

Final Report

Group: 1

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Section: 02

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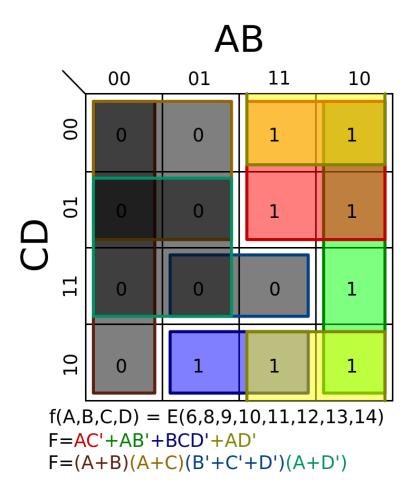
2 Question answer

Question

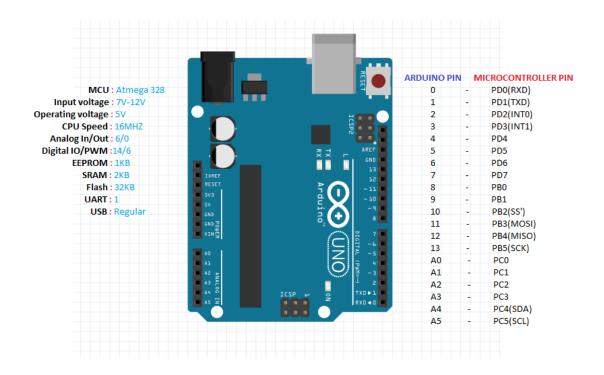
Implement the given encryption table using microcontroller. Use single pole, double throw switch to configure the inputs for high and low conditions. Use LEDs to represent the corresponding output statuses

Inp	ut			Out	put		
I 3	l 2	 1	I 0	O 3	O 2	O 2	O 1
0	0	0	0	1	1	0	1
1	0	0	0	1	1	1	0
0	1	0	0	0	1	1	0
1	1	0	0	1	0	1	0
0	0	1	0	1	0	1	0
1	0	1	0	0	0	0	1
0	1	1	0	0	1	1	0
1	1	1	0	0	0	1	1
0	0	0	1	1	1	0	0
1	0	0	1	0	0	1	1
0	1	0	1	1	1	0	0
1	1	0	1	0	0	0	1
0	0	1	1	1	0	1	1
1	0	1	1	0	0	1	1
0	1	1	1	1	1	1	0
1	1	1	1	1	0	0	0

Hints for deriving the logic expression:



Example microcontroller: (Arduino UNO)



Main Objective

The main objective of the project is to Implement the given encryption table using microcontroller. We will be using single pole, double throw switch to configure the inputs for high and low conditions and Use LEDs to represent the corresponding output statuses. Following this we will code the encryption table in three different arduino boards and compare the power consumption between the three boards.

Methodology

- Step 1: Derivation of equations from truth table using k-maps.
- Step 2: Draw the logic circuit in Logisim.
- Step 3: Code the expression in Arduino IDE.
- Step 4: Generate the hex file.
- Step 5: Draw the circuit in Proteus.
- Step 6: Repeat for three different board.
- Step 7: Burn the hex file and see the operation.
- Step 7: Use digital multimeter to measure current.
- Step 8: Use P=VCC*Current to calculate the power consumption by each board and compare.

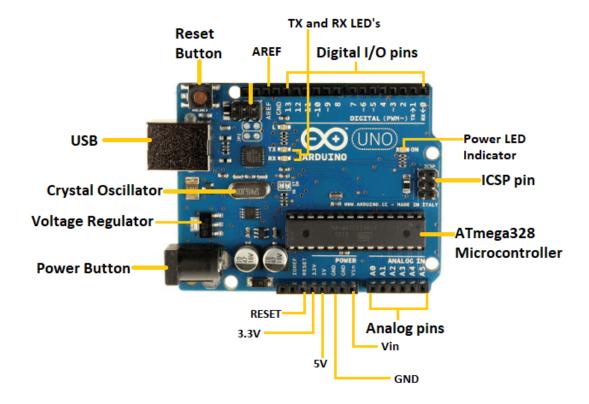
1. General Description

1.1 Arduino UNO

The Arduino UNO is a standard board of Arduino. Here UNO means 'one' in Italian. It was named as UNO to label the first release of Arduino Software. It was also the first USB board released by Arduino. It is considered as the powerful board used in various projects. Arduino UNO is based on an ATmega328P microcontroller. It is easy to use compared to other boards, such as the Arduino Mega board, etc. The board consists of digital and analog Input/Output pins (I/O), shields, and other circuits.

The Arduino UNO includes 6 analog pin inputs, 14 digital pins, a USB connector, a power jack, and an ICSP (In-Circuit Serial Programming) header. It is programmed based on IDE, which stands for Integrated Development Environment. It can run on both online and offline platforms.

The IDE is common to all available boards of Arduino.



1.2 Arduino IDE

It is an open source Arduino Software(IDE) where it's easier to write code and upload it to the board. It can be used with any Arduino board.

1.3 Proteus 8 Pro

The Proteus Design Suite is a proprietary software tool suite used primarily for electronic design automation. The software is used mainly used to create schematics and electronic prints for manufacturing printed circuit boards.

1.4 Logisim

Logisim is a tool for designing and simulating digital logic circuits. With its simple toolbar interface and simulation of circuits as you build them, it is simple enough to facilitate learning the most basic concepts related to logic circuits. It has the capacity to build larger circuits from smaller sub circuits, and to draw bundles of wires with a single mouse drag, Logisim can be used (and is used) to design and simulate entire CPUs for educational purposes.

2. Equipment

Hardware

- Arduino UNO
- Breadboard
- Resistors
- Wires
- Switch
- Red LED

Software

- Proteus 8 Professional Software
- Arduino IDE
- Logisim

3. Method of Derivation

3.1 Truth Table

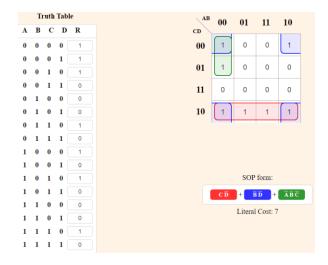
13	I 2	I1	10	О3	02	01	00
0	0	0	0	1	1	0	1
1	0	0	0	1	1	1	0
0	1	0	0	0	1	1	0
1	1	0	0	1	0	1	0
0	0	1	0	1	0	1	0
1	0	1	0	0	0	0	1
0	1	1	0	0	1	1	0
1	1	1	0	0	0	1	1
0	0	0	1	1	1	0	0
1	0	0	1	0	0	1	1
0	1	0	1	1	1	0	0
1	1	0	1	0	0	0	1
0	0	1	1	1	0	1	1
1	0	1	1	0	0	1	1
0	1	1	1	1	1	1	0
1	1	1	1	1	0	0	0

I3,I2.I1,I0=Input

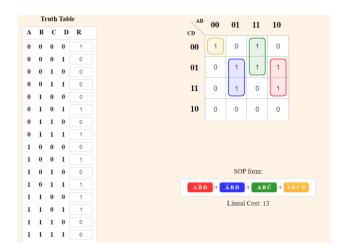
03,02,01,00=Output

3.2 Derived Result

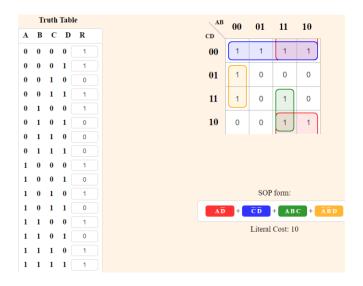
Kmaps



00=I0I1'I3+I0'I1I3+I0I1I2'+I0'I1'I2'I3'



01=I1I3'+I0'I2+I1'I2'I3+I0I2'I3



02=I2I3'+I1'I3'+I0'I1'I2'



O3=I2'I3'+I0I3'+I0'I1'I3+I0I1I2

Kmap Expressions

00=1011'13+10'1113+101112'+10'11'12'13'

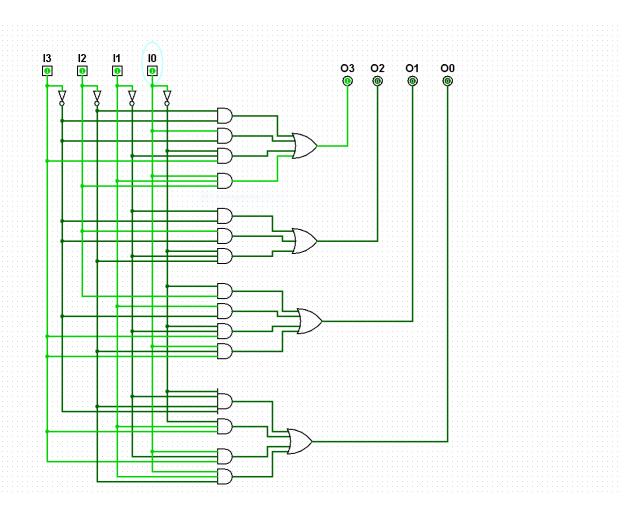
01=I1I3'+I0'I2+I1'I2'I3+I0I2'I3

02=I2I3'+I1'I3'+I0'I1'I2'

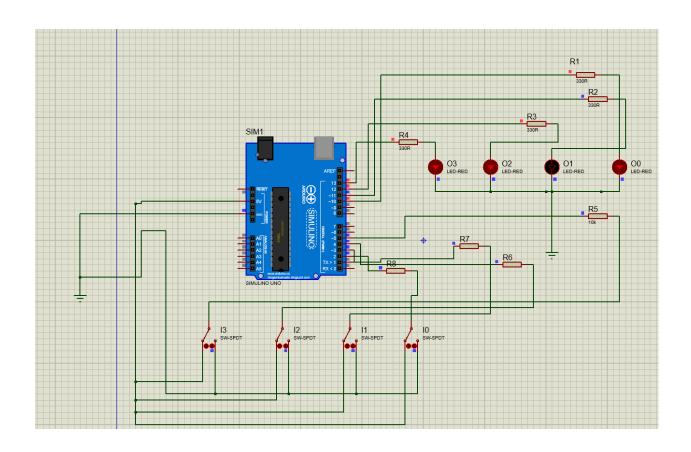
O3=I2'I3'+I0I3'+I0'I1'I3+I0I1I2

4. Circuit Diagram with Values of Electrical Components

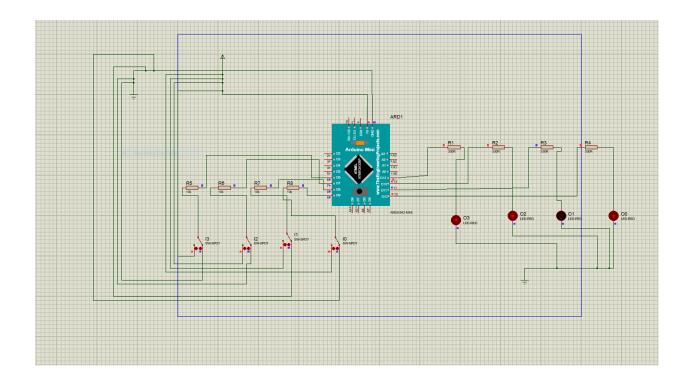
4.1 Logisim Circuit



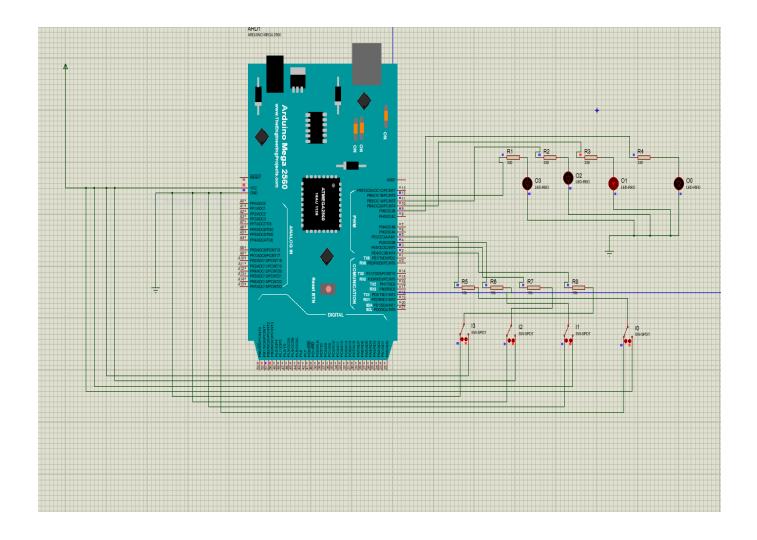
SIMULINO UNO



Arduino Pro mini



Arduino Mega 2560



Circuit Operation Principles

Firstly, the encryption table provided was solved using Karnaugh Map and we got 4 different equations for 4 outputs O0, O1, O2, O3

The equations are:

```
O0 = I3' I2' I1' I0' + I2' I1 I0 + I3 I1' I0 + I3 I1 I0'
O1 = I3' I1 + I2 I0' + I3 I2' I1' + I3 I2' I0
O2 = I3' I1' + I2' I1' I0' + I3' I2
O3 = I3' I2' + I3' I0 + I2 I1 I0 + I3 I1' I0'
```

Secondly, these equations were used to design the Circuit Diagram in Logisim.

Thirdly, using Proteus 8 Professional Software we built our main Hardware Circuit using three different Arduino boards.

We have used the following components:

1. **Arduino Uno, Arduino Pro mini, Arduino Mega:** Used three different Arduino boards as the microcontroller

We connected the power supply of 5V and the ground pin of the Arduino boards to a Ground component.

- 2. **Resistors:** We have used 8 resistors in total. We have used 330 ohm resistors for connection with the LEDs and 10k ohm resistors with the SP-DWT Switches.
- 3. **Single Pole Double Throw Switches:** We used four of these Switches with our Arduino Digital pins.

They are arranged in such a way for Arduino Uno

For the other two boards the arrangement is same according to the Digital Pins they are connected with.

4. **LEDs:** We have connected Four LEDs to the Digital Pins of Arduino boards for output. They are arranged in the following order:

```
Arduino UNO Digital Pin No. 10 ------ LED1 (00)
Arduino UNO Digital Pin No. 11 ------ LED2 (01)
Arduino UNO Digital Pin No. 12 ----- LED3 (02)
Arduino UNO Digital Pin No. 13 ----- LED4 (03)
```

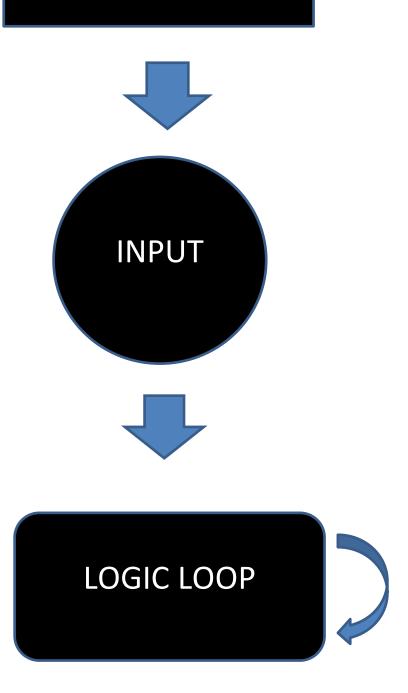
For the other two boards the arrangement of LED's is same according to the Digital Pins they are connected with.

After making the whole circuit we loaded the arduino code for each of the board and simulated the circuit.

Arduino Code:

We used Arduino IDE to write the Arduino code by using the K-maps equations we got and then generate the hex file and load it into the circuit in Proteus.





Arduino Program

```
Arduino Uno
int I0 = 2; //Input pins connected to digital pin
int I1 = 3;
int I2 = 4;
int I3 = 5;
int O0=10; //Output pins connected to digital pin
int O1=11;
int O2=12;
int O3=13;
void setup() {
 pinMode(I0,INPUT); //Sets I0,I1,I2,I3 as INPUT
 pinMode(I1,INPUT);
 pinMode(I2,INPUT);
 pinMode(I3,INPUT);
 pinMode(O0,OUTPUT); //Sets output pins as OUTPUT
 pinMode(O1,OUTPUT);
 pinMode(O2,OUTPUT);
```

```
pinMode(O3,OUTPUT);
}
void loop() {
 boolean IOState = digitalRead(I0); //Reads input pins
 boolean I1State = digitalRead(I1);
 boolean I2State = digitalRead(I2);
 boolean I3State = digitalRead(I3);
 boolean OOState;
 boolean O1State;
 boolean O2State;
 boolean O3State;
O0State= (!I3State & !I2State & !I1State & !I0State)|(!I2State & I1State &
IOState)|(I3State & !I1State & I0State)|(I3State & I1State& !I0State);
//Setting the kmap equations for each output pins
O1State= (!I3State & I1State)|(I2State & !I0State)|(I3State & !I2State &
!I1State)|(I3State & !I2State & I0State);
O2State= (!I3State & !I1State)|(!I2State & !I1State & !I0State)|(!I3State &
I2State);
O3State= (!I3State & !I2State)|(!I3State & I0State)|(I2State & I1State &
IOState)|(I3State & !I1State & !I0State);
```

```
digitalWrite(O0,O0State); //lighting of the LED's
digitalWrite(O1,O1State);
digitalWrite(O2,O2State);
digitalWrite(O3,O3State);
```

}

Hex File

			00000000	OC.	94	61	00 0	ac 0.	1 72	00	90	04 7	2 /	0 0	0.4	72	00	
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Data Ins	spector (Little-endian)	-	00000030	0C	94	73		9C 94 9C 94						00 00			00	.ösösösös.
Туре	Unsigned (+) Sign	ed (±)	00000040 00000050	0C	94 94	26 73		9C 94 9C 94						00 00			00	.ö&ösösös.
8-bit Integer	12 12	(-)	00000060	0C	94	73		9C 94						0 24			00	.ösös\$.'.
			00000070	2A	00	00	00 0	90 00	25	00	28	00 2	В 6	0 00	00	00	00	*%.(.+
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24-bit Integer	6394892 639489		00000090	02	02 80	02 01		93 03 94 08)2 04)8 10			20	00
32-bit Integer	6394892 639489	92	000000A0 000000B0	00	08	00		94 08 91 00						00 00			00	@Ç
64-bit Integer (+)	32532401588638732		000000C0	00	00	11		LF BE						F CI			E0	\$1±∩+α ⊩1-1!α
64-bit Integer (±)	32532401588638732		000000D0	AΘ	E0	В1	E0 6	91 C	1D	92	A9 :	30 B	2 6	7 E	L F7	0E	94	áα∭α. L.Æ⊢0∭.ß≈.ö
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32-bit Float. P.	8.9611523e-39		000000F0	81 C9	30 F0	99 84		32 30 31 F4				95 8 00 8		0 A9			30 91	ü0Ö≡é0-≡.òç0-≡ê0
64-bit Float. P.	1.742527264393204e-30	16	00000100 00000110	80	00	8F		30 93 31 F2						D 03			BD	r≡ä0∭∫ÇæÇ.Å}. LÇæ Ç.ÅwÇôÇòä⊨Åwä∐
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LEB128 (±)	12		00000130	В0	00	08	95 8	80 93	L B0	00	8F	7D F	9 (F CI	93	DF	93	\\òÇæ\\.Å}• <u></u> d•ô•ô
MS-DOS DateTime	1980-03-01 18:32:24 Loca		00000140	28	2F	30		F9 0:						1 F9			56	(/0α·.ΓU Oäæ·.μV
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Data In:		 ned (±)	00000280 00000290	A1 A0	1D 93	B1 07	1D 2	20 93 B0 93	3 04 3 08	01 01	80 80	93 0 91 0)5 ()0 ()1 90)1 90	9 93 9 91	06 01	01 01	í.∭. ôÇôÉô áô∥ôÇæÉæ
			00000280 00000290 000002A0	A1 A0 A0	1D 93 91	B1 07 02	1D 2 01 E	20 93 B0 93 B0 93	3 04 3 08 1 03	01 01 01	80 80 01	93 0 91 0 96 A)5 ()0 ()1 1	01 90 01 90 ID B	93 91 L 10	06 01 80	01 01 93	í.∭. ôÇôÉô áô∥ôÇæÉæ áæ∥æûí.∭.Çô
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Type 8-bit Integer 16-bit Integer	Unsigned (+) Sign 12 12 37900 -27636	92	00000280 00000290 000002A0 000002B0 000002C0 000002D0 000002E0	A1 A0 A0 00 AF 1F 78	1D 93 91 01 91 90 94	B1 07 02 90 9F 18	1D 2 01 B 01 B 93 C 91 B 95 2 B5 8	20 93 80 93 80 93 91 03 8F 93 26 E8	3 04 3 08 1 03 1 A0 1 3F 3 23 9 84	01 01 01 93 91 0F BD	80 80 01 02 2F 02 84	93 0 91 0 96 A 01 B 91 0 96 A B5 8	05 6 00 6 11 1 80 9 11 1 81 6	01 90 01 90 1D B: 03 03 00 01 1D B:	9 93 9 91 1 10 3 91 5 BE 1 10	06 01 80 BF 0F D2 85	01 01 93 91 90 CF B5	í
Type 8-bit Integer 16-bit Integer 24-bit Integer	Unsigned (+) Sign 12 12 37900 -27636 6394892 639488	92	00000280 00000290 000002A0 000002B0 000002C0 000002D0 000002E0 000002F0	A1 A0 A0 00 AF 1F 78 82	1D 93 91 01 91 90 94 60	B1 07 02 90 9F 18 84 85	1D 2 01 E 01 E 93 G 91 8 95 2 B5 8 BD 8	20 93 80 93 80 93 91 03 8F 93 26 E8 82 60 885 B8	3 04 3 08 1 03 1 A0 1 3F 8 23 9 84 5 81	01 01 01 93 91 0F BD 60	80 80 01 02 2F 02 84 85	93 0 91 0 96 A 01 B 91 0 96 A B5 8	05 6 00 6 11 1 80 9 11 1 81 6	01 90 01 90 1D B: 03 03 00 01 1D B: 60 84	9 93 9 91 1 10 8 91 8 91 8 BE 1 10 4 BC	06 01 80 BF 0F D2 85	01 93 91 90 CF B5 60	1
Type 8-bit Integer 16-bit Integer 24-bit Integer 32-bit Integer	Unsigned (+) Sign 12 12 37900 -27636 6394892 639489 6394892 639489	92	00000280 00000290 000002A0 000002B0 000002C0 000002D0 000002E0 000002F0 00000300	A1 A0 A0 00 AF 1F 78 82 80	1D 93 91 01 91 90 94 60 93	B1 07 02 90 9F 18 84 85 6E	1D 2 01 F 01 F 93 0 91 8 95 2 B5 8 BD 8	20 93 80 93 80 93 91 03 8F 93 26 E8 82 60 85 B8	3 04 3 08 1 03 1 A0 1 3F 3 23 9 84 5 81 2 81	01 01 93 91 0F BD 60	80 80 01 02 2F 02 84 85 80	93 0 91 0 96 A 01 B 91 0 96 A B5 8 BD 8	05 6 00 6 11 1 80 9 11 1 81 6 80 9	01 90 01 90 1D B3 03 03 00 01 1D B3 60 84 91 61	9 93 9 91 1 10 3 01 5 BE 1 10 4 BC 2 66	06 01 80 BF 0F D2 85 81	01 93 91 90 CF B5 60 93	1
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Type 8-bit Integer 16-bit Integer 24-bit Integer 32-bit Integer 64-bit Integer (+) 64-bit Integer (±) 16-bit Float. P.	Unsigned (+) Sign 12 12 37900 -27636 6394892 6394892 6394892 6394893 32532401588638732 32532401588638732 -0.0009880066	92	00000280 00000290 000002A0 000002B0 000002C0 000002D0 000002E0 000002F0 00000310	A1 A0 A0 00 AF 1F 78 82 80 81	1D 93 91 01 91 90 94 60 93	B1 07 02 90 9F 18 84 85 6E 80	1D 2 01 E 01 E 93 G 91 S 95 2 BD S 60 2 91 S 93 S	20 93 80 93 80 93 91 03 8F 93 82 66 82 66 85 83 10 93	3 04 3 08 1 03 1 A0 1 3F 3 23 9 84 5 81 2 81 9 80	01 01 93 91 0F BD 60 00 60	80 80 01 02 2F 02 84 85 80 80 B1	93 6 91 6 96 A 01 B 91 6 96 A B5 8 BD 8 91 8 93 8	05 6 00 6 11 1 80 9 11 1 81 6 81 6 81 6	01 90 01 90 1D B3 03 03 00 01 1D B3 60 84 91 61 00 80	9 93 9 91 1 10 8 91 1 10 4 BC 5 96 9 91 9 93	06 80 BF 0F D2 85 81 80 80	01 93 91 90 CF B5 60 93 00	1 ô Çô Eô
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Type 8-bit Integer 16-bit Integer 24-bit Integer 32-bit Integer 64-bit Integer (+) 64-bit Integer (±) 16-bit Float. P. 32-bit Float. P. 64-bit Float. P.	12 12 37900 -27636 6394892 6394892 6394892 6394893 32532401588638732 32532401588638732 -0.0009880066 8.9611523e-39 1.742527264393204e-30	92	00000280 00000290 000002A0 000002E0 000002E0 000002E0 000002E0 00000310 00000310 00000330 00000330 00000340	A1 A0 A0 00 AF 1F 78 82 80 81 81 80 80 7A	1D 93 91 01 91 90 94 60 93 00 60 91 93 00	B1 07 02 90 9F 18 84 85 6E 80 80 B0 7A	1D 2 01 8 91 8 95 2 B5 8 BD 8 00 2 91 8 93 8 00 8 60 8	20 93 80 93 80 93 91 03 88F 93 26 E8 82 66 85 83 10 93 81 00 81 60 88 93 88 93	3 04 3 08 1 03 1 A0 1 3F 3 23 9 84 5 81 9 81 9 80 9 80 1 7A 3 7A	01 01 93 91 0F BD 60 00 60 91 93 00	80 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	93 6 91 6 96 A 91 6 91 6 96 A 85 8 8D 8 91 8 93 8 90 8 90 8	05 6 00 6 11 1 130 9 141 1 151 6 153 1 164 6 165 9 165 9	01 90 01 90 1D Bi 03 03 00 01 1D Bi 00 82 00 80 00 80	93 93 93 91 1 1 1 1 1 1 1 1 1 1 1 1 1 1	066 011 800 BF 0F D2 85 81 80 80 81 84 80	01 93 91 90 CF B5 60 93 00 60 91	1
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Type 8-bit Integer 16-bit Integer 24-bit Integer 32-bit Integer 64-bit Integer (±) 64-bit Integer (±) 16-bit Float. P. 32-bit Float. P. 64-bit Float. P. LEB128 (±) MS-DOS DateTime	12 12 37900 -27636 6394892	92 92 92 966	00000280 00000290 000002A0 000002B0 000002E0 000002E0 000002E0 000003E0 00000310 00000320 00000330 00000340 00000350 00000350	A1 A0 A0 00 AF 1F 78 82 80 81 81 81 80 7A 7A 83	1D 93 91 91 90 94 60 93 00 60 91 93 00 00 E0	B1 07 02 90 9F 18 84 85 6E 80 80 7A 81 10 0E	1D : 01 01 01 01 01 01 01 01	20 93 880 93 931 03 932 66 882 66 883 66 938 93 948 93 95 95 96 95 97 97 97 97 97 97 97 97 97 97 97 97 97 9	3 04 3 08 1 03 1 A0 1 3F 3 23 8 44 5 81 2 81 9 80 9 80 1 7A 3 7A 6 60 6 60 6 60 6 1	01 01 93 91 0F BD 60 00 60 91 93 00 E0 E0	80 80 80 80 80 80 80 80 80 80 80 80 80 8	93 6 91 6 96 A 91 6 91 6 91 6 8 91 8 8 91 8 8 91 8 90 8 8 90 8 90 8 90 6 8 90 6 8 90 6 8	05 6 00 6 11 1 13 1 6 13 1 6 13 1 6 13 1 6 13 1 6 14 1 1 15 1 1 16 1 1 17 1 1 18 1	01 90 01 90 01 90 03 03 00 01 00 01 00 82 00 80 00 80	93 91 91 11 11 11 11 11 11 11 11 11 11 11	06 01 80 BF D2 85 81 80 80 80 60 60 61	01 93 91 90 CF B5 60 93 00 60 91 93 E0 E0	1
Type 8-bit Integer 16-bit Integer 24-bit Integer 32-bit Integer 64-bit Integer (+) 64-bit Integer (±) 16-bit Float. P. 32-bit Float. P. 64-bit Float. P. LEB128 (+) LEB128 (±)	12 12 37900 27636 6394892 6394892 6394892 6394892 6394892 6394892 6394892 6394892 6394892 6394892 6394893	92 92 92	00000280 00000290 000002A0 000002B0 000002C0 000002E0 000002E0 000003E0 00000310 00000340 00000340 00000350 00000350 00000370 00000380 00000380	A1 A0 A0 00 AF 1F 78 82 80 81 81 80 7A 7A 83 85 81 83	1D 93 91 91 90 94 60 93 00 60 91 93 00 E0 E0 E0	B1 07 02 90 9F 18 84 85 6E 80 80 7A 81 10 0E 0E 0E	1D : 10 1 10 1 10 1 10 1 10	20 9.5 9.6 9.6 9.6 9.6 9.6 9.6 9.6 9.6 9.6 9.6	3 044 3 08 1 03 1 A0 1 3F 3 23 8 24 8 25 8 81 1 7A 8 80 9 80 9 80 9 60 9 60 9 61 9 61 9 61 9 60	01 01 93 91 0F BD 60 00 60 91 93 00 E0 E0 E0 E0 E0	80 80 90 90 90 90 90 90 90 90 90 90 90 90 90	93 6 991 6 996 A 901 B 991 6 991 6 992 A 8 993 8 8 993 8 993 8 991 7 7 6 6 6 6 6 8 9 9 6 9 6 9 9 6 9 9 9 9 9 9	05 6 00 6 01 1 03 9 05 9 07 1 07 1 08 9 09 9	01 90 01 90 01 90 02 90 00 01 00 01 00 82 00 80 00 80	9 93 9 91 9 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	06 01 80 BF D2 85 81 80 80 81 84 80 60 61 61	01 93 91 90 CF B5 60 93 00 60 91 93 E0 E0 E0	1
Type 8-bit Integer 16-bit Integer 24-bit Integer 24-bit Integer 32-bit Integer (±) 64-bit Integer (±) 16-bit Float. P. 32-bit Float. P. 32-bit Float. P. 64-bit Float. P. LEB128 (±) MS-DOS DateTime UNIX 32-bit DateTime	Unsigned (+) Sign 12 12 37900 27636 6394892 6394892 6394892 32582401588638732 -0.0009880066 8.9611523e-39 1.742527264393204e-30 12 12 1980-03-0118:32:24 Local	92 92 92 06	00000280 00000290 000002A0 000002C0 000002C0 000002C0 000002C0 000003C0 00000310 00000310 00000340 00000350 00000350 00000360 00000380 00000380	A11 A00 000 AF 78 82 80 81 80 7A 7A 83 85 81 83 6C	1D 93 91 91 90 94 60 93 00 60 91 93 00 E0 E0 E0	B1 07 02 90 9F 18 84 85 6E 80 80 7A 81 10 0E 0E 0E BB	1D : 01 1 93 0 95 2 95 8 95 8 95 95 95 95	20 9.5 9.6 9.6 9.6 9.6 9.6 9.6 9.6 9.6 9.6 9.6	3 044 3 08 3 08 3 08 3 08 3 08 3 08 3 08	01 01 93 91 0F BD 60 00 60 91 93 00 00 E0 E0 E0 E0 2B	80 80 91 92 92 93 94 94 94 94 94 94 94 94 94 94 94 94 94	93 6 91 6 91 6 91 6 91 6 91 6 91 6 85 8 85 8 85 8 86 8 89 1 7 86 8 86 8 86 8 86 8 86 8 86 8 86 8 86	05 6 00 6 00 6 00 7 01 1 03 1 03 1 04 6 05 9 06 9 07 9	01 90 01 90 01 90 02 90 00 00 01 60 00 80 00 80	93 93 93 94 95 95 95 95 95 95 95 95 95 95 95 95 95	06 01 80 BF D2 85 81 80 80 81 84 80 60 61 61 9E	01 93 91 90 CF B5 60 93 00 60 91 93 E0 E0 E0 00 94	1 ô Çô Éò âô \ ô \ Çæ Çæ Eæ \ ô \ cô
Type 8-bit Integer 16-bit Integer 24-bit Integer 32-bit Integer 64-bit Integer (e) 64-bit Integer (g) 16-bit Float. P. 32-bit Float. P. 64-bit Float. P. LEB128 (e) MS-DOS DateTime OLE 2.0 DateTime	Unsigned (+) Sign 12 12 37900 -27636 6394892 639489 32532401588538732 -0.0009880066 8.9611523e-39 1.742527264393204e-30 12 12 1980-03-01 18:32.24 Loc 1899-12-30 00.00.00.00.00	92 92 96 96 96 90 90 90 90 90 90 90 90 90 90 90 90 90	00000280 00000290 000002A0 000002A0 000002C0 000002C0 000002E0 000003E0 00000330 00000330 00000350 00000360 00000380 00000380 000003B0	A11 A00 A00 AF 78 82 80 81 81 80 7A 7A 83 85 81 83 6C 9E	1D 93 91 01 90 94 60 93 00 60 91 93 00 E0 E0 E0 E0	B1 07 02 90 9F 18 84 85 6E 80 80 7A 10 0E 0E BB 7C	1D : 01 1 93 0 1 95 2 1 95 2 1 95 2 1 95 2 1 95 2 1 95 1 9	20 9:388 9:3	3 044 3 08 3 08 3 08 3 08 3 08 3 08 3 08	01 01 93 91 0F BD 60 00 60 91 93 00 E0 E0 E0 E0 E0 2B 2B	80 80 90 90 90 80 80 80 80 80 80 80 80 80 80 80 80 80	93 69 99 69 89 89 89 89 89 89 89 89 89 89 89 89 86 89 89 86 86 86 86 86 86 86 86 86 86 86 86 86	05 6 00 6 01 1 03 9 04 1 05 9 06 9 07 1 08 9 08 9	01 90 01 90 01 90 00 80 00 80	93 93 93 94 95 96 96 96 96 96 96 96 96 96 96 96 96 96	80 80 87 87 88 80 81 80 80 81 80 80 80 60 61 61 9E 9E 9E	01 93 91 90 CF B5 60 93 00 60 91 93 E0 E0 E0 00 94	1
Type 8-bit Integer 16-bit Integer 24-bit Integer 32-bit Integer 64-bit Integer (+) 64-bit Integer (±) 16-bit Float. P. 32-bit Float. P. 64-bit Float. P. LEB128 (+) LEB128 (±) MS-DOS DateTime UNIX 32-bit DateTime Macintosh HFS DateTime Macintosh HFS	Unsigned (+) Sign 12 12 37900 -27636 6394892 639489 6394892 639489 32532401588638732 -0.009880066 8.9611523e-39 1.742527264393204e-30 12 12 1980-03-01 18:32-24 Loc 1899-12-30 00:00.00.00 1970-03-16 00:21:32 UTC 1970-03-16 00:21:32 UTC	992 992 996 996 997 998 998 998 998 998 998 998 998 998	00000280 00000290 000002A0 000002C0 000002C0 000002E0 000002E0 00000310 00000310 00000330 00000340 00000350 00000360 00000380 00000380 00000380 00000380 00000380 00000380	A11 A00 A00 AF 78 82 80 81 81 80 7A 7A 83 85 81 83 6C 9E	1D 93 91 91 90 94 60 93 00 60 91 93 00 E0 E0 E0 E0 00 00	B1 07 02 90 9F 18 84 85 6E 80 80 7A 81 10 0E 0E 0E BB 7C 4C	1D : 01 1 93 0 1 95 2 1 95 2 1 95 2 1 95 2 1 95 2 1 95 1 9	20 9.5 9.6 9.6 9.6 9.6 9.6 9.6 9.6 9.6 9.6 9.6	3 044 3 088 3 098	01 01 93 91 0F BD 60 00 60 91 93 00 E0 E0 E0 E0 E0 2B 2B 94	80 80 80 90 90 89 5 5 6 80 90 90 89 5 6 80 90 90 80 90 80 90 80 90 90 80 90 80 90 90 80 90 90 80 90 90 80 90 90 80 90 90 80 90 90 80 90 90 80 90 90 80 90 90 90 80 90 90 90 80 90 90 90 80 90 90 90 90 90 90 90 90 90 90 90 90 90	93 69 99 69 89 89 89 89 89 89 89 89 89 89 89 89 89	05 6 00 6 01 1 01 1 03 1 6 03 1 6 03 1 6 04 6 05 9 06 9 07 A 6 06 9 07 A 6 07 A 6 07 A 6 08 9 09 B 6 09 B 6 09 B 6 09 B 7 09 B 7	01 90 01 90 01 90 00 80 00 80	93 93 93 93 94 95 95 95 95 95 95 95 95 95 95 95 95 95	80 01 80 BF D2 85 81 80 80 60 61 61 9E 0E 85	01 93 91 90 CF B5 60 93 00 60 91 93 E0 E0 E0 94 94 E0	1 ô Çô Éò âô \ ôô Çô Éò âô \ ôô (\$\pi\$ \ \$\pi\$ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \
Type 8-bit Integer 16-bit Integer 24-bit Integer 24-bit Integer 32-bit Integer (+) 64-bit Integer (±) 16-bit Tloat. P. 32-bit Float. P. 32-bit Float. P. LEB128 (+) LEB128 (-) MS-00S DateTime UNIX 32-bit DateTime Macintosh HFS DateTime Macintosh HFS	12 12 37900 -27636 6394892 6394892 6394892 6394892 6394892 6394892 6394892 6394892 6394892 6394892 6394892 6394892 6394892 6394892 649482 649482 649482 649482 649482 649482 649482 6494	992 992 996 996 906 907 907 907 908	00000280 00000290 000002A0 000002A0 000002C0 000002C0 000002E0 000003E0 00000330 00000330 00000350 00000360 00000380 00000380 000003B0	A11 A00 A00 AF 78 82 80 81 81 80 7A 7A 83 85 81 83 6C 9E 9E	1D 93 91 91 90 94 60 93 00 60 91 93 00 E0 E0 E0 E0 00 94	B1 07 02 90 9F 18 84 85 6E 80 80 7A 81 10 0E 0E 0E BB 7C 4C 9E	1D : 01 1 93 0 94 94 94 94 94 94 94	20 9:388 9:3	3 044 3 088 3 098 3 098 3 098 3 098 3 098 3 098 3 098 3 098 3 098 3 099	01 01 93 91 0F BD 60 00 60 91 93 00 E0 E0 E0 2B 2B 94 E0	80 80 80 90 90 89 89 89	93 69 96 A 69 97 98 98 99 99 99 99 99 99 99 99 99 99 99	05 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6	01 90 01 90 01 90 03 03 00 01 00 01 00 82 00 86 00 86	9 93 9 91 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	80 60 61 61 62 65 A1	01 93 91 90 CF B5 60 93 00 60 91 93 E0 E0 e0 94 94 E0 E0	i ô Çô Eò àô \ô \chio \chio.
Type 8-bit Integer 16-bit Integer 24-bit Integer 24-bit Integer 32-bit Integer (+) 64-bit Integer (+) 64-bit Integer (±) 16-bit Float. P. 32-bit Float. P. 32-bit Float. P. LEB128 (+) LEB128 (+) LEB128 (±) MS-DOS DateTime UNIX 32-bit DateTime Macintosh HFS DateTime Macintosh HFS- DateTime Macintosh HFS- DateTime Macintosh HFS- DateTime Macintosh HFS- DateTime Binary	12 12 37900 -27636 6394892 6394892 6394892 6394892 6394893 25532401588658732 -0.0009800066 8.9611523e-39 1.742527264393204e-30 12 1980-03-01 18:32:24 Loc 1899-12-30 00:00.000.000 1970-03-16 00:21:32 UTC 1904-03-15 06:14:52 Loc 1904-03-15	992 992 996 996 906 907 907 907 908	00000280 00000290 000002A0 000002A0 000002C0 000002C0 000002C0 000003C0 000003A0 000003A0 000003A0 000003A0 000003A0 000003A0 000003A0 000003A0 000003A0 000003A0 000003A0	A1 A0 A0 00 AF 78 82 80 81 81 80 7A 7A 83 85 81 83 6C 9E 9E 9E 9E 41 60	1D 93 91 91 90 94 60 93 00 E0 E0 E0 00 94 15 E0	B1 07 02 90 9F 18 84 85 6E 80 80 7A 81 10 0E 0E BB 7C 4C 9E 51 B1	1D : 01 01 03 04 05 06 07 07 07 07 07 07 07	200 9:388 9:	3 044 3 084	01 01 93 91 0F BD 60 00 60 91 93 00 00 E0 E0 E0 2B 2B 94 E0 E0 e0 40 60 60 60 60 60 60 60 60 60 60 60 60 60	80 80 80 91 92 92 93 93 93 93 93 93 93 93 93 93 93 93 93	93 69 99 69 89 99 89 89 99 89 89 99 89 99 89 99 89 99 89 99 89 99 9	05 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6 6	01 90 01 90 01 90 01 90 02 80 00 01 00 80 00 80	9 93 93 93 94 95 96 96 96 96 96 96 96 96 96 96 96 96 96	80 81 80 80 60 61 61 9E 85 A1 99 2E	01 93 91 90 CF B5 60 93 00 60 91 93 E0 E0 94 94 E0 E0 F0 29	1 ô Çô Éò àô \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \
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Type 8-bit Integer 16-bit Integer 24-bit Integer 24-bit Integer 32-bit Integer (+) 64-bit Integer (+) 64-bit Integer (±) 16-bit Float. P. 32-bit Float. P. 32-bit Float. P. LEB128 (+) LEB128 (+) LEB128 (±) MS-DOS DateTime UNIX 32-bit DateTime Macintosh HFS DateTime Macintosh HFS- DateTime Macintosh HFS- DateTime Macintosh HFS- DateTime Macintosh HFS- DateTime Binary	12 12 37900 -27636 6394892 6394892 6394892 6394892 6394893 25532401588658732 -0.0009800066 8.9611523e-39 1.742527264393204e-30 12 1980-03-01 18:32:24 Loc 1899-12-30 00:00.000.000 1970-03-16 00:21:32 UTC 1904-03-15 06:14:52 Loc 1904-03-15	992 992 996 996 906 907 907 907 908	00000280 00000290 000002A0 000002C0 000002C0 000002C0 000002C0 00000320 00000310 00000330 00000340 00000350 00000360 00000360 00000360 00000360 00000360 00000360 000003F0 000003F0 00000410 00000410	A1 A0 A0 00 AF 1F 78 82 80 81 81 80 80 7A 7A 83 85 81 83 6C 9E 9E 9E 9E 9D 9D 9D 9D 9D 9D 9D 9D 9D 9D 9D 9D 9D	1D 93 91 91 90 93 00 60 91 93 00 E0 E0 E0 E0 01 00 94 15 E0 29 23	B1 07 02 90 9F 18 84 85 6E 80 80 7A 81 10 0E 0E BB 7C 4C 9E 51 B1 28 F7	1D 2 1 1 93 (1 94 1 94 1 94 1 94 1 94 1 94 1 94 1 9	20 9:388 9:3	3 044 89 81 1 7 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	01 01 93 91 0F BD 60 00 60 91 93 00 E0 E0 E0 E0 E0 E0 E0 E0 E0 E0 E0 E0	80 80 80 80 80 80 80 80 80 80 80 80 80 8	93 69 99 69 89 89 89 89 89 89 89 89 89 89 89 89 89	05 00 00 00 00 00 00 00 00 00 00 00 00 0	01 90 01 90 01 90 03 03 03 03 00 01 00 82 00 80 01 61 00 82 00 80 00 80	9 933 911 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	806 801 80 BF D2 85 81 80 80 80 60 60 61 61 9E 9E 85 87 80 80 60 61 9E 9E 9E 85 80 80 80 80 80 80 80 80 80 80 80 80 80	01 93 91 90 CF B5 60 93 00 60 91 93 E0 E0 E0 E0 E0 E0 E0 E0 E0 E0 E0 E0 E0	1
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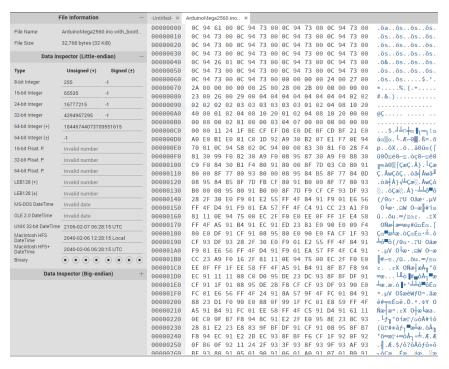
```
Arduino Mega
int I0 = 5; //Input pins connected to digital pin
int I1 = 4;
int I2 = 3;
int I3 = 2;
int O0=9; //Output pins connected to digital pin
int O1=10;
int O2=11;
int O3=12;
void setup() {
 pinMode(I0,INPUT); //Sets I0,I1,I2,I3 as INPUT
 pinMode(I1,INPUT);
 pinMode(I2,INPUT);
 pinMode(I3,INPUT);
 pinMode(O0,OUTPUT); //Sets output pins as OUTPUT
 pinMode(O1,OUTPUT);
 pinMode(O2,OUTPUT);
 pinMode(O3,OUTPUT);
```

```
}
void loop() {
 boolean I0State = digitalRead(I0); //Reads input pins
 boolean I1State = digitalRead(I1);
 boolean I2State = digitalRead(I2);
 boolean I3State = digitalRead(I3);
 boolean OOState;
 boolean O1State;
 boolean O2State;
 boolean O3State;
O0State= (!I3State & !I2State & !I1State & !I0State)|(!I2State & I1State &
IOState)|(I3State & !I1State & I0State)|(I3State & I1State& !I0State);
//Setting the kmap equations for each output pins
O1State= (!I3State & I1State)|(I2State & !I0State)|(I3State & !I2State &
!I1State)|(I3State & !I2State & I0State);
O2State= (!I3State & !I1State)|(!I2State & !I1State & !I0State)|(!I3State &
I2State);
O3State= (!I3State & !I2State)|(!I3State & I0State)|(I2State & I1State &
IOState)|(I3State & !I1State & !I0State);
```

```
digitalWrite(O0,O0State); //lighting of the LED's
digitalWrite(O1,O1State);
digitalWrite(O2,O2State);
digitalWrite(O3,O3State);
```

}

Hex File



-Untitled- × ArduinoMega2560.ino... × 00000270 08 01 30 91 04 01 23 E0 23 0F 2D 37 58 F5 01 96 ..0æ..#α#.-7XJ.û A1 1D B1 1D 20 93 04 01 80 93 05 01 90 93 06 01 00000280 í. . ô. . Cô. . Éô. . 00000290 A0 93 07 01 B0 93 08 01 80 91 00 01 90 91 01 01 áô..√ô..Çæ..Éæ. 000002A0 A0 91 02 01 B0 91 03 01 01 96 A1 1D B1 1D 80 93 áæ...\æ...ûí.∭.Cô 00 01 90 93 01 01 A0 93 02 01 B0 93 03 01 BF 91 ..Éô..áô..∭ô..┐æ 000002B0 000002C0 AF 91 9F 91 8F 91 3F 91 2F 91 0F 90 0F BE 0F 90 ȾfæÅæ?æ/æ.É.∃ 000002D0 1F 90 18 95 26 E8 23 0F 02 96 A1 1D B1 1D D2 CF .É.ò&⊕#..ûí.∭.╥┸ xöä=é`ää=ü`ää= é`àäa=ü`àäÇæn.ü` 000002E0 78 94 84 B5 82 60 84 BD 84 B5 81 60 84 BD 85 B5 000002F0 82 60 85 BD 85 B5 81 60 85 BD 80 91 6E 00 81 60 00000300 80 93 6E 00 10 92 81 00 80 91 81 00 82 60 80 93 Çôn..Æü.Çæü.é`Çô 00000310 81 00 80 91 81 00 81 60 80 93 81 00 80 91 80 00 ü.Cæü.ü`Côü.CæC. 00000320 81 60 80 93 80 00 80 91 B1 00 84 60 80 93 B1 00 ü`ÇôÇ.Çæ∭.ä`Çô∭ 00000330 80 91 B0 00 81 60 80 93 B0 00 80 91 7A 00 84 60 Çæ\\.ü`Çô\\.Çæz.ä 00000340 80 93 7A 00 80 91 7A 00 82 60 80 93 7A 00 80 91 Çôz.Çæz.é`Çôz.Çæ 00000350 7A 00 81 60 80 93 7A 00 80 91 7A 00 80 68 80 93 z.ü`Côz.Cæz.ChCô z...Æ. `αàα.ö|. `α 00000360 74 00 10 92 C1 00 60 E0 85 E0 0E 94 E5 00 60 E0 äα.ö|.`αâα.ö|.`α 00000370 84 F0 0F 94 F5 00 60 F0 83 F0 0F 94 F5 00 60 F0 00000380 82 E0 0E 94 F5 00 61 E0 89 E0 0E 94 F5 00 61 E0 éα.öl.aαëα.öl.aα 8A F0 0F 94 F5 00 61 F0 8B F0 0F 94 F5 00 61 F0 00000390 èα.ö aαïα.ö aα 8C E0 0E 94 F5 00 00 E0 10 E0 85 E0 0E 94 9E 00 000003A0 ĵα. Ö . . α . αàα . ÖP . l._¶\$|öë+.[∭,äα.ö 000003B0 6C 01 BB 24 B3 94 89 2B 09 F4 B1 2C 84 F0 0F 94 P. | - παë+. | παâα. ö 000003C0 9E 00 7C 01 D1 E0 89 2B 09 F4 D0 E0 83 E0 0E 94 9F 00 4C 01 AA 24 A3 94 89 2B 09 F4 A1 2C 82 F0 ₽.L.¬\$úöë+.[í.éo 000003D0 000003E0 0E 94 9E 00 AC 01 71 E0 89 2B 09 F4 70 E0 A1 E0 .öP.¼.gαë+.[pαία 000003F0 41 15 51 05 09 F0 A0 F0 61 F0 81 14 91 04 09 F0 Α.Ο..=άαααϋ.æ..= 60 E0 B1 E0 E1 14 F1 04 09 F0 B0 E0 96 01 2E 29 `α\\\αβ.±..≡\\αû..) 00000400 3F 29 28 29 39 29 E1 E0 CD 28 09 F0 E0 E0 9B 2D ?)()9)βα=(.≡αα¢-00000410 9D 23 F7 2F FB 23 8A 2D 8E 23 CD 2F CA 23 C8 2B ¥#≈/√#è-Ä#=/<u>L</u>#L+ 00000420 00000430 87 2F 86 23 B8 23 CB 2B 8B 21 C8 2B E4 2A F5 2A ç/å#q##+ï! L+Σ*]* 00000440 81 E0 EF 28 09 F0 80 E0 EA 2C EA 22 E8 2A 81 E0 üα∩(.≡ÇαΩ,Ω"Φ*üα 00000450 21 15 31 05 09 F0 80 E0 E8 2A FB 2C F6 2A FA 22 !.1..≡ÇαΦ*√,÷*·" ·"»(•. "•(i#¬"k) 00000460 A9 22 AF 28 FE 2E FF 22 FA 28 69 23 BF 22 6B 29 00000470 D7 23 DE 23 6D 2B 24 2B 35 2B 91 E0 23 2B 09 F0 ####+\$+5+æx#+.= 00000480 90 E0 69 2B 89 E0 0E 94 C7 00 6C 2F 8A E0 0E 94 Ëαi+ëα.ö .l/èα.ö -.n-ïα.ö -.o-îα.ö -....[Ç≟.ö..}≟ °ö ≟ C7 00 6E 2D 8B E0 0E 94 C7 00 6F 2D 8C E0 0E 94 00000490 000004A0 C7 00 01 15 11 05 09 F4 80 CF 0E 94 00 00 7D CF 000004B0 F8 94 FF CF FF

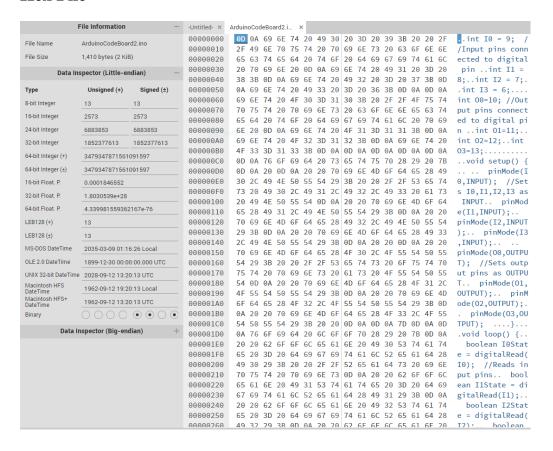
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          FF 27 09 94 FF FF FF FF FF FF FF FF FF 04 04
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0008000
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Arduino Pro Mini

```
int I0 = 9; //Input pins connected to digital pin
int I1 = 8;
int I2 = 7;
int I3 = 6;
int O0=10; //Output pins connected to digital pin
int O1=11;
int O2=12;
int O3=13;
void setup() {
 pinMode(I0,INPUT); //Sets I0,I1,I2,I3 as INPUT
 pinMode(I1,INPUT);
 pinMode(I2,INPUT);
 pinMode(I3,INPUT);
 pinMode(O0,OUTPUT); //Sets output pins as OUTPUT
 pinMode(O1,OUTPUT);
 pinMode(O2,OUTPUT);
 pinMode(O3,OUTPUT);
}
```

```
void loop() {
 boolean I0State = digitalRead(I0); //Reads input pins
 boolean I1State = digitalRead(I1);
 boolean I2State = digitalRead(I2);
 boolean I3State = digitalRead(I3);
 boolean OOState;
 boolean O1State;
 boolean O2State;
 boolean O3State;
O0State= (!I3State & !I2State & !I1State & !I0State)|(!I2State & I1State &
IOState)|(I3State & !I1State & I0State)|(I3State & I1State& !I0State); //Setting the kmap
equations for each output pins
O1State= (!I3State & I1State)|(I2State & !I0State)|(I3State & !I2State & !I1State)|(I3State
& !I2State & I0State);
O2State= (!I3State & !I1State)|(!I2State & !I1State & !I0State)|(!I3State & I2State);
O3State= (!I3State & !I2State)|(!I3State & I0State)|(I2State & I1State & I0State)|(I3State
& !I1State & !I0State);
digitalWrite(O0,O0State); //lighting of the LED's
digitalWrite(O1,O1State);
digitalWrite(O2,O2State);
digitalWrite(O3,O3State);
```

Hex File



Question/Answers

Arduino Uno:

I) Clock frequency of the microcontroller used-

Arduino Uno is a popular microcontroller development board based on 8-bit <u>ATmega328P</u> microcontroller. Arduino Uno has an inbuilt clock frequency up to 8Mhz whereas an external crystal frequency 16MHz is also available.

- **II**)Data bus width of the microcontroller-The data buses are 32-bit wide. The external address bus is 24 bits wide. This will allow you to access up to 16 MB of memory. It also has 8 chip selects.
- **III**) Size of hex file generated-3.32 KB (3,409 bytes)
- **IV**) Can the project be implemented using interrupt -

Yes the project can be implemented using interrupt As previously stated on Arduino Uno you can only use pin 2 and 3 for interrupts. On the Arduino Uno pins 2 and 3 are capable of generating interrupts and they correspond to interrupt vectors 0 and 1 respectively.

- **V**) Is the main routine required to be an infinite loop Yes
- **VI**) Is there any difference between level triggered and edge triggered operation for the given project-

The main difference between edge and level triggering is that in edge triggering, the output of the sequential circuit changes during the high voltage period or low voltage period while, in level triggering, the output of the sequential circuit changes during transits from the high voltage to low voltage or low voltage to high voltage.

vii) Is the project referring encryption or decryption for input to output-For input it's referring to encryption.

Arduino Pro mini:

- I) Clock frequency of the microcontroller used-
- 8 MHz (3.3V versions) or 16 MHz (5V versions)
- **II**)Data bus width of the microcontroller-The data buses are 32-bit wide. The external address bus is 24 bits wide. This will allow you to access up to 16 MB of memory. It also has 8 chip selects.
- **III**) Size of hex file generated-3.32 KB (3,409 bytes)

IV) Can the project be implemented using interrupt -

Yes the project can be implemented using external interrupt As previously stated on Arduino Uno you can only use pin 2 and 3 for interrupts. On the Arduino Uno pins 2 and 3 are capable of generating interrupts and they correspond to interrupt vectors 0 and 1 respectively.

- **V**) Is the main routine required to be an infinite loop Yes
- **VI**) Is there any difference between level triggered and edge triggered operation for the given project-

The main difference between edge and level triggering is that in edge triggering, the output of the sequential circuit changes during the high voltage period or low voltage period while, in level triggering, the output of the sequential circuit changes during transits from the high voltage to low voltage or low voltage to high voltage.

vii) Is the project referring encryption or decryption for input to output-For input it's referring to encryption.

Arduino Mega 2560

I) Clock frequency of the microcontroller used-

The controller used in this board is ATmega2560 has a clock speed of 16 MHz.

II)Data bus width of the microcontroller-

Many chips like the Mega1284 and 2560 actually address 128 or 256k of flash, that means their address bus is **17 or 18 bits**. Yet they are called an 8-bit processor because the data bus is 8 bits. Some 16-bit processors like the 68000 had 24-bit address busses

- **III**) Size of hex file generated-3.32 KB (3,409 bytes)
- **IV)** Can the project be implemented using interrupt **External Interrupts:** 2 (interrupt 0), 3 (interrupt 1), 18 (interrupt 5), 19 (interrupt 4), 20 (interrupt 3), and 21 (interrupt 2). These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attach Interrupt() function for details.
- V) Is the main routine required to be an infinite loop Yes
- **VI**) Is there any difference between level triggered and edge triggered operation for the given project-

The main difference between edge and level triggering is that in edge triggering, the output of the sequential circuit changes during the high voltage period or low voltage period while, in level triggering, the output of the sequential circuit changes during transits from the high voltage to low voltage or low voltage to high voltage.

vii) Is the project referring encryption or decryption for input to output-For input it's referring to encryption.

Power Consumption

I)Maximum and minimum power consumption sequence for a specific bit sequence for a specific board(In case of multiple cases, report all. exclusively comment on the input-output pair that will draw the maximum power assuming a single power supply is used for the system (compulsory)

II) Comparison of maximum and minimum power consumption sequence between the three selected boards –

Arduino Uno:

Minimum Operating voltage -2.7V

Maximum operating voltage-6V

Arduino Pro Mini:

3.35 -12 V (3.3V model) or 5 - 12 V (5V model)

Arduino Mega 2560 Minimum Operating voltage -5V Maximum operating voltage-6-20 V

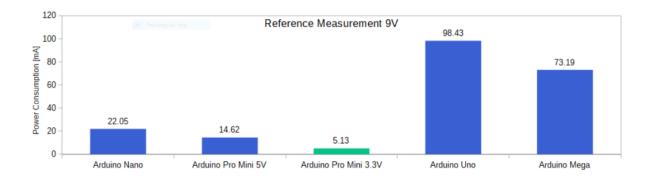
- III) Comparison of power consumption between the three selected boards in idle mode (battery on with no switching)-
- IV) Discussion on variation of power consumption among the three selected boards based based on the technical parameters provided in slide –

Arduino Uno-The power supply of an Arduino Uno can be between 7V-12V. The current consumption lies between 45mA-80mA while the current consumption deep is 35mA.

Arduino Pro mini- The Arduino Uno board draws about 42 mA assuming no power draw from sensors or other components needed in your system. With a minimum supply voltage of 7 volts, the power consumption of the board is therefore 0.29 Watts.

The lowest current consumption has the Arduino Pro Mini with 1.58mA

Arduino Mega 2560-With no pin IO,we can expect a load between 50mA and 75 mA.It has an upperlimit of 200 mA.



Current reading with no code and code burnt

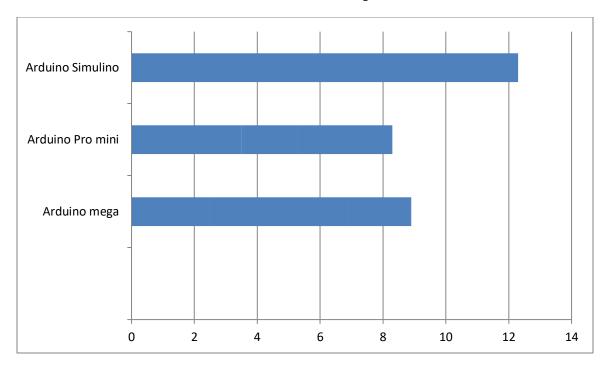
Board	Current/mA(No code)	Current/mA(Code Burnt)
Arduino simulino	9	135.9
Arduino Mega	10	44.5
Arduino Pro mini	16	35

Sequences that give maximum reading for each board

Board	Maximum	Minimum
Arduino Simulino	1000	1101
Arduino Mega	1111	1010
Arduino Pro mini	1000	1010

Power Consumption chart for each board

Power Consumption



Discussion

In the group project we had to Implement a given encryption table using microcontroller using single pole, double throw switch to configure the inputs for high and low conditions and LEDs to represent the corresponding output statuses. We used the software Proteus to build the software circuits for the three boards and implemented one of the software circuit using hardware equipments. We used Arduino Uno, Breadboard, Double pin switch, LED's and wires. The implementation of the circuit in the software was hassle free but while implementing the hardware we faced a series of problems regarding some of the hardware equipment's.

- The switches we initially used were single pin switches so therefore it was hard to deduce when it the switch is ON/OFF. We had to rely on the output. Again when we shifted to double pin switch the problem remained the same. The switches had degrading quality as well as it was hard to insert them in the breadboard.
- The LED's we used as output only worked for an hour/two and got dimmer with time. All the LED's we used weren't of good quality so we often got confused of the problem was in our circuit or in the LED's.
- Lastly, we had little knowledge of the hardware therefore we were at a dead end multiple times and it required a lot of time than expected to build one simple circuit.

Conclusion

Overall, the project provided us with a tremendous learning opportunity by allowing us to learn about various software programs and get our hands on hardware that we otherwise would not have had access to.