

**College of Engineering, Pune**

Dept. of Electronics and Telecommunication Engineering

**SY MCA PROJECT – 2021-22**

**PROJECT NAME –** Bidirectional Visitor Counter

(Using 8051 Microcontroller)

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**Abstract**

**Microcontroller/Microprocessor** is the most versatile device in the world. It’s once a creature of science fiction is today a reality. In real sense it is a device which allows human beings to implement their intelligence in machines. Visitor counting is simply a measurement of the visitor traffic entering and exiting offices, malls, sports venues, etc. Counting the visitors helps to maximize the efficiency and effectiveness of employees, floor area and sales potential of an organization. Visitor counting is not limited to the entry/exit point of a company but has a wide range of applications that provide information to management on the volume and flow of people throughout a location. A primary method for counting the visitors involves hiring human auditors to stand and manually tally the number of visitors who pass by a certain location. But human-based data collection comes at great expense. Here is a low-cost microcontroller-based visitor counter that can be used to know the number of persons at a place. All the components required are readily available in the market and the circuit is easy to build. The result of this project is a thorough design for an autonomous visitor counter including a detailed test plan for the use by subsequent design teams.

**Introduction**

This project titled **“Microcontroller based Bidirectional Visitor counter”** is designed and presented in order to count the visitors of an auditorium, hall, offices, malls sports venue, etc. The system counts both the entering and exiting visitor of the auditorium or hall or other place, where it is placed. Depending upon the interrupt from the sensors, the system identifies the entry and exit of the visitor. On the successful implementation of the system, it displays the number of visitor present in the auditorium or hall. This system can beeconomically implemented in all the places where the visitors have to be counted andcontrolled. Since counting the visitors helps to maximize the efficiency and effectiveness of employees, floor area and sales potential of an organization, etc.

**Problem analysis**

Design of a bidirectional visitor counter using microcontroller. The design is analysed by understanding the working principle of the circuit which is shown in the form of a block diagram as follows.

**Block Diagram**

Diagram, schematic

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**Sensor Arrangement at the way**

**Diagram, schematic

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**Review of Literature**

**I. Sensors**

The block shows the sensor arrangement at the entrance cum exit passage. Here a pair of IR transmitter – receiver is used as sensor. Photo transistors are used as IR receiver, since it has sensitivity to receive IR rays.

**IR Sensor Module**

The IR sensor module includes five essential parts like IR Tx, Rx, Operational amplifier, trimmer pot (variable resistor) & output LED. The pin configuration of the IR sensor module is discussed below.

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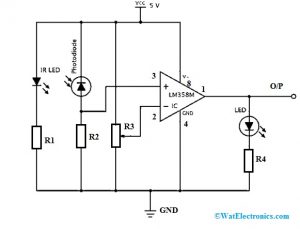
IR Sensor Module

* VCC Pin is power supply input
* GND Pin is power supply ground
* OUT is an active-high o/p

**IR Sensor Circuit**

The application circuit of the IR sensor is an obstacle detecting circuit that is shown below. This circuit can be built with a photodiode, IR LED, a OP-Amp, LED & a potentiometer, The main function of an infrared LED is to emit IR light and the photodiode is used to sense the IR light. In this circuit, an operational amplifier is used as a voltage comparator and the output of the sensor can be adjusted by the potentiometer based on the requirement.

Once the light generated from the infrared LED can be dropped on the photodiode once striking an object, then the photodiode’s resistance will be dropped.



**IR Sensor Circuit Diagram**

Here, op-amp’s one of the input at threshold value can be set through the potentiometer whereas other inputs can be set by using the series resistor of the photodiode. Once the radiation on the photodiode is more, then the voltage drop will be more across the series resistor. In the operational amplifier, both the voltages are evaluated.

If the series resistor’s voltage is higher than the threshold voltage then the IC output is high. When the IC output is given to an LED then it will blink. So using a potentiometer, the threshold voltage can be adjusted based on the conditions of surroundings.

In this circuit, the arrangement of the IR receiver and the IR LED is a very essential factor. Once the infrared LED is placed directly ahead of the infrared receiver, then this arrangement can be known as Direct Incidence.

So, in this case, nearly the whole radiation from the infrared LED will drop on the infrared receiver. Therefore, there is a row of view contact among the IR Tx & Rx. If a target drops in this row, it blocks the emission while approaching the receiver by reproducing or absorbing the radiation.

**specifications and features of the IR sensor**

* The operating voltage is 5VDC
* I/O pins – 3.3V & 5V
* Mounting hole
* The range is up to 20 centimetres
* The supply current is 20mA
* The range of sensing is adjustable
* Fixed ambient light sensor

**II. Microcontroller AT89C51**

 The AT89C51 is a low-power, high-performance CMOS 8-bit microcomputer with 4Kbytes of Flash programmable and erasable read only memory (PEROM). The device is manufactured using Atmel’s high-density non-volatile memory technology and is compatible with the industry-standard 80C51 and 80C52 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional non-volatile memory programmer. By combining a versatile 8-bit CPU with Flash on a monolithic chip, the Atmel AT89C51 is a powerful microcomputer which provides a highly flexible and cost-effective solution to many embedded control applications.

**Features:**

• Compatible with MCS-51™ Products

• 4K Bytes of In-System Reprogrammable Flash Memory

• Endurance: 1,000 Write/Erase Cycles

• Fully Static Operation: 0 Hz to 24 MHz

• Three-level Program Memory Lock

• 128 x 8-bit Internal RAM

• 32 Programmable I/O Lines

• Two 16-bit Timer/Counters

• Six Interrupt Sources

• Programmable Serial Channel

• Low-power Idle and Power-down Modes

A picture containing text, electronics, circuit

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**Pin configuration of Microcontroller AT89C51:**

**Table

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**Pin Description:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Pin No | Function | | | | Name |
| 1 | External count input to Timer/Counter 2, clock-out | | | T2 | P1.0 |
| 2 | Timer/Counter 2 capture/reload trigger and direction control | | | T2 EX | P1.1 |
| 3 | 8 bit input/output port (P1) pins | | | | P1.2 |
| 4 | P1.3 |
| 5 | P1.4 |
| 6 | P1.5 |
| 7 | P1.6 |
| 8 | P1.7 |
| 9 | Reset pin; Active high | | | | Reset |
| 10 | Input (receiver) for serial communication | RxD | 8 bit input/output port (P3) pins | | P3.0 |
| 11 | Output (transmitter) for serial communication | TxD | P3.1 |
| 12 | External interrupt 1 | Int0 | P3.2 |
| 13 | External interrupt 2 | Int1 | P3.3 |
| 14 | Timer1 external input | T0 | P3.4 |
| 15 | Timer2 external input | T1 | P3.5 |
| 16 | Write to external data memory | Write | P3.6 |
| 17 | Read from external data memory | Read | P3.7 |
| 18 | Quartz crystal oscillator (up to 24 MHz) | | | | Crystal 2 |
| 19 | Crystal 1 |
| 20 | Ground (0V) | | | | Ground |
| 21 | 8 bit input/output port (P2) pins  /  High-order address bits when interfacing with external memory | | | | P2.0/ A8 |
| 22 | P2.1/ A9 |
| 23 | P2.2/ A10 |
| 24 | P2.3/ A11 |
| 25 | P2.4/ A12 |
| 26 | P2.5/ A13 |
| 27 | P2.6/ A14 |
| 28 | P2.7/ A15 |
| 29 | Program store enable; Read from external program memory | | | | PSEN |
| 30 | Address Latch Enable | | | | ALE |
| Program pulse input during Flash programming | | | | Prog |
| 31 | External Access Enable;  Vcc for internal program executions | | | | EA |
| Programming enable voltage; 12V (during Flash programming) | | | | Vpp |
| 32 | 8 bit input/output port (P0) pins    Low-order address bits when interfacing with external memory | | | | P0.7/ AD7 |
| 33 | P0.6/ AD6 |
| 34 | P0.5/ AD5 |
| 35 | P0.4/ AD4 |
| 36 | P0.3/ AD3 |
| 37 | P0.2/ AD2 |
| 38 | P0.1/ AD1 |
| 39 | P0.0/ AD0 |
| 40 | Supply voltage; 5V (up to 6.6V) | | | | Vcc |

**Block Diagram of Atmel 89C51 Microcontroller:**

Diagram, schematic

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**III. Display**

The display section comprises of a 16x2 LCD for displaying the number of visitors present.

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.

A **16x2 LCD** means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. Click to learn more about internal structure of a LCD.

Graphical user interface

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**Pin Diagram:**

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**![Table

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**Implementation Details**

**Schematic Diagram of Bidirectional Visitor Counter**

**Diagram, schematic

Description automatically generated**

**Circuit Operation**

The circuit shows the microcontroller based bidirectional visitor counter, wherein the transmitter and the receiver form the IR detection circuit. Control logic is built around operational amplifier LM324. The IR transmitter-receiver setup at the entrance-cum-exit of the passage is shown at the block diagram. Two similar sections detect interruption of the IR beam and generate clock pulse for the microcontroller. The microcontroller controls counting and displays the number of persons present inside the hall. When nobody is passing through the entry/exit point, the IR beam continuously falls on IR receiver D5 and D7. IR Rx1 conducts and the voltage at the pin 2 of Op-amp N1 goes low. The voltage at the pin 2 is adjusted by a potentiometer so that it is higher than the low voltage at pin 3. Hence the output of the Op-amp i.e. voltage at pin 1 of N1 is high. Now if someone enters the place, first the IR beam from IR TX1 is interrupted and then the IR beam from IR TX2 is interrupted. When the IR beam from IR TX1 is interrupted the voltage at the pin 2 of Op-amp N1 goes high, while the voltage at pin 3 of N1 is lower than that at pin 2, so the output of N1 goes low. Similarly when IR beam of TX2 is interrupted Output of N2 becomes low. The output of the Op-amps are fed to pin P1.0 and P1.1 of the 8-bit microcontroller AT89C51. The AT89C51 us an 8-bit microcontroller with 4 KB of flash based program memory,128 bytes of RAM, 32 input/output lines, two 16 bits timers/counters, on-chip oscillator and clock circuitry. A 12MHz crystal is used for providing clock. Port 2 is configured for LCD display. Port-0 is an 8-bit, open-drain, bidirectional, input/output (I/O) port. Port-1 and port-2 are 8-bit bidirectional I/O ports with internal pull-ups (no need of external pull-ups).

The microcontroller is programmed in such a way that when it will sense low signal at P1.0 it will increment the count by 1 and when it will sense a low signal at P1.1 it will decrement the count by 1. Now when someone enters the place due to interruption of TX1 low signal is sensed at P1.0 of microcontroller, it increases the count by 1 and then there is a delay of 100ms during which the microcontroller wont sense any signal at P1.0 and P1.1 thus the person can cross the IR beam of TX2 without the microcontroller noticing it, and hence the count wont decrease. Similarly when a person exits it first interrupts the IR beam of IR TX2 and thus low signal is sensed at P1.1,it decreases the count by 1 and goes into a delay subroutine of 100ms during which the person can safely cross the IR beam of TX1 without the microcontroller sensing it i.e. the count won’t increase. In this way a separation is maintained between successive sensing at P1.0 and P1.1.

The count is displayed on a 16x2 LCD through the data sent through port 2 which is configured as an output port.

**Algorithm and Code**

**Algorithm:**

**Step 1:** Start the process

**Step 2:** Select port 1 as output port for displaying the count value in LCD.

**Step 3:** When a low signal is sensed at P2.0, increment the count by 1.

**Step 4:** When a low signal is sensed at P2.1, decrement the count by 1.

**Step 5:** Continue the process, whenever a low pulse is sensed at pin P2.0 and pin P2.1.

**Flowchart**

**Diagram

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**Code**

#include<reg51.h>

// P1 connected to LCD data pins.

#define lcd P1

// pins P3.6 and P3.7 to rs and e pins of LCD display.

sbit rs=P3^6;

sbit e=P3^7;

// pins P2.0 and P2.1 are connected to the data pins of the IR sensor.

// usually these pins act as a input pins.

sbit s1=P2^0;

sbit s2=P2^1;

// usually LCD requires ascii values as a input, to display the characters and numbers.

// so, in order to display numbers from 0 to 9, we need to send ascii values to the lcd from 48 to 57.

int no[10]={48,49,50,51,52,53,54,55,56,57};

// initializing all used function globally.

void delay (int);

void cmd (unsigned char);

void display (unsigned char);

void init (void);

void view (int);

void string (char \*);

int count=0;

// delay function which produce approx of 1ms delay if d is 1.

// so, if d is 1000 it produce approx 1sec delay.

void delay (int d)

{

    unsigned char i=0;

    for(;d>0;d--)

    {

        for(i=250;i>0;i--);

        for(i=248;i>0;i--);

    }

}

//the function will holds a set of primary commands to display which is used to initialize it.

void cmd (unsigned char c)

{

    lcd=c;

    rs=0;

    e=1;

    delay(5);

    e=0;

}

// display function is used to give data to the lcd, which is to be displayed.

// usually a single character.

void display (unsigned char c)

{

    lcd=c;

    rs=1;

    e=1;

    delay(5);

    e=0;

}

// string function is used display the string characters (words).

// this function will work by keep on calling the display function to display the individual character in a word,

// untill it detect '/0'. usually an end of string (word).

void string (char \*p)

{

    while(\*p)

    {

        display(\*p++);

    }

}

//the function will holds a set of primary commands to display which is used to initialize it.

void init (void)

{

    cmd(0x38);

    cmd(0x0c);

    cmd(0x01);

    cmd(0x80);

}

// NOTE : we cant send the 2 or more digit values directly to the LCD display. like, 22, 234, 4321, etc....

// to over come this problem this \_view\_ function will split the 2 digit value (as this project concentrate

// only values from 00 to 99) seperately and send them one by one to the display function.

void view (int n)

{

    cmd(0xc0);

    display(no[(n/10)%10]);

    display(no[n%10]);

}

void main()

{

    //P2=0x00;// as the IR sensor connected to PORT2, to detect the 1 (HIGH) o/p from the IR sensor make this PORT as 0 (LOW).

    init();// call init function to to initialize the display.

    string("  COEP  ");

    cmd(0xc0);

    string("      Welcome      ");

    delay(500);

    cmd(0x01);

    cmd(0x80);

    string("Visitor Counter.");

    cmd(0xc0);

    view(count);// as the count value was 0, the view function will make the LCD to display 00 initially.

    // once if, s1 detects high follow by s2 then the value will increament.

    // unless if, s2 detects high follow by s1 then the value will decreament.

    while(1)

    {

        if(s1==0)// this condition will become true if, first sensor o/p will become HIGH at first.

        {

            while(s2==0);// this condition will wait until the second sensor o/p becomes HIGH.

            if(count!=99)// this condition will stop the increament, once if the count reaches 99.

            count=count+1;// increament statement.

            while(s2==1);// this condition will wait until the second sensor o/p becomes LOW.

            view(count);// display the count on the LCD.

        }

        else if(s2==0)// this condition will become true if, secont sensor o/p will become HIGH at first.

        {

            while(s1==0);// this condition will wait until the first sensor o/p becomes HIGH.

            if(count!=0)// this condition will stop the decreament, once if the count reaches 0.

            count=count-1;// decreament statement.

            while(s1==1);// this condition will wait until the first sensor o/p becomes LOW.

            view(count);// display the count on the LCD.

        }

    }

}

**Result**

**A picture containing text, electronics

Description automatically generated**

**Applications**

**Uses:**

* Used to count the visitors of an auditorium, hall, offices, mall, sports etc.
* Used as integral part of security system in high confidential areas.
* Used in Parking Lot.
* Used in Elevator to prevent the maximum limit of weight.

**Advantages:**

* High precision and accuracy can be achieved through it.
* Since it is bidirectional it can count in both directions peoples entering and exiting the place.
* Since it is compact it can be easily implemented anywhere.
* It is also cost effective.

**Conclusion**

Thus, the project entitled “Bidirectional Visitor Counter” helps to measure the visitor entering and exiting a particular passage or way. The circuit counts both entering and exiting visitors and displays the number of visitors present inside the hall. Visitor counting is not limited to the entry/exit point of a company but has a wide range of applications that provide information to management on the volume and flow of people throughout a location. The visitor helps to maximize the efficiency and effectiveness of employees, floor area and sales potential of an organization. The circuit may also be enhanced with a wide counting range of above three digits by modifying software section of the system. It can also be enhanced for long and accurate sensing range using a laser torch instead of IR transmission circuit. Thus, the circuit can be used to monitor visitor flow in effective manner, where the visitors have to counted and controlled.

**References**

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