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CSE 3009 Internet of Things

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Digital Assignment -I

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Question 1)

What do you mean by ARDUINO?

Answer 1)

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.

The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware (called a programmer) in order to load new code onto the board -- you can simply use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible package.



Arduino Uno Board

```

Footstep_power_generator_code | Arduino 1.6.4
File Edit Sketch Tools Help
Footstep_power_generator_code $
void setup() {
  Serial.begin(9600);
  Serial.println("Voltage(V) / Current (A)");
}

void loop() {
  int vt_temp = analogRead(VT_PIN);
  int at_temp = analogRead(AT_PIN);
  float Reading = analogRead(fsrPin);
  float Force = (1000.0*fsrReading)/(1023.0);
  double voltage = vt_temp * (ARDUINO_WORK_VOLTAGE/1023.0) * 5;
  double current = at_temp * (ARDUINO_WORK_VOLTAGE/1023.0);
  Serial.print("Power = ");
  Serial.println((voltage) * (current));
  Serial.print("Force Value = ");
  Serial.println(Force);

  delay(2000);
}

```

Arduino Code and IDE

Question 2)

Why should we use Arduino and in which language Arduino software was written?

Answer 2)

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board.

The main reasons why we should use Arduino are stated below :

- Arduino is the basis for many projects that provide a solution to various real world problems. For example a motion sensor connected to the arduino circuitry can become the threshold of a smart and automated house light system
- Arduino is a great introduction to programming in the electronic and IOT domain. The code written is fairly simple and easy to understand. Hence, arduino is a good software for beginners to expert level coders
- Arduino is easy to learn and better suited than Raspberry PI for a majority of the consensus. It has various advantages of raspberry pi owing to its simplicity and is hence better suited to be used for making projects
- Arduino is cheap and can be easily purchased as compared to other alternatives in the market and is therefore widely used.

Arduino software is coded in C++ language.

Question 3)

Discuss the importance of Arduino

Answer 3)

While some of these Arduino projects may seem frivolous, the technology taps into several trends that will make it a potentially important force in the industry. The Internet of Things (IoT) is a popular phrase used in the tech community to describe everyday items that are connected to the internet and able to share information. Smart energy meters are an often-used example, which could regulate appliance usage to save money on energy.

Public perception is shifting toward integrating technology into the fabric of everyday life. The small form factor of Arduino allows it to be applied to all kinds of everyday objects. In fact, the Arduino LilyPad form factor allows for wearable Arduino devices.

Open source projects like Arduino lower the barrier of entry for developers that are looking to experiment with interactive objects. These innovators will be able to rapidly prototype and experiment with interactive devices by using the Arduino platform, before creating a production-ready offering. The next Mark Zuckerberg or Steve Jobs may one day be found creating new ways for computers to interface with the physical world. Arduino is a great way to experiment with the possibilities of smart devices.

Question 4)

List out three important parts of Arduino

Answer 4)

Arduino programming language can be divided into three main parts: functions, values (variables and constants), and structure.

Functions : Functions provide a way to modularize your code and make it reusable. Instead of having a single, very long program, you can break up your code into modules of code with functions. These functions perform certain tasks, extending the kinds of things your code can do, and can be used multiple times without having to re-write the same code.

Values : They are constants and variables. Constants are predefined expressions in the Arduino language. They are used to make the programs easier to read. The variables are defined as the place to store the data and values. It consists of a name, value, and type. The variables can belong to any data type such as int, float, char, etc. Consider the url - Arduino data types for detailed information.

Structure : Software structure consists of two main functions –Setup() function, Loop() function.

The setup() function is called when a sketch starts. Use it to initialize the variables, pin modes, start using libraries, etc. The setup function will only run once, after each power up or reset of the Arduino board. After creating a setup() function, which initializes and sets the initial values, the loop() function does precisely what its name suggests, and loops consecutively, allowing your program to change and respond. Use it to actively control the Arduino board.

Question 5)

Explain briefly about the following concepts

a) Arduino Software

The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. This software can be used with any Arduino board. Active development of the Arduino software is hosted by GitHub. See the instructions for building the code. Latest release source code archives are available [here](#). The archives are PGP-signed so they can be verified using this [gpg key](#).

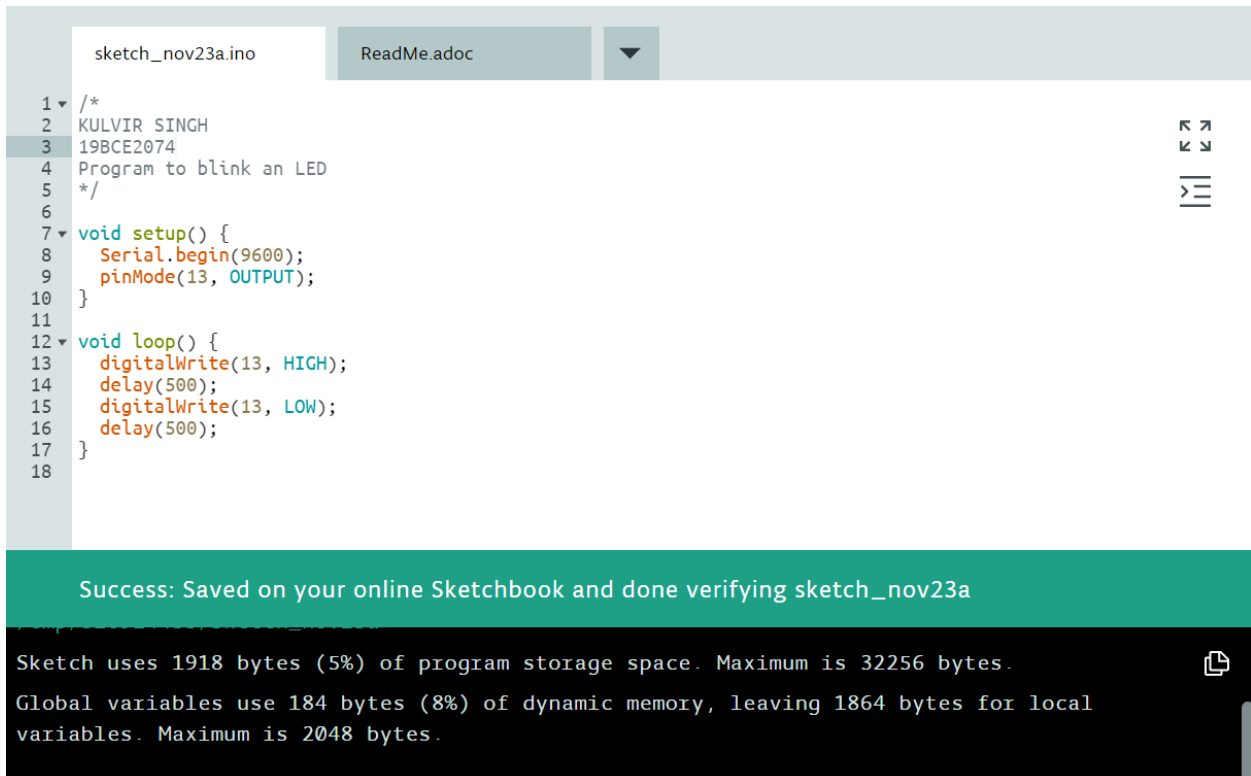
b) Arduino Hardware

Arduino is open-source hardware. Most Arduino boards consist of an Atmel 8-bit AVR microcontroller with varying amounts of flash memory, pins, and features. The boards use single or double-row pins that facilitate connections for

programming and incorporation into other circuits. These may connect with add-on modules termed shields. Multiple and possibly stacked shields may be individually addressable via an I²C serial bus. Most boards include a 5 V linear regulator and a 16 MHz crystal oscillator or ceramic resonator. Some designs, such as the LilyPad, run at 8 MHz and dispense with the onboard voltage regulator due to specific form-factor restrictions.

c) Arduino Programming

Arduino IDE (Integrated Development Environment) allows us to draw the sketch and upload it to the various Arduino boards using code. The code is written in a simple programming language similar to C and C++.



The screenshot displays the Arduino IDE interface. At the top, there are tabs for 'sketch_nov23a.ino' and 'ReadMe.adoc'. The main editor area shows the following C++ code for a sketch named 'sketch_nov23a.ino':

```
1  /*
2  KULVIR SINGH
3  19BCE2074
4  Program to blink an LED
5  */
6
7  void setup() {
8      Serial.begin(9600);
9      pinMode(13, OUTPUT);
10 }
11
12 void loop() {
13     digitalWrite(13, HIGH);
14     delay(500);
15     digitalWrite(13, LOW);
16     delay(500);
17 }
18
```

Below the code editor, a green status bar indicates: "Success: Saved on your online Sketchbook and done verifying sketch_nov23a". At the bottom, a black console window shows the following output:

```
Sketch uses 1918 bytes (5%) of program storage space. Maximum is 32256 bytes.
Global variables use 184 bytes (8%) of dynamic memory, leaving 1864 bytes for local
variables. Maximum is 2048 bytes.
```

The above Arduino program is written to blink an LED. It has been coded in the online editor of Arduino and verified.

Question 6)

What do you mean by Raspberry Pi?

Answer 6)

A low-cost Linux and ARM-based computer on a small circuit board sponsored by the charitable Raspberry Pi Foundation in the UK. Raspbian is the Debian-based Linux OS that is provided with the device. Pi computers are used in many ways: as a Web server, media center, network monitor, security system and more. The Raspberry Pi Foundation looks to bridge the gap by providing an economically friendly way to learn beginning programming languages. In 2012, the Foundation launched Raspberry Pi, a single-board computer designed to teach programming skills, build hardware projects, do home automation, and explore industrial applications of computer technology. It runs Linux (a computer operating system) and provides general-purpose input and output (GPIO) pins that allow the user to control electronic components for physical computing and exploring the Internet of Things (IoT).

Question 7)

How does the Raspberry Pi work? What is the language used by Raspberry Pi?

Answer 7)

The Raspberry Pi is a tiny computer about the size of a deck of cards. It uses what's called a system on a chip, which integrates the CPU and GPU in a single integrated circuit, with the RAM, USB ports, and other components soldered onto the board for an all-in-one package. The Raspberry Pi works on the basis that it receives a signal from the sensors and communicates that information to the device connected to it. The hard coded program enables the flow of control in the OS of the system and hence the Raspberry Pi can communicate with the sensors and perform the actions accordingly.

Raspberry Pi uses Python for programming.

Question 8)

Differentiate between the Arduino and Raspberry Pi?

Answer 8)

Arduino	Raspberry Pi
Control unit of Arduino is from Atmega family.	While control unit of Raspberry Pi is from ARM family.
Arduino is based on a microcontroller.	While Raspberry Pi is based on a microprocessor.

It is designed to control the electrical components connected to the circuit board in a system.	While Raspberry Pi computes data and produces valuable outputs, and controls components in a system based on the outcome of its computation.
Arduino boards have a simple hardware and software structure.	While Raspberry Pi boards have a complex architecture of hardware and software.
It has a higher I/O current drive strength.	While Raspberry Pi has a lower I/O current drive strength.
It is cheaper in cost.	While Raspberry Pi is expensive.

Question 9)

List out the significant components of Raspberry Pi? What kind of projects have you done with Raspberry Pi?

Answer 9)

There are three main components of Raspberry Pi :

CPU and GPU

The CPU is the brains behind the Pi. It has a speed of 1.5GHz instead of 1.4GHz. This allows it to function even closer to an average full-scale PC without being as expensive. It can comfortably support office applications and web browsing. Furthermore, the GPU that the Raspberry Pi 4 uses is a VideoCore VI graphics processor that is the first in the Raspberry Pi models to support 4K video at 60 frames per second.

RAM

A different component of the Raspberry Pi 4 that sets it apart from past versions is its RAM. Before, you were limited to 0.5GB, and later 1GB RAM. 1GB of memory is usually sufficient for electronic projects, but not for more complicated PC-like tasks. With the Raspberry Pi 4, you can choose between 2GB, 4GB, or 8GB RAM. In combination with the improved CPU, the larger RAM opens more possibilities for how you interact with the Pi, and you can select the amount that you need for your intended purposes.

CONNECTIONS

Following the theme of making the Raspberry Pi 4 more akin to a full-fledged PC, it also has more connection components. The dual-band wi-fi that it supports is actually the same as the last update of the Raspberry Pi 3, called the Model B+, but it has Bluetooth 5.0 as opposed to Bluetooth Low Energy 4.2. On top of this wireless functionality, it has an Ethernet port, two USB ports that are perfect for a mouse and keyboard, a micro

USB port for its power supply, two micro HDMI ports, an audio jack, and a CSI camera port. However you want to use it, the Pi 4 has pretty much every base covered.

PROJECTS DONE ON RASPBERRY PI

Developed a smart fence system for industry level implementation for fatality prevention.

Developed a locked door indicator.

Developed a system access control system which can have various industry level implementations.

Question 10)

Explain briefly about the following concepts

d)Raspberry Pi Software

The Raspberry Pi OS was made specifically with the Raspberry Pi in mind, and it'll run on every single kind of Raspberry Pi board, apart from the Pico edition, due to its far smaller size and computing power. The Raspberry Pi OS uses a modified version of the Lightweight X11 Desktop Environment(or LXDE) as its desktop environment. LXDE is a desktop environment specifically made for single-chip computers and those with low resources. It uses an Openbox stacking window manager together with its own unique theme to bring a cohesive and unique user experience. Each distribution of the OS will come with an algebra program called Wolfram Mathematica, as well as the Minecraft: Pi Edition game, in addition to a hyper-lightweight version of Chromium.

e)Raspberry Pi Hardware

The Raspberry Pi hardware has evolved through several versions that feature variations in the type of the central processing unit, amount of memory capacity, networking support, and peripheral-device support. This block diagram describes models B, B+, A and A+. The Pi Zero models are similar, but lack the Ethernet and USB hub components. The Ethernet adapter is internally connected to an additional USB port. In Model A, A+, and the Pi Zero, the USB port is connected directly to the system on a chip (SoC). On the Pi 1 Model B+ and later models the USB/Ethernet chip contains a five-port USB hub, of which four ports are available, while the Pi 1 Model B only provides two. On the Pi Zero, the USB port is also connected directly to the SoC, but it uses a micro USB (OTG) port. Unlike all other Pi models, the 40 pin GPIO connector is omitted on the Pi Zero, with solderable through-holes only in the pin locations. The Pi Zero WH remedies this.

f)Raspberry Pi Program


Program to blink the pin 5 times

It is written and compiled in the online IDE and compiler for Raspberry Pi




mycode.py

```
1 #KULVIR SINGH
2 #19BCE2074
3 import RPi.GPIO as GPIO
4 import time
5 GPIO.setup(3, GPIO.OUT)
6 for i in range(5):
7     GPIO.output(3, GPIO.HIGH)
8     time.sleep(1)
9     GPIO.output(3, GPIO.LOW)
10    time.sleep(1)
```

mycode.py

 RPi GPIO connectors:

2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40
5V Power	5V Power	Ground	BCM 14	BCM 15	BCM 16	Ground	BCM 23	BCM 24	Ground	BCM 25	BCM 8	BCM 7	BCM 1	Ground	BCM 12	Ground	BCM 18	BCM 20	BCM 21
1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39
3V3 Power	BCM 2	BCM 3	BCM 4	Ground	BCM 17	BCM 27	BCM 22	3V3 Power	BCM 19	BCM 9	BCM 11	Ground	BCM 0	BCM 5	BCM 6	BCM 13	BCM 19	BCM 26	Ground



Running code...