Independent Project

Basic Electrical and Electronic Engineering

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Report: Phase-1

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Aim: Design an Arduino Object counter by using Seven Segment display.

Tools and Components:

- **Hardware:** Arduino Uno board, Breadboard, Jumper wires, 1 - Seven Segment display, 2-Infrared sensors (Ir sensor), Potentiometer, Resistors, USB cable.
- **Software:** Arduino IDE.

Basic concept:

Our project is a simple objects counter based on Arduino and two IR sensors. More in details, it is a 0 to 9 counter in which the first sensor is used to count ingoing people, the second those outgoing. The difference (IN – OUT) is shown on a 7-segments display.

A counter can be made not only with IR technology but also with thermal imaging systems that use an array of sensors which detect heat sources or using machine vision which usually requires complex image processing algorithms.

An object can be detected with an infrared system consisting of an infrared transmitter and a receiver. More in detail an IR transmitter, also known as IR LED, sends an infrared signal with a certain frequency compatible with an IR receiver which has the task to detect it. There is different kind of IR sensors for different type of application. IR technology is used, for example, in proximity sensors to detect a near object, in contrast sensors to find a path or in counting sensors to count objects.

Hardware description:

Focusing on the 7-segments display SMA42056, this is an electronic component designed to display numbers and often used in digital clocks, electronic meters and other kind of numeric displays.

The SMA42056 model is a common cathode 7-segments display with eventually an additional segment called decimal point or simply dot. Each segment is just a simple LED, and is often represented by the letters from A to G. The 7-segment display doesn't embed a series resistor for each LED and driving them with a constant DC voltage can permanently damage junctions: to avoid this we will use a series resistor of 220Ω for each LED.

Methodology:

This section introduces the methodology involved in the block diagram of the Counter system.

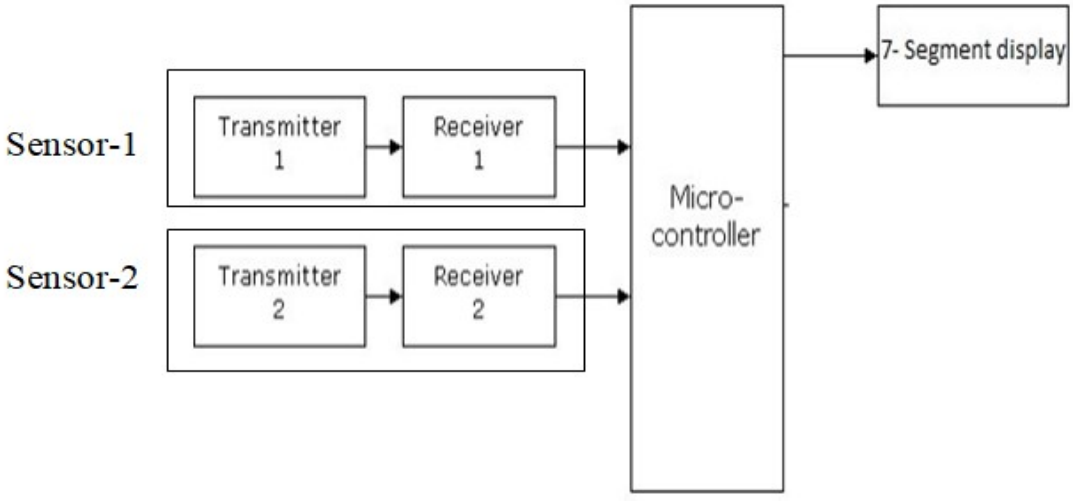

Fig. 1.0 Block diagram of the Counter System.

The first sensor is used to count ingoing people, and the second for those outgoing. We are using Infrared transmitters because infrared beams are not visible to human eyes.

We are using ON- System microcontroller board known as “Arduino Uno board”. The various functions of microcontroller are like:

I. Reading the digital input received from two infrared receivers and calculates the number of objects or persons.
II. Sending this data to display so that the person operating this project should read the number of persons inside the room.

Principle of Operation:

- The IR transmitter sends an infrared signal that, in case of a reflecting surface (e.g. white color), bounces off in some directions including that of the IR receiver that captures the signal detecting the object.

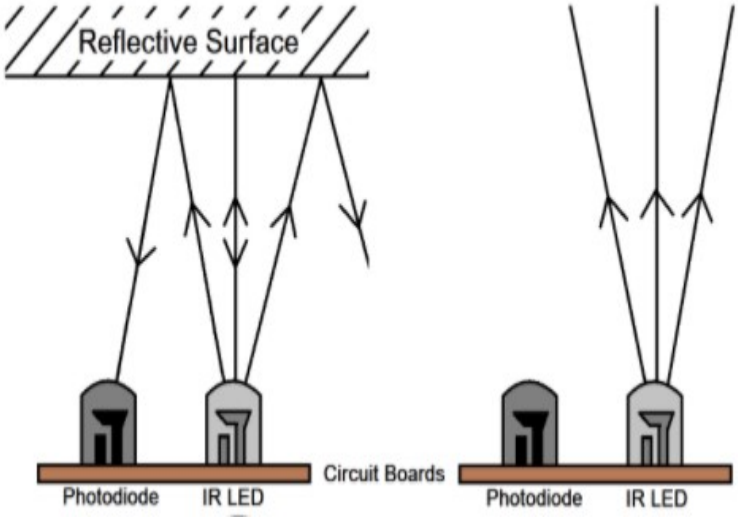

Fig. 1.1 Working Principle of the Infrared sensor

- When the surface is absorbent (e.g. black color) the IR signal isn’t reflected and the object cannot be detected by the sensor.
- This result would occur even if the object is absent.

Circuit Diagram:

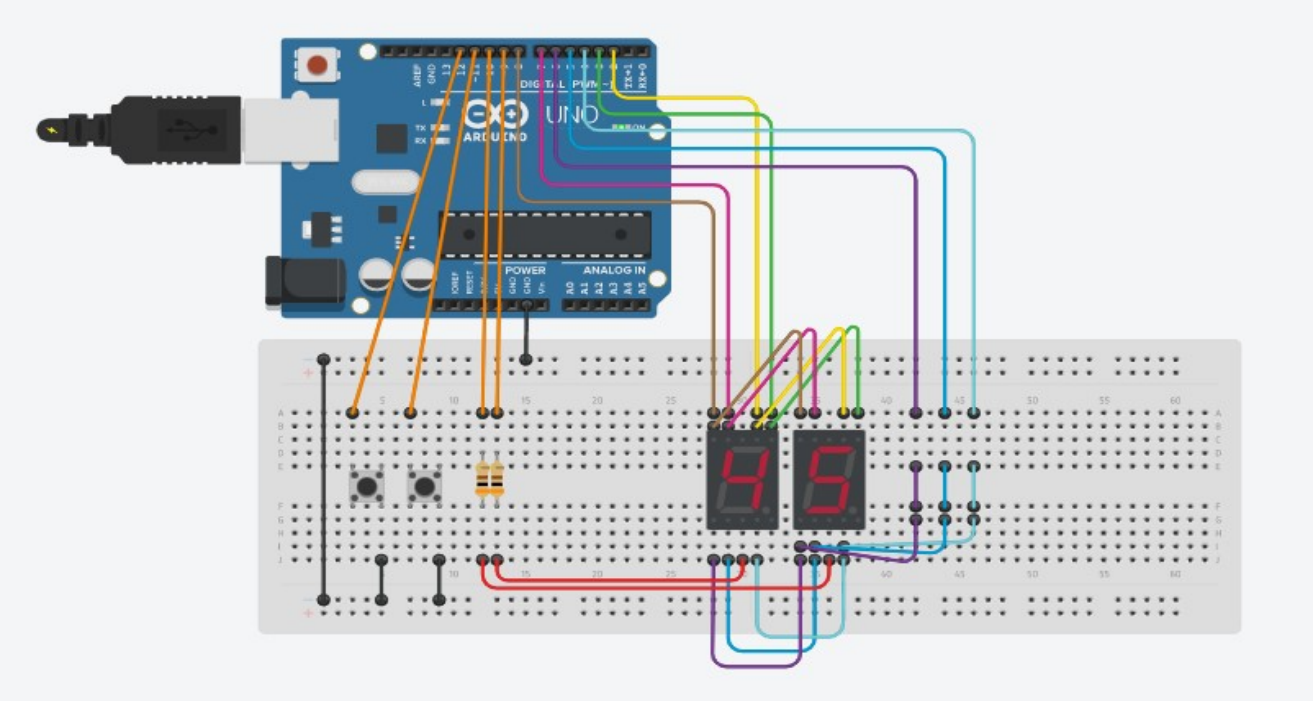

Fig. 1.2 Tinker Circuit Diagram of the Counter system (using push buttons).

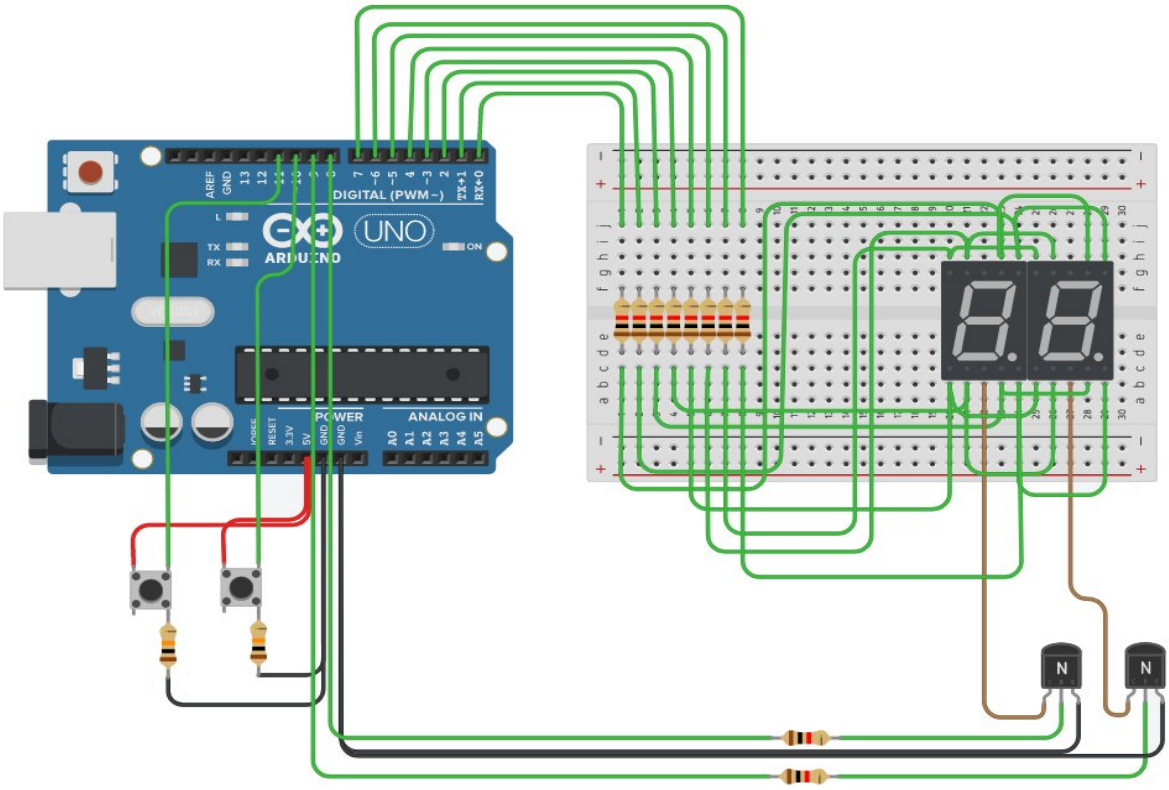

Fig. 1.3 Tinker Circuit diagram of Counter system (using Ir-sensors and push buttons).

Both the circuits as shown in the Fig 1.2 and 1.3 are built on Simulation software known as “tinkercad”. In the fig 1.2 we are using push buttons only, to show that how we are going to give an input to 7- Segment display. In the fig 1.3 we have used 2x Ir sensors and 2 push buttons. But, during the physical demonstration we can use only 2- IR sensors.

Physical Demonstration:

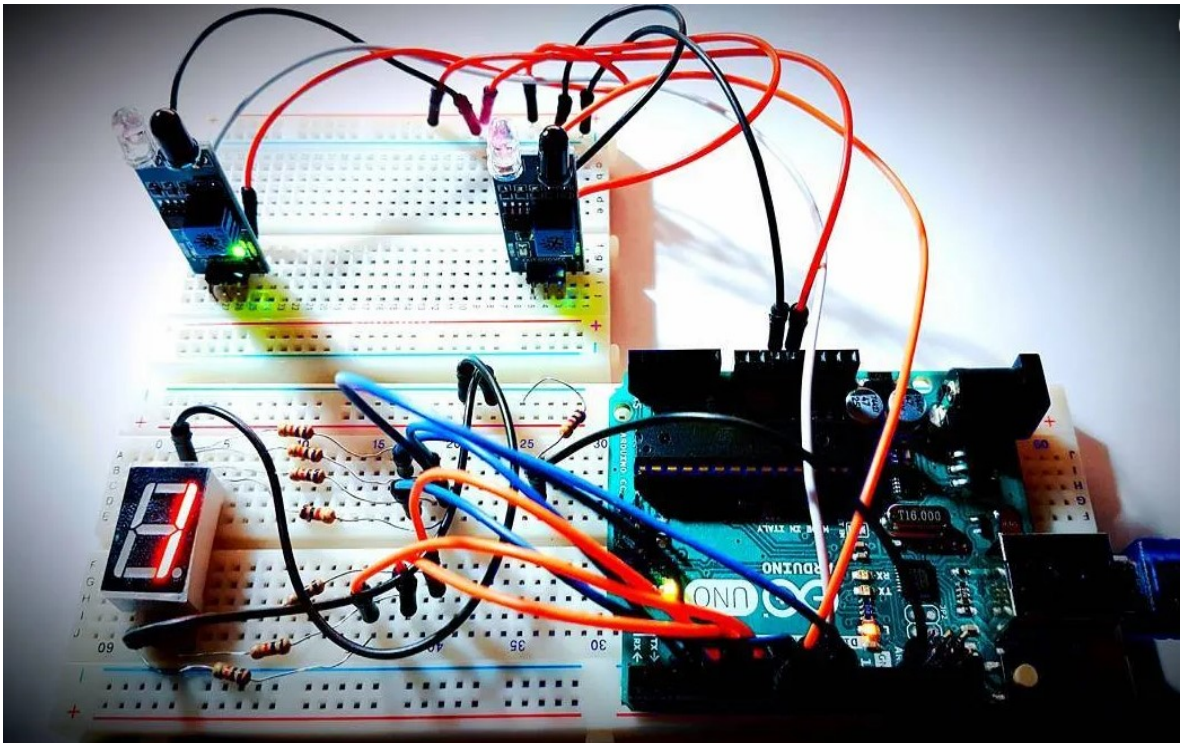

Fig. 1.4 Hardware Simulation of Counter system.

Working:

- There are 2 transmitters and 2 receivers placed in front of each other.
- Swap any object in front of those sensors.
- Then Microcontroller increments or decrements the counter.
- Now swap object in reverse direction then the system decrements the count.

Code description:

```
#define DISP_PIN_0          2       /* digital pin input for segment A  */
#define DISP_PIN_1          3       /* digital pin input for segment B  */
#define DISP_PIN_2          4       /* digital pin input for segment C  */
#define DISP_PIN_3          5       /* digital pin input for segment D  */
#define DISP_PIN_4          6       /* digital pin input for segment E  */
#define DISP_PIN_5          7       /* digital pin input for segment F  */
#define DISP_PIN_6          8       /* digital pin input for segment G  */
#define IR1                 9       /* digital pin input for ir sensor  */
#define IR2                 10      /* digital pin input for ir sensor  */
#define NUMB_OF_PRESET          10      /* Available preset      */
#define NUMB_OF_SEGMENTS        7       /* Available segments    */
#define MAX_NUMB                9       /* High counting range limit   */
* Lookup table.*/
const byte displaySEG[NUMB_OF_PRESET][NUMB_OF_SEGMENTS] = {
      /*  A     B     C     D     E     F     G          */
      { HIGH, HIGH, HIGH, HIGH, HIGH, HIGH,  LOW }, /*  0  */
      {  LOW, HIGH, HIGH,  LOW,  LOW,  LOW,  LOW }, /*  1  */
      { HIGH, HIGH,  LOW, HIGH, HIGH,  LOW, HIGH }, /*  2  */
      { HIGH, HIGH, HIGH, HIGH,  LOW,  LOW, HIGH }, /*  3  */
      {  LOW, HIGH, HIGH,  LOW,  LOW, HIGH, HIGH }, /*  4  */
      { HIGH,  LOW, HIGH, HIGH,  LOW, HIGH, HIGH }, /*  5  */
      { HIGH,  LOW, HIGH, HIGH, HIGH, HIGH, HIGH }, /*  6  */
      { HIGH, HIGH, HIGH,  LOW,  LOW,  LOW,  LOW }, /*  7  */
      { HIGH, HIGH, HIGH, HIGH, HIGH, HIGH, HIGH }, /*  8  */
```

```
        { HIGH, HIGH, HIGH, HIGH,  LOW, HIGH, HIGH }, /*  9  */
};

int IR1_out = HIGH; /* Avoiding initial false detections.    */
int IR2_out = HIGH; /* Avoiding initial false detections.    */
int counter = 0;
int i = 0;
void setDisplayValue(int n) {
  for(i = 0; i < NUMB_OF_SEGMENTS; i++){
    digitalWrite(DISP_PIN_0 + i, displaySEG[n % 10][i]);
  }
}
#define initDisplay() setDisplayValue(0)
void increaseAndDisplay() {
  counter++;
  if(counter > MAX_NUMB) {
    counter = 1;
  }
  setDisplayValue(counter);
}
void decreaseAndDisplay() {
  if(counter) {
    counter--;
    setDisplayValue(counter);
  }
```

```
}
void setup() {
  Serial.begin (9600);
  pinMode(IR1, INPUT);
  pinMode(IR2, INPUT);
  /* Setting Display related PIN as OUTPUT */
  for(i = 0; i < NUMB_OF_SEGMENTS; i++) {
    pinMode(DISP_PIN_0 + i, OUTPUT);
  }
  initDisplay();
}
void loop() {
  IR1_out = digitalRead(IR1);
  IR2_out = digitalRead(IR2);
  if(IR1_out == LOW) {
    increaseAndDisplay();
    delay(500);
  }
  if(IR2_out == LOW) {
    decreaseAndDisplay();
    delay(500);
  }
  delay(100);
}
```

Applications:

- Counting objects or merchandise in industrial sector.
- This counter can be used near the Parking area to know the number of vehicles entering or exiting the area.
- This object counter can also be used in the food factories. **For e.g.;** In the Chips making factories, in chocolate factories to know the per day production.
- This counter can also be used in the hospitals to count the number of increasing or decreasing strength of patients.
- This project can be used as digital Visitor counter in various rooms like seminar hall, conference hall where the capacity of the room is limited and should not be exceeded. The project will display an actual number of persons inside the room.
- Counting people traversing a certain passage or entrance. For example, in commercial buildings there are gates which control user access or presence often used to optimize energy consumption.

Future Scope:

- Human efforts to check the number of counts of objects will be eliminated if we will connect this circuit to the cloud platform.
- Voice alarm system can be added to indicate that the room is full & persons can't enter inside.
- We can also add buzzer in it, this will beeps sound in case of parking area is full of vehicles.
- Camera module can be added, this will helps to count the no. of persons entering or leaving at the same time without any error (Which will increase the efficiency.)

Advantages:

- It is very cheaper, easy to implement and having very low power consumption.
- This counter project can also be used as bidirectional counter. Since this counter does the automatic person counting with the help of two sensors installed on the door frame.
- Very beneficial in the areas like **parking lots.** This counter will not only count the number of cars entering or leaving but, this will helps the guard to know the no. of cars in the parking area. In this way he will be easily able to check whether there is any space left in the parking area for the other vehicles.
- The counter project can be used in Cinema halls, multiplex, malls as well as in temples to count the number of a person entering inside. So that these places should not get overcrowded to avoid congestion.
- This project can also be used in any public transport/trains to count the number of passengers for monitoring purpose.

Challenges:

- The range of IR sensor is very much low so adjusting it accordingly is a difficult task.
- IR sensors have a difficulty in working in the sunlight.
- Black colour absorbs infrared radiations so receiver will have difficulty receiving the signals.

Conclusion:

This project is very beneficial the areas like parking lots. This counter will not only count the number of cars entering or leaving but, this will helps the guard to know the know cars in the parking area. In this way he will be easily able to check whether there is any space left in the parking lot for the other vehicles. With further advancement in project it could become an AI based efficient project that could be implemented in universities, school, and offices for counting people.