ARTIFICIAL INTELLIGENCE AND ROBOTICS LABORATORY
UNIVERSITY OF LAGOS (aiRoL)

REVOLUTIONS

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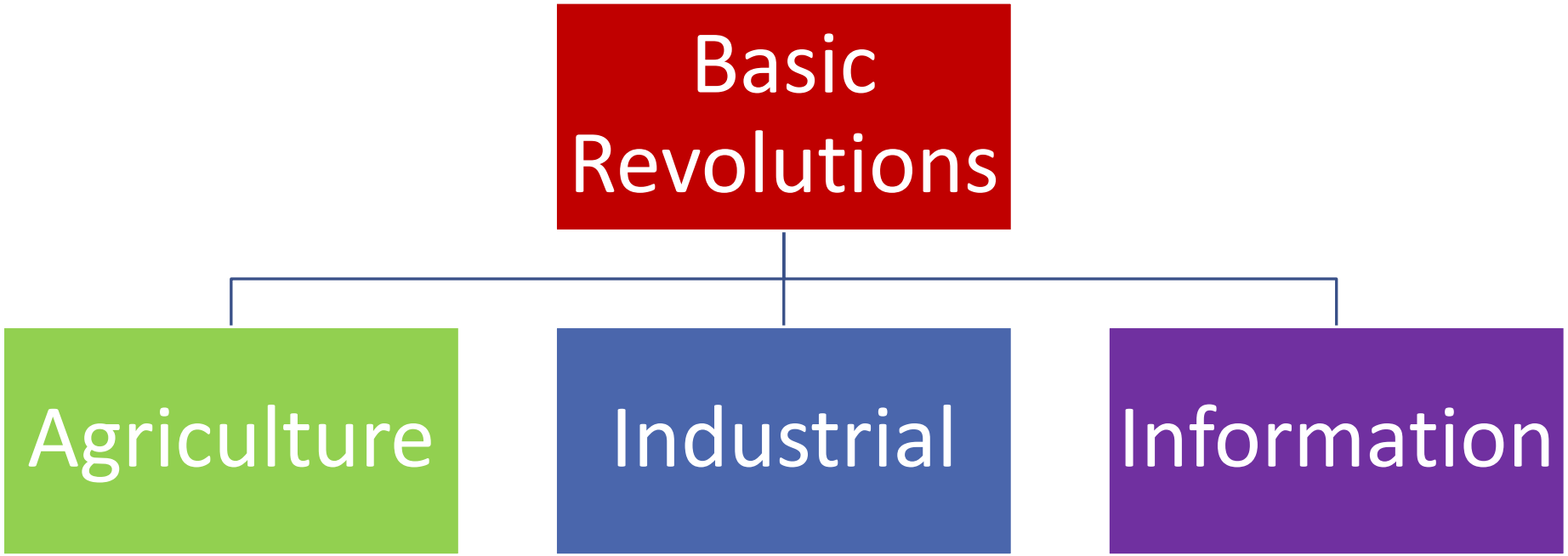
Revolution

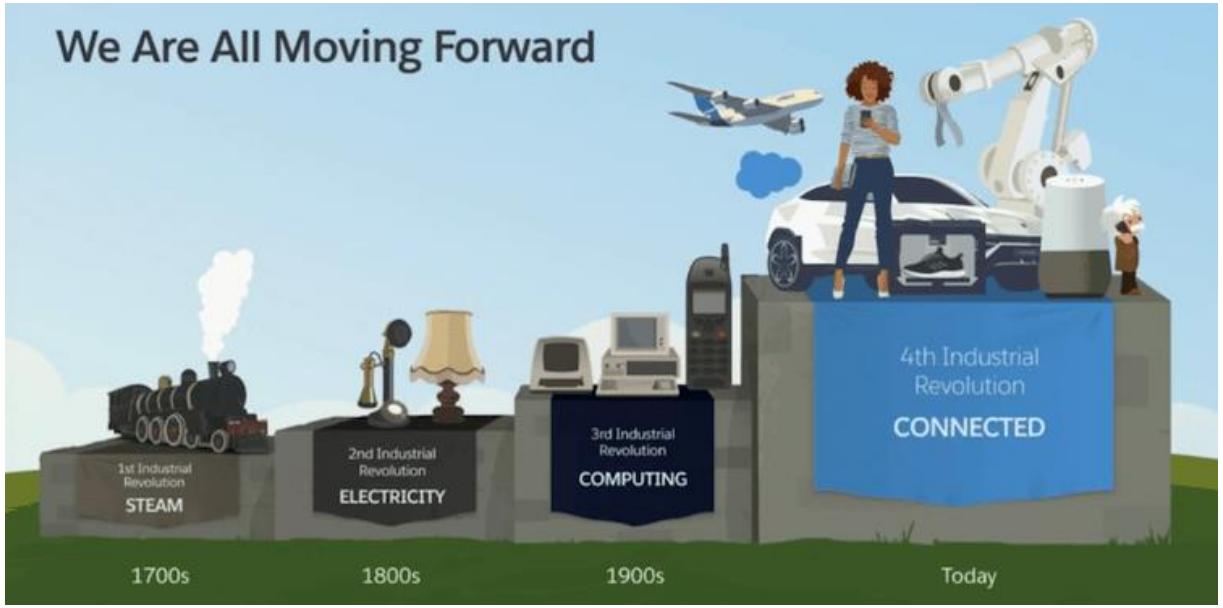
1. A sudden, radical, or complete change.
2. A fundamental change in political organization especially
3. Activity or movement designed to effect fundamental changes in the socioeconomic situation


Basic Revolutions
Agriculture
Industrial
Information

Agriculture Revolution

From:		To:
• Lots of farmers	→	• Very few farmers
• Most people farm	→	• Many work in factories
• Poorly used land	→	• Better used land
• Hand tools	→	• Machines
• Not much food	→	• Plenty of food

Industrial Revolution



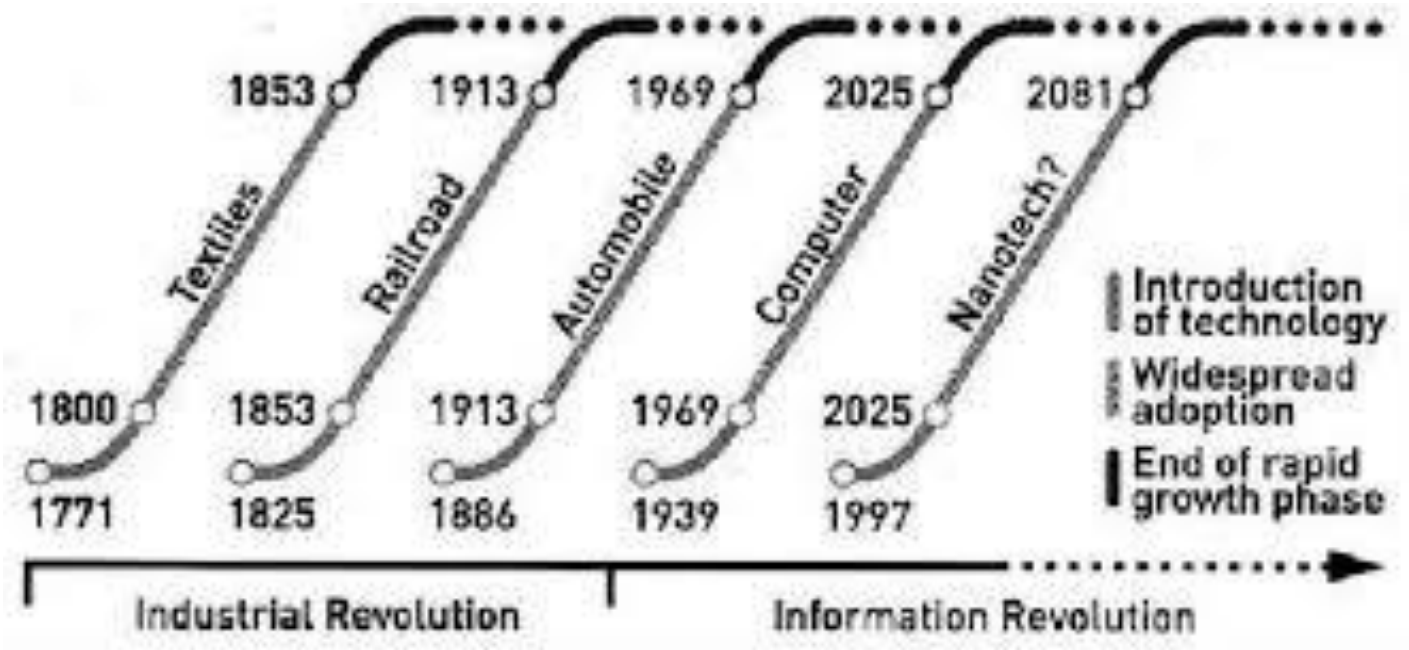
- **The Industrial Revolution.**
- Began in England during the 1780's and spread 1st to the US and Europe
- Factories made it possible to do secondary activities cheaply and efficiently providing more goods and improving peoples lives

Information Revolution

The Post-Industrial or Information Revolution.

- Tertiary and Quaternary activities are facilitated by computers and internet providing information and entertainment services cheaply and efficiently

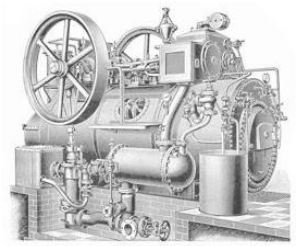
- The basic values for the Information Revolution is
    - globalization,
    - spreading ideas, and
    - reshaping societies and economies



First

Mechanical production

steam, water



1784: First power loom

Second

Mass production

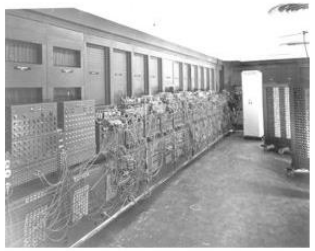
electricity

1870: First assembly line, Cincinnati slaughterhouses

Third

Digital

IT, Electronics



1969: First programmable logic controller (PLC)

Fourth

Cyber-physical systems

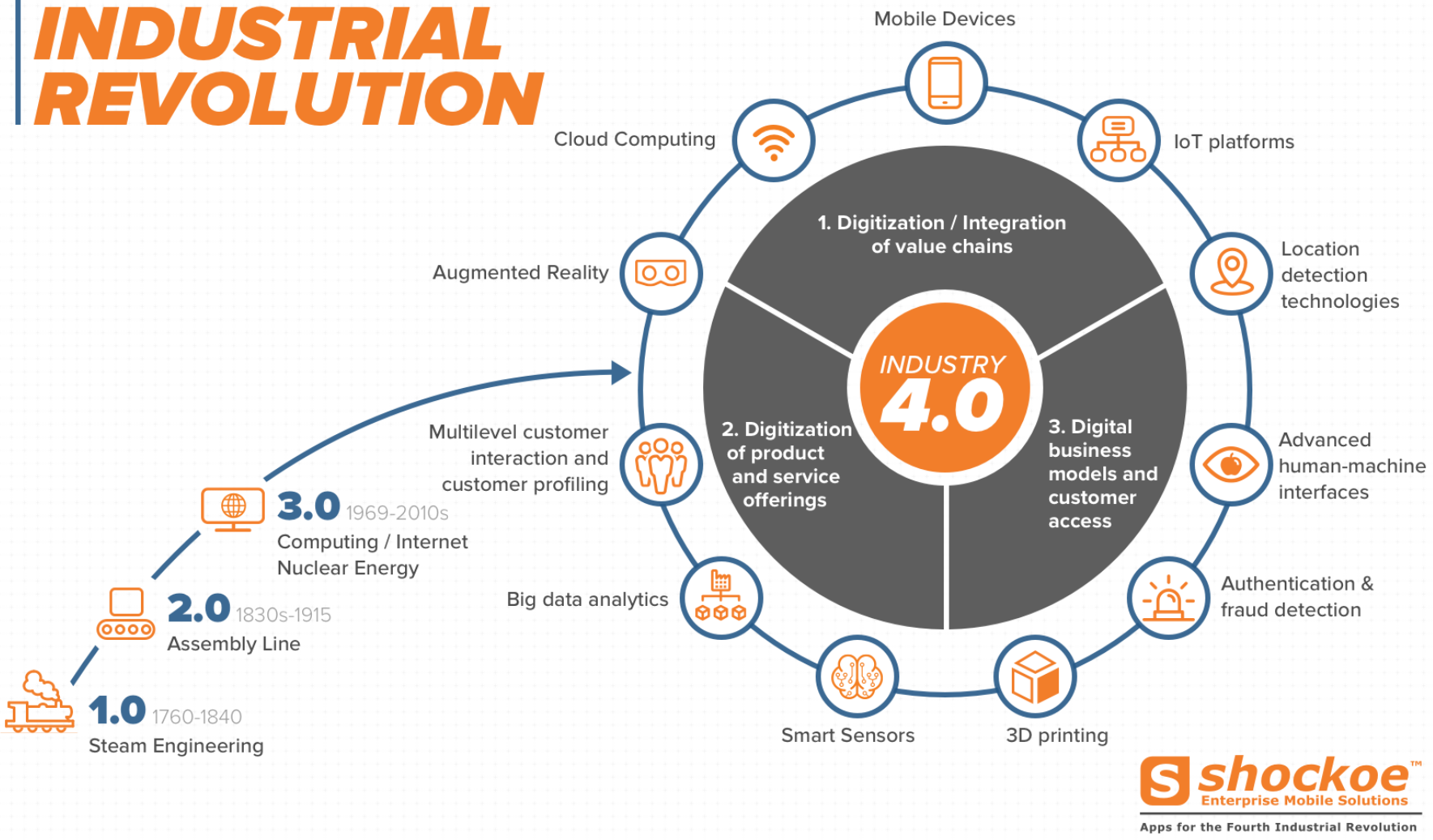
physical + digital + biological

Today: Cyber-physical systems and robots learning from humans

Source: Schwab, K. (2017) The Fourth Industrial Revolution

THE DAWN OF THE

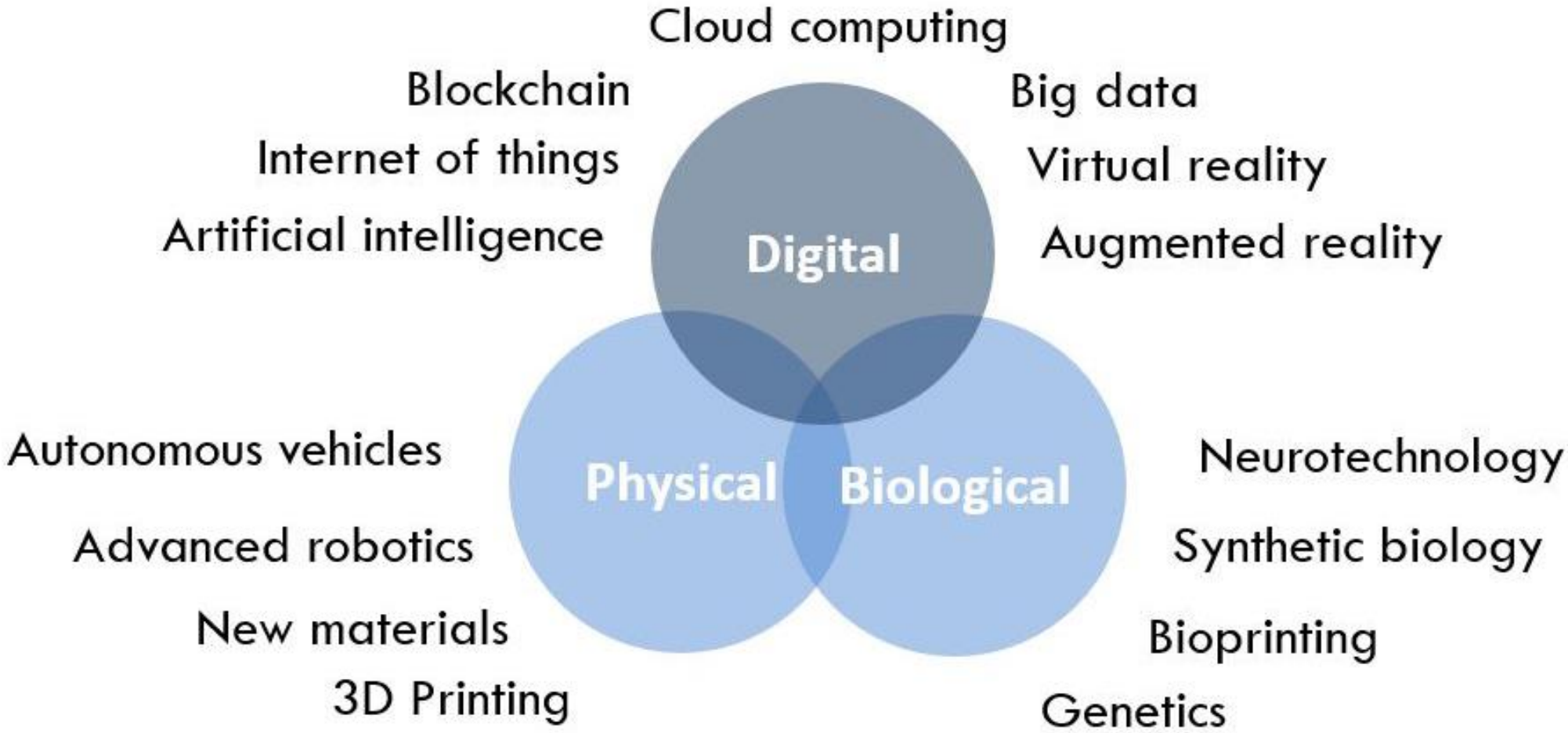
FOURTH INDUSTRIAL REVOLUTION



shockoe™
Enterprise Mobile Solutions
Apps for the Fourth Industrial Revolution

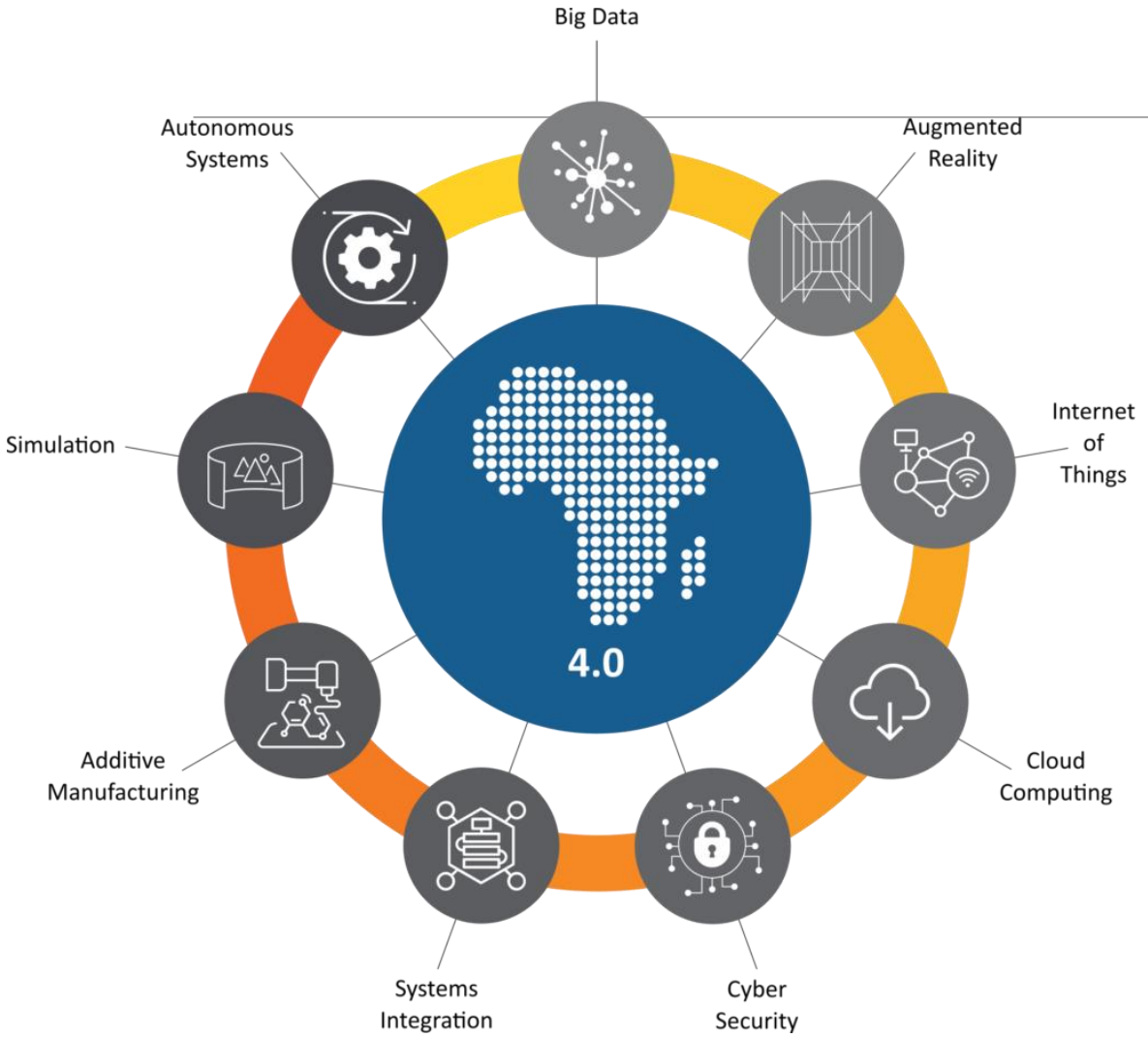
Today, in the fourth industrial revolution, something unique and unprecedented is happening: the boundaries between physical, digital and biological worlds are blurring

Dramatically change the way we relate to one another, live, work, and educate our children. These shifts are enabled by **smart technologies, including artificial intelligence, big data, augmented reality, blockchain, the Internet of Things, and automation**.



Source: John Grill Centre for Project Leadership and Silicon Valley Innovation Center

What are the technologies driving change?



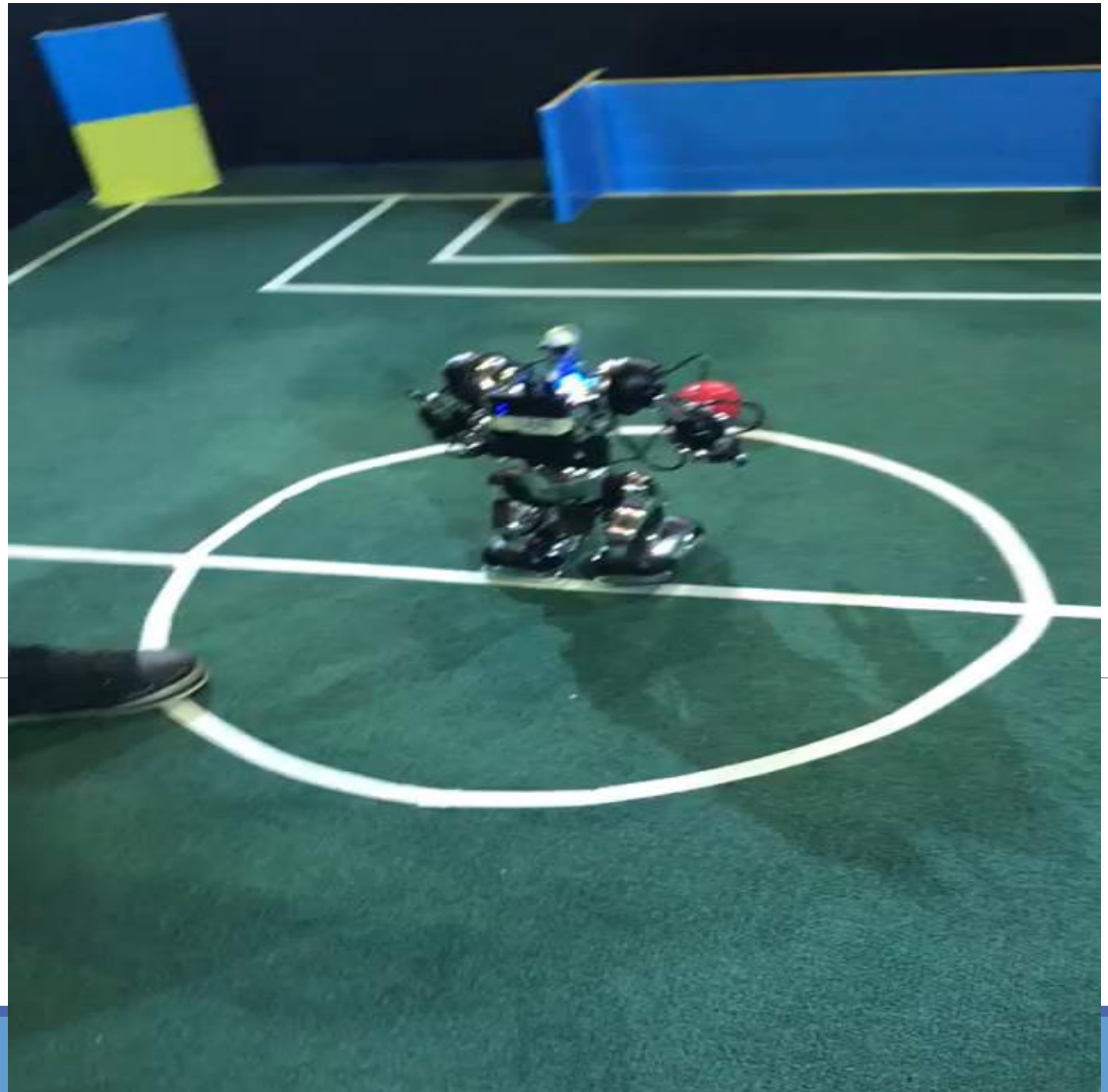
The easiest way to understand the Fourth Industrial Revolution is to focus on the technologies driving it. These include the following:

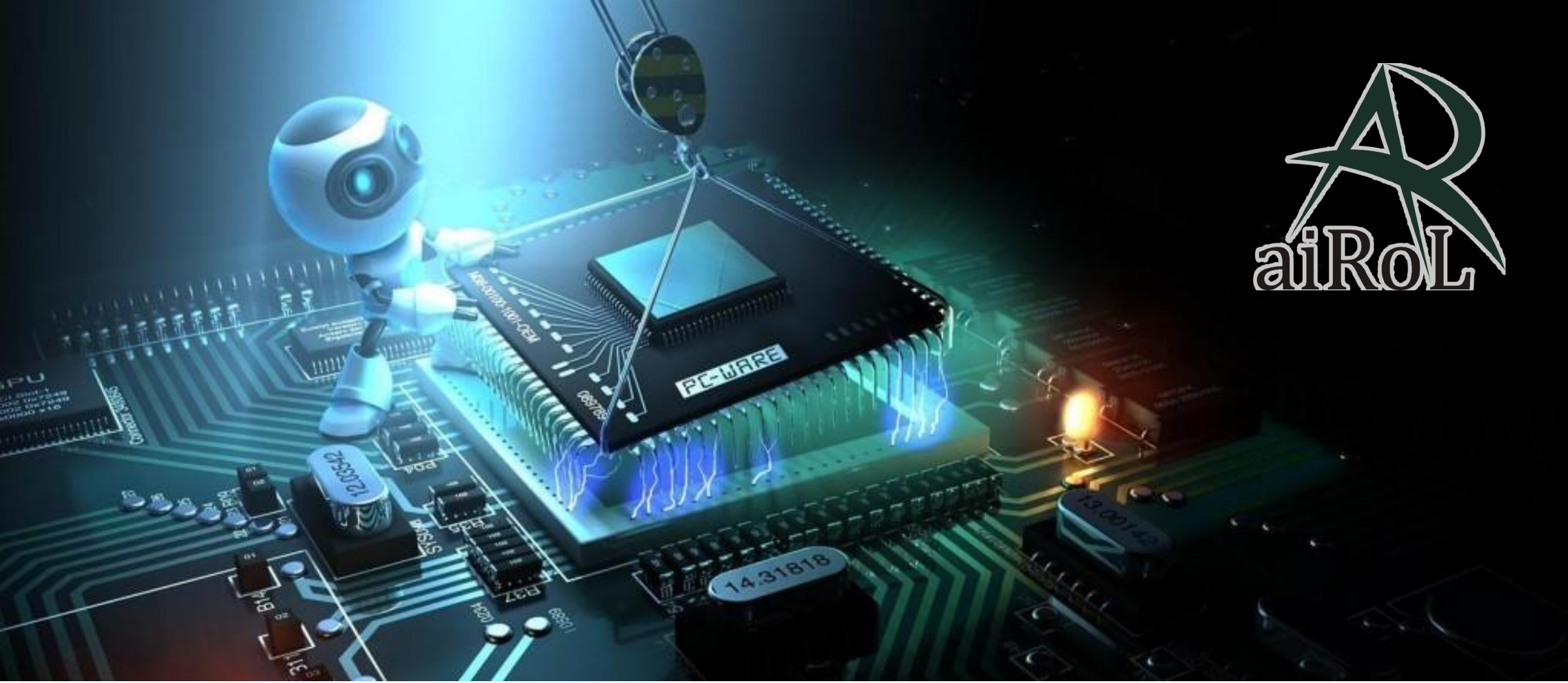
AR/VR

Cloud Computing – IOT--Big Data – Blockchain

Cyber Security

AI

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INTRODUCTION

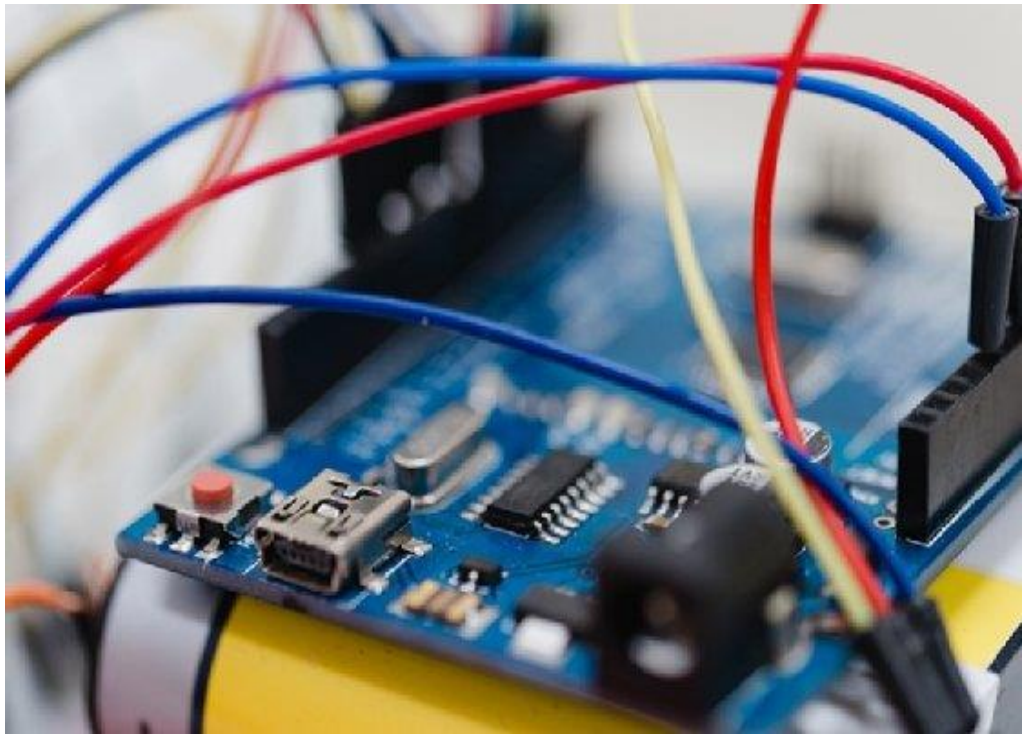
WORKSHOP OUTLINE

- Introduction
- Embedded Systems VS Robotics
- Embedded Systems Examples/Applications
- Embedded Systems Breakdown
- Embedded Systems Programming fundamentals
- Demonstration
- Conclusion/Questions

EMBEDDED SYSTEMS

- They are computer-based systems that do not appear to be computers.
- They are a combination of hardware and software that is specifically designed for a particular purpose.
- They are applications Specific.
- In almost all cases have a computational component but no network component in its architecture.
- Depending on its application, the user might interact directly or indirectly with such systems.
- Have user interfaces.

ROBOTICS VS EMBEDDED SYSTEMS



ROBOTICS VS EMBEDDED SYSTEMS

- Embedded Systems is a Subset of Robotics.
- Embedded System deals with Electronics, Software programming and **less likely involves mechanical parts that control the system's movement.**
- Robot deals with Electronics, Software programming and **more likely involves mechanical parts that control the system's movement.**
- A Robot is an embedded system.
- Robot: Computer + Sensor + Actuators

TYPES OF EMBEDDED SYSTEMS

They can be grouped into four based on performance as well as functional requirements:

- Real-Time
- Stand-alone
- Networked
- Mobile

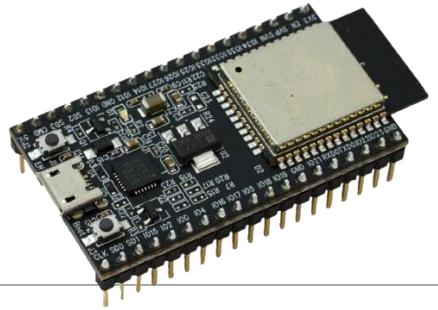
EMBEDDED SYSTEMS EXAMPLES

- Wearables e.g. necklaces, bands, fitness trackers, etc.
- Traffic Lights
- Printers
- Routers
- Medical Equipment
- Central Heating Systems
- Calculators,
- Automobiles, etc

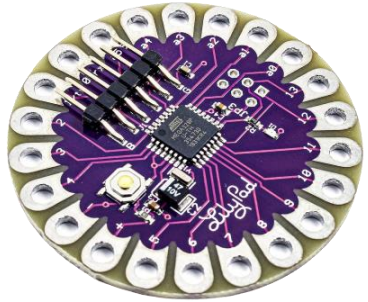
EMBEDDED SYSTEMS BREAKDOWN

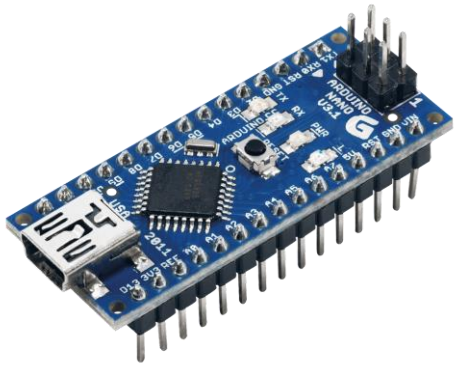
- They are mainly divided into Hardware and Software.
- The core of the Hardware of Embedded Systems is the processor a.k.a microcontroller.
- **The Processor** is the heart of the Embedded System.
- The processor/microcontroller used depends largely on the Embedded Systems Design.
- Input Components or **Sensors**.
- Output Components or **Actuators.**

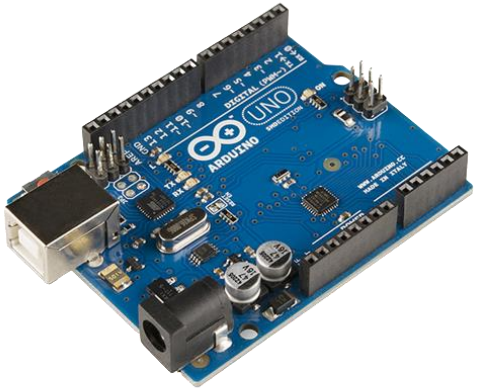
THE PROCESSOR



- They are the heart of the System.
- Responsible for the Systems Computation.
- Vary in sizes and complexities.
- Price range: $10 - $1000+







SENSORS

- Position Sensors.
- Light Dependent Resistors.
- Pushbuttons.
- Pressure Sensors.
- Temperature Sensors.
- Force Sensors.
- Vibration Sensors.
- Piezo Sensors.
- Camera.
- Accelerometers.
- Humidity Sensors.
- Gyro sensors.

ACTUATORS

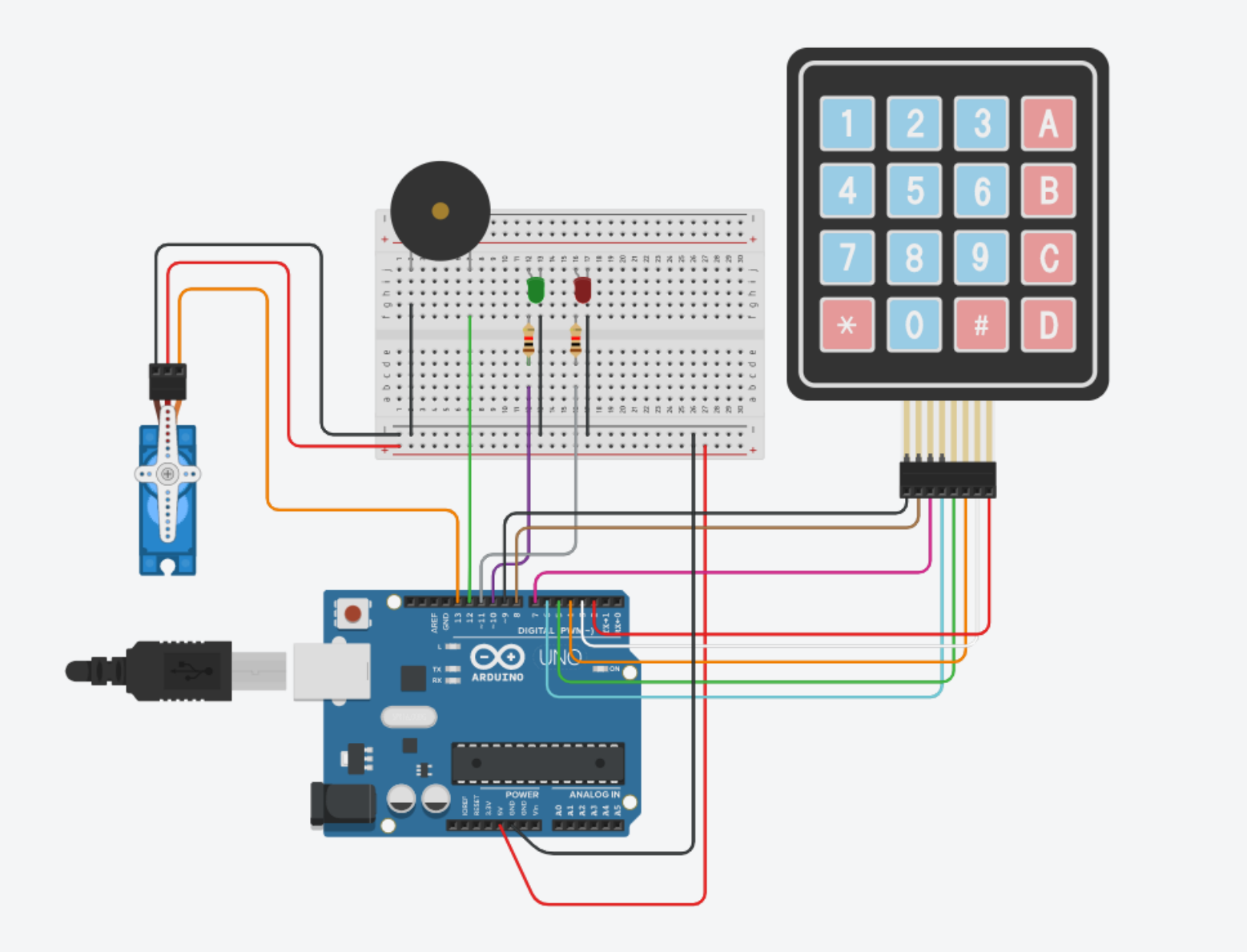
- Light Emitting Diodes (LED).
- Servos and Motors.
- Stepper Motors
- Solenoids.
- Display Screens
- Buzzers

PROGRAMMING EMBEDDED SYSTEMS

- Variables
- Libraries
- Functions
- Control Statements

DEMONSTRATION

DOOR LOCK WITH PASSWORD


1
2
3
A
4
5
6
B
7
8
9
C
*
0
#
D
ARDUINO
UNO
POWER
ANALOG IN

NCS_latest | Arduino 1.8.15

File Edit Sketch Tools Help

NCS_latest

```
1  //Including Libraries
2  #include <Keypad.h> //Keypad Library
3  #include <Servo.h> //Servo Library
4
5
6  //Declaring Variables
7  int greenLed = 11;  //Pin for the green LED
8  int redLed = 10;  //Pin for the red LED
9  int buzzer = 12; //Pin for buzzer
10
11 int pos = 90; //servo default position to lock the door
12
13 const byte ROWS = 4; //number of keypad rows
14 const byte COLS = 4; //number of keypad columns
15
16 //what the keys represents
17 char hexaKeys[ROWS][COLS] = {
18   {'1', '2', '3', 'A'},
19   {'4', '5', '6', 'B'},
20   {'7', '8', '9', 'C'},
21   {'*', '0', '#', 'D'}
22 };
23
24 byte rowPins[ROWS] = {9, 8, 7, 6}; //Keypad row pins
25 byte colPins[COLS] = {4, 5, 3, 2}; //Keypad column pins
26
27
28 //creating the keypad object
29 Keypad customKeypad = Keypad(makeKeymap(hexaKeys), rowPins, colPins, ROWS, COLS);
30
31 //creating the servo object
32 Servo myservo;
33
34 //PASSWORDS
35 String password = "1234"; //Master Password
```

```
//PASSWORDS
String password = "1234"; //Master Password
String mypassword; //User Password

int attempts = 0; //number of attempts
int maxAttempts = 3; //maximum number of attempts
int servoDelay = 5;



void setup(){
  Serial.begin(9600);

  //sets the LEDs and buzzer pinModes
  pinMode(redLed, OUTPUT);
  pinMode(greenLed, OUTPUT);
  pinMode(buzzer, OUTPUT);

  digitalWrite(redLed, HIGH); //turn on red LED
  digitalWrite(greenLed, LOW); //turn off green LED

  myservo.attach(13); //Servo Pin
  Serial.print("ENTER PASSWORD: ");
}

//function that runs repeatedly
void loop()
{
  //Function tha runs the program
  keypadfunction();
}

```

```
66
67  //**********KEYPAD FUNCTION*************//
68  void keypadfunction()
69  {
70    //Get the key pressed
71    char key = customKeypad.getKey();
72
73    if (key){
74      Serial.print(key);
75      //keypad tone function
76      keypress();
77    }
78    if (key == '1')
79    {
80      mypassword = mypassword + 1;
81    }
82    if (key == '2')
83    {
84      mypassword = mypassword + 2;
85    }
86    if (key == '3')
87    {
88      mypassword = mypassword + 3;
89    }
90    if (key == '4')
91    {
92      mypassword = mypassword + 4;
93    }
94    if (key == '5')
95    {
96      mypassword = mypassword + 5;
97    }
98    if (key == '6')
```

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