Answering Door Bell

An assistive device for the aged

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1. Introduction and brainstorming:

1.1 Introduction and Background:

Calling Bells are common and used in almost every household in our society. As soon as the bell rings, we come to know that someone has arrived but very often it happens that we are busy with our house hold work or something else and due to some reason, cannot open the door immediately. This answering bell has a solution to this problem.

1.2 The problem

This problem came up when the respected Chairperson of our school Mrs. Bhanumati Neelkanthan spoke to us. She says that due to her age, she is unable to attend her guests at the door immediately.

1.3 Problem Statement

Difficulties in answering to guests at the door immediately

1.4 Ideation (after brain storming session)

Make a device to display a message to the guest at the door with the help of a remote

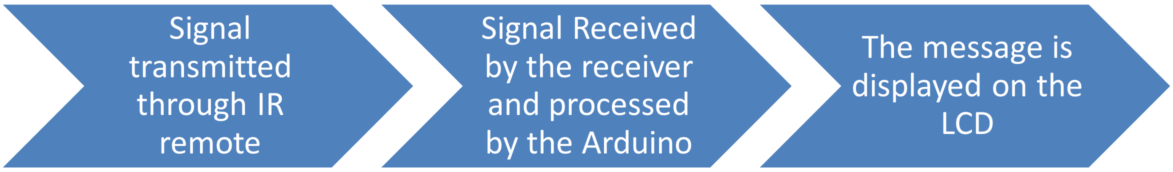
2. The First Prototype

2.1 Introduction:

A simple device with an LCD display (outdoor unit). This will contain some preloaded messages which may be displayed to the guest.
This display may be controlled with a remote.

2.2 Working :

Mostly all remotes work on IR technology. Whenever we press any button on the remote, it emits a IR with a particular frequency. This frequency is unique to all buttons on the remote and can be captured. We propose to use this feature to display different messages on different buttons.


Signal transmitted through IR remote
Signal Received by the receiver and processed by the Arduino
The message is displayed on the LCD

(flowchart representing working of device)

2.3 Pre-requisite :

- Basic knowledge of electronic circuits
- Basic knowledge of Arduino programming Language
- Basic knowledge of working with Arduino

2.4 Hardware required :

- 3 pin IR Receiver (TSOP-848)
- Any IR remote (like the one's used in TVs, here used Sony RMSC1)
- LCD Display (16x2)
- Arduino Uno
- Jumper wires
- potetiometer
- RGB Leds or buzzer

2.5 Circuit / Connections :

<u>IR Receiver</u>

- Vcc to 5V pin of Arduino
- GND to Ground pin of Arduino
- OUT to the pin 6 of Arduino.

LED / Buzzer Connection

- LED Positive to Pin 7
- LED Ground to GND

LCD Connection

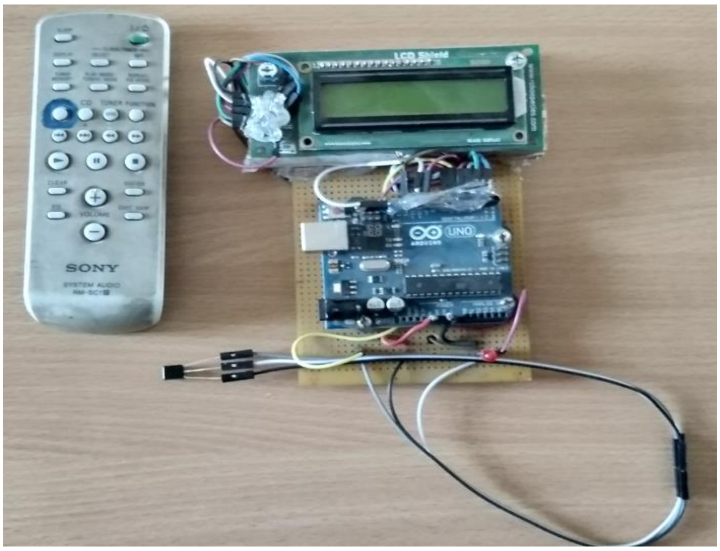
- Pin 1: GND to GND of Arduino
- Pin 2: 5V to 5V of Arduino
- Pin4: RS to Pin12 of Arduino
- Pin5: RW to GND of Arduino
- Pin6: EN to Pin11 of Arduino
- Pin7: -
- Pin8: -
- Pin9: -
- Pin10: -
- Pin11: D4 to Pin5 of Arduino
- Pin12: D5 to Pin4 of Arduino
- Pin13: D6 to pin3 of Arduino
- Pin14: D7 to Pin2 of Arduino
- Pin15: VCC to 10 of Arduino
- Pin16: GND to GND of Arduino

2.6 Source Code :

```
////(install additional libraries)
#include <IRremote.h>
#include <LiquidCrystal.h>
LiquidCrystalLCD(12,11,5,4,3,2);
int RECV_PIN = 6;
IRrecvirrecv(RECV_PIN);
decode_results results;
int LED=7;
#define BUTTON_1 0xC41
#define BUTTON_2 0xA41
#define BUTTON_3 0xF01
#define BUTTON_4 0xA81
```

```
#define LCD_LIGHT_PIN 10

void setup() {
pinMode (LED, OUTPUT);
irrecv.enableIRIn();
pinMode(4,OUTPUT);
pinMode(LCD_LIGHT_PIN, OUTPUT);
digitalWrite(LCD_LIGHT_PIN, LOW);

  }

void loop() {
if (irrecv.decode(&results))
  {
if (results.value == BUTTON_1)
  {
digitalWrite(LCD_LIGHT_PIN, HIGH);
digitalWrite(LED,HIGH);
LCD.begin(16,2);
LCD.clear();
LCD.setCursor(5,0);
LCD.print("PLEASE");
LCD.setCursor(1,1);
LCD.print("WAIT FOR 5 MIN");
    }
irrecv.resume();
if (results.value == BUTTON_2)
   {
digitalWrite(LCD_LIGHT_PIN, HIGH);
digitalWrite(LED,HIGH);
LCD.begin(16,2);
LCD.clear();
LCD.setCursor(2,0);
LCD.print("WE WILL MEET");
LCD.setCursor(5,5);
LCD.print("LATER");
   }
irrecv.resume();
if (results.value == BUTTON_3)
  {
digitalWrite(LCD_LIGHT_PIN, HIGH);
digitalWrite(LED,HIGH);
LCD.begin(16,2);
LCD.clear();
LCD.setCursor(1,0);
LCD.print("COME TOMORROW");
   }
irrecv.resume();
if (results.value == BUTTON_4)
  {
digitalWrite(LCD_LIGHT_PIN, LOW);
digitalWrite(LED,LOW);
   }
}

}
```

2.7 Prototype and working :



(prototype 1.1)

Video: https://www.youtube.com/watch?v=erJRWuSbBtY

2.8 Testing and usage :

The device was tested and was installed (after fubrishing) at Mrs Neelkanthan’s house. The device worked perfectly but lacked some features which were rectified in the upcoming prototypes.

2.9 Improvments :

After usage, mam pointed out the following possible improvements.

- Output was limited to only three messages
- Output was only in English, which may not be readable to some users
- Unless knowing who’s the guest, it is difficult to display an appropriate message

3. The Second Prototype

3.1 Introduction:

The second prototype is very similar to the first prototype in terms of working. It mainly eliminated the first two problems faced.

3.2 Difference from the first prototype:

The second prototype is slightly different from the first prototype in terms of hardware and software but showcases the following features absent from the first prototype:

- Can display name and address of host
- Can display a dozen different messages
- Can display messages in both Hindi and English

3.3 Hardware Required:

- IR Receiver (here used 1838T)
- An old Remote (Here using Sony RMT-TX111P)
- Arduino UNO

- LCD display(20 x 2)
- A few Jumper Wires
- An RGB LED or a buzzer
- Potentiometer

3.4 Connections / Circuit:

IR Receiver

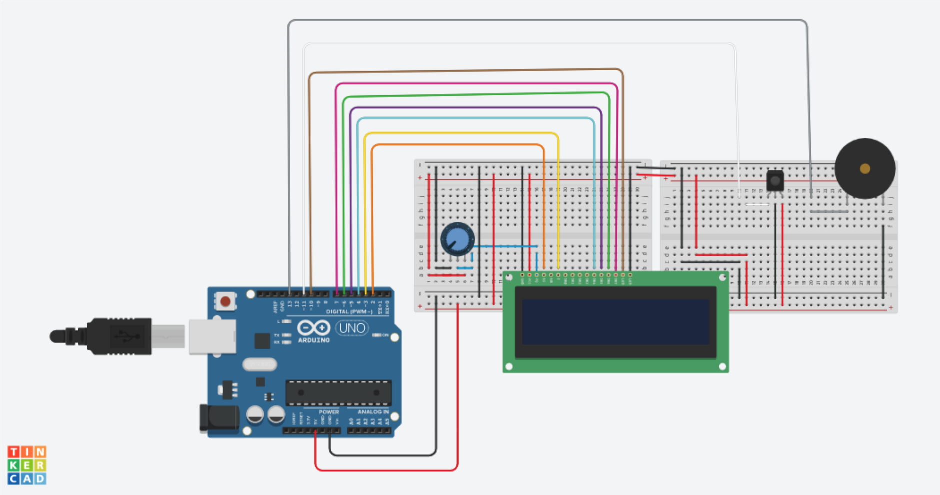
- Vcc to 5V pin of Arduino
- GND to Ground pin of Arduino
- OUT to the pin 11 of Arduino.

Buzzer/ RGB Connection

- Buzzer/ RGB Positive to Pin 13
- Buzzer/ RGB Ground to GND

LCD Connection

- Pin 1: VSS to GND of Arduino
- Pin 2: VDD to 5V of Arduino
- Pin 3: VO to potentiometer (centre pin)
- Pin4: RS to Pin2 of Arduino
- Pin5: RW to GND of Arduino
- Pin6: EN to Pin3 of Arduino
- Pin7: [Not used]
- Pin8: [Not used]
- Pin9: [Not used]
- Pin10: [Not used]
- Pin11: D4 to Pin4 of Arduino
- Pin12: D5 to Pin5 of Arduino
- Pin13: D6 to pin6 of Arduino
- Pin14: D7 to Pin7 of Arduino
- Pin15: A to 10 of Arduino
- Pin16: K to GND of Arduino



Visual circuit of the first prototype

3.5 Source Code :

```
///(this is the source code of device displayed in the following video.
///Not the latest one …)
///Required libraries must be installed

//initialization
#include <IRremote.h>
#include <IRremoteInt.h>
#include <LiquidCrystal.h>
int IRpin = 11;
IRrecv irrecv(IRpin);
decode_results results;
const int rs=2, e=3, d4=4, d5=5, d6=6, d7=7;
LiquidCrystal lcd(rs,e,d4,d5,d6,d7);
const int RGB=13, led=8, bl=10;


//setup
void setup() {
  lcd.begin(16,2);
  lcd.clear();
  Serial.begin(9600);
  pinMode(RGB,OUTPUT);
```

```
 pinMode(led,OUTPUT);
 pinMode(bl,OUTPUT);
 irrecv.enableIRIn(); // Start the receiver
 lcd.clear();
   digitalWrite(RGB,LOW);
   digitalWrite(led,LOW);
   digitalWrite(bl,HIGH);
   lcd.setCursor(0,0);
   lcd.print("D.B.M.S. English");
   lcd.setCursor(0,1);
   lcd.print("     School     ");
}

//working
void loop() {
 if (irrecv.decode(&results)){   //checks if signal is transmitted

   Serial.println(results.value);  // prints the value of the hex code on the serial monitor

//print message on L.C.D. according to the value received
   if(results.value==2672){
    lcd.clear();
    digitalWrite(RGB,LOW);
    digitalWrite(led,LOW);
    digitalWrite(bl,HIGH);
    lcd.setCursor(0,0);
    lcd.print("   B.H. Area   ");
    lcd.setCursor(0,1);
    lcd.print("   Road No. 7  ");
   }



   if(results.value==2704){
    lcd.clear();
    digitalWrite(RGB,LOW);
    digitalWrite(led,LOW);
    digitalWrite(bl, LOW);
```

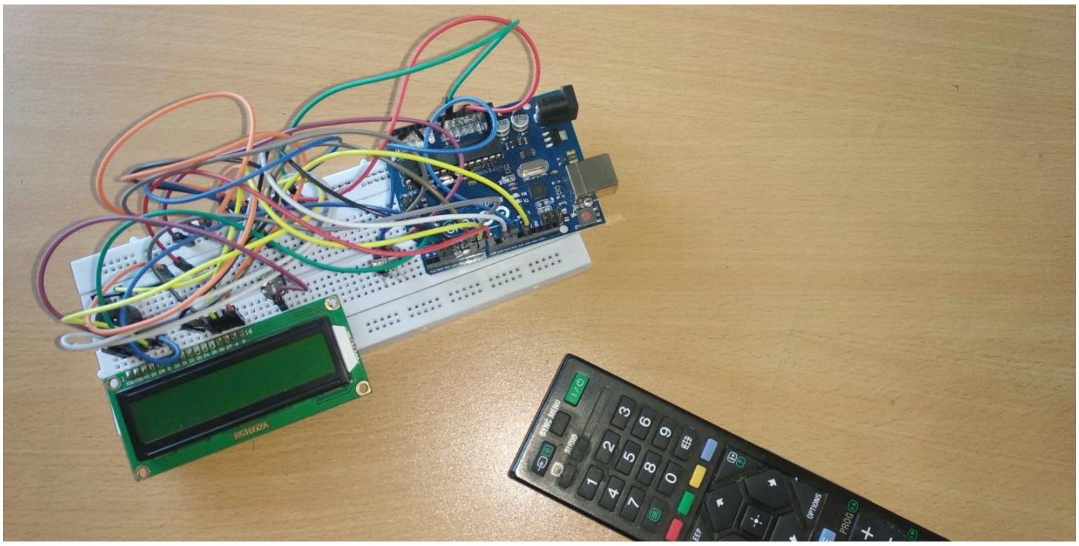
```
  lcd.setCursor(0,0);
  lcd.print("                ");
  lcd.setCursor(0,1);
  lcd.print("                ");
 }

 if(results.value==16){
 lcd.clear();
  digitalWrite(led,HIGH);
  digitalWrite(bl,HIGH);
  lcd.setCursor(0,0);
  lcd.print("Please wait for ");
  lcd.setCursor(0,1);
  lcd.print("    a minute    ");
  digitalWrite(RGB,HIGH);
  delay(500);
  digitalWrite(RGB,LOW);
  delay(100);
  digitalWrite(RGB,HIGH);
  delay(50);
  digitalWrite(RGB,LOW);
  delay(50);
  digitalWrite(RGB,HIGH);
  delay(50);
  digitalWrite(RGB,LOW);
  delay(50);
  digitalWrite(RGB,HIGH);
  delay(250);
  digitalWrite(RGB,LOW);
  digitalWrite(led,LOW);
}


if(results.value==2064){
 lcd.clear();
  digitalWrite(led,HIGH);
  digitalWrite(bl,HIGH);
  lcd.setCursor(0,0);
  lcd.print("    Please    ");
  lcd.setCursor(0,1);
  lcd.print("   Come  in   ");
  digitalWrite(RGB,HIGH);
  delay(500);
  digitalWrite(RGB,LOW);
  delay(100);
  digitalWrite(RGB,HIGH);
  delay(50);
  digitalWrite(RGB,LOW);
  delay(50);
  digitalWrite(RGB,HIGH);
  delay(50);
  digitalWrite(RGB,LOW);
  delay(50);
  digitalWrite(RGB,HIGH);
  delay(250);
  digitalWrite(RGB,LOW);
  digitalWrite(led,LOW);
}


if(results.value==1040){
 lcd.clear();
  digitalWrite(led,HIGH);
  digitalWrite(bl,HIGH);
  lcd.setCursor(0,0);
  lcd.print("    Just     ");
  lcd.setCursor(0,1);
  lcd.print("   coming    ");
  digitalWrite(RGB,HIGH);
  delay(500);
  digitalWrite(RGB,LOW);
  delay(100);
  digitalWrite(RGB,HIGH);
  delay(50);
  digitalWrite(RGB,LOW);
  delay(50);
  digitalWrite(RGB,HIGH);
  delay(50);
  digitalWrite(RGB,LOW);
  delay(50);
  digitalWrite(RGB,HIGH);
  delay(250);
  digitalWrite(RGB,LOW);
  digitalWrite(led,LOW);
}


if(results.value==528){
 lcd.clear();
  digitalWrite(led,HIGH);
  digitalWrite(bl,HIGH);
  lcd.setCursor(0,0);
  lcd.print("Please wait for ");
  lcd.setCursor(0,1);
  lcd.print("    5 minutes   ");
  digitalWrite(RGB,HIGH);
  delay(500);
  digitalWrite(RGB,LOW);
  delay(100);
  digitalWrite(RGB,HIGH);
  delay(50);
  digitalWrite(RGB,LOW);
  delay(50);
  digitalWrite(RGB,HIGH);
  delay(50);
  digitalWrite(RGB,LOW);
  delay(50);
  digitalWrite(RGB,HIGH);
  delay(250);
  digitalWrite(RGB,LOW);
  digitalWrite(led,LOW);
}
```

```
if(results.value==3088){
 lcd.clear();
   digitalWrite(led,HIGH);
   digitalWrite(bl,HIGH);
   lcd.setCursor(0,0);
   lcd.print(" Please drop it ");
   lcd.setCursor(0,1);
   lcd.print(" in the mailbox ");
   digitalWrite(RGB,HIGH);
   delay(500);
   digitalWrite(RGB,LOW);
   delay(100);
   digitalWrite(RGB,HIGH);
   delay(50);
   digitalWrite(RGB,LOW);
   delay(50);
   digitalWrite(RGB,HIGH);
   delay(50);
   digitalWrite(RGB,LOW);
   delay(50);
   digitalWrite(RGB,HIGH);
   delay(250);
   digitalWrite(RGB,LOW);
   digitalWrite(led,LOW);
}


if(results.value==2576){
 lcd.clear();
   digitalWrite(led,HIGH);
   digitalWrite(bl,HIGH);
   lcd.setCursor(0,0);
   lcd.print("   Can we meet  ");
   lcd.setCursor(0,1);
   lcd.print("     Later?     ");
   digitalWrite(RGB,HIGH);
   delay(500);
   digitalWrite(RGB,LOW);
```

```
  delay(100);
  digitalWrite(RGB,HIGH);
  delay(50);
  digitalWrite(RGB,LOW);
  delay(50);
  digitalWrite(RGB,HIGH);
  delay(50);
  digitalWrite(RGB,LOW);
  delay(50);
  digitalWrite(RGB,HIGH);
  delay(250);
  digitalWrite(RGB,LOW);
  digitalWrite(led,LOW);
}


if(results.value==1552){
 lcd.clear();
  digitalWrite(led,HIGH);
  digitalWrite(bl,HIGH);
  lcd.setCursor(0,0);
  lcd.print("   Can we meet  ");
  lcd.setCursor(0,1);
  lcd.print("    tomorrow    ");
  digitalWrite(RGB,HIGH);
  delay(500);
  digitalWrite(RGB,LOW);
  delay(100);
  digitalWrite(RGB,HIGH);
  delay(50);
  digitalWrite(RGB,LOW);
  delay(50);
  digitalWrite(RGB,HIGH);
  delay(50);
  digitalWrite(RGB,LOW);
  delay(50);
  digitalWrite(RGB,HIGH);
  delay(250);
  digitalWrite(RGB,LOW);
  digitalWrite(led,LOW);
}

if(results.value==3600){
 lcd.clear();
  digitalWrite(led,HIGH);
  digitalWrite(bl,HIGH);
  lcd.setCursor(0,0);
  lcd.print("  We will meet ");
  lcd.setCursor(0,1);
  lcd.print(" one hour later ");
  digitalWrite(RGB,HIGH);
  delay(500);
  digitalWrite(RGB,LOW);
  delay(100);
  digitalWrite(RGB,HIGH);
  delay(50);
  digitalWrite(RGB,LOW);
  delay(50);
  digitalWrite(RGB,HIGH);
  delay(50);
  digitalWrite(RGB,LOW);
  delay(50);
  digitalWrite(RGB,HIGH);
  delay(250);
  digitalWrite(RGB,LOW);
  digitalWrite(led,LOW);
}

if(results.value==272){
 lcd.clear();
  digitalWrite(led,HIGH);
  digitalWrite(bl,HIGH);
  lcd.setCursor(0,0);
  lcd.print("    Meet you    ");
  lcd.setCursor(0,1);
  lcd.print("     there.     ");
```

```
      digitalWrite(RGB,HIGH);
      delay(500);
      digitalWrite(RGB,LOW);
      delay(100);
      digitalWrite(RGB,HIGH);
      delay(50);
      digitalWrite(RGB,LOW);
      delay(50);
      digitalWrite(RGB,HIGH);
      delay(50);
      digitalWrite(RGB,LOW);
      delay(50);
      digitalWrite(RGB,HIGH);
      delay(250);
      digitalWrite(RGB,LOW);
      digitalWrite(led,LOW);
    }

     if(results.value==2320){
     lcd.clear();
      digitalWrite(led,LOW);
      digitalWrite(bl,HIGH);
      digitalWrite(RGB,LOW);
      lcd.setCursor(0,0);
      lcd.print("D.B.M.S. English");
      lcd.setCursor(0,1);
      lcd.print("    School    ");
    }

    delay(499);
    irrecv.resume();
    delay(499);
   }//if any results received
}//void loop
```

3.6 Prototype and Working :



(The second prototype)

The second prototype worked perfectly and was able to eliminate the first two objectives, but to add a camera was still a problem, which was fixed in the third prototype.

Video link: https://www.youtube.com/watch?v=Oe4iaxCR6WY

4. The Third Prototype (V 3.1)

4.1 Introduction:

The third prototype adds a camera to the second prototype and an app to stream the camera. The third prototype also enables to unlock the door with the app .

4.2 Difference from the previous prototypes:

Prototype 1 and Prototype 2 were only directive but not interactive. Also, it only had a remote but this may be controlled with an app…

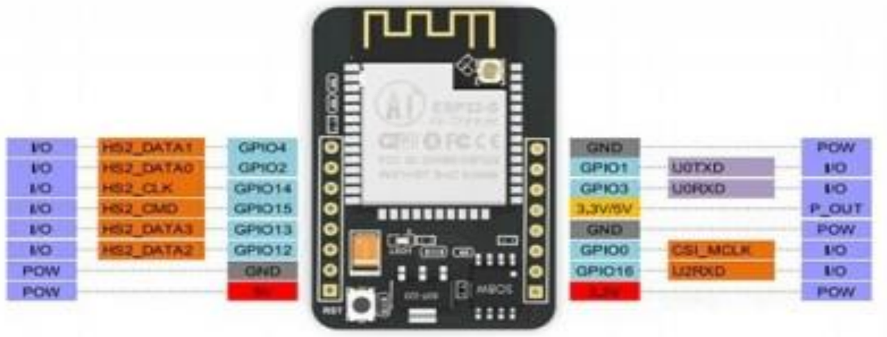
4.3 Hardware required :

In addition to the second prototype, the following hardware may be required

- ESP32-CAM board
- Jumper Wires
- FTDI programmer to upload code (here used Arduino Uno instead)

4.4 Additional software required :

To prepare the app for the third prototype, we have used the Blynk IOT platform. Blynk is a platform which helps us to interact with specially enabled hardware. In this project, we'll be using esp-32 board which is wifi enabled. So, using blynk, we'll be able to communicate with the app and hardware through wifi.



(Esp32 cam pinout diagram)

4.5 Circuit :

- Esp-32 cam GND to Arduino GND
- Esp-32 cam 5v to Arduino 5v
- Esp-32 cam U0R to Arduino TR
- Esp-32 cam U0T to Arduino TX
- Esp-32 cam GPIO-0 to Esp-32 cam GND
- Arduino reset to Arduino GND
- GPIO 21 (pin 5) to switch

4.6 Preparing the app :

1. Install the Blynk (legacy) software from Google Play Store / Apple App Store and sign up / log in
2. Click on the new project button and name the project. Save the Auth Token (also sent to the registered email ID)
3. Add the image gallery widget and configure to work with virtual pin V1
4. Add the notification widget
5. Connect mobile network to same wifi whose credentials have been uploaded onto the esp32cam board

4.7 Source Code :

The source code has 4 parts:

Esp32cam.ino:

```
#include "esp_camera.h"
#include <WiFi.h>
#include <WiFiClient.h>
#include <BlynkSimpleEsp32.h>
//
// WARNING!!! Make sure that you have either selected ESP32 Wrover
Module,
//           or another board which has PSRAM enabled
//

// Select camera model
```

```
//#define CAMERA_MODEL_WROVER_KIT
//#define CAMERA_MODEL_ESP_EYE
//#define CAMERA_MODEL_M5STACK_PSRAM
//#define CAMERA_MODEL_M5STACK_WIDE
#define CAMERA_MODEL_AI_THINKER

#include "camera_pins.h"


#define LED 21
#define BUTTON 14

const char* ssid = "SSID";
const char* password = "PASS";
char auth[] = "AUTH_TOKEN";

String my_Local_IP;

void startCameraServer();


void capture()
{
  digitalWrite(LED,HIGH);
  uint32_t number = random(40000000);
  Blynk.notify("Someone is at the door..");
  Serial.println("http://"+my_Local_IP+"/capture?_cb="+
(String)number);
  Blynk.setProperty(V1, "urls",
"http://"+my_Local_IP+"/capture?_cb="+(String)number);
  delay(1000);
  digitalWrite(LED,LOW);

}
void setup() {
  Serial.begin(115200);
  pinMode(LED,OUTPUT);
  Serial.setDebugOutput(true);
```

```
 Serial.println();

 camera_config_t config;
 config.ledc_channel = LEDC_CHANNEL_0;
 config.ledc_timer = LEDC_TIMER_0;
 config.pin_d0 = Y2_GPIO_NUM;
 config.pin_d1 = Y3_GPIO_NUM;
 config.pin_d2 = Y4_GPIO_NUM;
 config.pin_d3 = Y5_GPIO_NUM;
 config.pin_d4 = Y6_GPIO_NUM;
 config.pin_d5 = Y7_GPIO_NUM;
 config.pin_d6 = Y8_GPIO_NUM;
 config.pin_d7 = Y9_GPIO_NUM;
 config.pin_xclk = XCLK_GPIO_NUM;
 config.pin_pclk = PCLK_GPIO_NUM;
 config.pin_vsync = VSYNC_GPIO_NUM;
 config.pin_href = HREF_GPIO_NUM;
 config.pin_sscb_sda = SIOD_GPIO_NUM;
 config.pin_sscb_scl = SIOC_GPIO_NUM;
 config.pin_pwdn = PWDN_GPIO_NUM;
 config.pin_reset = RESET_GPIO_NUM;
 config.xclk_freq_hz = 20000000;
 config.pixel_format = PIXFORMAT_JPEG;
 //init with high specs to pre-allocate larger buffers
 if (psramFound()) {
   config.frame_size = FRAMESIZE_UXGA;
   config.jpeg_quality = 10;
   config.fb_count = 2;
 } else {
   config.frame_size = FRAMESIZE_SVGA;
   config.jpeg_quality = 12;
   config.fb_count = 1;
 }

#if defined(CAMERA_MODEL_ESP_EYE)
 pinMode(13, INPUT_PULLUP);
 pinMode(14, INPUT_PULLUP);
#endif
```

```
  // camera init
  esp_err_t err = esp_camera_init(&config);
  if (err != ESP_OK) {
    Serial.printf("Camera init failed with error 0x%x", err);
    return;
  }

  sensor_t * s = esp_camera_sensor_get();
  //initial sensors are flipped vertically and colors are a bit saturated
  if (s->id.PID == OV3660_PID) {
    s->set_vflip(s, 1);//flip it back
    s->set_brightness(s, 1);//up the blightness just a bit
    s->set_saturation(s, -2);//lower the saturation
  }
  //drop down frame size for higher initial frame rate
  s->set_framesize(s, FRAMESIZE_QVGA);

#if defined(CAMERA_MODEL_M5STACK_WIDE)
  s->set_vflip(s, 1);
  s->set_hmirror(s, 1);
#endif

  WiFi.begin(ssid, password);

  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }
  Serial.println("");
  Serial.println("WiFi connected");

  startCameraServer();

  Serial.print("Camera Ready! Use 'http://");
  Serial.print(WiFi.localIP());
  my_Local_IP = WiFi.localIP().toString();
  Serial.println("' to connect");
  Blynk.begin(auth, ssid, password);
}

void loop() {
  // put your main code here, to run repeatedly:
  Blynk.run();
  if(digitalRead(BUTTON) == LOW)
  capture();
}
```

The esp32camera_web_server example code's ino file has to be replaced with the above esp32cam.ino file. Rest 3 files (camera_index.h, camera_pins.h and app_httpd.cpp) must not be changed ….
Replace 'SSID' with wifi name, 'PASS' with wifi password and 'AUTH_TOKEN' with the auth key sent by blynk to the registered ID

4.8 Uploading Procedure :

Unlike the previous protypes, the code cannot be directly uploaded onto the board.

1. Connect the Arduino according to the above circuit and to the computer
2. Upload code by changing the following settings:
    - Install esp32 cam libraries and board managers
    - Under upload settings select Board as ESP wrover module
    - QIO as falsh mode
    - Partition scheme: huge app
    - Flash frequency: 40MHz
    - Upload speed: 115200
3. After the code is successfully uploaded, disconnect the following pins (that were used for shorting)
    - Esp32 cam GPIO-0 and esp32 cam GND

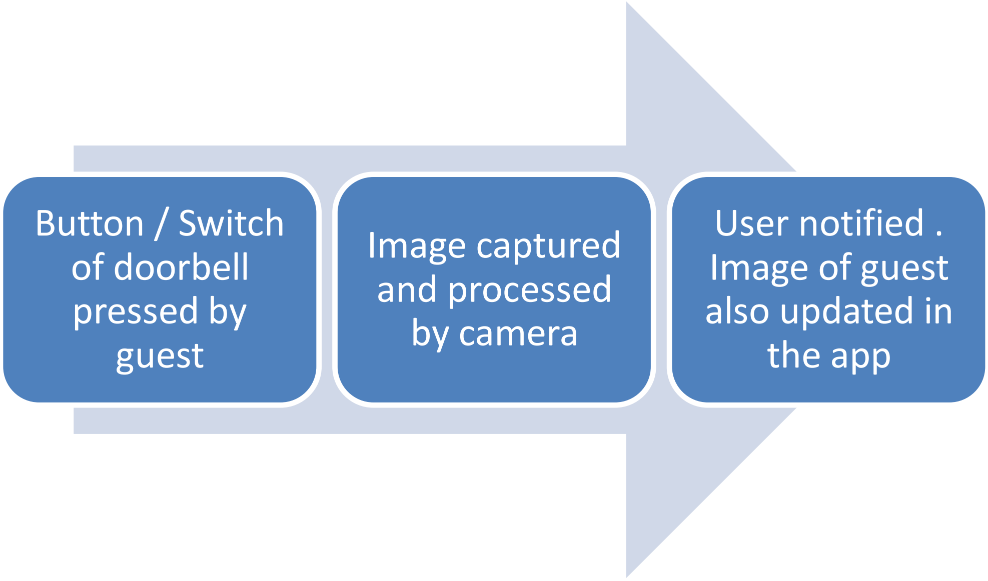
4. Also reset the esp32cam board by pressing the reset button for 2-5 seconds.

Troubleshooting and upload Guide (references):

- https://randomnerdtutorials.com/program-upload-code-esp32-cam/
- https://randomnerdtutorials.com/esp32-cam-troubleshooting-guide/#:~:text=Important%3A%20if%20you%20can't,jumper%20cap%20set%20to%205V.
- https://create.arduino.cc/projecthub/noah_arduino/using-esp32-cam-with-arduino-b4f12c
- https://www.youtube.com/watch?v=U7qbehy9aDo

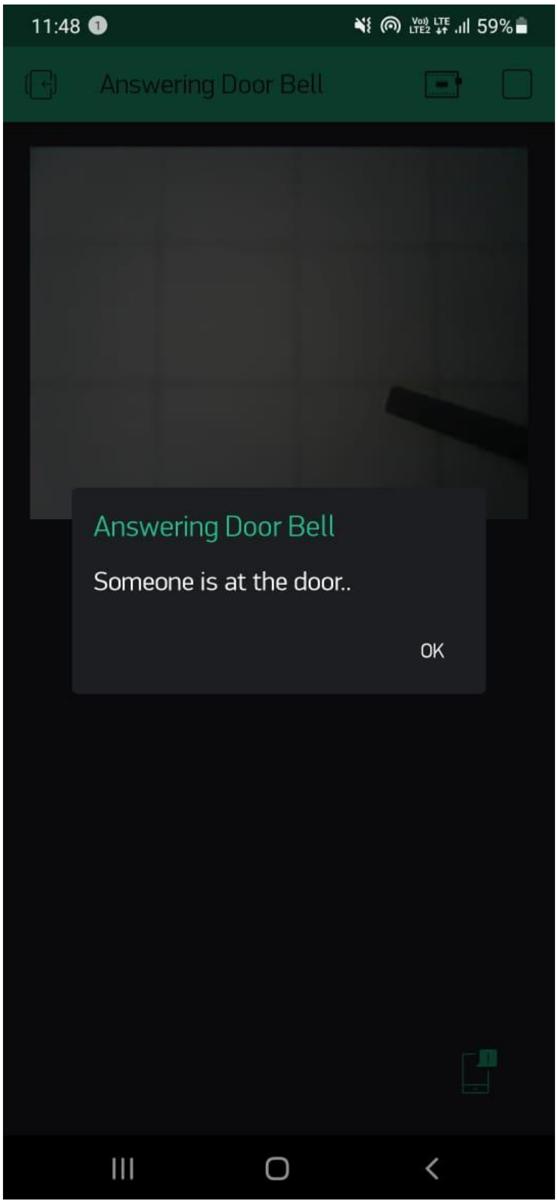
4.9 Working :

Whenever someone presses the doorbell, an image of the guest is captured
This image is sent over to the app and the user is notified as well


Button / Switch of doorbell pressed by guest
Image captured and processed by camera
User notified . Image of guest also updated in the app

(Block diagram of working of third prototype)

4.10 Screenshots :

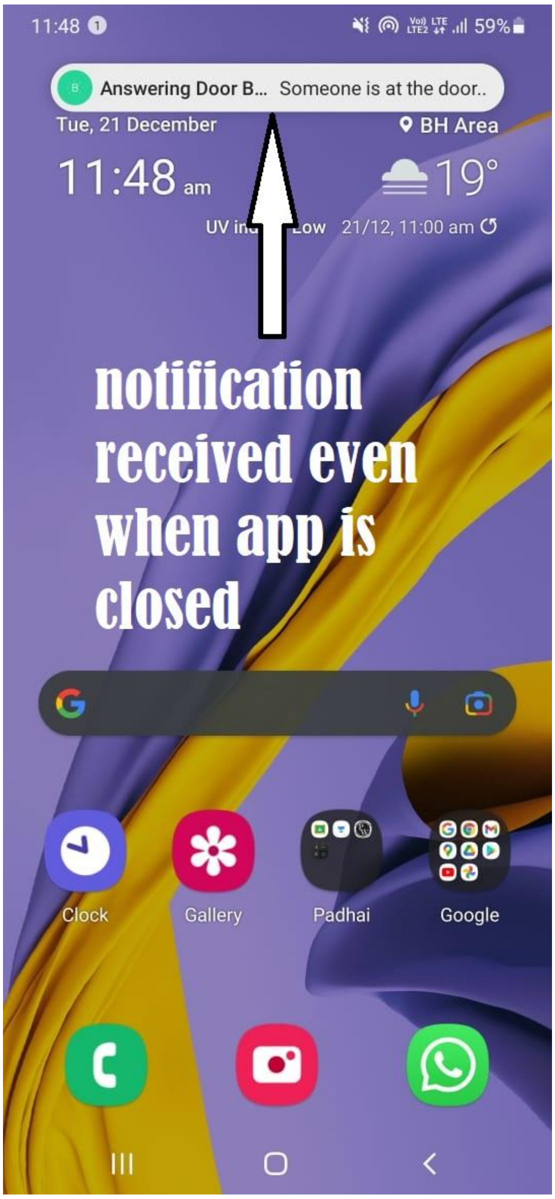


11:48 59%

Answering Door Bell

Answering Door Bell

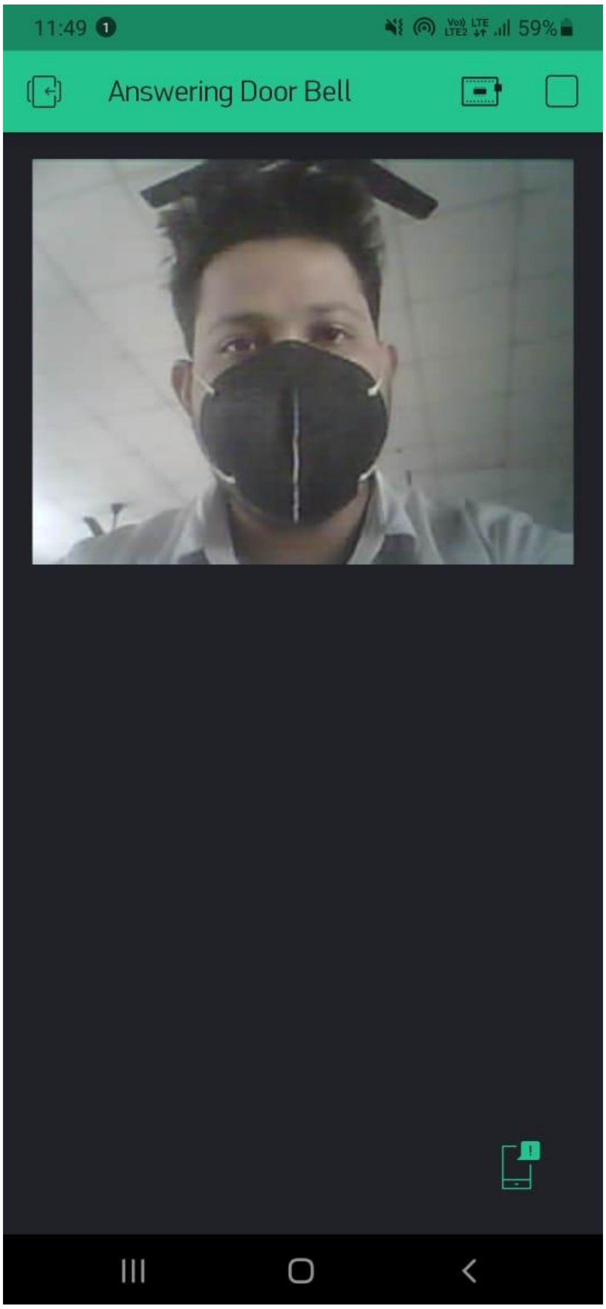
Someone is at the door..



11:48 59%

Answering Door B... Someone is at the door..

(user is notified whenever doorbell is pressed)



(Image captured by camera)

4.11 Demonstrtation :

A short demonstration of prototype 3.1 can be found here : https://youtu.be/y8ASDURxpCY