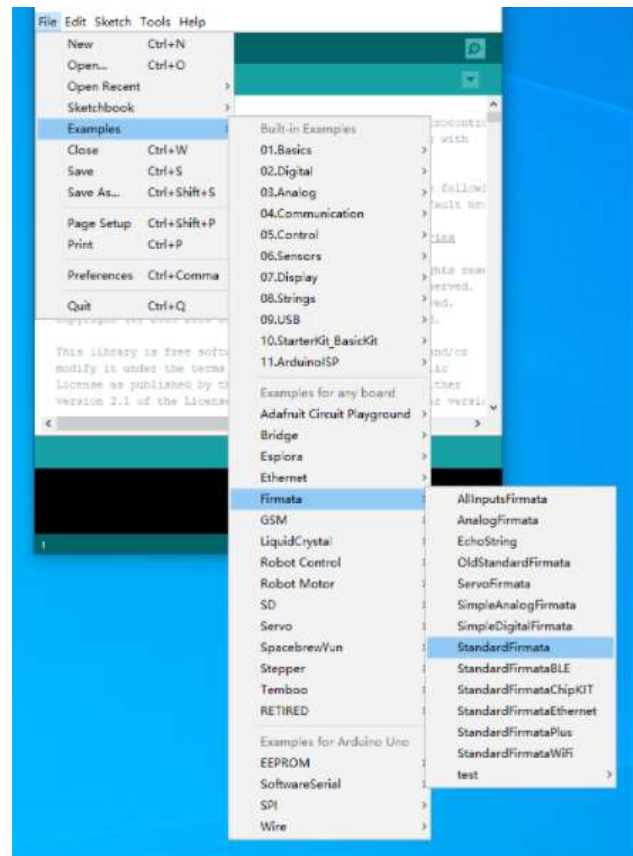
## Lab Project: Firmata – HMI Controller. . .

Actual Wired  
Breadboard View



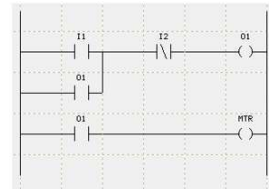
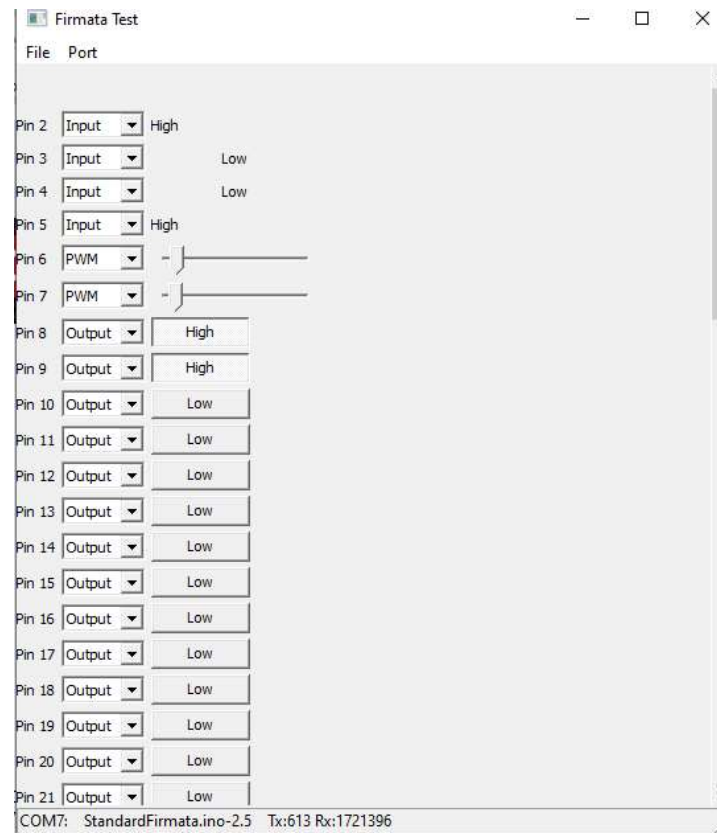
## Lab Project: Firmata – HMI Controller. . .

StandardFirmata  
Arduino Code



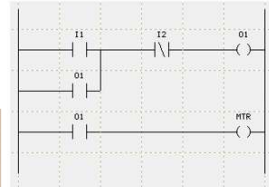
## Lab Project: Firmata – HMI Controller. . .

Firmata Test  
Application: aka HMI

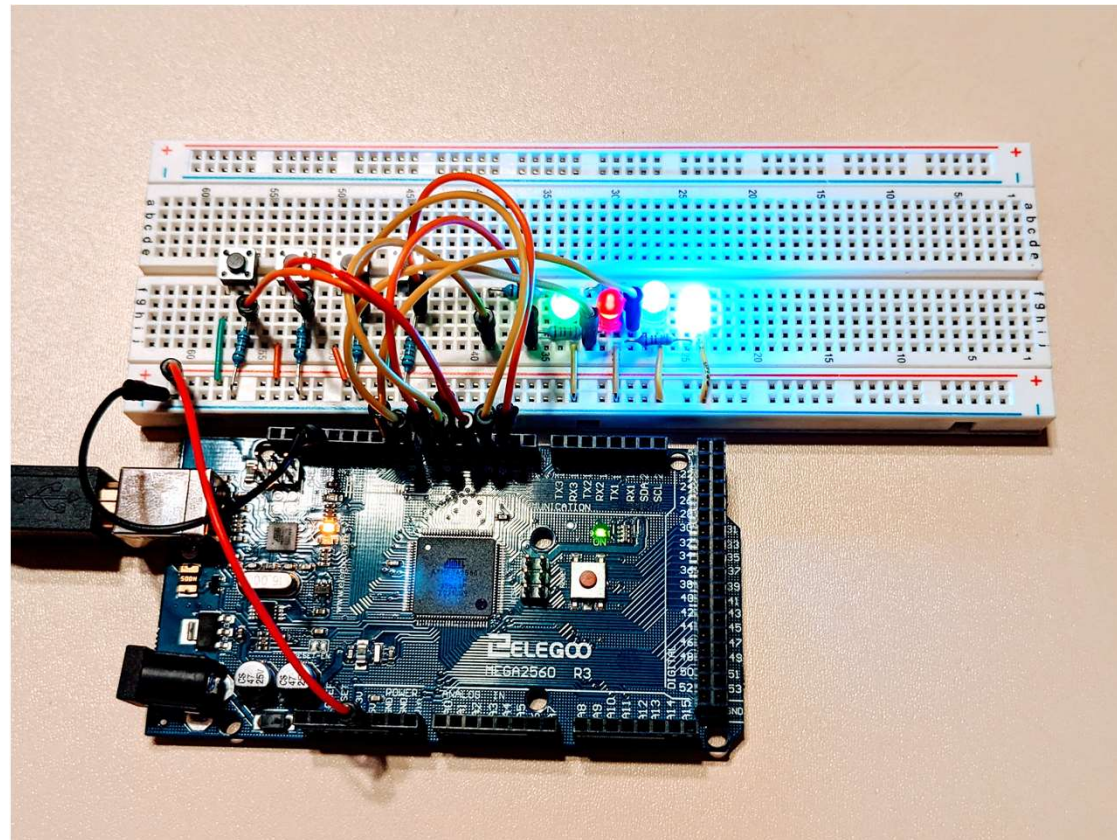


Source: Firmata Test Application:  
[http://firmata.org/wiki/Main\\_Page](http://firmata.org/wiki/Main_Page)

## Lab Project: Firmata – HMI Controller. . .



Functional Firmata-  
HMI Controller





## Question 5

**In reviewing slide 29, what version of Standard Firmata is being implemented?**

- a) 5**
- b) 4**
- c) 2.5**
- d) None of the Above**

## Thank you for attending

Please consider the resources below:

- Automation Direct.  
[https://www.automationdirect.com/c-more/software/project\\_simulator](https://www.automationdirect.com/c-more/software/project_simulator)
- Firmata  
<https://github.com/firmata/protocol>
- Firmata Test Application  
[http://firmata.org/wiki/Main\\_Page](http://firmata.org/wiki/Main_Page)





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