AIM OF THE EXPERIMENT:-

VGA Interfacing using ESP32S microcontroller using D15 VGA cable.

EQUIPMENT REQUIRED:-

Sl. No.	Equipment Name	Specification	Quantity
1.	ESP32S MICROCONTROLLER	NODEMCU	01
2.	Jumpers/wires	-	as req.
3.	USB Data cable	USB-A to Micro USB	01
4.	Breadboard	-	01

SOFTWARE REQUIRED:-

1. ARDUINO IDE

THEORY:-

The **ESP32** is a powerful, low-cost microcontroller with dual-core processing (up to 240 MHz), 520 KB SRAM, and support for Wi-Fi and Bluetooth (4.2 BLE). It features 34 GPIO pins, 12-bit ADC, PWM, DAC, and multiple communication protocols (SPI, I2C, UART). The ESP32 has low power consumption, with deep sleep modes consuming less than 10 µA, making it ideal for battery-powered projects. It's supported by development environments like Arduino IDE and MicroPython, and is widely used in IoT, smart devices, and embedded systems

General Specifications:

- Processor: Dual-core 32-bit LX6 microprocessor
- Clock Speed: Up to 240 MHz
- RAM: 520 KB SRAM
- Flash Memory: Varies (usually 4 MB to 16 MB depending on the model)
- GPIO Pins: Up to 34 programmable input/output pins
- PWM Channels: Up to 16
- Analog Inputs: 12-bit ADC, up to 18 channels (depends on the variant)
- DAC Outputs: 2x 8-bit DAC for audio or analog output

Connectivity:

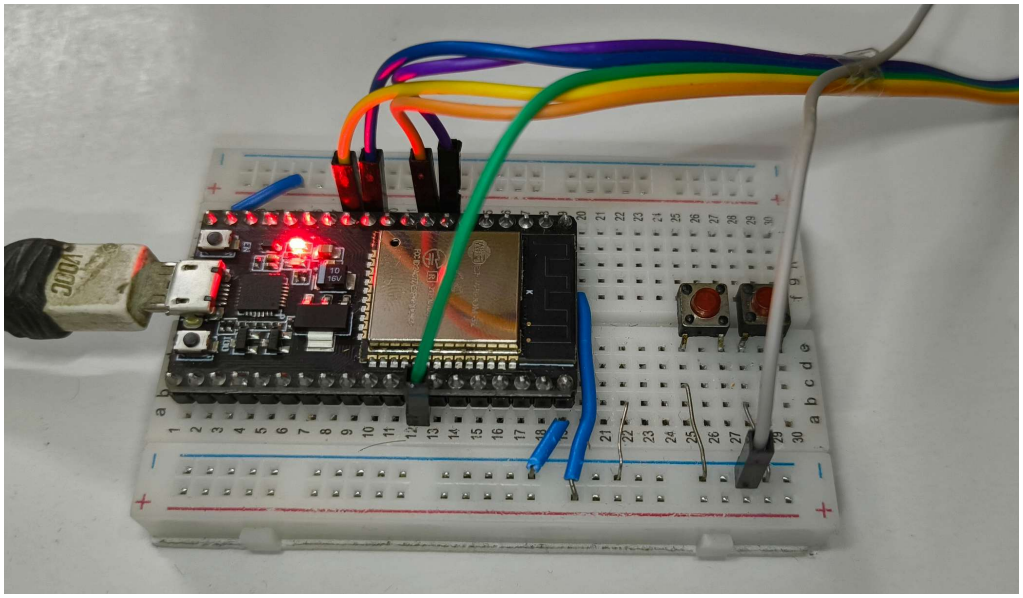
- Wi-Fi: 802.11 b/g/n, support for both station and access point modes
- Bluetooth: Bluetooth 4.2 (Classic and BLE - Bluetooth Low Energy)
- SPI, I2C, UART: Full support for all major communication protocols

VGA (Video Graphics Array) is an analog video display standard introduced by IBM in 1987. It became one of the most widely used video display standards for computer monitors, especially during the 1990s.

The standard VGA resolution is 640x480 pixels with 16 colors (from a palette of 256) or 256 colors in the 320x200 resolution mode. VGA uses analog signals for transmitting video data (separate red, green, blue color channels and synchronization signals). The VGA connector typically has 15 pins in a D-sub (DB-15) configuration, with pins for red, green, blue, horizontal and vertical sync signals, ground, and power.

PROCEDURE:-

1. Arduino IDE software was opened.
2. Then the USB-A was connected to PC and micro USB was connected to ESP32S micro-controller dev kit.
3. Board was selected as ESP32 DEV kit .
4. COM port was select to which the board was connected.
5. Code was written.
6. The button named “Verify ” was clicked.
7. The button named “Upload” was clicked.
8. The BOOT/FLASH button was pressed to turn on the BOOTLOADER mode of ESP32S microcontroller.
9. The code was Uploaded.



10. Then the assigned pins were connected to the respective pins of VGA cable

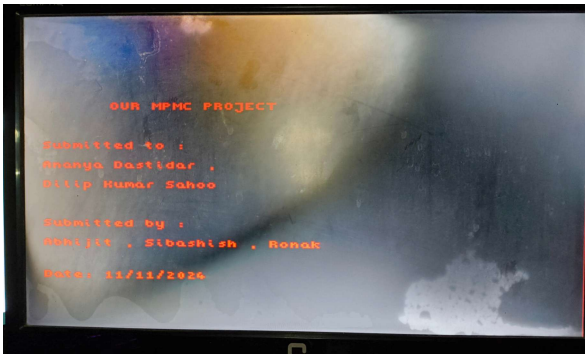
Component	VGA Pin	ESP32 Pin	Description
VGA Red	R	GPIO 14	Red color signal
VGA Green	G	GPIO 19	Green color signal
VGA Blue	B	GPIO 27	Blue color signal
VGA Horizontal Sync	Hsync	GPIO 32	Horizontal Sync signal
VGA Vertical Sync	Vsync	GPIO 33	Vertical Sync signal

11. Outputs were observed on VGA Monitor screen.

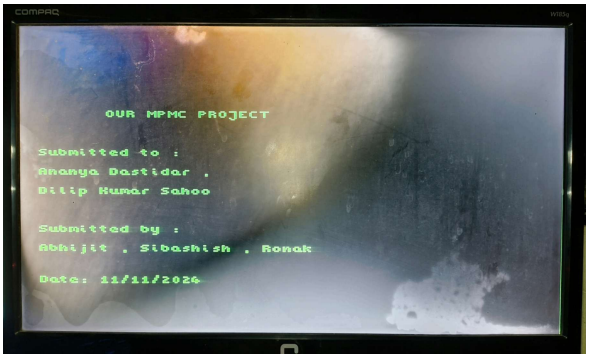
CODE:-

```
#include <ESP32Video.h>
#include <Ressources/Font6x8.h>

const int redPin = 14;
const int greenPin = 19;
const int bluePin = 27;
const int hsyncPin = 32;
const int vsyncPin = 33;

VGA1BitI videodisplay;

const uint8_t frontColors[] = {0x2, 0x0, 0x1, 0x4, 0x1, 0x7, 0x3};
const uint8_t backColors[] = {0x0, 0x7, 0x0, 0x6, 0x7, 0x0, 0x4};

void setup() {
 videodisplay.init(VGAMode::MODE320x240, redPin, greenPin, bluePin, hsyncPin, vsyncPin);
 videodisplay.setFont(Font6x8);
 displayProjectInfo();
 delay(5000);
 videodisplay.clear();
}

void loop() {
 for (int i = 0; i < 10; i++) {
  videodisplay.setCursor(random(1, 300), random(1, 220));
  videodisplay.println("Hello World!");
  delay(250);
 }
 delay(1000);
 videodisplay.clear();
 displayProjectInfo();
 delay(5000);
 videodisplay.clear();
}

void displayProjectInfo() {
 videodisplay.setCursor(60, 50);
 videodisplay.println("OUR MPMC PROJECT");
 videodisplay.setCursor(20, 80);
 videodisplay.println("Submitted to :");
 videodisplay.setCursor(20, 95);
 videodisplay.println("Ananya Dastidar ,");
 videodisplay.setCursor(20, 110);
 videodisplay.println("Dilip Kumar Sahoo");
 videodisplay.setCursor(20, 140);
 videodisplay.println("Submitted by :");
 videodisplay.setCursor(20, 155);
 videodisplay.println("Abhijit , Sibashish , Ronak");
 videodisplay.setCursor(20, 180);
 videodisplay.print("Date: ");
 videodisplay.println("11/11/2024");
 delay(2000);
}
```

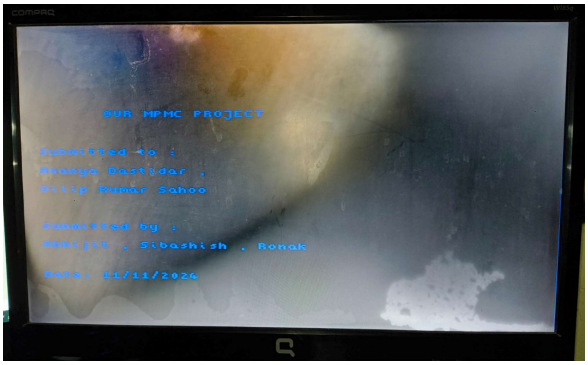
OBSERVATION:-



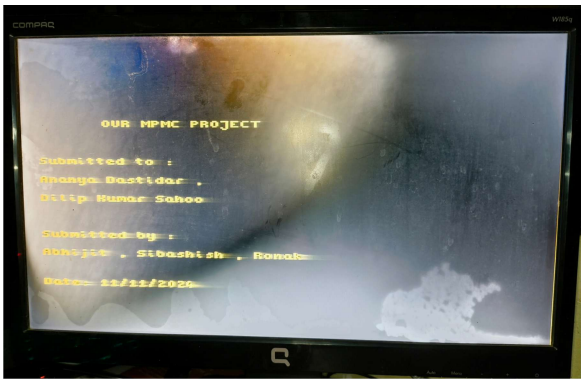
ONLY RED PIN CONNECTED



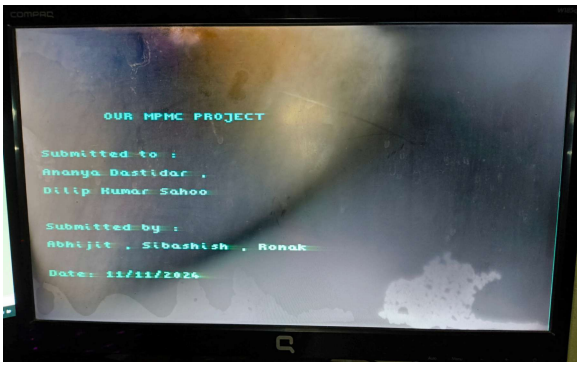
ONLY GREEN PIN CONNECTED



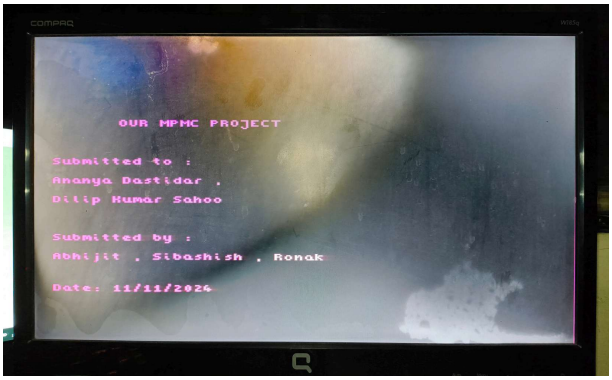
ONLY BLUE PIN CONNECTED



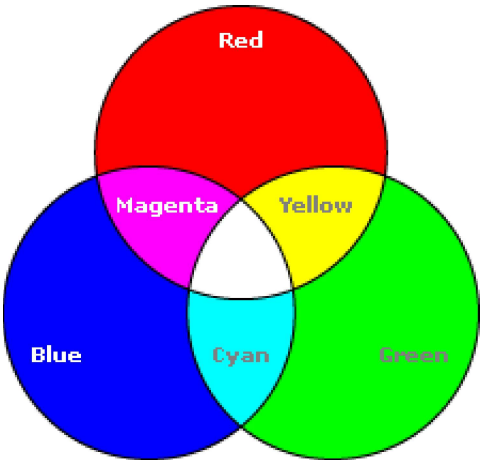
RED + GREEN

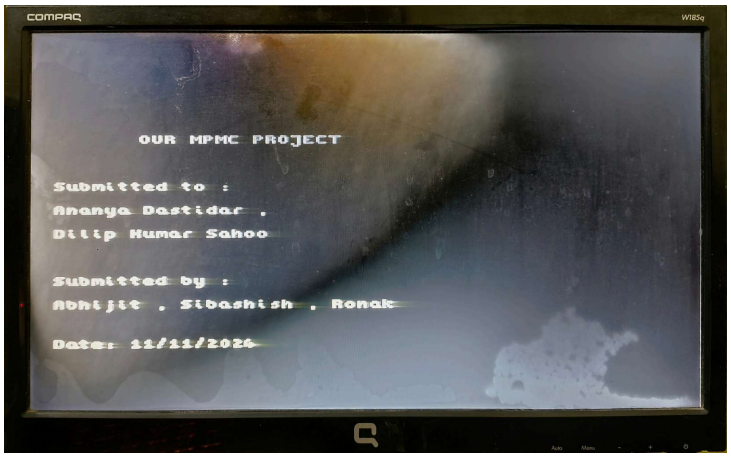


GREEN + BLUE

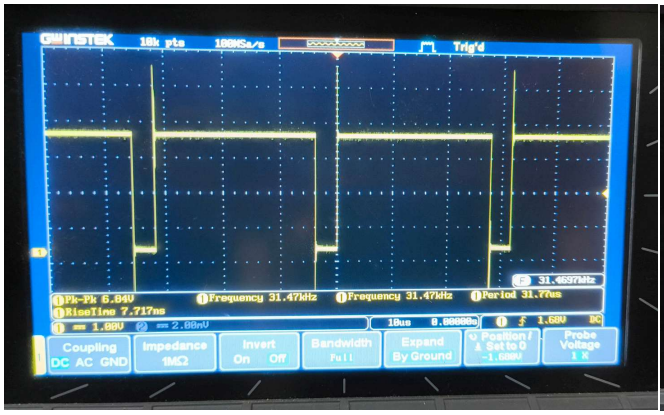


RED + BLUE

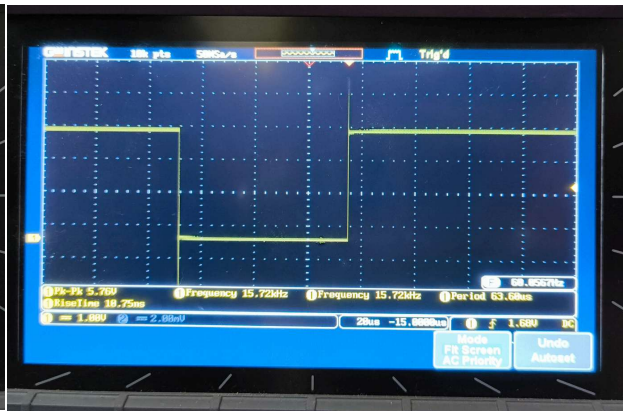




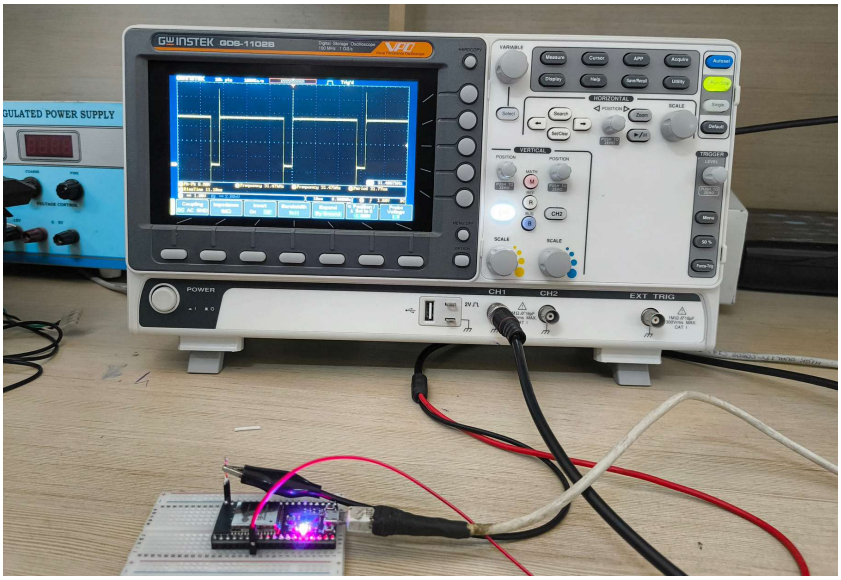
RED + GREEN + BLUE



H-Sync



V-Sync



CONCLUSION:-

In conclusion, this project successfully demonstrates the integration of an ESP32 microcontroller with a VGA display, creating an interactive and visually engaging interface. Through the use of the ESP32Video library, we were able to display text and graphical content on a 320x240 VGA screen.